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Restoring European Coastal Wetlands for Climate and Biodiversity: Do EU Policies and International Agreements Support Restoration?

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Abstract

Coastal wetlands provide crucial ecosystem services, including habitats for wildlife, carbon storage, greenhouse gas emission reduction, storm surge and flood protection, water purification, recreation, and nature-based tourism. Their protection and restoration are therefore of growing importance to conservationists, scientists, local communities, and policymakers. This paper analyses the European Union's (EU) policy framework, alongside international and regional agreements relevant to wetland conservation and restoration, focusing on coastal ecosystems. Drawing on policy content analysis, it assesses how 36 EU policies and multilateral agreements support or limit coastal wetland restoration and conservation efforts in Europe. The findings reveal two key gaps: first, an absence of a consistent definition of coastal wetlands within the EU policy framework; and second, the limited number of explicit policy references to these ecosystems. These shortcomings restrict opportunities for their effective inclusion in action plans and undermine coordinated conservation and restoration efforts. Most binding targets and objectives addressing coastal wetlands stem from EU policies and multilateral agreements on nature conservation, including regional sea conventions. This reliance risks overlooking opportunities within other policy sectors. While EU climate policies increasingly recognise the importance of wetland restoration, they often do so through non-binding provisions and voluntary action. To unlock the full potential of coastal wetlands for biodiversity and climate benefits, it is essential to embed coastal wetlands more explicitly within policy targets and to leverage emerging opportunities within the EU policy framework to further upscale coastal wetland restoration.

Keywords: coastal wetlands; wetland restoration; wetland protection; policy review; EU policy; regional sea conventions; international agreements; climate change mitigation; biodiversity enhancement; blue carbon

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1. Introduction

Coastal wetlands are ecosystems situated at the transition zone between marine and inland water-related environments. In Europe, coastal wetlands encompass diverse habitats such as coastal sub-tidal and intertidal seagrasses, salt marshes, unvegetated tidal flats (mudflats) and creeks, and freshwater marshes [1]. These wetlands provide a wide range of crucial ecosystem services, in particular direct resources such as food and biomaterials, habitats for wildlife, carbon storage, coastal protection against storms and

sea-level rise, sediment accumulation, water purification, among other functions [2–4]. In particular, "blue carbon", which is the carbon stored in coastal and marine ecosystems [5], has gained increasing attention over the past decade for its crucial role in mitigating climate change [4,6]. Coastal blue carbon specifically refers to carbon stocks within the coastal zone, especially in coastal marshes, mangroves and seagrass habitats [7].

Despite their significance for conservation and climate regulation, coastal wetlands are threatened by human activity and natural hazards, such as climate change, sea level rise, land reclamation, and decreased sediment supply [2,4,8]. Additional stressors such as saltwater intrusion, drought, pollution, eutrophication of coastal waters, and invasive species further endanger the health of coastal wetlands [4,8]. Given both the high value of benefits that healthy coastal wetlands deliver, and their current deteriorating ecological status, restoration efforts are essential to safeguard these valuable environments.

Policies that address various aspects of wetland restoration and conservation in the EU-27 territory are adopted at global, regional, EU and national levels. A key legal instrument for wetland conservation is the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) adopted in 1971 and later amended in 1982 and 1987. The key purpose of the Ramsar Convention is "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards sustainable development throughout the world" [9]. Recognising the fundamental ecological functions of wetlands, the Conference of the Contracting Parties to the Ramsar Convention, in its Resolution XIV.17 of 2022, has also acknowledged nature-based solutions, including the protection of coastal wetlands, as essential strategies for climate change adaptation and mitigation. Over time, the scope of the Ramsar Convention expanded to cover all elements of conservation and sustainable use of wetlands and their resources [10], setting in motion further conservation efforts at global and national levels. In the EU, subsequent policy and legal instruments, such as the EU Birds (BD) and Habitats Directives (HD), addressed wetland ecosystems in the context of biodiversity protection and habitat conservation. The Water Framework Directive (WFD) further reinforced the need for integrated water management, including through wetland restoration. The recent introduction of the EU Nature Restoration Regulation (EU NRR) signifies a progressive step, aiming to restore degraded ecosystems in the European territory of the EU Member States (EU-27).

Despite wetlands being among the first ecosystems considered for both European and international conservation instruments [11], many remain degraded. In the EU, this degradation is widely attributed to insufficient political attention and the absence of a coherent EU policy framework specifically targeting wetland ecosystems and addressing their principal threats and pressures [12]. Meanwhile, studies focusing on the policy framework for coastal wetland restoration rarely give attention to the EU policy developments and rather centre around North American and South or Southeast Asian contexts [13]. If Europe is selected as one of the case studies, research often addresses coastal wetland restoration at the national [10,14] or regional level [15], providing limited insight into an EU-level policy perspective.

This paper aims to explore how specific EU policies, international agreements and their specific features can support or hinder efforts for coastal wetland restoration and conversation in the EU-27. It focuses only on the level of international agreements and EU policymaking and does not address the questions related to implementation effectiveness. Coastal wetlands are emphasised due to their unique ecological functions on the land–sea interface, high biodiversity value, and crucial role in climate regulation and adaptation. The paper presents the results of a policy content analysis of 36 policy and legal instruments relevant to the EU, evaluating their strengths and limitations for wetland

restoration and conservation. These results will offer insights for policymakers, supporting the identification of policy synergies and addressing existing policy gaps.

2. Materials and Methods

Building on conceptual research frameworks previously applied to the assessment of EU policies on aquatic biodiversity [16] and on nature-based solutions [17], a methodological approach was developed to analyse EU policies, regional and global agreements relevant to coastal wetland conservation and restoration. For the purpose of this policy landscape analysis, the term 'policies' refers to the range of policy instruments, including EU directives, regulations, communications, recommendations and global and regional agreements applicable within the EU. These include international agreements, such as the Barcelona Convention (Mediterranean), the Helsinki Convention (Baltic Sea), and the OSPAR Convention (North-East Atlantic). The Bucharest Convention (Black Sea) was excluded from the assessment since the EU is not a contracting party to this treaty and the current geopolitical tensions and conflict have hampered any progress on unified policymaking. Moreover, although Romania and Bulgaria—both EU Member States—have ratified the Convention, Romania has not ratified the Black Sea Biodiversity and Landscape Conservation Protocol, limiting its scope in practice.

The methodological approach aimed to ensure consistency and enable comparability between the reviewed policy documents. The analysis proceeded in four steps (see Figure 1):

1. Document and web searches were used to identify EU policies, regional and global agreements carrying the potential to support wetland protection, restoration and conservation for climate change mitigation and other co-benefits (biodiversity support, disaster risk reduction and climate adaptation, water regulation). An initial long list (50) of potentially relevant policies was compiled, covering both those directly targeting wetland conservation and restoration and those considered indirectly supportive (see Appendix A).
2. The identified policies were classified into eight broad thematic clusters reflecting their primary focus areas: nature & biodiversity conservation; climate change mitigation & adaptation; water management; marine & coastal protection & management; pollution & water quality; disaster risk reduction; agriculture & soil; and cross-sectoral aspects.
3. The long list of policies underwent a keyword-based screening if using specific terms (wetlands, floodplain, saltmarsh, mudflat, seagrass, ecosystems, habitat(s) and/or species, biodiversity, restoration, protection, conservation, (natural) carbon sinks, carbon sequestration/removal/storage, carbon stock(s), carbon-rich ecosystems, blue carbon, coastal nature-based solutions).

In addition, each policy was assessed for its overall scope, targets, and objectives. For this study, policy objectives are defined as broad overarching goals expressed in general terms, while policy targets are understood as "a meaningful reference value expressing a desired operational policy outcome in a synthetic (often numerical) manner" [18]. The combination of keywords, overall scope and policy objectives was used to prioritise a set of policies for detailed analysis. Policies explicitly mentioning wetlands, floodplains, or specific coastal wetland types (saltmarsh, mudflat, seagrass) were included in the policy inventory. Policies not mentioning these keywords were only included if they explicitly referred to ecosystems, habitats, species, or biodiversity in conjunction with restoration, protection, or conservation, or if their scope and objectives indicated relevance to wetland restoration.

