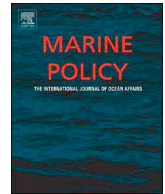




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## Saltmarshes, ecosystem services, and an evolving policy landscape: A case study of Wales, UK

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## ABSTRACT

Coastal areas are facing increasing pressures, resulting in unprecedented levels of change that require an adaptive and flexible governance system. Through its devolved powers, governance in Wales has undergone significant change, with new legislation providing ‘world-leading’ and ‘innovative’ approaches to a range of social, economic and environmental challenges. This provides an opportunity to examine the extent to which ecosystem services have been translated into national policy, providing a useful case study for global coastal governance. This paper reviews five recent Welsh acts, focusing specifically on the case study system of saltmarshes and their ecosystem services, benefits and processes. A number of themes are identified, highlighting opportunities and challenges for global coastal governance. One key observation found that the language used within these 5 Acts is more clearly linked to ecosystem benefits, rather than language traditionally associated with ecosystem services. This evaluation of these Acts highlighted a limited inclusion of ecosystem services – perhaps, if ecosystem services are to be the lynchpin of coastal governance, a more explicit consideration of the concept is required at the highest of policy scales. Finally, recommendations are presented calling for greater inclusion of ecosystem services within high-level policy, and for an integrated and adaptive approach to coastal governance. In addition, it should be noted that although the study is based in a Welsh context, the outcomes are framed within a global scale, providing transferable insights. This paper contributes to the ongoing dialogue surrounding the concept of ecosystem services and its application within coastal governance.

## 1. Introduction

Globally, coastal environments support a diverse range of ecosystem services (ES) and benefits (MEA, [45,26]). However, as coastal ecosystems around the world experience unprecedented levels of pressure and stress as a result of human activity and ongoing climate change impacts [26,35,57,58], their natural capacity to provide ongoing support for the diverse range of services and benefits is called into question. Environmental governance and how best to manage our natural resources, and their associated ES, remains central to the debate amongst global decision-makers and policy practitioners. In a marine and coastal context, there has been a long-standing move towards a more integrated approach to coastal management [2]. More recently, adopting an ecosystem-based approach to managing natural resources is becoming the globally accepted norm [29,37,6]. Despite efforts to move towards more holistic, integrated approaches to marine and coastal governance, the policy landscape remains complex [10,11], making effective management of ecosystems difficult. Governance

varies considerably across coastal and marine ecosystems. As such, there is no one-size-fits-all approach [38]. However, given the importance of effective governance in supporting healthy, resilient, marine and coastal ecosystems and the successful delivery of a range of ES [21], it is vital that we understand the governance instruments influencing management, as well as how and why different approaches do or do not work.

Welsh coastal areas represent an area of significant importance, with 60% of the Welsh population living on, and benefiting from, the coast [59]. As one of the key coastal fringe ecosystems, saltmarsh environments are at the forefront of coastal change and represent an estimated 6950 ha [23,32]. They are most commonly found in the low energy areas of coastal estuarine environments and act as a connector between fresh and marine water systems. As a coastal system, saltmarshes are dynamic and vulnerable to change, yet are increasingly recognised for their role in coastal protection and defence. Recent years have seen a growing emphasis on conservation and restoration of saltmarsh environments as a result of this capacity [58,8]. With this

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recognition of their role in vital ecosystem service provision (e.g. coastal defences, flood regulation and prevention, and increasingly, carbon capture), saltmarshes are set to play an ever greater role in society's adaptation and mitigation of future change and ecosystem regime shifts [57,58]. As a result, they were selected as an ideal case study system; however, it is anticipated that that the results will be transferrable to the broader coastal environment. This paper provides a starting point by developing an understanding of the role of ES within key policy rather than a review of the entire Welsh saltmarsh governance regime. This paper presents an overview of the methodological approach undertaken to evaluate these 5 key pieces of Welsh national legislation, followed by a discussion of the findings. Finally, the paper highlights potential synergies and opportunities relating to the application of Ecosystem Approach, and the wider ES concept, to global coastal management and governance.

## 2. Ecosystem services and a changing policy landscape in Wales

This section presents a brief overview of the current governance landscape for natural resource management in Wales and introduces the Welsh national legislation that will be the focus of the paper.

There have been some improvements to the historically fragmented coastal governance in the UK, and across the devolved governments, through the Marine Strategy Framework Directive (2007), the enactment of the Marine and Coastal Access Act (2009), associated High Level Marine Objectives (HLMOs) and the ongoing marine planning processes [25]. In addition to the ongoing marine planning process and other UK and European policies and initiatives, Wales, unlike the other UK nations, has set additional policy drivers that it must adhere to. Building on initial commitments to sustainable development [67], and a long history of site-based conservation management under national (Westminster) legislation [1], Wales has enacted an innovative and unique suite of legislation. This evolution of Welsh national legislation signals the intention to move towards increasingly interdisciplinary, integrated and holistic approaches to societal challenges [16].

Following the enactment of the Government of Wales Act (2006), Welsh Government has a legal duty to support and promote sustainable development, with Wales becoming one of the first countries to build this legal mandate into national legislation. This was recognised through the generation of the Welsh Sustainable Development Charter launched in 2009 [65,71], and the intention is further promoted through the five Acts focused on in this paper. On the global scale, integrated approaches to natural resource management are being aspired to across Europe, but there is limited evidence that this is being successfully delivered. This new suite of legislation positions Wales a step ahead of other nations in working towards realising these goals, providing a valuable opportunity for others to learn from the process.

Table 1 provides an overview of the key elements of this suite of new legislation, notably the Active Travel Act (2013), the Well-being of Future Generations Act (2015), the Planning (Wales) Act (2015), Environment (Wales) Act (2016), and the Historic Environment Act (2016). Collectively, this legislative portfolio emphasises the importance of building resilient governance and management systems in order to engender long-term sustainability; aspirations which are supported by the integration and connectivity between the Acts themselves. Further to the new legislation, the recent publication of the Welsh State of Natural Resources Report (SoNaRR) (2016) outlines not only the importance of ecosystem resilience, but also the need for greater focus on the coastal fringe ecosystems of the land-sea interface.

