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Where and how can Africa and India leverage the blue economy opportunities of the Indian Ocean region as a driver for sustainable development and partnerships?

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ABSTRACT

Through the blue economy (BE), Africa and India can attain sustainable development, transnational partnerships, and continental engagement targets, never been seen before. However, efforts on how this could be done have been pedestrian and less explored. This review and perspective paper utilizes a bibliometric analysis technique to analyze 1712 documents, systematically sourced from Scopus. Thus, this paper situates itself as one of the first scholarly pieces to comprehensively highlight strategic aspects that could advance sustainable Africa-India regional development partnership. Mixed comparative results are found in the literature. Since 2012, research on the BE in Africa and India has increased. The BE is emphasized as a critical topical issue in Africa, albeit this is mostly led by non-African scholars and institutions. In India, most BE research perspectives target regional issues, e.g., in the Indo-Pacific region. African researchers have published more in high-impact journals compared to their Indian counterparts. The annual growth rate of research on the BE in India is comparatively higher than that of Africa (8.69 to 5.49 percent, respectively). However, the average citations of research in all regions are declining. African authors have higher national and international co-authorship collaborations. Collaborations between Africa and India on the BE are few. Most country-level collaborations are with developed nations. Nevertheless, there is recognition of the increasing vulnerability of Africa's and India's coastal communities to megatrends and marine environmental threats. Most documents emphasize that the resource endowments in the Indian Ocean (IO) could mitigate maritime challenges to socioeconomic development and environmental stewardship. Five valuable findings are emphasized: (1) the BE is essential to the prospects of sustainable development, (2) inclusive and sustainable actions are needed to address coastal socioecological shifts, (3) several BE solutions are proposed but not put into practice, and (4) BE partnerships in the IO must include China and other emerging states of the Global South, and (5) the IO is paramount towards sustainable BE between Africa and India. Borrowing from the literature insights, and as a contribution to BE-led sustainable development partnerships between Africa and India, five strategic leverage points are identified and developed: socio-cultural, economic, institutional, environmental, and scientific. As the development of BE engagements and partnership is a new development arena in Africa and India, policymakers and researchers should: (a) initiate the Africa-India BE journal, b) leverage and link Africa's and India's existing BE initiatives, visions, and programs, c) reimagine Africa and India's development connotations, d) start slowly but consistently, and e) recognize existing shared sustainability or sustainable development visions. To achieve this, the IO must be recognized as a shared natural resource that has the potential to compartmentalize and link the proposed leverage points. Thus, policymakers and researchers must work towards rejuvenating shared ties, histories, vulnerabilities, and BE visions. This can help strengthen regional partnerships, trust, and collaborations for a better and sustainable BE.

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1. Introduction

The 21st century is witnessing a nexus of renewed geopolitical shifts and neostrategic partnerships that could determine how emerging and/or developing countries match global development agendas [1–4],. Amidst the current Sino-U.S. (United States) global geopolitical contestations and mumblings, emerging and frontier countries are braced for tougher times [5–7]. As has been a *modus operandi* since colonial times, the changing development shifts and partnerships have perpetuated a continuum of historical development deficiencies that matured due to Western-centric/rich countries' development models [8–10]. Western-centric development models have relegated emerging economies as: (i) dependents on official development assistance (ODA), (ii) arbitrary economic and or financial beggars, (iii) development policy consumers and subordinates, and (iv) passive players in the sustainable development policy theatre [9,11] (Also see *Appendix 1*). This is partly because 'development support' used as a 'gold standard' for securing ODA and concessional loans is determined by the Organization for Economic Co-operation and Development's (OECD's) Development Assistance Committee (DAC) [12–14]. The resultant national and regional development indicators emanating from this model, especially after the COVID-19-induced lockdown and 'economic relief packages,' have been always worrisome, at least and unjust, at most (https://www.oecd.org/). Although ODA from DAC member states rose to a record high of US$223.3 billion in 2023 (a 1.6 percent increase from 2022), it was meager when compared to the United Nations' targets. Unsurprisingly, only five DAC countries met or exceeded the United Nations' target of spending 0.7 percent of their national wealth on ODA (https://www.oecd.org/).

Although developing countries received a total of US$258.4 billion in the form of development aid (including concessional loans, financial offers from providers outside the DAC, outflows from multilateral/philanthropist organizations, and ODA) in 2023, which helped mitigate crises, e.g., floods and health issues, most of it was tied aid or development support (www.oecd.org). For instance, the largest percentage of the +3 percent and +4 percent increase in total aid and concessional finance to sub-Saharan Africa and least developed countries from 2022 to 2023 was tied to aid on social issues, rather than key infrastructure developments, e.g., in technology, transport infrastructure, and targeted skills development (See *Appendices 9–10*). This means that donor economies' aid and ODA (un) surprisingly just massage the real development support or targeted visions required for equity and inclusive development in recipient countries [9,11]. Little wonder that most emerging and/or frontier countries are unable to satisfy their development targets, arbitrarily accept concessions, and experience budgetary deficiencies, a barbeque for perpetual underdevelopment, forced migrations, missed development targets, and acute dependence syndrome [15,16]. For instance, tied donor conditions have led to concession agreements on key resources, such as coltan, titanium, and sand in resource-rich developing countries, e.g., the Democratic Republic of Congo (DRC) [9,11,17]. Although some developing countries have sought country-specific needs development support from China, the results have remained the same or pedestrian: conditioned aid with exorbitant interest rates [12,13]. Where ODA and aid support are channelled to projects and programs that promote socioeconomic transformations, such as agricultural modernization, they have sprouted unfathomable, unsustainable externalities, notably, greenhouse gas (GHG) emissions [9,11,18,19]. For instance, 51 percent of terrestrial-based GHG emissions are concentrated in China, India, and Indonesia [18,20]. Most of these have arisen out of complex megatrends, especially industrialization, urbanization, and large-scale commercial farming (due to the green revolution) in developing countries [18,20,21]. Overall, anthropogenic land-based activities have transformed two-thirds of the planetary surface, with cropland and artificial surfaces increasing by 133 % from 1992 to 2020 [20].

In Africa, the insatiable appetite for development transitions has led to excessive natural resource exploitation, elite capture, and land dispossession/eviction of vulnerable communities/populations to attract foreign direct investments and large-scale development (agricultural and industrial) projects [1,17]. These have bubbled innumerable hidden and overt social, economic, and environmental costs [22–26]. The complex development conundrum, passage of time, and history proved that ODA might not be the magic bullet to the sustainable development targets in emerging countries [12,27]. The unsustainable indicators proliferated by the dependence-driven development model are confirmed in recent studies that revealed that with 5 years to Agenda 2030, no country has attained the Sustainable Development Goals (SDGs) [12,27]. Unsurprisingly, out of the 107 countries analysed from 2000–2022, countries in the Global South (Africa, Asia, South America, and the Caribbean) have the worst SDGs progress indicators (Fig. 1). In Fig. 1, the PC1 indicates the primary principal components of the primary patterns in the captured or analyzed data. PC2 indicated the secondary principal component of the analyzed data. Negative scores indicate SDG regression, and positive scores indicate SDG progression. The two-dimensional plot represents the positioning of countries concerning the SDGs. Lines link points in different years for each continent. Oscillating paths suggest varying rates of advancement, with Africa and Asia slightly lagging as compared to Europe. The black dot in the lower right corner represents the ideal goal for achieving the Agenda 2030 of the United Nations SDGs.

The lacklustre progress towards the realization of SDGs targets and indicators cripples global Agenda 2030 and future sustainable development targets beyond 2030 [28–30]. A rethink of the global development paradigm is urgently needed, especially with the increasing focus on futurology or futurism [31,32]. However, as evidenced by the burgeoning protectionist policies, e.g., under the United States administration (2025–2029), we postulate that attaining fair development transitions that benefit developing economies might be hatched through the ocean. In this perspective paper, an argument is presented to advance the blue economy (BE) as a novel answer to the sustainable development questions lingering in emerging or developing economies and regions. Before validating this perspective, a contextual perspective on the BE is presented in *sub*-Section 1.1.

1.1. Contextualizing the BE as the hope for emerging economies and regions

Since 2012, the BE has been envisioned as a novel development paradigm and new frontier for sustainable livelihoods and development, especially among emerging and small island developing states (SIDS) [22,28,29]. Although the BE-induced development model was hatched by emerging economies, especially SIDS at Rio +20, it provides promising sustainable ocean development indicators never seen before [17,33]. Part of this is well-documented in the working definition of the BE,

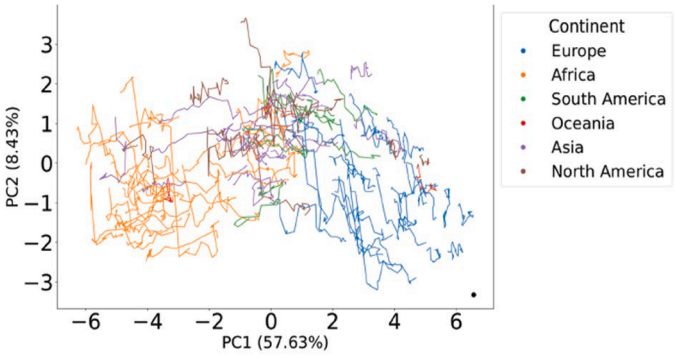

Fig. 1. Principal Component Analysis (PCA) SDG progress trajectory by continents from 2000–2022. (Sourced from [27] and slightly modified by the authors).

as advanced in expert panel reports [19,34]. The BE is defined as

> '*an ocean-based economy that provides equitably distributed social and economic benefits for current and future generations while restoring and protecting the intrinsic value and functionality of coastal and marine ecosystems, and is based on clean technologies and circular material flows*.'

This definition categorically reveals that the BE addresses the triple bottom lines of sustainability, and redresses the socioecological bottlenecks that have perpetually affected developing economies, e.g., gender exclusion and inequalities [29,35–40]. Statistically, it is reported that a sustainable BE (via ocean goods and services) would fetch US$22 trillion by 2050. By emphasizing sustainability and BE transitions across the five sustainable ocean development pillars, the BE avails realistic targets for realizing the Ocean Decade targets and SDGs beyond 2030 [17,28,41]. These targets are possible if inclusive development models, pathways, and frameworks are developed across the three BE classes and thirteen BE sectors (See *Appendix 2*).

Realizing the opportunities availed through the BE, rich countries and regions have proactively and futuristically initiated strategic programs, partnerships, and ocean-based initiatives [19,42]. In the European Union, for instance, efforts to operationalize the Marine Spatial Planning (2014/89) and marine strategy framework (2008/56) directives are fast-tracked [43]. More robust national and regional-level initiatives are being advanced, e.g., in North America. For instance, Canada has launched the BE Strategy 2040 as a comprehensive vision and plan to harness the untapped potential of Canadian marine resources and ocean space, including integrated ocean energy system models [44,45]. To reduce marine freight. seafoods and research costs and/or dependence on the Global South, developed or rich economies envision creating navigable sea routes in the Arctic Ocean [46,47]. More ambitious BE projects have been launched or envisioned by China, such as the *Marine Silk Road Initiative* [48,49]. In all these populist and extensive capital-intensive investments, developing and frontier regions, such as Africa, South America, and India, are mostly secluded [12,13]. As a reactionary measure, strategic BE initiatives have been developed. The 2021 draft BE framework and Marine India Vision 2030 have been developed in India (FICCI, 2021; [50]). Through this, India would reap at least US$700 billion under an improved business-case scenario and an estimated US$1–2 trillion in the next few decades ([29]a). Conversely, Africa, through the African Union (AU), has launched the *Blue Wall Initiative, Ocean Governance Strategy,* and Agenda 2063 to, among other things, develop strategic frameworks for sustainable development and inclusive growth [23,29]. By 2030, through a sustainable BE, Africa could reap US$405 billion [17]. Pacific Island nations have also formed organizations, such as the Pacific Island Forum (PIF), which includes 18 countries and territories, with the hope of benefiting from the '*Blue Pacific'*, as categorically emphasized in the PIF's 2050 Strategy for the Blue Pacific Continent [51]. These are promising strategies and initiatives that could invigorate the Global South renaissance. This could be true, if the BE-induced development paradigm entangles collaborative regional development narratives and addresses regional (mal)development issues.

1.2. Policy and scholarly gaps and issues that warrant reimagining sustainable development partnerships and regional engagements

A foundational cornerstone of this perspective paper is hinged on evidence that with the increasing geopolitical contestations, shifts, and (re)strategization, kickstarting impetus for feasible regional cooperation and partnerships, notably with a marine circular and BE-focused perspective, is a valuable and plausible proposition [17,28,52]. The question that emerges in the regional policy and development context, mostly in emerging countries and regions, e.g., in Africa and India, is: what magic bullet could halt or help in the comprehension of historical and emerging issues, such as declining foreign direct investments (FDIs), protectionism, declining border trade, and partnership? Although the BE is a promising paradigm, what is not seen in most literature is the comprehensive synthesis of existing knowledge to situate the diverse trends in (under)development, which would enhance strategic learning and development cooperation rethinking. This means that sustainable development transitions, espoused under emerging development frontiers, e.g., the BE, will holistically and squarely depend on how well policymakers and researchers understand the diverse oscillations and chronological trends, and networks in the global and regional development arena, including in the Ocean-scapes.

However, in most SIDS and emerging countries of the Global South, what still looms large is what, how, when, and where knowledge on sustainable BE partnerships and cooperations should evolve or be hatched [7,22,53]. In this paper, we argue that a credible starting point should be: (i) exploring the research and policy dynamics in vulnerable countries or regions with shared (mal)development struggles or histories, and (ii) reflecting on what emerging economies or regions with shared resources and future development aspirations in the Global South, could offer in extruding or showcasing effective sustainable win-win development agenda and partnerships with tangible or acceptable development outcomes. Additionally, as emerging countries and regions in the Global South, such as those under the South-South Cooperation (SSC) and the BRICS (Brazil, Russian Federation, India, China, and South Africa), are painfully seeking solutions that can (re)-ignite inclusive and sustainable development, scholarly focus on documenting the plausibility of new development frontiers, e.g., in the vast maritime zones, could accentuate sustainability transformations or possibilities never seen before. Surprisingly, perforations are still prevalent in policy and research, as most economies and regions still don't know where or how to start in leveraging their unique maritime endowments, notably in the regional tropical marine zones, e.g., the Indian Ocean, Southern Atlantic, and Pacific Ocean, among others. As a contribution to policy research and directions, this study hypothesizes that the BE as a new frontier could be leveraged to attain the long-forgotten positive development trajectories that emerging countries yearn for. Two case study regions of Africa and India are utilized to show how this could be done. Before documenting this, *sub*-Section 1.3 gives the rationale for choosing the two case studies.