This screening resulted in a prioritised set of 36 EU policies, regional and global agreements which were selected for detailed content analysis (see Appendix A for the

list of policies screened out and the policies selected for further analysis). Each policy was evaluated using a standardised policy template, completed by one policy expert and reviewed independently by a second expert to ensure accuracy and consistency.

4. The policy content analysis using the standardised policy template enables the analysis of each policy's elements and provisions to identify factors that may support or hinder coastal wetland restoration and conservation (analysis of policy strengths and policy barriers). For this, the analysis focused on five key policy elements:
   (a) Coverage and definitions of coastal wetland ecosystems. Assessment of whether the policy explicitly mentions specific coastal wetland types and whether it provides clear definitions of wetlands.
   (b) Targets/objectives. Evaluation of the presence of clearly defined targets or objectives related to (coastal) wetlands, including whether these targets or objectives are mandatory legal provisions or non-binding, voluntary commitments.
   (c) Support to ecosystem services of wetlands. Examination of whether the policy supports one or more ecosystem services provided by restored wetlands, including direct or indirect references to such services.
   (d) Monitoring and assessments relevant to (coastal) wetlands. Analysis of policy requirements related to data reporting, monitoring, or the development of assessment methods relevant to (coastal) wetlands.
   (e) (Coastal) wetland management or restoration measures. Review of policy measures supporting (coastal) wetland management or restoration, including mandates for management or conservation plans relevant to wetlands.

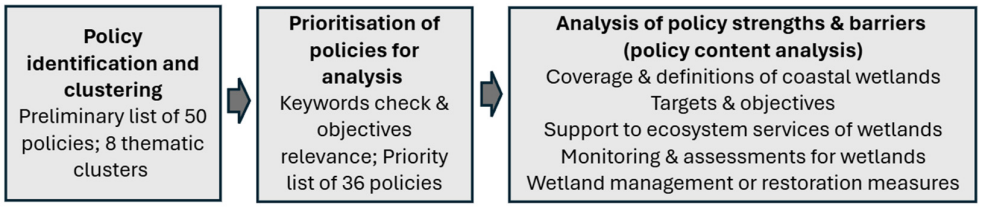

Figure 1. Steps of methodological approach for analysis of policies on coastal wetland restoration.

3. Results

3.1. Relevance of Policies to Coastal Wetlands Conservation and Restoration

Of the 36 EU policies and international and regional agreements analysed, 29 address wetlands explicitly, i.e., they explicitly mention wetlands in the policy scope, objectives, targets or in Annexes which further determine the scope of the specific policy instrument (see list of policies and agreements on nature and biodiversity conservation in Table 1, on marine and coastal protection in Table 2, on climate change mitigation and adaptation in Table 3, on water management, pollution and water quality in Table 4 and on agriculture and soil, disaster risk reduction and cross-sectoral aspects in Table 5). Out of these policies, regional and global agreements, only 12 explicitly refer to coastal wetlands (or specific types of coastal wetlands) in their policy scope, objectives, targets or in supporting Annexes. Eight of these policies and agreements which explicitly cover coastal wetlands concern nature and biodiversity issues (Ramsar Convention, EU HD, EU Green infrastructure (GI) Strategy, EU Biodiversity Strategy 2030 (EU BDS 2030), EU NRR, Barcelona Convention, OSPAR Convention) and marine environment (EU Sustainable Blue Economy). In addition, two of the analysed policies and agreements in the climate field (EU Sustainable Carbon Cycles Communication, United Nations Framework Convention on Climate Change (UNFCCC)) (Table 3), as well as the EU Sustainable Finance Taxonomy (Table 5) and the Nitrates Directive (Table 4) explicitly refer to coastal wetland ecosystems as well.

Table 1. Policy and legal instruments on nature and biodiversity conservation at international, EU, and regional levels that are relevant to wetlands and coastal wetlands.

Policy/Agreement (Abbreviation) [1]	Related Coastal Wetland Terms Used in Official Texts	Key Relevant Implementing Instruments or Citation
Ramsar Convention	Coastal wetlands, habitat types (marsh, fen, estuary, mangrove, tidal marsh, seagrass)	Convention text, i.a. Article 1.1
Convention of Biological Diversity (CBD)	Wetlands (general)	Convention text; Kunming-Montreal Global Biodiversity Framework (GBF) (2022) [2]
Barcelona Convention	Coastal wetlands, estuaries, blue carbon sinks, salt marshes, salt pans, intertidal mudflats, coastal lagoons	Convention text, i.a. Art 10 of Integrated Coastal Zone Management (ICZM) Protocol; Specially Protected Areas and Biological Diversity Protocol; Post-2020 Strategic Action Programme for the Conservation of Biodiversity and Sustainable Management of Natural Resources in Mediterranean Region (Post-2020 SAPBIO) [3]; Mediterranean Strategy for Marine & Coastal Protected Areas [4]
Helsinki Convention	Wetlands (general), coastal habitats	Annex III of Helsinki Convention; HELCOM Recommendations 18/4 & 40-1
OSPAR Convention	Coastal wetland habitat types (*Zostera* beds, intertidal mudflats, *Cymodocea* meadows, seagrass beds, saltmarshes)	The North-East Atlantic Environment Strategy 2030 (NEAES 2030) [5]
Birds Directive (BD)	Wetland habitats, sites designated for waterbirds/wetlands	Directive text, i.a. Article 4(1) (designation of Special Protection Areas)
Habitats Directive (HD)	Coastal wetland habitat types (list): coastal lagoons, estuaries, salt marshes, intertidal mudflats, *Zostera* beds/seagrass	Directive text, i.a. Article 3 (Natura 2000/Special Areas of Conservation from Annex I (list of habitat types of community interest, includes coastal/marine habitat types))
EU Green Infrastructure (GI) Strategy	Coastal wetlands, tidal habitats, blue carbon	Strategy text (EU Communication)
EU Biodiversity Strategy for 2030 (EU BDS 2030)	Coastal wetlands, specific habitats (mangroves, seagrass)	Strategy text with references to ecosystem protection and restoration targets (EU Communication)
EU Nature Restoration Regulation (EU NRR)	Coastal wetland Habitat types (estuaries, mudflats and sandflats, coastal lagoons, salt marshes, seagrass beds)	Regulation text, i.a. Article 4 (binding restoration targets, list of ecosystems), Annex I and Annex II
Invasive Alien Species (IAS) Regulation	None	Regulation text, i.a. Article 20 requires ecosystem restoration

[1] For full name of each policy/agreement, refer to Appendix A; [2] CBD/COP/15/L.25; [3] Decision IG.25/11, 2021; [4] Decision IG.25/12 (Annex I), 2021; [5] OSPAR Agreement 2021-01, as amended by OSPAR Agreement 2025-01.

Table 2. Policy and legal instruments on marine and coastal protection and management at EU level that are relevant to wetlands and coastal wetlands.

Policy/Agreement (Abbreviation) [1]	Related Coastal Wetland Terms Used in Official Texts	Key Relevant Implementing Instruments or Citation
Strategic Guidelines for the Sustainable Development of EU Aquaculture	Ponds, wetlands and brackish waters	Communication text, i.a. Section 2.2.1 (promoting aquaculture in wetlands)
Marine Strategy Framework Directive (MSFD)	None	Directive text with references to coastal environment and ecosystems, coastal and transitional waters
Recommendation on ICZM in Europe (EU ICZM Recommendation)	None	Recommendation text, i.a. Chapter I on the strategic approach to ICZM aiming to protection of the coastal environment, based on an ecosystem approach
Sustainable Blue Economy Communication	Coastal wetland Habitat types (salt marshes, seagrass fields, mangroves, dunes, coral reefs, macro-algal forests)	Communication text, i.a. references to habitats and ecosystem services

[1] For full name of each policy/agreement, refer to Appendix A.