More broadly, the field of ES research has rapidly developed in recent years and is increasingly adopted as the most effective governance approach to managing natural environments and social-ecological interactions ([53,72,18,29]). Although ES as a concept has been widely accepted as the appropriate underpinning for decision-making frameworks for managing complex socio-environmental systems ([41,72]; Ruckelshaus et al., [54]; EC [24]), there are still surprisingly few evaluations of its practical application within a marine or coastal policy context [40], with existing studies commonly linked to terrestrial land use (e.g. [18,3,30,52]). Central to this review is the need to ensure the entire governance landscape is future-proofed, adaptive and flexible

**Table 1**

Summary of the key points from the five focal pieces of Welsh national legislation [66,68,69,70].

Welsh National Act	Summary of Key Points
Active Travel (Wales) Act 2013	<ul style="list-style-type: none"> <li>– Legal requirement for local authorities in Wales to map and plan for sustainable and active travel.</li> <li>– Creates new duties that consider the needs and provisions required by walkers and cyclists.</li> <li>– Aims to better connect critical infrastructure (e.g. workplaces, hospitals, shopping centres) to reduce reliance on cars.</li> <li>– Requires annual updates from Welsh Government regarding progress made on the implementation of the Act.</li> </ul> (Welsh Government [68])
Environment (Wales) Act (2016)	<ul style="list-style-type: none"> <li>– Positions Wales as a low carbon, green economy prepared to adapt to the impacts of climate change.</li> <li>– Encompasses a number of topics including: sustainable management of natural resources, climate change, waste reduction and management, fisheries, marine licensing, flooding and coastal erosion.</li> <li>– Mandates the preparation and implementation of a National Natural Resources Policy (under development).</li> </ul> Welsh Government [70]
Historic Environment (Wales) Act (2016)	<ul style="list-style-type: none"> <li>– Amends the pre-existing UK law providing legislative guidance for protecting and managing the historic environment (i.e. the Ancient Monuments and Archaeological Areas Act, 1979, and the Planning (Listed Building and Conservation Areas) Act, 1990.</li> <li>– Provides greater protection to listed buildings and scheduled ancient monuments in Wales.</li> <li>– Aims to improve sustainability of management of historic environments in Wales.</li> <li>– Will create greater transparency and accountability within relevant decision making.</li> </ul> Welsh Government [68]
Planning (Wales) Act (2015)	<ul style="list-style-type: none"> <li>– Aims to ensure fair, resilient planning that supports sustainable development.</li> <li>– Modernises the framework for delivering planning services, including allowing applications to be made directly to Welsh ministers.</li> <li>– Improves resilience by advocating collaboration between local planning authorities.</li> <li>– Enables an effective enforcement and appeals process.</li> </ul> (Welsh Government [69])
Well-being of Future Generations (Wales) Act (2015)	<ul style="list-style-type: none"> <li>– Aims to improve the social, economic, environmental and cultural wellbeing of Wales through the achievement of 7 national wellbeing goals.</li> <li>– Promotes more joined-up thinking to national wellbeing and decision making through the development of regional Public Service Boards (PSBs).</li> <li>– Establishes the role of a Future Generations Commissioner for Wales who is mandated as a steward for the interests of future generations in Wales.</li> </ul> Welsh Government [69]

[26]. Due to the emphasis currently placed on the ecosystem service-based approach to natural resource management and governance, this study aims to examine the level of consideration given to ES within key policy. Given their position as innovative and new policies, and therefore drivers of new practice, this paper takes a content analysis based approach to evaluate five recent pieces of Welsh legislation. This new suite of legislation positions Wales as a global leader, taking active strides towards integrated approaches to national policy. This aspirational approach to national policy in Wales provides a valuable opportunity to glean best practice approaches that can be used to enable effective development of future global policy. The legislative review presented by this paper provides a timely contribution to policy interpretation as Welsh governance systems evolve to implement this new suite of legislation.

### 3. Governance review: methodological approach

As discussed above, saltmarshes are a valuable ecosystem supporting a diverse range of ecosystem characteristics that are directly linked to processes, services, and benefits. In order to conduct a detailed interrogation of the consideration of saltmarsh ES within the five Welsh Acts identified, a multi-phased research approach was applied.

#### 3.1. Phase 1: Development of saltmarsh ecosystem services framework

The first stage involved the generation of a saltmarsh ES framework, adapted from the Millennium Ecosystem Assessment (2006) and the UK National Ecosystem Assessment [62] classification, outlining the ecosystem processes, final ecosystem services, and benefits associated with saltmarshes (presented in Table 2). The ES framework developed was used to ensure a thorough consideration of all services and benefits associated with saltmarshes. For the purposes of this paper, ecosystem processes (EP) are defined as fundamental processes which occur in the

natural environment and would continue to exist regardless of human intervention. Ecosystem services (ES) are the specific results of ecosystem processes which directly sustain or enhance human wellbeing. An ecosystem benefit (EB) results when an ecosystem service (ES) is exploited, directly or indirectly. Ecosystem benefits are sometimes defined as “goods” (NEA 2011), but as these benefits are both tangible (e.g. fish or other goods) and non-tangible (e.g. cultural, for example recreation) the term benefits is considered to be more suitable in this context.

#### 3.2. Phase 2: Development of Search Protocols and validation of framework

Using the ES classification (Table 2), two keyword search protocols were developed to support the keyword search and content analysis based evaluation of the five Acts. Search Protocol 1 (Table 3) was validated through a series of stakeholder interviews (August to November 2016), during which Welsh practitioners with experience working with saltmarshes were asked to identify the ecosystem services and benefits that they would associate with saltmarshes [43]. The interview responses were used to further validate and refine the ES framework for saltmarshes; this was then presented to a multidisciplinary team of expert reviewers (the RESILCOAST project team) for final input and verification.

In addition to search protocol 1 as based on the ES framework (Table 3), a further search protocol, Search Protocol 2, was developed to examine each of the ES categories (i.e. regulating, provisioning, supporting and cultural services). This was validated through the same process as the Search protocol 1 (See Table 4).

#### 3.3. Phase 3: Keyword search and content analysis

NVivo 11 was used for the initial keyword search query to identify word frequency for each term. This initial keyword search provided an

**Table 2**  
Ecosystem processes, services and benefits exhibited by saltmarsh ecosystems. Adapted and guided by: [4]; UK NEA, [62]; [24,27,33,39,55,73,47]; MEA, [45].

