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Linking the blue economy to Women's empowerment to create avenues for the realization of ocean sustainability targets in the global south

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ABSTRACT

The blue economy (BE) presents a unique opportunity for women's empowerment (WE), especially in the global south. (Un)surprisingly, limited research has been done on how WE in the BE can be achieved. 158 documents are reviewed and participatory engagements with 58 coastal women in Alappad are conducted, to (i) understand the current landscape of the BE and WE and (ii) gain evidence-based perspectives that can drive WE. Findings revealed that the global south has unique BE endowments and comparative advantages for WE and ocean sustainability. Long-established BE sectors where women have historically participated present better opportunities for WE. WE in the BE could increase profits from ocean-based sectors to US$22 trillion by 2050. These can be scaled up to emerging BE sectors, e.g., renewable energy. However, complex WE dynamics persist. The socio-economic benefits women get from coastal sectors are low. Women's participation in BE sectors has not translated into holistic WE. Livelihood survival pressures have increased due to human-environmental threats. Socioeconomic impediments lead to women's engagement in seasonal jobs and secondary value-chain coastal activities. Socioecological grief is rising. Women are shifting to masculine jobs. There is limited sex-disaggregated data on WE in BE sectors, such as renewable ocean energy. Positive perceptions towards women's engagement in coastal activities are emerging. If streamlined, these can create new possibilities for WE. A novel '*blue economy for women empowerment* (BEWE)' framework is developed to sustain the emerging transformative narratives for WE in the BE and ocean sustainability. Using micro-level participatory research narratives of vulnerable coastal women/communities in the global south, and insights (policy and academic) from literature, possibilities for creating holistic WE and transformative ocean sustainability outcomes in the BE are possible. These can help promote collaborative stakeholder engagements, generate novel perspectives for

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positive transformations, and create evidence-based indicators for identifying progress toward ocean equity/WE. Future studies can use multi-case studies in other coastal regions to develop transformative narratives to build and sustain WE, equity, and ocean transformative actions.

1. Introduction

Since 2012, interest in the blue economy (BE) has dramatically increased in academic and policy literature (Cisneros-Montemayor et al., 2022; Qi, 2024; Matovu et al., 2025). The BE is a new frontier that could reverse unsustainable ocean risks and coastal livelihood challenges (Matovu et al., 2024a; Croft et al., 2024; Hoegh-Guldberg et al., 2023, 2019; OECD, 2023; Adewumi et al., 2022). The BE could further create avenues for the attainment of sustainable ocean development pillars (social, economic, institutional, environmental, and scientific) (Cisneros-Montemayor et al., 2022; UNCTAD, 2022; Lubchenco and Haugan, 2023). By streamlining the BE, progress towards the realization of the United Nations' sustainable development goals (SDGs), could be reinforced (WOA II, 2021; World Bank, 2022). This perspective is well-documented in the global working definition of the BE. Accordingly, the BE is '*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*' (IRP, 2021). Within this context, it is evident that the BE intrinsically aligns with the key tenets of livelihood empowerment and sustainable development goals (SDGs), such as SDG 5 (gender equality), SDG 8 (decent work and economic growth), SDG 10 (reduced inequalities), SDG 11 (sustainable cities (coastal) and communities), SDG 12 (sustainable consumption and production), SDG 13 (climate action), SDG 14 (life below water), SDG 16 (inclusive societies for sustainable development) and SDG 17 (shared peace and prosperity for people and the planet, now and into the future), among others (Glavovic and Boonzaier, 2007; WOA II, 2021; IRP, 2021; World Bank, 2022; UNSDGs, 2023; FAO, 2024).

However, the working BE definition surprisingly remains silent concerning an elaborate definition of gender equity, women empowerment (WE), and equality, as emphasized in ocean equity and sustainability studies (FICCI, 2019; Juneja et al., 2021; Croft et al., 2024; Matovu et al., 2024; 2025). Thus, to eliminate concerns about whether the working definition of the BE is not merely a repack of earlier global ocean policy experiments, we make an initial contribution by redefining the BE in the context of WE. Here, the BE in the context of WE is '*any ocean or coastal-based activity/ies that improve the socioeconomic well-being of coastal women in the short-run to progressively achieve holistic empowerment (social, economic, technological/scientific, psychological, political/-institutional) in the long-run, across geographies including sustainable management of ocean resources, now and in the future*.' With this refined definition, we argue that transformative actions needed for crystalizing WE and vulnerable coastal communities could be identified, streamlined, and sustained. This can lead to new transformative spaces for ocean equity (equitable access to ocean resources, goods, and services), equality (gender parity in ocean stewardship, innovation, governance, and management), and ocean justice across geographies (Ocean Panel, 2020; Cisneros-Montemayor et al., 2022; Partelow et al., 2023a, 2023b; Spalding et al., 2023; Paterson and Chabay, 2024; Lukambagire et al., 2024; Matovu et al., 2024b). Emphasis on this transformative paradigm could further create comparatively better possibilities for sustained livelihood benefits and socioeconomic development in the global south (herein referred to as emerging coastal economies, including Small Islands Developing States (SIDS), in Africa, Asia, South America, and the Caribbean; with relatively low human development and sustainable development indicators) (Hoskisson et al., 2000; Goyal, 2016; Matovu and Raimy, 2022).

