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Governance Innovation for Coastal Wetlands: Dependencies, Challenges, and Opportunities in the Valencian Community

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Abstract

Coastal wetlands rank among the world's essential ecosystems, and yet, despite decades of conservation efforts, they continue to face degradation, transformation, and loss. This ongoing decline underscores the need for innovative approaches to their governance. However, much of the existing literature remains broadly focused on littoral governance and does not address the specific challenges of coastal wetland planning and management. In response, this article provides a specific assessment of coastal wetland governance, examining challenges and opportunities across five key dimensions: land–sea management integration, scientific knowledge, stakeholder participation, strategic foresight, and digital tools. Grounded in the evolutionary governance theory and informed by a focus group and in-depth interviews, the study explores the extent to which innovative strategies drive the evolution of governance in six protected littoral wetlands of the Valencian Community: l'Albufera, El Hondo, Lagunas de La Mata y Torrevieja, Marjal de Pego-Oliva, Prat de Cabanes-Torreblanca, and Salinas de Santa Pola. The findings reveal that the opportunities linked to dependencies in the Valencian context can help to overcome barriers to innovation, particularly in the areas of scientific knowledge, stakeholder involvement, and e-governance tools. Notably, common obstacles persist across the five dimensions, including the lack of coordination between government bodies, rigid regulations, frequent political changes, and funding instability, all of which underline the critical importance of addressing institutional and organizational dependencies.

Keywords

coastal wetlands; digital tools; evolutionary governance; land–sea integration; scientific knowledge; stakeholder participation; Valencian community

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1. Introduction

On October 29, 2024, intense floods occurred in the Valencian community and had devastating effects in numerous flood-prone areas, such as those near ravines in the coastal wetland of l'Albufera. This event exposed the heightened risk of environmental disasters that coastal wetlands face, especially in a Mediterranean region where such ecosystems are already under significant environmental and anthropogenic pressure (Camacho et al., 2024). At the same time, it underscored their crucial role in mitigating flood impacts by retaining excess water (Barua et al., 2021). As well as highlighting the function of coastal wetlands as habitats for diverse flora and fauna and their capacity for carbon storage, this emphasizes the critical need for their protection and conservation. However, achieving effective preservation remains particularly challenging due to the complexity of their governance, shaped by overlapping jurisdictions and competing priorities, including persistent tensions between conservationist and productivist interests (Jégou & Sanchis-Ibor, 2019).

The first significant step taken by the international community toward wetland conservation can be traced back to the Ramsar Convention in 1971 (Erwin, 2009). This treaty aimed to protect wetlands' ecological functions and cultural significance while promoting sustainable socio-economic development (Gardner & Finlayson, 2018). Although countries all over the world subscribed to this convention and participated in research on their protection and sustainable use, the total wetland area has continued to shrink worldwide, and its ecological quality has declined (Gardner et al., 2015). Notably, coastal wetlands are among the most severely damaged littoral ecosystems, having experienced significant deterioration, transformation, and loss due to rapid population growth, urban expansion, and the associated human activities such as tourism (Barbier et al., 2011; Cvetkovic & Chow-Fraser, 2011). Additionally, rising global sea-levels caused by climate change are further intensifying the degradation of this specific typology of wetlands (Edenhofer, 2015).

Such issues emphasize the urgent need for innovative approaches in coastal wetland governance. In this regard, a comprehensive understanding of the adaptive capacities and trajectory-shaping mechanisms—known as dependencies—that arise from interactions between institutions and actors is crucial for effective governance reform. Thus, recent studies on littoral governance rely on an innovation-driven model that balances the opportunities and constraints posed by dependencies across five fundamental dimensions: the integration of land–sea management, the application of scientific knowledge, stakeholder engagement, strategic foresight, and the use of digital governance tools (Fobé et al., 2024). Nevertheless, the expectations derived from the literature based on this general model cannot be directly extrapolated to the unique characteristics of coastal wetlands (Barua et al., 2021).

Against this background, this article presents a coastal wetland-based assessment of the five dimensions presented in six critical ecosystems in the Valencian community: l'Albufera, El Hondo, Lagunas de La Mata y Torrevieja, Marjal de Pego-Oliva, Prat de Cabanes-Torreblanca, and Salinas de Santa Pola. It seeks to address the following core research question: How do innovative approaches contribute to the evolution of coastal wetland governance? Grounded in evolutionary governance theory, the study draws on a focus group and several in-depth interviews with a total of 31 stakeholders. It begins by reviewing the current state of the art on governance innovation in coastal areas and particularly littoral wetlands. It then provides background information on the study region and methodology, before discussing the key findings. Finally, the article discusses the results and concludes with a summary of the insights gained from the research and their implications for future wetland governance.

2. Evolutionary Governance in Coastal Wetlands

This article builds on the theoretical and conceptual framework of evolutionary governance theory (Beunen et al., 2015; Van Assche et al., 2020), which conceptualizes governance as the outcome of a co-evolutionary process shaped by interactions among various elements (Schlüter et al., 2020). Within this framework, actors evolve through engagement with one another and the institutions that coordinate them, both formally (e.g., policies, laws, and plans) and informally (e.g., parallel coordination mechanisms).

Through these strategic and routine interactions, governance systems develop adaptive capacities and trajectory-shaping mechanisms, which evolutionary governance theory defines as dependencies (Beunen et al., 2015). Each governance system has a unique configuration of these dependencies, which collectively define its evolutionary trajectory. While dependencies can impose constraints, they also create opportunities for transformation. Indeed, introducing conscious changes based on accumulated learning over time is essential for fostering innovation (Aldeguer, 2016). In the context of coastal governance, this process requires addressing both the barriers and opportunities associated with five key dimensions of institutional innovation identified in recent literature reviews: land–sea management integration, the use of scientific knowledge, stakeholder participation, strategic foresight, and digital governance tools (Fobé et al., 2024).

The first dimension highlights innovations capable of integrating governance across multiple institutional levels and policy sectors (Platjouw et al., 2024). A notable example is the Action Plan developed by the Norwegian government to address the degradation of the Oslofjord ecosystem (Norwegian Ministry of Climate and Environment, 2021). Faced with a situation in which governmental responsibilities were fragmented, the plan takes a comprehensive approach, considering the fjord as a whole and engaging relevant authorities and stakeholders across different governance levels and sectors. Another key example is the development of multi-use platforms, such as the ones proposed by the H2Ocean project (Stuiver et al., 2016). These platforms facilitate the coexistence of traditional maritime activities such as aquaculture, with land-based measures, and renewable energy generation, thus optimizing shared infrastructure for a more integrated and sustainable resource management.

