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A stakeholder-informed framework for the sustainable management of coastal lagoons in West Africa

K. S. Davies-Vollum[1*], S. Puttick[2], A. Agyekhumene[3], T. Amolegbe[4], I. Aneyo[5], I. Boateng[6], A. Danby[7], E. Yeboah Danso-Wiredu[8], G. Degbe[9], F. Doherty[4], S. Hemstock[10], S. Mitchell[11], D. Raha[12] and Z. Sohou[9]

Abstract

Coastal lagoons are highly susceptible to the impacts of climate change. In lagoons of the Global South development challenges and growing coastal populations compound climate stressors to create complex inter-connected problems that cross social, economic and environmental boundaries. The successful governance of lagoons thus requires multidimensional approaches that combine disciplines and incorporate multiple knowledges. A stakeholder informed management framework was developed for West African lagoons using a transdisciplinary and participatory approach. A network of researchers from across the region, collectively known as the Resilient Lagoon Network, facilitated participatory platforms for stakeholders to share their experiences of the stressors facing lagoons and their management. Participants were from academia, government organisations, NGOs, traditional authorities and coastal lagoon communities. The information acquired enabled an understanding and relative importance of the challenges facing lagoons as well as what constituted good management practice and an appreciation for the breadth of lagoon stakeholders. From this information a framework was created comprising three strands that outlined the "what, how and who" of sustainable lagoon management. The "what" consists of a series of social, economic, environmental and governance indicators, linked to the sustainable development goals, that provide a checklist for lagoon sustainability. The "how" outlines tenets of good governance with an emphasis on equity, participation, cooperation and open communication. The "who" maps the range of possible lagoon stakeholders. The framework has been sense tested with lagoon practitioners and made available across the region. Although based on the experience of West African lagoon stakeholders, it could be used to inform the management of lagoons across the Global South.

Keywords Coastal management, Lagoon, West Africa, Sustainability, Stakeholder

*Correspondence:
K. S. Davies-Vollum
Sian.Davies-Vollum@Northampton.ac.uk
[1] Faculty of Arts, Science and Technology, University of Northampton, Northampton, UK
[2] Department of Education, University of Oxford, Oxford, UK
[3] Department of Marine and Fisheries Science, University of Ghana-Legon, Accra, Ghana
[4] Department of Biological Science, Environmental Biology Unit, Yaba College of Technology, Lagos, Nigeria
[5] Department of Zoology, Ecotoxicology and Conservation Unit, University of Lagos, Akoka, Nigeria
[6] Faculty of Business Education, Akenten Appaih-Menka University of Skills Training and Entrepreneurial Development, Kumasi, Ghana
[7] Environmental Sustainability Research Centre, University of Derby, Derby, UK
[8] Department of Geography Education, University of Education Winneba, Winneba, Ghana
[9] Institut de Recherches Halieutiques et Océanologiques, Cotonou, Benin
[10] Themba Trust, Uxbridge, UK
[11] School of Civil Engineering and Surveying, University of Portsmouth, Portsmouth, UK
[12] International Business School, University of Lincoln, Lincoln, UK

1 Introduction

Lagoons are dynamic aquatic environments found globally at low-lying coastlines at the nexus between land and ocean. They are defined as "sea water bodies situated at the coast but separated from the sea by land spits or similar land features…and open to the sea in restricted spaces" (UNSD 2006). They are diverse and they vary in size, shape, biota and water chemistry as well as the nature of their connection to the ocean. They support high biodiversity and high primary productivity (Danovaro and Pusceddu 2007). Lagoons provide ecosystem services that provide cultural, environmental, economic and social benefits (Rodrigues-Filho et al. 2023) which are essential to surrounding communities. Many lagoons include wetlands that act both as a carbon sink and as natural protection for the coastline (Blankespoor et al. 2014). Coastal lagoons have been identified as a "hot spot of global change" (Newton et al. 2014). Of critical importance is the shared vulnerability of lagoons to the impacts of climate change (Sanchez-Arcilla et al. 2016). Rising sea levels, changes in weather patterns and the incidence of extreme weather events contribute to coastal erosion and flooding as well as altering the natural hydrological and ecological cycles of a lagoon (Brito et al. 2012).