The pending concern, however, is how to streamline WE synonymously, advance equity or equality in the historically male-dominated ocean-based sectors, and tap the innumerable socioeconomic, and environmental benefits of the BE in the most vulnerable coastal regions/communities (Farmery et al., 2021; Bennett et al., 2023; Spalding et al., 2023; Croft et al., 2024; Matovu et al., 2024a). In this paper, we argue that this could be through (i) understanding the comparative potential and benefits of the BE, (ii) highlighting critical concerns regarding WE, and (iii) developing evidence-based frameworks that link coastal women to emerging BE opportunities, and empowerment spaces. A duopoly of benefits could be reaped by unearthing novel evidence-based situational indicators and co-creating transformative frameworks in the global south. First, the promotion of ethical principles of ocean sustainability (including fairness, and equality) that explicitly differentiate the BE from previous ocean-based approaches (IRP, 2021), and second, advancing gender equality-based solutions, knowledge, and innovations for sustainable ocean livelihoods (Patil et al., 2016; Sarker et al., 2018; Ocean Panel, 2020; IOC-UNESCO, 2022; UNCTAD, 2022). However, few studies have succinctly dived deeper into the literature or explicitly engaged vulnerable coastal women in the global south to map out the systemic challenges women face and co-create evidence-based pathways based on micro-level narratives (Spalding et al., 2023; Partelow et al., 2023a, 2023b; Matovu et al., 2024a). Additionally, perspectives of coastal women on transformative sustainable ocean-based solutions have been largely overlooked, such as in environmental sustainability (greenhouse gas (GHGs) emission gaps), social sustainability, equity, and the symbiotic synergies WE uncover for a sustainable BE (Melkonyan et al., 2019; Bennett et al., 2022). Since operationalizing WE in the BE is an urgent necessity, in this paper, literature on the BE in the global south and coastal women interactions in Alappad in India are explored to generate transformative perspectives for WE in the BE. Specifically, the key focus was to.

(i) Explore literature to understand the key BE sectors and the comparative benefits they could provide towards WE, and ocean sustainability in the global south.
(ii) Examine the women (dis)empowerment landscape in the BE sectors and its ramifications towards WE and ocean sustainability in the global south.
(iii) Engage with coastal women to understand micro-level narratives of (dis)empowerment and remedial strategies in the BE sectors.
(iv) Develop a transformative framework that can help increase and sustain WE in the BE sectors and ocean sustainability transitions.

2. Material and methods used

Systematic literature review and (ii) community participatory interactions with coastal women, were utilized to obtain study findings.

2.1. Systematic literature review (SLR)

To gather secondary data sources on the BE, and the women (dis) empowerment landscape, the SLR utilized the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) technique (Neumann, 2014; Idris et al., 2022). The PRISMA technique comprised four phases: (i) identification, (ii) screening, (iii) inclusion, and (iv) qualification. These steps were in line with the definition of the Cochrane Collaboration (Bahipanti et al., 2021; Matovu et al., 2024b).

2.1.1. Identification

A summary of the search criteria is highlighted in Table 1.

Table 1
Summary of literature identified for screening (Authors' creation).

Sourced Database(s)	Search query/terms	Documents generated/ considered
Scopus	TITLE-ABS-KEY *(blue AND econom* AND (africa OR asia OR (ocean AND econom*) OR (south AND america) OR caribbean OR (small AND island AND developing AND states) OR (Indian AND ocean) OR (pacific AND ocean)))*	1818
Science Direct	-'*Blue Economy and Women's Empowerment*', *Blue Economy*', '*Blue Economy and Equity*', '*Blue Economy and Ocean Justice*', and '*Blue Economy in the Global South.* -'*Gender Equality and Ocean Sustainability*', '*Ocean sustainability and women inequality*', '*Blue Economy and Empowerment in Africa*', '*Blue Economy and Women's Empowerment in Asia*', '*Blue Economy and Women's Empowerment in South America and the Caribbean*', and '*Blue Economy and Women's Empowerment in Oceania.*'	849
Google Scholar	Grey literature from www.fao.org, www.oec.world; www.resourcetrade.earth, www.unwto.org; www.openknowledge.worldbank.org	16
Total documents included		2683

2.1.2. Screening and inclusion

Documents obtained using Scopus and Science Direct were selected, and exported, as *Scopus.ris* and *Science Direct.ris* files on the desktop. These were then imported into the Covidence software; a new tool that helps in the easy screening (exclusion & inclusion of large volumes of documents by reading document titles, abstracts, and full-text screening) (www.covidence.com). During the screening process, the emphasis was on including documents that have the following terms: BE or coastal activities or sectors, coastal women/equity and blue justice, challenges to gender or women inclusion, and regional preference to countries or regions or zones of the global south. After the exclusion of literature that was out of scope and the inclusion of grey literature, 158 documents were included for the SLR (Fig. 1).

