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Coastal cities governance in the context of integrated coastal zonal management: a sustainable development goal perspective under international environmental law for 'coastal sustainability'

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Literature on integrated coastal zonal management (ICZM) for coastal sustainability from a legal perspective provided significant measures. Recently, sustainable development goals (SDGs) have become a focus in ICZM literature, which establishes coastal goals and connects these goals with other goals. Although integrating coastal goals into ICZM under international law challenges the existing models presented in the literature, the comprehensive literature review (CLR) methodology is appropriate for observing the current literature and provides a way-forward for coastal goals. Therefore, through this research, a CLR on ICZM literature is conducted to observe how far SDGs are integrated for coastal sustainability. The CLR identified that coastal city governance is a pertinent part of ICZM, and the coastal goals are devised in the form of environmental goals of SDG – 14 (life below water). This CLR examines the anthropogenic connections of waste, sanitation, and emissions management and urban planning with coastal ecosystems under the ICZM system. For such purposes, governance tools of science-policy integration under international law and policy for sustainable development are utilized to form an obligatory framework. The CLR further provided coordination, adaptivity, monitoring, and capacity-building tools, which were utilized thoroughly throughout the literature and can be incorporated with the SDGs in a multilevel governance framework of ICZM. Throughout the study, international law formulating SDGs is pivotal to be transplanted successfully into the ICZM governance processes.

KEYWORDS

Integrated Coastal Zonal Management (ICZM), International Environmental Law (IEL), Sustainable Development Goal - 14 (SDG - 14), coastal cities governance, science-policy, legal framework

1 Introduction

The coastal areas (including coastal cities) serve as ecosystems between terrestrial and marine environments. Due to such transactions between ocean and land, coastal cities are impacted by pollution in both terrestrial and marine ecosystems. Atmospheric pollution (or climate change) is causing sea-level rise, which may lead to coastal flooding and ocean acidification (Caffyn and Jobbins, 2003). Moreover, due to such pollution, fisheries are under severe threat, and water quality in the oceans is deteriorating. This is mainly because of inefficient governance of waste and sewerage in coastal cities, which is a significant challenge for coastal sustainability (Caffyn and Jobbins, 2003). The coastal cities as ecosystems face different combinations of problems, but in particular, attention is given to the marine environment, fisheries preservation, and coral reefs (Gonzalez-Bernat and Clifton, 2017).

Albeit, in some ways, the ongoing tradeoffs between increasing population and the utilisation of more coastal regions question the sustainability of coastal cities (Sekovski et al., 2012). With this comes the need to address the governance challenges in the coastal cities. The differences in the aforementioned governance mechanisms are significant in coasts because collectively, such mechanisms affect the substance of what governance does, how governance actors do it, and what is governed for the sustainability of coastal cities (Cicin-Sain, 1993). In this scenario, governing coastal cities is complex, multiple, anthropogenic, and compoundable.

The latest Sustainable Development Agenda 2030 (also known as Sustainable Development Goals or SDGs) is helpful for the further development of Integrated Coastal Zone Management (ICZM) systems (Hutton et al., 2018). A legal framework under international law can be adopted to govern coastal cities to mitigate land-based and atmospheric pollution and operationalize the SDGs in the ICZM systems (Islam and Shamsuddoha, 2018). Most of the research in this context suggests that land-based pollution mainly emerges from the coastal cities in the form of waste, sewerage, and industrial effluents, and atmospheric pollution consists of contamination of air due to combustion engines (including motor vehicles, industry, and shipping) (Liang and Li, 2020).

A variety of literature exists on the impacts of coastal cities' governance on coastal sustainability with ICZM, governance, and management perspectives (Gonzalez-Bernat and Clifton, 2017). However, a smaller amount of literature exists on the legal perspectives of ICZM with SDG advancements. Perhaps one of the reasons behind such scarcity is the lack of legal (academic) experts on the subject of coastal, ocean, and marine environmental governance (Knecht, 1994). Therefore, this research adopted a comprehensive literature review (CLR) methodology to review the existing literature on SDGs and the legal perspective of ICZM. The literature collected indicates what needs to be done and how to empower ICZM with SDGs and legal perspectives.

The CLR methodology is adopted in the next section, providing a firm basis for operationalizing international law in the context of ICZM for coastal sustainability. The methodology initially defined 'coastal sustainability' in the context of governing coastal cities in ICZM systems, selection criteria of the CLR have been presented,

and selected research articles for this CLR are discussed in a manner that provided governance tools for evaluation of SDG – 14. The following sections take governance tools of science-policy, adaptivity, coordination, monitoring, and capacity-building as approaches in ICZM systems for coastal sustainability. Significant recommendations on international law and governance framework in ICZM systems for coastal sustainability follow the conclusion.

2 Methodology – CLR

A better method to achieve 'coastal sustainability' as a concept is the primary objective of this research. In this context, 'coastal sustainability' is defined in terms of Sustainable Development Goal – 14 (SDG – 14' life below water') (Zhang et al., 2023). The two coastal goals in SDG – 14 urged for sustainable management of coastal ecosystems to "avoid significant adverse impacts, including by strengthening their resilience, and act for their restoration, and conservation of at least 10 percent of coastal areas, consistent with national and international law and based on the best available scientific information" (Zulfiqar and Butt, 2021). The coastal goals in the context of SDGs invoke effective implementation of international law (Waldmüller et al., 2019). Therefore, the citing literature or articles are collected depending upon the relative significance of each of the governance mechanisms impacting the sustainable development of the coastal cities under ICZM systems and international law.

Given the above, the methodology of CLR has utilized the terminologies of governance tools repeatedly reflected in ICZM systems. The governance tools in terms of SDGs are directly related to Sustainable Development Goal – 17 (SDG – 17' peace, justice, and strong institutions') and SDG – 14 to develop a framework for ICZM under international law (Colard-Fabregoule, 2020). A coordinated, cooperative, and consistent method has been presented connecting two coastal goals as demonstrated in SDG – 14: protecting complex ecosystems (including marine, terrestrial, and atmospheric environments) (Final list of proposed Sustainable Development Goal indicators, 2016; Gupta and Nilsson, 2017; Bartram et al., 2018). ICZM and the governance of coastal cities form an interconnected governance that seeks a combination or cohesion of various governance mechanisms at diverse levels and hierarchies (Kardos, 2012). The cited articles are replete with data on anthropogenic interconnections of the SDGs related to the coasts and the driving forces in the identified governance mechanisms (Tait and Lyall, 2017).

While examining the articles on regional and national ICZM systems, it became apparent that the pressure of interdependence of numerous authorities requires an integrated but flexible governance mechanism (Teampău, 2020). It is necessary to take into account international and local authorities and stakeholders if the sustainability of the coasts is to be achieved (Eisma et al., 2005; White et al., 2006). This research aims to develop a governance framework of interconnected SDGs in the context of coastal sustainability, which is impacted by the coastal cities. Therefore, the following two sub-sections of this section provide search criteria, selected or citing articles, and interconnected SDGs with coastal sustainability and governance tools of ICZM. The search

criterion is well defined in the following subsection, which adopts various keywords related to ICZM, coastal sustainability, and governance of coastal cities. The results produced through the methodology and its application on ICZM systems paved the way for further discussion, and it was concluded that a legal basis through a legal framework under international law for the implementation of ICZM is an obligation.

2.1 Selection criterion

The literature on ICZM provides a flexible and real-time solution-based approach to the governance of coastal cities (Bin et al., 2009). ICZM recognizes that at national levels in any State, the policies are heterogeneous and rigid, which cannot be changed, and with thorough negotiations, a coordination mechanism can be developed to govern multiple authorities for sustainable development (Hatzioles, 1997). In this context, ICZM provides objectives with governance tools: coordination, monitoring, adaptivity, capacity building, law and policy, science and policy, and reporting and evaluation (Cicin-Sain et al., 1998).