Lagoons can be found along many coastlines in the Global South. The communities that live around them face anthropogenic challenges common to many coastal settlements: population growth, unplanned development and resource management (Hauer et al. 2019; Diop et al. 2014). These conditions result in multiple, interconnected stressors that act to hinder the sustainability of lagoons and their associated communities. Poor water quality, lack of sanitation, resource depletion, urban fragmentation and limited waste management present challenges to the communities that are reliant on coastal lagoons (Davies-Vollum et al. 2024). These development challenges are compounded by the impacts of climate change, which lagoons experience as coastal inundation, loss of land by erosion, and the degradation of ecosystems and natural resources (Davies-Vollum et al. 2021). Addressing these intertwined, complex challenges and stressors requires interdisciplinary approaches that integrate concepts, frameworks, study design, methods and skills from multiple disciplines (Tobi and Kampen 2018). Using such an interdisciplinary approach enables connections between the complementary analytical lenses of social, economic and environmental knowledge that is necessary for the management of coastal communities and their environments (De Miranda Grilli et al. 2019; Berkes 2015).

West Africa was selected as a regional case study for the development of a framework to underpin the sustainable management of coastal lagoons. Its low-lying coastline is dominated by lagoons with more than 200 of them extending from the Niger delta to Senegal (Fig. 1).

Commonalities of lagoons across the region support a holistic approach to their management. Lagoons in the region provide a breadth of ecosystem services and essential resources to the coastal communities that live around them, many of which depend on lagoons for livelihoods and food security (Koomson et al. 2022). Mangroves are the predominant lagoon vegetation, providing not only a carbon resource but also natural coastal protection (World Bank 2023). Lagoons contribute approximately $3 billion annually to West African economies through the ecosystem services they supply (Boateng 2018). Fishing is a key activity providing job and food security to lagoon communities in the region as well as contributing to the regional economy with lagoon fisheries recognized as contributing more than $400 million annually (USAID 2014). West African lagoons are the locus of some of the most rapidly growing and economically important cities on the continent. Nearly half of Ghana's population lives along the lagoon-dominated coastline with highest population density in the capital, Accra (Ghana Statistical Service 2021). Nigeria's largest city, Lagos, sits on the shores

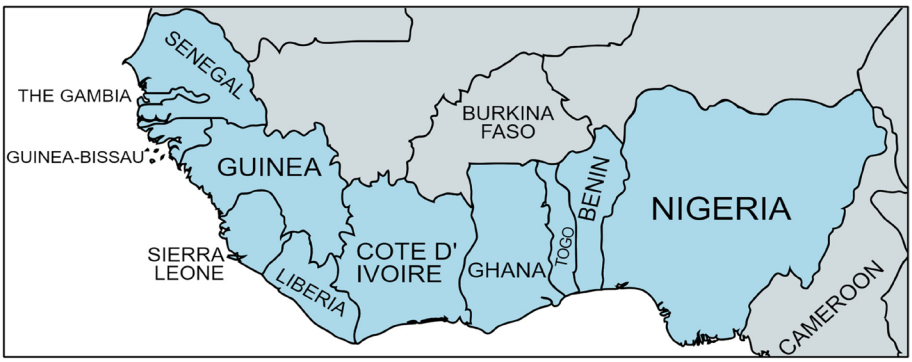

Fig. 1 Map of coastal West Africa

of the Lagos lagoon. Population growth in this mega-city is approximately 3% per year and it is estimated that two thirds of these live in unplanned, informal settlements (Osanyintuyi et al. 2022). Cote D'Ivoire's economic hub and main port is built around the Ébrié Lagoon, with over 90% of the country's industry located there (Coulibaly et al. 2018).

Despite the significance of lagoons in the region, management that supports their sustainability is lacking. Top-down policy has failed to reach lagoons and the needs and activities of lagoon communities have not been adequately linked to policy and decision making (Takyi et al. 2022). There are some examples of participatory approaches and of the inclusion local stakeholders in lagoon governance but these approaches have not been successfully adopted across the region (Davies-Vollum et al. 2024). Frameworks can provide guidelines and principles to link national policy to local practice and enable bottom-up approaches and local knowledge to be embedded in the management of lagoon environment but they do not exist. Here we present a novel framework that can inform the management of coastal lagoons in West Africa and bridge the gap between coastal policy and how it is enacted. We also provide an authentic account of how the framework was established using a collective intelligence, interdisciplinary perspective and transdisciplinary approach that emphasised stakeholder input and lived experience. We define a transdisciplinary approach as one that is founded on the participatory co-creation of knowledge (Raha et al. 2024).