Table 3. Policy and legal instruments on climate change mitigation and adaptation at international and EU levels that are relevant to wetlands and coastal wetlands.

Policy/Agreement (Abbreviation) [1]	Related Coastal Wetland Terms Used in Official Texts	Key Relevant Implementing Instruments or Citation
United Nations Framework Convention on Climate Change (UNFCCC)	Coastal wetland habitat types (Managed coastal wetlands including mangrove forests, managed tidal marshes and seagrass meadows)	Convention text, i.a. Article 4, par. 1 (d) (conservation of sinks and reservoirs of greenhouse gases (GHG), including coastal and marine ecosystems); Paris Agreement, i.a. Article 5 (conservation of sinks and reservoirs of GHG); IPCC Wetlands Supplement (Technical guidance)
EU Land Use, Land Use Change and Forestry (LULLUCF) Regulation	Wetlands (general) as a managed land category for GHG accounting and carbon storage	Article 2 (scope), 7 (accounting for managed wetlands), 13b (land use mechanism for 2026–2030); recitals refer to importance of wetlands as high carbon stock ecosystems
European Climate Law (ECL)	None	Regulation text with references to natural sinks, emission sources; Article 5 on adaptation to climate change
EU Strategy on Adaptation to Climate Change (EU Adaptation Strategy)	Wetlands (general) as nature-based solutions	Strategy Communication text, i.a. Section 11 (promoting nature-based solutions for adaptation)
Sustainable Carbon Cycles Communication	Wetlands (general) and coastal wetlands	Communication text with references to nature-based solutions and high-carbon-stock lands
EU Carbon Removals and Carbon Farming (CRCF) Regulation	Wetlands (general)	Preamble refers to nature-based removals; references to wetlands and coastal environments included in the Regulation
EU Renewable Energy Directive (RED)	Wetlands (general)	Article 29(4)(a) on sustainability criteria defines land with high-carbon stock and explicitly includes wetlands

[1] For full name of each policy/agreement, refer to Appendix A.

Table 4. Policy and legal instruments on water management, pollution and water quality at EU level that are relevant to wetlands and coastal wetlands.

Policy/Agreement (Abbreviation) [1]	Related Coastal Wetland Terms Used in Official Texts	Key Relevant Implementing Instruments or Citation
Water Framework Directive (WFD)	Wetlands (general), transitional waters and coastal waters	Article 2, Annexes addressing definitions and scope; Supporting Common Implementation Strategy guidance
Floods Directive (FD)	None	The legal text refers to the role of certain wetland types in natural flood retention (Article 4(2)(d))
European Water Resilience Strategy	Wetlands (general), coastal restoration	Strategy Communication text with reference to wetlands and coastal areas, a source-to-sea approach
Groundwater Directive (GD)	Wetlands (general)	Article 3 on criteria for assessing groundwater chemical status
Nitrates Directive	Coastal wetlands habitat types (estuaries), coastal and marine waters	Article 6, Annex I on criteria for identifying waters affected by pollution or which could be affected by pollution
Farm to Fork Strategy (F2F)	Wetlands (general)	Communication text includes general references to wetlands
Zero Pollution Action Plan (ZPAP)	None	Action Plan Communication text on zero pollution ambition for all aquatic ecosystems

[1] For full name of each policy/agreement, refer to Appendix A.

The vast majority, i.e., 24 out of 36 policies, global and regional agreements with relevance to wetlands do not explicitly refer to coastal wetlands. Those that do refer to coastal wetlands can be divided into two groups: (i) three policies and agreements that include detailed lists of coastal wetland habitats (Ramsar Convention, HD, EU NRR) and (ii) the rest of policies and agreements (nine) that make reference to few coastal wetland habitats in particular saltmarshes, mangroves, seagrass beds, tidal habitats, estuaries, as well as blue carbon.

International legal instruments offer a range of wetland definitions. For example, the Ramsar Convention and the UNFCCC, through the IPCC Wetlands Supplement, both provide definitions that shape how wetlands are addressed within their respective mandates. The Convention on Biological Diversity (CBD), in its Decision VII/4, par. 27, formally adopted the Ramsar definition. EU policy, however, lacks a uniform definition of wetlands. While the HD and the EU NRR identify numerous coastal wetland habitat types requiring protection and restoration, they do not provide an explicit definition of wetlands. In the context of national greenhouse gas (GHG) inventories, Member States also apply varying approaches, as the use of the IPCC Wetlands Supplement definition is not mandatory. Notably, the Renewable Energy Directive (RED) stands as the only EU-level policy that explicitly defines wetlands (Table 6), while the EU Sustainable Finance Taxonomy is the only EU legal instrument explicitly referring to the international definition of wetlands provided by Ramsar Convention. The RED also recognises 'land with high-carbon stock,' including wetlands such as peatlands and continuously forested areas, as specified in Article 29(4)(a–c). However, neither RED, nor other EU policies specifically define coastal wetlands.

Table 5. Policy and legal instruments on agriculture and soil, disaster risk reduction and cross-sectoral aspects at EU level that are relevant to wetlands and coastal wetlands.

Policy/Agreement (Abbreviation) [1]	Related Coastal Wetland Terms Used in Official Texts	Key Relevant Implementing Instruments or Citation
Common Agricultural Policy Regulation (CAP)	Wetlands (general)	Regulation texts refer to wetlands in conditionality rules (e.g., Good Agricultural and Environmental Conditions (GAEC)) and eco-schemes
EU Soil Strategy for 2030	Wetlands (general)	Strategy Communication text with references to the role of peatlands/wetlands for carbon/soil health
Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR)	Wetlands (general), coastal floodplain areas	Article 30(g) on mainstreaming the disaster risk assessment into rural development planning and management of different areas
Environmental Impact Assessment (EIA) Directive	Wetlands (general)	Annex III on selection criteria to determine locations of projects for Environmental Impact Assessment considers wetlands
Infrastructure for Spatial Information in the European Community (INSPIRE) Directive	Wetlands (general)	Annex II on spatial data themes includes wetlands as a land cover type
EU Sustainable Finance Taxonomy Regulation	Wetlands (general) Coastal wetland habitats (mangroves, seagrass)	Regulation text, i.a. Article 10 on substantial contribution to climate change mitigation; Delegated Regulation (EU) 2021/2139 (Climate Delegated Act); Delegated Regulation (EU) 2023/2486 (Environmental Delegated Act)
EU Bioeconomy Strategy	None	Strategy Communication text with references to restoration of ecosystems, water quality and biodiversity

[1] For full name of each policy/agreement, refer to Appendix A.

Table 6. Definitions of wetlands in key international and EU policy frameworks.

Policy/Agreement (Article, If Available)	Definition of Wetlands
Ramsar Convention (Art. 1.1)	*"Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres".*
IPCC Wetlands Supplement (Glossary)	*"Land with wet soil that is inundated or saturated by water for all or part of the year to the extent that biota, adapted to anaerobic conditions, particularly soil microbes and rooted plants, control the quality and quantity of the net annual GHG emissions and removals".* A coastal wetland is defined as a *"wetland at or near the coast that is influenced by brackish/saline water and/or astronomical tides".*
RED (Art. 29(4)(a))	*"Land that is covered with or saturated by water permanently or for a significant part of the year".*

3.2. Policy Objectives and Targets for Coastal Wetlands Conservation and Restoration

20 of the 36 analysed policies and global and regional agreements include objectives or targets which are specifically addressing the conservation and restoration of wetland ecosystems, while 11 policies and agreements refer specifically to coastal ecosystems and coastal wetlands in their targets or objectives (see Tables 7 and 8). For the OSPAR

Convention and the CBD, wetland-related objectives or targets are not included in their legal texts but in complementary instruments for their implementation such as action plans, guidance for implementation, programmes or strategies.

Table 7. Key policy objectives and targets for coastal wetlands in 6 regional and global agreements, including indication of their bindingness degree.