The keywords initially employed in the search criteria (in the databases of Scopus and Web of Science) were 'law and policy' and 'science and policy' with 'ICZM' as a keyword/key term. After the initial search, it was analyzed that 'coastal sustainability' in the context of 'ICZM' and 'coastal cities sustainability' integrates the concepts of 'law,' 'policy,' and 'scientific knowledge' into one single framework for policy or rulemaking. Therefore, 'law and policy' and 'science and policy' concepts are integrated and applied in diverse forms such as 'ICZM for coastal sustainability,' 'governance of coastal cities,' 'law for ICZM,' and 'scientific information in ICZM.'

The selection process of the research articles is based on the governance tools provided by the ICZM. The literature selected with a search criterion of 'law' and governance tools of 'coordination,' 'monitoring,' 'adaptivity,' 'capacity building,' 'law and policy,' 'science and policy,' and 'reporting and evaluation' is presented in the ICZM systems repetitively (Nursey-Bray et al., 2014). Adding 'law,' 'sustainability,' and 'coasts' into ICZM

provides the dimensional literature of SDGs integrating with 'law,' 'policy,' 'governance,' and 'ICZM' (Tobey et al., 2010). After reviewing numerous articles, fifty-six were selected for this CLR based on keywords. In the context of ICZM, it was discovered during the CLR that the two search criteria, 'coordination' and 'adaptivity,' reflect the intertwined elements in the context of the law. Similarly, 'monitoring,' 'reporting' and 'evaluation' are organized horizontally and presented interconnectedly as core elements or ICZM under law. Therefore, the elements of ICZM were amalgamated as i) Coordination and Adaptivity, ii) Monitoring, Reporting, and Evaluation, and iii) Capacity Building to present the data in an improved format (Figure 1 and Table 1).

The primary reason for selecting and modifying the search criterion is to ensure that ICZM, law, and governance connect with coastal sustainability. The two coastal goals for sustainable development provide a requirement for novel means of governance in the context of ICZM. After thoroughly reading and analyzing various research articles, fifty-six were selected, and they discussed the multidimensions of ICZM for sustainable coastal development. From a legal perspective, only twelve articles are indicated through this CLR. In contrast, other articles identify complex challenges to the governance of coastal cities and their anthropogenic connections relating to SDGs.

2.1.1 Coordination and adaptivity

- 39 Articles analyzed coordination and adaptivity as the primary tool of ICZM;
- 42 Articles suggested that coordination and adaptivity are required for the sustainability of the coastal areas, including coastal cities;
- 11 Articles emphasized the importance of legal mechanisms for coordination and adaptivity in the context of coastal sustainability;
- 09 Articles suggested the operationalization of scientific information in the ICZM for coordination and adaptivity. As shown in Figure 2.

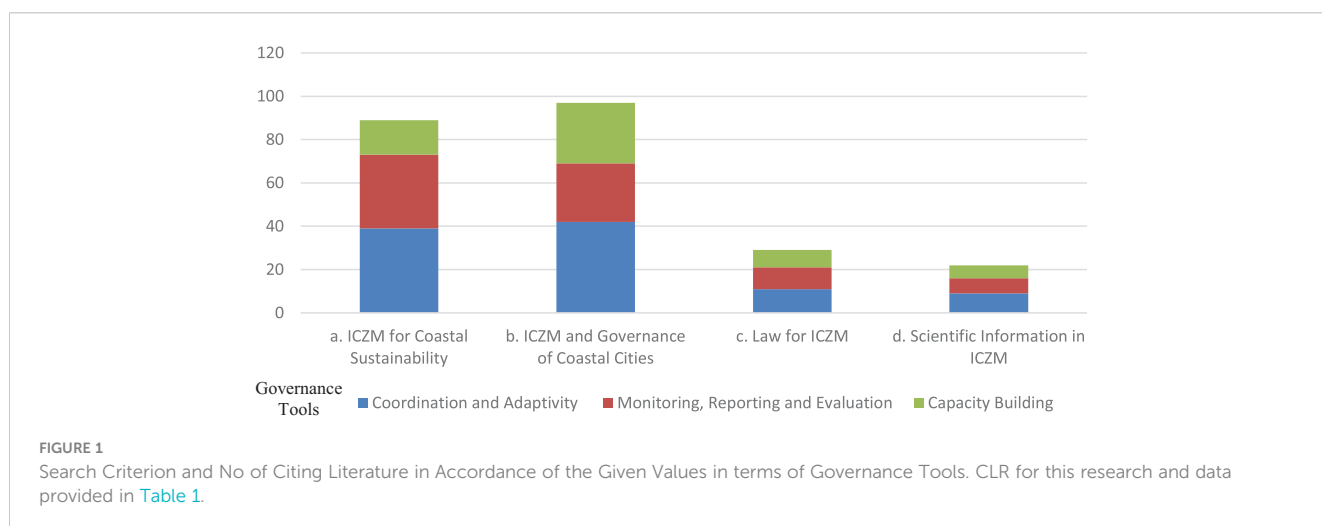


TABLE 1 Selected Literature for this CLR.

Sr no	Title	Journal	Year
1.	Implications of the Earth Summit for Ocean and Coastal Governance	Ocean Development & International Law	1993
2.	Implementing Agenda 21: oceans, coasts and the Barbados outcomes in the Pacific region	Ocean & Coastal Management	1995
3.	Canada's Atlantic Coastal Action Program: A community-based approach to collective governance	Ocean & Coastal Management	1997
4.	Considerations in Developing a Functional Approach to the Governance of Large Marine Ecosystems	Ocean Development & International Law	1999
5.	Using Stakeholder Decision-making Simulation to Teach Integrated Coastal Management	Journal of Geography in Higher Education	2001
6.	Governance Profiles and the Management of the Uses of Large Marine Ecosystems	Ocean Development & International Law	2001
7.	Governance Capacity and Stakeholder Interactions in the Development and Management of Coastal Tourism: Examples from Morocco and Tunisia	Journal of Sustainable Tourism	2003
8.	Indicators to measure governance performance in integrated coastal management	Ocean & Coastal Management	2003
9.	Improving science applications to coastal management	Marine Policy	2003
10.	Constructs of sustainability in coastal management	Marine Policy	2004
11.	Legal and Policy Dimensions of Coastal Zone Monitoring and Control: The Case in Ghana	Ocean Development & International Law	2004
12.	Integrated Coastal Management in Philippine Local Governance: Evolution and Benefits	Coastal Management	2006
13.	Network Governance and Policy Integration—the Case of Regional Coastal Zone Planning in Norway	European Planning Studies	2007
14.	Limits of governability: Institutional implications for fisheries and coastal governance	Marine Policy	2007
15.	The Role of Participatory Governance and Community-Based Management in Integrated Coastal and Ocean Management in Canada	Coastal Management	2007

(Continued)

TABLE 1 Continued

Sr no	Title	Journal	Year
16.	Principles for sustainable governance of the coastal zone: In the context of coastal disasters	Ecological Economics	2007
17.	Governing Coastal Spaces: The Case of Disappearing Science in Integrated Coastal Zone Management	Coastal Management	2007
18.	Facts, Fictions, and Failures of Integrated Coastal Zone Management in Europe	Coastal Management	2007
19.	Stimulating Vertical Integration in Coastal Management in a Federated Nation: The Case of Australian Coastal Policy Reform	Coastal Management	2009
20.	Fisheries and coastal governance as a wicked problem	Marine Policy	2009
21.	Overcoming Governance and Institutional Barriers to Integrated Coastal Zone, Marine Protected Area, and Tourism Management in Sri Lanka	Coastal Management	2009
22.	Governance of Marine Protected Areas in East Africa: A Comparative Study of Mozambique, South Africa, and Tanzania	Ocean Development & International Law	2010
23.	Assessing Progress Toward the Goals of Coastal Management	Coastal Management	2010
24.	Practicing Coastal Adaptation to Climate Change: Lessons from Integrated Coastal Management	Coastal Management	2010
25.	Megacities in the coastal zone: Using a driver-pressure-state-impact-response framework to address complex environmental problems	Estuarine, Coastal and Shelf Science	2012
26.	Integrated coastal zone management under authoritarian rule: An evaluation framework of coastal governance in Egypt	Ocean & Coastal Management	2012
27.	Implementing integrated coastal management in a sector-based governance system	Ocean & Coastal Management	2012
28.	Mobilising Knowledge for Coastal Governance: Re-Framing the Science–Policy Interface for Integrated Coastal Management	Coastal Management	2013
29.	Coastal and Ocean Governance in the Seas of East Asia: PEMSEA's Experience	Coastal Management	2013
30.	Enhancing the knowledge-governance interface: Coasts, climate and collaboration	Ocean & Coastal Management	2013
31.	The development of world oceans & coasts and concepts of sustainability	Marine Policy	2013
32.	England's evolving marine and coastal governance framework	Marine Policy	2014
33.	A sustainable development goal for the ocean and Coasts: Global ocean challenges	Marine Policy	2014

