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A policy analysis of peatland-related policies - pressures, ecosystem services, conservation and restoration

Chaitanya Suárez-Rojas [a,b,*], Camilla Widmark [a,b]

[a] Department of Forest Economics, Swedish University of Agricultural Sciences (SLU), Umeå, Sweden
[b] Centre for Environmental and Resource Economics (CERE), Umeå, Sweden

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ABSTRACT

Over the last fifty years, peatlands have shifted from being intensively drained and exploited to being at the heart of debates about fighting climate change and other environmental crises. Despite current efforts towards peatland restoration and conservation, political action is not reaching the desired targets. Are policies really providing consistent and coherent solutions? This study reviews how peatland issues have been addressed in the international political discourse and how policies in Europe and Sweden are responding to such issues to halt peatland degradation. The study follows a multi-step approach comprising i) policy selection, ii) framing process, and iii) policy coherence analysis. The results reveal that European and Swedish policies from different fields (biodiversity and conservation, climate change, agriculture, forestry, land use and soil, energy, and water) broadly emphasise the need for peatland protection and conservation. However, these policies lack coherence in addressing the different impacts affecting peatlands, comprehending certain ecosystem functions and services, and identifying explicit nature-, financial-, and social capacity-based solutions for their restoration and sustainable use. This evidence highlights the need to foster coordination among decision-makers within and across different policy fields at both governance levels.

1. Introduction

Peatlands are embedded in a complex political and socioeconomic context, especially when their protection and conservation conflict with traditional economic development (Communication from the Commission to the Council and the European Parliament, 1995). While governments have been subsidising peatland drainage since the early 20th century to support agricultural and forestry expansion and as an alternative energy source to fossil fuels (Nordbeck and Hogl, 2024), their protection has only been at the forefront of political concerns during the last few decades. This recent interest is linked with strong global advocacy to reach a future with zero net carbon emissions (Barthelmes et al., 2015; Connaughton, 2024) and the recognition of peatlands as "climate superpowers" (Ramsar Secretariat, 2025). Peatlands – which form due to the incomplete decomposition of organic matter in waterlogged conditions, and oxygen and nutrient deficiency of soils – store 30 % of global carbon emissions, double the carbon of all forests combined (Balode et al., 2024; Girkin and Davidson, 2024; Lourenco et al., 2023).

Despite increasing political efforts, pressures on peatlands continue to grow (Noebel, 2023). The current global extension of drained and degraded peatlands is about 12 %, 50 % if only looking at the EU countries (UNEP, 2021, 2022). These degraded peatlands are responsible for 25 % of anthropogenic carbon emissions (Bonn et al., 2014; Girkin and Davidson, 2024). Further negative effects are associated with biodiversity loss, land fragmentation, eutrophication, and increased flooding (Chen et al., 2023).

Coherence is crucial when policies involve complex or detailed steering mechanisms (Bouwma et al., 2018). A synergetic or coherent process will assist policies in adequately defining their targets and avoiding any possible legal impediments that may constrain them (Buschmann et al., 2020). For example, it may assist the financial distribution and management of resources, thereby reducing any possible competition, overlapping, or contradiction between policies involved in environmental issues (Akhtar-Schuster et al., 2011). Policy coherence thus refers to how well policies complement or align with each other, creating a coordinated ensemble of goals and actions (Nilsson et al., 2012).

Accordingly, analysing coherence is especially relevant in the context of peatlands, given the number of regulations and strategies that have been developed and adopted in a relatively short timeframe

* Corresponding author at: Department of Forest Economics, Swedish University of Agricultural Sciences (SLU), Skogsmarksgränd 17, 907 36 Umeå, Sweden.
E-mail address: chaitanya.suarez.rojas@slu.se (C. Suárez-Rojas).

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(Nordbeck and Hogl, 2024). Are policies coherently aligned to benefit peatland conservation and restoration, especially among sectors with different interests? We explore how peatlands are framed in the international political context and how peatland-related policies at lower levels, i.e., regional (EU) and national (Sweden), address them.

Noebel (2023) underlined that *"to reach climate neutrality by 2050, virtually all drained peatlands should be restored"* (p. 1). However, Europe, including Sweden, is still far from this goal: less than 1 % of European degraded peatlands have been restored (Mathias, 2022). One of the main problems is associated with a lack of understanding of the full range of peatland functions and services (Byg et al., 2017; Lindsay, 1992). For instance, the significance of peatlands in regulating the climate and water cycle (Nordbeck and Hogl, 2024; Verhoeven and Setter, 2010) has long been overshadowed by their solely perceived value for providing land for other uses or as a source of biomass (Joosten et al., 2017; UNEP, 2022). This situation has significantly delayed their adequate protection (Chen et al., 2023; Lindsay, 1992). Understanding the wide range of peatland ecosystem services (ES) is therefore paramount in policy decision-making and implementation to reconcile integrated land management with the protection and conservation of these ecosystems (Bonn et al., 2014; Costanza et al., 2017).

According to the Ramsar Convention on Wetlands, the wise use of peatlands involves reconciling sustainable use with preserving their natural functions, including efforts to mitigate any damage to them (Joosten and Clarke, 2002). Restoration and rewetting are, in this regard, crucial in recovering degraded ecosystems (Ramsar Convention, 2021). Rewetting implies raising the water table of peat soils back to its original level by filling ditches or constructing dams and other facilities (Sommer and Frank, 2024). This action could be complemented by other alternative restoration measures, such as revegetation (Andersen et al., 2017). A fully restored peatland will help mitigate and adapt to climate change, enhance biodiversity, ensure water quality, and support livelihoods by reducing the risk of natural disasters (Ramsar Convention, 2018, 2021; Zak and McInnes, 2022).

Previous studies have pointed out that not all policies share a common target for safeguarding these carbon-rich ecosystems or that they fail to provide coordinated guidance for their conservation and restoration (Chen et al., 2023; Noebel, 2023). This has been attributed to insufficient financial resources and knowledge for monitoring and evaluation, or the absence of social acceptance and support for their application (Balode et al., 2024; Maes et al., 2020; Ramsar Convention, 2021; Zak and McInnes, 2022). In light of advocacy for coherent peatland management (Chen et al., 2023; Nordbeck and Hogl, 2024), there is a need to evaluate how policies foster or hinder nature-based solutions and financial, corporate, and capacity development strategies to ensure peatland conservation and restoration, regardless of the socioeconomic interests such policies may serve.

This study examines how peatland-related policies address the pressures on these ecosystems and recognise the diverse ES they offer to trigger the adoption of feasible responses that will contribute to restoring damaged peatlands and conserving pristine ones. With this in mind, we conducted a chronological review of intergovernmental declarations and treaties together with a multi-step policy analysis of European and Swedish policies in the fields of biodiversity and environmental protection, climate change, agriculture, forestry, land use and soil, energy, and water. The multi-step approach consisted of: i) policy selection, including binding and non-binding documents; ii) framing process, to select preexisting critical issues to be used as guiding topics (i.e., pressures, ES, and solutions); and iii) policy coherence analysis, to identify the presence and degree of coexistence of the guiding topics between policies.

Sweden was selected as representing the lowest governance level, motivated by the following reasons: i) it is the second richest peatland country in Europe after Finland (Balode et al., 2024); ii) it has traditionally exploited peatlands for energy and horticulture purposes, and extensively transformed them for forestry and agriculture uses (Barthelmes et al., 2015; Naturvårdsverket, [Swedish Environmental Protection Agency], 2022c); and iii) to our knowledge, there has been no previous evaluation of the current policies that regulate and guide the management and use of these ecosystems (Nordbeck and Hogl, 2024). In addition, Sweden is positioned at the forefront of sustainable development and the fight against climate change (Adebayo and Ullah, 2024; Bie et al., 2023). Thus, we aimed to assess the extent to which this "environmental pioneer" country (Si, 2024) is tailoring peatland European policies at the national level and to what degree of coherence.

2. Empirical methods: a multi-step policy analysis

A multi-step policy analysis was conducted to understand how peatlands (and wetlands) are addressed and framed from the global scale to the European and Swedish one. This process consisted first of policy document selection at the different governance levels (see Fig. 1). For the international context, a chronological review was conducted. For the European and Swedish cases, the next steps of the analysis consisted of i) frame definition and ii) policy coherence analysis.

2.1. Step 1. Policy document selection

2.1.1. International context

Our focus was primarily on the Conference of the Parties (COPs) regarding: i) the Ramsar Convention of Wetlands of International Importance (henceforth Ramsar), ii) the Convention on Biological Diversity (CBD), and iii) the United Nations Convention on Climate Change (UNFCCC). We reviewed all resolutions, recommendations, and decisions according to the following criteria:

- If "peat (−land)", "bog", "fen", "mire", "swamp forest", or "wetland" was mentioned.
- If the information provided in the documents regarding these keywords was relevant.
- If the documents were signed between 1971 (the Ramsar declaration) and September 2024.

A total of 27 COP-related documents were considered for the review. We also included 20 other reports and documents launched by the Conventions and other leading intergovernmental agencies (e.g., the Intergovernmental Panel on Climate Change - IPCC) as they complement the COPs in their capacity to provide the parties with decision-making support. The most relevant international agreements to combat climate change, i.e., the Kyoto Protocol and the Paris Agreement, were also included, even though the study keywords were not identified in them. Note that none of the treaties, decisions, or reports consulted have a binding legal status on the national level (Chang, 2010).

Having compiled the final list of intergovernmental declarations, treaties, and agendas, we conducted a chronological review to understand how issues related to peatland conservation, use, and management have been addressed globally.

2.1.2. European and Swedish contexts

The following criteria determined the selection of the peatland-related policies at both political-administrative levels (inspired by Ambroise et al., 2023):

i) If "peat (−land)", "wetland", "bog", "fen", "mire", or "swamp forest"[1] was mentioned in the documents.
ii) If the information provided was relevant for the scope of the study, independently of the proportion of the content addressed in the document.