2 Methods

The development of the stakeholder informed framework took a transdisciplinary approach. It was based on the lived experiences of stakeholders from lagoon settings in Benin, Ghana and Nigeria. Key lagoons were Muni lagoon (Ghana), Lagos lagoon (Nigeria) and Lake Nokue (Benin). This approach was enabled by the formation of a network of researchers from across the region, the Resilient Lagoon Network. The Resilient Lagoon Network (RLN) was established through a GCRF (Global Challenges Research Fund) networking grant and is built on a multinational and multidisciplinary ethos. Founding members of the network were drawn from academics and practitioners from Ghana, Nigeria, Benin and the UK with a range of disciplinary backgrounds including ecology, ecotoxicology, oceanography, geoscience, sociology, human geography, education and civil engineering. It was formed to bring together coastal researchers from West Africa and the UK to develop a multi-disciplinary network that focused on understanding and addressing the challenges facing lagoon communities in West Africa. The network has united researchers, practitioners and stakeholders to help understand the problems facing West African coastal lagoons and the communities they support and it provides a platform to share expertise, experiences and good practice for building resilience in coastal communities.

The over-arching goal of the network was to develop a framework for the sustainable management of coastal lagoons that could be used across the region. The framework is intended to provide guidance to help develop governance structures and assist with sustainability-focused decision-making in the management of lagoons. Its development took place over a period of 18 months spanning 2022–23 and was informed by the research of the members of the RLN, experiences of practitioners from NGOs, and the lived experience of lagoon stakeholders. Part of the network's work builds on long-standing research collaborations that provide a stronger sense of collaboration and participation in the work, while also acknowledging the shifting nature of participatory research relationships (Armstrong et al. 2023). To help ensure that the framework addressed the real needs of lagoon stakeholders and reflected their lived experience the network provided a participatory platform for stakeholders to engage via online and hybrid stakeholder events that were supplemented by an online survey. The aim of these extended conversations and interdisciplinary collaboration was designed to develop 'shared understandings and intellectual coherence' (Hasan et al. 2023, p.2) or 'collective intelligence' (Woolley et al. 2010) into these complex management challenges. The first stakeholder conference and associated survey took place virtually in March 2022. This was followed by the second (hybrid; in person and online) stakeholder conference held in Ghana in July 2022, and an online practitioner's focus group in November 2022. The knowledge produced through these events, supported by the pre-conference survey formed the basis upon which the framework was established.

The first stakeholder conference aimed to share, and think across, multiple perspectives on the current state of lagoons and the main issues facing them and the communities they support. Using a range of policy, academic, practice and community networks and mailing lists, invitations were extended to a wide variety of stakeholders across the region and internationally. There were 48 participants, including; researchers, NGOs, practitioners, members of traditional authorities and lagoon communities. The exact nature of traditional authorities varies across the region but these are essentially indigenous leaders and the tribal groups they represent who have an identity that is often deeply connected to lagoons. These traditional authorities see themselves as local custodians of lagoons and use their indigenous knowledge to

provide stewardship and management (Davies-Vollum et al. 2024). Countries represented were Ghana, Nigeria, Benin, India and the UK. All participants were invited to complete a pre-conference survey. Questions in the survey focused on identifying the most important challenges faced by lagoons (Table 1) and suggestions for dealing with these challenges. Nearly half of all participants (Twenty-two) completed responses to the survey, which were collated online and analysed. Respondents were mainly academic researchers, environmental managers and practitioners from government organisations. Discussion during the conference was guided by broad over-arching questions that asked stakeholders to reflect on the challenges faced by lagoons and their surrounding communities, and on how resilience to these challenges could be enhanced (Table 1). They were also asked about the impacts of climate change on lagoons and how those impacts might be addressed. Common themes from the conference discussion were noted and collated for analysis. These notes were in some sense made as minutes of some of the conversations that took place during the conferences, and in another sense might be seen as fieldnotes being created while we also participated in the conferences. Understanding these notes as fieldnotes points towards the role they played in analysis. That is, they are not 'raw' data, but instead, 'we are aware of the analytical' in fieldnotes: 'analysis is a feature of note taking' (Jones 2024).