(Continued)

TABLE 1 Continued

Sr no	Title	Journal	Year
	benefit from regional initiatives supporting globally coordinated solutions		
34.	Queensland's Coastal Planning Regime: The Extent of Participation in Coastal Governance	Planning Practice & Research	2014
35.	Drawing a line in the sand: managing coastal risks in the City of Cape Town	South African Geographical Journal	2015
36.	Impact of maritime transport emissions on coastal air quality in Europe	Atmospheric Environment	2014
37.	The coproduction of knowledge and policy in coastal governance: Integrating mussel fisheries and nature restoration	Ocean & Coastal Management	2015
38.	Sustainable Coastal Science-Policy-Practice Interface Development: Municipal Coastal Governance Indicator System	International Journal of Environmental Science	2016
39.	The Baltic Sea as a time machine for the future coastal ocean	Science Advances - Oceanography	2018
40.	Analysing the legal framework of marine living resources management in Bangladesh: Towards achieving Sustainable Development Goal 14	Marine Policy	2018
41.	Defining the qualitative elements of Aichi Biodiversity Target 11 with regard to the marine and coastal environment in order to strengthen global efforts for marine biodiversity conservation outlined in the United Nations Sustainable Development Goal 14	Marine Policy	2018
42.	Mangrove management for climate change adaptation and sustainable development in coastal zones	Journal of Sustainable Forestry	2018
43.	Coastal and marine conservation strategy for Bangladesh in the context of achieving blue growth and sustainable development goals (SDGs)	Environmental Science and Policy	2018
44.	A capital approach for assessing local coastal governance	Ocean & Coastal Management	2019
45.	Examining linkages between ecosystem services and social wellbeing to improve governance for coastal conservation in Jamaica	Ecosystem Services	2019
46.	Managing coastal protection through multi-scale governance structures in Romania	Marine Policy	2019
47.	Land-sea interactions and coastal development: An evolutionary governance perspective	Marine Policy	2019
48.	Challenges and opportunities in promoting integrated coastal zone management in Algeria: Demonstration from the Algiers coast	Ocean and Coastal Management	2019

(Continued)

TABLE 1 Continued

Sr no	Title	Journal	Year
49.	The Marine Plan Partnership for the North Pacific Coast – MaPP: A collaborative and co-led marine planning process in British Columbia	Marine Policy	2020
50.	Transforming coastal and marine management: Deliberative democracy and integrated management in New South Wales, Australia	Marine Policy	2020
51.	Governance and the coastal condition: Towards new modes of observation, adaptation and integration	Marine Policy	2020
52.	Regional public policy for Integrated Coastal Zone Management in Central America	Ocean & Coastal Management	2020
53.	Multilevel governance of coastal flood risk reduction: A public finance perspective	Environmental Science and Policy	2020
54.	Using a resilience thinking approach to improve coastal governance responses to complexity and uncertainty: a Tasmanian case study, Australia	Journal of Environmental Management	2020
55.	Coordinated planning effort as multilevel climate governance: Insights from coastal resilience and climate adaptation	Geoforum	2020
56.	Building resilience to natural hazards through coastal governance: a case study of Hurricane Harvey recovery in Gulf of Mexico communities	Ecological Economics	2020

Authors' Search Criteria through Different Mediums (Web of Science and Scopus).

The selected literature analyzed is from 1993 to 2020 because the latest literature in the context of ICZM is still in development, and before 1993, the literature was almost obsolete. While narrowing down the selection of articles to observe the implementation of ICZM with governance tools, the following are the findings of this CLR:

2.1.2 Monitoring, reporting, and evaluation

- 34 Articles suggested vital means of monitoring, reporting, and evaluation mechanisms for effective ICZM;
- 27 Articles argued that without effective monitoring, reporting, and evaluation, coastal sustainability cannot be achieved;
- 10 Articles provide national and regional legal mechanisms for monitoring, reporting, and evaluation;
- 07 Articles recommend the integration of scientific knowledge in monitoring, reporting, and evaluation of policy mechanisms for sustainable coastal development. As shown in [Figure 2](#).

2.1.3 Capacity building

- 16 Articles suggested capacity building of the authorities for effective ICZM;
- 28 Articles suggested capacity building and training for coastal sustainability;
- 08 Articles suggested a thorough and professional transfer of legal and policy knowledge to authorities;

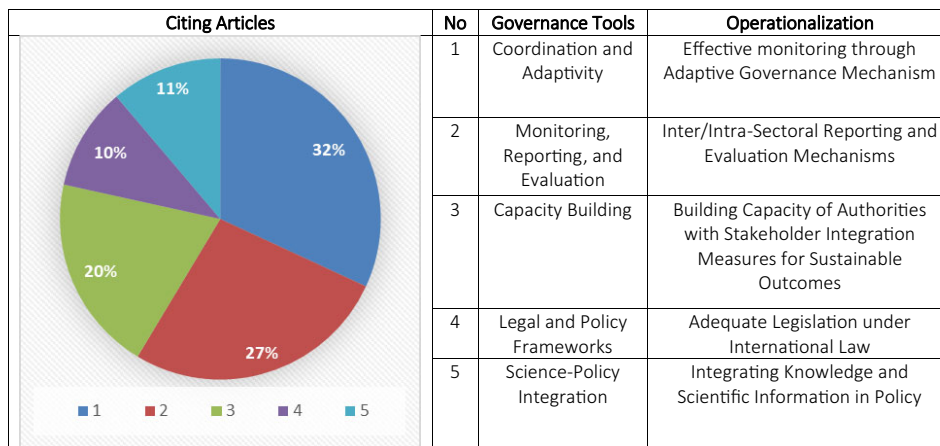


FIGURE 2 Governance Tools expanded through literature in terms of law, science, and policy integration. Various Citing Articles as mentioned in the Table 1 Interconnected SDGs in the Context of Coastal Sustainability.

d. 06 Articles suggested scientific integration into policy frameworks of various authorities for capacity building. As shown in Figure 2.

The governance tools provided in the citing articles connect the ICZM governance elements with those provided in SDG – 17 (Bisaro et al., 2020). Furthermore, the legal, policy, and scientific knowledge elements of ICZM connect with SDG – 14 (Visbeck et al., 2014). From a legal and policy framework perspective, most of the articles focused on national or regional governance dimensions with theoretical and normative methodologies. The list below provides a more precise articulation of the selected, researched, and analyzed articles in the context of SDG – 17 which provides means of implementation and revitalization of partnerships (or coherence among authorities) for sustainable development:

1. The core elements of coordination and adaptivity for coastal governance, as reflected in literature for policy coordination and coherence for sustainable development, are well presented in SDG 17.13 – 17.15 Waldmüller et al., 2019);
2. Monitoring, reporting, and evaluation are the tools effectively presented in SDG – 17.19 in terms of building on existing initiatives to develop measurements of progress on sustainable development (Zhu et al., 2021);
3. Capacity building for effective governance is highlighted in the literature, and SDG 17.9 also urged for enhanced international support for implementing effective and targeted capacity-building to implement all the Sustainable Development Goals (Olsen, 2010);
4. The legal and policy framework for ICZM is discussed in fewer articles but is well-articulated in SDG 14 (Islam and Shamsuddoha, 2018);
5. The articles on SDG 14 thoroughly stressed integrating scientific knowledge into policy or decision-making Hutton et al., 2018).

