Stakeholder Engagement in Blue Carbon Sector: A Bibliometric Analysis

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Abstract. As part of its commitment to the Paris Agreement and addressing climate change, Indonesia has submitted its first Nationally Determined Contribution (NDC) and is now preparing its Second NDC with more ambitious targets, incorporating a broader focus on the blue carbon sector. Achieving these climate goals requires strengthening stakeholder engagement within the blue carbon sector. This study employs a comprehensive bibliometric analysis, followed by a Systematic Literature Review (SLR), to assess stakeholder engagement in the blue carbon sector and identify relevant knowledge. The findings reveal that only thirteen articles were identified, with a significant concentration of studies from Australia. The research also compares four selected countries— the United States, Australia, the Philippines, and Indonesia— in the context of blue carbon, based on insights extracted from six key articles. The study identifies similarities in both the blue carbon context and the approaches to stakeholder engagement.

1 Introduction

Indonesia has shown its commitment to combat climate change by submitting its First Nationally Determined Contribution (NDC) in 2016. This was part of its obligations under the Paris Agreement and followed the Intended Nationally Determined Contributions (INDC) presented in 2015. The Updated NDC was submitted in 2021, and the most recent version, the Enhanced NDC, was submitted in 2022. This document includes a supporting strategy titled "Indonesia Long-Term Strategy for Low Carbon and Climate Resilience 2050" (LTS-LCCR 2050), which aims for national net-zero emissions by 2060 or earlier. The Enhanced NDC sets a target of reducing emissions by 31.8% through national efforts and 43.2% with international support, an increase from the initial targets of 29% and 41% outlined in the First NDC (2016). Indonesia is currently developing its Second NDC, which will focus more on mitigation and adaptation initiatives, particularly in the blue sector, including mangrove conservation, to achieve more ambitious climate goals.

As a home to about 22 percent [1], [2] of global mangrove or more than 3,3 million hectares area [3], and around 3 million hectares [4] accounts for 44.48 percent of the total seagrass across Southeast Asia [5], Indonesia has huge potential for carbon net sinks from

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blue sector. These ecosystem—mangrove forests, seagrass beds, and salt marshes—comprise the majority of the Blue Carbon Ecosystem, which has enormous potential for sequestering and storing carbon and for contributing significantly to attempts to mitigate climate change. Expanding the application of blue carbon can contribute to the enhancement of carbon sinks [6].

Mangroves, in particular, are regarded as valuable components of Natural Climate Solutions (NCS) helping nations meet their Nationally Determined Contributions (NDC) target [2][7]. However, Indonesia's seagrasses are in a precarious state. If their condition continues to deteriorate, Indonesia's seagrasses will lose their high ecosystem service value and become less resilient to climate change [8].

Although the Enhanced NDC document takes the marine sector into account, more can be done to leverage this sector to achieve the net zero goal through more ambitious initiatives. Indonesia's coastal and ocean areas offer significant climate mitigation potential, necessitating the inclusion of ocean-based action in their forthcoming 'Second Nationally Determined Contribution' (NDC) [9]. A balanced focus on the government coordination process, stakeholder engagement—both bottom up and top-down is essential for implementing a low-carbon and climate resilience strategy. Involving stakeholders early on and using their knowledge in the decision-making process is beneficial for the management of marine activities [10].

To effectively leverage stakeholder engagement in achieving goals, five key principles of communication and engagement should be considered: (1) participation; (2) access to information and disclosure; (3) social inclusion; (4) transparency; and (5) informed consultation without coercion. These principles are based on guidelines from the Indonesia Environmental Fund, the Ministry of Environment and Forestry, and the National Peatland and Mangrove Restoration (2022) [11]. Furthermore, stakeholder engagement should be central to local climate action efforts [12].