The second stakeholder conference took place in Ghana. It was part of a hybrid event that included a stakeholder discussion, sharing of best practice from three lagoons and field visits to lagoons. A diverse range of participants were present, representing a variety of different connections to lagoons. Those who attended in person included local leaders with responsibility for governance, representatives from the Ghanaian Forestry Commission (who oversee management of specific protected lagoons), stakeholders from the Muni lagoon in Winneba (including representatives from indigenous groups), coastal researchers from the RLN and coastal researchers from other institutions in Ghana. Those participating virtually included researchers from West Africa and the UK, and coastal practitioners and representatives from NGOs in Benin, Nigeria and Ghana. Key questions were developed from the information garnered in the March stakeholder meeting. These questions guided the discussions on development of a management framework and included key indicators to measure the resilience of a lagoon, as well activities for sharing awareness, good practice and knowledge from lagoons around the region (Table 1). The responses to these questions from those attending in person and virtually were logged. Practitioners from the Lagos (Lagos lagoon waterkeepers NGO), Bouche de Roy (Eco-Benin NGO) and Muni (Ghana Forestry Commission) lagoons shared their lived experiences of managing the challenges of lagoons in the region. Members of the RLN also participated in visits to the Muni, Fosu and Benya lagoons to see at first hand the status of lagoons in Ghana and provide comparisons with lagoons from their own locales. The members of the RLN then met to collaboratively review and undertake a thematic analysis (Williamson et al. 2018) of all data collected. This analysis crystallised the main themes emerging from the March and July conferences, and informed both the main dimensions of the framework, and the substantive content within these dimensions. The draft

Table 1 Questions used at stakeholder conferences (March 2022, July 2022)

First stakeholder meeting (March 2022)
Are the challenges faced by lagoon environments the same as other coastal environments? If different then why/how?
What are main problems facing lagoon environments and communities?
Is climate change a problem for lagoons? If so, how do we deal with the impact of climate change on coastal lagoons?
How can we build more resilient lagoon communities?
Second Stakeholder meeting (July 2022)
How can we measure success in lagoon management?
What are the features of a resilient lagoon?
What are the key indicators of good condition in a lagoon?
What data are we mostly interested in?
What are the key indicators of good practice in lagoon management?
Can we identify areas of good practice in lagoon management?
What have we learned about stakeholder engagement?
How can we raise awareness of the importance of resilient lagoons?
How can we share best practice among different lagoons in the region?
What can we learn from the lagoons we already know about to generalize our understanding of Lagoons in West Africa?

framework was developed collaboratively with members of the RLN, and then in dialogue with a wider group of stakeholders and practitioners to maximise the relevance and usefulness of the framework to those actively managing lagoons. Practitioners from three lagoons from each of the three West African countries represented by the RLN reviewed the draft framework and their comments and suggestions were developed through an online focus group. All activities were reviewed and approved by the University ethics committee of the lead author.

3 Results

3.1 Network knowledge

Collecting researcher experiences from members of the RLN brought out the economic, industrial, historic and cultural importance of lagoons and their significance for urban and rural coastal communities in the region. It also enabled an initial identification of the diverse range of challenges that threaten the sustainability of lagoons in West Africa. The key drivers for the challenges were identified as population growth, resource use and climate change. Key challenges were established around themes of the impacts of climate change, limited waste management, poor sanitation and water quality and unsustainable resource use.

3.2 Survey results

Full results of the survey are provided in Supplementary Material 1. The survey revealed that the impacts of climate change were ranked as the most important challenge facing coastal communities. Health, sustainable livelihoods, maintenance of biodiversity (especially mangroves) and water quality were also placed highly. Energy poverty and the growth of coastal settlements were ranked of least importance. National governments and coastal communities were considered most important stakeholders in finding solutions and strategies for coastal sustainability. Solutions suggested to enhance the resilience of coastal communities were wide-ranging but can be broadly grouped into enforcement of national policy and laws, coastal planning and management, collaborative working between stakeholders, empowerment of and capacity building in communities, regulation and monitoring of waste and pollutants, protection from climate hazards, and conservation and natural resource management.

3.3 Conference one

Key points that came out of the conference discussion were collated into four themes around governance, challenges, solutions and needs. Discussions related to governance focused on the need to include stakeholders in collaborative and holistic approaches, the importance of traditional knowledge and the current lack of planning and coordination. Population growth at the coasts and unplanned urbanisation resulting in anthropogenic impacts was identified as being of most concern/importance. Specific challenges noted are listed in Table 2 themed around waste, hazard management, water quality and sanitation, and hydrology. Possible solutions suggested included the use of nature-based solutions, better waste management (particularly for plastics), improved recycling, a better understanding of the circular economy, and the use of buffer zones for lagoons. The role of environmental education was emphasized, not just in schools but through community workshops, with the importance of the delivery of these in local languages highlighted. Needs identified were capacity building and education as well as training to support the circular economy and funding to support initiatives. The information gleaned from this workshop and survey informed the approach of the second conference and contributed to the development of the management framework.