1.3. Rationale for advancing the blue economy-led sustainable development and regional engagements or partnerships between Africa and India

Africa and India are experiencing stratospheric megatrends never seen before [29,31,54]. Five megatrends are prominently happening across Africa and India: (i) economic trends, (ii) socio-demographic shifts, (iii) technological shifts, (iv) ecological and natural resource management or resource nexuses and contestations, and (v) political trends [31,32,55,56]. In all jurisdictions, commonalities in the interconnectedness of various megatrends and the fears they pose toward sustainable futures are reported. Accordingly, megatrends are deep and long-term transformation processes and key shifts that cause major disruptions in socioecological systems and their interactions [54,56–58]. Most often, the megatrends lead to irreversible occurrences, which are, most often, dotted with unsustainability ramifications to key development sectors [17,1928,31]. According to the US Bureau of the Census population statistics indicators, in 2024, India had a population of 1409,128,296, and Africa had 1.48 billion people [59], and is projected to increase, especially in Africa, by 2040 [57] (*Fig. 2*).

Population surges have increased or worsened the demand for food and other livelihood survival resources, and a catalogue of resource nexus constraints. These paradoxes could lead to regression in Agenda 2030 of the United Nations SDGs, or proliferate regional vulnerabilities, e.g., forced migrations or resource conflicts [31,32,55–58]. Additionally, infrastructure developments have increased the demand for natural resources, e.g., sand and energy, way higher than the existing policy

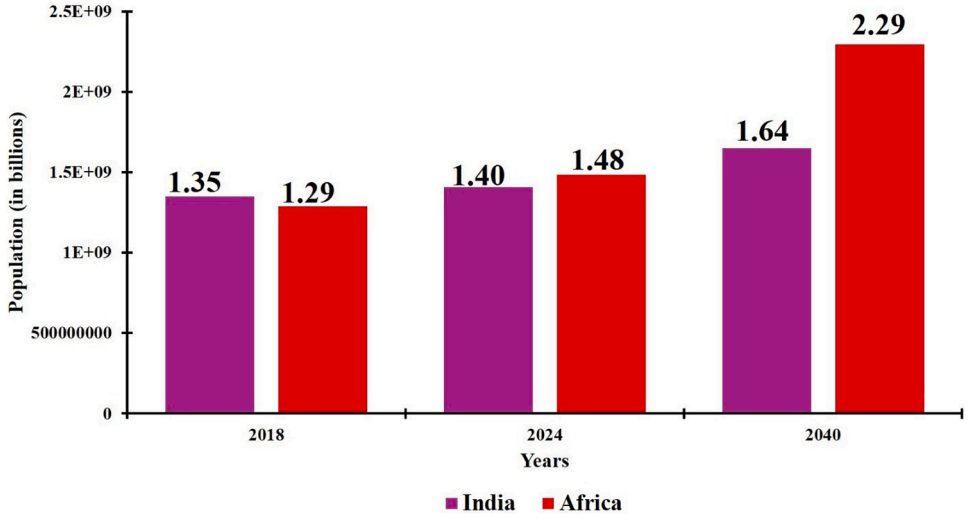

Fig. 2. Population trends and changes for Africa and India (Sources: Authors' creation based on data from the CIA, n.d; [57]).

scenarios [29,57,60]. Unsustainable natural resource and energy demand spikes undermine sustainability targets, posing bleak futures to the entire global energy system, in the context of green transitions or reduced carbon or GHG emissions [19,52] (Also see Fig. 3). By 2060, construction sand demand is expected to increase about 86 Gt (Gigatons) by 2060; with India's sand demand expected to exceed 1.5 billion tonnes by 2030 [60]. Conversely, Africa is experiencing construction sand scarcities, mining-induced sustainability costs, and revenues losses due to sand importation [17,61]. In Fig. 2, it is observed that although policy instruments to mitigate leading GHG-emitting energy sources, e.g., coal, are advanced, there is a projected increase in energy demand, and with the world economy growing at about 3.4 percent annually, the demand for gas is projected to increase [57]. This means that demand-driven non-renewable energy increases are expected to rise, in conflict with the rising interest in low-carbon energy transitions [62,63]. With oil markets projected to surge to 65 million barrels per day (mb/d) in 2040, reversing to unsustainable energy scenario indicators last seen in the 1990s is an increasing reality [57].

The insights in the preceding paragraphs anecdote that megatrends and the associated trade-offs from the economic-centered development approaches (mostly centered on extractivism, mass production, and consumerism) have challenged policymakers and communities in the way we think, communicate, and envision the future. With the changing current geopolitical and ecological context, calls for a reconsideration of traditional development paradigms in favor of regenerative, inclusive, and resource-based models, especially in Africa, India, and China, have increased [19,57]. This is because India has emerged as the largest source of demand-driven growth, and Africa is projected to become a key factor in influencing global growth, development, and megatrends [17,57]. Thus, how Africa's and India's decision makers brace for these development paradoxes to chart sustainable development futures will posit grandiose global development trajectories, and a cobweb of future regional partnerships and development agendas.

Recognizing this emerging space, policy actors and development practitioners in both regions, owing to the failed development attempts in the terrestrial landscape (brown and green economy or revolution), are pivoting towards the maritime space, i.e., BE. Headlining Africa's futuristic development agenda, the AU Agenda 2063, which superimposes Africa's oceans (BE), as an untapped landscape that could cascade sustainability transformations, and usher in comprehensive regional and continental development outcomes aligned with global development targets, including the leveraging of ocean-based sustainable economic opportunities [17,23,31,32,54,55,57]. Conversely, since 2015, notably after the formulation of the 2021 draft BE framework, India has

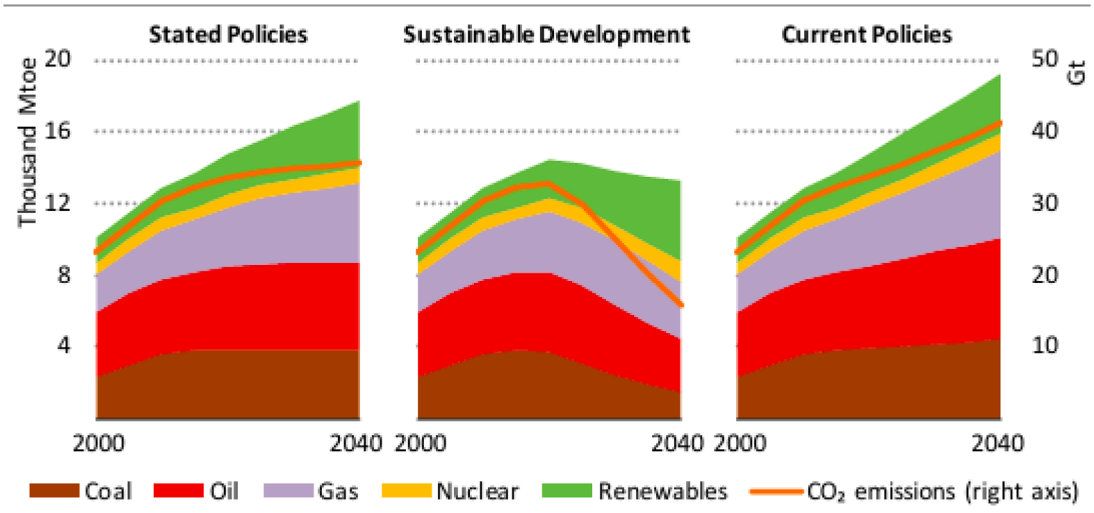

Fig. 3. Sustainable development scenario representation of the global primary energy demand based on fuel and other energy resources emitting carbon dioxide (Source: IEA's World Energy Outlook report, 2019).

headlined the BE as pivotal to its development vision, stipulated under the Maritime India Vision 2030 and *Amrit Kaal 2047* [28,29,33]. Through this, India has captioned seven priority BE sectors or themes that are primed to ameliorate socioeconomic, regional, and national development worries.

These ambitious marine-focused initiatives and programs accentuate a renewed fervor for Global South-led development or global stewardship in determining sustainable development futures [13,14,61]. Additionally, they present a noble opportunity to probe and pilot strategic research and policy development takeaways or initiatives, that could be channeled into mainstream policy to chart sustainable BE development paths. This is because, Africa and India have not only prioritized the BE as a possible conduit for development [25,28,29,33,35], but are also trying to craft and streamline, institutional mechanisms to promote regional BE partnerships, e.g., in the Indian Ocean Rim, through partner initiatives, e.g., the Indian Ocean Rim Association (IORA) (the IORA vision for regional partnership among countries in the Indian Ocean countries was kickstarted in 1995 when President Nelson Mandela visited India) [64,65]. In fact, President Nelson Mandela underlined that

> '*The natural urge of the facts of history and geography should broaden itself to include the concept of an Indian Ocean Rim for socio-economic co-operation…*' (Sourced from www.iora.int), signifying the link Africa and India could play in the global development and strategic partnership sandwich.

These are noble initiatives that could guide policy and research on sustainable development. Surprisingly, the rhetoric towards regional cooperation among African countries and India has receded over time. Today, most of the regional states are cajoling with established or developed economies, some of which are accountable for the underdevelopment woes and injustices across Africa and in India [13,14,17,23,28]. Nevertheless, global policy shifts have rejuvenated efforts to break the unjust development histories and bring in a cycle of shared justice, development, and sustainable future visioning [23,32,56,61,62]. This means that emerging and frontier countries and regions have an unquestionable heaven-sent opportunity to: (i) reorganize their development futures, and (ii) determine how or where to chart a sustainable future. In the context of Africa and India, this could be refurbished through the BE. This paper situates itself as one of the first scholarly pieces to comprehensively source and analyze literature to highlight strategic aspects that could advance the Africa and India regional development partnerships, with a focus on the BE. To further contribute to the mushrooming BE development arena, valuable sustainability partnership leverage points in the BE are spotlighted. The leverage points are mapped, synthesized, and interlinked to the diverse development strategies envisioned in Africa and India, to anecdote the necessary policy and research starting points that could cement strategic development partnerships and future engagements in other development arenas. Specifically, in this paper, three questions are probed as a situational response in understanding the existing trajectory of the BE, including

a. What are the performance trends in research and policy networks on the BE in Africa and India, and what do they reveal regarding the requirements for strengthening regional engagements and development partnerships?
b. What are the ramifications of the current research and policy insights in the BE of Africa and India toward the development of sustainable development partnerships and engagement arenas?
c. Are current mechanisms fit enough to address historical development deficiencies between Africa and India? What specific gaps and barriers exist? How can existing research help unravel critical leverage points that contribute to the development of novel and sustainable BE regional pathways/partnerships between Africa, India, and other emerging/frontier economies of the Global South?

2. Research method utilized

The study utilized secondary literature sourced from the Scopus online database through a systematic literature review (SLR) technique [66,67]. A coherent process was leveraged to explicitly source, analyze, and report findings from literature on the development prospects availed by the BE in Africa and India.

2.1. Literature sourcing

Literature utilized to bring out study findings and insights was sourced on Tuesday, 11th March 2025. To source literature, the Scopus digital database was utilized. The focus on utilizing the Scopus database was because: (i) it is one of the comprehensive repositories of peer-reviewed literature on a given topic, and (ii) unlike Science Direct, Scopus allows for the direct download and synthesis of sourced literature as Microsoft Excel CSV files [29,67]. As bibliometric analysis was envisioned as a technique for data analysis, this eased the importation of sourced literature for analysis [68]. Two customized search queries were made to explicitly include literature capturing BE issues in Africa and India. The first query was TITLE-ABS-KEY (ocean AND econom* AND in AND India) AND PUBYEAR $>$ 2011 AND PUBYEAR $<$ 2025, and 887 documents were obtained. The second query was TITLE-ABS-KEY (ocean AND econom* AND in AND Africa) AND PUBYEAR $>$ 2011 AND PUBYEAR $<$ 2025, and 825 documents were included. Thus, a total of 1712 documents were included without filters. Separate Microsoft Excel CSV files for Africa and India were downloaded for comparative analysis purposes.

2.2. Data analysis and reporting

A bibliometric analysis technique was utilized to analyze the 1712 documents. The popularity of the bibliometric analysis technique stems from its ability to contextualize huge datasets on a given topic and capture key research performance themes, indicators, policy networks, structures, and their interrelation [29,68]. Additionally, the bibliographic analysis of data allows for bringing out key qualitative and quantitative information from the sourced literature [67]. This made it suitable for capturing comparative indicators in research on the BE in Africa and India to bring out key policy insights for learning about sustainable development prospects. A step-by-step process was undertaken to analyze and report findings that answered the research objectives confidently.

First, the RStudio program was downloaded, installed, and executed on the computer. This was followed by installing a bibliometric analysis, Biblioshiny in R, as guided by previous studies [29,66,68]. Four steps were followed to install the Biblioshiny tool in RStudio: (i) installing Bibliometrix by clicking on packages, (ii) typing "library(bibliometrix)" and pressing run, and (iii) typing "Biblioshiny ()" and pressing enter. The analysis was completed on an automated dashboard that appeared upon entry. Seven comparable bibliometric analyses were conducted to capture key insights on the BE in Africa and India comparatively (See Fig. 4). The analyzed data were modified to highlight comparative tabulations, visualizations, and figures that reveal critical research, policy, and conceptual and thematic networks on the BE. These could help reveal critical policy and research issues to guide sustainable BE partnerships and development opportunities between Africa and India.