2.1.3. Qualification of included documents for transparent reporting/ extraction/analysis

All 158 documents were downloaded and included as a Microsoft Word Excel CSV file. To scoop out literature, including key policy issues in the BE to promote WE and equity, six components were broken down in the Microsoft word Excel sheet: identification of BE sector/activities, region/place, components of WE/equity, supporting/impediments aspects for WE, ramifications, and policy recommendations. The extracted data was visualized, and key indicators of women's (dis)empowerment were summarized and compared with the field data to generate critical insights on WE in the BE.

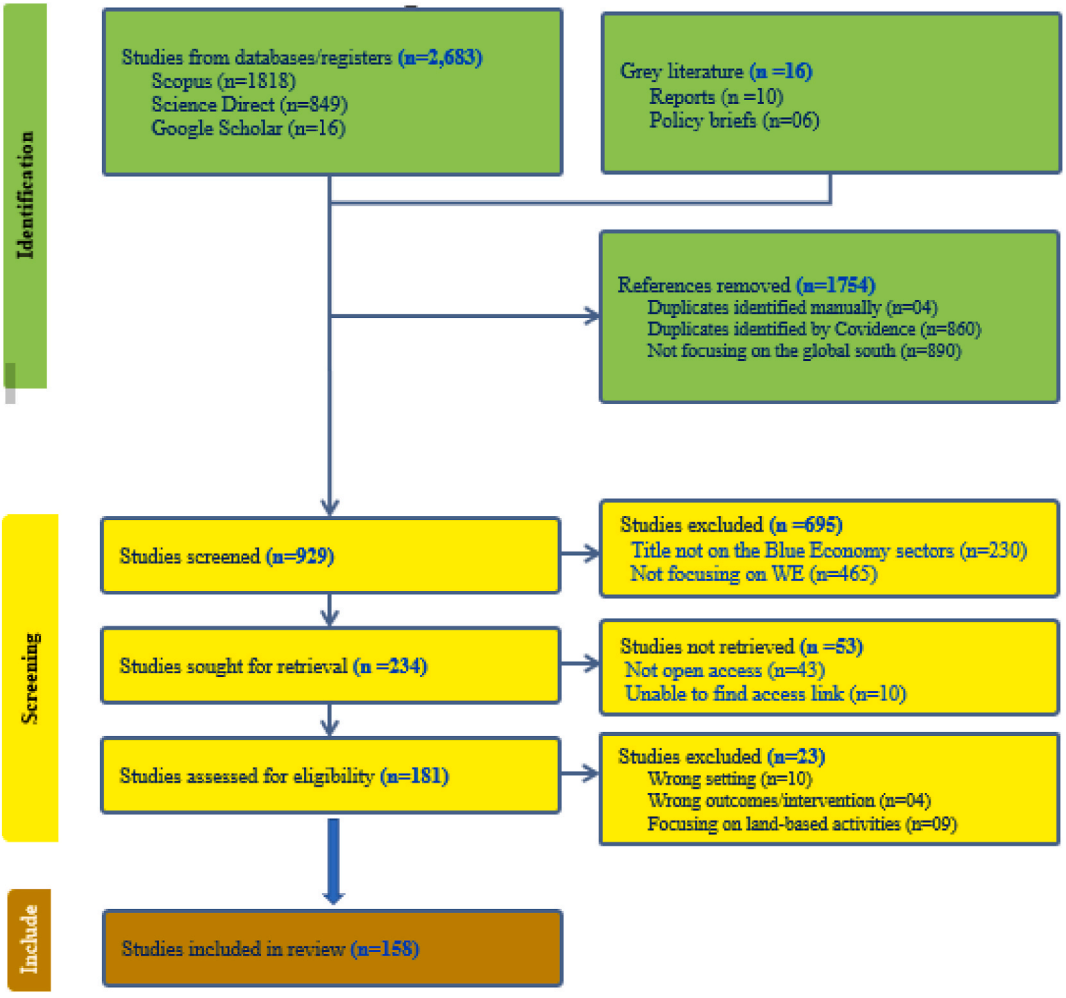

Fig. 1. PRISMA chart showing documents included for SLR (Authors' creation).

2.2. Coastal Community Participatory Interactions

Participatory interactions were conducted with 58 coastal women (15 interactions were done through random sampling, and 43 interactions were conducted through two focus group discussions (FGDs)) in Alappad in Kerala, India. This was meant to obtain micro-level perspectives (critical in transdisciplinary approaches in marine social science research), on systemic dynamics (such as disempowerment spaces, and possible transformative actions) for WE.

2.2.1. Overview of Alappad Coastal Area

Alappad is a coastal *panchayat*, located in Kollam district, in Kerala state, along the Arabian Sea along the southwestern coast of India (Fig. 2).

Alappad was chosen for two reasons: (i) increasing coastal anthropogenic-environmental vulnerabilities are comparatively affecting the socially marginalized groups, especially coastal women (Narayanan, 2017; Mitra & Rajib, 2023; Few et al., 2023; Ghosh et al., 2023), and (ii) demographic trends indicate that over 1054 coastal women are marginal, with limited socio-economic and environmental safeguards (Table 2). Thus, a once in a lifetime research opportunity exists to generate micro-level narratives that could be factored into the developed BE framework for India (FICCI, 2019; Matovu et al., 2024a).