Scientific knowledge plays a crucial role in promoting evidence-based adaptive policymaking, overcoming barriers such as lack of communication, institutional fragmentation, and limited access to research (Connor et al., 2009). Advances in this area include the development of knowledge-based innovation ecosystems, which foster collaboration between public, private, and scientific actors to generate technological solutions for coastal governance challenges (Gifford et al., 2021). In Spain, for example, the regional government of the Canary Islands relies on advisory committees to guide policy decisions. Some, such as the Climate Change Committee (Canary Islands Government, 2018), consist exclusively of scientists, while others, including the Nature Conservation and Agenda 2030 Committees, incorporate diverse stakeholders for broader input (Canary Islands Government, 2024). For its part, in collaboration with local and regional governments, the University of Valencia established l'Albufera Biological Station to conduct and disseminate scientific research (Universitat de València News, 2023).

Stakeholder participation is crucial for enhancing governance, building stronger political support, and reinforcing the legitimacy of policy decisions (Singh & Ort, 2020). Recent years have seen an increase in

community-led initiatives, fostering collaborative networks and polycentric coastal governance systems (Koning et al., 2021). For instance, on the Isle of Wight, conflict resolution mechanisms have been developed to promote dialogue and cooperation among stakeholders (Directorate of Economy and Environment, 2010). Similarly, the Flemish-Dutch Scheldt Commission plays a key role in translating high-level political ambitions into administrative and technical measures for the cross-border management of the Western Scheldt. This institution includes the Scheldt Council, composed of various stakeholder groups, such as port authorities, environmental and agricultural organizations, and representatives of regional and local governments in Flanders and the Netherlands (de Mulder, 2008).

Strategic foresight is instrumental for long-term, proactive policymaking that shifts away from the prevailing reliance on current and past experiences (Serrao-Neumann et al., 2016). A key innovation in this field is marine spatial planning, which not only addresses current land and sea uses but also incorporates future challenges such as climate change and coastal urbanization (Monteiro & Dal Borgo, 2023). Another significant example is the Dutch Delta Program for the 21st century, which aims to anticipate and mitigate flood risks in the Netherlands (Hermans et al., 2024). Unlike reactive approaches, this initiative adopts a forward-looking strategy, integrating geo-ecological changes (e.g., climate change, sea-level rise, and subsidence) with socio-economic trends (e.g., demographic and economic shifts) to develop four delta scenarios for 2050 and 2100.

Last but not least, digital tools can enable the adoption of an integrated, interactive, and forward-looking approach to coastal governance (European Commission, 2022). They do so by improving the availability of information, enhancing transparency, increasing accessibility, and fostering participation as well as feedback between policymakers and stakeholders. Key innovations include geoportals that integrate data from diverse sectors and sources, fostering collaboration among stakeholders (both private actors and the broader public) alongside policymakers in governance (Davret et al., 2023). Likewise, the Adriatic region has been a pioneer in implementing such technologies, as exemplified by the EU Strategy for the Adriatic and Ionian Region Platform (Enrico & Christiaan, 2022), a digital tool that enables policymakers, stakeholders, and organizations to exchange ideas, engage in joint planning, and implement projects, fostering economic, social, and environmental benefits across the region.

Applying innovative approaches across each of the five dimensions may help to overcome challenges related to governance dependencies and foster the evolution of coastal systems. However, these aims may need to be adapted to the unique challenges and opportunities faced by coastal wetlands, due to the complex interactions among physical, anthropogenic, and biological factors (Barua et al., 2021). Indeed, these ecosystems have experienced transformation, deterioration, and loss due to rapid population growth, urban expansion, and human activities such as sewage discharge, land/wetland reclamation, and sea enclosures (Barbier et al., 2011; Cvetkovic & Chow-Fraser, 2011). At the same time, the global sea-level rise caused by climate warming from the increase in anthropogenic activities has a huge impact on coastal wetland ecosystems (Edenhofer, 2015).

While some research suggests potential improvements in wetland protection, such as better outcomes when the decision-making process integrates water, land, human, and wildlife sectors (Endter-Wada et al., 2020, in the case of the US), few studies to date have focused explicitly on land–sea integration in coastal wetlands. A similar gap exists in the study of strategic foresight. Nor has the role of scientific knowledge in littoral wetland governance been examined in detail, since only a few evidence-based studies have focused directly

on this issue. Some of these investigations emphasize their significance for environmental initiatives in the French Atlantic wetlands, such as the designation of protected areas and the evaluation of the ecological effectiveness of conservation measures (Steyaert et al., 2007).

Likewise, only a handful of experimental research papers specifically assess the benefits of electronic tools in coastal wetlands, such as radar methods for tracking the temporal evolution of water depth in the Yellow River Delta in China, which are crucial for long-term health assessments (Xie et al., 2015). While research on stakeholder participation is also limited, it provides a few more insights: for instance, certain observational studies emphasize the benefits of stakeholder and community involvement, whether in preserving environmental quality and resources in South Asian coastal wetlands (Ramesh et al., 2017) or in enhancing ecotourism management in the Chilika marsh in India (Samal & Dash, 2024).

Thus, building on the insights from the existing experiences of coastal governance, this study operates under the central expectation that innovative approaches will help to overcome challenges linked to governance dependencies and thus guide the evolution of coastal wetland governance systems. Based on this premise, we propose the following five expectations:

> E1: Integrated land–sea management and planning enhance policy coherence and governance efficiency in coastal wetlands.

> E2: The effective integration of scientific knowledge into coastal wetland governance fosters more adaptive and evidence-based policymaking.

> E3: Inclusive stakeholder participation and engagement strengthen the legitimacy, acceptance, and overall effectiveness of coastal wetland governance.

> E4: Strategic foresight in coastal wetland governance enhances their long-term resilience and adaptability, particularly in response to climate change.

> E5: The adoption of digital governance tools improves transparency, efficiency, and stakeholder participation in coastal wetland governance.

3. The Case Study: Wetland Protection in the Valencian Community

This case study was carried out in the coastal wetlands of the Valencian community. This selection was based on the premise that wetland governance is most effectively assessed at the local level. Additionally, the region presents significant opportunities for learning and innovation, given the interplay of specific risks faced by its coastal wetlands and the complexity of the multilevel framework for their protection.