The citing articles also identify complex coastal problems and their anthropogenic connections relating to SDGs—the discontinuity between the interconnections among governance

mechanisms of coastal cities under the ICZM system (Dunning, 2020). The citing articles recognize that a crucial obstacle in the implementation of ICZM is often unidirectional dependencies on the coastal commons (Kim et al., 2020). While suggesting policy integration, the articles examine multiple dimensions impacting coastal sustainability, which include coastal goals, ocean goals, environmental goals, and governance tools (Jozaei et al., 2020).

The first coastal goal in SDGs is 14.2 for “prevention of coastal pollution,” which is intertwined with goals 14.1 and 14.2 of “protection of the marine environment” (Bisaro et al., 2020). Similarly, SDG 14.5, “conservation and preservation of coastal areas” under the “international law and based on the best available scientific information,” connects with SDG 14.a to “increase scientific knowledge, develop research capacity and transfer marine technology in order to improve ocean health and to enhance the contribution of marine biodiversity” and 14.c for “enhancement of the conservation and sustainable use of oceans and its resources by implementing international law” Caviedes et al., 2020).

Furthermore, this goal-based approach is interconnected with SDG – 6 on “ensure availability and sustainable management of water and sanitation for all” and SDG – 11 on “making cities and human settlements inclusive, safe, resilient and sustainable” (Final list of proposed Sustainable Development Goal indicators, 2016; Van Assche et al., 2020). SDG – 6.3 urges to “improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse,” and SDG – 11.6 urges to “reduce the adverse environmental impact of cities, including by paying special attention to municipal and other waste management” (Final list of proposed Sustainable Development Goal indicators, 2016; Brooks et al., 2022).

Similarly, the goal of coastal and marine conservation, as presented in SDG - 14.5, calls for mitigation and reduction of coastal flooding and ocean acidification (Diggon et al., 2022). This goal is primarily connected with SDG – 13 on “taking urgent action to combat climate change and its impacts,” SDG – 13.1 for “strengthening resilience to climate-related hazards,” and 13.b for

“effectively addressing climate change” (Khelil et al., 2019). The two goals in the context of coastal cities governance are attached to SDG – 11.6 on “reducing the adverse per capita environmental impact of cities by paying special attention to air quality” (Schlüter et al., 2020).

3 Analysis of CLR

While connecting the dots in the literature on ‘legal and policy frameworks’ and ‘science-policy integration for ICZM,’ new literature on ‘coastal sustainability’ and ‘SDGs for oceans and the coasts’ provides suggestions based on international environmental law (IEL) and United Nations Convention on Law of the Sea (UNCLOS) (United Nations Educational, Scientific and Cultural Organization, 1982; Väidianu et al., 2020). However, the concepts of “ICZM for coastal sustainability,” ‘ICZM for coastal cities,’ ‘legal-governance of coastal cities,’ and ‘science-policy integration in ICZM’ under international law and policy standards are not analyzed in a single context throughout the literature (Chan et al., 2019). The primary reason behind such paucity in the existing literature is the obsolescence of current ICZM practices (Hershman et al., 1999; McLaughlin and Cooper, 2010).

3.1 Literature review on ICZM systems

It has been identified in the literature that ICZM systems are limited to coastal development, and management is restricted to the management of coastal areas. The authorities governing coastal cities, climate, environment, waste, and sewerage perform their functions in ICZM systems with limited control and influence (Fletcher et al., 2011; Tabet and Fanning, 2012; Grech et al., 2013). While evaluating the expansion of ICZM systems as suggested in the literature, the findings suggest that current ICZM systems focus on one or another governance mechanism that may impact coastal sustainability directly or indirectly (Celliers et al., 2020). For example, the recent literature on ‘coastal sustainability’ from the ‘climate change’ perspective provides valuable suggestions for mitigation of ocean acidification, rising sea levels, and coastal flood risk (Chow, 2018). However, the literature provides suggestions that appear to be problematic while implementing ‘climate change’ within legal parameters (McFadden et al., 2009).

Furthermore, the findings of CLR identify various anthropogenic interconnections of ‘coastal sustainability’ and ‘ICZM’ with the development and governance of ports, shipping, traffic, climate, and coastal cities (Rees et al., 2018, p. 14). Such literature suggested that if the given governance mechanisms are integrated within ICZM, it will become a laborious system due to the interdependence of the authorities, conflicting interests, and utilization of power and knowledge (Cicin-Sain et al., 1998; Viana et al., 2014). Contrariwise, there are strong arguments supporting the development of new means of ICZM to address ‘coastal sustainability,’ ‘climate sustainability,’ ‘oceans sustainability,’ and ‘coastal cities sustainability’ through different scales of governance and innovative solutions (Reusch et al., 2018).

Preventing marine and coastal pollution requires adequate scientific knowledge, efficient research capacity, and effective marine

technology (Kudrenickis et al., 2016). As suggested through the literature, scientific knowledge is about ‘Science-Policy Integration for ICZM’ reflected in the ‘governance tools’ throughout the literature, as mentioned above and shown in Figure 3 (van der Molen et al., 2015). Furthermore, the coastal, ocean, and environmental goals require effective ‘legal and policy frameworks’ as provided under international law and presented in the literature for ICZM systems (Figures 3, 4). The goals-based approach of ‘coastal sustainability’ is well presented in SDGs 14.1 – 14.5, and the tools of ‘ICZM’ are suggested in SDGs 14.a and 14.b. Such development in literature evolved after 2010, as shown in Figures 3, 4 (Viana et al., 2014).

In the broad context, this goal means to “sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience and take action for their restoration and enhance the conservation and sustainable use of oceans and their resources” (Colenbrander et al., 2015). In the context of this CLR, the protection of coastal ecosystems requires the governance tools as mentioned above, and in applying these tools to the governance mechanisms, there shall be policy integration and institutional coordination between different authorities at different levels as provided below:

1. Municipal authorities governing waste and sewerage in coastal cities and marine environmental protection authorities, usually central or within the state/province (Colenbrander et al., 2015).
2. Motor vehicle control authority (at the central or provincial level), traffic management authority (at the district or local level), and climate change/atmospheric pollution control governing authority (at the central or sub-national level) (Zafrin et al., 2014).
3. Authorities governing fisheries, climate change authorities, and authorities governing coastal cities (Visbeck et al., 2014).

3.2 Literature review from the legal perspective of ICZM

Another question that arises through the analysis is how these authorities can be integrated under the current ICZM systems. In such a case, it can be argued that such arrangements in governance mechanisms are inorganic (Fletcher et al., 2014). On the other hand, this research argues that the structure is polycentric because ‘polycentric governance’ in ocean governance and marine environmental protection is a self-arranging pattern of authority. In terms of law, polycentric governance is organic, arranged under the law patterns for ‘sustainability.’ On the other hand, ‘coordination and adaptivity,’ ‘monitoring, reporting and evaluation,’ ‘capacity building,’ ‘legal and policy frameworks,’ and ‘science-policy integration’ as tools of ICZM are replete in adaptive governance under IEL (Stojanovic and Farmer, 2013). Therefore, vertical and horizontal integration of the authorities through multilevel governance can be formed to resolve the complex issues of ‘coastal sustainability’ observed while conducting this CLR (Morrison et al., 2017).

