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Understanding Flood Governance in the Dutch-Flemish Scheldt Estuary: An Evolutionary Governance Perspective

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Abstract

This article presents a comparative account of the evolution of flood governance in the Dutch (Western Scheldt) and Flemish (Sea Scheldt) regions of the Scheldt estuary through the lens of evolutionary governance theory. Evolutionary governance theory is based on three assumptions: governance is continuously evolving, change is contingent, and discourses are drivers of change. Employing a comparative research design and secondary data analysis, this study examines how institutional, material, and discursive factors, goals, path dependencies, and interdependencies have shaped flood risk governance and influenced the integration of nature conservation goals alongside traditional flood safety objectives. While dike reinforcement prioritizes flood safety, integrated strategies—such as transitional polders and dike setbacks—aim to balance flood protection with ecological restoration. This is particularly pertinent in the Scheldt estuary, where ecological degradation has raised concerns regarding the long-term loss of biodiversity and ecosystem services. A significant challenge in transforming the governance of the estuary is anticipating long-term risks while pursuing ecological and flood safety objectives. Through a longitudinal cross-case comparison, this study identifies barriers to the adoption of nature-based solutions in flood risk management. The findings emphasize the need for a more integrated approach that aligns flood safety and nature conservation development policies for resilient and long-term climate solutions.

Keywords

evolutionary governance theory; flood risk governance; nature conservation; Scheldt estuary; Sea Scheldt; Western Scheldt

1. Introduction

Flood risk governance has emerged as a critical field of inquiry within environmental governance, especially in low-lying coastal regions bustling with activities yet vulnerable to hydrological extremes (Aukes et al., 2020; van Slobbe et al., 2013). In riverine and estuarine systems, the interplay between flood management, spatial planning, and the environment has far-reaching implications. For a long time, floods have represented a driving force in the process of developing delta landscapes (Francesch-Huidobro et al., 2017). Audacious structural actions have allowed communities to keep water away from cities (Sayers et al., 2021). As a result, the Netherlands and parts of Flanders have been made inhabitable thanks to the complex system of waterworks, such as dredging works, dikes, land reclamation, and dams (Disco, 2002; Francesch-Huidobro et al., 2017). While having enormously contributed to the actual welfare of these countries, infrastructural water works—expression of the *hydraulic mission*—have been questioned due to their economic, social, and environmental impacts (Molle et al., 2009).

Principles of sustainable development started to emerge following a prolonged discursive struggle instigated in the late 1950s and extended into the 1970s (Allan, 2003). Ecological consciousness about the damage being done to nature prompted the so-called *ecological turn* in water management, first globally and then locally (Allan, 2006; Disco, 2002). Rising concern about ecological risks led to strong public opposition to large infrastructure projects. This brought environmental issues into the political spotlight and helped drive major changes in environmental laws in many democratic countries. Nature was reconsidered as intrinsically valuable, and it was emphasized that "civilization had been incurring heavy ecological debts" (Disco, 2002, p. 208). Such ecological uptake became evident and was also observed in the Scheldt estuary. For example, while the closing of the Oosterschelde was initially praised as a major work of civil engineering, it was soon described as an environmental catastrophe (Disco, 2002). Although hard control infrastructure had not yet "exhausted the technological means available" to cope with climate challenges, hard engineering approaches began to be substantially questioned (van Slobbe et al., 2013, p. 949). The ecological turn in water management was, however, mostly political rather than technical.

As flood control technologies became more reliable, flood-prone areas began to experience increased urbanization driven by demographic and economic factors. This highlighted an important consequence: the increasing exposure and vulnerability to flooding in the event of defense failures. It was then that innovative concepts such as building with nature began to emerge as an alternative option to the hard engineering approach, in response to both environmental and community concerns (van Slobbe et al., 2013). Nature-based solutions began to be praised for their ability to achieve water security goals while adapting to climatic and environmental changes, ecological values, and socio-economic functions (van Slobbe et al., 2013). However, while the implementation of nature-based solutions for flood safety has been increasingly advocated, the integration of ecological expertise into hydraulic engineering bureaucracies remains contested, and the extent of actual change is still debated (Disco, 2002). These approaches continue to face persistent barriers rooted in the dominant engineering paradigm of hydraulic bureaucracies or *hydrocracies*, which have historically relied on command-and-control methods (Molle et al., 2009). In coastal regions, especially, decision-making is further complicated by a diverse group of stakeholders, conflicting interests, and pre-existing institutional frameworks (Aukes et al., 2020). Understanding how these institutional and technical path dependencies shape the uptake of nature-based solutions is essential for exploring new modalities of knowledge co-production and the potential reconfiguration of flood governance. This manuscript takes up that task.

By adopting an evolutionary governance theory (EGT) perspective, this article offers a comprehensive and nuanced understanding of the factors shaping flood risk governance, with particular attention to the challenges of integrating ecological objectives alongside flood safety goals. EGT is particularly well-suited for this study because it captures the complex, dynamic, and historically embedded nature of governance in the Scheldt estuary by focusing on three fundamental premises: governance systems are continuously evolving, influenced by both internal dynamics and external pressures; change is contingent, meaning that it depends on a complex set of contextual factors, historical trajectories, and stakeholder interactions; and discourses, or how issues are framed and communicated, play a pivotal role in driving governance change (Beunen et al., 2022; Van Assche et al., 2014). This enables a deeper understanding of how governance evolves in response to environmental changes, stakeholder interactions, and shifting priorities, making it ideal for analyzing the integration of nature-based solutions alongside engineering approaches. This article contributes to flood risk governance literature by highlighting the long-term, path-dependent processes through which ecological and flood safety goals are negotiated in complex estuarine settings. In doing so, this research emphasizes the often-overlooked role of physical conditions in shaping governance choices—an aspect that institutional analyses, typically focused on actors, rules, and resources, tend to underplay in flood governance research. Moreover, the article advances evolutionary governance scholarship by applying the EGT framework to the field of flood governance, which remains relatively underexplored from this theoretical perspective.

Shared by the Netherlands and Flanders, the Scheldt estuary offers a unique and dynamic case for examining these interdependencies. Originating in France, the Scheldt (355 km) flows through Belgium and the Netherlands before reaching the North Sea; in Flanders, the tidal section is known as the Sea Scheldt, extending to the Dutch border, where it becomes the Western Scheldt (Vlaams-Nederlandse Scheldecommissie, 2019, 2025). The Sea Scheldt and Western Scheldt together form the tidal Scheldt estuary. As one of Western Europe's youngest and most natural estuaries (Zheng et al., 2021), it holds significant ecological value. It plays a crucial role in nature conservation, water quality, and ecology, while also supporting diverse interests such as fisheries, sand mining, tourism, and cultural heritage. Both the Netherlands and Flanders have developed distinct governance strategies over time, shaped by their specific socio-political contexts, historical developments, and environmental challenges. Flood risk management in the Netherlands (Western Scheldt) has traditionally relied on engineering-based solutions like dike enhancements, while Flemish strategies (Sea Scheldt) have increasingly incorporated nature-based approaches. Conventional measures prioritize flood protection, but integrated strategies, such as transitional polders and dike setbacks, seek to balance protection with ecological restoration. For example, in contrast to poldering, which involves controlling water to reclaim and retain dry land, transitional polders are reclaimed areas intentionally re-exposed to tidal influence (temporarily and partially) to restore natural processes such as sedimentation and land elevation. By focusing on the Scheldt estuary, where ecological degradation threatens biodiversity and ecosystem services, this study examines historical barriers and evolving challenges to advancing sustainable, integrated flood risk management. The longitudinal analysis begins with the catastrophic 1953 North Sea flood, which served as a critical juncture prompting major shifts in flood governance, infrastructure, and institutional approaches in both the Netherlands and Flanders.