[1] In the Swedish documents we searched for: "torv [−mark]", "våtmark", "moss", "kärr", "myr", and "sumpskog".

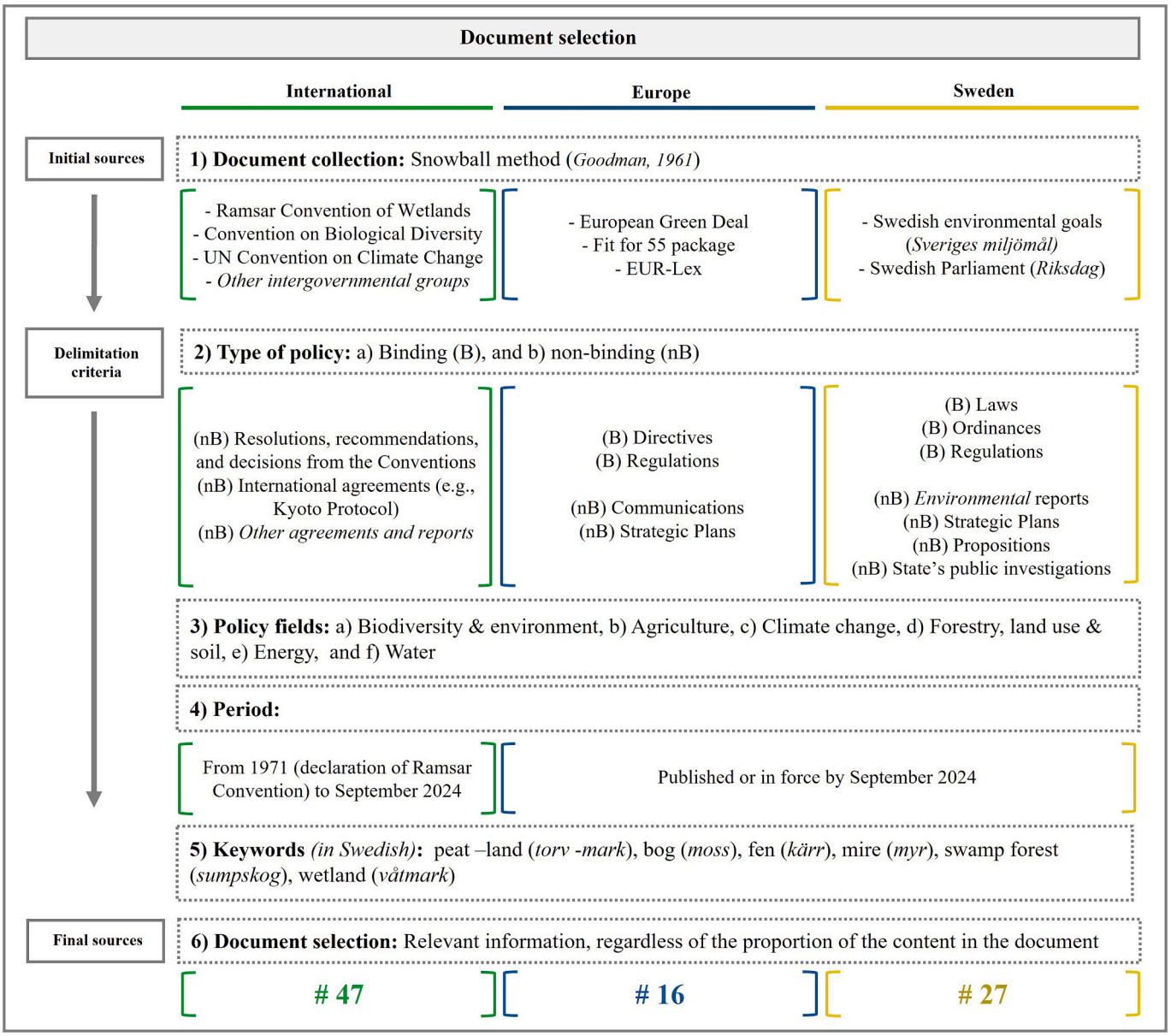

Fig. 1. Flow diagram of document selection.

iii) Of legal (binding) and non-legal effect.
iv) If they were published or in force by September 2024.

Documents were mainly retrieved from EUR-Lex (https://eur-lex.europa.eu/homepage.html) and the Swedish Parliament website, "Sveriges Riksdag" (https://www.riksdagen.se/sv/). The final database consisted of a total of 16 documents at the European level and 27 at the Swedish level (see Tables 1.1 and 1.2, respectively in Supplementary data 1).

We did not include in the policy list the European and Swedish climate laws (Regulation (EU) 2021/1119 and Klimatlag 2017:720, respectively). These policies do not reference peatlands or wetlands, even though these ecosystems provide crucial climate-regulating services (Bonn et al., 2014; Kimmel and Mander, 2010) and are the leading terrestrial carbon sinks (Barthelmes et al., 2015; Girkin and Davidson, 2024). The same occurred regarding the New European Forest Strategy for 2030, the Swedish National Forest Program, and the Forestry Law (Skogsvårdslag 1979:429). Although peatlands can be found in forests – e.g., swamp forests are a type of wetland ecosystem (Barthelmes et al., 2015) - and afforestation has considerably destroyed peatlands (European Union, 1995), none of the study keywords was found in these documents. This lack of reference also applies to the Swedish Water Management Ordinance (Förordning 2004:660).

2.2. *Step 2. Frame identification*

Framing is important for taking coherent policy action (Elomina and Pülzl, 2021). The framing process facilitates identifying and depicting arguments and counterarguments surrounding complex social issues (e.g., a particular problem definition or inconsistent actions for the item described) that deserve attention and evaluation (Creed et al., 2002; Nordbeck and Steurer, 2016; Runhaar et al., 2014; Shawoo et al., 2023; van Hulst et al., 2024).

To understand how issues regarding peatlands (and wetlands) are addressed in the European and Swedish policies, we adopted a framing approach consisting of the selection of pre-existing categories as a guiding concept (Ambroise et al., 2023; Glaser and Laudel, 2011). This approach enables the modification and expansion of the analysis

according to the needs of the researcher and the study (Elomina and Pülzl, 2021). In the present study, "EU Thematic Ecosystem Assessment" (Maes et al., 2020) was utilised as a guiding framework because it covers the following information: i) the pressures on particular habitats such as wetlands and peatlands, ii) the ES they provide, and iii) the integrated narratives, i.e., the management solutions or responses required to support policy action (Maes et al., 2020).

To frame peatland (and wetland) pressures, we followed the "*inland wetlands indicators of pressure*" (Maes et al., 2020, p. 155). These indicators include habitat conversion and degradation, pollution and nutrient enrichment, over-exploitation, and climate change.

Concerning peatland (and wetland) ES, we reviewed and adapted the four ES categories from Bonn et al. (2014) and Kimmel and Mander (2010): i) provisioning (e.g., peat for energy and grazing), ii) regulating (e.g., climate and water regulation, erosion protection), iii) supporting (e.g., biodiversity, soil formation), and iv) cultural services (e.g., recreational and aesthetic). As Elomina and Pülzl (2021) point out, framing based on the ES concept is valuable because these services benefit both the natural environment and society, a fact of cross-sectoral policy attention.

We retrieved peatland (and wetland) responses from the policies under study and contrasted them with previous investigations (see, e.g., Bonn et al., 2014). In so doing, we followed Ranabhat et al. (2018) in organising the responses into: i) measures, defined in our study as nature-based solutions, as it includes, for example, rewetting and revegetation, specific actions required to achieve peatland restoration (Strack et al., 2022); ii) resources, renamed as financial and corporate-based solutions, as we include, for example, funding and voluntary certifications; and iii) monitoring and evaluation, understood in the present study as capacity development-based solutions, since we include knowledge and technology investment as frames. We also added another frame group, general solutions, to register broader actions such as protection and conservation, and restoration.

Some frames were reconstructed to respond better to the policy documents, i.e., to be more self-evident and explicit (Rein and Schön, 1996). For instance, we added drainage into the pressure group since it directly alters the watercourses of peatlands, impacting their natural conditions (Tanneberger et al., 2021). Supplementary data 2 presents the final list of frames and a description of them.

2.3. Step 3. Policy coherence analysis

In the field of policy implementation and governance, it is critical to determine policy coherence (May et al., 2006). Policy coherence aims to understand how one policy addresses and interacts with political issues from another (Ahmed et al., 2022) – that is, whether different but related policies share common objectives and whether there is any (in) coherence between them (Ranabhat et al., 2018) – with the aim to enhance synergies and reduce conflicts (Nilsson et al., 2012).

To study policy coherence, attention must be paid to the interactions of policies within (internal) and across (external) different fields, and within (horizontal) and across (vertical) political-administrative levels (Nilsson et al., 2012). Fig. 2 illustrates the interactions that are the focus of this study. The policy documents were organised into the following policy fields: i) biodiversity and environment, ii) climate change, iii) agriculture, iv) forestry, land use, and soil, v) energy, and vii) water. In terms of political-administrative levels, Europe and Sweden were analysed. Note that insights from the international context were also considered for the vertical interaction to provide a more accurate analysis.

We explored whether the information provided in the policies about the identified frames is consistent (within each document) and coherent (between them), considering the abovementioned policy interactions (Fig. 2). To do so, relevant segments of the policy texts were identified and coded according to the selected frames (Elomina and Pülzl, 2021).