Policy/Agreement	Objectives Relevant to Coastal Wetlands and Their Bindingness Degree	Targets Relevant to Coastal Wetlands and Their Bindingness Degree
Ramsar Convention	Designate, manage, and wisely use wetlands of international importance (binding)	- Designate Ramsar Sites (binding) - Promote wise use in national policy (binding) - Maintain ecological character of listed wetlands (binding)
CBD	Conserve biodiversity, sustainably use its components, and share the benefits fairly and equitably (binding)	GBF: Ensure 30% area-based conservation and restoration of degraded ecosystems (incl. wetlands) by 2030 (non-binding)
Barcelona Convention	- Prevent, reduce, combat pollution and protect the marine and coastal environment, incl. wetland habitats (binding) - Ensure the protection of coastal landscapes via legislation, planning and management (binding)	Implement ICZM Protocol and Post-2020 SAPBIO targets: - restore degraded coastal wetlands to reactivate their positive role in coastal environmental processes (binding) - regulate or prohibit activities that may have adverse effects on wetlands and estuaries (binding)
Helsinki Convention	Protect the Baltic Sea from all sources of pollution from land, air and sea (binding)	- Retain and restore wetland areas to be able to reduce plant nutrient losses and to retain biodiversity (binding) - Implement 18/4 Recommendation on Managing Wetlands for Retention of Nutrients (non-binding)
OSPAR Convention	Conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected (binding)	Implement NEAES 2030: Develop a regional approach to apply nature-based solutions for carbon storage and restoring relevant habitats by 2025 (seagrass beds, kelp forests, saltmarshes) and to reinstate natural capacity to sequester nutrients through conservation and restoration of estuarine, coastal, and marine habitats by 2030 (non-binding)
UNFCCC	Promote conservation and enhancement of sinks and reservoirs of GHGs, including coastal and marine ecosystems (binding)	Implement Paris Agreement: - Conserve/enhance sinks and GHG reservoirs (including coastal ecosystems) (binding) - IPCC Wetlands Supplement: Improve reporting of GHG emissions and removals from wetlands (non-binding)

Eight policies, global and regional agreements set forth time-bound policy targets and objectives for wetland conservation and restoration to be achieved by 2030, while the other policies and agreements assessed reveal an absence of long-term targets and objectives for coastal wetland ecosystems beyond 2030. The recently adopted EU NRR was the first to introduce further time-bound targets for wetland restoration by 2040 and 2050.

Nine of the twenty policies and agreements include non-binding objectives or targets relating to wetlands (see Tables 7 and 8). These targets and objectives mainly stem from policies which are key strategies in the marine & coastal protection & management and

climate change mitigation & adaptation fields, but their specific provisions for wetlands and restoration concern voluntary measures by EU countries.

Table 8. Key policy objectives and targets for coastal wetlands in 14 EU policies, including indication of their bindingness degree.

Policy/Agreement	Objectives Relevant to Coastal Wetlands and Their Bindingness Degree	Targets Relevant to Coastal Wetlands and Their Bindingness Degree
BD	Preserve, maintain and re-establish sufficient diversity and area of habitats for all wild birds (binding)	- Designate Special Protection Areas covering key wetland sites (binding) - Maintain population trends at healthy levels (binding)
HD	Ensure that species and habitat types are maintained, or restored, to favourable conservation status in EU (binding)	Designate and manage Special Areas of Conservation for listed wetland habitat types within six years after adoption of Sites of Community Importance (binding)
EU BDS 2030	Protect and restore biodiversity, including wetlands as priority ecosystems (non-binding)	By 2030: - protect 30% of EU land and sea (non-binding) - strictly protect 1/3 of EU protected areas (non-binding) - strictly protect significant areas of carbon-rich ecosystems, e.g., wetlands, seagrass meadows (non-binding) - aim for 30% favourable conservation status or positive trend for habitats/species (non-binding)
EU NRR	Restore degraded ecosystems, including coastal and freshwater habitats (binding)	- Restore at least 30% of area of habitat types of Annex I and Annex II not in good condition by 2030; 60% by 2040; 90% by 2050 (binding) - Re-establish habitat types of Annex I and Annex II to reach their favourable reference area (phased targets for 2030, 2040 and 2050) (binding) - Restore habitats of species necessary to improve the quality and quantity of habitats, including enhancing connectivity (binding)
MSFD	Achieve "Good Environmental Status" (GES) in marine waters, including biodiversity and seafloor integrity linked to coastal wetlands (binding)	Achieve or maintain GES in the marine environment by 2020, including coastal and transitional waters where these are not covered by the WFD (binding)
EU LULUCF Regulation	Account for and manage emissions/removals from land use including wetlands (binding)	Meet EU-wide net removal target of 310 Mt CO2e by 2030 through reporting and accounting for wetlands, among others (binding)
EU CRCF Regulation	Facilitate and encourage carbon farming in terrestrial and coastal environments (binding)	Certify carbon removals and support deployment of carbon farming in terrestrial or coastal environments (binding, where applicable)
Communication on Sustainable Carbon Cycles	Promote carbon farming upscaling through, i.a., restoration of wetlands that reduces carbon stocks oxidation and enhances carbon sequestration potential (non-binding)	Restore wetlands and peatlands and promote blue carbon farming, including on coastal wetlands, to upscale carbon farming up to 2030 (non-binding)

Table 8. *Cont.*

Policy/Agreement	Objectives Relevant to Coastal Wetlands and Their Bindingness Degree	Targets Relevant to Coastal Wetlands and Their Bindingness Degree
EU Adaptation Strategy	Promote use of wetland and coastal ecosystem restoration as cost-effective nature-based solution for adaptation (non-binding)	No specific targets for wetlands
WFD	Prevent further deterioration, protect and enhance the status of wetlands directly depending on aquatic ecosystems and groundwater (binding)	Achieve good ecological and chemical status of all surface water bodies and good chemical and quantitative status of all groundwater bodies by 2015, at the latest 2027 (binding)
European Water Resilience Strategy	Restore and protect the water cycle as basis for sustainable water supply (non-binding)	- Set up a "sponge facility" as funding tool that may support wetland restoration (non-binding) - by 2027, set up a Green and Blue Corridors initiative to support the restoration of ecological infrastructure, including wetlands, using a "source-to-sea" approach (non-binding)
Nitrates Directive	Reduce water pollution caused or induced by nitrates from agricultural sources and prevent further such pollution of ground and surface waters (binding)	Designate Nitrate Vulnerable Zones, which may include wetlands, and apply mandatory measures to reduce pollution from nitrates (binding)
CAP	Protect wetlands and peatlands as part of GAEC 2 (binding, where applicable)	Ensure appropriate protection of wetland and peatland due to their role as carbon stores, as of 2025 at the latest (binding, where applicable)
EU Soil Strategy for 2030	Limit drainage of wetlands and organic soils and restore managed/drained peatlands (non-binding)	By 2030, maintain/increase soil organic carbon, minimise flood/drought risks and enhance biodiversity through wetland protection and restoration (non-binding)

15 of the 20 policies include policy objectives or targets of legally binding nature relevant to wetlands. Many of the binding targets and action requirements originate from EU policies and multilateral agreements in the nature and biodiversity conservation field, including regional sea conventions. EU policies with legally binding provisions that concern wetlands, their conservation and/or restoration include the HD and BD, the EU NRR, the WFD, the MSFD, the LULUCF Regulation, and the CAP. At the regional level, the Barcelona and Helsinki Conventions, and at the international level, the Ramsar Convention and the UNFCCC contain binding provisions relevant to wetlands, including coastal ones.

It is important to note that four global and regional agreements (i.e., the UNFCCC, CBD, the Helsinki and OSPAR Conventions) contain both legally binding and non-binding targets and objectives with relevance to coastal wetlands.