2.3. Limitations of this study's methodological process

While SLRs provide a catalogue of peer-reviewed articles or documents from which valuable insights into diverse topics can be uncovered, we acknowledge some limitations that should be recognized to guide future research. Firstly, while the 1712 documents captured diverse governance and sustainable development perspectives on the BE in Africa and India, only one database, i.e., Scopus, was utilized.

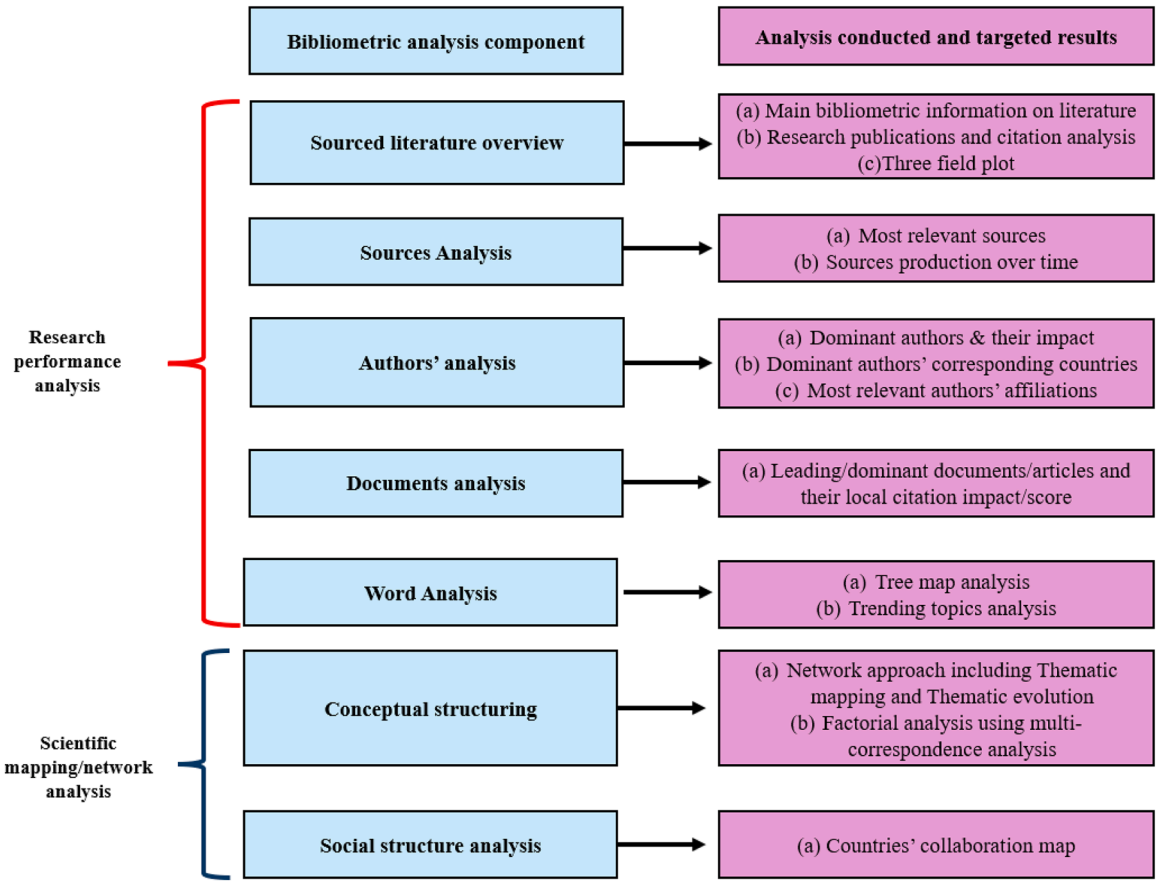

Fig. 4. The seven bibliometric analyses conducted to unravel key findings in this study (Source: Authors' development).

Although this was due to the cost limitations required to access other multidisciplinary data repositories, such as Web of Science, this might have limited the capturing of some unpublished reports or research that capture valuable perspectives on Africa-India development partnerships. Second, the included documents were entirely in English, and yet Africa and India have diverse literatures published in other regional, national, and local languages, e.g., French in West Africa and *Kannada* in Karnataka [69], or *Malayalam* in Kerala ([17]a), states of India. Third, the utilization of only the bibliometric analysis technique implies that in-depth extraction and exploration of valuable possibilities or elaborate examples of Africa and India's sustainable development opportunities, especially in the BE around the Indian Ocean, might have been missed. To ameliorate these limitations and enhance the reporting of representative and replicable findings, in Section 4, we utilized the Google Scholar database to source policy reports and documents that explicitly elaborate on the intricacies behind historical and emerging partnership and development opportunities between Africa and India, such as the 2019 FICCI and IORA reports [33,64,65], among others. This helped in the sourcing of evidence-based narratives, quantitative data, and perspectives that were utilized in identifying, expounding, and accounting for the need to advance the five developed leverage points. Nevertheless, practical efforts and evidence-based facts in research and policy are still needed to catalyse efforts towards advancing sustainable development partnerships and engagements in the BE between Africa and India. As a precaution, researchers can utilize mixed methods and a case study approach from coastal zones of India and Africa, e.g., around the Kenyan coast, to explore the situational BE opportunities and perspectives on how or where sustainable BE partnerships and engagements between India and Africa could be co-designed, implemented, and streamlined.

3. Results and discussion

3.1. Comparative summary of the sourced and analyzed literature

A general overview of the literature on the BE in Africa and India is indicated in Table 1. Findings reveal mixed comparative results in the sourced literature. In some components, African scholars, researchers, and institutions reveal better indicators than India and vice versa. In the main information category, the annual growth rate of research on the BE in India is comparatively higher than that of Africa (*8.69* to *5.49* percent, respectively). On the other hand, African scholars have published research works on the BE earlier than Indian scholars, based on the average age of published documents. Promising indicators are documented in collaborations, where authors in Africa have higher national and international co-authorship collaborations. This could be critical and vital in the sharing of multi-country ideas and increasing partnerships in the BE space and attraction of collaborative research findings.

3.2. Comparative research performance trends and indicators

3.2.1. Annual research publications performance, citation analysis, and three-field plotting

The number of publications and their citation impact published in Africa and India on the BE are indicated in Fig. 5. Accordingly, publications on the BE have been increasing. India has the highest number of publications in a single year (106 in 2024). Both Africa and India recorded the highest mean total citations (TC) per article in 2018 (41.97 and 50.16, respectively). However, the mean TC per article has plummeted, with worse indicators in India (0.96). A similar declining trend in average citations per year is observed in all jurisdictions (See *Appendices 3a* and *3b*).

Table 1
Comparative summary of the bibliometric information of the analyzed literature on the BE from 2012 to 2024 (Source: Scopus/Biblioshiny).

Research timespan (2012–2024, i.e., 12 years)							
Category	Description	Africa Results	India Results	Category	Description	Africa Results	India Results
Main information overview	Sources, e.g., journals, books, etc	548	576	Authors' collaborations	Single-authored documents	275	335
	Documents	825	887		Co-Authors per document(s)	4.27	3.5
	Annual Growth Rate %	5.49	8.69		International co-authorships %	35.15	20.18
	Document Average Age	5.96	5.84	Published document types	Articles	556	557
	Average citations per document	17.83	18.29		Books & Book Chapters	175	210
	References	53,845	50,295		Conference papers & conference reviews	39	60
Document contents	Keywords Plus (ID)	4069	4147		Data papers	1	0
	Author's Keywords (DE)	2613	2659		Editorial	5	6
Authors	Number of authors	3175	2621		Note	4	4
	Authors of single-authored docs	253	294		Review & short surveys	45	50

Note: The green colour indicates a region with a comparatively better bibliometric literature analysis indicator.

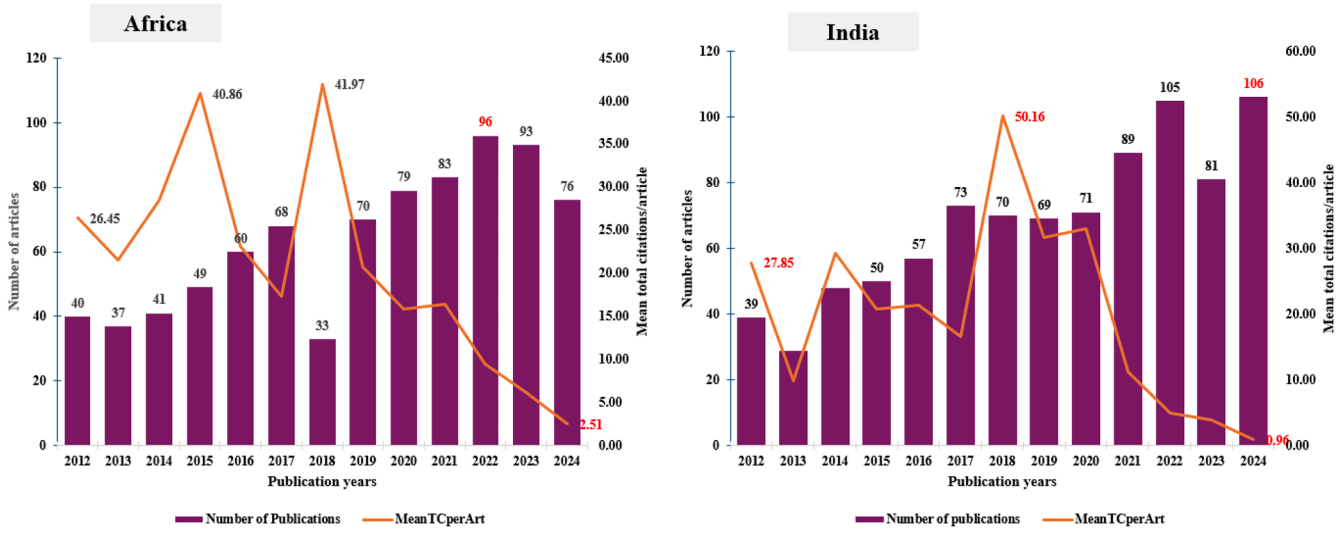

Fig. 5. Performance analysis of research publications and average citations (mean total citations per article) on the BE from 2012 to 2024 (Source: Scopus/Biblioshiny).

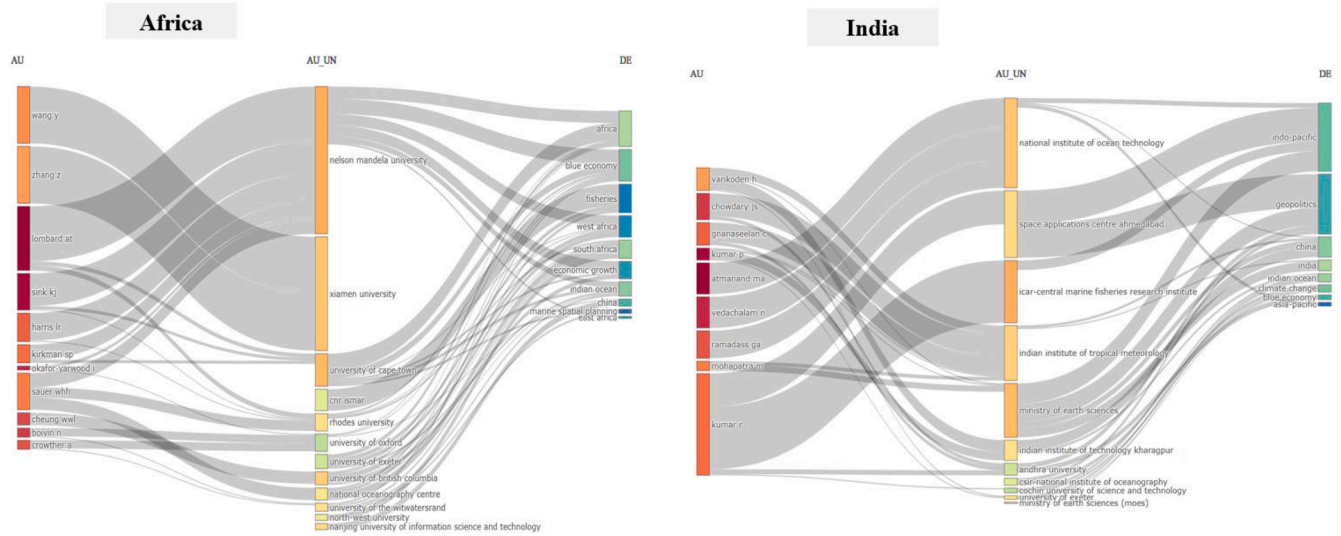

Fig. 6. Three-field plot analysis of the dominant authors, institutions, and keywords emphasized on the BE (Source: Scopus/Biblioshiny).

Three-field plotting partly explains the cause of the mixed comparative research performance results and indicators on the BE (Fig. 6). This analysis helps situate who publishes research on which key topic or area. Accordingly, the BE is emphasized as a critical topical issue in Africa, albeit this is mostly led by non-African scholars and institutions, such as Xiamen University in China. India's scholars and institutions mostly focus on regional issues in the Indo-Pacific region, including geopolitics. The Indian Ocean (IO) is recognized as a burgeoning space for policy and research by African and Indian scholars and institutions. The recognition of the IO is a valuable perspective in the context of initiating Africa-India strategic partnerships and development agenda [70,71]. Recent studies have the IO is not only resource-endowed, but also a nodal hub for mouthwatering maritime goods and services, which are mostly beneficial to global established economies, and not fully tapped by IORA nations [70]. When contextualized within Africa and India's regional development needs, the IO resources, goods, services, and development opportunities could ably satisfy population and national development targets [70,72]. As the IO region represents one-third of the global population, this could be leveraged as the largest consumer market, especially for agricultural, seafood, and textile goods, which frequently experience 'artificial price declines due to flooding of western consumer markets' [70,72].