2.4. Step 3.1. Explicitness analysis

We first evaluated the presence of the frames in the policy documents following the "explicit/implicit" criteria (Ranabhat et al., 2018). "Explicit" means that information concerning the frame under consideration is mentioned in the text and expressly refers to peatland and/or wetland. "Implicit" indicates that the information about the frame is not clearly attached to peatland and/or wetland, but some general information about the frame is provided. Otherwise, we will treat the frame as not mentioned (Ahmed et al., 2022). We attached different values to explicit (= 2), implicit (1), and not mentioned (0) to assist in the next steps of the analysis (Fig. 3). In the case of peatland responses, we excluded the implicit level, as the actions must be clearly proposed (or not) in order to be undertaken. Therefore, the frames relating to responses can only be explicit (= 2) or not mentioned (0).

To reduce any potential subjectivity in the analysis, the authors

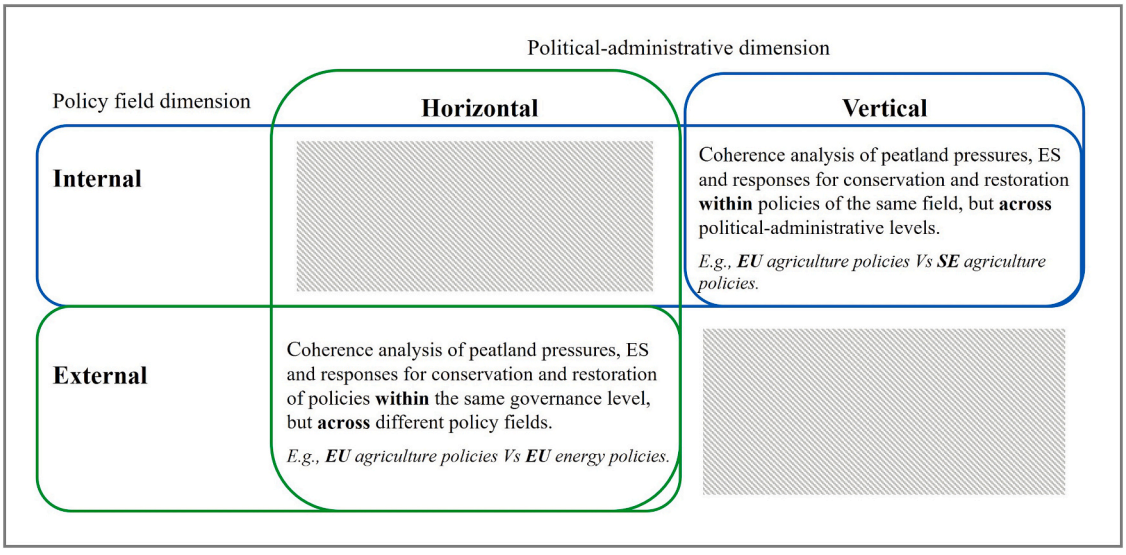

Fig. 2. Combinations of the political interactions of study.
Notes: EU = European Union, SE = Sweden; adapted from Nilsson et al. (2012).

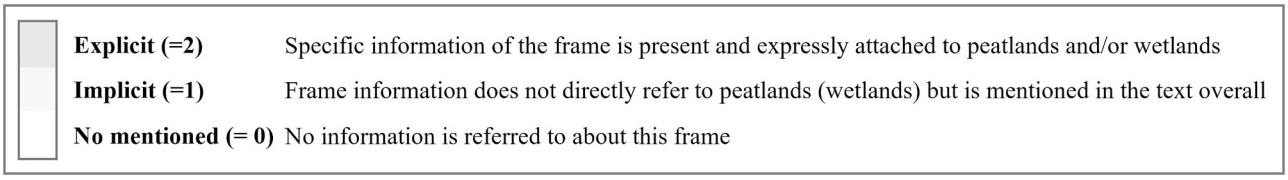

Fig. 3. Explicit/implicit criteria to score the frames in the policy texts.

independently scored the explicitness of the frames within the policy texts. This involved two rounds of cross-checks: first, to confirm the correct interpretation of the frames, and second, to discuss and validate the scoring we had each conducted separately (Bucci Ancapi et al., 2024).

Note that, despite the different languages of the policies, no issues were found regarding their interpretation. Swedish policies were translated into English, but the identification of keywords was conducted in the original document and then compared with the translated version. Moreover, one of the authors is a native Swedish speaker, so any potential misinterpretations were easily discussed and resolved.

2.5. Step 3.2. Consistency analysis

After this, we assessed the consistency of each policy in providing information about the pressures and ES framesets (Ahmed et al., 2022). Consistency refers to how a policy interacts with or recognises the key issues affecting peatland conditions – i.e., the pressures deteriorating their natural conditions and the services that should be valued to avoid the first scenario. In so doing, we calculated the average of the explicit values previously identified. Fig. 4 describes the different degrees of consistency (see Supplementary data 3 for further details).

For the analysis of the response framesets, we followed the "identified/non-identified" approach (Ranabhat et al., 2018) instead of the consistency analysis. The aim was to see whether policies explicitly consider any of the framesets relating to responses – i.e., general solutions or nature-, financial-, corporate-, or capacity development-based responses - to combat peatland degradation. Fig. 5 describes both levels of presence for the analysis of the response frames (more information in Supplementary data 3).

We considered this method a better approach for the response framesets than the consistency analysis because carrying out certain management actions simultaneously or in different land uses may be impractical or even incompatible. For example, actions like revegetation and constructing new peatlands or paludiculture and afforestation are not necessarily conducted on the same land. Therefore, indicating whether a policy addresses at least one action from the tagged frameset was considered, in this case, more valuable than determining the degree of consistency.

2.6. Step 3.3. Coherence analysis

Following the same approach as we used for the consistency analysis, we determined the degree of coherence within each policy field concerning pressures, ES, and responses by calculating the average value of the framesets. Coherence analysis will show the extent to which measures (or frames) in a policy are integrated with other policies (Nilsson et al., 2012). Fig. 6 explains the degrees of coherence (see the legend of Supplementary data 3 for further details).

We critically compare the coherence values within and between policy fields at the same level of governance, i.e., horizontally, to observe if any potential conflicts exist across policies that may limit the recognition of peatland values and impacts, and their conservation and restoration needs. We also compared the coherence values obtained for each policy field between Europe and Sweden to discuss whether differences (incoherence) exist at the vertical level. According to Hertegård and Widmark (2025), vertical comparison assists in visualising which policy measures or instruments suggested by the European Union are implemented at national levels and how well they support each other to ensure that the regulated issues are addressed without conflict. These results were also compared with evidence from the international section, to check how aligned (or not) the three levels of governance are in relation to the information provided about the services peatlands provide, the pressures on them and what solutions are proposed, if any, to restore and mitigate their increasing deterioration.

3. Results and discussion

3.1. Chronological review: peatlands in international policy

In this section, we present a chronological understanding of peatland (and wetland) conservation and use strategies, which has been addressed together with the policy analysis (Fig. 7).

The rate of disappearance of wetlands led these ecosystems to be the only ones subject to a particular international treaty in the early 1970s, the Ramsar Convention (European Union, 1995; Ramsar Convention, 2016). These worrying rates were partly driven by the promotion of peatland drainage as part of the expansion plan for agriculture during the "Green Revolution" (1945–1975) (Nordbeck and Hogl, 2024; Sommer and Frank, 2024; Verhoeven and Setter, 2010) and the oil crisis of the 1970s (Rulli, 2021; Verhoeven and Setter, 2010). At this time, peatlands were promoted in some of the most peat-rich countries, including Sweden, as an alternative energy source to fossil fuels, especially for heating (Couch, 1993; Heikkilä et al., 2012; Paavilainen and Päivänen, 1995).

In its first Conference of the Parties (COP) in 1980, Ramsar criticised

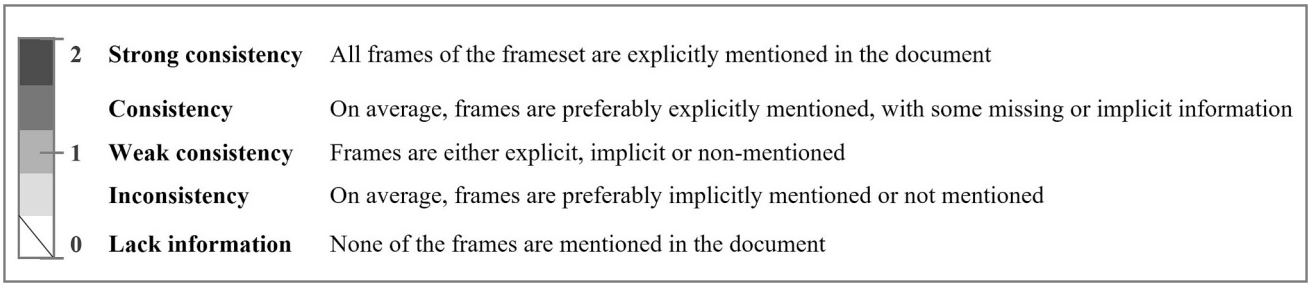

Fig. 4. Degree of consistency of pressure and ES frames within a policy document.

2	**Identify**	At least one of the frames of the response frameset is explicitly mentioned
0	**No identify**	None of the frames are referred to in the document

Fig. 5. Degree of presence of the response frames within the documents.

2	**Strong coherence**	The information about the frameset is strongly consistent across the document within a policy field, meaning that each document explicitly references all measures of the frameset
	Coherence	On average, information of the frameset is consistent across documents within the same field
1	**Weak coherence**	On average, information on the frameset is weakly consistent and/or implicitly mentioned in the documents within the policy field
	Incoherence	Information of the frameset is weakly consistent and/or implicitly mentioned in the documents of the same field, indicating that some frames were either implicitly referenced or not mentioned
0	**Lack information**	No information is provided concerning the frameset in any of the documents within the field

Fig. 6. Degree of coherence within policy fields.