3.3. Policy Support to Retain and Enhance Ecosystem Services from Wetland Conservation and Restoration

Supporting biodiversity is the ecosystem service provided by wetlands that is most frequently recognised in the strategies and agreements analysed (Table 9). It is addressed and recognised in most of the analysed EU policies, regional and global agreements (31 of 36 policies). Out of these, nine policy and legal instruments provide strong support to the biodiversity ecosystem service of wetlands, i.e., there are explicit policy aims to enhance this wetland service, for example, the Ramsar Convention, the BD, the HD, the EU NRR, but also the Sustainable Blue Economy Communication, and the Barcelona and Helsinki

Conventions. Furthermore, the EU CRCF Regulation is the only of the climate policies strongly supporting biodiversity enhancement function of wetland restoration as it directly requires biodiversity and ecosystem co-benefits from carbon farming activities in terrestrial or coastal environments. Most of the policies and agreements (22) provide moderate support to the biodiversity ecosystem services, i.e., this wetland ecosystem service is simply recognised by policy or agreement or indirectly supported by the policy targets, objectives or actions.

Table 9. Level of support of policies and global and regional agreements to ecosystem services from wetland restoration [1].

Policy/Global or Regional Agreement	Biodiversity Support	Climate Change Mitigation	Disaster Risk Reduction & Climate Change Adaptation	Water Supply and Quality Regulation
Nature & biodiversity conservation				
Ramsar Convention	++	+	+	+
CBD	+	+	+	+
Barcelona Convention	++	++	++	+
Helsinki Convention	++			++
OSPAR Convention	+	++		++
BD	++			
HD	++	+		+
IAS Regulation	+			
EU GI Strategy	+	+	+	+
EU BDS 2030	++	++	+	+
EU NRR	++	++	++	+
Climate change mitigation & adaptation				
UNFCCC	+	++	+	
EU LULUCF Regulation	+	++		
EU Adaptation Strategy	+	+	+	+
ECL	+	++	+	
Communication on Sustainable Carbon Cycles	+	++	+	+
EU CRCF Regulation	++	+	+	+
RED	+	+		
Marine & coastal protection				
EU ICZM Recommendation	+		+	
MSFD	+			
Strategic Guidelines for the Sustainable Development of EU Aquaculture	+			+
Communication on Sustainable Blue Economy	++	++	++	

Table 9. *Cont.*

Policy/Global or Regional Agreement	Biodiversity Support	Climate Change Mitigation	Disaster Risk Reduction & Climate Change Adaptation	Water Supply and Quality Regulation
Water management				
WFD	+			++
FD	+/−		+	
European Water Resilience Strategy			+	++
Pollution & water quality				
GD	+			+
Nitrates Directive	+			+
F2F	+			
ZPAP	+			
Agriculture & soil				
CAP	+/−	+/−		+
EU Soil Strategy 2030	+	+	+	+
Disaster risk reduction				
SFDRR			++	
Cross-sectoral aspects				
EU Sustainable Finance Taxonomy	+	++	++	+
EIA Directive	+			+
INSPIRE Directive				
EU Bioeconomy Strategy	+	+		+

[1] In the table, the level of policy support "++" stands for "strongly supporting" meaning that expressed policy or agreement aim exists to enhance this wetland service; "+" stands for "supporting" meaning that wetland service is simply recognised by policy or agreement or indirectly supported by the policy/agreement targets or actions; "+/−" refers to "mixed support" meaning that both supporting and hindering elements for this wetland service are identified in the policy/agreement; blank cell means that the policy or agreement neither supports nor hinders this wetland service.

Climate change mitigation (carbon sequestration and/or GHG emissions reduction) is recognised as an ecosystem service provided by wetlands restoration in about half of the assessed EU policies, regional and global agreements (19 of 36 policies). Of these, 10 policies and agreements strongly support this ecosystem service of wetlands. They contain explicit policy aims to report on changes in GHG emissions and to enhance, restore, or conserve wetlands as blue carbon ecosystems, marine and coastal carbon sinks, or as nature-based solutions for climate change mitigation. These are, in particular, the UNFCCC, the EU LULUCF Regulation, the EU Communication on Sustainable Carbon Cycles, the ECL, the EU Sustainable Finance Taxonomy, the Sustainable Blue Economy Communication, the EU BDS2030, the EU NRR, as well as two regional legal instruments, i.e., the Barcelona and OSPAR Conventions. Nine policies support the climate change mitigation service by simply recognising it or indirectly promoting it through policy targets, objectives or actions, without explicitly encouraging it.

Disaster risk reduction and adaptation to climate change are directly or indirectly supported as ecosystem services provided by wetlands restoration in 18 of the 36 EU policies, regional and global agreements assessed. However, only five policies and agreements strongly support the disaster risk reduction role of wetlands, with relevant pol-

icy aims, namely the EU NRR, the Communication on Sustainable Blue Economy, the Barcelona Convention, the Sendai Framework for Disaster Risk Reduction and the EU Sustainable Taxonomy.

Similarly, water regulation (maintaining and improving the good condition of water quality and/or water quantity) is supported directly or indirectly as an ecosystem service from wetlands restoration in 22 of the assessed EU policies, regional and global agreements. However, only two EU policies (WFD, European Water Resilience Strategy) and two regional legal instruments (Helsinki Convention, OSPAR Convention) strongly support the water regulation role of wetlands through relevant policy aims.

3.4. Policy Provisions for Monitoring and Assessments Relevant to Wetlands

Most of the EU policies and global or regional agreements analysed (27 out of 36) lack clear and sufficient provisions for wetland monitoring and assessment. Specifically, of the 36 policy and legal instruments reviewed, only 9 contain specific provisions relevant to wetlands monitoring and assessments, in certain cases specifically covering coastal habitats. These include international instruments, namely the Ramsar Convention, the Barcelona and OSPAR Conventions, as well as the EU policies such as the EU NRR, the WFD, the HD and BD, and the LULUCF Regulation. The UNFCCC also enables and encourages wetlands monitoring and assessment through the IPCC Wetlands Supplement, which provides guidance on the assessment of wetlands within the UNFCCC process. However, the monitoring provisions do not always comprehensively address the specific characteristics of wetlands. For example, the habitats definitions and categories used in the HD do not cover the full extent of European wetlands [19]. This also applies to the EU NRR, which refers to the habitat categories of the HD, while a monitoring approach with clear indicators is still under development for this Regulation. Additionally, competent authorities often face difficulties when collecting reliable and accurate data on wetlands (e.g., monitoring and data gaps for nature assessments under the HD, carbon accounting data for the LULUCF Regulation) [20,21].

In some cases, the applicability of existing data collection and monitoring mechanisms to wetland habitats remains unclear (e.g., MSFD) while the lack of harmonisation in monitoring procedures between Member States further complicates the comprehensive tracking of wetland-related trends and the planning of protection and management measures.

Strategic policies, such as the EU BDS 2030, the Sustainable Carbon Cycles Communication, the Sustainable Blue Economy Communication, the EU Bioeconomy Strategy, often do not contain explicit monitoring provisions. Instead, they encourage the development or enhancement of monitoring mechanisms. For instance, the Communication on Sustainable Blue Economy proposes measures such as establishing a Blue Economy Observatory to improve monitoring and data collection in blue economy activities, with potential applicability to coastal wetland actions.

3.5. Policy Provisions for Wetlands Conservation or Restoration Measures

Most of the policies and agreements analysed (31) do not require the development of specific wetland conservation or restoration measures. Only few policies (5 out of 36) include specific provisions for wetland conservation and restoration actions, including those under the Ramsar Convention, which requires the submission of management plans for all Ramsar designated wetlands including coastal ones, and the EU NRR, which obliges Member States to develop National Restoration Plans, encompassing, among other ecosystems, coastal habitats. The BD and HD require effective conservation measures, if wetlands host protected species or habitats. They also advocate for the development of wetland management plans; however, the final decision remains at the discretion of national au-

thorities. The CAP also requires the inclusion of wetland protection measures, covering peatlands and wetlands in general, in national CAP Strategic Plans as part of the GAEC 2. However, the CAP offers significant flexibility to Member States on how they design their CAP Strategic Plans, and the specific requirements set for GAEC 2 in the Plans are largely weak or unclear [22].