Ecosystem Processes (EP) / Ecosystem Characteristics (EC)	Final ecosystem service (ES): Regulating (RS), Provisioning (PS), Cultural (CS)	Benefits to society (EB)
Primary Production (EP)	Climate Regulation (RS)	Carbon Sequestration /Equable Climate
Nutrient Cycling (EP)		
Soil Formation (EP)	Hazard Regulation – Vegetation and Other Habitats (RS)	Natural Sea /Flood Defence
Water Cycling (EP)		Erosion Prevention
Biodiversity (wild species diversity) (EC)	Waste Breakdown and Detoxification (RS)	Immobilisation of pollutants
Habitat/ Environmental Setting / Structural Landscape Element (EC)	Soil Quality Regulation (RS)	
	Pollination (RS)	
	Disease and Pest Regulation (RS)	Provision of habitat for predators that provide natural pest control for adjacent land and properties (RS)
	Wild species diversity (RS)	High diversity, or rare unique plants, animals, birds, insects; breeding, over wintering and/ or feeding grounds for birds
	Environmental Setting: Recreation/ Tourism (CS)	Opportunities for recreation, including walking, hunting, bird-watching, cycling, horse-riding, dog-walking, fishing, wildlife watching, running, picnicking, horse/donkey grazing
	Environmental Setting: Aesthetic / Inspiration (CS)	Including visual, aural, tactile, olfactory, sense of space. Inspiration for art and artists, sculpture, books, photography, painting, poetry, writing, sketching, drawing, music, song, dance, theatre.
	Environmental Setting: Religious / Spiritual, Cultural and Natural Heritage and Media (CS)	Memories, peace, solitude, emotional healing, folklore, TV and radio, films; Natural and landscape heritage; Historical value, cultural heritage, tradition, archaeology.
	Environmental Setting: Education / Ecological Knowledge (CS)	Including informal learning, formal education, scientific value, research
	Environmental Setting: Enfranchisement and Neighbourhood Development (CS)	Local stewardship of ecosystem
	Environmental setting: Physical/Mental Health and Security/Freedom (CS)	Opportunities for exercise, local meaningful space, wilderness, personal space
	Domesticated Livestock (PS)	Agricultural production - sheep (meat and wool); cattle (beef) (PS)
	Wild Fish and Food (PS)	Nursery grounds or migratory routes for commercial marine fisheries, including European Seabass, Sea Trout, Atlantic Salmon, European Flounder, Grey Mullet (PS); also includes collection of species like Samphire.
	Wild Game (PS)	Game-food, including, wild-fowling for Mallard, Wigeon, Teal (PS)

**Table 3**

Search Protocol 1: Key word search terms used to search governance instruments.

<b>General Ecosystem Terms</b>
'ecosystem based management' OR 'ecosystem' OR 'ecosystem service' OR 'natural resource management' OR 'ecosystem management'
<b>Ecosystem Processes/ Characteristics</b>
'primary production' OR 'nutrient cycling' OR 'soil formation' OR 'water cycling' OR 'biodiversity' OR 'wild species diversity' OR 'diversity' OR 'habitat' OR 'environmental setting' OR 'structural landscape element' OR 'environment' OR 'landscape'
<b>Final Ecosystem Services</b>
'climate regulation' OR 'hazard regulation' OR 'waste breakdown' OR 'detoxification' OR 'soil quality' OR 'soil regulation' OR 'pollination' OR 'disease regulation' OR 'pest regulation' OR 'wild species diversity' OR 'species diversity' OR 'biodiversity' OR 'diversity' OR 'recreation' OR 'tourism' OR 'aesthetic value' OR 'inspiration' OR 'environmental setting' OR 'religious' OR 'spiritual' OR 'cultural heritage' OR 'natural heritage' OR 'media' OR 'education knowledge' OR 'ecological knowledge' OR 'enfranchisement' OR 'neighbourhood development' OR 'physical health' OR 'mental health' OR 'security' OR 'freedom' OR 'domesticated livestock' OR 'wild fish' OR 'wild game' OR 'wild food'
<b>Ecosystem Benefits</b>
'carbon sequestration' OR 'carbon storage' OR 'equable climate' OR 'climate change' OR 'natural sea' OR 'flood defence' OR 'flood protection' OR 'coast protection' OR 'flood and coast erosion risk management' OR 'erosion prevention' OR 'erosion control' OR 'immobilisation of pollutants' OR 'habitat provision' OR 'pest control' OR 'rare species diversity' OR 'breeding grounds' OR 'nursery grounds' OR 'overwintering grounds' OR 'bird habitat' OR 'feeding grounds' OR 'recreation' OR 'walking' OR 'hunting' OR 'game-keeping' OR 'shooting' OR 'bird-watching' OR 'cycling' OR 'horse-riding' OR 'dog-walking' OR 'fishing' OR 'wildlife watching' OR 'running' OR 'picnicking' OR 'horse grazing' OR 'donkey grazing' OR 'visual benefits' OR 'aural' OR 'tactile' OR 'olfactory' OR 'sense of space' OR 'inspiration' OR 'art' OR 'artists' OR 'sculpture' OR 'literature' OR 'books' OR 'photography' OR 'painting' OR 'poetry' OR 'writing' OR 'sketching' OR 'drawing' OR 'music' OR 'song' OR 'dance' OR 'theatre' OR 'performance' OR 'memories' OR 'peace' OR 'solitude' OR 'emotional healing' OR 'folklore' OR 'tv' OR 'television' OR 'radio' OR 'films' OR 'natural heritage' OR 'landscape heritage' OR 'historical value' OR 'cultural heritage' OR 'tradition' OR 'archaeology' OR 'informal learning' OR 'formal education' OR 'scientific value' OR 'research' OR 'local stewardship' OR 'local connection' OR 'exercise' OR 'local meaningful space' OR 'wilderness' OR 'personal space' OR 'agriculture' OR 'sheep' OR 'meat' OR 'wool' OR 'cattle' OR 'beef' OR 'wild food' OR 'samphire' OR 'lamb' OR 'nursery grounds' OR 'migration' OR 'migratory' OR 'fisheries' OR 'seabass' OR 'sea trout' OR 'Atlantic salmon' OR 'European flounder' OR 'grey mullet' OR 'game food' OR 'wild fowling' OR 'mallard' OR 'wigeon' OR 'teal'

**Table 4**

Search Protocol 2 based on ES categories for saltmarshes (adapted from Table 2).