3.2.2. Sources analysis

This reveals the main journals or publishers of research on the BE in Africa and India. The impact and quartile (Q) of a given source go a long way in determining research impact, ranking, and visibility across academia and policy. In all jurisdictions, there is increased publication of research (*Appendix 4a and 4b*). However, African researchers have published more in high-impact journals compared to their Indian counterparts (Fig. 7). Frontiers in Marine Science is a *Q1* journal well as Maritime Affairs is a *Q4* journal. This doesn't in any way discredit the commendable work of Indian authors. But, with the increasing situation and competition for research project funding, grants, and collaborations with impactful or highly cited research, African researchers might reap more benefits.

3.2.3. Word analysis

Word analysis helps in characterizing and quantifying research output, its impact, and reception within the scholarly community. First, tree map analysis revealed that in Africa, 5 percent of research emphasizes the BE, especially in the Indian Ocean (Fig. 8a). Complex environmental vulnerabilities, such as climate change, account for 4 percent of research. However, only 2 percent of research focuses on India. Additionally, only 1 percent of research is conducted on possible impediments to BE and regional development, such as maritime security, piracy, ocean governance, vulnerability, ENSO (El Niño-Southern Oscillation), and remote sensing, among others.

Conversely, in India, concerning indicators for collaborative partnerships with Africa are revealed (Fig. 8b). Only 1 percent of research focuses on Africa, foreign policy, and cooperation. Most emphasis is on regional issues or national level BE programmes or initiatives to ameliorate ocean-based vulnerabilities, such as monsoon and tsunami in the Bay of Bengal, global warming, security, and the Indian Navy, among others. A promising indicator is that 7 percent of research is focusing on the Indian Ocean. In all contexts, colonialism is reported.

The worrying revelations in *sub-sections: 3.2.1 to 3.2.3*, are emblematic of the myopic lens in research to document valuable sustainable engagement and development opportunities as well as the historical interlinkages, socio-cultural ties, and economic connections that have been reported in several ethnographic and recent geological studies between Africa, especially East Africa, and India, especially during the Indian Ocean trade and marine scientific research expeditions, respectively. For instance, cultural studies have reported massive cultural, transoceanic migrations, millennia-long shared civilizations, and commercial exchange histories, which are observable to date, e.g., in Zanzibar and western states of India, such as Karnataka and Gujarat [73–76]. Here, it is claimed that some descendants of African ancestry, called *Siddi*, have assimilated in India. Conversely, in Zanzibar, some Swahili words, such as Gali (transporting mediums, such as bicycle or motorcar), and Gomesi (traditional wear that was brought and adapted by several tribes, brought by a trader known as Gomes, from Goa), emerged from cultural or language exchanges. Recent geological surveys report that the Indian Ocean rim is endowed with 90 % of the world's diamonds, 60 % of the world's uranium, 40 % of the world's gold, one-third of the world's natural gas, two-thirds of the world's proven oil reserves, and 60 % of the world's uranium, and the region is potentially the world's largest area of marine exploitable wealth [70,71,77]. Surprisingly, dominant authors have not reported these unique endowments and opportunities that could entice policymakers. But, owing to the hidden substrates of classical development theories, e.g., the dependency theory, and foundational targets of global politics, with haves and have-nots [78,79], your guess is as good as mine in reasoning why leading global policymakers are not emphasizing these possible sustainable South-South sustainable development opportunities. To Africa's and India's researchers and policymakers, it is valuably paramount

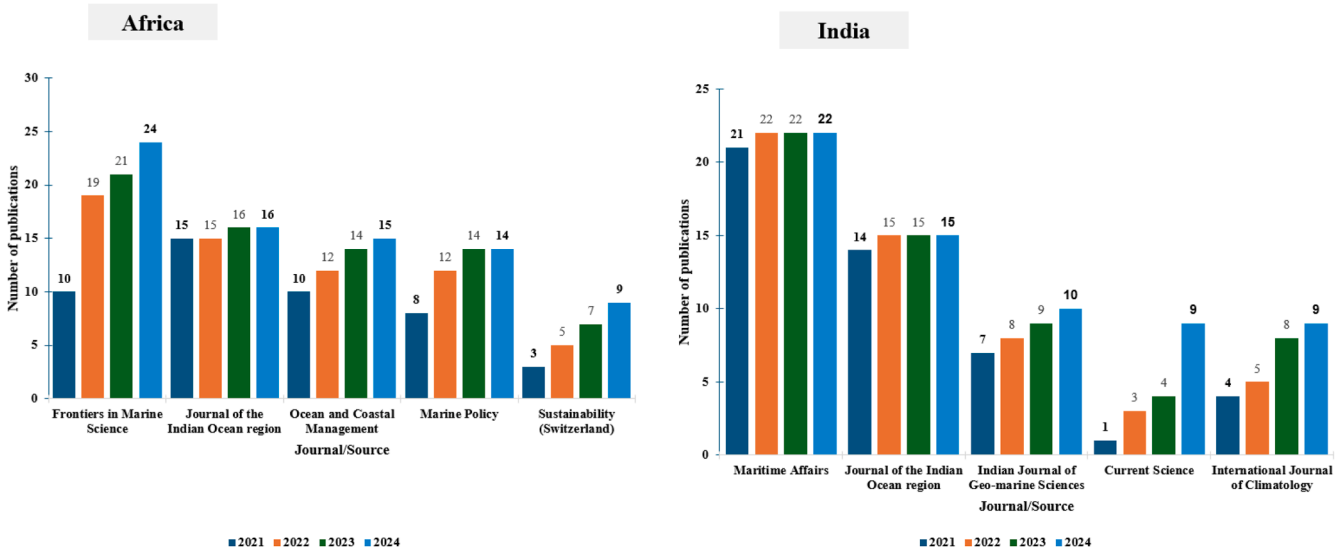

Fig. 7. Analysis of the five leading journals publishing BE-related research on Africa and India (Source: Scopus/Biblioshiny).

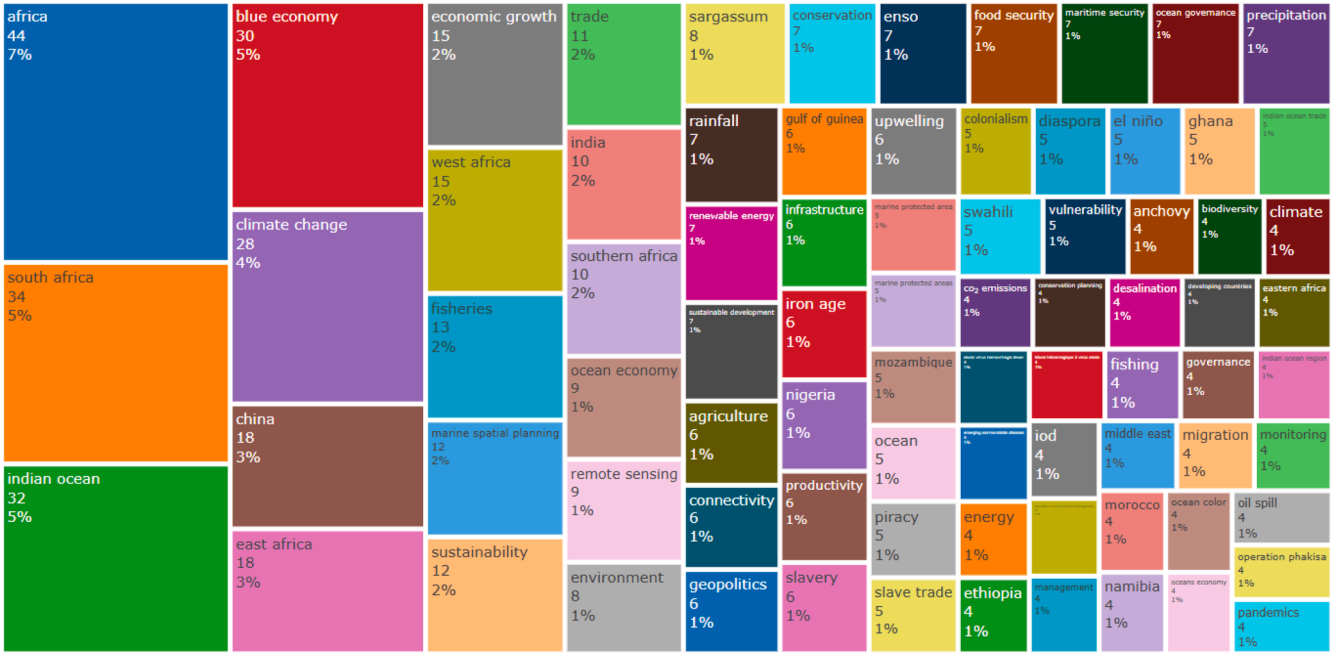

Fig. 8a. Tree map analysis of the 80 dominant keywords in research on the BE in Africa (Source: Scopus/Biblioshiny).

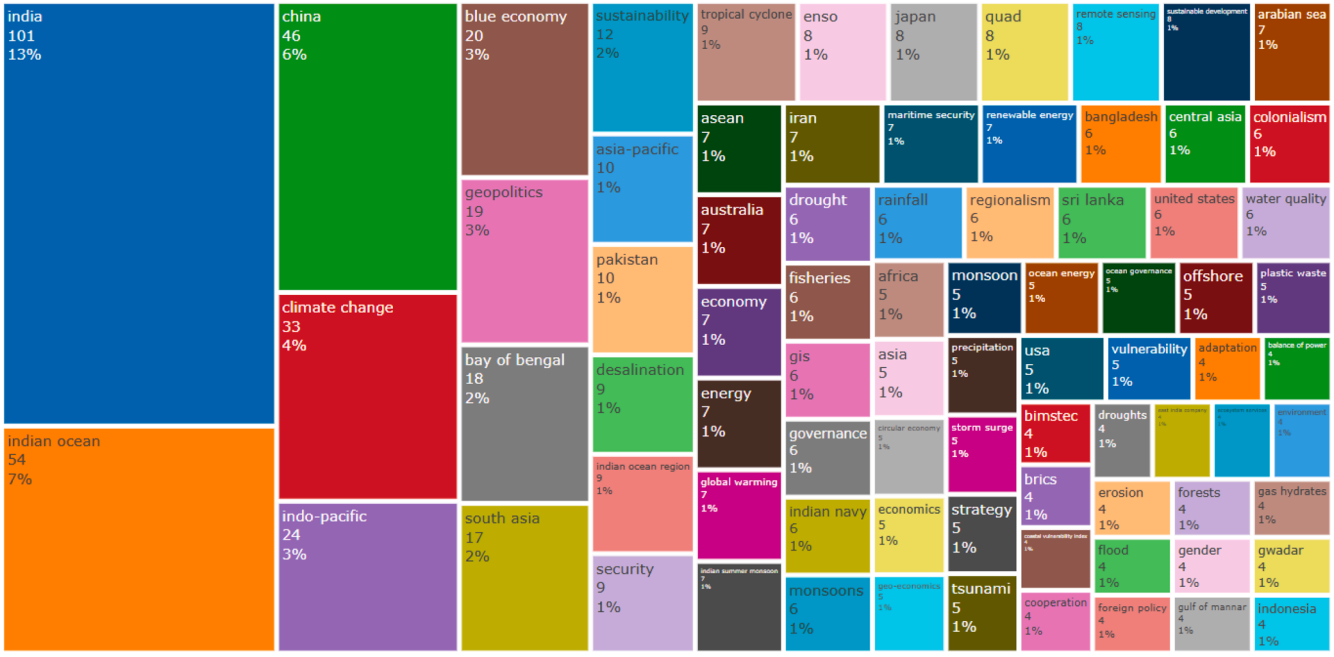

Fig. 8b. Tree map analysis of the 80 dominant keywords in research on the BE in India (Source: Scopus/Biblioshiny).

to unleash a wave of scholarly and policy undertones that epitomize or at least profile these endowments across the IO [70,71,75–77]. This could help reimagine where to outsource resources or investigate in case there is a need to rejuvenate fair socioeconomic agreements, dealings, and robust development initiatives.

Good enough, in all jurisdictions, promising directions for BE partnership and engagement are unearthed through the analysis of the trending topics in research and policy (Fig. 9). Since 2020, the BE, Indian Ocean, sustainability, and climate change have emerged as critical topics in navigating unsustainable ocean development indicators and crippled development trajectories. Fisheries, as a critical BE-sector, are emphasized. In all jurisdictions, China is emerging as a new actor in the BE engagement, partnership, and development space.

3.3. *Authors' analysis*

The works of authors, their affiliations, collaborations, and impact are critical in understanding key conceptual and thematic areas of interest in each field. A comparative analysis of the dominant authors and their impact is indicated in Table 2. Across Africa and India, authors publishing work on the BE have increased. Their works have garnered commendable impact in ocean-related studies. The dominant authors have thankfully documented key insights that could guide BE research, partnerships, and sustainability in India and Africa. In Africa, for

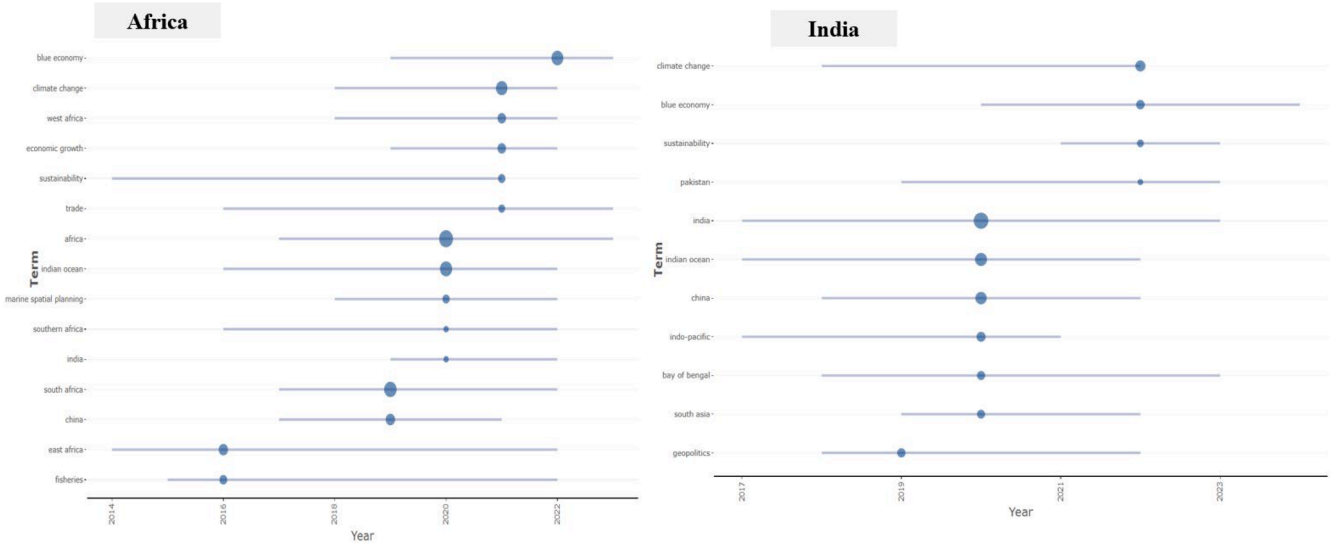

Fig. 9. Trending topics analysis in research and policy on the BE in India and Africa (Source: Scopus/Biblioshiny).