The Valencian community has a high concentration of coastal wetlands, whose Mediterranean location exposes them to a series of demanding challenges. On the one hand, they face significant environmental risks, including the increasing frequency of extreme climate events such as prolonged droughts, heat waves, and rising temperatures, along with greater variability in precipitation patterns (Kim et al., 2019). These challenges are further exacerbated by climate change, which acts as a key risk factor, particularly concerning water

resources, amplifying existing vulnerabilities and introducing new threats (Semenza, 2020). On the other hand, the region is also subject to substantial anthropogenic pressures, such as competition between agricultural water demands and environmental water needs (Fornés et al., 2008), rapid urban and infrastructure expansion (Sebastiá-Frasquet et al., 2014), and the continued growth of mass tourism (Viñals, 2024).
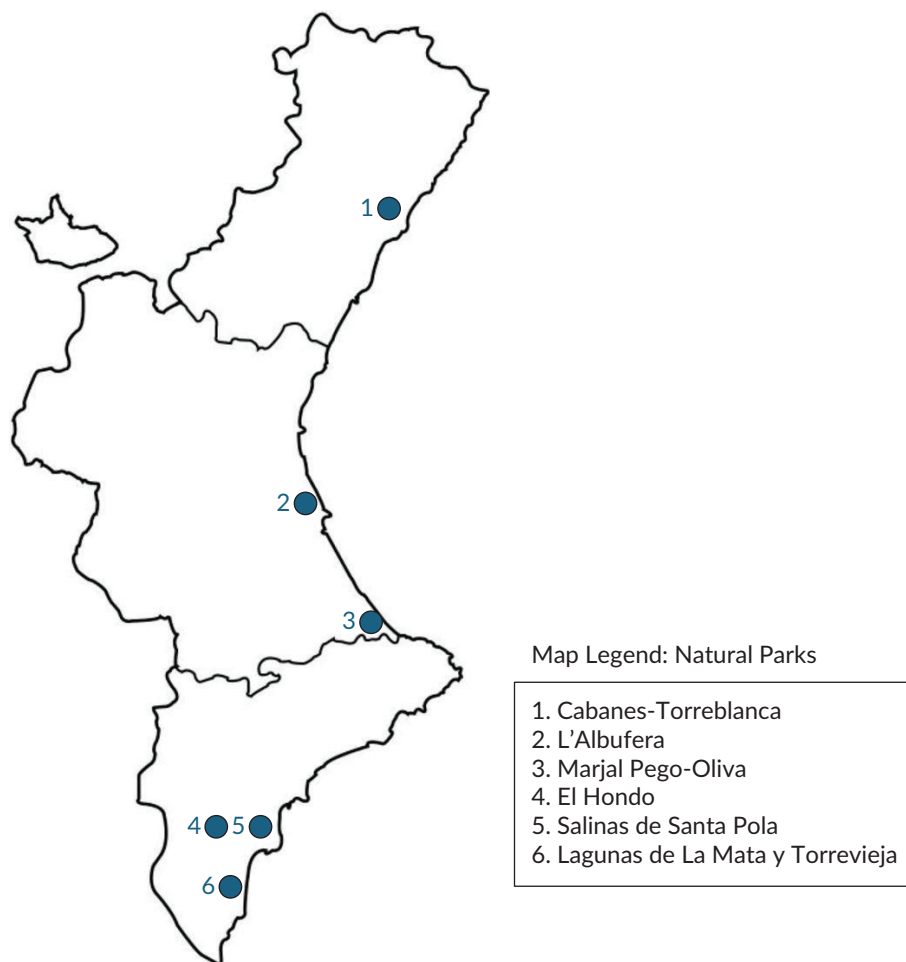
Facing such risks and pressures, an extensive legal framework has evolved, engaging multiple levels of government (Viñals, 2024). One of the most significant at the international level is the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (known as the Ramsar Convention), signed in 1971. This treaty aimed to promote the conservation and sustainable use of wetlands by establishing the first global list of wetlands of international importance, which now includes approximately 2,471 sites. Spain ratified the convention in 1982 and by 2025, had 76 listed sites, 28 of which are coastal. The Valencian community, in turn, has seven Ramsar wetlands, six of which are coastal (Secretariat of the Ramsar Convention on Wetlands, 2025).

The EU also plays a crucial role in wetland protection (Viñals, 2024). Among the most relevant directives are the Habitats Directive (Directive 92/43/EEC, 1992), adopted in 1992, which required the designation of "special areas of conservation" for habitats supporting a high number of plant and animal species (excluding birds), and the Birds Directive (Directive 2009/147/EC, 2009), adopted in 2009, which declared certain areas as "special protection areas for birds" based on their importance for avian species. Together, these directives led to the creation of the Natura 2000 Network, a European-wide conservation system comprising special areas of conservation and special protection areas for birds. Spain currently has 392 wetlands included in this network, 29 of which are in the Valencian community (Sanchís Ibor & Ibáñez Martí, 2024). Beyond these rules, other key European regulations include the 2000 Water Framework Directive (2000/60/EC), the 2007 Directive on Flood Risk Assessment and Management (2007/60/EC), and the recently approved 2024 Nature Restoration Regulation (2024/1991).

Spain first embraced the growing momentum for wetland protection with the enactment of the Conservation of Natural Areas and Wild Flora and Fauna Act (Law 4/1989; Da Costa & Ramil-Rego, 2023). This law set up the Spanish Wetland Catalogue, which was to be compiled by the country's regions (known as autonomous communities). However, its implementation progressed slowly, as its regulatory framework was not established until 15 years later with the Royal Decree on the National Wetlands Inventory (RD/435/2004). Spain also developed the Spanish Strategy for the Conservation and Sustainable Use of Biological Diversity following its ratification of the Convention on Biological Diversity (or Rio Convention) in 1993. Additionally, the protection of Ramsar wetlands was formally incorporated into Spanish legislation through the Natural Heritage and Biodiversity Act (Law 42/2007).

In response to Law 4/1989 (Conservation of Natural Areas and Wild Flora and Fauna Act), Spanish regions began taking significant steps toward the environmental protection of wetlands. Notable examples include the adoption of natural resource management plans, such as Decree 89/1986, which established the legal framework for l'Albufera Natural Park, and Decree 49/1995, which approved the master plan for use and management of the Lagunas de La Mata y Torrevieja Natural Site (Rosa-Moreno, 2008). However, the outstanding milestone is probably the Protected Natural Areas Act of the Valencian Community (Law 11/1994), which laid the foundation for the designation, management, and protection of various protected landscapes, including natural parks, reserves, and natural monuments (Almenar-Muñoz, 2016).