<b>Ecosystem Service Based Search Categories</b>
<b>Regulating Services (RS)</b>
'climate regulation' OR 'hazard regulation' OR 'waste breakdown' OR 'detoxification' OR 'soil quality' OR 'soil regulation' OR 'pollination' OR 'disease regulation' OR 'pest regulation' OR 'wild species diversity' OR 'species diversity' OR 'biodiversity' OR 'diversity' OR 'geodiversity' OR 'soil stabilisation' OR 'coast stabilisation' OR 'Sediment stabilisation' OR 'soil stability' OR 'coast* stabili*' OR 'stabili*' OR 'pollution mitigation' OR 'pollution control' OR 'bioremediation' OR 'water quality' OR 'wave attenuation' OR 'storm protection' OR 'pest control'
<b>Provisioning Services (PS)</b>
'livestock' OR 'Wild fish' OR 'wild game' OR 'wild food' OR 'salicornia' OR 'sheep' OR 'meat' OR 'wool' OR 'cattle' OR 'beef' OR 'wild food' OR 'samphire' OR 'lamb' OR 'nursery grounds' OR 'migration' OR 'migratory' OR 'fisheries' OR 'seabass' OR 'sea trout' OR 'Atlantic salmon' OR 'European flounder' OR 'grey mullet' OR 'game food' OR 'wildfowling' OR 'mallard' OR 'wigeon' OR 'teal'
<b>Cultural Services (CS)</b>
'recreation' OR 'tourism' OR 'aesthetic value' OR 'inspiration' OR 'environmental setting' OR 'religious' OR 'spiritual' OR 'cultural heritage' OR 'natural heritage' OR 'media' OR 'education knowledge' OR 'ecological knowledge' OR 'enfranchisement' OR 'neighbourhood development' OR 'physical health' OR 'mental health' OR 'security' OR 'freedom'
<b>Supporting Services (SS)</b>
As per the UK NEA [62], supporting services were considered to be implicit within the other three categories.

indication of the level of consideration given to Ecosystem services (ES), Ecosystem Processes (EP) and Ecosystem Benefits (EB) related to saltmarshes within the new legislation. Due to the shallowness of the keyword query analysis, additional in-depth content analysis and coding was conducted to identify key themes within the legislation and to establish a more comprehensive understanding of the consideration of ES and the implications for saltmarshes. Coding nodes were developed by grouping similar search terms through emergent theme development (e.g. climate change or coastal protection and flooding). This supported a more in depth review of the five Acts, allowing comparison between Acts, as well as reviewing the consideration of EP, ES and EB within these key pieces of legislation. As discussed above, the focus of this study was to examine the level of ES content within 5 key Welsh policy documents, with a view to elucidating the level of consideration given to saltmarsh ES at this governance level. Given this, it should be noted that the analysis of the documents focused on content, and did not evaluate the use, function or implementation of these particular governance instruments.

## 4. Results: Ecosystem services in governance

### 4.1. Governance content analysis: initial findings

#### 4.1.1. Saltmarshes in new Welsh acts

As an initial starting point, a keyword search was performed using the terms 'saltmarsh', 'salt marsh', 'wetland', and 'coastal marsh'. This search was used to give an indication of the level of consideration given to saltmarshes within the new Welsh legislation. Analysis found that there was limited inclusion of any terms directly related to saltmarshes, with no mention of either 'saltmarsh' or 'saltmarshes'. 'Coastal marsh' was the only term included in the new Acts, with only 3 explicit references in the Planning (Wales) Act, 26 mentions in the Environment (Wales) Act and no mentions in the other 3 Acts. Examination of the terms identified found that none of the mentions in the Planning (Wales) Act were linked to ES or, indeed, to saltmarshes instead focusing on coastal marsh. In the Environment (Wales) Act, all 26 mentions were with reference to the formation of a new Flooding and Coastal Erosion Committee. It should be noted that an additional search was carried out to evaluate the inclusion of other coastal ecosystems; this search found no inclusion of the following terms in any of the Acts: 'wetland', 'sand dunes', 'seagrass', 'coastal fringe', 'coast', 'beach', or 'mudflats'.

4.1.1.1. *Ecosystem Services, Benefits and Processes in Governance (Search Protocol 1)*. As shown in Fig. 1, initial analysis found that of the five Acts, the Environment (Wales) Act appeared to have the highest level of consideration of all forms of ecosystem terminology searched. The Active Travel (Wales) and Historic Environment (Wales) Acts were found to have significantly lower levels of content associated with saltmarshes and their ecosystem services. The analysis also found that although ecosystem services is the terminology and language currently being promoted for adoption in governance, the phrases and language associated with ecosystem benefits has been identified most frequently in each of the Acts (Fig. 1).

Further examination of the data presented in Fig. 1, through content analysis, indicated that consideration of saltmarsh ecosystem services, and related concepts, was much lower than initially observed through the keyword search. Table 5 presents a summary of the inclusion of each saltmarsh-related ES keyword identified within each piece of legislation. It should be noted that the data presented in this table only includes references picked up by the search terms within the five Acts; there is more detail which may have implications for Welsh saltmarshes. For example, the Environment (Wales) Act (2016) includes a whole section on marine licensing which may have implications for offshore activities adjacent to saltmarshes.