2.2.2. Procedure for conducting participatory interactions

First, ethical clearance was obtained from Amrita Vishwa

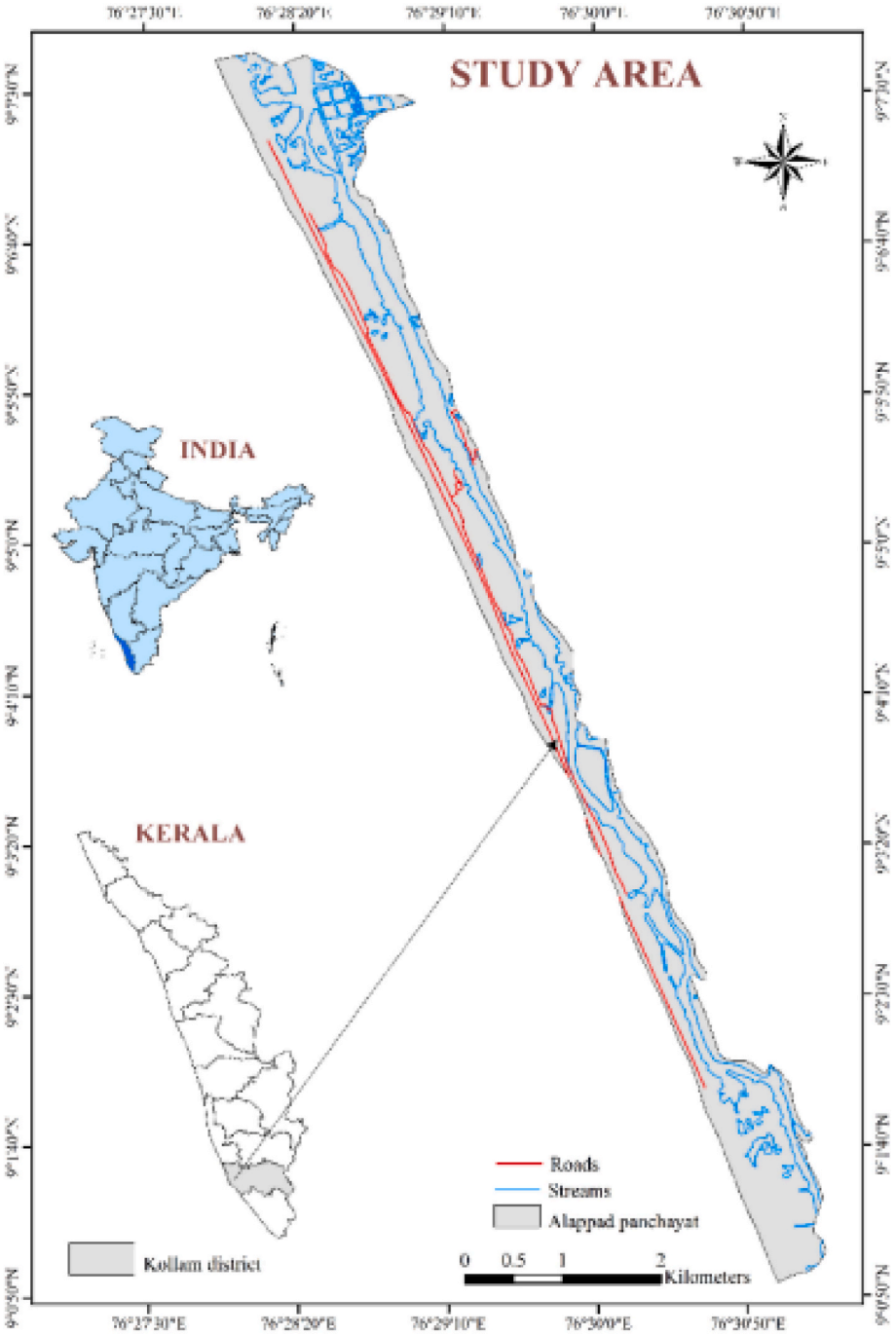

Fig. 2. Alappad coastal area (Authors' creation, data layers obtained using ArcGIS).

Table 2
Key demographic and livelihood indicators of coastal people in Alappad (Source: GoI: Ministry of Rural Development Socio-Economic and Caste Census, 2024; Matovu et al., 2024b).