3.4 Conference two

Responses to the questions posed during the second conference (Table 1) raised three main questions, summarised as the "What, How and Who" of managing lagoons.

Table 2 Challenges facing lagoon communities as identified in conference one

Waste	Plastic waste (including micro-plastics)
	Behaviour and attitudes to waste (cultural practices)
	Land-based sources of waste
Hazard management	Flooding
	Storm waters
Water quality and sanitation	Eutrophication
	Poor sanitary practices (especially open defecation)
Hydrology	Changes to lagoon watersheds
	Dredging/sand winning
Biodiversity	Ecosystem degradation

These broad areas underpinned the development and structure of the lagoon management framework. These questions were:

1. What are the key indicators of a sustainable lagoon?
2. How do we govern lagoons to ensure their sustainable future?
3. Who needs to be included in and informs the sustainable management of lagoons?

Discussion of what a lagoon in a "good condition" would look like led to the development of a series of key indicators to understand the sustainability status of a lagoon. The indicators mirrored the key challenges previously established from conference one and included education, livelihoods, health, institutional frameworks, planning and policy, natural resource management, biodiversity, water quality and hydrology. The need for governance that embodied participation, cooperation and coordination became clear from discussions about how lagoons could be best managed. The sharing of good practice to support sustainable lagoon management surfaced a set of inclusive and equitable approaches that informed the establishment of approaches to lagoon governance. The importance of stakeholder involvement was emphasised in discussions of governance and the need to understand who might comprise lagoon stakeholders led to the development of a stakeholder map. From the three questions and the outcomes of the resultant discussions, three distinctive and tangible strands of a management framework emerged: the key indicators of a sustainable lagoon; the tenets of sustainable lagoon governance; and a map of lagoon stakeholders. A draft framework with these three strands was then created to share with a practitioner focus group.

3.5 Practitioner focus group

The practitioner focus group scrutinised the draft framework, critically discussing the extent to which it suitably covered measures of lagoon condition, best practice in lagoon governance and the breadth of lagoon stakeholders. This diverse group were positive about the overall structure and focus, and there was strong support for the dimensions proposed. Suggested amendments focused on developing further guidance relating to lagoon governance. Practitioners noted the importance of transparency in decision making and the blocker of unwieldy and protracted administrative processes. This resulted in additions to the governance strand of the framework.

4 Lagoon management framework

The management framework was finalised with three strands, which can be viewed individually but are interconnected and should ideally be considered in connection with each another. Each strand was developed as a visual guide (Figs. 2, 3 and 4) to enable clear conceptualisation and ease of use. The framework was launched at an online event to which those involved with its development were invited and it has been disseminated for use via the Resilient Lagoon Network website.

4.1 Strand one: key indicators of sustainable lagoon

The first strand of the framework relates to the key indicators of sustainable lagoons. Much of the experiences shared by stakeholders during information gathering were framed around problems and challenges faced. We have considered how these challenges can be reframed to understand what indicators should be used to assess sustainability. The resultant indicators are presented as 16 characteristics and/or aspects of a lagoon and its surrounding communities and are divided into governance, social and economic, and environmental aspects (Fig. 2).

The indicators and their associated challenges are driven by three over-arching key drivers of climate change, growing coastal populations and resource use. The terms functioning and effective are used in key indicators. Here functioning is used to denote working ecological and hydromorphic systems without barriers to essential biological and hydrological process. The term effective is used to denote processes and structures in