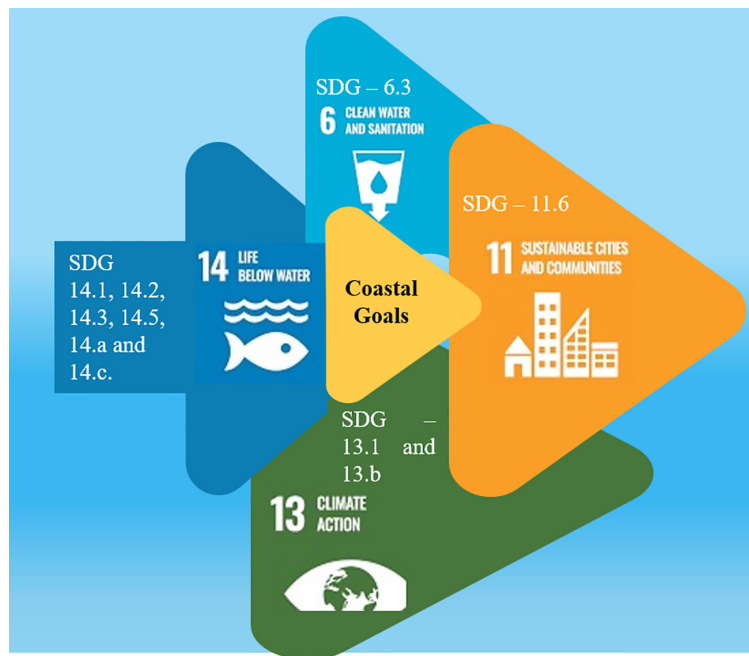


FIGURE 3 Interconnected SDGs with Coastal Goals. CLR and Discussion above.

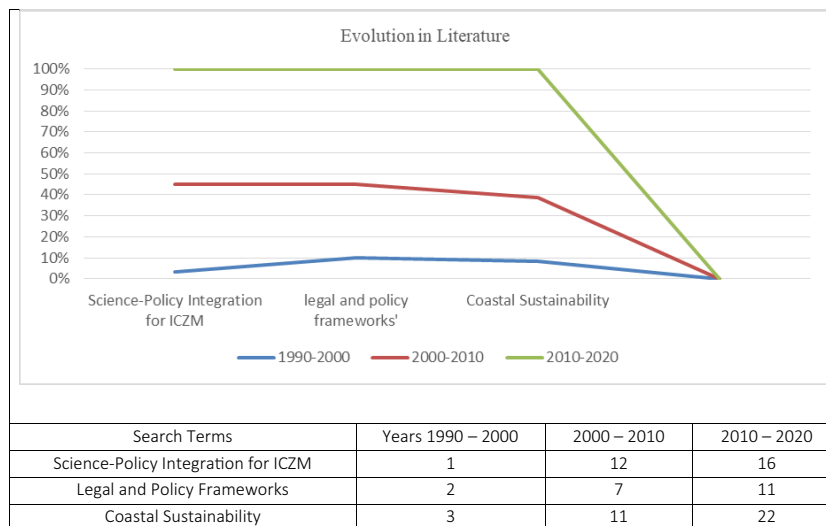


FIGURE 4 Citing Literature on Legal Governance Tools in ICZM for Coastal Sustainability. CLR as mentioned in Table 1.

The literature from the legal perspective of ‘coastal sustainability’ provides significant means of utilizing normative values of soft-law declarations or national or regional strategies (Rees et al., 2018, p. 11). However, the literature does not provide much clarity on how the legal obligations can be incorporated into ‘ICZM’ for ‘coastal sustainability’ (Harrould-Kolieb and Hoegh-Guldberg, 2019). Although there is prospective literature on IEL and UNCLOS dealing with marine environmental protection, fisheries preservation, and ocean conservation, ‘coastal sustainability’ is amalgamated with typical approaches that do not consider the

direct impacts of diverse governance mechanisms as mentioned above (United Nations Educational, Scientific and Cultural Organization, 1982; Miles et al., 1995; Ali, 2004).

The primary requirement for developing new means of ICZM is the multiplexity of governance mechanisms at some level that operate for substantive coastal goals (Visbeck et al., 2014; Timko et al., 2018). As ICZM cannot stand alone anymore, the SDGs under IEL have paved the way for tools of governance mechanisms in the form of multilevel governance. It has been observed that control and effective governance of waste, sewerage, and atmospheric

pollution can be integrated into ICZM with multilevel governance methods (Chua, 2013). The legal frameworks forwarding adaptive and polycentric governance mechanisms for sustainable oceans and coastal ecosystems have become obsolete.

In this case of multilevel governance, adaptive and polycentric governance can be integrated with the tool-based approach of ICZM (Bremer and Glavovic, 2013). Science-policy integration, law and policy frameworks, coordination and adaptivity, monitoring, reporting and evaluation, and capacity building are effective tools (Ehler, 2003; Nursey-Bray et al., 2014). Although approaching a more updated form of 'coastal sustainability' under SDGs is challenging due to the strong connections of diverse ecosystems, SDG – 14 formulates a goal-based approach and interconnects with SDGs – 6, 11, and 17 for 'coastal sustainability' in the context of 'coastal cities governance' (Taljaard et al., 2012). Therefore, applying such a multilevel governance mechanism is able to address coastal flooding, ocean acidification, marine pollution, and harmful impacts on fisheries (Harrould-Kolieb and Hoegh-Guldberg, 2019).

UNCLOS provided a scientific, logical, and precisely coherent approach to marine environmental protection through various means of governance. From the IEL perspective, the Rio Declaration on Environment and Development (Rio Declaration) and the United Nations Framework Convention on Climate Change (UNFCCC) established various mechanisms for the protection of the marine environment (United Nations, 1992; United Nations Educational, Scientific and Cultural Organization, 1992; Tabet and Fanning, 2012). Although the coastal goals or preservation of coastal ecosystems was not substantially incorporated in both the international commitments, the Rio Declaration established coastal goals in terms of "protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources" (Miles et al., 1995; United Nations, 2002).

The Rio Declaration establishes a mechanism of coastal ecosystem protection. In this way, it can be said that the Rio Declaration provides a commentary to UNCLOS besides literature and establishes the legal basis for collaborative governance of coastal city authorities (for waste, sewerage, and atmospheric pollution governance and control) (Visbeck et al., 2014; van der Molen et al., 2015). The literature advanced the Rio Declaration agendas of coastal governance by suggesting data and information sharing mechanisms, assessment and evaluation, capacity building, preventive measures, and precautionary approaches (Stojanovic and Farmer, 2013).

Rio Declaration (Chapter 17 of Agenda 21) works as a policy instrument for ICZM because it urges for "integration of sectoral programs on sustainable development for (coastal) settlements, agriculture, tourism, fishing, ports and industries affecting the coastal area" (United Nations, 2002). Further, it provides that sustainable planning and governance of the coastal cities and the ports from development and management perspectives are necessary for coastal sustainability (Fletcher, 2001). The literature

on the Rio Declaration suggested that the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), Montreal Guidelines for the Protection of the Marine Environment from Land-Based Sources (Montreal Guidelines), International Convention for the Prevention of Pollution from Ships (MARPOL), and International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) governs the marine environment and also deals with coastal pollution prevention from ship source of pollution (United Nations Educational, Scientific and Cultural Organization, 1954; United Nations Educational, Scientific and Cultural Organization, 1972b; United Nations Educational, Scientific and Cultural Organization, 1973; Weston's and Carlson, 2015).

The literature was further enhanced in the field of ICZM through the Aichi Biodiversity Target – 11 (for the conservation of the coastal and marine areas) (Jonas and Lucas, 2011). Aichi Biodiversity Targets are on the agenda of the Convention on Biological Diversity (CBD) and are dealt with through the Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) (United Nations Educational, Scientific and Cultural Organization, 1972a; United Nations Educational, Scientific and Cultural Organization, 1992; Rees et al., 2018). The regional and national legislative developments under UNCLOS and the Rio Declaration provide scientific dimensions of coastal cities' and ports' policies. The vertical and horizontal integration presented in UNCLOS and Rio Declaration also provides implementation mechanisms (Ali, 2004; Wescott, 2009). These mechanisms significantly integrate stakeholders in national legislative frameworks through spatial planning and governance.