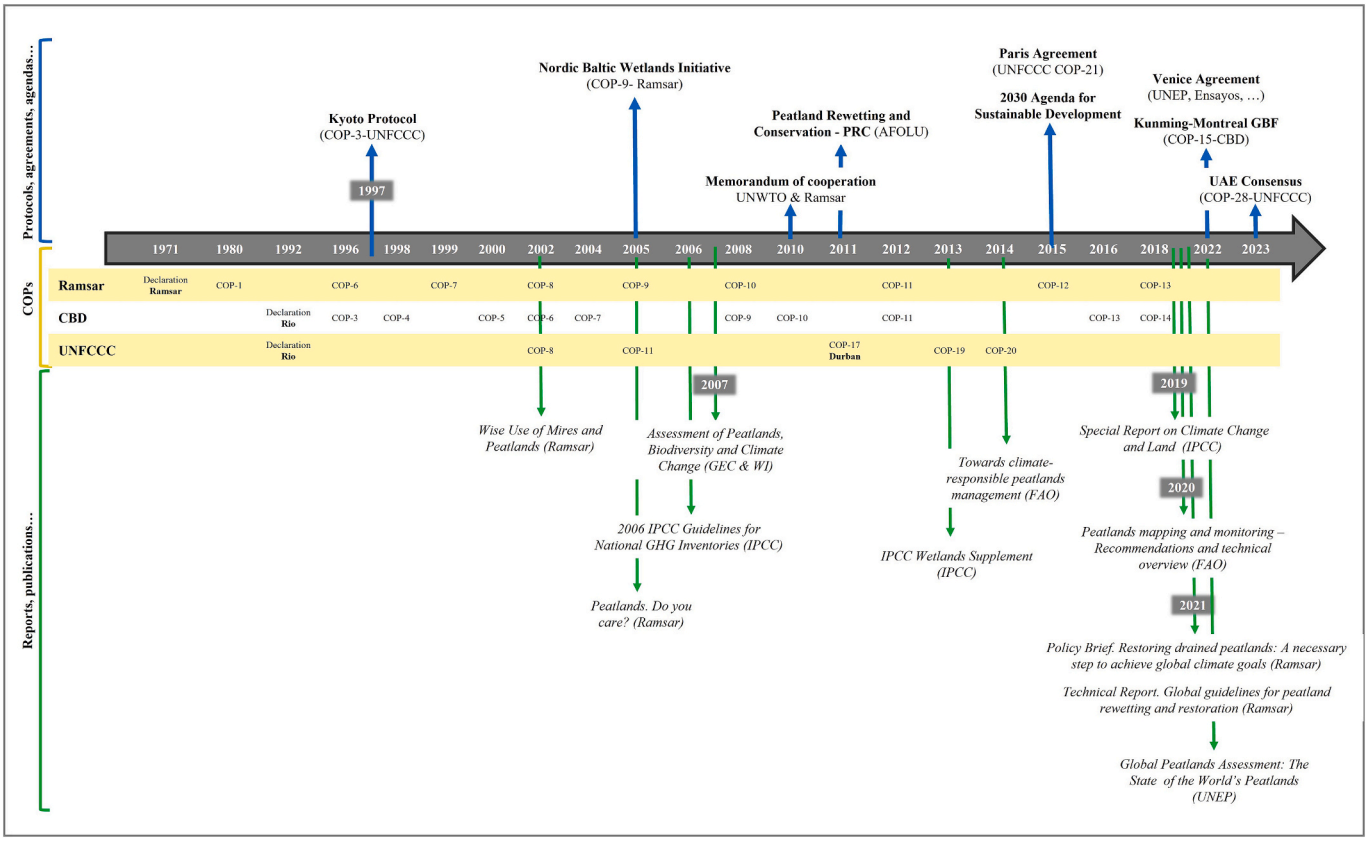

Fig. 7. Main international policies on peatlands.

wetlands' threatened status and lack of protection despite their importance as a refuge for very "special" fauna and flora (Ramsar Convention, 1980a, 1980b). However, in the late 1980s, legislation to license peatland drainage continued to be in force to benefit forestry, among other sectors, in countries like Sweden, Norway, the United Kingdom and Canada (Barthelmes et al., 2015; Härkönen et al., 2023). Drainage, which includes the actions of cleaning old ditches and complementary ditching, has long been considered a necessary intervention to prevent waterlogging and maximise wood production (Härkönen et al., 2023; Marttila et al., 2020).

In 1996, the Convention of Biological Diversity (CBD) officially recognised the imperative need to protect wetlands to preserve biodiversity (UN CBD, 1996a), calling on the Secretariat of Ramsar to participate in their conferences (UN CBD, 1996b). By that time, Ramsar

had already dedicated a specific recommendation to the conservation of peatlands, urging the parties to prioritise the development and adoption of regional guidelines for peatland management (Ramsar Convention, 1996).

As a result, from 1980 to 1998, wetland degradation due to energy production (Ramsar Convention, 1980a), agriculture expansion, and inadequate crop management (UN CBD, 1996a) were on the agenda. In 1996, the Intergovernmental Panel on Climate Change (IPCC) considered peat a solid fossil combustible in the energy field and a carbon source from drained peatlands in the land use change and forestry field, ruling out the potential value of pristine peatlands as carbon sinks (IPCC, 1996). In this period, preserving and using peatlands sustainably, especially in the agricultural sector, was emphasised to improve biological diversity and water quality (UN CBD, 1996a, 1998).

In 1999, Ramsar explicitly linked the concept of "wise use" to peatlands (Ramsar Convention, 1999). This concept entails the implementation of all actions aimed at conserving and sustainably using peatlands and their ES (Ramsar Convention, 2010). The upgraded recognition of the ES provided by peatlands, including their role as carbon sinks, marked a turning point in how they were viewed and managed (Barthelmes et al., 2015). Accordingly, Ramsar recognised for the first time the need to include peatlands and other wetlands in the global discussion on climate change mitigation (Ramsar Convention, 1999). This recognition was preceded by the adoption of the Kyoto Protocol in 1997, which aimed to establish limits to reduce greenhouse gas (GHG) emissions (UNFCC, 1997). In 2002, the UN Framework Convention on Climate Change (UNFCCC) involved the Ramsar Secretariat – and thereby the peatland debate - in their meetings (UNFCCC, 2002).

In 2002, Ramsar recognised peatlands as among the most vulnerable wetland types, highly threatened by drainage and fires (Ramsar Convention, 2002b). As such, Ramsar called on the parties to manage peatlands responsibly to mitigate these impacts and their associated effects on biodiversity and climate (Ramsar Convention, 2002a, 2002b). Also in 2002, the CBD expressed concern about the lack of legal protection of wetlands despite their formal recognition as being of International Importance (UN CBD, 2002).

In 2005, the UNFCCC agreed to exclude peat burning from the list of renewable energy sources for small-scale clean energy (UNFCCC, 2005). It was noted that peat has a slow renewal rate (up to 1000 years) and that the emissions from its burning could be comparable to those from fossil fuels (Falatehan and Sari, 2020). Also in 2005, aware of the importance of peatlands for climate regulation, a group of Nordic and Baltic countries and regions, including Sweden, established the NorBalWet Regional Ramsar Initiative (Barthelmes et al., 2015). This alliance marked a milestone for the European continent, as these regions are home to some of the largest peatland extensions (Balode et al., 2024).

In its "Guidelines for National Greenhouse Gas Inventories" of 2006 (IPCC, 2006), in contrast to those of 1996 (IPCC, 1996), peatlands were categorised in the field of energy as other fossil combustibles but with emissions comparable to that of fossil fuels. In the field of agriculture, forestry, and other land use, a special chapter was dedicated to estimating wetland GHG emissions but restricting them to drained and human-created wetlands in agricultural land (IPCC, 2006). This issue was solved in the IPCC "Wetlands Supplement" of 2013, indicating that wetland emissions and removals can occur under any land-use category (IPCC, 2014). At this point, peat was considered an organic soil fuel (IPCC, 2014). In 2019, the Refinement to the IPCC Guidelines requested an update to include CO_2 emissions from land converted to wetlands and wetlands remaining flooded (IPCC, 2019).

During the 2008 COP of the CBD, the parties discussed for the first time the role of peatlands in forests, recognising their significant presence in these productive ecosystems (UN CBD, 2008). As a result, they urged i) the preservation of pristine peatlands, ii) the limitation of extractive activities on already drained ones, and iii) the implementation of sustainable forest and agricultural practices, including paludiculture, to mitigate any adverse impacts of biofuel production. As an inclusive solution (Wichtmann et al., 2016), Ramsar highlighted that paludiculture, i.e., biofuel crop production, could be sustainable if wetlands of International Importance and their water resources were unaffected (UN CBD, 2010b).

The CBD had underlined in 2000 the need to pay attention to wetlands due to the growth of ecotourism in these areas (UN CBD, 2000). Wetlands provide a wide range of recreational opportunities, e.g., walking, wildlife appreciation, and recreational hunting and fishing (Byg et al., 2017; Kosenius et al., 2014; Waylen et al., 2016). In 2010, peatlands were brought to the attention of the tourism sector with the signing of a memorandum between the UN World Tourism Organisation (UNWTO) and the Ramsar Convention to raise the value of these fragile ecosystems within the tourism sector (Ramsar Secretariat and UNWTO, 2010). Meanwhile, the CBD also recognised that year the importance of keeping wetlands healthy to protect local communities from natural disasters (UN CBD, 2010a).

On 2011, the Durban Convention continued the negotiations on enforcing the Kyoto Protocol and settled new carbon emissions limits (UNFCCC, 2011b). Within this frame, the parties declared that GHG emissions from drained and rewetted wetlands should be accounted for within land use, land-use change, and forestry activities (UNFCCC, 2011a). From 2011, "rewetting" was more explicitly mentioned in policy documents as a specific restoration measure. According to Ramsar, rewetting involves regenerating drained peatland water levels to their original position (Ramsar Convention, 2021). The Peatland Rewetting and Conservation (PRC) programme was approved in 2011 to credit climate benefits from peatlands and other wetlands (FAO and Wetlands International, 2012). This specific standard was necessary because, on the one hand, peatlands are a dominant soil carbon pool and, on the other, the carbon stocks are vulnerable to hydrological conditions (Joosten, 2009). Ramsar recognised the significance of this standard in 2012 (Ramsar Convention, 2012a). Despite these advances, peatlands were still under-represented as wetlands of International Importance (Ramsar Convention, 2012a).