Fig. 2 Key indicators of lagoon sustainability

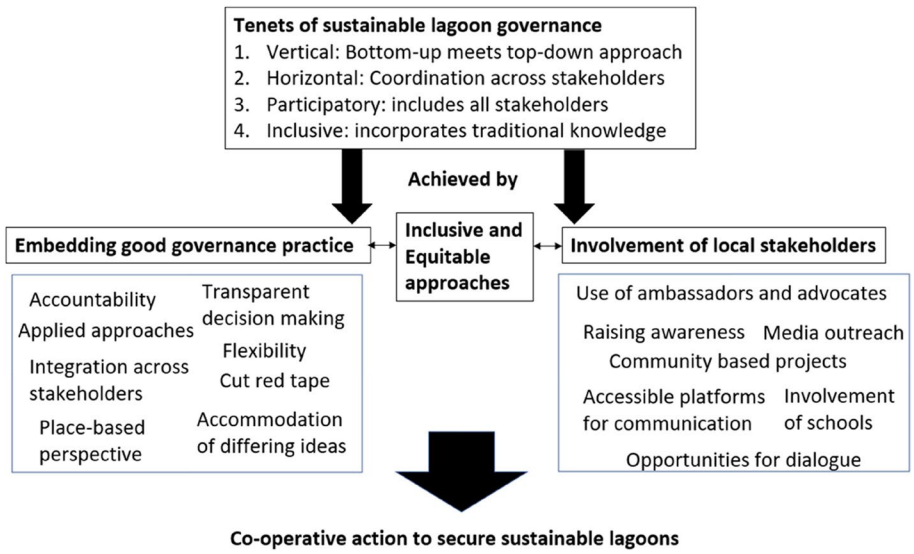

Fig. 3 Tenets of lagoon governance

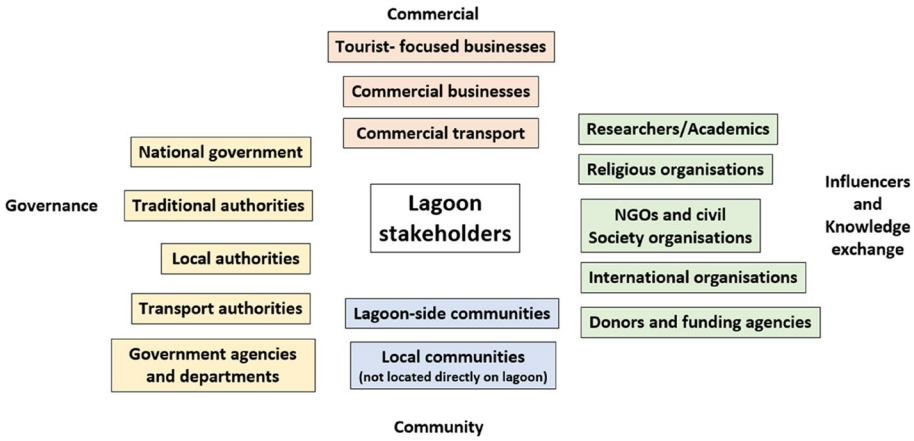

Fig. 4 Lagoon stakeholders

place that produce the desired result. To provide broader context and assist with establishing linkages between indicators that can support management prioritisation we have connected each indicator to one or more of the United Nations Sustainable Development Goals (Table 3). Linking key lagoon indicators to the SDGs also enables connection to a set of global targets and indicators that can support target setting on a local management level.

4.2 Strand two: tenets of lagoon governance

The second strand of the management framework establishes the tenets of lagoon governance and provides practices for achieving these (Fig. 3). Four tenets of lagoon governance are set out that are founded on inclusive, equitable and participatory processes. Coordination across stakeholder groups as well as between users and those with responsibility for governance (bottom-up meets top-down) is emphasised. The necessity for management that incorporates the perspectives of all stakeholders and which facilitates knowledge exchange, cooperation and communication between them was a recurring theme in conferences. The concept of good governance here is based directly on the lived experience of the stakeholders, as shared in the conference and focus group, and what stakeholders perceived as good governance practice. Governance that is transparent and accountable with applied and flexible approaches, and which takes into consideration the different need and ideas of stakeholders is stressed. A range of ways to

Table 3 Indicators of sustainable lagoons mapped against the UN-SDGs

Key indicators of sustainable lagoons	Aligned to UN-SDGs
Governance	
Effective and integrated institutional framework	16
Involvement of local stakeholders	10, 17
Inclusion of indigenous knowledge	10, 17
Effective planning systems	11, 16
Social and economic	
Food security	2
Sustainable livelihoods	1, 3, 7, 8
Access to healthcare and wellbeing support	3, 5
Effective sanitation systems	6, 14, 15
Functioning ecosystem services	12, 13, 14, 15
Provision for environmental education	4
Environmental	
Water quality	3, 6, 14
Functioning ecosystems	6, 13, 14, 15
Biodiverse	12, 14, 15
Functioning hydromorphology	6, 13
Sustainable resource use	11, 12, 14, 15

involve stakeholders are incorporated into the strand, including platforms for dialogue and communication, school and community-based projects, use of ambassadors and advocates, and outreach through media.