The manuscript is organized as follows. Section 2 outlines the theoretical frameworks that underpin this research. Section 3 explains the case selection and research methodology. Section 4 presents the findings from the longitudinal analysis of flood governance in Flanders and the Netherlands. Section 5 offers a comparative discussion of the results and Section 6 concludes the study.

2. EGT

2.1. Introducing EGT

Throughout history, the progress of human societies has been shaped by institutional change. Institutional change can be defined as the ongoing process through which governance institutions comprising formal rules, informal norms, and actor interactions evolve in response to shifting societal priorities, environmental conditions, and historical legacies (Beunen & Van Assche, 2021; Van Assche et al., 2024). As a result, social and economic development processes have always been closely linked to institutional change, whether driven by a conscious willingness to deviate from established paths or triggered by external circumstances such as crises or shocks (Micelotta et al., 2017; Samadi & Alipourian, 2021). Institutional change in ocean and coastal governance consists of the continual evolution in how the resources in these realms are managed and protected. Among the others, institutional change can be driven by the dynamic interplay between shifting societal priorities and emerging resource scarcities (Schlüter et al., 2013). For example, when marine resources were abundant, there was little need for regulatory institutions because regulation was unnecessary. However, as these resources became scarcer and demand increased, institutions began to emerge to manage and protect them.

An alternative view on how institutional change can be explained is through the EGT. This perspective suggests that changes in the environment and the way institutions—understood here as established systems of rules, norms, and practices—respond to these changes gradually drive institutional evolution and, potentially, lead to institutional change. While some institutions adapt to changing conditions over time, others may persist despite inefficiencies due to historical path dependencies, the influence of entrenched interests such as dominant coalitions, or actors who benefit from the status quo, or the inherent complexity of the governance process. Institutional change is not necessarily a matter of survival of the fittest, but rather an ongoing process of adaptation and reconfiguration shaped by different selection pressures and governance contexts. Institutions can be diverse because they are influenced by selection pressures and the environmental conditions they encounter. Furthermore, institutions carry a form of heredity associated with the evolution of habits (Hodgson, 2004). However, unlike genetic inheritance, which tends to produce exact copies apart from occasional mutations, habits are not replicated with the same precision across long-standing institutions (Sperber, 1996).

Moreover, EGT views governance as a constantly evolving process, driven by co-evolution between actors and institutions (Van Assche et al., 2013). Changes in governance occur even without intentional steering, as actors and institutions continuously interact and influence each other. While this dynamic interaction may appear similar to what discursive or constructivist institutionalist perspectives describe as path-shaping change, EGT distinguishes itself by emphasizing evolution as a non-linear, recursive, and multi-dimensional process. In EGT, evolution refers not only to shifts in actor strategies or institutional structures but also to how discourses, power dynamics, and rule systems co-evolve in unpredictable and contingent ways. This evolutionary process unfolds without a central guiding logic, driven instead by constant feedback loops and historical embeddedness. Actors adapt through their engagement with institutions, which function as coordination mechanisms ranging from simple rules to complex political laws, while also interacting with informal institutions such as social norms, traditions, and unwritten practices. Actors are not static but evolve through these interactions and discursive means, using knowledge and narratives to strategize and understand themselves, even as discourse shapes and constrains their strategies (Schlüter et al., 2020; Van Assche et al., 2013, 2024).

In the literature on environmental governance, there is frequent advocacy for significant institutional change, such as reform, innovation, and transformation, to effectively address several pressing environmental governance issues (Beunen & Patterson, 2019). Institutional change is driven by purposive actions but also by ongoing patterns of interpretation and behavior, all of which are shaped by the various dependencies that define the governance context. Therefore, reforms in the context of institutional change in any country, especially those with an impact on the economy or the environment, must consider the country's unique local and cultural contexts. Because institutional change is often an incremental process, countries with rich cultural traditions and deep historical roots need to quickly identify and address the key drivers of change (economic change, social stress, or environmental crisis) that may accelerate or inhibit the change process (Faghih & Samadi, 2021). Viewing environmental governance through an evolutionary lens implies adopting a holistic approach, thereby emphasizing the critical role of the temporal dimension and the impact of past policies (Beunen & Van Assche, 2021; Beunen et al., 2022).

EGT offers a distinctive perspective when compared to other institutional and discursive governance theories. While EGT fits within the broader landscape of governance theories, its dynamic and multidimensional approach contrasts with more static or linear theories. For example, traditional institutionalism, including rational choice and historical institutionalism, focuses on institutional stability and incremental change (Thelen, 1999). In contrast, EGT conceptualizes governance as inherently evolutionary, emphasizing the co-evolution of institutions, actors, and power relations over time (Van Assche et al., 2013). EGT highlights path dependency and co-evolutionary processes, providing a more dynamic perspective than traditional institutionalism (Fürstenberg, 2016). Another interesting element is that discourse analysis and EGT complement each other in understanding governance dynamics. Both approaches acknowledge the influence of power/knowledge relationships and discourses (Hardy & Thomas, 2015; Rydin, 2021). EGT links discourses to material changes in governance, emphasizing the co-evolution of knowledge, power, and institutions (Van Assche et al., 2014). While discourse analysis focuses on language, narratives, and power in shaping governance outcomes (Rydin, 2021), EGT extends this by linking discourses to broader governance frameworks and actor configurations. In comparison, sociological institutionalism and discursive institutionalism differ in their focus on the social and cultural context of institutions. Sociological institutionalism emphasizes the role of norms, values, and cultural frameworks in shaping institutional behavior and governance dynamics. It focuses on how institutions are shaped by broader societal structures and ideologies (Saurugger, 2017). On the other hand, discursive institutionalism emphasizes the role of ideas, discourse, and narratives in shaping institutional change (Zurnić, 2014). Like EGT, it emphasizes language and ideas as the primary drivers of change, rather than the co-evolution of institutions, actors, and power dynamics.

EGT is particularly useful for examining how co-evolutionary processes shape governance and options for change (Partelow et al., 2020). In sum, the key contribution of EGT is its multidimensional and temporal depth, recognizing the continuously evolving configuration, shaped by interdependent institutions, discourses, actors, and power relations. While some strands of institutionalist theory, such as discursive or constructivist approaches, emphasize institutional change and path-shaping dynamics, EGT offers a more explicit focus on co-evolution and recursive feedback across multiple dimensions. Its emphasis on historical contingency and non-linear change complements institutional, discursive, and network theories, while offering a more integrated framework for understanding complex, long-term governance transformations. EGT also offers a promising framework for understanding institutional change over time, making it suitable for longitudinal case studies. It views governance as an evolutionary process shaped by cognitive capacities, ideas, and decision-making (Lewis & Steinmo, 2012). EGT emphasizes the co-evolution of governance systems, highlighting how steering options emerge from unique governance paths and contextual factors (Beunen & Van Assche, 2021). This approach is particularly important for analyzing experimental governance arrangements, where decision-making roles between governments and citizens shift and are institutionalized differently across cases (Ubels et al., 2019).

2.2. EGT Dimensions

Through the lens of EGT, the evolution of governance is characterized by the continuous interplay of multiple dimensions, each of which exerts a shaping and constraining influence on decision-making processes over time (see Figure 1). These dimensions encompass institutional structures, material realities, discursive influences, governance goals, historical path dependencies, and interdependencies, all of which co-evolve to form the governance landscape.