The literature analyzed top-down, bottom-up, and cross-sectoral governance of ecosystems within ICZM systems of various States. A strong analysis of the governance mechanisms of atmospheric pollution of coastal cities, ports, and shipping with their substantial impacts on coastal floods and ocean acidification exists (Jentoft and Chuenpagdee, 2009; Bisaro et al., 2020). The literature criticized national and regional governance mechanisms because UNFCCC is still ineffective (United Nations Educational, Scientific, and Cultural Organization, 1992; Hermwille et al., 2017). After the enactment of the Paris Agreement and Kyoto Protocol (as parts of UNFCCC), IMO improved the regulation of atmospheric pollution from ships in the form of Sulphur 2020 and GHG Emissions Frameworks. However, with limited applicability, IMO's mechanisms are not satisfactory in terms of ocean acidification and coastal flood risk because port and coastal city authorities do not have the capacity to control and regulate such emissions effectively (Rothenberg and Nicksin, 2008; Miola et al., 2011; Galaz et al., 2012).

Most of the literature suggests that the integration of authorities governing atmospheric pollution shall collaborate with environmental and marine authorities to observe coastal flood risk and ocean acidification as relative problems (Kudrenickis et al., 2016). Literature also highlighted the national efforts to integrate governance of port, shipping, and coastal cities

governance within ICZM systems under IEL and UNCLOS (Rees et al., 2018, p. 14; Schlüter et al., 2020; Văidianu et al., 2020). The efforts to protect coastal ecosystems are regarding applying preventive and precautionary measures in planning and while implementing, including prior assessment and systematic observation (Vince and Hardesty, 2017). Such scientific integration into policy is the notion of the Rio Declaration for spatial planning and governance and adopting a coherent approach that is applicable to adaptive and polycentric governance to share responsibility (United Nations, 2002). Such efforts resolve political ambiguity associated with coastal sustainability and put in place effective ICZM systems. It has been urged that besides national integration or regional coherence, there is a need for international cooperation in the governance of ocean and coastal ecosystems, which may include IMO, United Nations Educational, Scientific, and Cultural Organization (UNESCO), the Intergovernmental Oceanographic Commission (IOC), United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP) (Juda, 1999; Mahon et al., 2010).

4 International legal framework for ICZM to achieve coastal sustainability

Climate change and marine pollution are global issues that require international, regional, and multilateral (sub-regional) cooperation and national, sub-national, and local action (Ehler, 2003). From a coastal sustainability perspective, inculcating ICZM in any such cooperation mechanism and action, international legal framework building national policies on climate change and marine environmental protection becomes relevant (Baird et al., 2009). However, the CLR and analysis above settled that international, regional, and national legal frameworks are not adequate in dealing with the risks faced by coastal sustainability (Ward et al., 2013). Therefore, this section provides an international legal framework for ICZM based on the above CLR, analysis, and existing IEL and UNCLOS mechanisms.

4.1 Legal framework and governance tools for coastal sustainability

As already discussed, the international legal framework for coastal sustainability has been provided in SDG – 14 in the form of goals. Such goals are part of UNCLOS and the Rio Declaration urging the mitigation of adverse impacts on marine and coastal ecosystems (United Nations Educational, Scientific and Cultural Organization, 1982; United Nations, 2002; Harrould-Kolieb and Hoegh-Guldberg, 2019). SDG – 14 establishes that significant adverse effects particularly emerge from land-based sources, including marine debris and nutrient pollution (Bigagli, 2016; Final list of proposed Sustainable Development Goal indicators, 2016). The results of this CLR found that the impact of waste and sewerage on coastal sustainability is higher than other sources of

pollution, in particular of the coastal cities (Reusch et al., 2018). The CLR also analyzed the impacts of climate change on coastal sustainability, including ocean acidification and coastal flooding. It has also been established that coastal flooding risk, ocean acidification, atmospheric pollution, and climate change are not unidimensional issues (Baird et al., 2009; Harrould-Kolieb and Hoegh-Guldberg, 2019).

Coastal sustainability issues require an enhanced understanding of the issues from multiple dimensions. Setting climate change issues within ICZM systems requires a coordinated effort of multiple governing mechanisms from and across international, regional, national, and local levels (West, 2003). It also establishes that SDG – 14, in terms of land-based pollution of the coastal cities, is interconnected with SDGs – 6, 11, and 15. Furthermore, climate change and coastal sustainability connect SDG – 14 with SDGs 11, 13, and 15 (Gallagher et al., 2004). Therefore, the basic legal framework in terms of IEL and UNCLOS is required to mitigate land-based and atmospheric pollution from coastal cities as per the scope of this research under the governance tools mentioned above.

4.1.1 Coordination and adaptivity - effective monitoring through adaptive governance mechanism

Integrating coastal sustainability with terrestrial and ocean ecosystems requires coordination and adaptivity among national, sub-national, and local governance mechanisms. Expansion of the ICZM framework for such governance mechanisms recognizes the need for flexibility and allows for adaptations in different ecosystems and their governance (Hovik and Stokke, 2007). Explicitly focussing on the issues of ICZM, any governance solution may generate further problems (West, 2003; Jentoft, 2007). Ports, shipping, and coastal tourism are quite relevant governance mechanisms for ICZM, which challenge coastal sustainability (Van Assche et al., 2020). Therefore, the appraisal of integration at this juncture is more conflicting and thus represents contradictory interests vertically and horizontally among governing authorities (Pittman and Armitage, 2016).

Coordination and adaptivity promote shared responsibility, capacity, knowledge and data sharing, and co-evaluation of policy implementation programs (Ali, 2004). As ICZM faces diverse challenges of overlapping jurisdictions, conflicting interests, and fragmentation, coordinated efforts in a single direction are not easily grasped. The coast is a liminal space with the ocean on the one side and land on the other (Hovik and Stokke, 2007). In this era of complexity, taking climate change as a particular challenge is a multidimensional, multi-sectoral, and multi-jurisdictional question (Jozaei et al., 2020). Waste and sanitation management through a scale of land-sea interaction is also indented as a cross-sectoral concern (Colenbrander et al., 2015; Kudrenickis et al., 2016; Khelil et al., 2019; Van Assche et al., 2020). Similarly, the development and planning of coastal cities and ports involve multiple authorities with or without coordination (Sekovski et al., 2012). The literature analyzed through this CLR suggested that governance of the coastal cities for sewerage and waste mitigation and control

requires precautionary and preventive measures (Jentoft, 2007). The principles of ‘precautionary and preventive measures’ are well defined in the CBD, UNFCCC Rio Declaration, and UNCLOS, and all the IEL urges to enhance mechanisms of coordination and adaptivity for such pollution control.

Legal frameworks under IEL and UNCLOS are not limited to a specific implementation of any definite policy. In ICZM systems, IEL and UNCLOS may not go beyond coastal and marine environmental protection authorities but are capable of calibrating within various governance mechanisms under multiple governing authorities as networks and collaborations (Powell et al., 2009; Galaz et al., 2012). Adaptivity in governance is a flexible and knowledge-sharing collaboration involving diverse authorities to coordinate the management of ecosystems (Vugteveen et al., 2015). Moreover, collaboration and adaptivity in governance integrate vertically, and polycentricity focuses on horizontal integration for effective implementation (Chaffin et al., 2014). As there is a multiplication of authorities as well as a wide diversity of networks from local to national and regional levels in ICZM, adaptivity poses issues of coordinated means of implementation (Tobey et al., 2010). Considering the adverse impacts of pollution on coastal sustainability, adaptivity, and coordination, a mechanism to enable horizontal cooperation among port, shipping, urban, coastal, and ocean authorities and vertically and nationally, sub-national, and local authorities is needed.