From Table 5, it is clear that the Environment (Wales) Act

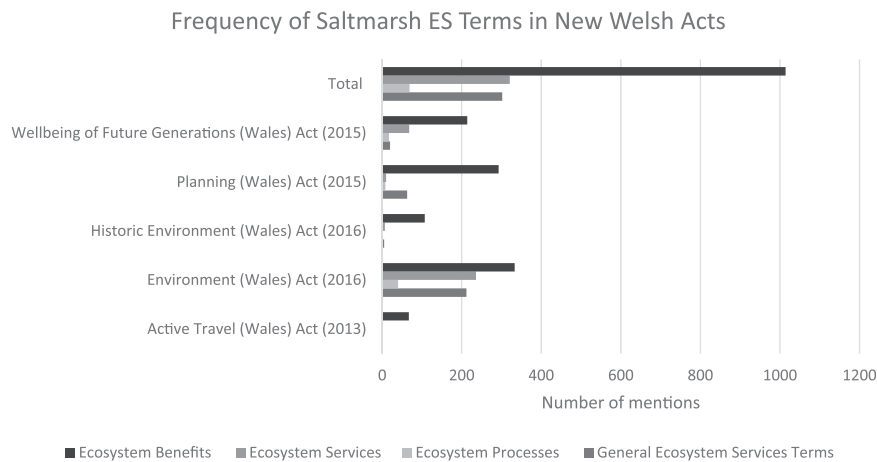


Fig. 1. Initial indication of support for Ecosystem Services, Benefits and Processes associated with saltmarsh ecosystems within new suite of Welsh legislation.

Table 5  
Summary of Ecosystem Service Consideration across the Five Acts.

	General Ecosystem Services Terms (GEST)	Ecosystem Processes (EP)	Final Ecosystem Services (FES)	Ecosystem Benefits (EB)
<b>Active Transport (Wales) Act (2013)</b>				
Total Number of Terms Found:	2	There is no consideration of ecosystem services or ecosystem processes terminology within the Active Travel (Wales) Act (2013)		67
Summary of Saltmarsh Ecosystem Services Terms	None			None
Total Number of Relevant Terms:	None			None
<b>Environment (Wales) Act (2016)</b>				
Total Number of Terms Found:	212	40	236	333
Summary of Saltmarsh Ecosystem Services Terms	1. Natural beauty (2) 2. Natural beauty (2) 3. Protection of marine habitats and their ecosystems (3) 4. Coastal and flood risk (5)	1. Water (7) 2. Soil (1) 3. Wild fauna (1) *Also included specific mention of the need to support fisheries	1. Natural beauty of marine and coastal systems (6) 2. Climate change (12) 3. Water (5) 4. Soil (1) 5. Wild fauna (1)	1. Climate change (10) 2. Flood (20) 3. Erosion (18) 4. Natural beauty of marine and coastal systems (6) 5. Habitat (7)
Total Number of Relevant Terms:	10	9	25	61
<b>Historic Environment (Wales) Act (2016)</b>				
Total Number of Terms Found:	85	1	7	101
Summary of Saltmarsh Ecosystem Services Terms	1. Natural heritage (1)	None	None	1. Landscape in the context of cultural heritage (1) 2. Cultural heritage (3) 3. Natural heritage (2)
Total Number of Relevant Terms:	1	None	None	6
<b>Planning (Wales) Act (2015)</b>				
Total Number of Terms Found:	20	8	10	293
Summary of Saltmarsh Ecosystem Services Terms	None	1. Environmental wellbeing (1)	1. Environmental wellbeing (1) 2. Cultural wellbeing (1)	1. Cultural wellbeing (1)
Total Number of relevant terms:	None	1	2	1
<b>Wellbeing of Future Generations (Wales) Act 2015</b>				
Total Number of Terms Found:	63	19	68	212
Summary of Saltmarsh Ecosystem Services Terms	None	None	1. Environmental wellbeing (16) 2. Cultural wellbeing (16) 3. Climate change (5) 4. Ecological resilience (1) 5. Physical and mental health (2)	1. Cultural wellbeing (16) 2. Climate change (5)
Total Number of relevant terms:	None	None	50	11
<b>TOTAL number of relevant terms found across all Acts</b>	<b>11</b>	<b>10</b>	<b>77</b>	<b>78</b>

represents the highest level of potential consideration of saltmarsh ES and their associated processes and benefits at a national level. However, although there are implied applications of this Environment (Wales) Act (2016) to saltmarshes, there is limited explicit recognition of ES, both in general and with specific reference to saltmarsh ecosystem services, processes or benefits, or indeed in any of the other new pieces

of legislation.

4.1.1.2. Ecosystem Service Categories in Welsh Governance (Search Protocol 2). While it is important to understand how, and to what extent, these key legislative drivers consider the services, benefits and processes associated with ecosystems, it is also necessary to ascertain

whether different categories of ecosystem services (and by association, the relevant processes and benefits) in Wales receive differing levels of support. In order to assess this, an initial word search was conducted using the ES categories presented in Table 3<sup>1</sup>. As before, the Environment (Wales) Act (2016) was found to exhibit the highest level of support or consideration across all three categories, while there was no inclusion of any ES concepts found in the Active Travel (Wales) Act (2013) (Fig. 2).

As before, content analysis was conducted on the responses identified by the search (Table 6). Again, considerable variation in the level of consideration given to the three ES categories in the Acts was observed. Analysis of the keyword search results found there to be no consideration given to provisioning services linked to saltmarshes across any of the Acts. Terms relating to cultural services were most frequently considered within the Acts (45 mentions).

#### 4.2. Content analysis: cross-cutting themes

As discussed previously, the keyword based search protocol identified significant gaps in the level of consideration afforded to ecosystem services in general, let alone those specifically linked to saltmarsh environments across Wales. However, the application of the content analysis approach allowed cross-cutting themes relevant to saltmarsh management to be identified. Cross-cutting themes were identified as: sustainable development, sustainable management of natural resources, coastal defence and flood protection, climate change and environmental and cultural wellbeing in Wales (Fig. 3). To examine the frequency of mentions, these themes were used as terms for a final 3rd search protocol:

- ‘climate change’
- ‘sustainable development’
- ‘sustainable management of natural resources’<sup>2</sup>
- ‘coastal defence and flood protection’,<sup>3</sup>
- ‘Wellbeing’

While it should be noted that these themes were not always mentioned in the context of ecosystem services, or saltmarshes, they were identified as common themes intersecting across all the Acts, which have potential implications for management of saltmarshes and their associated ES. As shown in Fig. 3, none of these themes were identified as being explicit within the Active Travel (Wales) Act (2013), while wellbeing was identified as the most common cross-cutting theme.

### 5. Discussion

This study presents a detailed review of the consideration given to ecosystem services, processes and benefits within the recent additions to Welsh national policy, particularly focusing on those associated with saltmarshes. Through the content analysis approach, this section presents a number of areas for discussion, including: 1) references to ES, EB, and EP within legislation, 2) cross-cutting themes for global coastal management and 3) recommendations, transferability and areas for further investigation.