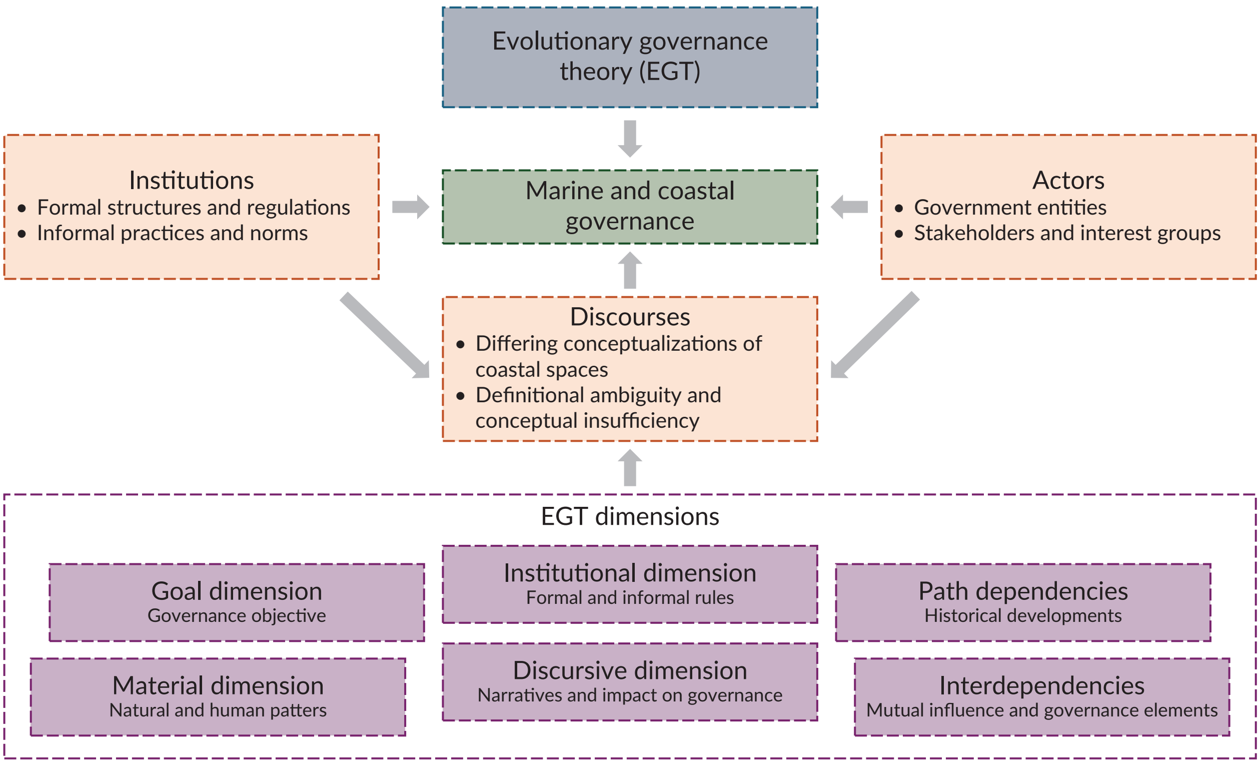

Figure 1. Key dimensions and dynamics shaping marine and coastal governance through an EGT lens.

The institutional dimension captures the interaction between formal and informal rules, network-based steering, and knowledge systems (Van Assche et al., 2014). Governance arrangements emerge from the dynamic relationship between political and regulatory structures, shaping how institutions evolve and influence decision-making processes. Over time, formal legal frameworks, including laws, regulations, and formally adopted policies and guidelines, interact with informal norms and practices, leading to gradual transformations in governance structures.

The material dimension refers to the role of natural and man-made elements in shaping governance. In marine and coastal governance, environmental conditions, resource availability, and man-made infrastructure, such as ports or artificial reefs, influence governance dynamics. As governance must adapt to ecological constraints, technological advances, and socio-economic needs, the presence or absence of these material factors affects decision-making processes. Changes in these patterns can significantly alter governance strategies and institutional responses, such as ecosystem degradation or technological innovation.

Language, narratives, and framing play a central role in governance through the discursive dimension. EGT highlights how discourse acts both as a tool for influencing policy and as a constraint on governance options (Partelow et al., 2020). Governance strategies often take the form of "productive fictions," meaning they are based on narratives that must be continuously adapted as they rarely unfold exactly as expected (Van Assche et al., 2020). The dominance of particular narratives can shape policy directions, define governance priorities, and reinforce power structures within governance systems.

The goal dimension emphasizes how existing goals and aspirations shape governance decisions. Along with path dependence and interdependence, goal dependency is one of the three core dependencies in EGT; this influences how governance systems evolve in response to their external environment (Van Assche et al., 2013). Goals within a governance system are not static but evolve through historical trajectories, interactions among actors, and the broader socio-political context (Beunen et al., 2015). The long-term visions embedded in governance structures guide decision-making processes but also constrain the range of available policy options.

Path dependency highlights the enduring impact of historical decisions and institutional legacies on the evolution of governance. Past policy choices, institutional structures, and vested interests shape current governance configurations, often creating inertia that makes rapid transitions difficult (Van Assche et al., 2024). Self-reinforcing mechanisms consolidate existing institutional frameworks, making it challenging to break away from established governance patterns (Vergne & Durand, 2010). The interplay between path dependence, interdependence, and goal dependence determines how governance systems adapt or resist change over time. Recognizing these historical constraints is essential for designing effective governance innovations that acknowledge institutional realities rather than assuming the possibility of rapid structural overhauls (Schmidt & Spindler, 2002).

Finally, interdependency is a fundamental concept in the study of governance that underscores the mutual influence and reliance among governance elements, including actors, institutions, and knowledge systems (Schlüter et al., 2020; Van Assche et al., 2024). Governance does not operate in isolation. Rather, it is shaped by intricate connections and feedback loops, where changes in one component often trigger responses in others. To illustrate this dynamic interdependence, consider the potential consequences of a newly implemented regulation that restricts fisheries in a coastal region. Such a regulation could lead to economic shifts among fishing communities, prompting changes in livelihood strategies, shifts in market dynamics, or even increased pressure on alternative marine resources. In turn, these socio-economic changes may influence future policy decisions, illustrating the dynamic and co-evolutionary nature of governance interdependencies.

This interconnected nature of governance is particularly evident in complex systems such as coastal governance, where terrestrial and marine environments interact, creating dynamic interdependencies within social-ecological systems, which have ecological components and governance rules, regulations, and resource users in the social component (Dahdouh-Guebas et al., 2021; Eger et al., 2021). The relationships between governance actors, regulatory frameworks, and material realities such as resource availability and environmental conditions add further layers of complexity. These intricate interdependencies exert a profound influence on decision-making processes, the effectiveness of policy, and the adaptability of governance. Consequently, the design of integrated frameworks that can effectively respond to the evolving challenges posed by these intricate interdependencies is imperative.

By integrating these dimensions, EGT establishes a comprehensive framework for understanding governance as a continuously evolving process shaped by institutional structures, material conditions, discursive influences, long-term goals, and historical constraints. This perspective underscores the complexity of governance evolution and highlights the need for adaptive strategies that account for co-evolutionary dynamics.