4.3 Strand three: stakeholder mapping

The third strand of the framework is a mapping of lagoon stakeholders. The mapping provides suggestions for who might potentially be considered lagoon stakeholders to ensure consideration is given to all interested parties. It includes the roles of all those who participated in the network events or that were suggested by participants as potential stakeholders. Stakeholders are divided into four interest groups: governance, commercial, community, and influencers and knowledge exchange (Fig. 4). The influencers and knowledge exchange interest group is diverse and may include local, regional, national and international stakeholders. It encompasses those championing knowledge exchange as well as those who may have direct influence on other stakeholders. The role of religious organisations in decision making in the region is recognised in this aspect of stakeholder mapping.

5 Discussion

5.1 Use of the framework

The lagoon management framework is a conceptual structure intended to serve as a guide that outlines best practices and operating principles for the governance of West African coastal lagoon environments and the communities that live around them. It draws on the multidisciplinary and holistic ethos of classic integrated coastal zone management (ICZM), setting out which indicators to consider in managing a lagoon for sustainability, how management is best approached and who might be involved in that management. However, in contrast to ICZM (Forrest 2006), it takes a distinctly human-centred approach developed from stakeholder experience and establishes indicators for lagoon sustainability that cut across socio-economic, environmental and governance facets. This is significant as there has been a policy gap in the region where top-down approaches have failed to meet the needs of lagoon environments and communities (Davies-Vollum et al. 2021). The framework addresses socio-economic and environmental factors with climate change, coastal population growth and resource use noted as key drivers of change.

The challenge of combining the societal and environmental in coastal zone management has been highlighted previously. Christie (2011) stressed the need for interdisciplinarity in the management of coastal environments with social dimensions valued equally to ecological dimensions. García-Ayllón (2017), working specifically at coastal lagoons, noted the complex nexus of human activities and the natural environment and suggested the integrated analysis of lagoon indicators. Sousa and Alves (2020) opined that the inclusion of broad-ranging ecosystem services were integral to managing and planning at coastal lagoons in Portugal. The DSPIR (Atkins et al. 2011; Gregory et al. 2013) and subsequent DAPSI(W)R(M) (Elliot et al. 2017) frameworks have been used as a tool to analyse, understand and manage change in complex socio-ecological systems. These frameworks are not specific to lagoons but have been used to consider their management in Europe (Newton et al. 2014), North Africa (El Mahrad et al. 2020) and Ghana (Takyi et al. 2022).

Not all lagoons are created equally and the application of the framework will vary, with no one approach working for all. The main challenges facing lagoons in the region are similar: population growth and development, resource use, and the impacts of climate change. The derived lagoon indicators for sustainability (Fig. 2) cover the breadth of the United Nations Sustainable Development Goals (Table 3). Deciding which indicators should be prioritised will depend on the situation and status of a specific lagoon. A place-based perspective is needed, which recognises and understands the differing characteristics of lagoons and the needs of their stakeholders. Mensah (2019) advocated using situational analysis when prioritising resource allocation for management of the Benya lagoon in Ghana. Dada et al. (2021) considered

the complexities of the social and ecological aspects in West African coastal systems and used a scenario process to understand the implications of selecting different management paths. Such approaches could be used in combination with the lagoon management framework to support decision-making.

5.2 Approaches to governance

The co-created participatory approach taken to develop the framework mirrors the tenets of good governance that emerged in developing the framework (Fig. 3). Participation and inclusiveness are key features with both vertical and horizontal collaboration across stakeholders identified (Fig. 3). Creating stakeholder networks with connectivity and coordination between groups facilitates such collaboration. Establishing stakeholder networks with shared goals has been shown to be critical to achieving participatory management in Mediterranean lagoons (Ballarini et al. 2021) and in Vietnam local management bodies and associations were formed to successfully co-manage resources at lagoons (Van Tuyen et al. 2010). Such approaches eschew the top-down coastal governance that has been common in West African coastal management (Davies-Vollum et al. 2021) and which hampers effective lagoon management. Participatory management will fail if it is not underpinned by equitable, accountable and transparent decision making. At Fosu lagoon (Ghana) participatory management has failed when communities have not been included in decision making (Armah et al. 2010) and at Avu lagoon (also in Ghana) the success of a community resource management area was compromised by decisions influenced by power struggles and inequities between stakeholders (Agyare et al. 2015; Ahmed and Gasparatos 2020).