<sup>1</sup> Although it is recognised that there are four categories of ES, the UK NEAFO (2014) takes the view that Supporting Services underpin the other three categories of ecosystem services. On this basis, it has been omitted from the search terms as an independent category, and the search has been done using the following three categories: Regulating, Provisioning and Cultural Services.

<sup>2</sup> This was also searched against ‘sustainable management’.

<sup>3</sup> This had to be searched as ‘coastal erosion’ and ‘flood protection’.

#### 5.1. Ecosystem services, processes and benefits: language and references in legislation

Despite the UK’s National Ecosystem Assessment (NEA 2011) review highlighting a concerning and significant decline in the ability of the UK’s natural resources to deliver ecosystem services, and a need for more effective valuation and consideration of ESs within policy and decision-making ([61]; UK NEA, [62]), this review found that at a national (Welsh) level, explicit support is not evident (as identified in Table 4). As noted by Kabisch [34], in a review of implementing the ES framework within urban landscape planning, few planning and/or policy documents include explicit mention of specific ecosystem services; this is further supported by the findings of this study, which highlight a distinct lack of explicit inclusion of ecosystem services terminology and language within Wales’ landmark legislation. It should be noted that this is not a criticism of the newest additions to Welsh legislation, but an observation of the language being used at a high policy level.

Given their broad scale, national (Welsh) legislation may not be expected to include much specific detail regarding saltmarsh ES (or any other ecosystem, for that matter), as these Acts have been designed to be applicable to the full range of marine, freshwater and terrestrial environments; although it should be noted that we find minimal mention of ecosystem services in any regard. They are, however, key drivers for coastal management and protection in Wales, and the absence of this terminology gives an indication of the remaining lack of understanding regarding the ecosystem service approach and its application across all sectors. This suggests that these new Acts may not provide a strong policy framework for an ecosystem services based approach to saltmarsh governance, although future national guidance under the Acts may support this.

As coastal management continues to strive towards adopting an ecosystem approach, a more explicit level of consideration of ecosystem services, even on a general level, could improve the impact of governance instruments. In spite of the lack of explicit mention of ES in these Acts, content analysis highlights key opportunities for application to saltmarsh environments. For example, the Wellbeing of Future Generations (Wales) Act (2015) outlines the importance of achieving ecological resilience, without referring to the ES that might support this in any environment. A further example can be seen in the Environment (Wales) Act (2016), which sets out the need for Welsh Ministers to develop a natural resources policy that takes account of climate change, without any real indication of the ES implications of this (although it is expected that Welsh Government and NRW will provide guidance on this). By mentioning ES and indeed saltmarshes in this context, their role and the benefits of adopting the ES approach to natural resource management could be further emphasised by the implementation of the national guidance associated with these flagship legislative drivers.

Given the continuing emphasis on the ES approach as *the* environmental management approach, explicit support in legislation and policy at all levels is crucial, rather than the current implicit inclusion of ES and EB, if it is to be successful as a natural resources management approach. In line with this, from a saltmarsh perspective, there are grounds for arguing that the broader legal and policy framework for saltmarshes needs to provide greater recognition of specific ES. For example, marine and fisheries legislation and strategies could recognise the important role played by saltmarshes in providing nursery habitat for commercially significant fish species. Similarly, and as alluded to above, climate change governance instruments could specifically highlight the relative importance of saltmarsh, and other coastal systems, in providing carbon sequestration. Further to this, the risk-based approach to flood and coastal erosion management being developed in Wales could place greater emphasis on the natural flood defence role played by saltmarshes and other ecosystems. Additionally, as Wales attempts to move towards an integrated governance approach through these new Welsh national Acts [22,46,64], with the Wellbeing of Future

### Frequency of ES Categories in New Welsh Acts

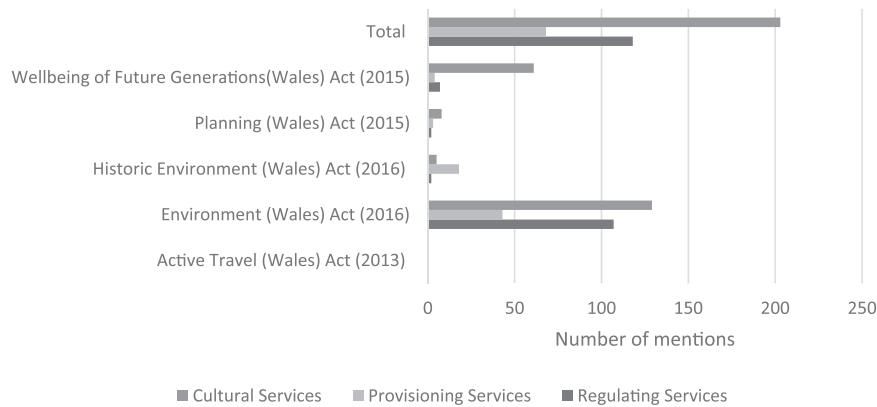


Fig. 2. Frequency of ES categories consideration in recent Welsh legislation.

Table 6  
Summary of ES category (Search Protocol 2) inclusion in each of Act.

	Regulating Services	Provisioning Services	Cultural Services
<b>Active Transport (Wales) Act (2013)</b>	No consideration of any of the ES categories identified in the Active Transport (Wales) Act (2013).		
<b>Environment (Wales) Act (2016)</b>	129	43	129
Total Number of Terms Found:	129	43	129
Summary of Saltmarsh Ecosystem Services Terms	1. Fisheries	None	1. Natural beauty of marine and coastal areas (6) 2. Natural habitats and species (3)
Total Number of Relevant Terms:	4	None	9
<b>Historic Environment (Wales) Act (2016)</b>	5	18	5
Total Number of Terms Found:	5	18	5
Summary of Saltmarsh Ecosystem Services Terms	None	None	1. Cultural heritage (3) 2. Natural heritage (2)
Total Number of Relevant Terms:	None	None	5
<b>Planning (Wales) Act (2015)</b>	8	3	8
Total Number of Terms Found:	8	3	8
Summary of Saltmarsh Ecosystem Services Terms	None	None	1. Environmental wellbeing (1) 2. Cultural wellbeing (1)
Total Number of Relevant Terms:	None	None	2
<b>Wellbeing of Future Generations (Wales) Act (2016)</b>	61	4	61
Total Number/ frequency of Terms Found:	61	4	61
Summary of Saltmarsh Ecosystem Services Terms	None	None	1. Environmental wellbeing (16) 2. Cultural wellbeing (16) 3. Ecological resilience (1) 4. Physical (1) and mental health (1) and wellbeing
Total Number of Relevant Terms:	None	None	35
<b>TOTAL Number of Relevant Terms</b>	<b>4</b>	<b>0</b>	<b>45</b>