Population						
Total population	Male	Female	Scheduled Caste (SC)	Scheduled Tribe (ST)	Transgender	Sex ratio
21033	10469	10563	334	14	1	1009
Population distribution by age (in years)						
Below 15	16–25	26–35	36–45	46–55	56–65	66+
4494	**3275**	**3520**	3418	2786	2043	1497
Population by marital status						
Never Married	Currently Married	Widowed	Separated	Divorced		
8240	11482	1061	78	28		
Population by highest education level completed						
Illiterate	Primary & below	Middle	Secondary	Higher Secondary	Graduate or above	Other
1498	4968	5525	4527	2639	1436	440
Households, household ownership, land ownership, monthly income/earnings						
Owned	Rented	Any Other	Total unirrigated land (in hectares)	Total irrigated & other irrigated land	Households with the highest Earning member earning less than 5000 rupees/ month	Households with the highest earning member earning more than 5001 rupees/month
5164	105	48	844.62	219.95	4585	733
Household indicators						
Total household	Excluded Household	Household Owing Land	Deprived Household	Households with any member earning more than Rs. 10,000/ month	Households with three or more rooms with pucca walls and pucca roof	Households having Kisan credit card with the credit limit of Rs.50,000 and above
5318	4642	1264	216	355	3761	18
The main source of household income/livelihood indicators						
Total Working Population	Male working population	Female working population	Estimated Fisherfolk Population	Manual Casual Labour	Number of persons insured with the Matsya Board (Fisheries Board)	Marginal Workers
7789	5924	1863	6243 (Male = 5475; Female = 768)	75	234 (Male = 233; Female = 1)	1432 (Male = 378; Female = 1054)

Vidyapeetham, a key requirement for conducting participatory community research (Neumann, 2014). The creation of the questionnaire to be utilized during the interactions came next. A research coordinator from Ammachilabs, a research center of Amrita Vishwa Vidyapeetham volunteered to translate the questionnaire into *Malayalam* (a local language spoken by people in Kerala). The research questions focused on three main issues: (a) identification of the coastal/BE activities that women in Alappad engage in for their livelihoods (b) micro-community system interactions/issues on WE spaces/livelihood activities (why women are engaged in such jobs, barriers, and effects) and (c) identification of the existing strategies for sustaining and creating WE spaces.

First, to engage with women, three transect walks along Alappadu Road from Azeekhal to Ponmana were conducted (in February, March, and April 2022). Random interactions with 15 coastal women were made. At least one coastal woman in each of the wards in Alappad participated. Each interaction lasted 25–60 min depending on the participant's willingness to continue giving information.

Second, to identify coastal women to participate in the FGDs, we (i) liaised with a coordinator for a women-led self-help group (SHG) (*Amritashree*) in Alappad. To obtain in-depth data from other coastal women sedentary in Alappad, five student assistants (*Malayalam speakers*) volunteered, including in conducting transect walks from Alappad to Ponmana wards in February 2023. The preference for only women participants was based on: (i) most research focusing on coastal activities, such as fishing in Kerala has targeted coastal fishermen (Lukambagire et al., 2023, 2024), (ii) qualitative narratives for WE in coastal zones are less studied (Matovu et al., 2024a, 2024b). This increases the risk of relegating coastal women's perspectives in charting empowerment and equity spaces in the BE. During the transect walks, access to coastal women through individual household interviews was difficult due to their daily busy schedules. Thus, interactions with women were scheduled in October 2023 (i.e., their day off work). Out of the targeted 100 coastal women, 58 voluntarily agreed to participate in the interactions.

For conducting FGDs, a community training center under the *Amritashree* SHG projects was freely offered. The 43 participants were split into two FGDs to decrease the likelihood of random responses and obtain more detailed and varied information. There were 23 participants in FGD1 and 20 in FGD2. One female participant and the Ammachilabs research coordinator read the consent form before each FGD, and any doubts were answered before agreeing to participate. FGD1 was held for 2 hours in the morning (11:00 a.m. to 1:00 p.m.). FGD 2 took place in the afternoon for 1.5 hours (2:15 p.m. to 3:45 p.m.). The FGDs were ended within that time frame as women's responses became repetitive, indicating data saturation, as emphasized by (Neumann, 2014; Ferrari, 2015; Idris et al., 2022).

2.2.3. Analysis of the data from the community interactions

The results were first, translated from *Malayalam* to English by Authors 8, 9, and 10. We engaged a researcher from Amrita Vishwa

Vidyapeetham (unrelated to our work) to compare and verify the translations and transcriptions. Since there were few participants in the research, we employed the manual line-by-line coding technique as guided by Neumann (2014) (Also *see Appendix VII*). This was accomplished by first, writing all the translations in a Microsoft Word document, and then, choosing the codes to produce themes that matched the coastal women's concerns and addressed the main research objectives. The next section gives details of the main findings of our study.

3. Results

3.1. BE opportunities for WE

BE opportunities for WE could be reaped across 13 ocean-based sectors (Ocean Panel, 2020; UNCTAD, 2022) (Fig. 3). Ocean-based outputs alone contribute to over three trillion USD (Sarker et al., 2018; UNCTAD, 2021; OECD, 2022). The economic value of only ocean goods and services ranges from $6 trillion and $21 trillion, but this might negatively change depending on how the transition away from oil and gas is managed (IRENA, 2022; OECD, 2023). Increasing equity and WE in the BE could thrust the profits from ocean-based sectors to US$22 trillion by 2050 (CBD, 2021; WOA II, 2021; Cisneros-Montemayor et al., 2022; Croft et al., 2024).