Seven other policies and global and regional agreements promote and encourage conservation or restoration measures for different types of wetlands in a non-binding manner. Within the Mediterranean, carbon-rich ecosystems such as wetlands are a priority under the regionally adopted, time-framed Post-2020 SAPBIO ambition of the Barcelona Convention, which aims to identify restoration sites, initiate restoration actions, and increase the coverage of protected areas and other effective area-based conservation measures. Under the CBD, National Biodiversity Strategies and Action Plans are to be regularly prepared by the majority of signing parties and may include wetland restoration actions. Under the WFD, restoration measures for wetlands may be included in the supplementary measures of the river basin management plans but the extent to which this takes place differs between Member States. Similarly, to achieve good environmental status under the MSFD, measures may be required for the conservation and/or restoration of wetland habitats such as seagrass beds. In the climate policy field, the LULUCF Regulation provides that National Energy and Climate Plans may incorporate conservation and enhancement measures for wetlands under specific conditions, particularly when utilising a "flexibility mechanism". Additionally, the EU Adaptation Strategy encourages the integration of nature-based solutions, including coastal wetland restoration, within National Adaptation Plans and Strategies. In addition, the Commission Delegated Regulation (EU) 2023/2486, which sets out the conditions under which an economic activity qualifies as environmentally sustainable, further strengthens the policy framework by introducing nature-based solutions for flood and drought risk prevention and protection as criteria for sustainable investment. The regulation explicitly highlights a broad range of wetland-related measures, including the conservation and restoration of coastal wetlands functioning as natural barriers, thereby reinforcing and promoting the role of wetlands in climate adaptation and disaster risk reduction.

4. Discussion

Below we discuss key findings of the policy analysis and contextualise them with existing literature. We discuss the main strengths and barriers of the policy framework for European coastal wetland restoration and conservation and then reflect on the main opportunities ahead for further promoting the restoration of these ecosystems in the EU, which is summarised in Table 10.

4.1. Policy Strengths and Policy Barriers for Coastal Wetland Restoration

Our analysis demonstrates that the EU and international policy framework provides substantial support for the conservation and restoration of wetland ecosystems overall, but specific references to coastal wetlands remain limited. Only few EU policies explicitly refer to coastal wetlands, these include the HD and the EU NRR, which list specific types of coastal wetland habitats. Other policies that reference coastal wetlands include the EU GI Strategy, the EU BDS 2030, the EU Sustainable Carbon Cycles Communication, the EU Sustainable Blue Economy Communication, and the EU Sustainable Finance Taxonomy. Additionally, there are EU policies, such as the WFD and the MSFD, that incorporate terms relevant to coastal wetland, such as "coastal waters", which can provide an indirect legal basis for their protection and management. At the global level, the most influential and supportive legal instrument for wetland restoration and conservation, specifically concerning coastal wetlands, is the Ramsar Convention.

Table 10. Policy strengths, barriers and opportunities for coastal wetland restoration.

Strengths What levers do policies offer to support coastal wetlands protection and restoration? - Binding targets and objectives for conservation and restoration in the EU nature and biodiversity policies and regional sea conventions - Systematic recognition of biodiversity and climate benefits of wetland restoration	**Barriers** Are there elements in the policies that limit the protection and restoration of coastal wetlands? - Absence of a consistent coastal wetlands definition at EU level - Lack of a baseline to refer to, no reference value to be reached—within defined deadlines. - Lack of or insufficient monitoring and assessment provisions for wetland restoration across policies - Lack of policy targets for wetland restoration as a climate change mitigation and adaptation measure
Opportunities Are there any potential opportunities linked to policies which could benefit coastal wetland restoration? - Harmonising wetland and coastal wetland definition - Leveraging synergies between EU nature and climate/energy policies - Further promoting coastal wetlands in the climate change mitigation policy framework and national implementation of actions and measures - Enhancing coastal flood protection from coastal wetlands as nature-based solutions	

Despite the existence of policies and agreements explicitly referencing coastal wetlands, very few offer clear definitions of these ecosystems that would facilitate the planning and implementation of concrete conservation actions. Definitions of (coastal) wetlands are predominantly provided by global agreements, such as the Ramsar Convention and the UNFCCC through its IPCC Wetlands Supplement, without adaptation to the specific needs and policy settings at the EU. At the national level within the EU, definitions of wetlands for GHG inventory reporting vary, as the implementation of the IPCC Wetlands Supplement remains non-mandatory [23]. Under the EU LULUCF Regulation, wetlands are recognised as a land use category and reporting of wetland emissions and removals remain voluntary until 2026. The scope and interpretation of "wetlands" for reporting purposes are largely determined at the national level and there is a clear gap for coastal wetlands and managed wetlands. This definitional fragmentation reduces comparability of data, complicates the aggregation of EU-wide GHG balances, and can ultimately weaken the ability to track progress towards restoration and climate mitigation targets.

Furthermore, while approximately half of the analysed policies include objectives or targets specific to wetland conservation, only a small proportion of these explicitly address coastal ecosystems. Nonetheless, objectives or targets pertaining to wetland ecosystems in general can also encompass coastal wetlands. Most of the time-bound targets identified are set to be achieved by 2030, with the recent adoption of the EU NRR, introducing longer-term restoration objectives up to 2050. Legally binding targets for wetlands conservation and restoration are primarily derived from EU directives and regulations as well as global agreements in the nature and biodiversity field, many of which have been established for several decades and have shaped ecosystem restoration practices within the EU. It is noted that EU regulations are directly binding in all EU Member States once adopted. EU directives need to be transposed into national law and, based on the subsidiarity principle, governments have certain flexibility on how to adapt a directive's requirements to their legal system; however, achieving the objectives of an EU directive is a binding commitment for EU Member States. Regional sea conventions further complement these legally binding commitments. Importantly, legally binding targets act as stronger policy levers for conservation and restoration actions at national and sub-national scales compared

to non-binding targets. These findings align with those of Ryfisch et al. [24] who revealed a path dependency between the legal status of habitats, primarily established by EU Nature Directives (HD and BD), and opportunities for implementing nature-based solutions, applicable also for wetland restoration.

Conversely, non-binding targets related to wetlands, primarily originating from climate, marine, or coastal protection strategies, encourage but do not mandate conservation and restoration actions from EU Member States. Since the 2015 Paris Agreement negotiations, climate policies have increasingly emerged as key policy levers, further promoting the conservation and restoration of EU coastal wetlands. Our analysis shows that climate change mitigation is acknowledged as an important ecosystem service of wetland restoration in approximately half of the assessed EU policies, regional and global agreements, ranking second only to biodiversity support. This aligns with findings by Ryfisch et al. [24], which reaffirm wetlands as crucial ecosystems for climate change mitigation and adaptation, supported by financing and planning instruments. Climate change mitigation and adaptation policies can enhance wetland ecosystems either directly or indirectly through measures aimed at strengthening natural carbon sinks, reducing emissions from natural ecosystems, and promoting nature restoration as nature-based solutions. A strong example of this approach is coastal adaptation plans based on ecosystem restoration, as Sánchez-Arcilla et al. [25] describe. Such plans effectively demonstrate how to manage flooding and erosion risks while simultaneously contributing to natural capital stocks and climate change mitigation through coastal blue carbon [25].

The three regional sea conventions also vary in how explicitly they address wetland protection, conservation, and restoration. The Helsinki Convention is the most explicit at the treaty level, with Annex III requiring the retention and, where possible, restoration of wetlands for nutrient reduction, supported by technical recommendations such as hydrological restoration and rewetting of drained areas. By contrast, the Barcelona Convention's ICZM Protocol sets a general obligation for "appropriate restoration" where coastal damage occurs and mandates spatial planning measures (e.g., setback zones) that can indirectly safeguard coastal wetlands. Its most concrete restoration ambitions are articulated in the Post-2020 SAPBIO regional strategy, which aims to identify priority sites and sets 2030 biodiversity recovery targets. On the other hand, the OSPAR Convention addresses wetlands mainly through its climate and biodiversity agenda, with a strong emphasis on nature-based solutions and blue carbon ecosystems. Under this Convention, the NEAES 2030 includes time-bound targets for restoring blue carbon habitats, though the binding convention text does not contain a quantified restoration clause.