3. Methodology

This study employs a comparative research design grounded in qualitative methods. Desk research draws on a variety of sources, including governmental reports, policy documents from Dutch and Flemish authorities, legislation, and scientific studies. These materials pertain to key flood management initiatives such as dike reinforcement (Room for the River program) and nature-based solutions. Central to the analysis are major policy frameworks, including the Dutch Delta Plan and the Flemish Sigma Plan, supplemented by recent policy updates like the Dutch High Water Protection Programme (Hoogwaterbeschermingsprogramma, 2021) and the Flemish Integrated Water Policy Plan (Coördinatiecommissie Integraal Waterbeleid, n.d.-a). Data analysis followed a primarily deductive approach, structured according to the dimensions of the theoretical framework.

The Scheldt basin covers a total catchment area of approximately 21,863 km^2 and is home to over 10 million people (on average 477 inhabitants per km^2; Mees et al., 2016). The Scheldt river originates in Saint-Quentin, France, and flows for 355 km, primarily through Flanders (Belgium), before reaching the North Sea near Vlissingen (the Netherlands). The river can be divided into distinct sections (see Figure 2): from its source to Ghent, it remains a non-tidal freshwater river known as the Upper Scheldt; beyond Ghent, it transitions into a predominantly tidal river extending to Temse, where it becomes the Sea Scheldt (Zeeschelde). This section consists of a brackish upper stretch from Temse to Antwerp and a lower saltwater stretch from Antwerp to the Belgian–Dutch border. Beyond this point, the river continues as the Western Scheldt, flowing through Dutch territory and branching into multiple channels before reaching the North Sea (Baeyens et al., 1997; Meire et al., 2005).

The Dutch Western Scheldt and the Flemish Sea Scheldt are both highly vulnerable to flooding due to their low-lying geography and proximity to the North Sea. The Western Scheldt serves as a major shipping route to the port of Antwerp and is part of the Dutch Delta, renowned for its advanced flood defense systems. Over the past two decades, flood risk management in the region has shifted from traditional infrastructure-based solutions, such as dike reinforcement, to more integrated approaches, such as depoldering and nature-based solutions. Depoldering involves restoring previously reclaimed land to the

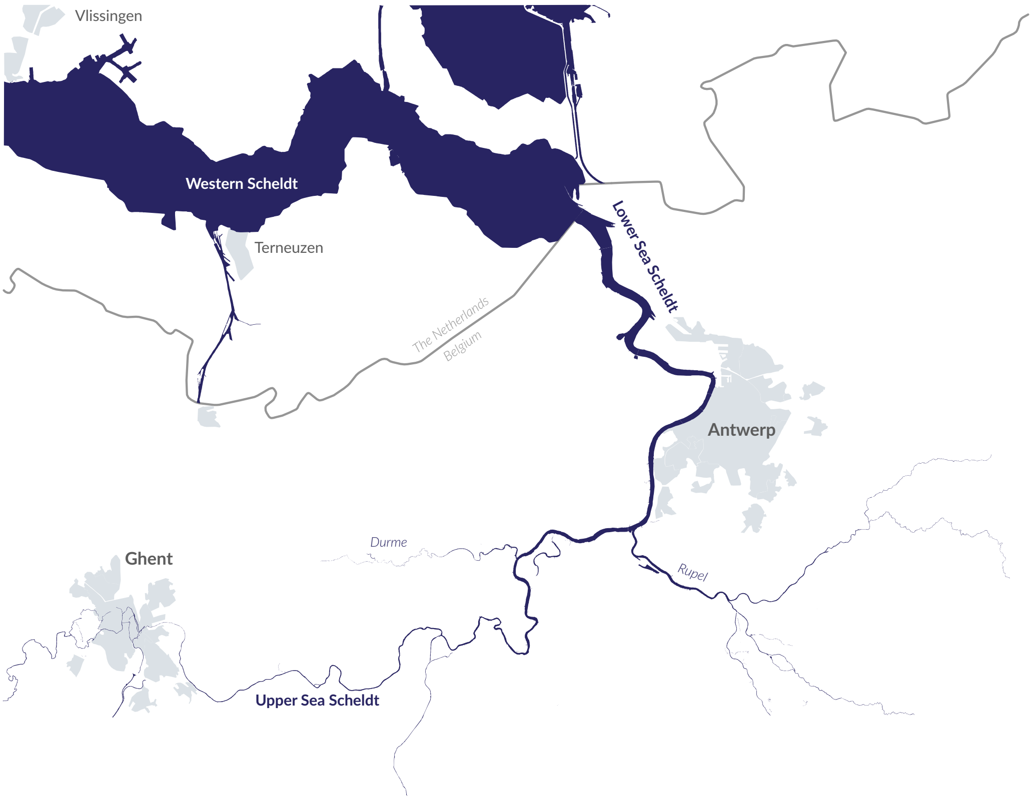

Figure 2. Sea Scheldt and the Western Scheldt.

estuary by breaching dikes and allowing tidal waters to re-enter low-lying areas; this provides additional capacity for tidal waters, thereby mitigating flood hazards. This shift was driven, in part, by the recognition of the deteriorating biodiversity conditions within the estuary, prompting a reorientation towards nature conservation and ecosystem restoration. The Sea Scheldt plays a pivotal role in both flood management and ecological restoration. While facing flood risk challenges analogous to those experienced in the Netherlands, Flanders' governance is influenced by distinct institutional, discursive, and material dependencies. Historically, flood risk management in the Sea Scheldt has centered on dike construction and reinforcement. However, in recent decades, Flanders has been recognized for its efforts in floodplain restoration and adaptive management, reflecting a gradual shift towards more integrated water management approaches.

Two main reasons for the cross-case comparative approach are identified in this study. First, the cross-border nature of the Scheldt estuary provides a valuable opportunity to explore how institutional responses to flood risks have developed in parallel yet distinct ways in the Netherlands and Flanders. Although both regions share a long history of flood risk management, their governance trajectories have diverged over time, shaped by different socio-political and institutional contexts. Second, understanding these differences is a crucial step toward the future harmonization of cross-border policies—an essential goal for achieving environmental objectives, reducing flood risks, and protecting biodiversity, especially considering evolving European regulatory frameworks. By analyzing the Dutch (Western Scheldt) and Flemish (Sea Scheldt) contexts through the lens of evolutionary governance, this study not only identifies key similarities and differences but also stresses the need for coordinated strategies that integrate flood protection with ecological restoration when promoting long-term resilience and sustainability in shared river systems.

4. Results

This section explores the evolution of flood risk governance in the Western Scheldt (Section 4.1) and Sea Scheldt (Section 4.2), followed by an examination of their interactions (Section 4.3). The study offers insights into how past dependencies influence present and future governance responses. A summary of the main empirical findings—organized by case and EGT dimensions—is presented in Table 1 for the Western Scheldt and Table 2 for the Sea Scheldt.