In 2015, the UN launched the "2030 Agenda for Sustainable Development" as an action plan for the planet's prosperity (UN General Assembly, 2015). Among its Sustainable Development Goals (SDGs), the protection, restoration, and sustainable use of peatlands was expressly attached to goals 6 – provision of clean water and sanitation, and 15 – protection of life on land (UN General Assembly, 2015). The same year, as the Paris Agreement was adopted as a landmark in the multilateral process to combat climate change (UNFCCC, 2015), Ramsar underlined the role of peatlands in both climate change adaptation and mitigation, urging the limitation of their drainage (Ramsar Convention, 2015).

Interest in peatlands has been growing since 2018 (see Fig. 7). For instance, at the 2018 Ramsar COP, in addition to encouraging peatland restoration for climate and biodiversity benefits, the parties also called for developing legislation to achieve this aim, especially within the agriculture and forestry sectors (Ramsar Convention, 2018). In 2022, a group of worldwide peatland custodians signed the Venice Agreement to set a new bottom-up standard for peatland ecological and cultural valuation and management (Ensayos, WCS-Chile, and Michael Succow Foundation., 2022). Meanwhile, at the Dubai Climate Change Conference in 2023, the UNFCCC signed the UAE Consensus, an agreement to reach net-zero emissions by 2050 (UNFCCC, 2023). The Parties stressed the role of peatlands as critical to setting the climate goals of the Paris Agreement back on track, and also recognised the need to raise social awareness of their protection, as had been done with forests (IISD, 2023).

In 2000–2023, peatlands and wetlands received attention in the context of climate change, both as "victims" – i.e., these ecosystems are degraded because of climate change and other environmental impacts – and "executioners" – i.e., they contribute to GHG emissions. In line with this last issue, discussions on i) which kind of energy source peatlands

are (fossil fuel, renewable, etc.), ii) in which sector peatland emissions and removals should be considered (agriculture, land use, forestry, etc.), and iii) from which kind of ecosystem (drained, human-made, undrained, etc.) emissions should be accounted for, have driven some of the debates. The role of peatlands as key for biodiversity preservation has not changed in the last twenty years compared to the previous period (1980–2000). In contrast, their function of ensuring water quality seems to have moved into the background. Nonetheless, rewetting, i.e., the regeneration of peatland water conditions – has been positioned as a primary restoration measure from the early 2010s until today. Lastly, the peatland debate has been mainly associated with the agriculture, energy, and land use sectors, followed by forestry and tourism to a lesser extent.

3.2. Policy coherence analysis

3.2.1. Horizontal-external interaction: Europe

3.2.1.1. Pressures. The information about which impacts jeopardise peatland conditions is incoherent across European policy fields (Table 1). Some documents either fail to explicitly recognise the different pressures or overlook them completely (for further details, see Table 3.2 of Supplementary data 3). An example is drainage. It is completely ignored in the agriculture-related policies and the new EU Regulation on Land Use, Land-Use Change and Forestry (LULUCF), even though over 15 % of European peatlands have been drained for agricultural purposes and more than 20 % for forestry practices (Drösler et al., 2008).

Various reasons could explain this evidence. On the one hand, consistent with Bouwma et al. (2018), we found an information bias towards the aim and application of the policies. Some documents straightforwardly align their aims and scope with specific pressures, while neglecting to include other transversal or more comprehensive information in this regard. For instance, policy documents on the field of biodiversity and environment underline, on average, habitat and biodiversity loss as peatland pressure while ignoring drainage, land overexploitation, and climate change. Within the forestry, land use, and soil field, the Soil Strategy for 2030 and the Regulation (EU) 2021/57 on Registration, Evaluation, Authorisation and Restriction of Chemicals (henceforth, REACH) also follow this linear logic. While the former explicitly recognises drainage as a pressure frame, the REACH associates the impacts on wetlands with habitat degradation and pollution, explicitly underlining that "*there is an unacceptable risk to the environment and a potential risk to human health stemming from the discharge of lead gunshot in or around wetlands*" (Commission Regulation (EU) 2021/57 of 25 January 2021 Amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council Concerning the Registration, 2021, p. 3). Something similar occurs with the Directive (EU) 2023/959 on Emissions Trading System (EU ETS), the only document identified in the field of climate change, which only implicitly mentions pollution and climate change.

On the other hand, there is a bias related to the publication date of the policies (Bouwma et al., 2018). We found that the more recent the policies are, the more likely it is that the information is explicitly addressed or the higher the number of pressures (implicitly) identified. The exception to this is the Communication about the Wise Use and Conservation of Wetlands (henceforth, COM (95) of Wetlands), which explicitly recognises all pressures on peatlands and wetlands except for climate change. The omission of climate change could be because, in 1995, the debate about climate change was still in its infancy. As mentioned earlier, the Kyoto Protocol was adopted in 1997 (UNFCC, 1997) and peatlands were not incorporated in the UNFCCC debate on climate change until 2002 (UNFCCC, 2002).

3.2.1.2. Ecosystem services. European policies reflect a certain degree of awareness about peatland ES, although there is little to no coherence in the information provided within and across policy fields (Table 1 and Table 3.2. of Supplementary data 3). On average, documents pay great attention to peatlands' supporting services such as biodiversity hosting, carbon storage, and climate and water regulation. In contrast, they extensively overlook cultural services, except for the COM (95) of Wetlands, "*wetlands are ecosystems of paramount importance (…) represent a valuable cultural and natural heritage*" (European Union, 1995, p. 3). According to Kimmel and Mander (2010), the lack of recognition of recreational opportunities is also evident in the research arena.

As with the pressure frameset, information bias is linked to the aim and application of policies (Bouwma et al., 2018). For instance, agricultural-related policies pay particular attention to peatlands' capability to regulate soil nutrients and chemical water characteristics. In contrast, the Water Framework Directive (Directive 2000/60/EC) implicitly mentions peatlands' role in water provision and regulation, as well as erosion control. These findings indicate that European policies have failed to provide a holistic view of ES.

Taylor et al. (2012) pointed out that environmental policies often oppose those driven by economic interests. In line with this, we found that some policies have a more "environmentally protective" profile while others could be defined as more "resource extractive". Concerning the former profile, biodiversity and environment-related policies provide consistent and coherent information on peatlands' services for biodiversity support, soil formation, and landscape connectivity. This is consistent with the policies' goals to ensure biodiversity through the conservation of natural habitats and wild fauna and flora by implementing effective restoration measures (Council Directive 92/43/EEC, 1992; Regulation (EU) 2024/1991, 2024). Similarly, the LULUCF and the Soil Strategy for 2030 stress the capacity of peatlands to regulate the climate, soil, and water systems as they aim to reduce GHG emissions and restore degraded carbon-rich soils (Communication from the Commission to the European Parliament, 2021; Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 Amending Regulation (EU) 2018/841 as Regards the Scope, 2023). In contrast, the Renewable Energy Directive, whose objective is to promote renewable energy generation, could be considered a more "resource-extractive" policy, as it emphasises the role of peatlands in providing raw materials and biomass for energy production (Directive EU 2023/2413 of the European Parliament, 2023).

We also found that the publication date of these policies may explain some of the incoherencies observed (Bouwma et al., 2018). Documents published before 2010 barely provide any explicit information about peatland ES, except for the COM (95) of Wetlands. It should be noted that the Millennium Ecosystem Assessment, the report that popularised the concept of ES globally, was launched in 2005 (EEA, 2005).

3.2.1.3. Responses. Protection and conservation, as well as restoration, are widely recognised general responses by European policies within and across the different fields to reverse peatland degradation. Among the specific responses, limiting drainage is commonly cited as a nature-based solution across the fields (Table 2 and Table 3.2 of Supplementary data 3). However, attention to other frames of specific responses is quite vague across European policies.

An information bias is found between the aim and application of the policies and the nature-based solutions suggested in them (Bouwma et al., 2018). First of all, rewetting, the action that should deliberately follow up drainage (Sommer and Frank, 2024), is addressed in the agriculture-related policies (CAP Regulation and its Strategic Plan) and the Nature Restoration Law, the first legally binding policy to protect nature in Europe (Wetlands International Europe, 2022a). In both policy fields, this practice is suggested (i.e., application is voluntary) among other restoration actions, such as paludiculture or the establishment of peat-forming vegetation. For instance, paludiculture is considered a sustainable, productive solution (Wichmann and Nordt, 2024). Beyond

Table 1
Summary of the coherence analysis of pressures and ES - Europe.

	Biodiversity & Environment	Climate Change*	Agriculture	Forest, Land Use & Soil	Energy	Water
Pressures	(0.66)	(0.33)	(0.67)	(0.61)	(0.085)	(0.09)
ES - Provisioning	(0.56)		(0.5)	(0.06)	(0.42)	(0.17)
ES - Regulating	(0.64)		(0.73)	(0.73)		(0.3)
ES - Supporting	(1.14)		(0.88)	(1.11)	(1)	(0.17)
ES - Cultural	(0.2)					

Notes: Numbers in brackets represent the average coherence value.
* The Climate Change column represents consistency values (it comprises only one document).

Strong coherence (2)
Coherence (1 < aver. < 2)
Weak coherence (1)
Incoherence (0 < aver. < 1)
Lack of information (0)

Table 2
Summary of the coherence analysis of responses - Europe.