There are several studies demonstrating the context of stakeholder engagement process, needs, and its importance level, including on how the stakeholder engagement practice in marine sector, both in the policy level and in the implementation level [2][13][14][15]. The bibliometric analysis in this study is used to analyse and provide information on stakeholder engagement in blue carbon sector, revealed the method and aspects related to the topic through scientific publications published in various journals and other scientific literature resources. The bibliometric analysis provides insights into the field and highlights existing gaps, challenges, and future research directions aimed at advancing both research and practical applications [16]. While the Systematic Literature Review (SLR) provide analysis on how stakeholder engagement is used in several countries. Systematic reviews search, appraise and collate all relevant empirical evidence in order to provide a complete interpretation of research results [17]. In comparison to other methodologies such as interviews, surveys, or case studies, bibliometric analysis and SLR provides advantages in revealing stakeholder engagement in the blue carbon sector since this method is more efficient, methodical, and can produce complete and quantitatively measurable results data and analysis.

This study's primary objectives include describing publication trends and identifying popular keywords from the past five years; identifying journals that focus on stakeholder engagement in the blue carbon sector; identifying participating countries; examining research trends in stakeholder engagement methodology; and conducting a thorough content analysis of the selected articles. This study can be used as a reference for investigating and enhancing stakeholder engagement between Indonesia and other nations, particular in the blue carbon sector.

2 Methodology

Using data from Scopus, this study examined the literature on stakeholder engagement in the blue sector using both quantitative and qualitative analytical approaches. A global, multidisciplinary database for finding academic literature, Scopus offers measures to assess research performance in addition to visualisation tools for analysing search results [18]. The quantitative approach utilized in this study is bibliometric analysis, techniques are based on quantitative approaches designed to identify, describe and evaluate published research [19]. The bibliometric method involves applying quantitative analysis and employing a statistical strategy to measure the literature [20].

Information on publication counts, author productivity, networks of collaboration between authors, institutions, and nations, as well as research trends pertaining to the selected subject, are all provided by the bibliometric analysis. Technologically, the bibliometrics could be used to reveal and evaluate the performance of disciplines, journals, authors, institutions and countries, and also be used to assess the patterns of author co-authorship, institution co-authorship, and country or region co-authorship [21]. Conversely, content analysis, a method for examining the content of documents, can make use of a qualitative approach. In order to determine the kinds of information published in publications concerning stakeholder engagement across multiple nations, this study employed content analysis, using these two approaches are combined: quantitative bibliometric tools, to show how scientific knowledge has evolved in a field, and systematic reviews help determine the in-depth substance of a certain topic.

2.1 Processing and cleaning of the selected article

A web search was done for data articles covering the 2014–2024 timeframe by this study. The utilization of the updated data item (2014-2024) holds greater significance within the present study setting due to the fact that studies on stakeholder engagement undergo continuous evolution. Using the Scopus database created by Elsevier, more recent data will give a more accurate view of current trends and challenges.

2.2 Data analysis: Bibliometric analysis

This study utilized VOSviewer 1.6.20 to find and show scientific maps by interpreting and comprehending the network of linkages between keywords, authors, journals, countries, and institutions for the article data from the Scopus database in clean CSV format and bibliometric analysis. The keywords used in this study is “BLUE” AND “CARBON”AND “STAKEHOLDER” AND “ENGAGEMENT”, with limitation of year between 2014-2024 and limited to the article and conference paper. The flow diagram of the study design is shown in the Figure 1.