This law was further expanded through subsequent regional regulations, such as Decree 161/2004, which governs municipally protected areas known as Municipal Natural Sites, and the publication of the Valencian Community Wetlands Catalogue on September 10, 2002. The catalogue comprises six coastal wetlands also designated under the Ramsar Convention—l'Albufera, El Hondo, Lagunas de La Mata y Torrevieja, Marjal de Pego-Oliva, Prat de Cabanes-Torreblanca, and Salinas de Santa Pola—which constitute the principal units of analysis in this study (Figure 1 and Table 1). Significantly, the recent enactment of Law 7/2016 has expanded legal protection to all wetlands, irrespective of their prior inclusion in the regional catalogue (Almenar-Muñoz, 2016).

Map Legend: Natural Parks

1. Cabanes-Torreblanca
2. L'Albufera
3. Marjal Pego-Oliva
4. El Hondo
5. Salinas de Santa Pola
6. Lagunas de La Mata y Torrevieja

Figure 1. Geographic distribution of the coastal wetlands studied in the Valencian Community.

Table 1. Coastal wetlands of the Valencian community: area, origin, and significance (from North to South).

Coastal wetland	Area (Ha)	Geomorphological origin and coastal evolution context	Significance
Prat de Cabanes-Torreblanca	866,3	Formed by the natural infilling of an ancient lagoon approximately 6,000 years ago, due to the creation of a sandbar from materials carried by the Cuevas or San Miguel rivers. Over time, peat accumulation from wetland vegetation created the current landscape	The most important wetland in the province of Castellón and one of the least altered wetland habitats in the entire Valencian community. One of its most notable features is its rich wildlife, with a significant presence of endemic species. Birds are the best-represented faunal group. Human activities include agriculture, livestock farming, commercial peat extraction, hunting, tourism, and recreation
L'Albufera	21,120	Originated from a subsiding geological depression filled with Quaternary alluvial sediments. The formation of a coastal sandbar, due to sediment deposition from the Turia and Júcar rivers, isolated the bay from the sea, creating the lagoon. This process began approximately 6,000 to 4,500 years ago	The largest freshwater littoral wetland in Spain, which plays a crucial role in the conservation of numerous species of aquatic birds. Currently, the three most important traditional uses of the area are fishing, hunting, and agriculture, particularly rice cultivation. In addition, it is a major periurban green zone for the city of Valencia, attracting significant levels of tourism for birdwatching, boat trips, gastronomy, and environmental education
Marjal Pego-Oliva	1,255	Remnant of an ancient lagoon which has taken on its present form due to an advanced silting process. Two main rivers flow through the area: the Bullent (or Vedat) in the northern part, and the Racons (or Molinell) in the southern section. In addition, the wetland is fed by numerous tributaries and natural springs, the latter locally known as ullals	Rich in biodiversity, as well as in water quality and resources, the wetland supports agricultural activities, particularly citrus and rice cultivation, and serves as a habitat for several protected species, including the Samaruc (Valencia toothcarp, *Aphanius iberus*). It also supports low-impact tourism, especially nature walks and birdwatching
El Hondo	2,387	Located on land that once formed part of the large Elche lagoon, which existed until the 18th century. The local place names, such as almarjales and saladares, reflect this historical past. The original lagoon disappeared due to natural sedimentation and extensive drainage works	It hosts a wide variety of bird species, including several that are threatened, and serves as a vital stopover for migratory birds and a key area for the conservation of aquatic species. In total, 172 species have been recorded. The wetland holds considerable ecological and economic value, contributing to the local economy through agriculture, tourism, birdwatching, and regulated hunting and fishing

Table 1. (Cont.) Coastal wetlands of the Valencian community: area, origin, and significance (from North to South).

Coastal wetland	Area (Ha)	Geomorphological origin and coastal evolution context	Significance
Salinas de Santa Pola	2,469,7	Geologically, the area is a large tectonic depression that has been subsiding since the Miocene, bordered to the south by the Bajo Segura reverse fault and to the north by the current folding zone of Altet. The gradual infilling of this expansive gulf was driven by sediment contributions from the Segura and Vinalopó rivers, as well as numerous ravines descending from the surrounding mountain ranges. Over time, marine deposits formed sandbars that eventually separated the area from the sea, giving rise to a large coastal lagoon. This wetland, together with El Hondo, once constituted a vast wetland known as the Elche lagoon. Continued sedimentation, primarily from the Vinalopó River, ultimately led to the lagoon's complete isolation from the sea, resulting in the formation of inland wetlands known as almarjales	It includes salt production facilities, freshwater ponds with varying salinity levels, a dune and beach area, and a small portion of farmland. The diversity of environments supports a wide range of plant formations and animal groups, which are distributed according to the water's salinity and depth
Lagunas de la Mata y Torrevieja	3,743	Located in the Bajo Segura basin, these wetlands were formed by the isolation of a coastal bay through the development of a sandbar during the Holocene. The area exhibits characteristics of a subsiding neotectonic basin with Holocene sedimentary infill. The area consists of two lagoons separated by an anticlinal called El Chaparral. A canal connects the two depressions, which are also artificially linked to the sea through two other channels known as *acequiones*, thus forming a unit for salt exploitation	Together with El Hondo and the Salinas de Santa Pola, they form a triangle of wetlands that are crucial for the biological cycles of numerous species, which use them during migration, nesting, or wintering. The area contributes to the local economy through salt production, sustainable tourism, environmental education, and birdwatching

Environmental planning is closely linked to territorial planning at the regional level (De Leonardo, 2018). In the Valencian community, the Law on Territorial Planning and Landscape Protection (Law 4/2004) is particularly notable (Rosa-Moreno, 2008). More recently, the Territorial Action Plan for the Green Infrastructure of the Coast (PATIVEL; Generalitat Valenciana, 2022) was created under the Law on Territorial Planning, Urban Development, and Landscape (Law 58/2018). This plan serves as the key framework for organizing environmental assets from an eco-hydrological perspective within the region (Jódar-Abellán & Molina, 2019).

The role of the regional level in wetland protection within the Valencian community must be understood in the broader context of the gradual consolidation of environmental responsibilities, both within the region's

parliament (Les Corts) and across various government departments with executive functions. Thus, a key milestone in this process was the establishment of a permanent legislative commission during the regional parliament's third legislature. This commission retained the name Environment until the eighth legislature (2011), when it was renamed the Commission on Environment, Water, and Territorial Planning. At the same time, Les Corts has set up several commissions in response to major catastrophic or disruptive events for the purposes of research, monitoring, and evaluation.

Within the regional executive branch, the territorial ministries (Consellerias) responsible for environmental affairs have played a central role, serving as the highest-ranking political and administrative bodies within the Valencian government. Initially, environmental matters fell under the jurisdiction of the Conselleria de Obras Públicas, Urbanismo y Transporte. In 1991, a new ministry was established to manage environmental responsibilities. Since then, this institution has undergone several processes of restructuring and name changes, reflecting the shifting political and environmental priorities over time. It is currently known as the Conselleria de Medio Ambiente, Infraestructuras y Territorio.