The core elements identified through this CLR in SDGs for coordination and adaptivity are provided in SDG – 17, which enhances adaptivity and coordination among SDG – 14, 13, and 7 to improve the efficiency of the authorities to handle climate-related hazards and to enable access to clean energy at international, regional and national levels (Miola et al., 2011; Sekovski et al., 2012; Final list of proposed Sustainable Development Goal indicators, 2016). Further, the elements promote processes to build and raise capacity for effective emission mitigation strategies (including clean energy), and with target 14.a to transfer marine technology in order to improve ocean health and marine biodiversity, its applicability on ports and shipping emissions seems effective for ICZM (Rothenberg and Nicksin, 2008; Final list of proposed Sustainable Development Goal indicators, 2016). In terms of coastal cities’ emissions management, SDG – 11 urges paying particular attention to air quality and reducing adverse environmental impacts. Along with SDG – 13, the stakeholders are able to influence policy for climate change measures at the national level (Ballinger, 2015; Final list of proposed Sustainable Development Goal indicators, 2016).

4.1.2 Monitoring, reporting, and evaluation inter/intra-sectoral reporting and evaluation mechanisms

Coordination and adaptivity devices that share governance create co-benefits by establishing mechanisms within a transparent system of governance (United Nations Educational, Scientific and Cultural Organization, 1992; Puppim de Oliveira et al., 2011). Further, the transparency for evaluation, monitoring, and

reporting is established in the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) (United Nations Educational, Scientific and Cultural Organization, 1998; Mason, 2010). Under the Aarhus Convention, UNCLOS and UNFCCC set flexible means of implementation and promoted cooperative monitoring, reporting, and evaluation mechanisms by sharing responsibility (Bodansky, 1991; Benioff et al., 2010). As the form of international obligations as provided in the IEL, the Rio Declaration conveyed a mechanism to establish a coherent monitoring program to control land-based pollution (waste and sewerage) and climate change (atmospheric pollution) from the coastal cities (United Nations, 2002).

In terms of SDG – 14, coastal sustainability requires a ‘coherent monitoring program to control the effluent discharge and emissions through shipping and port activities and the coastal cities’ and ‘conservation of coastal areas’ (Chemane et al., 1997; Kim et al., 2020). Further, it develops shared responsibility, adaptive capacity, knowledge and data sharing mechanisms, and co-evaluation of policy implementation programs. Interpretation of IEL through literature forwards the mechanism of adaptivity and coordination by providing a network of authorities monitoring, evaluating, and reporting coastal sustainability issues at different scales (Miles et al., 1995).

UNCLOS adopted a more scientific, logical, precise, and coherent approach by establishing mechanisms of monitoring, evaluation, data-sharing, and scientific cooperation among the States and within the States to curb the land-based sources of marine pollution (Bauerlein, 1994; Lawrence Juda, 2001; Analysing the legal framework of marine living resources management in Bangladesh: Towards achieving Sustainable Development Goal 14, 2018). Functionally, coordination and adaptivity in governance are mechanisms to develop cohesion among various governance mechanisms through performing checks and balances as they provide cross-sectoral dimensions of transparency in the form of monitoring, reporting, and evaluation (Homsy et al., 2019). As a result of this CLR, the governance tools of monitoring, reporting, and evaluation propose that data and information sharing, coordinated monitoring, and sharing of innovative strategies at various governance levels through national authorities via coastal, environmental, or ocean authorities play a significant role in coastal sustainability (Kudrenickis et al., 2016; Reusch et al., 2018; Caviedes et al., 2020; Diggon et al., 2022).

The element of coordination in monitoring, data information, and technology sharing is applicable while developing local cross-border integration, or it may take a bottom-up approach through national integration (Visbeck et al., 2014). Rethinking ICZM under the measures of monitoring, reporting, and evaluation establishes close connections of coastal goals of SDG – 14 with SDG – 17, which involve national, sub-national, and local governance mechanisms to evaluate coastal sustainability. Reporting coastal flood risk and ocean acidification to climate governing authorities and marine pollution to coastal city authorities are practical forms of application of these governance tools (Duxbury and Dickinson, 2007; Kim, 2012; Taljaard et al., 2012).

4.1.3 Capacity building - building capacity of authorities with stakeholder integration measures for sustainable outcomes

Effective implementation of governance tools, as mentioned above, requires enhanced capacity of authorities and stakeholder integration to help authorities in building capacity. Furthermore, such implementation calls for enhanced scientific cooperation, research capacity, and technology transfer at all levels (McFadden et al., 2009). It is already established that the UNCLOS or UNFCCC urges to enhance scientific knowledge to improve the ocean ecosystem and the contribution of marine biodiversity (Kim, 2012). In such terms, SDG - 17 encourages the development of policy coherence and coordination, respect for international policy space, multi-stakeholder partnerships, and enhanced capacity for data, monitoring, and accountability. The agenda for the coastal goals realizes the weaknesses in governance and requests the stakeholders to develop capacity through coordination, adaptivity, and continuous negotiation (Gupta and Nilsson, 2017).

Integrating governance, law, and policy for coastal sustainability into one framework is a difficult task that calls for global and national cooperation. SDG - 14 urges the developed states to transfer marine technology and scientific knowledge through coordination and adaptivity to least developed and developing States to improve ocean health (Granit et al., 2014). Therefore, governance mechanisms provided in SDG - 17 are taken as critical elements of coordination, adaptivity, monitoring, reporting, evaluation, and capacity-building in ICZM. The governance tools of SDG - 17 are reflected throughout this CLR, identifying the gaps in governance and covering those gaps through the capacity-building of various authorities. Capacity building presents a formula of coordination within and between authorities, building on the premise that ICZM is a means of achieving coastal sustainability.

4.1.4 Legal and policy frameworks in regions and states - adequate legislation under international law

Interpretation and potential extension of the IEL and UNCLOS for the development of a legal framework effectively governing coastal cities and atmospheric pollution are significant governance tools for coastal sustainability. At national and regional levels, the authorities and stakeholders on the coasts are encountering new responsibilities that require continuous scientific integration, institutional reforms, and new approaches (Duxbury and Dickinson, 2007). Therefore, evolutionary legal frameworks are necessary to resolve such annexed policy issues considering coordination, adaptivity, monitoring, and reporting issues (Schlüter et al., 2020).

The regional initiatives for ocean governance built on the 'Global and Regional Cooperation' notion under UNCLOS and the Rio Declaration have promoted sustainable coastal solutions (Someya et al., 1992). Partnerships in Environmental Management for the Seas of East Asia are good examples, and the European ICZM model is another (McKenna et al., 2008; Chua, 2013). Although inconsistencies and fragmentations exist at various levels, the recent shifting paradigm shows that the European

ICZM model has realized that consistent long-term actions are strategically coherent rather than vertically integrated (Shipman and Stojanovic, 2007; Fletcher et al., 2014). This strategic coherence is holistically based on a bottom-up approach and is flexible for diverse cooperation mechanisms (Zafrin et al., 2014).

Cross-border governance for the land-sea interaction under UNCLOS and the Rio Declaration is significantly applicable to coastal sustainability (United Nations, 2002) (As mentioned in Table 2). Similarly, UNFCCC, CBD, and World Heritage Convention promote regional and international partnerships for atmospheric pollution control and coastal conservation. Therefore, establishing the legal basis for coastal sustainability in ICZM systems is forwarded through the UNCLOS, UNFCCC, CBD, and World Heritage Convention as a goal and Rio Declaration and SDGs as mechanisms (As mentioned in Table 2). Rio Declaration also provides the mechanism of adaptivity and coordination by providing network organization, collaboration process, and coordination of multiple authorities at different scales (Miles et al., 1995). Therefore, a legal framework promotes conflict management and resolution tools, vertical and horizontal harmonization, and coordinated capacity building for ICZM implementation.