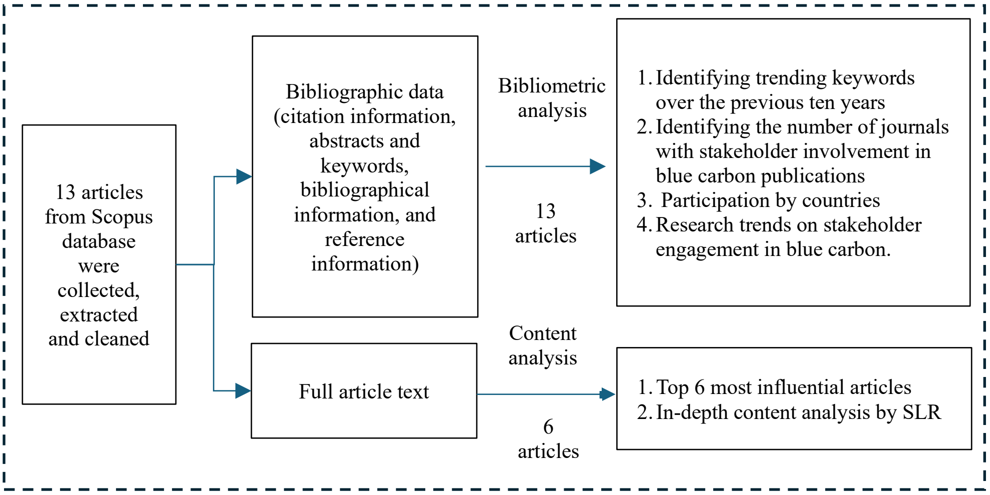

Fig. 1. Flow diagram of study design

2.3 Content analysis: Systematic literature review

Though the theory's application to stakeholders has grown, a few studies have examined how to develop, execute, and measure the outcomes of this strategic approach with stakeholders [22]. A critical initial phase in research to comprehend the state-of-the-art and identify gaps and challenges in the field is conducting a literature review [23]. By expanding on earlier findings, literature reviews and evidence syntheses are crucial research outputs which help in the incremental progress of knowledge [24]. However, the focus of a literature review is to synthesise and summarise other people's thoughts and arguments without adding new contributions [25].

This study comprises four countries related to the stakeholder engagement in the blue carbon sector from the selected six articles. Six articles were selected based on the four selected countries and have a close connection with the stakeholder engagement in the blue sector. The four countries are selected based on the most appear countries from the Scopus database, as result of screening process by the keywords.

3 Results and discussion

3.1 Bibliometric mapping of current research

In the range year of 2014 to 2024, by searching tools in Scopus using the keywords, there were 13 documents found, consist of 11 articles and 2 reviews. This shows there are not many studies that have been conducted in this sector worldwide.

The statistical results showed the development of research on blue carbon stakeholder engagement by year. The graph on the Figure 2 shows there was only one study in 2019, four studies in 2021, one study in 2022 and 2023, and increasing to six studies in 2024. What's interesting is that, prior to 2019, no research has been done on this topic. However, since 2024, there have been more studies conducted on this subject, and more is expected. The low number of research on stakeholder engagement in blue carbon captured in this study may not reflected on the number of research in actual. This because, the research captured in this study is limited to the searching tool in Scopus.

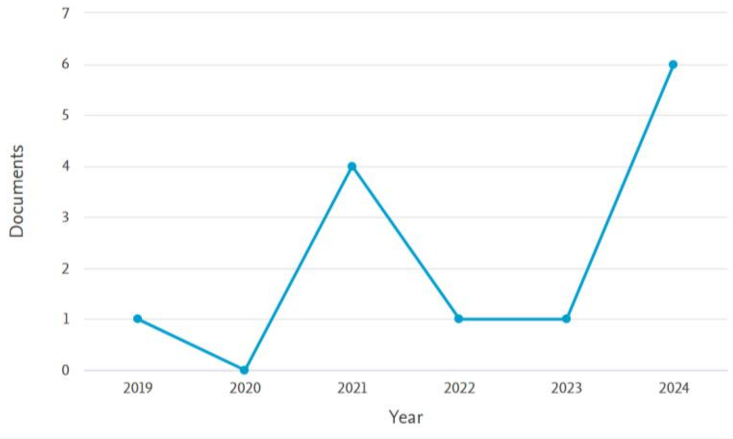

Fig. 2. Statistics on documents by year (source: Scopus database analysis)

The Figure 3 shows that there is one study each from Fiji, Ethophia, Belgium and Austria, two studies coming from United States, Spain, Singapore and Norway. The research shows that the documents are dominate by Australia and Japan with three studies from each country. Upon closer review, three out of the three documents from Australia are actually about Australia. However, articles stated from Japan are conducted about Ethiopia, the Philippines, and Philippine-Indonesia. While the study refers to Norway, the content of research was about Norway and the European Union. Furthermore, one out of two Singapore originated studies was conducted about the Philippines. This indicates that the country-detected articles were not specifically identified the location of the study itself.