4. Methods

This study analyses the perspectives of key institutional actors and stakeholders on the challenges and opportunities presented by governance innovation in coastal wetlands within the Valencian community. The period of analysis spans from the early 1990s, when the autonomous communities began to take on a progressively important role in this field, until the present day.

Data collection included a combination of a focus group and several in-depth individual and collective interviews with stakeholders of different profiles, including activists, representatives of the economic sector, protected area managers, as well as academics specializing in coastal wetlands in the Valencian community (Table 2). This diversity of participants ensured that multiple perspectives were represented, thus achieving a more comprehensive understanding of the factors influencing wetland governance. The focus group was held in June 2024, and the interviews were conducted between November and December 2024.

The stakeholders were selected using a systematic two-stage procedure. First, a prospective analysis was carried out to identify relevant actors, followed by a prioritization based on a matrix of two variables: the stakeholders' degree of interest in the issues addressed in the interviews and the level of influence on the issues analysed. This ensured that the initial interviews captured the opinions of both people who were deeply engaged in the issues and of decision-makers. To broaden and validate our sample, we then applied a chain (snowball) sampling, in which each interviewee recommended additional contacts, thus allowing the network of participants to expand organically until reaching thematic saturation. A total of 31 stakeholders were involved.

The focus group, which included 11 participants, applied a participatory methodology and was structured in two main sessions. Each was divided into two sub-sessions to facilitate a progressive analysis of the barriers and facilitators in coastal wetland governance (see Supplementary File, Appendix A). While the first session aimed to identify and categorize key challenges in littoral wetland governance, the second one focused on the design of potential solutions and strategies for improvement. Both sessions lasted between 90 and 120 minutes.

Table 2. Focus group and interviews.

Code	Actors			
	Institutional	Political	Social	Academic
FG01	X		X	X
I01	X			X
I02	X			
I03	X			X
I04			X	
I05	X			
I06				X
I07	X			
I08	X			
I09	X			
I10				X
I11				X
I12		X		
I13	X			

In-depth interviews provided an opportunity to gather more detailed and specific information on the topics under study. Prior to conducting the interviews, a set of questions was carefully designed to ensure a comprehensive exploration of key issues related to coastal wetland governance (see Supplementary File, Appendix B). The duration of the interviews ranged from 60 to 120 minutes.

The qualitative data obtained through the focus group and in-depth interviews were analysed using thematic analysis (Enguer & Schaub, 2024). In the first step, we transcribed and reviewed the recorded interviews. We then applied open coding to the descriptive content related to the challenges and opportunities associated with each of the key governance dimensions considered in our study. The coded statements were subsequently grouped into five overarching themes: (a) land–sea management integration, (b) the use of scientific knowledge, (c) stakeholder participation, (d) strategic foresight, and (e) digital governance tools. Once these themes were defined, excerpts of particular interest were selected.

5. Coastal Wetland Governance Dependencies and Innovation in the Valencian Community

5.1. Integrated Land–Sea Planning Management

Spain's accession to the EU in 1986 and the subsequent adoption of European directives into national law have been pivotal in protecting the country's coastal wetlands and in enhancing land–sea integration. Key directives include the Birds Directive (2009/147/EC), the Habitats Directive (92/43/EEC), and the Water Framework Directive (2000/60/EC). As one interviewed stakeholder noted: "The entry into the EU has been a blessing...The Water Framework Directive sets the framework for protection and includes inland waters" (I10). By establishing a unified regulatory framework, these directives have fostered coordination and efficiency in natural resource management while promoting the conservation of biodiversity and

environmental sustainability in littoral wetlands. The benefits of EU integration also extend to Spain's participation in protected area networks, such as the Natura 2000 Network, which has made a significant contribution to safeguarding threatened habitats and species within these protected sites.

At the national level, the Law on Natural Heritage and Biodiversity (Law 42/2007) introduced modern conservation principles, such as ecosystem connectivity, to better integrate environmental policies into territorial planning. This legislation is implemented through the autonomous communities' adoption of the Natural Resources Management Plan and the Master Plan for Use and Management. These documents are essential for the planning and administration of coastal wetlands, as they establish protection zones, regulate permitted activities, and define sustainable land uses (I03).

Regional regulations have further advanced land–sea management. Decree 89/1986 laid the legal foundation for the protection of l'Albufera, designating it as the region's first natural park. Another milestone came with the Law on Protected Natural Spaces of the Valencian Community (Law 11/1994), which established a framework for the designation and conservation of natural areas and parks in this Autonomous Community. The approval of the Law on Spatial Planning and Landscape Protection in 2004 (Law 4/2004) marked further progress, reinforcing the region's commitment to coastal wetland conservation. This commitment was strengthened in 2018 by the adoption of the first Territorial Action Plans (I02, I09), alongside the PATIVEL (Law 58/2018; Generalitat Valenciana, 2022), which has played a crucial role in integrating the management and planning of the Valencian coastline (I07). However, its recent repeal through the Administrative Simplification Decree-Law (7/2024) is raising concerns about the future of coastal wetland protection and management (I09, I12).

A further challenge in integrated land–sea governance is the lack of adequate human and financial resources. Coastal wetlands continue to suffer from insufficient staff and funding: "The problem is that they don't have resources for anything. They do what they can and try to learn as much as they can" (I11); "The lack of human and financial resources remains a significant barrier, and the environmental administration needs more personnel and funding to make adequate investments" (I06). Additionally, poor coordination between administrative services presents a major obstacle: "One of the problems we might have now, and I hope it will be resolved, is that there is no coordination between two services that belong to the same sub-directorate" (I08). Rigid institutional structures and inflexible regulations further limit the ability to respond to rapid environmental changes. This issue, which is particularly pronounced when state and regional government bodies interact (I09), is to some extent mitigated when political leaders at different levels share the same political orientation (I05, I13).

Along these lines, it is important to emphasize the impact of political parties on the management of coastal wetlands, with shifts in policy direction and priorities often being influenced by the party in power at the regional level. A persistent challenge for land–sea governance has been the lack of continuity in management and the inconsistency in policy implementation, as the leadership of these protected areas changed based on political considerations (I06, I01, I05). After the change in the regional government in 2015 and the reform of the Law on Protected Natural Spaces (Law 7/2016), the management of coastal wetlands saw a major shift toward professionalization. Civil servants began overseeing these areas instead of political appointees, leading to a more specialized approach to management that is less susceptible to political influence (FG01, I01, I08, I02, I03). This transition has the potential to enhance policy coherence and governance efficiency over time.