Table 2
Analysis of the 20 leading/dominant authors and authors' impact on publishing research on the BE in Africa and India (Source: Scopus/Biblioshiny).

Africa							India						
Author	h_index	g_index	m_index	TC	NP	PY_start	Author	h_index	g_index	m_index	TC	NP	PY_start
Lombard AT	10	12	1.25	231	12	2018	Varikoden H	5	5	0.5	290	5	2016
Sink KJ	7	8	1	164	8	2019	Bopp L	4	4	0.5	4437	4	2018
Cheung WWL	5	5	0.455	201	5	2015	Chowdary JS	4	5	0.333	33	6	2014
Harris LR	5	5	0.625	112	5	2018	Hazra S	4	6	0.444	85	6	2017
Boivin N	4	5	0.4	194	5	2016	Lienert S	4	4	0.5	4437	4	2018
Crowther A	4	5	0.4	222	5	2016	Sitch S	4	4	0.5	3305	4	2018
Holness SD	4	4	1	71	4	2022	Tian H	4	4	0.5	4437	4	2018
Kirkman SP	4	5	0.571	75	5	2019	Zaehle S	4	4	0.5	4437	4	2018
Okafor-Yarwood I	4	6	0.667	225	6	2020	Agarwala N	3	4	0.429	19	4	2019
Prendergast ME	4	4	0.4	220	4	2016	Atmanand MA	3	6	0.25	36	9	2014
Sauer WHH	4	5	0.571	92	5	2019	Balakrishnan-Nair TM	3	3	0.375	22	3	2018
Sumaila UR	4	4	0.364	59	4	2015	Barbero L	3	3	0.375	3298	3	2018
Zhang Z	4	5	1	142	5	2022	Bhaskaran PK	3	3	0.375	182	3	2018
Appeaning Addo K	3	3	0.75	44	3	2022	Ciais P	3	3	0.375	3197	3	2018
Beaujard P	3	3	0.333	39	3	2017	Dahdouh-Guebas F	3	3	0.273	89	3	2015
Belhabib D	3	3	0.3	170	3	2016	Fernandes JA	3	3	0.3	137	3	2016
Berline L	3	3	0.3	95	3	2016	Friedlingstein P	3	3	0.375	3298	3	2018
Campbell G	3	5	0.231	35	6	2013	Gnanaseelan C	3	5	0.25	29	5	2014
Cowley PD	3	3	0.75	46	3	2022	Harris I	3	3	0.375	3298	3	2018
Da Silva C	3	3	0.75	48	3	2022	Hasan M	3	3	0.375	40	3	2018

instance, the most cited work of Lombard et al. [80] documents that as the southern part of southern Africa is blessed with three oceans around South Africa (the Atlantic, Indian, and Southern Oceans), they are critical determinants to global ocean circulation patterns, marine food biomes, and abiotic species movements. To tap the benefits of these oceans, collaborative ocean governance is key. In South Africa, such as around Algoa Bay, this could be kick-started through ecosystem-based approaches (EBA), such as marine spatial planning. Additionally, authors, such as Sink et al. [81] in one of the notable works (https://doi.org/10.3389/fevo.2023.1108118), reveal that to drive sustainable BE transitions, an iterative approach is needed. This should include situational mapping of marine ecosystems and abiotic resources, and commendable outcomes are being reported. In South Africa, for instance, this has helped in the identification of 34 biozones informed by bathymetry data, and 163 ecosystem types informed by 83 environmental and biodiversity datasets that align with the IUCN Global Ecosystem Typology. These mechanisms can kickstart evidence-based ecosystem assessment, decision-making, and informed ecosystem management and governance.

In India, the works of leading authors, such as Varikoden H, document the increasing environmental vulnerabilities in the Indo-Pacific region and how they will impact coastal (less)vulnerable communities [82,83]. For instance, it is argued that regional climate elements, such as rainfall in the western part of India, are projected to increase monsoons (due to low-level jet stream (LLJ)), and this could lead to coastal flooding [82]. This necessitates long-term climate change planning. Additionally, among the notable works of Bopp L, it is argued that the BE transitions require the development of sustainable frameworks that recognize the socio-ecological synergies. To advance this, understanding the core tenets of the Ocean Decade (2021–2030) is paramount. In the context of Africa and India, this could be enhanced through the co-creation and co-production of enabling conditions, such as sustained political will, partnerships, ocean literature, finance, and marine science-social science integration [84].

Another positive stride is observed in the increased institutional emphasis on the BE. Top research institutions and government ministries, departments, and agencies (MDAs) in Africa and India are advancing research across key BE sectors, such as fishing (Fig. 10). For instance, in India, the Ministry of Earth Sciences (MOES) has drafted India's BE framework that includes seven priority sectors to drive the BE

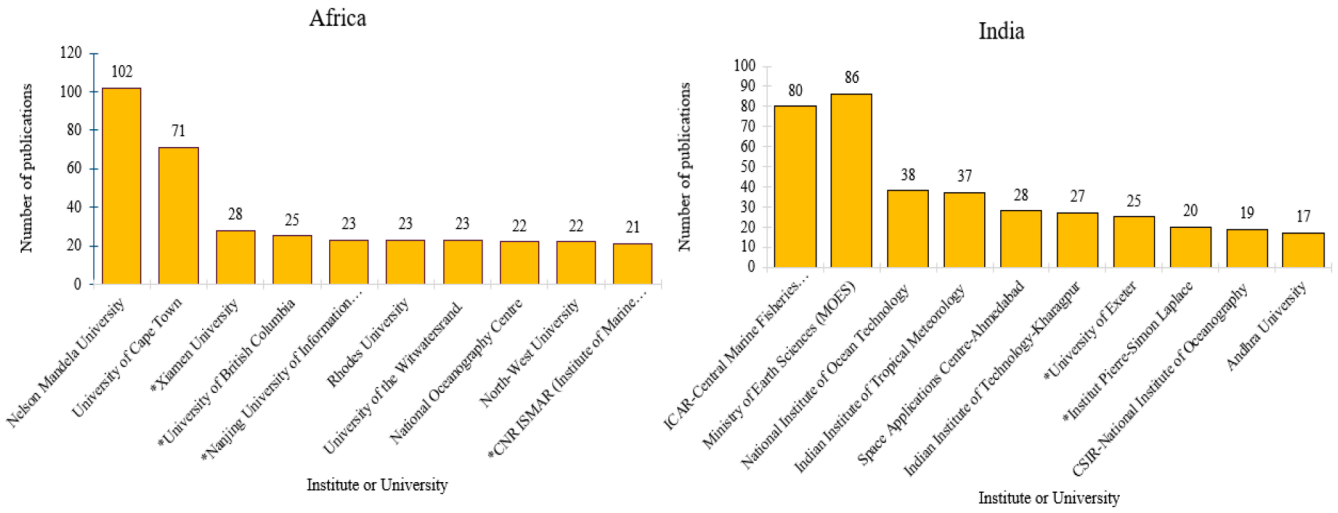

Fig. 10. The leading institutions or authors' affiliations publishing research on the BE in Africa and India from 2012 to 2024 (Source: Scopus/Biblioshiny). NB: The * indicated on some institutions in *Fig. 10* denotes an institution(s) which is not located in Africa or India.

[29,33,50]. In Africa, institutions, especially in South Africa, such as Nelson Mandela University, are developing an integrated ocean governance framework for the sustainable growth of the ocean economy. This is meant to maximise marine socio-economic benefits whilst ensuring adequate ocean environmental protection, and usher in South Africa as a steward of BE transitions in Africa. The University has also developed a special Vision 2030 program that encompasses a range of ocean sciences education and training, global institutional partnerships, research, innovation, and engagement programmes to support the blue economy nationally and on the African continent (https://publications.mandela.ac.za/).

A worrying concern is the prevalence of few collaborations among institutions, authors, and countries. This is observed by the comparatively higher number of single-country publications (SCPs) than multi-country publications (MCPs). This is irrespective of the higher MCPs in Africa than in India (Fig. 11). Most often, SCPs lead to limited research visibility and impact, unless published in top impact sources. These benefits could partly explain the better research performance of South African institutions and authors concerning BE research. 25 percent of articles published on the BE in South Africa are MCPs (see *Appendix 5a* and *5b*). Additionally, corresponding/leading authors in research are mostly in other jurisdictions. This has partly led to limited citation of BE works from institutions in Africa and India (see *Appendix 6a* and *6b*).

3.3.1. *Document analysis*

Document analysis dissected critical insights concerning the conceptual, policy, and theoretical insights on the BE in India and Africa. The most impactful documents/articles on the BE published by researchers or institutions, including their impact scores, are indicated in *Table 3*.

A thorough dissection of the documents in Table 3 reveals three diverse nuances on the BE: (i) comparative marine resource endowments, (ii) recognition of marine resources and coastal communities' vulnerabilities, and (iii) an urge for novel sustainable ocean development perspectives or mechanisms. In Africa, for instance, Belhabib et al. [85] documented that Africa has the four most productive Large Marine Ecosystems (LMEs) globally, including the Guinea Current Large Marine Ecosystem and Canary Current Large Marine Ecosystem (CCLME). Unfortunately, climate change impacts (including intense cyclones, e.g., in 2019 in Mozambique) [1], and unsustainable anthropogenic practices have created unprecedented concerns no livelihood vulnerability and fish stocks collapsing by 2050 [86]. In the CCLME, a 14.6 percent decline in fish catch potential is projected. The unsustainable practices have coalesced due to ineffective enforcement against overexploitation and illegal fishing, piracy, human smuggling, climate-change risks, and weak governance [85]. Unsustainable marine fishing practices mean that above $24 billion is lost across the fisheries value chain [85]. To navigate the transboundary maritime concerns, it is recommended that

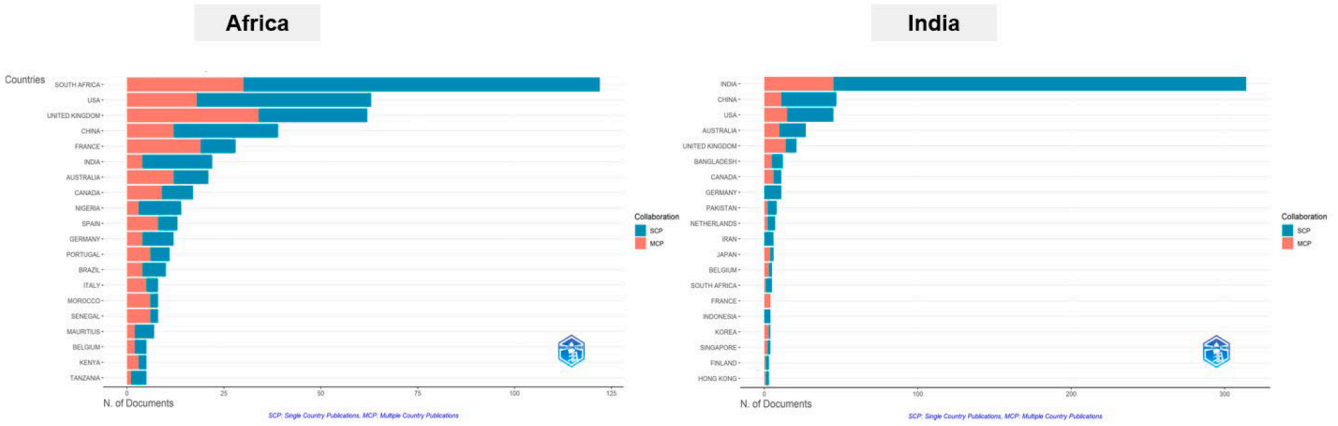

Fig. 11. The dominant corresponding authors' countries analysis based on the publications published on the BE, either as MCPs or SCPs from 2012 to 2024 (Source: Scopus/Biblioshiny).

Table 3
The 20 most impactful documents on the BE in Africa and India from 2012 to 2024 (Source: Scopus/Biblioshiny).