4.1. Western Scheldt (The Netherlands)

4.1.1. Dike Reinforcements After the Storm Surge of 1953 (1953–2005)

Following the catastrophic storm surge of 1953, which claimed 1,836 lives, the Dutch government enacted the Delta Act in 1957 and the Delta Plan, whose works (*Deltawerken*) began in 1958. The Delta Plan was primarily based on a strategy of coastline shortening (Meijerink, 2005), proposing the construction of large dams to close off the estuaries in the southwestern delta. The Delta Plan was based on a strong belief in engineering solutions (discourse dimension). During the implementation of the Delta Plan, most of the estuaries of the rivers Rhine, Scheldt, and Maas were closed off in order to shorten the coastline and to better protect the southwestern delta from sea flooding, demonstrating a clear goal dependency. However, the Western Scheldt estuary was an exception to this closure strategy. To maintain navigational access to the Belgian port of Antwerp (material dimension), the authorities opted to reinforce the dikes along the estuary instead of closing it, thus causing a change in the material dimension. These dikes meet the flood safety standards that were legally defined in the aftermath of the 1953 disaster (institutional dimension). As a result, the Western Scheldt remains the only natural estuary in the southwestern delta, preserving a significant ecological value (Saeijs et al., 2004, p. 5; material dimension). It encompasses several important natural reserves that serve as critical habitats for bird species. Notable sites include the Verdronken Land van Saeftinghe (about 3,500 ha), designated a Ramsar site since 1995 and located near the Belgian border, the Schor van Waarde (100 ha) near Hansweert, and the Verdronken Zwarte Polder (73 ha) in the mouth of the estuary (Sistermans & Nieuwenhuis, 2004). Although the Western Scheldt has remained open, ongoing activities such as channel deepening and maintenance dredging works to support navigation have caused significant morphological alterations to the estuary and significant habitat degradation (changes in the material dimension). In 2005, the Dutch government concluded new international agreements with the Flemish region and the Flemish community on the joint management of the Scheldt estuary, dredging works, and ecological compensation measures (institutional dimension). These international agreements included plans to compensate for the ecological damage caused by the dredging by returning land to the estuary through depoldering.

4.1.2. Conflicts Over Depoldering Along the Estuary (2005–2022)

Ecological experts have consistently emphasized that depoldering is the only effective strategy for restoring nature in the Scheldt estuary (Smits et al., 2006). This approach—returning land to the water to compensate for ecological losses—is part of a new discourse that challenges the long-standing tradition of protecting the land from sea and river floods by building dikes. However, the plans for depoldering were met with significant opposition from the majority of Zeeland's residents, politicians, and landowners, particularly farmers (A. Van Buuren et al., 2010). Opposition extended to the provincial government, the Dutch parliament, and the court. Much of this opposition can be partly attributed to Zeeland's history and cultural identity. Following the devastating storm surge of 1953, dikes were reinforced, and the land was protected from flooding. The idea of giving land back to the sea or the river did not fit into the deeply rooted culture of controlling nature. Additionally, landowners strongly opposed giving up their property, reflecting entrenched path dependencies. In the course of protracted debates over depoldering, alternative plans were proposed, but depoldering proved to be legally necessary to compensate for ecological losses in the estuary (institutional dimension).

In 2022, 17 years after the decision was made, the depoldering of Hedwige polder was finally carried out, marking a significant transformation in the material dimension. While depoldering is widely regarded as an effective measure to restore nature and compensate for ecological damage in the Western Scheldt, its contribution to flood safety remains minimal. For example, the depoldering of the Hedwige polder, situated near the Belgian border at the narrowest point of the estuary, reduces upstream water levels by only a few centimeters. Further downstream, where the estuary widens significantly, similar interventions have no measurable effect on water levels. However, depoldering can indirectly improve flood safety by restoring natural floodplains, promoting sedimentation, and creating buffer zones that absorb storm surges. Unlike rigid seawalls and dikes, which can fail under extreme conditions, restored wetlands and tidal areas adapt dynamically, strengthening coastal resilience over time. These natural barriers help dissipate wave energy, lower flood risks, and adapt to rising sea levels. However, their effectiveness depends on local conditions, sediment availability, and management strategies. In many cases, depoldering alone is not sufficient for flood protection and must be integrated with other measures in broader coastal protection strategies. Research demonstrates that various human interventions in the estuary, such as channel deepening, sediment extraction for infrastructure development, and commercial sand mining, have caused significant changes in the material dimension. These activities have widened the underwater trench, further altering the ecological and hydrodynamic balance of the estuary. The wider main trench has caused the tidal wave from the North Sea to move more quickly through the estuary. This effect is amplified by sea level rise and meteorological conditions, leading to higher water levels and greater water volumes (Nicolai et al., 2023).

4.1.3. The Implementation of New Flood Risk Standards and Innovative Dike Concepts (2022–Present)

Rising concerns about the impacts of climate change led to significant institutional changes (institutional dimension), culminating in the enactment of the Delta Act in the Netherlands in 2012. This act serves as the foundation for the Delta Programme, a national program focused on flood risk management and freshwater supply. The Act establishes the role of the Delta Programme commissioner, responsible for advising on the programming of the Delta Programme measures and ensuring long-term financial security through the Delta fund (Ministerie van Infrastructuur en Waterstaat, 2018). The Ministry defines flood protection policies and sets frameworks for other authorities (goal dimension). Since 1953, significant population and economic growth, along with the effects of climate change, have driven a revision of flood risk standards (institutional dimension). Enhanced land protection behind the dikes has led to substantial investments in these areas (material dimension), and while the frequency of disasters has declined (material dimension), the potential for damage has increased considerably (Saeijs et al., 2004, p. 4). Under the new standards, flood protection infrastructure across the Netherlands, including the dikes along the Scheldt estuary, requires reinforcement. The national government and regional water authorities jointly fund these reinforcements.

The Flood Protection Programme (*Hoogwaterbeschermingsprogramma*) primarily aims to meet flood safety standards but also explores opportunities to integrate additional objectives, such as recreation and nature development (*Meekoppelkansen*; Avoyan & Meijerink, 2021). However, the costs associated with these additional objectives are not covered by the program and must be financed through other policy sectors. Due to budgetary constraints, the program follows a "sober and efficient" approach, which strives to use existing resources as efficiently as possible and by making sure no additional costs are incurred (Hoogwaterbeschermingsprogramma, 2021). The national government and regional water authorities jointly fund the dikes' reinforcements along the Scheldt estuary.

From a flood safety perspective, the most effective measures along the Western Scheldt involve reinforcing existing dikes, which is why dike reinforcement remains the predominant approach. As a result, the Flood Protection Programme reinforces past strategies (path dependency). Whereas, from an ecological standpoint, depoldering or dike realignment would be the preferred alternative. However, the program does invest in innovative dike concepts, such as transitional polders (Weisscher et al., 2022). This approach involves temporarily reopening dike-protected areas to tidal influence, allowing sediment to accumulate until the land rises well above mean sea level, after which it can be returned to its original function (Weisscher et al., 2022). This nature-based solution leverages natural sedimentation processes, integrating flood safety with ecological objectives. Regarding the interplay between power and knowledge systems (institutional dimension and interdependencies), expertise in flood risk management and climate change scenarios remains central and highly influential. Additionally, the cross-border Flemish-Dutch Scheldt Commission (Vlaams-Nederlandse Scheldecommissie) with the Dutch-Flemish Schelderaad as an advisory board, conducts long-term system analyses on both nature conservation and the accessibility of the Scheldt. In the Flemish-Dutch Scheldt Commission, Flanders and the Netherlands work together on a sustainable and vital Scheldt estuary. As an impressive economic hub and valuable natural area at the same time, the estuary is of vital importance to the environment. These insights will be integrated into a revised long-term vision for the Scheldt in the coming years.

Table 1 shows how flood management of the Western Scheldt (in the Netherlands) has changed over time.

Table 1. Evolution of flood governance of the Western Scheldt (the Netherlands) from an evolutionary governance perspective.