For this reason, among other previously discussed factors, we consider that further research is necessary to clarify the extent to which the first expectation of this study may ultimately be validated.

5.2. Scientific Knowledge

The integration of scientific data into the governance of coastal wetlands has facilitated more informed and adaptive decision-making. In this context, collaboration with universities and research centres has been essential for the development of studies of littoral wetlands and their monitoring: "We have monitored the coastal wetlands with the Polytechnic University…we have developed numerous studies on fauna, ornithology, and vegetation that would not have been possible" (I13). This cooperation, combined with the use of advanced technologies such as sensitization and digital twins, has significantly enhanced the understanding and management of these areas (I06, I08).

The role of scientific knowledge is particularly important in aquifer conservation and the prevention of marine intrusion in coastal wetlands. This significance is reflected in efforts such as species reintroduction and the management of sluice gates to maintain appropriate water levels (I01): "To maintain a series of sectional reports on the conservation status of habitats and species required by European legislation, we need not only the common sense and technical expertise of the responsible authorities but [scientific] analysis as well" (I07).

The substantial progress made in this dimension of wetland governance has resulted in numerous examples of successful practices. The Devesa Albufera office is among the institutions that has achieved the most LIFE projects in Spain, showcasing a strong capacity to write and develop projects, integrate scientific knowledge, and collaborate with government bodies and universities (FG01, I06, I13). These studies have been fundamental in the planning and management of natural resources in the region.

Despite the undeniable progress made, the application of scientific knowledge still faces certain challenges. Interestingly, most stakeholders agree that scientific knowledge is available, but attribute the shortcomings to insufficient progress in its practical use. These challenges primarily involve the interaction between science and political parties, administrative structures, and the general public. Regarding the political parties, stakeholders underline both the difficulty of transmitting scientific knowledge and the dependency of its application on the changing political leadership of the regional government (I02, I10).

This lack of political continuity means that administrative staff do not have "the time and resources to apply [scientific knowledge] effectively" (I11, I03, I05). Indeed, resource availability is often reactive, tied to exceptional events such as the reddening of l'Albufera wetland observed in 2023: "When the red Albufera issue occurred, they immediately contacted us for the communiqué." Similarly, these improvements tend to rely on contexts of economic prosperity: "Explanations are provided during times of economic growth." However, as interviewed stakeholders emphasize, "there is no follow-up afterwards. Despite the significant effort required, the information is ignored and our contributions go unrecognized. As a result, we are increasingly reluctant to waste time on this" (FG01, I10).

These difficulties within the administration are compounded by the disconnect between technical staff and high-ranking officials (I05). This is further aggravated by the ongoing challenges the administration faces in aligning its work with other research institutions like universities: "The timing of the universities and the

administration are very different, though communication is increasing" (I03). Finally, regarding the public, interviewees emphasize the difficulty in ensuring that scientific knowledge reaches a broader audience. When it does, it often comes in a very limited and summarized form, which diminishes its impact (I13). All in all, despite the barriers that remain regarding this dimension, the progress in governance brought about by its implementation leads us to partially validate the second expectation of this article.

5.3. Participatory Practices and Stakeholder Involvement

The steady progress in participatory practices and stakeholder involvement in the Valencian community has been largely driven by the creation of governing boards, which bring together a diverse range of relevant actors. In this regard, stakeholders recognize governing boards as "the primary body of public participation" (I06) and note that "almost all relevant actors are represented in the governing boards, although there may even be too many representatives of the administration" (I08). Moreover, stakeholders emphasize their specific role in fostering dialogue and collaboration: "the governing boards have helped us get to know each other better and maintain an ongoing dialogue" (I07).

Governing boards are evaluated both as governance and representation bodies and as management tools. From a governance perspective, stakeholders highlight that these boards emerged as participatory mechanisms to "represent interests following developments in government after the designation of wetlands as Natural Parks" (I03). From a management standpoint, they are regarded as valuable instruments for strategic planning, with stakeholders noting that "the governing board should serve as an ideal tool for long-term planning" (I11).

The involvement of volunteers in conservation projects and citizen science initiatives also plays a crucial role in coastal wetland governance, for example, in the monitoring of biodiversity. As one stakeholder noted, "citizen participation drives and significantly enhances the quality of the measures that can be proposed in a transformative change such as the one ahead of us" (I12). Indeed, citizen participation consistently improves both the process and the quality of measures proposed by government offices. In some cases, it even surpasses institutional efforts, for example, the 2021 Citizens' Assembly for Climate reached bolder conclusions than any political party (I12).

Despite stakeholders' reports that the participation of local actors and civil society has increased over time, they also highlight significant ongoing challenges. One interviewee stated that "collaboration between institutions and society needs to be intensified" (I04), while another noted that "participation has improved but remains insufficient and is often instrumentalized" (I03). These respondents focus specifically on the importance of leadership skills and individual profiles within governing boards, beyond the mere existence of institutional frameworks (I06, I05). An example of this is l'Albufera Governing Board, which had not functioned effectively until its recent change in leadership. In addition, certain groups, such as small local bodies, remain underrepresented in governing boards (I08).

Regarding voluntary participation, stakeholders emphasize the scarcity of appropriate channels to represent their interests within citizen assemblies (I05). Another shortcoming is the fact that the agreements reached by these participatory bodies are not binding, a circumstance that underscores the power imbalance between the desires of the general public and the strong political influence of economic powers (I12). The stakeholders also

highlighted issues such as saturation and fatigue among certain volunteer groups who find themselves obliged to oversee almost all of the projects and actions (I10). The lack of any other non-volunteer groups representing communities near protected areas is notable, as is the absence of certain economic sectors (I07, I05). This adds to the tensions that persist between environmental managers and other actors such as farmers and local government bodies (I07, I05).

Other factors also play a crucial role in participatory mechanisms. Despite advances in data digitization, improvements in e-governance tools are still needed to enhance participation (I09). The lack of continuity in governance and policy implementation is an issue that comes in for a great deal of criticism. For example, the establishment of participatory structures at the regional level gained significant momentum under the leftist coalition government in power between 2015 and 2023 (I06, I08, I03). Additionally, stakeholders express concerns about the "lack of coordination between administrations and the absence of multidisciplinary and cross-sectoral teams that integrate all necessary perspectives" (I06). In conclusion, while innovation in participatory practices has been evident, the problems identified can be generally considered as issues pending for the strengthening of the progress, rather than "hard" barriers. Therefore, our third expectation is confirmed.