### Summary of Cross Cutting Themes Within the Five Welsh Acts

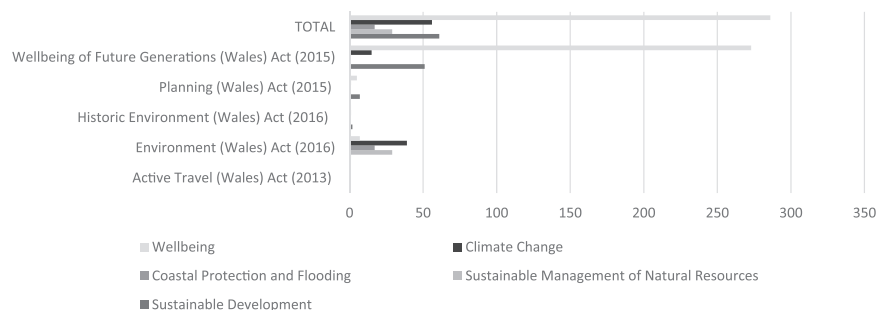


Fig. 3. Content Analysis of cross cutting themes identified across the Acts.

Generations (Wales) Act (2015) leading many governance decisions across sectors and social challenges, it is particularly important that the ESs underpinning the wellbeing goals (Welsh Government [70]) are

recognised.

Although this governance review was focused on a sample of Welsh legislation, it provides an indication of the trends in language and

content being used within national policy development. Content analysis of the five Acts found Ecosystem Benefit terms more frequent than terms associated with ES in general, ecosystem processes or ecosystem services (shown in Table 4). This suggests that the terminology associated with ecosystem benefits is more accessible and applicable at a national level, with benefits more easily linked to multiple ecosystems and sectors. A key question remains whether the ES concept is useful for decision and policy makers [60]; as a concept, its aim is to create a common language and communication tool that supports more effective dialogue between diverse stakeholders. Given the lack of explicit ES content across these five Acts, it is unclear if this is a case of a knowledge-governance gap (i.e. a gap between the science and its inclusion in policy; [48]) or just a case of ES as a concept being too complex for explicit inclusion in national level governance instruments. Equally, as discussed by Beery et al. [5], there is no guarantee that the uptake and the inclusion of the ES terminology within the Acts would mean the overarching environmental goals are more easily or effectively achieved.

More work is required to understand if, and how, the ES framework is an appropriate tool for managing saltmarsh sites, or indeed other coastal fringe environments. Throughout the Acts, there are clear opportunities for joined up thinking on their implementation – for example, the remit to support sustainable development is a cross-cutting thematic policy driver with implications for saltmarshes in Wales. However, uncertainties remain around how these new pieces of legislation will be interpreted by a diverse range of implementers, and how they will connect to each other, and other pre-existing policy drivers. Where in the past, national legislation has been quite targeted in focus, the Wellbeing of Future Generations (Wales) Act (2015) and the Environment (Wales) Act (2016), particularly, have a wide-reaching lens, tackling a diverse range of themes and topics. The ecosystem services approach has been framed as a common language through which decision-makers across different sectors can reach a common solution; greater inclusion of ES within national policy is an opportunity to create a common language at the highest level, ensuring that all cross-sector stakeholders work from and towards common goals.

## 5.2. Cross cutting themes and opportunities for global coasts

Assessing the five Acts through the lens of ecosystem services highlights a range of opportunities for saltmarsh governance; these are examined through five cross-cutting themes. It should be noted that these cross-cutting themes are underpinned by global priorities, policy drivers and legislation, and the review has identified application opportunities for wider coastal governance within each of these themes.

With regard to the sustainable management of natural resources, and associated sustainable development, there is limited guidance on management of specific ecosystem services in a broad sense, and even less that can be applied to saltmarsh environments. In order for natural resource management approaches to be effective, more detailed guidance recognising the entire spectrum of ecosystem services and benefits is required. While dialogue on sustainable development began in the early 1980's, it took time for the concept to be cemented within UK, and devolved legislation [56]. While there are no specific mentions of saltmarsh ES, and their potential role in sustainable development, the emphasis on sustainable development in these new Acts has clear implications for Welsh saltmarshes and their associated governance. Given the recognition of the diversity of recreational (or cultural service) value of coastal systems to walkers, bird watchers and game keepers (to name a few), the integrity of these sites, influenced by coastal flooding, soil and sediment stability, and general biodiversity, should be considered more explicitly within supporting legislation.

In the case of coastal defence and protection, most of the policy framework on this topic lies outside the remit of the new legislation, having been largely developed over decades at a UK level [49]. However, coastal defence and protection was identified as a common theme,

indicating clear implications for the coastal protection and flooding function of Welsh saltmarshes. While the coastal defence and protection attributes associated with saltmarshes are not directly considered within the new legislation, it should be noted that coastal protection and/or wave attenuation processes could be seen as having a protective capacity and should be afforded greater consideration in future coastal management policy and legislation. It is therefore recommended that there should be explicit reference to specific ES supporting flood risk management and planning at the operational scale, both within the case study region and on a wider national scale.

The concept of wellbeing, and the various ways in which the natural world can contribute to societal and human wellbeing, is being increasingly accounted for within environmental policy [13]. Central to the new Welsh legislation is the goal of securing Wales as a leader in social, economic and environmental wellbeing, across all communities, whilst supporting sustainable development. In our content analysis, this review found that four out of the five Acts make reference to the cultural and environmental wellbeing in some way, with explicit references to 'cultural wellbeing', 'environmental wellbeing', 'cultural heritage', 'natural heritage', 'physical health' and 'mental health', highlighting the importance of cultural and natural heritage, health and wellbeing as a national priority in Wales. As expected, the emphasis on this is highest within the Wellbeing of Future Generations Act, but there are indications of support across the legislation. As Wales continues to move towards achieving the wellbeing goals set out by the Act, local and regional decision-makers will require guidance on how to ensure their management of environmental resources supports these goals. The lack of explicit ES and EB content associated with wellbeing in the Acts may be indicative of this lack of understanding of saltmarsh ES provision and associated wellbeing.