Western Scheldt (the Netherlands)			
EGT dimensions	Phase 1	Phase 2	Phase 3
Goal dimension: Governance objective	Flood protection	Flood safety, but also depoldering to compensate for ecological degradation	Flood safety and updated flood safety standards
Material dimension: Natural and human patterns	Dike heightening and dike enforcement, closing of the estuaries with the exception of the Western Scheldt	Attempt to depolder while channel deepening, sediment extraction, and commercial sand mining continue	Strengthening the dikes: Innovative dike concepts like transitional polders integrate sedimentation and nature-based solutions alongside traditional reinforcement

Table 1. (Cont.) Evolution of flood governance of the Western Scheldt (the Netherlands) from an evolutionary governance perspective.

Western Scheldt (the Netherlands)			
EGT dimensions	Phase 1	Phase 2	Phase 3
Discursive dimension: Narratives and impact on governance	Control over nature via hydraulic engineering and navigation concerns towards balancing safety and economy	Ecological turn: water system perspective, working with nature. Depoldering challenges traditional flood control approaches based on dikes	Strengthening the dikes: possibilities for nature restoration, "building with nature" becomes a popular discourse
Institutional dimension: Formal and informal rules	The Delta Act and Deltaplan define the framework for intervention and flood safety standards	Nature compensation was legally required to compensate for ecological damage in the estuary	Delta Programme commissioner, funding mechanism, Flood Protection Programme, and strengthening of flood safety
Path dependencies: Historical developments	The 1953 disaster shaped Dutch flood protection policy; historical navigation needs ensured the Western Scheldt remained open	Zeeland's post-1953 flood protection created a culture of controlling nature with dikes. Landowners opposed depoldering due to its clash with regional identity	The Flood Protection Programme reinforces historical practices, especially dike reinforcement, reflecting path dependencies in flood management
Interdependencies: Mutual influence of governance elements	Safety standards balance with navigation needs, keeping the Western Scheldt open for economic and historical maritime reasons	Ecological turn. Dike culture and landowner resistance challenge nature-based approaches amid ongoing dredging	Depoldering to offset ecological damage, yet flood safety continues with strengthening the dikes

4.2. Sea Scheldt (Belgium)

4.2.1. Dike Reinforcements and Controlled Flood Areas After 1976 (1976–2005)

Significant flood events occurred in 1953 and 1976, causing extensive human, infrastructural, and environmental damage. While the 1953 flood sparked discussions in Belgium about the need for risk management, it was the 1976 flood that ultimately led to the development of the Belgian Sigma Plan. In 1976, conditions for inundation triggered a storm surge that flooded Ruisbroek. The failure of the Vliet dike on the Rupel, a tributary of the Scheldt, resulted in two fatalities and severe property damage (Sigmaplan, n.d.-a). In response, the Sigma Plan was introduced, drawing inspiration from the Dutch Delta Plan (institutional dimension). Ratified in 1977, the Sigma Plan outlined a series of projects prioritizing flood safety (goal dimension). The plan's flood control strategy included three key interventions, namely: heightening river embankments, establishing flood-controlled areas, and constructing a storm surge barrier downstream of Antwerp (material dimension; Broekx et al., 2011; Kellens et al., 2013). Heavily influenced by the Dutch approach, the plan reflected a reliance on hydraulic engineering to control natural forces, reinforcing a discursive dependency. Following institutional reforms in the 1980s, water governance was transferred to the regions, granting Flanders water management authority and establishing the legal framework for the Flemish government to implement the Sigma Plan. Since the 1980s, the Flemish region has been responsible for managing both navigable and unnavigable waterways. However, oversight was divided among multiple administrative authorities, each tasked with implementing integrated water management. The legal aspects of this governance structure are discussed later in this section, following an overview of the events and dependencies that shaped the Sigma Plan.

The prevailing discourse of control over nature aligned with the programmatic framework for a corps of engineers to manage water in line with the Sigma Plan's objectives, illustrating a discursive dimension and a form of institutional dependency. Implementation efforts continued throughout the 1980s, initially focusing on smaller flood control areas (Vikolainen et al., 2015). By the 1990s, 75% of the Sigma Plan projects had been completed, although the planned storm surge barrier at Oosterweel was canceled due to excessive costs (Heyse, 1997). Meanwhile, larger projects—such as the Kruibeke-Bazel-Rupelmonde—faced delays due to stakeholder opposition over the use of polders as flood control areas (interdependency). The Kruibeke-Bazel-Rupelmonde case demonstrates how, over 35 years beginning in the 1970s, water management evolved from a purely technical engineering approach to a more integrated flood risk management strategy (Vikolainen et al., 2015). However, the perceived success of flood control areas may have contributed to public complacency. As dike construction facilitated urban expansion, it created a path dependency that influenced decision-making in subsequent phases.

4.2.2. More Controlled Flooding Areas After 2005, in a coalition Between Hydraulic Engineers and Ecologists (2005–2025)

Over three decades, a series of problem-framing shifts reshaped the implementation strategy, moving away from the hydraulic engineering solutions of the 1970s and 1980s. In the 1990s, environmental considerations became central, followed by a shift in the 2000s toward stakeholder involvement and compensation-based approaches. To address opposition, a gradual transition toward a multi-purpose space for the river approach emerged, integrating flood security, ecological restoration, compensation, and local value creation. As policy goals expanded (goal dependencies) to encompass flood safety, environmental concerns, and later compensation, the material dimensions became increasingly interwoven. This resulted in a complex set of challenges in balancing dike-heightening measures with depoldering to manage flood risk in an environmentally sustainable manner.

In the early 21st century, Flemish authorities engaged in international cooperation with the Dutch, aligning with developments at the EU level, including the adoption of the Water Framework Directive (2000/60/EC) and the EU Birds and Habitats Directive (2009/147/EC). At the same time, they updated the Sigma Plan, restructuring it around four key pillars: safety, environment, economy, and recreation (Sigmaplan, n.d.-b). The Sigma Plan evolved in parallel with EU legislation, reflecting a new form of institutional dependency. By incorporating new scientific insights, the Sigma Plan's core focus shifted toward a multifunctional approach to flood protection, including cross-border cooperation. This marked a transition from a traditional flood control response to a risk-based approach, prioritizing nature restoration and recognizing the river's economic significance (interdependency; Kellens et al., 2013).

While the updated Sigma Plan continues to prioritize safety through dike construction, a discursive dependency emerged as a result of the ecological turn; this called for a water system perspective and a commitment to work with nature. This approach aimed to create more space for the river through floodplains (Mees et al., 2016). Rather than attempting to prevent floods, the plan adopted a strategy focused on protecting densely populated and industrialized areas from flood damage (Broekx et al., 2011). The combination of flood safety and nature development goals marked a shift in path dependencies, exemplified by a coordinated partnership between the Flemish Waterways Agency, responsible for hydraulic engineering and water management, and the Flemish Agency for Nature and Forests, tasked with nature development and nature conservation monitoring (Sigmaplan, n.d.-b).

The updated Sigma Plan raised complex questions regarding land use, particularly in areas designated for depoldering (goal dimension). Successful implementation of the Sigma Plan projects required cooperation between farmland owners and water managers, as some agricultural land was repurposed to create nature reserves. For example, the Hedwige-Prosper tidal area alone required 4,500 ha (Sigmaplan, n.d.-b). Collaboration between organizations such as the Boerenbond (the Flemish professional association of farmers) and the Flemish Waterways Agency was essential in facilitating the implementation of the Sigma Plan projects (interdependencies). To address landowner concerns, a series of flanking policies was introduced as part of negotiations to compensate farmers for land lost to flood control areas. These measures included phased implementation, allowing some projects to begin only when farmers became eligible for pensions; financial remuneration, offering competitive land prices with an additional "reinvestment fee"; land exchanges, where the Flemish Waterways Agency purchased land outside project areas to provide farmers with the option of compensation in either money or land; and damage compensation, ensuring that farmers who continued managing land within project areas received compensation for crop losses.