Development of the framework took a transdisciplinary approach, bringing together academic and non-academic knowledge from a diversity of institutions, researchers, practitioners and lagoon users. The framework itself is also underpinned by a transdisciplinary approach highlighting the inclusion of traditional, local knowledge to inform lagoon governance, facilitated by taking a place-based approach that appreciates the specific characteristics of a lagoon. Baumann et al. (2023) argue that such transdisciplinary approaches and the co-production of transdisciplinary knowledge are critical to achieve sustainable futures in coastal settings. The importance of indigenous knowledge in managing West African lagoons has been previously reported (Koranteng et al. 2000; Darkwa and Smardon 2010; Sètondji et al. 2021). Whether it has been incorporated into local lagoon management strategies is unclear and the decreased spiritual significance of lagoons has resulted in the loss of indigenous management practices (Stoop et al. 2016) further inhibiting its incorporation into management practices. The need to capture the complexity of interests and voices of coastal users is reported by Clarke et al. (2013). Sharing knowledge amongst stakeholders is addressed through the inclusion of best practices in the provision of education, community advocacy and accessible platforms for dialogue and communication. The diversity of potential stakeholders (Fig. 4) supports the incorporation and accommodation of multiple perspectives and ideas, which reinforces the transdisciplinary nature of the framework.

5.3 Limitations and future work

There are a number of limitations to the stakeholder-centred approach used to develop the framework. As the framework was guided by stakeholders who participated in RLN events, its content was limited to their experiences and knowledge. However, having multiple opportunities and formats for engagement and discussion will have maximised the number and variety of stakeholders who were involved. Including lagoon community members who may have barriers to accessing the internet was difficult. Their inclusion was achieved by facilitating access to online events through the provision of shared internet connections. The attendance of local lagoon community stakeholders at the in-person conference in Ghana was facilitated by connections RLN members had to local communities. The involvement of coastal communities from Francophone countries in the region such as Benin and Côte d'Ivoire would have enhanced the framework but RLN connections at the time of this work were limited.

Although the framework was developed with a focus on West Africa, the human-centred approach central to its development and the three-strand model could be used in other countries and regions from the Global South. Coastal lagoons have been described from many locations including India (Santhanam et al. 2010), Brazil (Tavora et al. 2021; Tundisi and Matsumura-Tundisi 2001), Mexico (Mayer et al. 2018), Vietnam (Thanh et al. 2020; Thanh et al. 2021), and North Africa (El Mahrad et al. 2020). Thus, there is an opportunity for future work to view lagoon management through the lens of this framework developed in West Africa and to understand regional differences and country specificity in sustainability indicators, governance practices, and the type and diversity of stakeholders associated with lagoons.

6 Conclusions

Lagoons are a significant coastal environment encountered throughout the world. They are vulnerable to the impacts of climate change and, in the Global South, face additional development-related challenges. Their sustainable

management is complex, needing to address development and climate stressors while meeting the needs of multiple stakeholders and supporting communities reliant on lagoons for essential resources. Coastal West Africa provided the location for the development of a stakeholder-informed framework for the sustainable management of lagoons. Led by the Resilient Lagoon Network (RLN), a series of stakeholder events gave voice to a range of lagoon stakeholders from the region and facilitated dialogue between them. This approach enabled a shared understanding of the challenges facing lagoons and catalysed discussion about ways to address these. From listening to the various parties and making use of stakeholder narratives, a management framework emerged that advocates a coordinated bottom-up approach. The lived experiences of stakeholders helped to identifying the key environmental, socio-economic and governance indicators for lagoon sustainability; best practice for lagoon governance; and the range of possible stakeholders. The framework is human-centred with the needs of lagoon stakeholders at its core. This is significant as coastal management in the region has focused on top-down policy approaches that do not take into account the lived experiences of lagoon communities. Although the framework was developed in West Africa it has potential to be applicable to the management of lagoon environments across the Global South.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1007/s44218-025-00093-x.

Supplementary Material 1.

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Authors' contributions
KSDV (lead author) wrote the article with contributions from SP (second author). The members of the Resilient lagoon Network listed as co-authors participated in the research activities outlined in the article and contributed to the development of the lagoon management framework.

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Data availability
Data will be made available on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval for the research presented in this manuscript was obtained through the University of Derby Ethics Committee.

Competing interests
The authors confirm that they have no competing interests.

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