	Biodiversity & Environment	Climate Change*	Agriculture	Forest, Land Use & Soil	Energy	Water
RESP – General	(2)	(2)	(1.33)	(2)	(1)	(1)
RESP - Nature-based	(0.8)		(1.33)	(1.33)	(2)	
RESP- Financial & corporate	(0.8)	(2)	(1.33)			
RESP - Capacity development	(0.8)		(0.67)	(1.33)		

Notes: Numbers in brackets represent the average coherence value.
* The Climate Change column represents consistency values (it comprises only one document).

Strong coherence (2)
Coherence (1 < aver. < 2)
Weak coherence (1)
Incoherence (0 < aver. < 1)
Lack of information (0)

contributing to peatland conservation and providing other environmental benefits (e.g., landscape connectivity), it also enables farming practices, thereby fostering economic growth (Chen et al., 2023; Myllyviita et al., 2024; Tanneberger et al., 2021).

The LULUCF encourages "*farmers, land and forest owners and managers to store more carbon on their lands by prioritising wetland restoration*" (Directive (EU) 2023/959, 2025R, p. 6). However, neither policies in the field of forestry, land use, and soil nor the article of the new Nature Restoration Law concerning peatland restoration in forests (Article 12) provide specific guidance for peatland restoration measures, such as rewetting. Something similar occurs in the energy field, where only drainage limitation is identified, while the water-related policies do not outline any specific solution at all. Thus, the evidence also indicates that restoration measures are significantly influenced by the economic sector that dominates European peatland territories – i.e., agriculture (Eurostat, 2025).

In line with the aim and application bias, we also found that the REACH (in the field of forestry, land use, and soil) limits nature-based responses to restricting the use of certain chemicals in wetlands, while the Renewable Energy Directive prohibits peat extraction from pristine peatlands or "*land that was peatland in January 2008, unless evidence is provided that the cultivation and harvesting of that raw material does not involve drainage of previously undrained soil*" (Directive EU 2023/2413 of the European Parliament, 2023, p. 58).

Regarding financial investment, the information is also biased towards the regulatory aim of policies. In this regard, agriculture-related policies (CAP Regulation and its Strategic Plan) provide the greatest amount of information and guidance about funding and eco-schemes to prompt peatland restoration, as this is one of the CAP objectives - incentivising peatland and wetland protection by supporting viable farm income (European Commission, 2025). This is followed by the policy in the climate change field, the Directive (EU) 2023/959 establishing the EU ETS. This directive suggests that Member States shall use revenues from allowances to support peatland protection and restoration (Directive (EU) 2023/959, 2025). Policies within the other fields overlook any financial measures. Only the biodiversity and environment-related policies acknowledge the need for funding but do not provide information about their own investment programmes (see, e.g., Regulation (EU) 2024/1991, 2024). According to Glenk and Martin-Ortega (2018), this situation may result in low policy guidance regarding the economic inputs and benefits associated with peatland restoration under other land uses different from agriculture.

The publication date of the documents has a lower impact on the definition of peatland responses compared to the framesets of pressures and ES. An exception is the COM (95) of Wetlands, which encourages the maintenance of intact peatlands and drainage restrictions, although ignoring rewetting or paludiculture. This omission could be due to the recent attention paid to these restoration measures around the late 2000s - early 2010s (Ramsar Convention, 2008, 2021), as discussed in the international section. We also found that strategic plans provide

more solutions than regulations (as in the CAP Specific Plan and Regulation). According to Bouwma et al. (2018), this could be due to the nature of the documents: strategic plans usually provide more detailed information and specifications. This evidence could also be extended to the COM (95) of Wetlands, as it is a communication that *"provides a strategic basis for such a policy aiming at the sustainable use of wetland resources"* (European Union, 1995 189 Final, 1995, p. 6).

3.2.2. Horizontal-external interaction: Sweden

3.2.2.1. Pressures. The most explicitly mentioned pressures on peatlands in Swedish policies are habitat and biodiversity loss, pollution, and climate change. However, there is an overall lack of coherence across fields in identifying the different pressure frames in the documents (Table 3 and Tables 3.3 and 3.4 of Supplementary data 3).

Peatlands in the Swedish context are not only seen as the "victims" of human-induced environmental impacts but also as contributors to these issues. This is particularly evident in the energy-related policies (see, e.g., Lag (1994:1776), 1994; Miljöbedömningsförordning (2017:966), 2017; Uthållig användning av torv [Sustainable Use of Peat], SOU (2002:100), 2002). These documents recognise peat (over-)exploitation as a factor that accelerates habitat and biodiversity loss and increases climate change effects, as its carbon sink function is affected (SGU, 2024). For instance, the SOU 2002:100 underlines that "*extraction and burning of peat can have negative effects primarily from a nature conservation and climate point of view*[2]" (Uthållig användning av torv [Sustainable Use of Peat], SOU (2002:100), 2002, p. 9). Such evidence reflects the important weight of the peat mining industry in the country (SGU, 2019) and, thereby, the political concern about its potential impacts and the need to regulate peat extraction.

There is an information bias regarding the aim and application of the policy fields (Bouwma et al., 2018). For instance, both documents in the climate change field explicitly address pollution and climate change. In contrast, the Ordinance on Pesticides (Förordning 2014:425) and the Ordinance on Prohibitions of Chemical Products (Förordning 1998:944) implicitly underline pollution as an impact threatening peatland natural condition.

We also found that the type of document (e.g., report/strategic plan or regulation) significantly influences the extent of information provided by policies (Bouwma et al., 2018). For instance, the reports that evaluate progress on Sweden's environmental objectives – namely Thriving Wetlands, A Rich Diversity of Plant and Animal Life, Sustainable Forests and Flourishing Lakes and Streams,[3] along with the Swedish Strategic Plan for the Common Agricultural Policy (CAP Strategic Plan)[4] – consistently address most of the pressure frames, including drainage. This is interesting given that the area of peatland under agricultural use in Sweden is relatively small compared to the whole of Europe (Noebel, 2023). In Sweden, only 8 % of the land is destined for agricultural use, while nearly 70 % constitutes forest (Jordbruksverket, [The Swedish Board of Agriculture], 2024).

3.2.2.2. Ecosystem services. Despite mentioning peatland ES, Swedish policies present a certain level of incoherence in the information provided in them across policy fields (see Table 3 and Tables 3.3 and 3.4 of Supplementary data 3 for more details). Cultural services receive some attention in Swedish documents, which may stem from the introduction of the concept of "*frilufstliv*" - outdoor recreation[5] in the policies. As noted in the Thriving Wetlands report, "*providing (…) cultural ecosystem services (in the form of providing natural environments for outdoor activities and recreation as well as pedagogy) is also relevant*"[6] (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022c, p. 10).

The information about the ES categories is biased towards the aim and application of the policies (Bouwma et al., 2018), as well as the nature of their fields - whether more "protective" or "extractive" (Taylor et al., 2012). For instance, within the fields of biodiversity and environment and forestry, land use, and soil, policies consistently focus on the role of peatlands in biodiversity support and landscape connectivity, while largely overlooking the other services. Similarly, climate change- and water-related policies present a higher degree of coherence regarding the role of peatlands in regulating climate, water, and soil. Energy-related documents tend to give greater attention to peatlands' provisioning of raw materials and biomass for the energy industry.

The kind of document also influences the consistency of the information (Bouwma et al., 2018), with reports and plans (e.g., Thriving Wetlands, Climate Action Plan, and the Swedish CAP Strategic Plan) more broadly listing the different services and benefits peatlands can offer.

3.2.2.3. Responses. Drainage limitation (or prohibition) and raising the water level in peatlands under forestry and agricultural uses are the most cited nature-based solutions in Swedish policies (Table 4 and Tables 3.3 and 3.4 of Supplementary data 3).

Rewetting and constructing new wetlands and lakes (especially on agricultural land) are identified as voluntary restoration measures after drainage in policies across different fields. The construction of new wetlands is pointed out as a measure that can provide both ecological and recreational benefits. For instance, new wetlands could be used for skating or berry picking (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022c). This finding highlights the value of wetlands' cultural services in terms of recreation for Swedish society and policymakers. Constructed wetlands are even recognised as a biotope area that deserves special protection under Swedish law (Förordning (1998:1252), 1998).

Swedish policies do not acknowledge paludiculture as a critical restoration measure contributing to economic development. The Thriving Wetlands report highlights a need for more knowledge and exploration of how policy instruments could be designed to support this restoration approach (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022c). Instead, policies encourage energy crop cultivation (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022a) and clear-cut forestry (Naturvårdsverket, [Swedish Environmental Protection Agency], 2023). Crop cultivation (as achieved by paludiculture) maximises economic returns by enabling the exploitation of wet peat soils with poor drainage (Kløve et al., 2017), as well as increases carbon storage (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022a). Meanwhile, clear-cut forestry, the most extensive silvicultural practice in Sweden (Lundmark et al., 2013), appears in some policies as another nature-based solution that contributes to raising the water table and keeping soils wet in forests (Korkiakoski et al., 2019; Naturvårdsverket, [Swedish Environmental Protection Agency], 2022b). This evidence suggests that responses reported by Swedish documents may also be biased towards the dominant economic sector of the territory. As pointed out in Nainggolan et al. (2021), land use in Sweden is represented by 62 % forest, 16 % wetlands, and 7 %

[2] "*utvinning och förbränning av torv kan medföra negativa effekter från främst naturvårds- och klimatsynpunkt*" (SOU 2002:100, 2002, p. 9).

[3] The Swedish names of the reports are the following:
Thriving Wetlands: *Myllrande Våtmarker*
A Rich Diversity of Plant and Animal Life: *Ett Rikt Växt- och Djurliv*
Sustainable Forests: *Levande Skogar*
Flourishing Lakes and Streams: *Levande Sjöar och Vattendrag*

[4] *Strategiska plan för den gemensamma jordbrukspolitiken 2023–2027*

[5] *Frilufstliv*: This concept reflects the Nordic understanding of outdoor recreation and spiritual connection with nature, supported by the right of public access (Naturvårdsverket, n.d.).