Africa							India						
Author(s)	Document digital object identifier (DOI)	LCs	GCs	LC/GC Ratio (%)	NLCs	NGCs	Author(s)	Document digital object identifier (DOI)	LCs	GCs	LC/GC Ratio (%)	NLCs	NGCs
Potgieter T, 2018	https://doi.org/10.1080/19480881.2018.1410962	9	36	25.00	27.00	0.86	Jin Q, 2017	https://doi.org/10.1038/NCLIMATE3348	5	190	2.63	16.59	11.43
Kirkman SP, 2019	https://doi.org/10.1016/J.Ocecoaman.2018.10.038	8	34	23.53	25.45	1.64	Nayak S, 2017	https://doi.org/10.1080/10095020.2017.1333715	5	52	9.62	16.59	3.13
Belhabib D, 2016	https://doi.org/10.1016/J.Marpol.2016.05.009	6	75	8.00	18.95	3.24	Uberoi P, 2016	https://doi.org/10.1177/0009445515613868	4	26	15.38	14.25	1.22
Van Wyk J-A, 2015	https://doi.org/10.1080/19480881.2015.1066555	5	31	16.13	12.89	0.76	Rumley D, 2012	https://doi.org/10.1080/19480881.2012.683623	4	28	14.29	8.67	1.01
Crowther A, 2016	https://doi.org/10.1080/15564894.2016.1188334	5	75	6.67	15.79	3.24	Kumar R, 2020	https://doi.org/10.1177/2347797020938996	3	3	100.00	17.75	0.09
Shipton C, 2016	https://doi.org/10.1080/0067270x.2016.1173308	5	40	12.50	15.79	1.73	Sahoo B, 2018,	https://doi.org/10.1016/j.jenvman.2017.10.075	3	145	2.07	21.00	2.89
Bond P, 2019	https://doi.org/10.2458/V26i1.23504	4	41	9.76	12.73	1.98	Sannasiraj SA, 2016	https://doi.org/10.1016/j.renene.2016.07.017	3	61	4.92	10.69	2.86
Almar R, 2015	https://doi.org/10.1016/J.Csr.2015.09.020	4	126	3.17	10.32	3.08	Krupakar J, 2017	https://doi.org/10.1080/09700161.2017.1296622	3	19	15.79	9.95	1.14
Boswell R, 2021,	https://doi.org/10.1080/19480881.2021.1935523	3	10	30.00	35.57	0.61	Sain K, 2012	https://doi.org/10.1016/j.gr.2012.01.007	3	130	2.31	6.50	4.67
Rogerson CM, 2019	https://doi.org/10.5379/Urbani-Izziv-En–2019–30-Supplement-002	3	25	12.00	9.55	1.20	Kunte PD, 2014	https://doi.org/10.1016/j.ocecoaman.2014.04.024	3	103	2.91	13.09	3.52
Potts W, 2015	https://doi.org/10.1007/S11160–015–9399–5	3	50	6.00	7.74	1.22	Naidu GVC, 2013	https://doi.org/10.1080/19480881.2013.847557	3	5	60.00	10.88	0.50
Ogwang BA, 2015	https://doi.org/10.5937/Geopan1502064o	3	42	7.14	7.74	1.03	Scott D, 2012	https://doi.org/10.1177/0020881714534038	3	24	12.50	6.50	0.86
Okafor-Yarwood IM, 2023	https://doi.org/10.1080/01436597.2023.2167706	2	5	40.00	62.00	0.82	Chacko P, 2014	https://doi.org/10.1080/10357718.2014.891565	3	29	10.34	13.09	0.99
Akpomera E, 2020	https://doi.org/10.1080/03056244.2020.1853517	2	4	50.00	39.50	0.25	Nayak S, 2020	https://doi.org/10.1007/s12524–020–01156-x	2	8	25.00	11.83	0.24
Kalina M, 2019	https://doi.org/10.2458/V26i1.23008	2	12	16.67	6.36	0.58	Banerji US, 2020	https://doi.org/10.1177/0959683619895577	2	54	3.70	11.83	1.64
Prendergast ME, 2017	https://doi.org/10.1002/Oa.2585	2	33	6.06	22.67	1.91	Roy-Chaudhury R, 2018,	https://doi.org/10.1080/13569775.2017.1408173	2	20	10.00	14.00	0.40
Crowther A, 2018	https://doi.org/10.1016/J.Quaint.2017.01.014	2	72	2.78	6.00	1.72	Ollapally DM, 2016	https://doi.org/10.1080/09733159.2016.1181392	2	5	40.00	7.13	0.23
Gamoyo M, 2015	https://doi.org/10.1007/S00704–014–1171–6	2	33	6.06	5.16	0.81	Fernandes JA, 2016	https://doi.org/10.1093/icesjms/fsv217	2	61	3.28	7.13	2.86
Naidu GVC, 2013	https://doi.org/10.1080/19480881.2013.847557	2	5	40.00	10.57	0.23	Parthasarathy A, 2015	https://doi.org/10.1007/s11069–014–1394-y	2	56	3.57	33.33	2.69
Harries P, 2014	https://doi.org/10.1017/S0021853714000097	2	13	15.38	7.45	0.46	Arun-Kumar A, 2012	https://doi.org/10.1007/s11069–012–0276–4	2	142	1.41	4.33	5.10

African countries urgently need systematic conservation planning, including marine spatial planning, across Ecologically or Biologically Significant Marine Areas [87]. Countries shifting towards these novel BE approaches, such as South Africa, are reaping better socioecological indicators [4]. This has been done through public-private partnerships and initiatives, such as Operation Phakisa [1,4].

In India, relatable BE complexities are reported. For instance, Jin & Wang [88] alerted that since 2002, the intensity of Indian summer monsoons has increased, impacting a fifth of the global populations, across the Indian sub-continent. This is worsened by the projected higher multi-hazard risk of most coastal communities in India and the Global South [89]. Although efforts to create socioeconomic national-level safeguards have been advanced, as seen in the proposed Bangladesh–China–India–Myanmar Economic Corridor (BCIM-EC) [77],

geopolitical shifts have stalled their implementation [77,90]. This conundrum has left policymakers and researchers seeking better partnerships and leverage points that crystallize win-win benefits. Across the Indian Ocean rim, researchers have advocated for integrated coastal zone management (ICZM) measures [90]. To regurgitate ICZM, emphasis on integrating developing regional-level socioecological databases (quantitative and qualitative) that comprehensively capture the environmental-anthropogenic dynamics is recommended [89,90]. This can be achieved by leveraging citizens' knowledge [86,85,91], and mapping technologies, such as the Synaptic ArcGIS tool [89].

3.4. Comparative scientific analysis and network mapping of research on the BE

3.4.1. Social structure analysis

This analysis unravels country or regional-level collaboration networks in research and policy. Partnerships on the BE between Africa, India, and other countries or regions are indicated in Fig. 12. (un)Surprisingly, there is a penchant for collaborations with more developed or richer countries that influenced development histories in Africa and India. In Africa, South Africa, a leading country in BE research, has uncharacteristically collaborated with the UK (24 collaborations), the USA (22), and Australia (15). Only 2 collaborations exist between South Africa and India. Additionally, fewer collaborations exist between South Africa and other African countries, such as Seychelles (see *Appendix 7a*). Additionally, a similar trend is observed in India. The highest number of collaborations is with the USA (29), the UK (22), and Australia (12). In Africa, 2 collaborations are observed with Nigeria and South Africa. India-Nigeria collaborations have been oiled by the November 2024 visit to Nigeria by India's leadership, which marked a milestone in reimagining Africa-India relations as critical for a multipolar global order. Since 2007, India and Nigeria have forged strategic partnerships coiled around development cooperation, economic, energy, and defense collaborations. >200 Indian companies have invested over USD 27 billion in important sectors in Nigeria (GoI, 2024). These can ameliorate maritime issues, such as piracy, around the Gulf of Guinea [23,85,86]. New collaborations are observed with North African countries (see *Appendix 7b*).

3.4.2. Conceptual structure analysis

Here, trending themes, their evolution, and thematic patterns (relatedness or closeness) are indicated. In Fig. 13, the keyword mapping reveals a positive and BE landscape. In all regions, the relevance of BE as a motor theme and its development level are increasing. Additionally, marine/coastal socioecological vulnerabilities, such as climate change and maritime security in the IO region, are promoted. The centrality of critical BE concepts is further reinforced by the factorial analysis of BE concepts and themes. In India, for instance, emphasis on regionalism, sustainable ocean solutions, such as desalination, and ocean governance is emphasized and closely interconnected (See *Appendix 8a*). In Africa, ocean governance in the BE is interconnected to key aspects, such as food security, marine spatial planning, renewable energy, regional focus, e.g., in the Gulf of Guinea, and the development of collaborative communication mechanisms. There is recognition of Swahili as a mode of communication for BE businesses and cooperation, especially in eastern Africa (*Appendix 8b*).

The positive thematic insights could partly be explained by the positive paradigm shift in ocean governance perspectives, which was spearheaded by emerging coastal countries since 2012. As indicated in Fig. 14, across Africa and India, there is an increasing emphasis on sustainability transformations & addressing environmental vulnerabilities in all regions. This partly indicates that, irrespective of the changing socioecological dynamics, critical safety nets that can guide BE partnership and engagement are emerging, such as the recognition of climate change vulnerabilities across the IO.

3.5. Observed research and policy insights, and ramifications in the BE landscape between Africa and India

Insights from *3.1 to 3.3* invoke a complex BE landscape in Africa and India. On the one hand, researchers exude confidence that the BE is the missing link towards sustainability transformations and equity, which had stalled for centuries [28,29,33,92,93]. This is partly due to the unique marine resource endowments, including the rare species of the genus *Gobiopsis* [93,94]. As succinctly emphasized by Bond [1], with a history of colonial contestations for African resources, the limits to resource-centric capitalism, overaccumulation, monopolism, and the intertwined crisis-displacement tactics are becoming more evident. The inclusive BE bottom-up approach offers a new ray of hope to legitimize social actions and renew socioecological interconnections that had been usurped by the extractivist model [1,93,95,96]. The success of this hinges on a never-before-seen institutional commitment and will to

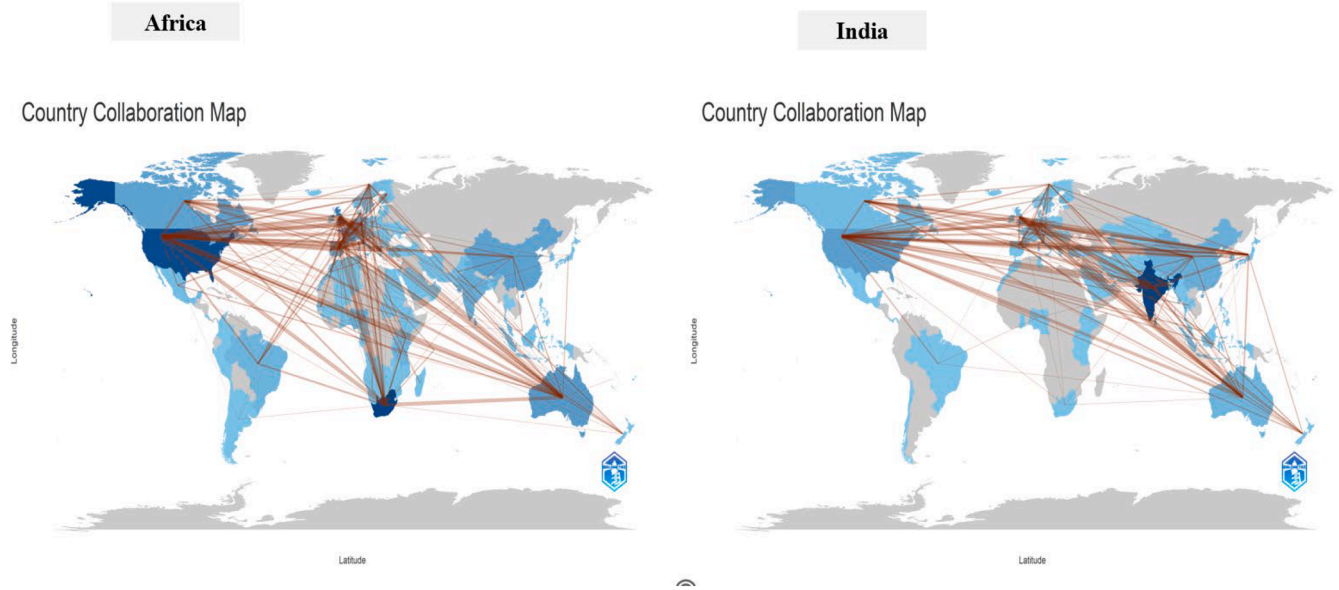

Fig. 12. Collaboration world map showing countries or regions networking or partnering in BE-related research and policy (Source: Scopus/Biblioshiny).

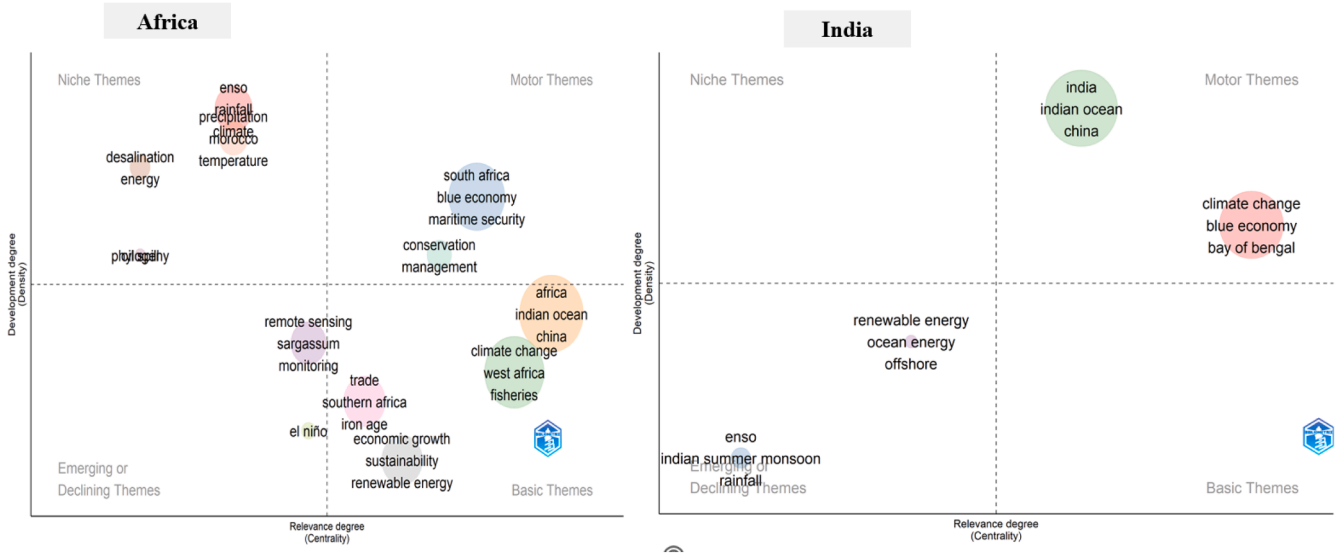

Fig. 13. Thematic mapping of the development and relevance degree of key themes on the BE (Source: Scopus/Biblioshiny).