Coastal states in the global south are well-positioned to reap more from the BE, creating opportunities for WE (i.e., employment and participation) (Bennett et al., 2021, 2022; Spalding et al., 2023; Cavaleri-Gerhardinger et al., 2023). The innumerable marine endowments, such as wild fish, could be used as a driver for WE in fish value chains (Partelow et al., 2023; FAO, 2024). The untapped abiotic resources could be a cornerstone for building equity transitions, such as in renewable energy (World Bank, 2020, 2022; IRENA, 2022; OECD, 2022; IORA, 2023; OEC, 2023; Ocean Energy Europe, 2023; European Investment Bank, 2022). Opportunities for WE are astounding, especially in the five long-established BE sectors. For instance, in the marine fishing and aquaculture sector, coastal regions and states in the global south are leading producers (see *Appendix II* and *III*). Fisherfolk employment is higher in the global south (UNECA, 2016; Lukambagire et al., 2023; FAO, 2024) (Fig. 4). Fisherwomen are increasingly participating in the value chains. Fisherwomen account for 53 percent of full-time employees, and 62 percent work as fish processors (FAO, 2024).

Tourism has historically presented unique employment opportunities for emerging economies and coastal women's livelihood benefits (Patil et al., 2016; Bennett et al., 2021; UNWTO, 2021, 2023b; UNCTAD, 2022; Matovu and Raimy, 2022; Matovu et al., 2024b) (Table 3). Women account for 54 percent of the tourism workforce globally (proportionately higher in the global south), especially in Asian countries, indicating promising gains for WE (UNWTO, 2023a) (See also *Appendix IV*). In SIDs, such as Vanuatu, tourism revenues account for about 80 percent of their total exports, with over 60 percent of coastal women employed in marine tourism-related sectors (UNCTAD, 2022). Tourism offers women greater opportunities for leadership roles—globally, 23 percent of tourism Ministers are female compared to 20.7 percent of Ministers overall (UNWTO, 2023b).

Additionally, over 80 percent of international trade is seaborne, and the main transnational shipping lanes and functional nodal zones are in the global south (i.e., based on container trade statistics) (UNECA, 2016; FICCI, 2019; IORA, 2019; IMO, 2023; UNCTAD, 2021, 2023; Lubchenco and Haugan, 2023) (Fig. 5). Women working in maritime transport fields, including seafaring are increasing (UNCTAD, 2023).

Furthermore, coastal states of the global south are endowed with highly demanded ocean-based abiotic resources (Mahadevan, 2019; Lamb et al., 2019; IRP, 2020; NRGI, 2021; Filho et al., 2021; UNEP FI, 2022; ISA, 2023). 40 percent of the salt produced globally is sourced from ocean coastlines of the tropics (UNECA, 2016; UNCTAD, 2022; World Bank, 2022; Jouffray et al., 2023). Multiplier opportunities for WE are emerging with increasing transboundary coastal sand mining and trade (Jouffray et al., 2020; Marschke and Rousseau, 2022; Rangel-Buitrago et al., 2023; OEC, 2023; Matovu et al., 2023, 2024a) (Table 4 and *Appendix V*). Globally, women are increasingly sharing the mining space (mostly in artisanal and small-scale mining (ASM) activities). The increased 'feminization of mining' defies the notion of mining as an archetypically masculine industry (Matovu et al., 2023). The empowerment benefits are becoming visible in Africa, Asia, and Latin America, where women mining entrepreneurs/workers/leaders have increased (Jouffray et al., 2020, 2023; Matovu et al., 2024). It is estimated that globally, women account for about 10–50 percent of ASM employment, with the highest percentage in Africa (40–50 percent) (Ofosu et al., 2024).

Tropical oceans present unique opportunities for renewable energy, bioprospecting, and research (UNEP FI, 2022a; IRENA, 2022; Lubchenco and Haugan, 2023; Constable et al., 2023). This is due to their location along the Indian Ocean Dipole (IOD), El-Nino Southern Oscillation (ENSO) zone, and the equator (UNEP FI, 2022a, 2022b; IOC-UNESCO, 2022). This enhances ocean circulation patterns; creating great potential production sources in the form of wind, submarine geothermal energy, and blue carbons (UNCTAD, 2022; IOC-UNESCO, 2022). The wind energy potential along Africa's coastline is estimated at 180,000 TWh.