Overall, the Helsinki Convention is the most prescriptive in legal terms, maintaining continuous, technically detailed obligations without fixed deadlines, while the Barcelona and OSPAR Conventions rely more heavily on strategic instruments to set restoration targets with time-bound commitments through the Post-2020 SAPBIO and the NEAES 2030, respectively. In addition, the ICZM Protocol under the Barcelona Convention provides a legally binding framework for integrated coastal restoration and planning.

Finally, the analysis highlights gaps in the policy framework concerning the monitoring, assessment, and provisions for conservation or restoration measures for coastal wetlands. While a limited number of policies and agreements, including the Ramsar Convention, the EU NRR, and the Barcelona Convention, explicitly address monitoring and assessment requirements, most policies either lack provisions in this regard or offer only limited guidance, especially with regard to indicators to be used. Additionally, although many policies encourage actions for wetland management and restoration, either directly or indirectly, they often do not impose legally binding obligations for the development of concrete management or restoration measures, leaving their implementation subject to

national discretion. This lack of enforceable measures, combined with inconsistencies in monitoring and assessment processes, presents challenges for effective wetland restoration and enhancement of their ecosystem services across jurisdictions.

4.2. Key Policy Opportunities and Proposed Actions for Coastal Wetlands

4.2.1. Harmonising Wetland Definitions

Harmonising wetland definitions in the EU policy framework with global frameworks, such as the Ramsar Convention, would help eliminate inconsistencies across policies and countries, thereby promoting more cohesive action across Member States. For instance, in Spain, the Ley de Costas (Coastal Law, Article 3/a) and the National Inventory of Wetlands (Royal Decree 435/2004) provide specific criteria for wetland identification. In France, wetlands are legally defined based on the presence of hydromorphic soils and/or aquatic vegetation [26]. However, this definition excludes several wetland types recognised under the Ramsar Convention, such as open water bodies, which are instead classified as "water bodies" and subject to different legislative frameworks. Developing a more standardised approach to classifying wetlands, including coastal wetlands, as either "managed" or "unmanaged," as outlined in the IPCC Wetlands Supplement and the LULUCF Regulation for the period of 2021–2025, is also essential to address current disparities. These inconsistencies result in knowledge gaps regarding the status of wetlands and their ecosystem services in areas that are not officially covered by national definitions or are considered unmanaged.

For coastal wetlands, an additional challenge lies in the absence of consistent criteria to distinguish between different habitat types such as saltmarshes, seagrass meadows, intertidal flats, freshwater wetlands, and coastal lagoons, despite their differing ecological functions, restoration needs, and climate mitigation potential. Without clear typological distinctions in EU policy and reporting frameworks, important habitat-specific trends risk being obscured, and opportunities for targeted management actions may be overlooked.

Aligning EU wetland classification and habitat definitions used by the European Commission for habitats monitoring under the Habitats Directive with the Ramsar Convention would enable hydro-ecologically robust wetland assessment and monitoring across Europe. Coupled with more detailed definitions and habitat-type differentiation for coastal wetlands, this would strengthen the delivery of wetland-related policy objectives, improve restoration planning as required under the EU NRR, and contribute to a more comprehensive understanding of ecosystem service provision.

4.2.2. Leveraging Synergies Between EU Nature and Climate Policies

Strong synergies between the EU Nature Directives, the EU BDS 2030, the recently adopted EU NRR, the LULUCF Regulation and other EU climate policies create a window of opportunity to enhance wetland restoration efforts in ways that both strengthen biodiversity and deliver climate benefits. The EU NRR is particularly significant, as its binding restoration targets and requirement for national restoration plans provide a strong framework to upscale initiatives, including those targeting coastal wetlands. By leveraging these national restoration plans, restoration measures can be streamlined and better integrated into broader ecosystem recovery strategies. Moreover, emphasising the value of wetland climate ecosystem services, such as carbon storage and emission reduction, can unlock additional incentives, including funding, for carbon-rich ecosystem restoration. To maximise this potential, national competent authorities responsible for national restoration plans should develop mechanisms to align restoration efforts with the EU CRCF Regulation, the EU Taxonomy Regulation and the LULUCF Regulation and further reinforce the role of wetlands as natural carbon sinks.

4.2.3. Promoting Coastal Wetlands in the Climate Change Mitigation Framework

Coastal wetlands are widely recognised as valuable nature-based solutions for climate change mitigation and adaptation. However, this recognition lacks legally binding commitments, as exemplified by the EU Adaptation Strategy. To strengthen the role of coastal wetlands in climate policy, it is essential to comprehensively integrate these ecosystems into EU climate frameworks, promoting their restoration as a strategic instrument for climate change mitigation and adaptation.

One potential approach would be to establish a dedicated wetland-specific sub-target within the LULUCF Regulation. Such a sub-target would quantify the required emission reductions from wetland ecosystems and could be complemented by a carbon removal sub-target, including from coastal wetlands, as data assessment and reporting methodologies are refined. Although the current Regulation (EU) 2023/839 sets binding national targets for net carbon removals by 2030, wetlands remain underrepresented due to limited accounting coverage and methodological challenges. The inclusion of managed wetlands as a mandatory reporting category is a step forward, but further refinement is needed to capture the full mitigation potential of wetland restoration and conservation. Delegated acts and implementing rules, such as those under Regulation (EU) 2019/1122 on the EU Emissions Trading Registry, are being developed to improve monitoring and verification of other ecosystem types and could serve as vehicles to operationalise wetland-specific targets. By integrating wetland-specific objectives into the LULUCF compliance architecture, Member States would be incentivised to prioritise restoration of degraded wetland habitats, thereby enhancing both climate and biodiversity outcomes.

The EU Sustainable Carbon Cycles Communication highlights the potential of promoting blue carbon practices as a component of carbon farming by 2030. The newly adopted EU CRCF Regulation presents an opportunity to unlock new financial resources for the restoration of coastal and marine ecosystems. The EU CRCF Regulation requires that activities do not cause significant harm to the environment while at the same time contributing to one or more sustainability objectives. In this context, coastal wetland restoration emerges as a highly multifunctional solution, delivering multiple co-benefits simultaneously, thereby representing a cost-effective carbon farming approach. However, challenges remain regarding uncertainties related to methodological approaches and the permanence of certified units. To address these challenges, upcoming delegated acts issued by the European Commission under the EU CRCF Regulation should aim to resolve methodological uncertainties while implementing robust ecological and social safeguards to mitigate risks associated with carbon farming in coastal wetlands.

4.2.4. Enhancing Coastal Flood Protection

The FD presents another opportunity to strengthen coastal wetland restoration by promoting nature-based or hybrid solutions for flood risk management in the context of flood risk management plans prepared by competent authorities of Member States for their river basin districts. Improved EU guidance for the Directive implementation could explicitly highlight the role of coastal wetlands in coastal flood prevention and protection, complementing traditional engineered approaches. This approach is supported by Sánchez-Arcilla et al. [25] who propose a transformative policy shift that prioritises habitat restoration over conventional coastal engineering solutions, fostering adaptation aligned with mitigation through low-carbon protection and enhancing coastal blue carbon. The recommendations of Casajus Valles et al. [27] align with this view encouraging policymakers to reduce reliance on grey infrastructure in favour of green solutions, which help prevent and mitigate hazards and, in the case of wetland restoration, deliver measurable reductions in disaster risk over relatively short timeframes. Emphasising the multifunctional benefits

of coastal wetlands in flood management, including biodiversity support and climate change mitigation and adaptation, would encourage investment in restoration projects that deliver multiple ecosystem services.