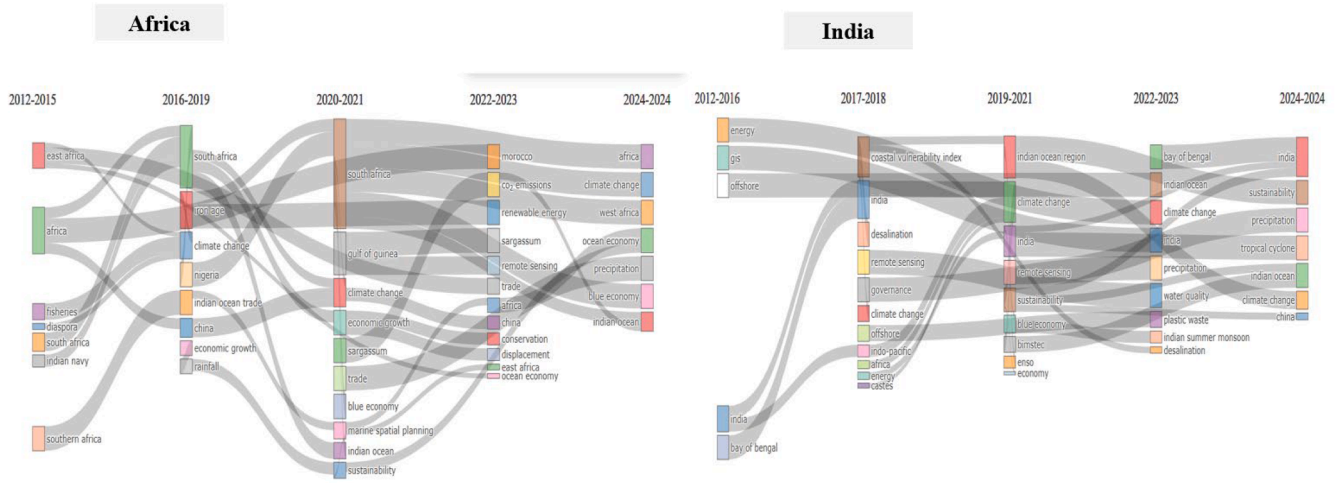

Figure 14. Thematic evolution of the critical themes and concepts on the BE from 2012 to 2024 (Source: Scopus/Biblioshiny).

support collaborative actions on blue equity, diversity, and inclusion. The unwavering conviction that the BE is the key for transformative change is supported by the mushrooming thematic and conceptual focus on the strategic development needs in the Global South [1,3]. Most often, emerging countries demonstrate a need for resource sovereignty and breaking vicious cycles of overdependence on capitalistic models, and unfulfilled regional development initiatives or programs, and the United States or China-led maritime projects dilemmas [17,97,98]. These dilemmas have been correctly reported as the genesis for sophisticated socioecological issues, such as incompatible sifting of maritime policy and choices, marine pollution, elite capture, and species decline [43,77,85,99–101], requiring a rethink of development paradigms.

On the flipside, however, literature insights also revealed that propelling the BE as the holy grail to galvanizing sustainable transformations and partnerships in Africa and India is still a mesospheric undertaking. Revelations of plummeting citations, publication in lesser-impact journals, and blind interest for lesser regional cooperation, and lesser prioritization of regional initiatives, among others, are concerning indicators [85,97,102,103]. The declining research citations and publications in lesser-impact journals might not be emblematic of the commendable work made by Afro-Indian scholars, in the context of BE. Rather, it could reflect the financial hurdles that researchers and institutes in the Global South experience concerning the astronomical article publication costs in most top impact or indexed journals [43]. More concerning is that there seems to be a 'competition versus cooperation dilemma' between Africa and India in terms of who to lead or guide the engagement arena [104]. This might be expected due to the nature of global contemporary politics (US-China), which creates mistrust and careful policy treads or gymnastics among emerging countries or partnership blocs [94,104,105]. This is more alarming as regional reports have revealed that (under)development concerns/needs in the Global Gouth are interconnected [102,106]. Today, as emerging economies are the most vulnerable, an urgent need to (re) focus on building resilience safeguards to biodiversity loss, nature's decline, and the projected collapse of key ecosystem functions is needed [17,28,30,62,107]. Delaying action to achieving socioecological sustainability and partnerships is costly compared to the schisms of political, socioeconomic opinions and beliefs [102,108,109]. For Africa and India to leverage the BE opportunities, it is paramount to recognize the shared historical opportunities, e.g., across the shared common-IO [93,96]. However, putting this into research and policy has not been well-documented in research. In Section 4, a novel pathway for attaining this is elucidated.

4. Cascading towards sustainable partnerships and development via the BE

Owing to the historical and current complexity in swimming in Africa and India towards sustainable development transformations (partnership and engagement), the BE proves to be a promising bet [17,22]. Bright spots to kickstart BE-led sustainability transformations, e.g., based on thematic mapping, evolution, and trending topics in literature, are evident. These could gravitate sustainable policy shifts, transcending traditional Global North-South development discourses to the SSC, as embedded under the IORA & 2023 Zanzibar consensus [64,65]. What remains to be seen is how to comprehend and operationalize the abundant Africa-India BE partnerships and development opportunities, to enchant Global South stewardship in global policy. This is an urgent opportunity for emerging economies as the race to achieve Agenda 2030 of the SDGs draws near, increasing research in various sectors [27,42]. To this effect, five BE sustainability partnership leverage points are identified and described (Fig. 15).

To legitimize the relevance of the leverage points, emphasis was on capturing comparable BE strengths, vulnerabilities, opportunities, and sustainability possibilities between Africa and India. Also, an effort is made to re-imagine the emerging Africa-India development partnership and reshape existing paradigms of the SSC with sustainable ocean development pillars and contribute to more equitable global systems. An explanation of the leverage points is indicated below.

Shared sustainable environmental leverage points. These focus on tapping the shared environmental (ocean) opportunities and comparative strengths. Africa is a biodiversity and marine resource haven, with innumerable marine resources across three oceans- the Atlantic, Indian, and Southern Oceans, and two seas, i.e., the Mediterranean and Red Sea [1,4]. Additionally, Africa is the 2nd largest (recent maps show it is the largest) continent globally, with a long coastline of 26,000 nautical miles and a combined exclusive economic zone (EEZ) area of 13,000 million kilometers [92]. Conversely, India is strategically located between Africa, the Middle East, and Far East Asia [29,93]. Contextually, as the IO is the 3rd largest among the world's five oceanic divisions (70, 560, 000 km^2) and accounts for 20 percent of the planet's ocean surface. Africa-India can leverage this water mass for climate change research, stewardship in circulation patterns (especially around the Indian Ocean Geoid Low (IOGL), and marine biodiversity (https://www.ncesc.com/). These strategic benefits are potential for marine shipping stewardship, environmental research, collaborative technological innovations, investment, and multilateral cooperation in blue transformations (Glavocic & Boonzaier, 2007; [36,34,63,110]).

With the search for sustainable blue transformations in capture fisheries, the IO and Africa's oceans offer answers to this, as they are some of the largest upwelling spots and most productive ocean ecosystems globally [85,102]. Additionally, the geo-strategic advantage of South Africa's Nelson Mandela Bay (i.e., a global mecca for the Indo-Pacific dolphin bottlenose) and water sport capital of the world, with three blue flag status beaches, provides a natural opportunity for India to (re)learn and refine the 2021 BE framework. This is because India is shifting towards promoting marine tourism, and certification of 7 blue-flagged beaches, e.g., in Kerala ([17]a; [30]). Thus, a natural synergy for cooperation in tapping abundant marine natural resources is evident. No wonder, India's first Prime Minister-Jawaharlal Nehru, rightly christened Africa a 'sister continent', cognizant of the shared natural resource affinity, and the history of utilizing the IO as a shared common resource [70,71]. Strategic collaborations can help Africa and India reap huge shares of the estimated $13 trillion of the annual value of highly nature-dependent industries, which account for 15 percent of the global gross domestic product (GDP) [62,107]. The biodiversity value can be streamlined by creating an Indian Ocean marine biodiversity biometric identification inventory. The inventory can borrow biodiversity management or governance guidelines, and tracking tools embedded under the High Seas Treaty on the establishment of Deep Sea marine protected areas ([19]; CBD, 2021; [43]), or the Knowledge Centre for Biodiversity (KCBD) of the European Commission (https://k

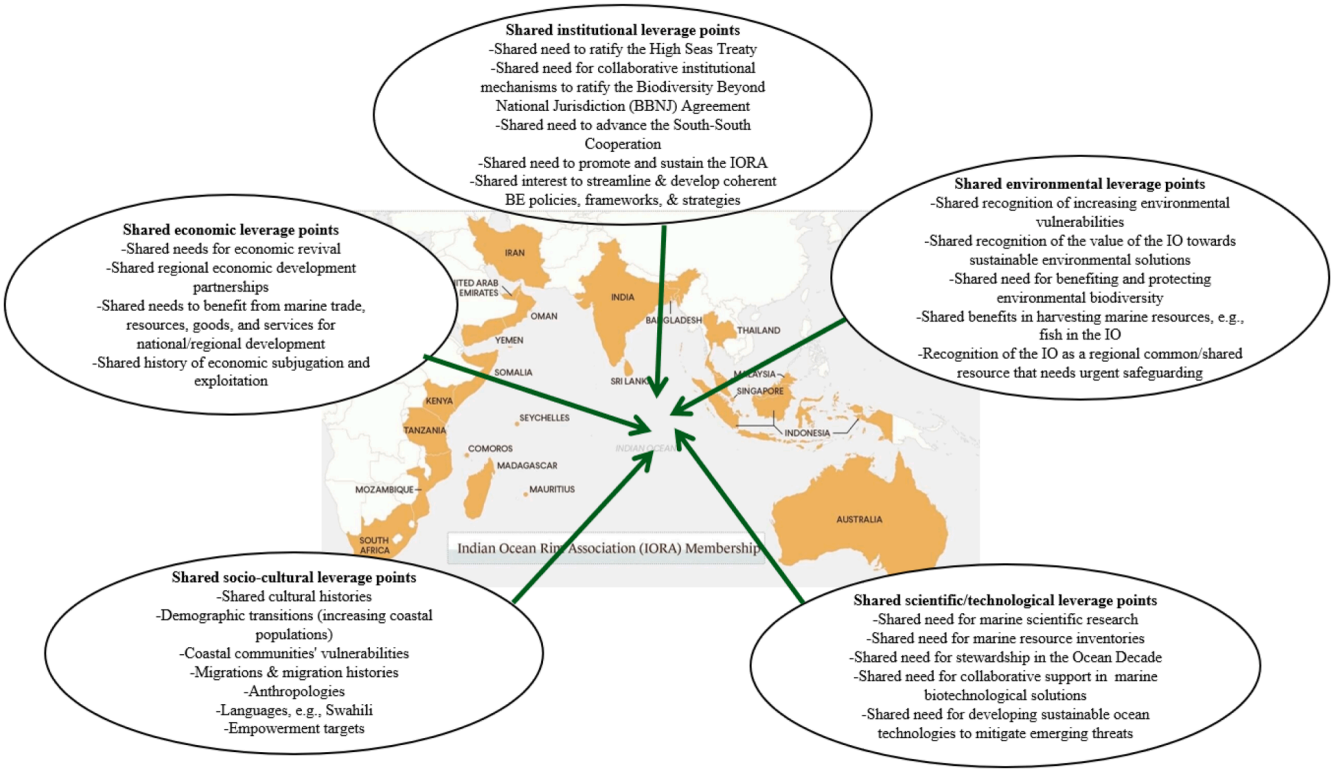

Fig. 15. The BE sustainable partnership leverage points that could be leveraged to promote BE-led sustainable development (Source: Authors' development). Note: The countries shown in the orange color are members of the IORA regional co-operation group (marked in orange).

nowledge4policy.ec.europa.eu/).

Shared sustainable economic leverage points. For centuries, Africa-India relations have encapsulated historical trade ties, solidary, and forward-looking approaches to reap economic dividends of the Indian Ocean (read Indian Ocean trade) [111]. This symbiotic win-win solidarity was ruptured during the colonial era and subsequent fettering of the global North-South trade partnerships [1,4]. This has created wealth inequalities, as by 2021, 39.2 percent of the global wealth was held by 1 percent of the global population (mostly in the global north), and 1.85 percent was owned by the bottom 50 percent of the global population [62]. Cognizant of the economic injustices in the global trade system and chains, including in natural resources trade (Africa and India supply rich countries), a renewed fervor for Africa-India partnership naturally emerges as a feasible force for rejuvenating regional and global economic agendas. This is more vividly demonstrated by the increasing interest in supply chain realignments across the 39 coastal states of Africa [17,92], and, more specifically, the 16 African countries and 18 Asian countries directly bordering the IO (https://www.ncesc.com/). This makes the IO a crucial waterway for regional trade, e.g., in cheaper shipping, logistics, and freight services [63]. Surprisingly, Africa and India have taken this long to recognize the unprecedented marine economic opportunities in their quest for sound economic dividends and fair economic partnerships.