Finally, there is frequent mention of the need to mitigate for the impacts associated with climate change across the suite of legislation, as indicated in Fig. 3. In particular, there is an emphasis on this in the Environment (Wales) Act (2016); while not directly linked to ES or EB, there are clear connections between the objectives set out by the Act, and the wellbeing goals of the Wellbeing of Future Generations (Wales) Act (2015) that have implications for saltmarshes, their governance and their continued role in supporting coastal communities in the face of climate change. Indeed, this has been realised as a Climate Change Expert Reference Group has been established with clear links to the work programme of the newly established Wellbeing Commissioner under this Act [17]. As the impacts of climate change continue to be realised, lessons may be learned from the integrated approach to governance and legislation being adopted by Wales to ensure that adaptive governance regimes are implemented globally to ensure coastal systems, including saltmarshes, can continue to provide their ecosystem service benefits [37].

## 6. Recommendations, transferability and areas for further investigation

This section outlines key recommendations for future research and policy, and comments on the transferability of the approach.

The primary finding from this review has been the lack of explicit inclusion of the ecosystem services concept within key policy drivers in Wales; this is in spite of it being the accepted approach to natural resource management [29,37,6]. It is recommended that clearer consideration of ecosystem services, including those of specific ecosystems through the use of examples, would strengthen these policies and lend weight to related management decisions.

While this paper focused on saltmarsh ecosystem services, the lack of clear support for the overall concept of ecosystem services within high-level policy is evident from this study. It stands to reason that greater inclusion of the ecosystem services framework, encompassing improved understanding of the values and benefits associated with coastal systems would lend itself to strengthened global coastal policy



and management. As with every method, there are limitations that can be associated with the content analysis approach to the research; however, the study has indicated where there might be opportunities for operational managers to collaborate on cross-cutting themes that are relevant not only for saltmarshes, but other coastal, or indeed, all ecosystems. Understanding where these opportunities lie will be crucial to the success of this new legislation, particularly given the complexities that can be associated with this form of whole ecosystem based approaches to natural resource management.

### 6.1. Interactions, policy effectiveness and resilience to change

This paper presents a high-level, focused review of five new pieces of National legislation in Wales; it does not interrogate the more detailed nuances of related, more regionally specific, governance instruments, their interactions or their effectiveness. However, despite the research requirements that remain, this paper provides an indication of the gaps likely to be present in the context of other environments, ecosystem services and locations. For example, the need for more explicit consideration of specific ecosystem services, processes and benefits is something that will apply to all coastal fringe systems, and will not be specific to saltmarshes. Therefore, this work is a starting point for supporting continued efforts for working towards a truly ecosystem based approach within coastal and marine governance. In order to fully understand how the underpinning concepts of ES are recognised within the governance landscape, a rigorous, comprehensive review of the entire governance landscape in Wales and the UK is required.

Following the UK's vote to leave the EU in June 2016, it can be reasoned that coastal governance, and therefore governance impacting Welsh saltmarshes and other coastal systems across the UK, will experience a period of change in the coming months and years. Coupling this with recent additions to international obligations (e.g. UN Sustainable Development Goals [63]), it will be necessary to monitor progress to ensure that the valuable coastal ecosystem services, processes and benefits are afforded adequate consideration within the evolving governance system, continuing to meet international and national objectives. It is evident that the existing legislative framework resulting from the UK's membership of the EU is complex, but comprehensive and influential [12]. Many saltmarsh, and other coastal fringe sites in Wales, fall under EMS (European Marine Site) designations, and are found in cross border locations, where their management is at least partially guided by a range of European Directives (e.g. Habitats Directive and Water Framework Directive). Under the Environment (Wales) Act (2016), harm cannot come to EMS sites or the habitats they support; however, the implications for these sites in a post-Brexit UK are currently unknown and will require close monitoring over the coming months and years following the triggering of Article 50. Given the current state of uncertainty and potentially significant change to policy and legislation within the UK's environmental governance system, now is a crucial time to initiate a reassessment of our approach to natural resource management and policy. Wales has initiated this process by embedding integration and holistic legislation into their policy landscape; an approach which could prove to be a useful blueprint for the remaining UK devolved governments.

## 7. Concluding comments

This paper aimed to examine the level of consideration given to saltmarsh related ecosystem services, benefits and processes within five key policy drivers in Wales. The review found there to be limited specific mention of these in the Acts, identifying a potential gap in the application of the ecosystem services concept at a high policy level in Wales. Additionally, this review has highlighted the complexity of the existing governance landscape through cross-references to other legislative guidance in each of the five Acts. In addition to this new suite of legislation in Wales, coastal managers must consider a myriad of

governance guidance, including both statutory and non-statutory documents. This complex web of governance makes it difficult to accurately assess effectiveness of the instruments and their implementation. However, it is increasingly evident that understanding how ecosystem services are considered within this governance landscape would contribute to the development of more effective management, and could, for example, support marine planning processes [35].

As stated by Fletcher et al. [25], the seas and coastlines of the UK are too intertwined with each other and with those of wider Europe for devolved governance approaches to operate in isolation. If Wales, and the UK as a whole, are to have governance instruments that are effective in their inclusion of ecosystem services, including those supported by cross border systems, devolved legislation in Wales, Scotland and Northern Ireland will need to be complementary. The new Welsh legislation provides an innovative and aspirational blue print for future natural resource governance; however, it remains to be seen how this will be implemented and whether the positive changes expected will be realised. For saltmarshes particularly, their position on the coastal fringe places them firmly within the land-sea interface; the integrated approach advocated by the new Welsh legislation should ensure saltmarsh ecosystem services are sufficiently considered within both marine and terrestrial planning, and furthermore, should seek and support complementarity across the two governance and planning systems to ensure the aspirations of this new legislation are met.

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