4.1.5 Science-policy integration – integrating knowledge and scientific information in policy

Scientific knowledge integration into policymaking is a phenomenon presented in the UNCLOS advanced through the Rio Declaration. Scientific research and policy integration with stringent rules and regulations occur with the final negotiation of UNCLOS (Juda, 1999). UNCLOS adopted a more scientific and legal approach by establishing mechanisms of governance with data and knowledge. Rio Declaration rationalizes the UNCLOS across the rights and obligations for scientific knowledge into policy mechanisms (Hildreth, 1999; Forrest, 2006). This enhanced the use of precautionary and preventive measures in any governance mechanism (Visbeck et al., 2014; van der Molen et al., 2015).

Establishing the legal basis for scientific knowledge into ICZM as a policy mechanism forwards information sharing, joint monitoring and evaluation, and capacity building (Stojanovic and

TABLE 2 Applicable International Environmental Laws for Coastal Sustainability.

Law	Application for Coastal Sustainability
UNCLOS & Montreal Guidelines	Protection of Marine Environment from Land-Based Pollution
Rio Declaration	Establishing a Mechanism of Coastal Ecosystem Protection
London Convention, MARPOL & OILPOL	Prevention of Ship Source of Pollution including Dumping and Oil
CBD	Preservation of Marine and Coastal Biodiversity
UNFCCC, Kyoto Protocol and Paris Agreement	Prevention of Atmospheric Pollution and Climate Change Strategies

CLR of this Research, as mentioned above.

Farmer, 2013). Issues of coastal flood risk and ocean acidification require enhanced scientific knowledge and incorporation of science into policymaking at all levels (Kudrenickis et al., 2016). Atmospheric pollution control of the coastal cities requires scientific assessment and control with coastal flooding and ocean acidification perspectives (Jentoft and Chuenpagdee, 2009; Bisaro et al., 2020). Such scientific knowledge in policymaking is also forwarded in the UNFCCC, Kyoto Protocol, and Paris Agreement (Rothenberg and Nicksin, 2008; Miola et al., 2011; Galaz et al., 2012). Such integration of scientific knowledge into policymaking forwards diverse approaches of ICZM at various levels (Rees et al., 2018, p. 14; Schlüter et al., 2020; Văidianu et al., 2020).

CLR suggested that aspects of science-policy integration are regarding the application of systematic observation, which should be a national agenda implemented through sub-national and local authorities (Vince and Hardesty, 2017). The notion of the Rio Declaration is the science-policy integration mechanism at various levels. Planning coastal cities with scientific integration and knowledge that shall mitigate coastal flood risk, ocean acidification, and land-based pollution control are pertinent issues presented in SDGs. SDG – 14, in this way, connects with SDGs – 13 and 17 for scientific and knowledge integration for coastal sustainability.

4.2 Coastal conservation and pollution prevention as goal

The findings of this CLR indicated that shipping and port governance are inclusive issues for coastal sustainability. This research focused on coastal city governance (sanitation and waste governance), which characterizes coastal sustainability from a legal perspective. This CLR shows that the governance tools of ICZM are with the coastal goals-based approach and are connected with the targets of SDGs directly impacting coastal sustainability, as provided below and presented in Table 3.

1. Sustainable management of the coasts under Target – 14.2 includes land-sea interactions and climate change impacts, and it connects with SDG – 6 (Clean Water and Sanitation), SDG – 11 (Sustainable Cities and Communities), and SDG – 14 (Life on Land). Target – 14.3, although not coastal and is an ocean goal, relates to the coastal flooding risk, which further connects it with SDG – 14.5 for the conservation of coastal areas (Mahon et al., 2010; Jonas and Lucas, 2011; Khelil et al., 2019). Thus, SDG – 14.3 relates to SDG – 13 (Climate Change) and SDG – 7 (Clean and Affordable Energy) in a specific dimension of the port, shipping, and urban emissions management (Rothenberg and Nicksin, 2008; Miola et al., 2011; Kim, 2012).
2. SDGs 13 and 7 are to improve flexibility and adaptivity to handle climate-related hazards and enable access to clean energy at international, regional, and national levels (Miola et al., 2011; Sekovski et al., 2012; Final list of proposed Sustainable Development Goal indicators, 2016). Further, it promotes processes to build and raise capacity for effective emission mitigation strategies (including clean energy), and with target 14.a to transfer marine technology in order to improve ocean health and marine biodiversity, its applicability on ports and shipping emissions seems effective for ICZM (Rothenberg and Nicksin, 2008; Final list of proposed Sustainable Development Goal indicators, 2016). Regarding coastal cities’ emissions management, SDG – 11 urges paying particular attention to air quality and reducing adverse environmental impacts. Along with SDG – 13, the stakeholders are able to influence policy for climate change measures at the national level (Ballinger, 2015; Final list of proposed Sustainable Development Goal indicators, 2016).
3. The strategies entailed in SDG – 11 to develop economic, social, and environmental links between urban, peri-urban, and rural areas and help least-developed countries build sustainable infrastructure are supportive of mitigating

TABLE 3 Governance Tools Utilised for Coastal Sustainability through SDGs framework and IEL.

Coastal Goals SDG – 14	Coordination and Adaptivity	Monitoring, Reporting and Evaluation	Capacity Building	Legal Framework	Science Policy
Coastal Pollution Prevention	SDG – 11 - Support positive economic, social and environmental links between urban, peri-urban and rural areas	SDG – 17 – for Monitoring, Reporting and Evaluation	Increase scientific knowledge and develop research capacity and transfer marine technology in order to improve ocean health and to enhance the contribution of marine biodiversity to the development	consistent with national and international law (UNCLOS, Convention on Biological Diversity, World Heritage Convention and Chapter 17 of Agenda 21)	SDG – 14 and all other SDGs based on the best available scientific information.
Preservation of Coastal Areas	SDG – 13 Integrate climate change measures into national policies.	SDG – 17 – for Monitoring, Reporting and Evaluation		UNFCCC, Kyoto Protocol and Paris Agreement)	

The discussion of this CLR.

population pressures on coastal cities (Sekovski et al., 2012; Final list of proposed Sustainable Development Goal indicators, 2016). Providing inclusive and sustainable urbanization by providing more benefits and developing capacity for participatory and sustainable settlement planning and management under SDG – 14 and 15 underpins that populations reaching coastal cities will reduce (Ballinger, 2015; Final list of proposed Sustainable Development Goal indicators, 2016). Further, adopting the ecosystem and biodiversity into national and local planning and increasing the number of cities is consistent with developing national legislation for the conservation of coastal areas.

5 Conclusion

Due to anthropogenic connections, pressures on coastal ecosystems are increasing within the ICZM systems, significantly demanding inclusive governance mechanisms. The SDGs promote anthropogenic governance, and addressing the vulnerability to coastal sustainability is becoming increasingly essential. However, the conflict between trade and sustainability in coastal cities and regions challenges the effective implementation of coastal goals. Development and implementation of adaptivity and coordination in ICZM systems with monitoring, evaluation, reporting, and scientific information under international law should be imperative. The coastal goals can act as a framework for the establishment of national, regional, and international regimes for ICZM. Improved stakeholder integration, emphasizing the impact on shipping, ports, and coastal cities' governance mechanisms, facilitates the successful application of the ICZM. Stakeholders' concerns can be addressed through a policy mechanism of 'participation' in ICZM systems to address trade and sustainability's conflicting interests and create a balance between both. The ICZM mechanism provides tools to adequately mitigate coastal flood risk by coping with ocean acidification and sea-level rise, including protecting ecosystems from coastal hazards and sufficiently conserving coastal areas.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Author contributions

SZ: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Software, Supervision, Writing – original draft, Writing – review & editing. QW: Writing – original draft, Writing – review & editing. MB: Formal analysis,

Project administration, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. Y-ML: Formal analysis, Project administration, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. Y-EW: Formal analysis, Project administration, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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