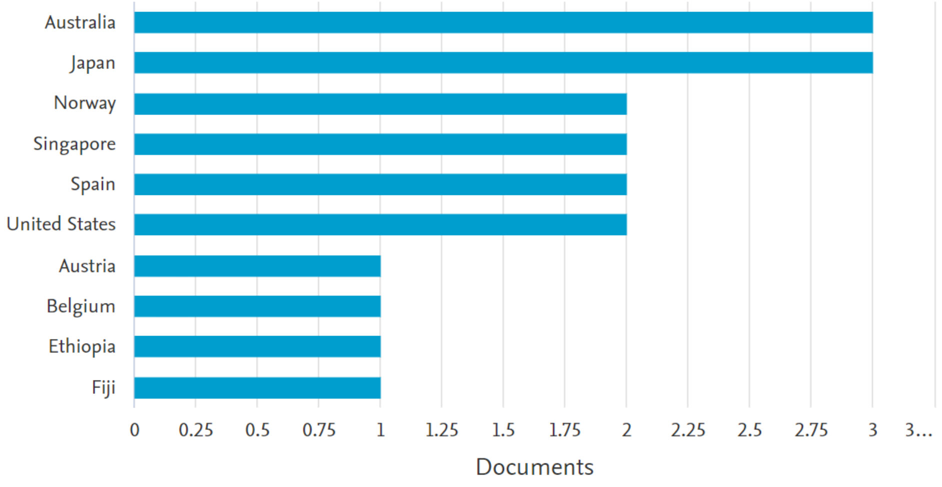

Fig. 3. Statistics on documents by country or territory (Source: Scopus database analysis)

The words associated with blue carbon stakeholder engagement are displayed in Figure 4, along with the seven terms that surfaced most frequently in the literature throughout the duration of the five-year study period. The keywords that appear most often during this time period are stakeholder engagement, carbon, stakeholder, carbon dioxide, carbon sequestration, climate change, and hydrogen storage. The words or phrases that are indicated to be used as search terms to retrieve information and represent the contents of connected journals are listed in the bibliographic database.

The main keyword in this study is blue carbon stakeholder engagement because the main discussion is related to the blue carbon (including all carbon preserved in mangroves, seagrass, seaweed, etc.) and its relationship with the engagement with relevant key stakeholders. Although the discussion on mangrove and its role to climate change, the topic of blue carbon itself has not been considered much. Furthermore, the role of the key stakeholders on blue carbon has rarely been studied throughout the five years behind or even more the study has not been seen before 2019.

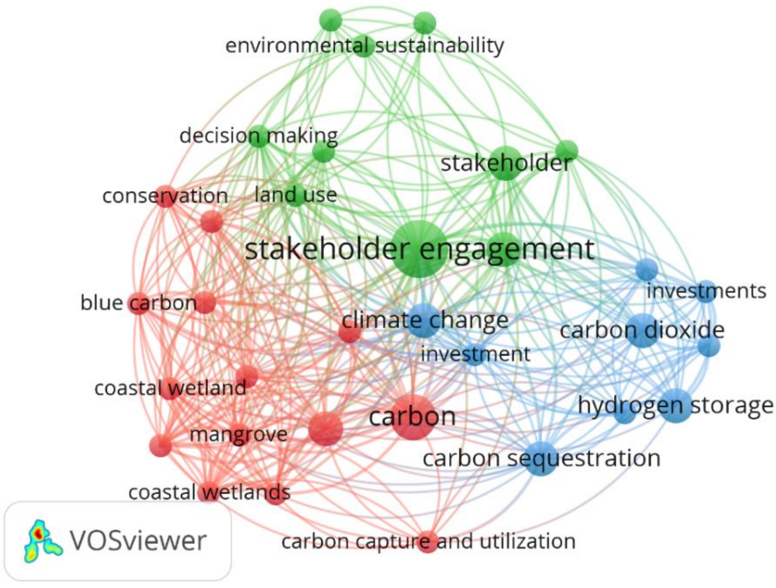

Fig. 4. Network of stakeholders' engagement in blue sector (bibliometric analysis)

The outcome reveals that the most frequent keywords may be broadly categorised into three colour groups. The group of mitigation actions is denoted by the red colour which is composed of the terms "carbon capture and utilisation", "mangrove", "coastal wetland", "blue carbon", "conservation", and "carbon". The terms "climate change", "investment" "carbon dioxide", "hydrogen storage", and "carbon sequestration" were all captured by the colour blue, which led to the grouping of mitigation financing. The green-coloured group of mitigation policies is led by the last group, which is made up of "decision-makers", "land use", "stakeholders", "stakeholder engagement", and "environmental sustainability".