5.4. Strategic Foresight

The past decade has seen a steadily increasing emphasis on proactive foresight strategies for coastal wetland governance in the Valencian community (I08). Thus, our case study highlights certain instances that integrate the use of prospective and predictive strategic planning tools. Among these, the most important are digital models and sensorization, which are used to evaluate the cumulative impacts of climate change on natural parks. As noted by our interviewees, data are being "used for a cumulative impact assessment of the possible effects of climate change on the natural parks" (I08) and "hydraulic models for flood risk prevention" (I09).

Along these lines, zoning, based on the recovery capacity of each area, and dune regeneration are key strategies. For example, in the case of l'Albufera wetland, historical data and cartography have been used to project and consider future erosion trends: "Management included the use of historical aerial photographs and comparative cartography to predict erosion trends" (I13). Similarly, the use of updated cartographic tools and monitoring systems such as the Water Material Suction System are fundamental for strategic planning and informed decision-making (I05).

Beyond issues related to the unpredictability of the climate (I10), particularly precipitation (I09), the important but still modest progress reflected in the previous examples highlights the ongoing predominance of reactive management strategies (I11). This issue, noted in both the political and technical fields, will not improve in the immediate future: "We are not there and no improvement is expected" (I10).

This limited general approach is further compounded by other barriers, such as those stemming from "institutional fragmentation and lack of coordination in decision-making and policy integration" (I01). This obstacle has a particularly negative impact on the coherence and effectiveness of coastal wetland governance due to the lack of cohesion sometimes observed between the Spanish Ministry of the Environment, responsible for nationwide coastal matters, and the Generalitat Valenciana, which is

responsible for water management (I07). Respondents note the absence of a unifying prevention body: "There is no body, let's say, for prevention...that globally analyses all risks" (I09).

The lack of political continuity also represents a significant barrier. Priorities frequently change with electoral cycles, generating distrust and hindering the development of sustainable long-term projects. According to one stakeholder, "short-term thinking is always prevalent...political support disappears or the commitment of the council is not there" (I11). This reactive approach limits the ability to plan with a strategic vision.

Additionally, current regulations are often too strict and inflexible to deal with the dynamic challenges posed by climate change. For one respondent, "the regulations and our plans are decrees of the Council that often have a rigidity of the norms that does not allow you to change much" (I07). Added to this is the fact that the management of protected areas largely depends on the government, limiting autonomy and innovation in governance (I11).

The lack of evaluation in many projects is also mentioned: "Here no one evaluates the plans, or the projects, or anything...no one is required to make an assessment of whether this plan that I implemented has turned out well or badly" (I06). This absence of feedback on the results prevents the adjustment of strategies and the improvement of governance. The assessment of the results of past actions must be established as an integral part of prospective governance so as to ensure that the policies and strategies fit the realities of the area. Moreover, this feedback approach must be continuous and include the input of experts and local actors. These actors "want...to give feedback on existing tools, or on what we consider may be missing" (I03). The limited innovations observed in this dimension, which highlight the widespread dominance of a reactive vision of coastal wetland governance, oblige us to reject the fourth expectation of this article.

5.5. E-Governance Tools

Digital tools play a crucial role in fostering transparency and access to management information regarding coastal wetlands. In some of the natural parks, management reports are digitized and made available online: "The management reports are on the website, and you can consult them" (I01). This allows "the city council to know where the data are or, at least, where to obtain them" (I03) and provides the public with access to information: "All those records were also available...having it digitized and available to the public is also very useful" (I09).

In the field of environmental monitoring and adaptive decision-making, digital tools provide key data for the management of ecosystems in real-time. In the littoral wetland of Alicante, "noise sensors have been installed to promote natural spaces as places of well-being" (I08). Additionally, these technologies help predict ecological problems, such as the synchronization of bird reproduction with food availability: "We can predict whether the main food, which is a crustacean called artemia, will synchronize its hatching with bird reproduction" (I08). Real-time data-driven decision-making allows for more flexible and effective management: "With these media, in real-time, we can observe daily data that is updated every five minutes'' (I08).

Digital tools also play a significant role in the participation of the general public and the communication between actors. In the coastal wetland of Pego-Oliva, mobile applications have been introduced to provide information to visitors without the need for physical signage: "We set up mobile applications where you go

to a place and they tell you things" (I01). Furthermore, educational initiatives like "a podcast, and the participation of environmental educators on Radio Pego" (I01) have been implemented. The new facilities that digitization has provided for the public to lodge allegations are also highlighted: "It was very difficult before, for example, to submit an allegation because of the lack of access" (I09).

Regarding the management of invisible resources such as groundwater, digitization facilitates transparency and efficiency in their use. A notable example is the E-Groundwater project, implemented in l'Albufera wetland, which allowed local owners to report water extractions through a mobile application in exchange for agroclimatic information (I05). This project generated trust among the actors involved by improving transparency: "Transparency results in trust" (I05). Additionally, AI tools and digital viewers integrate information on climatology, geology, and fauna, facilitating environmental studies: "AI itself has a significant role here…providing all the existing data as open data" (I03).

However, despite its potential, the implementation of digital tools is still in its early stages and needs to be made more dynamic. Some interviewees point out that "many demonstrative projects and many pilot actions are needed for this to be seen and for it to gradually take hold" (I03). They also note that already existing tools, like the radio programme La Marjal Curiosa, are not being used extensively, highlighting the need for greater promotion and adaptation: "La Marjal Curiosa has existed for years…but I don't think it's used that much" (I03).

In the technical field, the operation of tools like sensors and digital twins also presents limitations. For example, calibration problems and software failures have been identified in the Natural Parks of the South of Alicante: "The software is the crux of the matter…fine-tuning the sensor, calibrating it, and developing the graphs you need" (I08). These limitations also impact the transparency and accessibility of information, as it is still difficult to identify the source of data in existing viewers: "What we lack is a clear understanding of the source of the viewer's data…and how to integrate it" (I03). Nonetheless, although our study reflects that the implementation of digital tools requires greater dynamism, the advances in innovation within this dimension lead us to partially confirm the fifth expectation of the article.

6. Discussion and Conclusion

Through the lens of the evolutionary governance theory, this article has investigated the extent to which innovative approaches have contributed to the evolution of coastal wetland governance. Specifically, it has examined the barriers and opportunities that have shaped the governance of coastal wetlands in the Valencian community since the 1990s. This has been achieved through insights gathered from a focus group and in-depth interviews with stakeholders involved in six protected coastal wetlands, all listed in the Valencian community and Ramsar catalogues of protected areas: L'Albufera, El Hondo, Lagunas de La Mata y Torrevieja, Marjal de Pego-Oliva, Prat de Cabanes-Torreblanca, and Salinas de Santa Pola.