[6] "*Försörjande (…) kulturella ekosystemtjänster (i form av tillhandahållande av naturmiljöer för friluftsliv och rekreation samt pedagogik) är också relevant*" (Naturvårdsverket, 2022c, p. 10).

Table 3
Summary of the coherence analysis of pressures and ES - Sweden.

	Biodiversity & Environment	Climate Change	Agriculture	Forest, Land Use & Soil	Energy	Water
Pressures	(0.81)	(1)	(0.84)	(0.40)	(0.15)	(0.92)
ES - Provisioning	(0.58)	(0.5)	(0.44)	(0.26)	(0.67)	(0.17)
ES - Regulating	(0.83)	(1.2)	(0.67)	(0.32)	(0.13)	(0.8)
ES - Supporting	(1.17)	(1)	(0.89)	(0.53)	(0.21)	(0.67)
ES - Cultural	(1)				(0.19)	

Note: Numbers in brackets represent the average coherence value.

Strong coherence (2)
Coherence (1 < aver. < 2)
Weak coherence (1)
Incoherence (0 < aver. < 1)
Lack of information (0)

Table 4
Summary of the coherence analysis of responses - Sweden.

	Biodiversity & Environment	Climate Change	Agriculture	Forest, Land Use & Soil	Energy	Water
RESP – General	(2)	(2)	(1.33)	(0.8)	(1)	(1)
RESP - Nature-based	(1.67)	(2)	(2)	(0.8)	(1)	(2)
RESP- Financial & corporate	(1)	(2)	(1.33)	(0.8)	(1.5)	(1)
RESP - Capacity development	(1)	(2)	(0.67)	(0.8)	(1)	

Note: Numbers in brackets represent the average coherence value.

Strong coherence (2)
Coherence (1 < aver. < 2)
Weak coherence (1)
Incoherence (0 < aver. < 1)
Lack of information (0)

cropland and grassland.

We observe that whether or not financial or corporate solutions are stressed is determined by the nature of the policies and the sectors they regulate. Policies in the agriculture field present the broadest information about funding to encourage farmers and landowners to carry out restoration measures. In this regard, the Swedish CAP Regulation and its Strategic Plan present the "LONA",[7] a national support programme for constructing and restoring wetlands, and the "LOVA",[8] a programme for water investment. The Swedish CAP also emphasises the presence of "Focus on Nutrients",[9] a programme designed to provide free advisory services to farmers about wetland management and securing restoration compensation (Jordbruksverket, [The Swedish Board of Agriculture], 2024). This is followed by the field of biodiversity and environment. The Ordinance on Contributions to Local Nature Conservation Projects states that, as long as funds are available, government grants may be provided to municipalities for conservation projects, including peatland rewetting (Förordning (2003:598), 2003). Similarly, the Climate Action Plan underlines the availability of funds from the national budget for peatland restoration and the possibility of incorporating the Carbon Certification Framework (CFCF) to increase these financial incentives in the future (Regeringskansliet, [Government Offices of Sweden], 2023).

The need to obtain licenses, concessions, and permissions to regulate peat extraction and its use for electricity and heating is identified in the energy-related policies. The Law on Certain Peat Deposits also stipulates that once the permit expires, the concession holder must dismantle any facilities and implement specific measures to restore the peatland (Lag (1985:620), 1985). The Energy Tax Law is the only policy in this field that establishes a financial solution. It outlines provisions for taxing sulphur emissions when peat is used as a fuel (Lag (1994:1776), 1994), although no mention to carbon emissions.

Lastly, we also observe a bias between the information provided and the type of document (Bouwma et al., 2018). The reports evaluating progress on environmental goals, the Swedish CAP Strategic Plan, and the Swedish Government Official Report about the Sustainable Use of Peat (henceforth, SOU (2002:100) of Peat) provide broader information about peatland solutions than the binding policies do.

3.2.3. *Vertical-internal interaction: international, Europe, and Sweden*

As noted in the previous sections, peatlands, to various degrees, are key for reaching international, European, and Swedish policy goals in the fields of biodiversity and environment, climate change, agriculture, forestry, land use and soil, energy, and water. At the regional (EU) and national (Sweden) levels, the European COM (95) of Wetlands and the Swedish Thriving Wetlands report (both non-binding policies in the biodiversity and environment field) guide the conservation, restoration, and sustainable use of wetlands. However, neither of these documents places peatlands at the heart of their evaluation and discussion.

Overall, European and Swedish policies coincide in more frequently

[7] LONA - *Lokala naturvårdssatsningen:* Local Nature Conservation Initiative
[8] LOVA - *Lokala vattenvårdsprojekt*: Local Water Conservation Project
[9] *Greppa Näringen*

mentioning habitat and biodiversity loss, pollution, and climate change as significant pressures threatening peatlands and wetlands (Table 5), as was also emphasised in the COPs of the different conventions–Ramsar, CBD, and UNFCCC. However, in contrast to European policies, but in line with international treaties, peatlands at the national (Swedish) level are considered both "victims" and "executioners" of these pressures.

Information at the regional and national levels seems biased towards the policy's aim and application but also towards the political commitment to international treaties, such as the Kyoto Protocol, the Paris Agreement, or even the SDGs (see, e.g., Fakta-pm om EU-förslag 2015/16:FPM125, 2016; Regulation (EU) 2024/1991, 2024). However, as Tanneberger et al. (2021) emphasise, even in the SDGs there is limited mention of the potential of peatlands for ensuring human well-being. Beyond goals 6 (clean water and sanitation) and 15 (life on land), peatlands can also help alleviate poverty (goal 1), reduce hunger (goal 2), ensure good health and well-being (goal 3), ensure responsible consumption and production (goal 12), and, without doubt, combat climate change (goal 13), among others (Tanneberger et al., 2021).

Similarly, information about peatland ES in European and Swedish policies is biased towards certain services, such as biodiversity support, climate and water regulation, and material and energy provision (Table 5). This means that, besides the policy field or domain (Bouwma et al., 2018), how policies address ES seems to be aligned with global political concerns regarding environmental crises. Another reason for this information bias could be related to the complexity of the assessment of the total economic value of ES (Kimmel and Mander, 2010). In this regard, peatland services with a monetary value in the market – e.g., provision of space for agriculture and forestry, raw materials for horticulture, and biomass for the energy industry – are more frequently mentioned (particularly in the energy-related policies). On the contrary, cultural services are extensively omitted throughout policies in all the fields. As these services provide non-material benefits, they do not have a monetary value in the market, so determining their utility is more challenging (Waylen et al., 2016). Only in some Swedish documents (e.g., the reports Thriving Wetlands and A Rich Diversity of Plant and Animal Life and the SOU (2002:100) of Peat) do cultural services receive attention. As said before, this could be related to the concept of "outdoor recreation" and the right of public access (Naturvårdsverket,2025).

The need to restore drained peatlands is widely acknowledged across all policy fields at the European and Swedish levels (although it is not addressed by every single policy). This observation aligns with Wetlands International, which emphasises that restoration should occur regardless of the land type (Wetlands International Europe, 2022b).

At the European level, the Nature Restoration Law targets peatland and wetland restoration, particularly through rewetting. This new regulation is expected to constitute a turning point for the conditions of these ecosystems across the EU territory. First, it makes restoration measures a legal requirement, as expressed in Article 4 on "restoration of terrestrial, coastal and freshwater ecosystems" and Article 11, section 4 on rewetting measures to be put in place in drained peatlands under agricultural use (Regulation (EU) 2024/1991, 2024). In so doing, this regulation acknowledges that "*funding for measures to restore and rewet drained peatlands (…) can come from a wide range of sources, including expenditure under the Union budget and Union financing programmes*" (Regulation (EU) 2024/1991, 2024, p. 11).

Further, the regulation urges Member States to prepare and submit a National Restoration Plan in the coming year (2026). This will be key for Sweden. The country does not have a support model for rewetting organic agricultural land (Länsstyrelsen Västra Götaland, [Country Administrative Board of Western Gotland], 2024), even though the national CAP (like its European equivalent) emphasises the need for peatland restoration under agricultural use (under the specific standard GAEC 2). This could be because GAEC 2 only establishes the need to manage water retention on peatlands and wetlands and does not explicitly mention rewetting as a specific solution (European Commission, 2025; Jordbruksverket, [The Swedish Board of Agriculture], 2024). Besides, as mentioned above, Sweden also directs attention to constructing new wetlands on agricultural land.

Meanwhile, little to no attention is given to rewetting of forest lands in the policies under study across all three governance levels, despite this restoration measure providing favourable conditions for sustainable forestry (Dewitz et al., 2023). For instance, a recent study concluded that peatland drainage in forests results in an annual loss of approximately €307 million, while rewetting could transform these losses into a benefit of around €37 million (Makrickas et al., 2023). Despite this evidence, the new European Nature Restoration Law still does not explicitly address forest peatland rewetting in Article 12, which concerns the "restoration of forest ecosystems" (Regulation (EU) 2024/1991, 2024). At the Swedish level, only the Sustainable Forests report mentions the existence of "the Rewetting Project",[10] an assignment from the Swedish Forest Agency to reduce GHG emissions (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022b). In practice, this project is the only one in Sweden that involves signing voluntary agreements with landowners to rewet drained land, specifically drained peatlands in forests or agricultural land converted into forests (Länsstyrelsen Västra Götaland, [Country Administrative Board of Western Gotland], 2024; Naturvårdsverket, [Swedish Environmental Protection Agency], 2022b). One reason for keeping peatland management in the background may be the extractive-oriented aim of forestry policies, where drainage is a precondition for ensuring productive forestry (Härkönen et al., 2023). In other words, peatland rewetting does not seem to be compatible with (traditional) timber production (Marttila et al., 2020).