5. Conclusions

Coastal wetlands hold significant potential as nature-based solutions for biodiversity conservation, climate change mitigation and adaptation, and disaster risk reduction. This analysis demonstrates that realising this potential requires embedding coastal wetlands more explicitly in policy targets and objectives and leveraging emerging opportunities within the EU and regional policy frameworks to further upscale coastal wetland restoration. At present, reliance on non-binding strategic instruments introduces variability in national implementation, leaving outcomes dependent on political will and resource allocation. Without an upscaled restoration effort adapted to growing climate pressures, meeting EU and international targets and objectives will become increasingly challenging. This is especially critical for wetlands as ecosystems, which have a high potential for carbon capture and storage, as well as disaster risk reduction. Where wetlands remain degraded due to human activities, their sequestration capacity is reduced. Additionally, their degradation may trigger the release of the stored carbon. Regional sea conventions can further provide the legal architecture and policy framing to shape both the clarity and enforceability of wetland restoration commitments. By addressing current policy gaps, establishing specific, time-bound targets for wetlands and seizing key policy opportunities identified in this paper, a stronger and more effective contribution of European coastal wetlands to achieving mid- and long-term policy targets can be ensured.

Future research could extend this study by undertaking a comparative analysis of the EU wetland policy framework alongside other wetland policy regimes, for example, those in the United Kingdom, United States or selected Asian countries like China or the Republic of Korea. A comparative approach could support cross-regional learning through the identification of policy features that may be adaptable to the EU policy landscape, thereby informing and strengthening the development of the EU wetland policy framework.

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Abbreviations

The following abbreviations are used in this manuscript:

BD	Birds Directive
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
ECL	European Climate Law
EIA	Environmental Impact Assessment
EU	European Union
EU BDS 2030	EU Biodiversity Strategy for 2030
EU CRCF Regulation	EU Carbon Removals and Carbon Farming Regulation
EU NRR	EU Nature Restoration Regulation
F2F	Farm to Fork Strategy
FD	Floods Directive
GAEC	Good Agricultural and Environmental Condition
GBF	Global Biodiversity Framework
GD	Groundwater Directive
GES	Good Environmental Status
GHG	Greenhouse Gases
GI	Green Infrastructure
HD	Habitats Directive
HELCOM	Helsinki Commission (Baltic Marine Environment Protection Commission)
IAS	Invasive Alien Species
ICZM	Integrated Coastal Zone Management
INSPIRE	Infrastructure for Spatial Information in the European Community
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use, Land Use Change and Forestry
MSFD	Marine Strategy Framework Directive
NEAES	North-East Atlantic Environment Strategy
Post-2020 SAPBIO	Post-2020 Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region
RED	Renewable Energy Directive
SEA	Strategic Environmental Assessment
SFDRR	Sendai Framework for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
WFD	Water Framework Directive
ZPAP	Zero Pollution Action Plan

Appendix A

Table A1. List of policies and agreements screened out and policies and agreements selected for analysis.

Policy Thematic Cluster	Policy Name	Screening Outcome
Nature & biodiversity conservation	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) (1971)	Selected for further analysis
	Convention on Biological Diversity (CBD) (1992)	Selected for further analysis
	Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) (1976, amended 1995)	Selected for further analysis

Table A1. *Cont.*

Policy Thematic Cluster	Policy Name	Screening Outcome
	Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention) (1974, updated 1992)	Selected for further analysis
	Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) (1992)	Selected for further analysis
	Bucharest Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention) (1992)	Screened out
	Birds Directive (BD) (2009/147/EC) (2009)	Selected for further analysis
	Habitats Directive (HD) (92/43/EEC) (1992)	Selected for further analysis
	EU Green Infrastructure Strategy (EU GI Strategy) (COM/2013/ 249) (2013)	Selected for further analysis
	Invasive Alien Species Regulation (IAS Regulation) (1143/2014) (2014)	Selected for further analysis
	EU Biodiversity Strategy 2030 (EU BDS 2030) (key action of the European Green Deal) (COM/2020/380) (2020)	Selected for further analysis
	EU Nature Restoration Regulation (EU NRR) (2024/1991) (2024)	Selected for further analysis
Marine & coastal protection & management	Recommendation on Integrated Coastal Zone Management in Europe (EU ICZM Recommendation) (2002/413/EC) (2002)	Selected for further analysis
	Marine Strategy Framework Directive (MSFD) (2008/56/EC) (2008)	Selected for further analysis
	Marine Spatial Planning Directive (MSPD) (2014/89/EU) (2014)	Screened out
	Strategic Guidelines for the Sustainable Development of EU Aquaculture (COM/2021/236) (2021)	Selected for further analysis
	Sustainable Blue Economy Communication (COM/2021/240) (2021)	Selected for further analysis
Climate change mitigation & adaptation	United Nations Framework Convention on Climate Change (UNFCCC) (1992)	Selected for further analysis
	EU Land Use Land Use Change and Forestry Regulation (LULUCF Regulation) (2018/841) (2018)	Selected for further analysis
	EU Strategy on Adaptation to Climate Change (key action of European Green Deal) (EU Adaptation Strategy) (COM/2021/82) (2021)	Selected for further analysis
	European Climate Law (key action of European Green Deal) (ECL) (2021/1119) (2021)	Selected for further analysis
	Sustainable Carbon Cycles Communication (COM/2021/800) (2021)	Selected for further analysis
	EU Carbon Removals and Carbon Farming Regulation (EU CRCF Regulation) (EU/2024/3012) (2024)	Selected for further analysis
	EU Renewable Energy Directive (RED) (2018/2001) (2018)	Selected for further analysis

Table A1. *Cont.*

Policy Thematic Cluster	Policy Name	Screening Outcome
Pollution & water quality	Water Framework Directive (WFD) (2000/60/EC) (2000)	Selected for further analysis
	Floods Directive (FD) (2007/60/EC) (2007)	Selected for further analysis
	European Water Resilience Strategy (COM/2025/280) (2025)	Selected for further analysis
	Urban Wastewater Treatment Directive (UWWTD) (recast) (EU/2024/3019) (2024)	Screened out
	Drinking Water Directive (recast) (EU/2020/2184) (2020)	Screened out
	Bathing Water Directive (76/160/EEC) (2006)	Screened out
	Industrial Emissions Directive (2010/75/EU) (2010)	Screened out
	Nitrates Directive (91/676/EEC) (1991)	Selected for further analysis
	Groundwater Directive (GD) (2006/118/EC) (2006)	Selected for further analysis
	Farm to Fork Strategy (F2F) (key action of European Green Deal) (COM/2020/381) (2020)	Selected for further analysis
	Zero Pollution Action Plan (key action of European Green Deal) (ZPAP) (COM/2021/400) (2021)	Selected for further analysis
	Directive on Environmental Quality Standards (2008/105/EC) (2008)	Screened out
	Pesticides Directive (proposal) (2022)	Screened out
	Sewage Sludge Directive (86/278/EEC) (1986)	Screened out
	Chemicals Strategy for Sustainability (COM/2020/667) (2020)	Screened out
Agriculture & soil	Common Agricultural Policy (CAP) (Regulation (EU) 2021/2115) (2021)	Selected for further analysis
	EU Soil Strategy 2030 (COM/2021/699) (2021)	Selected for further analysis
	EU Forest Strategy (COM/2021/572) (2021)	Screened out
Disaster-risk reduction	Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) (2015)	Selected for further analysis
Cross-sectoral aspects	Environmental Impact Assessment Directive (EIA Directive) (2011/92/EU) (2014)	Selected for further analysis
	Strategic Environmental Assessment Directive (SEA) (2001/42/EC) (2001)	Screened out
	Infrastructure for Spatial Information in the European Community Directive (INSPIRE Directive) (2007/2/EC) (2007)	Selected for further analysis
	EU Bioeconomy Strategy (COM/2018/673) (2018)	Selected for further analysis
	EU Sustainable Finance Taxonomy Regulation (2020/852) (2020)	Selected for further analysis
	Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	Screened out
	Bern Convention on the Conservation of European Wildlife and Natural Habitats (1982)	Screened out

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