Regarding land–sea governance, the study reveals that despite progress made through the implementation of key European, national, and regional legislation in recent decades, certain dependencies specific to the Valencian context continue to pose significant barriers to governance innovation. Among the most critical barriers identified are excessive institutional rigidity, inflexible legal frameworks, and poor coordination between government bodies. These findings are consistent with previous research in coastal governance, particularly regarding horizontal coordination challenges caused by siloed sectoral responsibilities and limited

inter- and intra-organizational collaboration (O'Hagan et al., 2020). Similarly, our study reinforces earlier conclusions by identifying additional obstacles such as insufficient human and financial resources, as well as a lack of continuity in policy direction due to changes in government (Fobé et al., 2024). This reflects a broader tension between long-term environmental objectives and short-term economic or political agendas (Neal et al., 2018). Consequently, while our findings contribute valuable insights to the academic debates on land–sea management integration, the results related to the first expectation remain inconclusive.

The situation in Valencia demonstrates how scientific knowledge can drive governance innovation, particularly in aquifer conservation and the prevention of marine intrusion, through collaboration with universities and research centres. These interactions tend towards the creation of broader science–policy–society ecosystems, with higher potential for innovation through increased attention to scientific insights (Neilson & São Marcos, 2019). Nevertheless, this research also reports that progress remains limited by persistent communication gaps between universities and government bodies, as well as by challenges in making scientific knowledge accessible to the public. These deficiencies underscore ongoing issues related to the disorganized supply of scientific evidence and associated barriers that hinder its communication and availability to policymakers (Elliott et al., 2023). Further publications even highlight the risks posed by the erosion of scientists' credibility due to populist political discourses (Piwowarczyk & Wróbel, 2016). The latter issue aligns with additional evidence from the present study that reflects political instability and inconsistent funding—factors that may arise from concerns voiced and the electoral success achieved by skeptical actors. The complex balance of arguments regarding the second expectation allows for partial validation.

The findings confirm previous conclusions in the literature that inclusive participation enhances the legitimacy, acceptance, and effectiveness of governance (Day et al., 2021). In the Valencian community, this has been facilitated by the establishment of governing boards and increased voluntary participation in bodies such as citizen assemblies. In line with this, our study underlines the importance of building and utilizing networks across multiple sectors and shareholders (Singh & Ort, 2020), thus suggesting that the third expectation is fulfilled. It should be noted that challenges remain, including the lack of attention to leadership quality in governing boards, the underrepresentation of certain groups in both institutional and participatory bodies, and the limited influence of participatory assemblies compared to that of economic interests. Therefore, our results echo previously identified gaps between the rhetoric and the reality of participation, which have frequently limited meaningful engagement and have prevented the full realization of its expected benefits (de Vivero et al., 2008). Indeed, these misalignments often stem from inconsistent stakeholder involvement or power imbalances among groups (Grorud-Colvert et al., 2021).

Although early steps have been taken towards proactive planning, such as the use of digital models and sensor technologies to anticipate environmental changes, management still tends to be reactive. Thus, despite the positive emphasis in current scholarship on systems that incorporate extended policy horizons in coastal governance (Fobé & Brans, 2013), practical implementation in our case study presents significant challenges that lead us to reject the fourth expectation. Specifically, this research underscores the impact of institutional fragmentation, rigid regulatory frameworks, inadequate evaluation mechanisms, and frequent political shifts. These observations are consistent with broader literature highlighting persistent issues such as the difficulty of accessing integrated (as opposed to sector-specific) information for anticipating future developments and trends (Muccitelli et al., 2023), as well as the mismatch between foresight time horizons and the short-term focus commonly applied in democratic policymaking (Neal et al., 2018).

Digital tools enhance efficiency in littoral wetland governance by providing key data and making the information more transparent and accessible. Relatedly, e-governance tools strengthen stakeholder engagement, for example, through mobile applications and educational projects or by facilitating the submission of comments and objections by members of the public. The outcomes of this study contribute to the growing body of evidence on the benefits of digital tools for coastal management (European Commission, 2022). These include improved transparency and accessibility of environmental information, more effective monitoring and reporting of environmental policies, stimulation of innovation in green technologies, and greater integration of evidence and stakeholder input into decision-making processes (Casiano Flores & Crompvoets, 2023). Notably, implementation remains in its early stages and faces challenges such as underutilization, technical limitations, and accessibility issues. Accordingly, our findings also reflect the presence of specific structural, technical, and organizational barriers that shape the trajectory and effectiveness of e-governance projects (Wilson & Mergel, 2022). Based on these findings, we conclude that the fifth expectation is partially confirmed.

The specific findings for each expectation suggest that the opportunities arising from dependencies in the Valencian region indicate the clear presence of innovation in three of the five dimensions analysed: scientific knowledge, participatory practices and stakeholder involvement, and e-governance tools. Notably, across all five dimensions, three interlinked enablers consistently underpin innovation: first, coordination bodies that can formalize continuous dialogue among actors; second, digital platforms that aggregate real-time data into shared dashboards; and third, adaptive management cycles that institutionalize learning from pilots and emerging trends. Together, these cross-dimensional mechanisms can help create a self-reinforcing system in which coordinated governance structures leverage digital tools to capture stakeholders' insights and scientific knowledge, and adaptive processes can translate those insights into flexible, forward-looking policies.

Likewise, several barriers are common across dimensions, including the lack of coordination between different levels of government, inflexible regulations, frequent political changes, and irregular funding, underscoring the importance of institutional and organizational dependencies. Yet these very barriers can be reframed as enablers when leveraged in concert: cross-sector research networks can break down silos and secure more stable financing; multi-stakeholder governance bodies can embed continuity against political change; and interoperable digital platforms can unify data streams, streamline workflows between different levels of government, and introduce adaptive regulatory feedback. In this light, sustainable innovation in coastal wetland governance largely depends both on amplifying existing enablers and on transforming entrenched barriers into elements of reinforcement across interconnected dimensions.

While this case study offers a detailed examination of a specific context, its findings cannot be directly generalized to other regions. Future research could compare the results presented here across different regions to assess their broader applicability, particularly regarding the expectations discussed here, which were only partially confirmed or remain inconclusive. Further studies might also examine governance innovation in coastal wetlands through alternative dimensions or by focusing on other environmentally significant topics within this context (e.g., biodiversity conservation, water resource management, human impact, and so on).

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Conflict of Interests

The authors declare no conflict of interests.

Data Availability

The data supporting this study is owned by the BlueGreen Governance (BGG) team at the University of Valencia and can be made available upon reasonable request.

Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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