The other nature-based solutions and targets for restoration differ between policy fields and regional and national governance levels. Incoherence is found, for instance, towards paludiculture (overlooked by Swedish policies) and the construction of new wetlands (overlooked by Europe). However, Wichmann and Nordt (2024) argue that measures should be site-specific according to the country's needs, economic drivers, and land characteristics and conditions, so this incoherence is not seen as a "true" policy problem. Moreover, it has been found that combining restoration measures would result in a more efficient management solution for peatlands (Balode et al., 2024), in which rewetting should constitute a precondition for any such measures and under any land use (Wetlands International Europe, 2022b). A combined strategy may also contribute to mitigating or compensating for some (short-term) issues related to existing restoration actions, such as the increase of methane emissions and nutrient leakages from rewetting (Zak and McInnes, 2022) or the increase of GHG emissions and decrease of water quality following clear-cutting practices in peatland forests (Korkiakoski et al., 2019; Shah and Nisbet, 2019). Similarly, combining restoration measures with other extractive practices, such as sustainable forestry, could provide multiple benefits for the forest habitats (Makrickas et al., 2023).

Since its first convention in 1980, Ramsar has been calling for developing positive incentives to foster peatland conservation and restoration and to put an end to incentives supporting their drainage (Ramsar Convention, 1980a, 2018). However, we found that Swedish policies still hold license and concession permissions for peat extraction, especially in the energy field. In this regard, it is worth noting that the Proposition on Peat and Electricity Certificate (Prop 2003/04:42) and the Law on Electricity Certificates (Lag 2011:1200) classify peat as a source of renewable electricity due to its continuous formation. Similarly, the SOU (2002:100) of Peat recommends considering peat as slowly renewable biomass but not placing it in any existing classification system because, while peat should not be classified as a fossil fuel in geological terms, it should be comparable to them when reporting GHG emissions. These assumptions diverge from the international and European discourses, which only recognise peat as an organic fossil fuel

[10] Projektet *Återvätning*.

Table 5
Coherence analysis between Europe and Sweden.

	Biodiversity & Environment	Climate Change	Agriculture	Forest, Land Use & Soil	Energy	Water
Pressures	(0.74)	(0.67)	(0.76)	(0.51)	(0.12)	(0.51)
ES - Provisioning	(0.57)	(0.25)	(0.94)	(0.16)	(0.55)	(0.17)
ES - Regulating	(0.74)	(0.6)	(0.7)	(0.53)	(0.07)	(0.55)
ES - Supporting	(1.16)	(0.5)	(0.89)	(0.82)	(0.61)	(0.42)
ES - Cultural	(0.6)				(0.1)	
RESP - General solutions	(2)	(2)	(1.33)	(1,4)	(1)	(1)
RESP - Nature-based	(1,24)	(1)	(1,67)	(1.07)	(1.5)	(1)
RESP - Financial & corporate	(0.9)	(2)	(1.33)	(0.4)	(0.75)	(0.5)
RESP - Capacity development	(0.9)	(1)	(0.67)	(1.07)	(0.5)	

Note: Numbers in brackets represent the average coherence value.

Strong coherence (2)
Coherence (1 < aver. < 2)
Weak coherence (1)
Incoherence (0 < aver. < 1)
Lack of information (0)

(IPCC, 2014) as it is one of the most polluting energy sources (Directive EU 2023/2413 of the European Parliament, 2023).

Aware of the "leakages" of restoration measures, policies at the different governmental levels acknowledge the need for further investigation. This call has been found especially relevant in Swedish policies in the fields of biodiversity and environment, climate change, agriculture, and energy. Some documents (e.g., the Swedish Climate Action Plan) also recognise the need to revise existing regulations from other policy fields, as international conventions have also urged (Ramsar Convention, 2018). The current norms constitute an obstacle to peatland rewetting (Regeringskansliet, [Government Offices of Sweden], 2023) or do not ensure cost-effective processes and the rights of owners and users (Naturvårdsverket, 2023). As Buschmann et al. (2020) have pointed out, the existing peatland restoration incentives will remain unfeasible if national law does not change.

Lastly, we have found that policies, especially at the regional and national levels, have not adequately prioritised investment in technology. However, technological innovation – such as the development of low-cost and low-risk technologies for ground and remote monitoring - combined with other capacity development solutions, is crucial for reversing the decline of peatlands and wetlands and promoting their sustainable use (Andersen et al., 2017; Artz et al., 2018; Sakuntaladewi et al., 2022).

4. Conclusions and future policy recommendations

This study critically examines how peatland pressures, ES, and responses are being addressed, from global intergovernmental debates to European and Swedish regulations and plans. Further, we aimed to assess how and to what degree of coherence policies from different fields and at different governance levels (European and Swedish) respond to the international recommendations for halting peatland degradation and mitigating the effects of environmental crises.

Peatlands and wetlands have been the subject of international debates for more than fifty years. Since the 1970s, Ramsar and other international conventions and treaties have been urging the limitation of activities involving peatland drainage (Ramsar Convention, 1971, 2015) and calling for developing effective legislation to regulate peatland restoration, conservation, and wise use (Ramsar Convention, 2018).

Europe and Sweden have addressed these issues through peatland-related policies in the fields of biodiversity and environment, climate change, agriculture, forest, land use and soil, energy, and water. However, both Europe and Sweden need to develop a specific cross-sectoral strategic plan to support and incentivise coherent peatland management responses (Nordbeck and Hogl, 2024). This plan should also raise awareness of peatlands' natural and social value to halt its degradation and contribute to more sustainable practices.

Our results show that European and Swedish policies explicitly underline the need for peatland protection and conservation. However, documents do not provide a holistic vision, nor cross-sectional information, regarding the benefits peatlands can provide to natural habitats and society (ecosystem services), the factors that are causing their deterioration and loss (pressures), and specific solutions for their protection and sustainable use. This lack of coherence is mainly biased towards i) the aim and application of the policies, ii) the nature of the policy field (whether more protective or extractive), iii) the prominent sectors or industries of the territory and the economic interests behind them, followed by iv) the publication year of the document, and v) the nature of the document (e.g., regulations or non-binding plans and reports).

According to Ranabhat et al. (2018), policy incoherence is among the many factors hindering effective adaptation action. Coordination between decision-makers within and across different policy fields and political-administrative levels should therefore be encouraged. To achieve this aim, policymakers still need to understand peatlands' economic and non-economic (cultural services) value in order to provide integrated restoration actions in their regulations and land-use planning strategies (Bouwma et al., 2018; Kimmel and Mander, 2010; Waylen et al., 2016). Suppose the chain of services and benefits of peatlands, including their socio-cultural and recreational values, were emphasised. In such case, private beneficiaries (farmers, forest owners, etc.) may show an increased interest in restoration and compensation measures to protect peatlands (Hølleland et al., 2017).

Similarly, rewetting needs to be more explicitly recognised as the basis of peatland restoration at the European and Swedish levels. Following Sommer and Frank (2024), rewetting should be framed deliberately as an "exnovation" process, i.e., intentionally connected to the end of drainage practices. Failing to carry out this action will lead to increased CO_2 emissions (Tanneberger et al., 2021), among other environmental impacts such as biodiversity loss, land fragmentation, water eutrophication, and fires, which, in turn, are factors contributing to the climate crisis (Tanneberger et al., 2024; Zak and McInnes, 2022).

Despite investment in wetland rewetting and construction having increased in recent years in agricultural lands, forests, and protected areas, Europe (including Sweden) is far from reaching peatland restoration goals (Naturvårdsverket, [Swedish Environmental Protection Agency], 2022c; Noebel, 2023). The lack of funding opportunities or "fair" compensation costs constitutes a barrier (Mathias, 2022). In this regard, both European and Swedish policies should be more explicit in providing a road map for assisting potential beneficiaries with the existing financial alternatives and creating additional compensation programmes (for instance, a specific programme for rewetting agricultural land in Sweden). The Nature Restoration Law is expected to contribute to this aim.

It is important to emphasise that policies at the three levels agree that peat emissions are comparable to those of fossil fuels. However, they still diverge in terms of their consideration of peat as an electricity source. Policy decision-makers, particularly those from Sweden, face the challenge of wisely classifying peatlands from an energy perspective to prevent any potential legal inconsistency related to their exploitation and use and to avoid unnecessary additional GHG emissions that could exacerbate the effects of climate change (Buschmann et al., 2020).

4.1. Limitations

Lastly, this study is not exempt from limitations. This paper did not aim to compare different country cases; instead, it offers an analysis of Sweden's policy implementation within the European and international context. Hence, future research could compare and analyse policy coherence among countries with similar peatland extension and political conditions as Sweden, such as Finland, Germany, or Ireland. Similarly, extending the analysis to other peatland-rich nations, including Canada, Indonesia, and Brazil, using the multi-step methodology developed in this study could provide valuable insights into how policies worldwide address peatland use, conservation, and restoration.

Future studies could also consider policies from other fields, such as those related to property rights or construction regulations. For instance, the Swedish regulations, such as the Real Property Code – *Jordabalk* (1970:994) and the Building Code - *Byggningabalk* (1736:0123), provide some indications (and restrictions) related to the use and extraction of peat.

Furthermore, we did not consider or evaluate the opinions of policymakers and other stakeholders, such as landowners, farmers, or recreational users, which would be relevant to further understanding policy implementation. As Byg et al. (2017) underlined, an in-depth understanding of actors' perceptions, attitudes, and values regarding existing peatland-related policies and the responses proposed for their conservation and restoration is imperative for the success of peatland sustainability in the long run.

CRediT authorship contribution statement

Chaitanya Suárez-Rojas: Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization, Validation. **Camilla Widmark:** Writing – review & editing, Supervision, Investigation, Funding acquisition, Conceptualization, Validation.

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Declaration of competing interest

No potential conflict of interest was reported by the authors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.forpol.2025.103642.

Data availability

No data was used for the research described in the article.

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