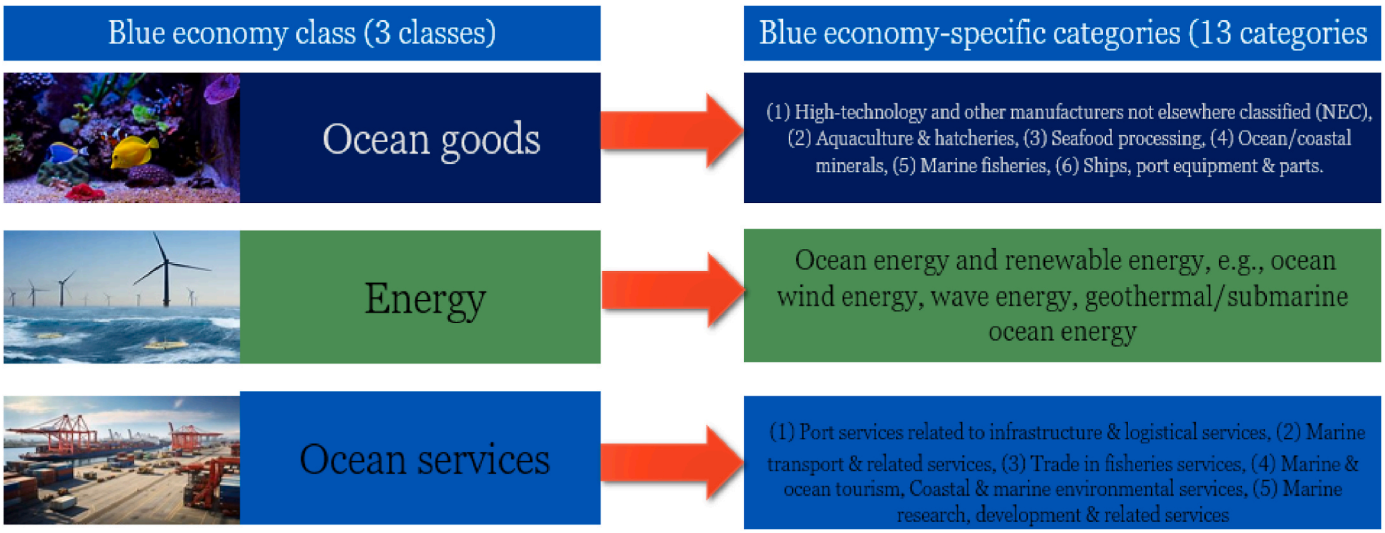

Fig. 3. The global BE classes and sectors based on the classification by the 2020 Ocean Panel report (Authors' creation based on the analysis of literature).

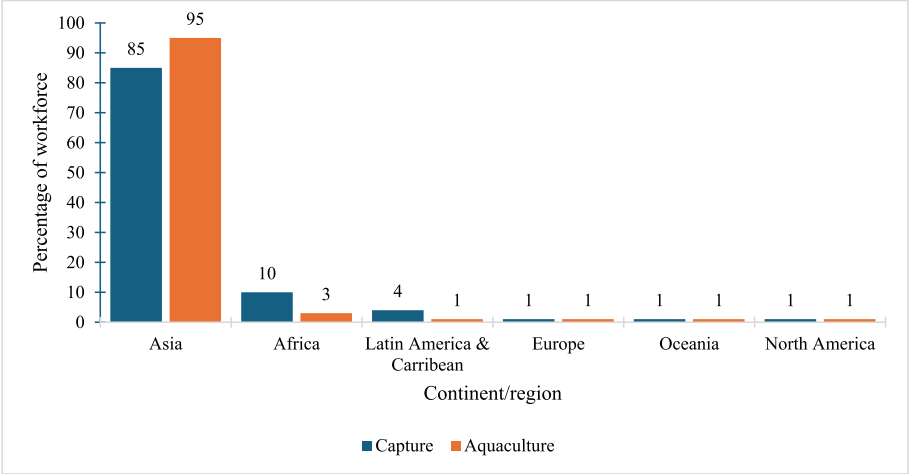

Fig. 4. Employment in fisheries and aquaculture sectors by region (Authors' creation, Source: FAO, 2024) (*In, 2022, 61.8 million fisherfolk were employed and the largest percentage of fisherfolk is in the global south).

Table 3
The 20 leading countries with the highest employees in tourism-related sectors (* represents countries categorized as global south) (Authors' creation, source: UNWTO, 2023b).

Country	Employees (000)	Latest data	Country	Employees (000)	Latest data
India*	29,683	2020	Spain	2368	2021
Japan	5889	2019	Brazil*	2192	2019
The Philippines*	4895	2021	Mexico*	2006	2020
Thailand*	4258	2016	Turkey	1437	2021
United States	3887	2020	France	1340	2020
Malaysia*	3520	2021	Russian Federation	1338	2015
United Kingdom	2743	2016	Argentina*	1260	2019
Indonesia*	2565	2020	Uganda*	1173	2015
Vietnam*	2501	2023	Saudi Arabia*	820	2021
Egypt*	2478	2023	South Africa*	774	2019