The implementation of the updated Sigma Plan also operates within a broader economic and international context. The management of the Scheldt has historically prioritized maintaining navigable channels to secure access to the Port of Antwerp, Europe's second-largest port, which received approximately 15,000 vessels in 2019 (Elias et al., 2023; Plancke et al., 2022). Given the economic significance of the port, the Scheldt basin remains densely populated and supports key industrial interests along the Sea Scheldt. As a result, policies must balance the estuary's ecological health with its economic and functional *interdependencies*.

4.2.3. Do the New Challenges Require a Continuation of the Coalition and/or New Partners? (2025–2030 and beyond)

By 2030, the updated Sigma Plan will be fully implemented, prompting the Flemish Waterways Agency and the Department of Mobility and Public Works to prepare for a third Sigma Plan. This next phase will focus on flood safety measures in response to climate change impacts. While policy development is ongoing, current discussions emphasize the importance of managing unnavigable waterways upstream, recognizing land management as a critical factor in ensuring flood safety in the Sea Scheldt (goal dimension). This focus extends to the broader management of watercourses in Flanders, closely linked to the implementation of integrated water policy.

Since the 1990s, water management in Flanders has undergone an ecological shift. Previously centered on stream regulation, the approach has evolved to encompass the entire water system, emphasizing area-specific, integrated water policy at the river basin scale (Crabbé, 2008). Despite the establishment of informal river basin committees in the 1990s and their formalization in the 2000s, watercourse management remains fragmented, leading to inefficiencies. The following section outlines "integrated water policy" in Flanders and the complex governance network shaped by institutional dependencies resulting from the strict separation of powers in managing navigable and non-navigable waterways.

At the Flemish level, the Coordination Committee on Integrated Water Policy—established in 2004 and chaired by the Flemish Environment Agency (Vlaamse Milieumaatschappij)—oversees the coordination of integrated water policy (Coördinatiecommissie Integraal Waterbeleid, n.d.-a). The Decree on Integrated Water Policy (approved in 2003) serves as the legal framework for implementing the EU Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC; institutional dimension). This decree defines water systems in Flanders as a cohesive and functional network of surface water, groundwater, waterbeds, banks, living ecosystems, and related physical, chemical, and biological processes, along with associated technical infrastructure (Coördinatiecommissie Integraal Waterbeleid, n.d.-b). Flemish water systems are categorized into three levels: border-crossing river basin districts (e.g., Scheldt and Meuse), river basins (Scheldt, Meuse, IJzer, and Polders of Bruges), and sub-basins (11 across Flanders; Tröltzsch et al., 2016). The management of non-navigable waterways is distributed across multiple authorities, creating path dependencies. First-category non-navigable waterways are overseen by the Department of Environment and executed by the Flemish Environment Agency. Second-category non-navigable waterways fall under the jurisdiction of provincial authorities. Third-category non-navigable waterways are managed by municipalities. Polders and wateringen (district-based water boards) manage second- and third-category waterways at the local level. This fragmented management structure poses challenges to achieving a fully integrated water management approach in Flanders.

The challenges Flanders faces in designing its climate adaptation strategy post-2030 are primarily driven by meteorological unpredictability, which calls for more integration of land management with water managers upstream. With increasing average precipitation, Flanders is experiencing wetter winters and drier summers, often accompanied by frequent heavy rainfall and thunderstorms. These shifts introduce additional goal complexities into water system management, converging three key flood risks: pluvial, fluvial, and coastal flooding (Vlaamse Overheid, 2023). The summer 2021 "water bomb," which caused unprecedented flooding in Wallonia, served as a stark reminder of the potential for further human suffering and economic damage unless adaptation measures are taken. The *Weerbaar Waterland* report calls for a shift to a more holistic systems approach, emphasizing the need for clear flood safety objectives at the Flemish level for flood risk management (Ovink et al., 2022). Unlike the Netherlands, these flood safety standards have not yet been established in Flanders (goal dimension). A blend of nature-based solutions and hydraulic engineering requires a robust institutional framework capable of efficiently implementing blue-green measures at the sub-basin level. This includes utilizing river valleys for flood management and adopting strategies to retain more runoff rainwater upstream (material dimension). These adaptation efforts are aligned with Flanders' obligations under the EU Nature Restoration Regulation (EU2024/1991), which sets targets for restoring free-flowing rivers by 2030 and includes additional requirements for floodplain conditions (institutional dimension). The next Sigma Plan will need to find a way to reconcile the region's obligations at the basin level with its responsibilities for both flood risk management and nature restoration, as dictated by regional and EU requirements.

Table 2 summarises how flood management of the Sea Scheldt (Flanders) has changed over time.

Table 2. Evolution of flood governance of the Sea Scheldt (Flanders), from an evolutionary governance perspective.

Sea Scheldt (Belgium)			
EGT dimensions	Phase 1	Phase 2	Phase 3
Goal dimension: Governance objective	Flood safety	Goal complexity: flood safety and depoldering as nature compensation	Goal complexity: flood safety and nature. Outlook for upstream water management
Material dimension: Natural and human patterns	Dike heightening and dike enforcement, flood control areas, and a storm surge barrier	Further dike heightening measures combined with nature development in a large number of flood control areas, with occasional depoldering	Development of reserve flood control areas specified in the updated Sigma plan. Introducing more meanders
Discursive dimension: Narratives and impact on governance	Control over nature via hydraulic engineering, inspired by the Dutch	Ecological turn: water system perspective, working with nature, and Room for the River	Climate adaptation calls for more integration of land management with water managers upstream, tackling new challenges such as drought and water bombs
Institutional dimension: Formal and informal rules	Sigma Plan provides the programme framework for the corps of engineers	Co-evolution of European directives (nature compensation for deepening Scheldt, EU legislation, and Birds and Habitats Directive) Integrated Water Policy	Further EU requirements via the Nature Restoration Regulation: ensure the good condition of floodplains
Path dependencies: Historical developments	Development behind the dikes because of a (potentially false) feeling of safety	A coalition between hydraulic engineers and nature development agencies	Hindrances are associated with the strict separation of management between navigable and non-navigable waterways
Interdependencies: Mutual influence of governance elements	Stakeholder resistance led to the evolution from technocratic approaches towards economic solutions (land buying)	Balancing ecological demands with navigable waterways is important for the economy	Feasibility of flood control areas and urban land use

4.3. Alignment and Divergences

The results of our analysis, detailed in Tables 1 and 2, reveal distinct governance trajectories in the Netherlands and Flanders. While both countries share similar goal dimensions across the three periods, they differ in material, discursive, and institutional aspects, path dependencies, and interdependencies. In the discursive realm, both countries initially embraced a control-over-nature paradigm in phase 1, with Flanders being influenced by the Dutch approach. The ecological turn in phase 2 marks a moment of divergence, although both countries adopted nature compensation measures under EU obligations, outcomes varied. In the Netherlands, path dependencies rooted in a tradition of hydraulic control sparked resistance to nature-based solutions such as depoldering. By contrast, Flanders' redesign of the Sigma Plan fostered collaboration between engineers and nature development agencies, enabling the implementation of nature-based interventions. Phase 3 underscores further divergence. The introduction of the Delta Act in the Netherlands institutionalized long-term budgeting for flood safety, a significant shift in the institutional dimension, but sidelined nature-based strategies. Meanwhile, Flanders' governance remains fragmented due to path dependencies; the administrative divide between navigable and non-navigable waterways impeded a fully integrated water management. Despite these differences, the Flemish-Dutch Scheldt Commission emerges as a key point of convergence on the perspectives of nature and flood risk management in the Scheldt. It anchors shared perspectives on nature and flood risk management, aligning institutional power and knowledge around a long-term vision for the Scheldt. The institutional dimension and interdependencies of power and knowledge coalesce around the Flemish-Dutch Scheldt Commission as an institution in which flood risk management and climate change scenarios remain central. As the EU Nature Restoration Regulation takes effect, the Flemish-Dutch Scheldt Commission will play a central role in integrating nature-based solutions into future flood governance for the estuary.