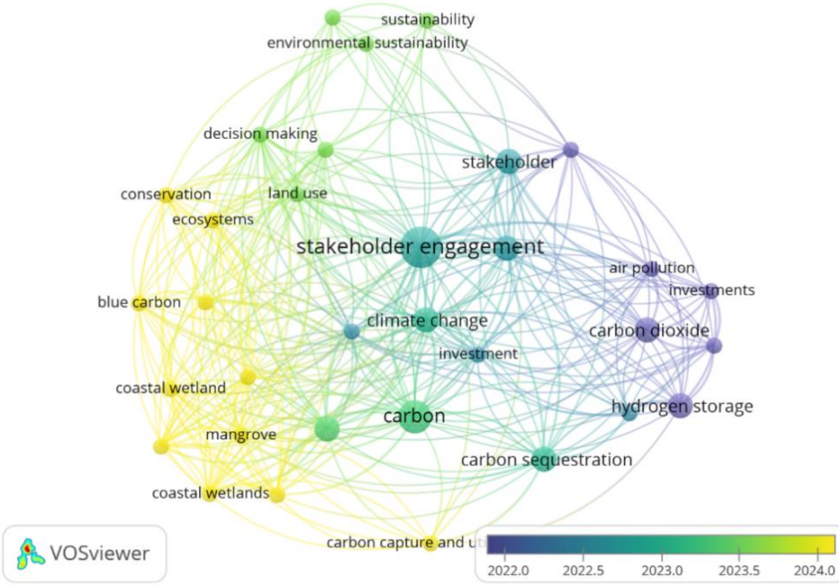

Fig. 5. The documents analysed based on year of recency from 2022-2024 (bibliometric analysis)

Along the year of 2024, the study is mainly focused on blue carbon, mangrove, coastal wetland and conservation. While the study on stakeholder engagement is mostly conducted in the period of 2022 and 2023. This brings a new perspective that there are very few studies on stakeholder engagement in blue carbon sector over past ten years and more, although it has direct line or connection.

During the time frame of 2022-2023, the study dominantly focuses on stakeholder engagement, climate change, investment, carbon, carbon sequestration, environmental sustainability, carbon dioxide, hydrogen storage, and air pollution. It is understandable, since in the past few years most of the discussion on blue sector is about carbon storage and its relation to investment and finance. This may lead to further exploration of the Clean Development Mechanism (CDM) policy. This issue has not been discussed much and may be research opportunity to drive carbon sequestration to the carbon market mechanism.

However, while bibliometrics can identify terms which appear up frequently in the articles, some phrases that have the same meaning are not grouped together. For instance, the terms "coastal wetland" and "coastal wetlands" are mentioned in separate groups. The word of “investment” and “investments” also appear in separate bullet points. Last, the word of “sustainability” and “environmental sustainability” which has similar meaning, appear in two different dots. This may lead to the inaccuracy of the analysis, in terms of the correlation between keywords.

3.2 Content analysis of the selected research

The shortlisted articles, which have strong connections with the keywords, are being further analysed and discussed. Six of the thirteen articles were selected for more detailed analysis in this study, as they are considered to be significantly relevant to the research objectives. Articles No. 11, 2, 3, and 13 will be examined to represent the United States of America, while Article No. 5 will represent the Philippines, and Article No. 12 will represent Indonesia.

These articles are highlighted in Table 1. List of the articles captured, which provides a list of the articles included in the analysis.

The synthesis of these studies underscores the critical role of stakeholder engagement in the successful implementation of environmental initiatives, particularly those related to blue carbon ecosystems, hydrogen production, and sustainable practices. Engaging local communities and diverse stakeholders fosters a sense of ownership, enhances project feasibility, and ensures that initiatives align with local needs and values.