In 2021, emerging countries, e.g., India, accounted for 55 percent of loaded seaborne goods and discharged 61 percent of the world's seaborne trade ([63]a; UNCTAD, n.d). Additionally, since 2019, Asia and Africa's marine shipping countries and ports are stewards in marine freight, accounting for 4.6 billion tonnes of loaded goods and 7.1 billion tonnes (64 percent) of all goods loaded at ports globally [29,30,63]. India and African countries directly contribute the largest share of the 13 million maritime jobs, such as seafarers, dockworkers, and port operators, and an additional 30 million jobs indirectly linked to shipping, such as logistics, port management, and supply chain services [63,112]. Thus, over US$150 billion in the form of wages is reaped by Global South countries, and this could drive economic growth, including port infrastructure development [63]. Most importantly, countries in Africa contribute the largest share of the over 50,000-plus merchant ships registered in over 150 nations (and contributing about US$380 billion in freight rates and being manned by seafarers of virtually every nationality) [63,113,114]. As seaborne trade is projected to expand by 2.4 percent and containerised trade by 2.7 percent between 2025 and 2029, Africa and India are well-positioned to leverage the IO to reap more economic and marine stewardship benefits [63]. These could be reinforced with targeted trade agreements, universal bank accounts, and mobile connectivity, including duty-free tax programs, to support emerging regional trade, e.g., under the African Continental Free Trade Area (AfCFTA). This can reduce the higher trade costs, especially in Africa, partly due to unsustainable trade partnerships and infrastructure deficits.

Shared sustainable socio-cultural leverage points. Africa and India have a unique tapestry of socio-cultural bonds, historically knit since pharaonic times, by shared migration patterns, and currently reinforced by multi-cultural integration, language (i.e., Swahili language borrows some Indian words, such as *masala (sometimes referred to as food in Uganda or spice in coastal East Africa and India)*, and unity in diversity [8,10,111]. History exemplifies that these bonds increased in the post-1947 period and are currently symbiotic (although somehow neglected in studies), including demand-driven exchanges in ideas, medical equipment, opportunities, religious beliefs, and social support equipment [8,111]. In the context of the BE, these social leverage points can be unearthed in BE sectors that complement the needs of Africa/India's coastal communities. For instance, due to increasing healthcare needs, the pharmaceutical market in Africa is projected to reach 70 billion USD by 2030. India is comparatively well-positioned to leverage its potential in availing cheaper or affordable and safer medical services and health products. Additionally, the biotic resources in the IO are novel arenas for advancing marine biomedicine research. Through the India Technical and Economic Cooperation (ITEC) program, established in 1963/'64, several scholarships can be offered to tap the indigenous knowledge of African herbalists and Indian *ayurvedic* researchers, to unravel novel marine-based resources to develop medicines and remedies for tropical diseases. Both regions are stewards in marine fishing, and with declining catches, indigenous knowledge of fisherfolk, such as transforming bycatch into biofuels, can be utilized [115]. Additionally, experiences of fisherwomen's leadership in seaweed fishing and small-scale fishing value chains in East Africa could be a new engagement arena for fisherwomen's empowerment [116,117]. These could energize the blue transformation roadmap and support small-scale fisherfolk livelihoods [110,118]. With an estimated population of 2.5 billion (mostly youths), the social innovations and inclusion mechanisms surely provide the social capital for job creation, blue innovations, and huge market potential, whilst remaining untapped. To sustain these partnerships, India's support must be demand-driven and not supply-driven, and not imposed to build trust based on win-win scenarios, devoid of manipulation or neoimperialism.

Shared sustainable scientific/technological leverage points. Shifting technological megatrends have positioned India as a global heavyweight in scientific research and technology. Contrary, supersonic technological advances have made Africa seek new technological answers and partners [12,119,120]. A technology achievement index (TAI) revealed that due to increasing internet and technological penetration, Africa is a future hi-tech hub [13,14]. However, the low level of application of technologies has translated into a paltry 16 percent share of manufacturing value-added in GDP [14]. Based on the revealed comparative advantage (RCA), this has been due to the high manufacturing, technological, and marketing costs that make African goods and markets expensive [121,122]. Additionally, technological imports and effort are expensive and high in Africa, creating a low technological infrastructure index, capacity, and capability (except for South Africa and Egypt) [12,14].

Through this, new technological development dispositions that recognize the technological needs and abilities can emerge. This can be situated under the AfCFTA [14]. Through a developing-to-developing FDI hybrid model [12], India is well-positioned as a key player. Levering the IO, the technological renaissance can encompass (i) bilateral agreements on technological transfer that benefit vulnerable livelihoods, such as agronomic technologies, (ii) collaborative scientific research, such as on ethical artificial intelligence (AI) in the IO to monitor ocean changes, and (iii) submarine cables and digital financial transfer systems in trade, shipping, and business [43,63]. This can be done through partnership with Indian Institutes of Technology (IITs), organizations, such as INCOIS, Kenya Marine Fisheries Research Institute (KEMFRI), Nelson Mandela University, Western Indian Ocean Marine Scientific Association (WIOMSA), and experts who have invented tsunami and landslide early warning systems [1,17,123,124]. As coastal communities in the IO region are some of the most vulnerable to marine human-environmental threats, e.g., tsunamis and climate change, as witnessed during the 2004 tsunami, technological innovations and partnerships will reduce vulnerability risks [125–127].

Additionally, AI technological transfers/partnerships can be created to help support the African Union (AU) Continental AI Strategy and Digital Transformation Strategy (DTS) for Africa 2020–2030 [128]. These can sustain and increase AI readiness in Africa, especially in Mauritius, South Africa, Kenya, Egypt, Ghana, and build human capital in emerging AI regional hubs (Nyirenda-Jere et al., n.d; [128]). Submarine internet cables can help increase Africa's internet penetration to over 41 percent and bolster rapid diffusion of digital technologies [14]. For instance, in the Indo-Pacific region, a multi-billion-dollar trade chain passes through submarine cables daily [129]. Additionally, 97 percent of India's global transmission is carried by approximately 545, 018 miles of fibre, at a speed of approximately. 4000 GB per second, through companies such as Bharti Airtel and Tata Communications

Limited (https://www.thegeostrata.com/). Through signing multi-country regulations in the IO region, better development indicators, such as in trade and commerce, could be reaped. These can bridge gaps in existing frameworks, such as Article 21(c) of the UNCLOS on creating strong regulations on laying, responsibility, and accountability for damage to submarine cables in international waters [43]. Additionally, with the docus on the Ocean Decade (2021–2030), Africa-India can collaborate in scientific research, expeditions, and trials for shared technologies in the Indian Ocean, across BE sectors, such as marine shipping and navigation [63,113,120].

Shared sustainable institutional/governance leverage points. Global trends reveal that India is rising and Africa is becoming more confident in the global policy and development arena. One need not go further than appreciate India's role in proposing and supporting AU's permanent membership in the G20 and the three India-Africa Forum Summits (IAFS) held since 2008. These display India's commitment towards amplifying the SSC and creating common positions that promote collaborative governance and institutional cordial relations. How to situate these emerging pro-SSCs and governance trends will go a long way in creating sustainable BE development opportunities. Policy experts espouse that this requires Africa and India to recognize their comparative advantages in global development, across BE sectors [19,64,65]. In the context of the BE, these opportunities could be leveraged to advance stewardship on complex maritime issues in the IO, such as piracy, shipping (including ballast water releases), transnational crimes, such as human trafficking and trade in illicit goods, and sustainable fishing practices, among others [17,29,63,113]. An additional institutional benefit could be the promotion of regional security through partnerships/initiatives, such as Africa-India marine field training exercises, maritime security dialogues, and Africa-India Military for Regional Unity (AMRUT), among others [6,7]. With the ratification of the high seas treaty, Indo-African partnerships could legitimize regional agreements embedded under the Indian Ocean Rim Association (IORA) and the 2023 Zanzibar consensus [43,64,65]. These mechanisms are paramount in positioning Indo-African BE agendas to global sustainability and sustainable transformative priorities, envisioned under global biodiversity and socioecological systems frameworks, such as the Kunming-Montreal Global Biodiversity Framework by 2030 and the 2050 Vision for Biodiversity, in which socioecological systems synergies and coastal communities' benefits can symbiotically thrive [29,62,130]. Additionally, the five key priority actions advanced under the 2024 IPBES report could be leveraged and piloted as the guiding principles to sustainable development and engagement arenas in the IO [62,107]. This can create shared visions for an equitable BE that shape Africa-India's collaborative approach in global governance forums [32,53,131,132]. Through this, advocacy for cultivating new contours for reformed multilateralism and inclusive BE governance/decision-making processes that superimpose mutual conversations for sustainable futures becomes realistic [22,41].

5. Conclusion

Valuable BE insights are revealed in this study. What is clear is that the BE is emphasized as a valuable development frontier that could be harnessed by Africa and India to reanimate the historical socioeconomic development ties and sustainable development futures. This perspective is supported by skyrocketing research publications, thematic focus, and networks, which reinforce the need to mature partnerships and engagement ecologies to tap into BE benefits. However, what remains lacking is the perpetuation of a lackluster interest in initiating feasible partnerships, as only 1 percent of emphasis on the Africa and India partnership is reported. Most often, there is a preference to situate BE research and policies at the national level priorities, rather than tap into the immense opportunities naturally availed by the IO. Further, it is still baffling that Africa and India are failing to detach themselves from colonial legacies and recognize that a pedestrian effort to SSC is painfully ruining the emerging progress and opportunities in the Global South.This is perplexing as some of these positive partnerships had been well-knit for millennia, and only capsized during and in the aftermath of the colonial era, notably from the resultant strategic neocolonial conundrums, and inroads in Africa and India. As global megatrends are stratospherically evolving in Africa and India, albeit with divergent results, an immediate rethink is needed. As the BE provides niche opportunities, Africa and India must recognize that the opportunity cost of debunking developed countries' dependence is diminishing today. This is more germane as developed economies are experiencing recessions and envisioning protectionist agendas. To the Global North or richer countries, this is not a slap in the face or meant to disregard the commendable development support to Africa or India, and jettison rich countries from partnering with the Global South. Rather, Global South-led insights could be viewed as a basis to invigorate novel perspectives that can be harnessed to advance equity and fairness in the BE, and the complex global geopolitical and polarized development landscape.

Cognizant of the research publication hurdles, e.g., astronomical publication costs in top marine journals and the largely slow progress towards the realization of the grandiose BE opportunities, some valuable research and policy recommendations, synthesized from the sourced literature, are brought forward and correlated with existing policy perspectives that could propel and cement sustainable development partnerships and renewed strategic engagements between Africa and India. These include

a) Initiation of the Africa-India BE journal. This can emerge as a novel scholarly or research outcome where transdisciplinary researchers from Africa and India could work together to capture evidence-based qualitative and quantitative marine research around the IO. This can enable the publication of specific African and Indian BE policy and research insights that uncover sustainability issues across the Global South coastal communities and countries. This can help increase the visibility/recognition of Indo-African scholarship and systematically map it with sustainability targets, goals, and indicators, through strategies, e.g., the Analytical Hierarchy Process (AHP).
b) Leveraging and linking Africa and India's existing BE initiatives, visions, and programs. For sound and sustainable policy frameworks, partnerships, and development agendas to be legitimized, an initial step could be leveraging existing BE initiatives at national and regional levels, such as *Sagarmala*, 2021 BE framework, and *Amrit Kaal 2047*, etc., in India, and the AU's Agenda 2063 and the country-level initiatives, e.g., *Operation Phakisa* (a Nine-Point Plan to stimulate BE growth and development in South Africa). As these ambitious programs recognize the BE as a new development space and opportunity, Africa and India can co-develop strategic areas of development cooperation and engagement around the IO that capture short- and long-term synergies, trade-offs, and feasible partnership opportunities, e.g., in regional trade, shared maritime technology networks, shared transnational currency or foreign exchange dealings or trade regulations, marine scientific research expeditions, and maritime peace or security, e.g., on sea pirates, among others.
c) Reimagining Africa and India's development connotations. Most often, two wrongs in policy and research are evident: (i) viewing Africa and India as single countries or entities or blocks, and (ii) Africa and India are socioeconomically or institutionally poor! This has stereotypically negated the realization that these regions are some of the richest continents, and have unique resource endowments, diverse opportunities that have technically not been streamlined or buried, to the benefit of key global players. For instance, few scholars and policymakers recognize the diversity of Africa (54 countries) and India's states (28 states and 8 Union territories), most of which have diverse cultures, speak different languages, and economic needs. Within the BE paradigm, policy targets should be focused on the explicit recognition of specific country or regional needs. Thus, siloed regional or country-to-country partnerships and

engagements should be targeted, and these can, in the long run amalgamated with clear comprehensive policy targets and implementation directions. This can help in the streamlining of BE targets and visions, based on shared visions, goals, BE sector comparative advantages, and national-level priorities, which have proved worthwhile in bringing long-term win-win benefits.

d) Starting slowly but consistently. Africa and India must tread carefully on which BE sectors or partners to include, taking into consideration the geopolitical interests of other countries operating in the region, who might jeopardize or dread strong South-South Cooperation. Thus, concerted efforts, where possible, must include bringing in interested parties with clearly stipulated or shared visions that will progressively enhance the cementing of development partnerships in the IO, or between Africa and India. A plausible safe ground could be kick-starting with long-established BE sectors where Africa and India have comparative advantages, e.g., fishing, mineral resources, and coastal populations (provide markets and cheaper human resources), and countries, e.g., Brazil and China, with a history of shared Global South development visions. In the long run, other powerful states can be brought in on fair terms.

e) Recognition of the shared sustainability or sustainable development visions, including existing promising sustainable transition agreements, and just development Agendas. To hatch comprehensive BE benefits, Africa and India's engagement and partnership overdrive must recognize prior global and regional schemes, especially those on biodiversity conservation in the IO, including the impeding Biodiversity Beyond National Jurisdiction (BBNJ) agreement, High Sea Treaty, and Zanzibar Consensus, among others, that are just and novel strategic policy approaches that global priority actions or frameworks envisioned to drive sustainable ocean governance transformations beyond 2030. This implies that valuable partnership agreements should inculcate key tenets, such as the protection of biodiversity in the Area, and collaborative actions, e.g., on marine scientific research, transparent data reporting on ocean activities, among others. This can ignite global support or present a valuable reference point on propelling sustainable regional development partnerships, engagement, and shared visions.

CRediT authorship contribution statement

Baker Matovu: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tahmina Akther Mim:** Writing – review & editing, Writing – original draft, Resources. **Bernard Lutalo:** Writing – review & editing, Writing – original draft, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

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

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