5. Discussion

The legacy of engineering-driven water management in the low-lying coastal regions of the Scheldt estuary has long shaped flood risk governance in the Netherlands and Flanders. Hydraulic infrastructure, grounded in command-and-control paradigms, has historically dominated governance strategies, prioritizing technological control and flood defense. However, as ecological consciousness grew and environmental concerns gained traction, a gradual transition toward integrated governance emerged—one that balances flood safety with ecological restoration. This shift aligns with the broader ecological turn in water management, offering opportunities to rethink flood resilience through nature-based solutions and climate adaptation. This shift also reflects the continuous evolution of governance systems, a key premise of EGT, where internal institutional dynamics and external regulatory pressures shape governance trajectories (Beunen et al., 2022; Van Assche et al., 2014).

The growing recognition of nature-based solutions as viable alternatives highlights the increasing role of ecological considerations in flood risk governance. However, deeply entrenched institutional and technical path dependencies, shaped by historical trajectories and actor coalitions, have continued to constrain their large-scale implementation (Hanger-Kopp et al., 2022; Pierson, 2000). In flood risk governance, technical and institutional lock-ins have favored traditional engineering solutions and limited transformative shifts (Seebauer et al., 2023; Vitale, 2023). These constraints illustrate the contingency of governance change. Where institutional transformation alone is insufficient, broader alignment of policy, discourses, and regulatory pressures is necessary to drive systemic reform (Lieberman, 2002; North, 1990).

The differences encountered in the Dutch and Flemish governance trajectories in the Scheldt estuary can be largely explained by material conditions and how these interact with discursive and institutional dynamics in shaping policy decisions. Initially, both regions prioritized large-scale hydraulic infrastructure, reinforcing the dominance of traditional engineering paradigms. However, as the ecological turn in water management gained momentum, governance strategies began to diverge. In the Netherlands, flood management remained heavily rooted in engineering-based approaches, exemplified by the Delta works. Two key material factors have influenced flood governance in the Dutch side of the estuary, namely the estuary's strategic economic role for the port of Antwerp and the limited flood protection benefits of depoldering, making large-scale ecological restoration politically and financially challenging. For what concerns the first material factor, the Western Scheldt remains the only tidal branch in the southwestern Netherlands that has not been dammed, preserving its unique ecological value (M. W. Van Buuren et al., 2015). Regarding the second, unlike the Room for the River program, where floodplain expansion demonstrably reduced water levels, Dutch water managers struggled to justify depoldering in the wide Western Scheldt, where flood safety benefits were minimal. Financial constraints further entrenched this approach, as sunk costs in flood defense infrastructure limited the feasibility of alternative strategies (Avoyan & Meijerink, 2021). Moreover, deeply ingrained socio-political narratives continued to prioritize land reclamation and economic interests over ecological restoration, fueling resistance from landowners and policymakers. In contrast, Flanders embraced a more adaptive governance model, driven by European regulatory frameworks and a shifting policy discourse that framed nature-based solutions as legitimate flood management tools. Unlike in the Western Scheldt, where depoldering offered little direct flood protection, in the Sea Scheldt, floodplain expansion significantly reduced peak water levels, directly benefiting urban centers like Antwerp. This material advantage facilitated greater acceptance of nature-based solutions. Additionally, evolving societal discourses in Flanders increasingly framed nature as integral to water governance, strengthening the legitimacy of nature-based solutions, and this integrative approach was further institutionalized by giving a strong role in the coordination of the Integrated Water Policy to the Flemish Environmental Agency.

While material conditions influence flood risk management choices, the relationship between ecosystem restoration and flood protection is also shaped by evolving societal discourses on the role of nature. The differences between the two regions highlight the pivotal role of discourses in governance transformation—another core tenet of EGT. In Flanders, evolving narratives redefined nature as an integral component of flood management, strengthening the legitimacy of nature-based solutions and facilitating their uptake. In the Netherlands, by contrast, discursive change remained constrained by economic and political interests that continued to prioritize land reclamation and infrastructural resilience over ecological restoration. The Hedwige Polder case illustrates these tensions, where depoldering was implemented only under international legal obligations despite prolonged societal and political resistance.

While external shocks such as the 1953 and 1976 floods have historically shaped governance responses, they primarily reinforced existing infrastructural paradigms rather than catalyzing transformative change. As Meijerink (2005) observes, the Delta Plan—despite its groundbreaking scale—represented a continuation rather than a rupture with pre-existing governance traditions. This pattern exemplifies how governance evolution is shaped by historical dependencies, where crises often reinforce dominant paradigms rather than dismantling them (Boin et al., 2009). Applying an EGT lens to flood governance in the Scheldt estuary reveals that institutional reform or discursive shifts alone do not drive systemic change; instead, transformation requires the alignment of policy integration, regulatory frameworks, and shifting societal perspectives. Although the Room for the River program signals growing recognition of ecologically informed approaches in the Netherlands, tensions persist between traditional engineering solutions and the need for adaptive, nature-based strategies. The Dutch case illustrates the challenge of overcoming entrenched governance structures, whereas the Flemish trajectory suggests that governance adaptation is most successful when material, institutional, and discursive shifts converge.

6. Conclusion

The case studies show that the transition toward integrated flood risk governance is a non-linear and contingent process, shaped by historical legacies, stakeholder dynamics, and external pressures. While aligning flood risk management with ecological restoration enhances resilience and promotes sustainable estuarine ecosystems, the pace of change remains incremental in both the Belgian and Dutch parts of the Scheldt estuary. Traditional institutional analysis frameworks often fail to capture the complex interdependencies shaping flood risk management. EGT helps address these limitations by emphasizing that governance systems evolve continuously through internal and external pressures. EGT also stresses that change is contingent upon historical trajectories, stakeholder interactions, and contextual factors, with discourses playing a key role in governance transitions (Beunen et al., 2022; Van Assche et al., 2014). The governance of the Scheldt estuary exemplifies these dynamics. Unlike many other governance theories, EGT points explicitly to the relevance of materialities. The case studies convincingly show that differences in material conditions partly explain why nature-based solutions to flood risks were adopted more easily in the Belgian than in the Dutch part of the Scheldt estuary. However, as we have seen, institutional choices also matter, as integrated water policies, combining green and blue governance, are more embedded in organizational structures in Flanders, while in the Netherlands, flood risk governance by a sector-based approach is more dominant.

The application of EGT to other cases of flood risk governance will teach us more about similarities and differences in trajectories of flood risk governance and the relevance of material and other conditions for understanding these differences.

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Data Availability

Data supporting the findings of this study are available from the authors upon request.

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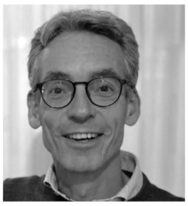

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