Effective stakeholder engagement facilitates the incorporation of local knowledge into decision-making processes, improving the relevance and sustainability of environmental projects. This reflects that stakeholder engagement, efficient interaction, and collaboration among varied actors are the most critical factors [26]. Furthermore, collaborative approaches can help overcome barriers to implementation, promote transparency, and build trust among stakeholders. Ultimately, prioritizing stakeholder engagement not only enhances the effectiveness of environmental initiatives but also contributes to greater social and ecological resilience, paving the way for successful outcomes in the face of global environmental challenges.

Table 1. Literature analysis comprises four countries

Context	USA	Australia	Philippines	Indonesia
Blue carbon context	Ecosystem service, carbon sequestration, salt marshes, mangrove, seagrass meadows, tidal flats.	Mangroves, saltmarshes, supratidal forests, tidal marshes	mangroves, seagrass beds, and possibly coastal wetlands	Blue carbon ecosystem (BCE), includes Mangroves, seagrass meadows, and tidal marshes
Stakeholder engagement approach	Identifying stakeholders, stakeholders mapping, navigating the geographic scales and various stakeholders, increase transparency and enable a participatory process, top-down dissemination.	Met with non-governmental organisations and state government departments to discuss the varying perspectives and restoration objectives, engaged with Traditional Custodians	Perceptions of stakeholders gathered from focus groups draw attention to problems and difficulties.	Identification of the survey locations, conducting interviews, and obtaining each respondent's consent
Method	Semi-structured interviews, sampled for place-based conservation organisations	Stakeholder engagement identification, workshop, stakeholder mapping based on value chain	A multi-framework analysis-encompassing DPSIR, SOAR, and PESTLE frameworks, FGD	Perception surveys, comparative analysis, multivariate regression and correlation analysis.
Challenge	Five barriers to action on blue carbon (1) structural	Although the possibility is contingent on Native Title rights,	Localised Blue Carbon Ecosystem (BCE) strategy	More work is still required at the local level, despite the fact

Context	USA	Australia	Philippines	Indonesia
	problems (finance, time, and access to other resources), (2) technical skills and/or experience, (3) politics and political views, (4) individual motivation and identity, and (5) localism	Traditional Custodians expressed interest in spearheading blue carbon initiatives.	development and execution frequently lag behind.	that transdisciplinary methods in the "blue carbon" discourse and cooperative initiatives are gaining traction in both the national and international areas.
Findings	A link to a research laboratory and familiarity with or connection to a national backbone organisation are two prerequisites for taking action inside a local organisation.	Sites for restoring coastal wetland for blue carbon and other advantages can be identified using a regional approach that engages Traditional Custodians, takes into account local knowledge and data availability, and adjusts to the particularities of each location.	Typhoon Haiyan's aftermath in 2013 sparked conservation efforts and increased awareness in the studied areas, however the effectiveness and durability of management and conservation initiatives are influenced by governance structures and policy enforcement.	The occupation of the respondents had a substantial impact on their utilization rate, with opposite correlations seen in Karimunjawa (negative) and Busuanga (positive)
Critical review	The study was carried out at the grassroots level with local conservation organisations, omitting national and international organisations. Mor eover, no analysis has been done on the national and local government stakeholders.	The study conducted with considering indigenous people to play important role and take a lead in the blue carbon conservation projects.	Not much discussion on how the stakeholder mapping was conducted and the relations between stakeholders.	Karimunjawa is not included in the Coral Triangle Scientific Boundary, despite the fact that Indonesia is one of the Triangle's regions. Moreover, the engagement of national stakeholders as the decision makers is not discussed.

(Source: extracted from Scopus database)

A number of selected articles considered to have significant relationships to the intention of this study. First article, discussed on the limitations of incorporating blue carbon ecosystem services in conservation action. Over the past ten years, environmental governance and decision-making have been significantly and increasingly impacted by the ecosystem services paradigm. However, the literature on ecosystem services governance highlights important conflicts including scale, identifying and involving stakeholders, understanding ecosystem services, and sharing the framework. Policy makers, NGO administrators, and even researchers still have unanswered questions about how to apply this evolving framework in practice.

Second article, discussed on the limitations and prospects for market-driven funding for preserving and repairing blue carbon ecosystems in Australia. The study explains on the opportunities to improve on current practice, including better stakeholder engagement and targeted use of public and philanthropic funding [27]. Effectively financing and implementing blue carbon restoration projects necessitates a multifaceted approach that incorporates innovative market-based solutions, informed decision-making tools, and lessons from past restoration efforts. By addressing financial constraints, utilizing supportive tools for site identification, and embracing local knowledge and adaptive management, stakeholders can maximize the ecological and socio-economic benefits of blue carbon ecosystems, ultimately contributing to climate change mitigation and coastal resilience. This integrated approach is essential for the sustainable protection and restoration of these vital ecosystems.

The third article emphasises how important local community attitudes are to the efficient management and preservation of the Coral Triangle's blue carbon ecosystems. It reveals that while some communities possess a strong understanding of the ecological and socio-economic importance of these habitats, others require further education and engagement to foster stewardship. To optimize the benefits of blue carbon ecosystems, it is essential to incorporate local knowledge and values into conservation strategies and policy frameworks. By actively involving communities in decision-making processes, stakeholders can enhance local ownership and support for restoration initiatives. This inclusive approach not only promotes the sustainability of blue carbon ecosystems but also empowers local communities to address environmental challenges, ultimately contributing to climate resilience and biodiversity conservation in the Coral Triangle region.

In Indonesia context, participating in ecosystem service evaluations with local communities helps in defining their position in multi-governance of ecosystems, the significance of ecosystem services (ES), and the variables influencing social preferences and trade-offs associated with decision-making and land-use change [28] The complexity of mangrove governance necessitates cross-agency and multi-stakeholder collaboration at the national and sub-national levels, notwithstanding the Presidential Regulation No 82 year 2020 simplifying the national institutional architecture for mangrove management [29]. Hence, the success of blue carbon ecosystem conservation in Indonesia hinges on the active involvement of local communities, governments, NGOs, and the private sector.

There are several restrictions on this study. First, because the sample of articles vary and had constraints, the combination of search queries in the Bibliometric analysis could have led to limitations and misunderstandings. Secondly, this analysis solely looked at the Scopus database. Extracting useful information from many databases—for example, by using sample articles from Science Direct, Google Scholar, and other sources—can yield more thorough data for bibliometric analysis in the future and enhance systematic literature review analyses. Thirdly, the articles that were chosen were limited to those written in English. Acquiring a thorough and in-depth comprehension of non-English articles is advised.

4 Conclusions

Although still limited, there is growing evidence of interest in disclosing stakeholder engagement in the blue carbon sector, as seen through a small but notable number of publications on the subject. Between 2014 and 2024, only 13 relevant studies were identified, with no prior research available in Scopus addressing this topic before 2019. Australia leads in research contributions, yet overall, only a handful of countries have shown interest in this area. The analysis reveals that stakeholder engagement in blue carbon research shares similarities with broader stakeholder frameworks, utilizing qualitative methodologies such as interviews and discussions. Mapping and identifying stakeholders are highlighted as a crucial preliminary step, underscoring the need for systematic approaches to engagement.

By fostering strong partnerships and facilitating open communication, stakeholders can address financial constraints and leverage opportunities for sustainable funding. Furthermore, integrating local knowledge and adaptive management practices ensures that restoration efforts are contextually relevant and ecologically sound. Lessons learned from past restoration projects highlight the importance of stakeholder participation in planning and implementation to enhance project outcomes and maximize the socio-economic and environmental co-benefits of blue carbon ecosystems. Ultimately, an inclusive and stakeholder-driven approach is essential to sustainable preserving and restoring of blue carbon ecosystems, contributing significantly to climate change mitigation and coastal resilience.

In line with the previous study, in order to guarantee the sustainable development and protection of blue carbon ecosystems, it is crucial to look into stakeholder preferences, particularly those pertaining to livelihoods. The study on stakeholder engagement in blue carbon sector, needs to be further explored.

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