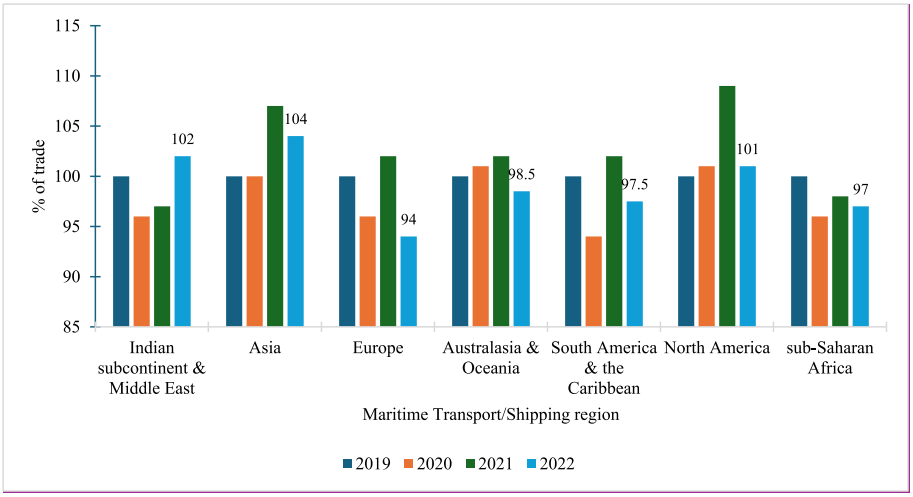

Fig. 5. Indicates regions with the highest international seaborne trade (Imports and Exports) based on container trade statistics (Base Year, 2019 = 100) (Authors' creation, source: UNCTAD, 2023).

Renewable energy could help reduce incidences of non-communicable diseases (NCDs), that vulnerable women are exposed to due to the use of unclean energy sources.

3.2. Findings from coastal women in Alappad

3.2.1. Coastal activities women engage in for their empowerment

Coastal women in Alappad engage in a diversity of livelihood activities (Table 5).

Some of the coastal-based activities women engage/that could enhance WE are indicated in Fig. 6. The field observations and engagements with coastal women revealed that there are several coastal resources that could enhance WE. These could be critical in promoting holistic WE in Alappad.

Qualitative narratives of the different activities were elaborated during FGD1 and interactions in Ponmana, Vellanathuruth, Srayikkavu,

Table 4
Natural Sand trade volumes in the global south (2021) based on the export value and global share of trade (Authors' creation, Source: The Atlas of Economic Complexity (www.atlas.cid.harvard.edu).

Region/Country	Gross Export Value (million USD)	Global Share (%)
Latin America		
Colombia	2.92	0.38
Guyana	1.26	0.16
Venezuela	1.04	0.14
Brazil	0.797	0.10
Chile	0.346	0.05
The Caribbean		
Jamaica	1.07	0.14
Costa Rica	0.730	0.10
Dominican Republic	0.292	0.04
El Salvador	0.439	0.01
Guatemala	0.10	–
Africa		
Mozambique	49.6	6.49
South Africa	7.03	0.92
Egypt	4.45	0.58
Tunisia	2.88	0.38
Morocco	2.40	0.31
South Asia and the Pacific		
Malaysia	152	19.84
The Philippines	23.1	3.02
Vietnam	7.90	1.03
Cambodia	3.21	0.42
India	1.40	0.18

and Azeekhal. Women narrated that

'*People have diverse occupations, but the main livelihood is through fishing. Fishermen can earn up to 5,000 rupees per day during the monsoon seasons. During fishing off-seasons, men and women work together in small business establishments such as selling souvenirs to cultural tourists visiting Kattil Mekkathil Devi in Ponmana.*'

Around Cheriyazheekal, one participant reported that,

'I mainly have a hotel and my family works in the hotel, we earn our wages from this. In a good season, we make a round of Rs.3000 per week. But, due to the increase in hotel businesses nearby, our business profits are decreasing.'

Through engagement in these activities, coastal women drive the value chains of established BE activities, such as fishing. For instance, during FGD 1, women narrated that,

'*Everyone knows fishing here … We are mainly engaged in fishing or fish-related activities, especially around Parayakadavu, Azeekhal, and Sriyakkadu.*'

3.2.2. (Dis)empowerment landscape and its ramifications

Although women acknowledged their involvement in coastal activities, such as fishing, the economic benefits are low and are excluded from key value-chain activities. During FGD2, women narrated that,

'*There are no wages, there is no daily work, work is only six months of the arrival of fish in which women's work is spinning and cleaning fish. Even getting support from Kudumbashree and other SHGs is hard for poor women.*'

Additionally, livelihood survival pressure is increasingly pushing women to highly masculine seasonal employment. In Ponmana, women revealed that

'*We do small-scale businesses and all jobs near sand mining areas to support the family.*'

In the coastal beach areas around Azeekhal, women narrated that

Table 5
The diverse coastal activities that women in Alappad engage in (Authors' creation from field data).

Coastal Women Livelihood	Frequency (number of participant responses N = 58)	Percentage
Fish Drying	11	19%
Fish selling	13	22%
Government Job (NREGA or MNREGS)	08	14%
Tailoring (developed under SHGs)	15	26%
Fish collection/cleaning	10	17%
Small businesses (like running tea shops, souvenirs, and fruit selling)	20	34%
Hotel jobs (owning and managing roadside hotels)	06	10%
Liquid soap and coconut oil making (developed under SHGs)	14	24%
Housewife/Domestic work such as livestock keeping	07	12%
Teaching	04	7%
Sand mining and sieving/winnowing	02	3%
Beekeeping	02	2%
Local factory work (fish ice/ exporting factory)	04	7%
Daily wages	05	9%
Coconut cutting/harvesting	03	5%
Backwater fishing	04	7%
Tourism-related activities like tour guiding/receptionist	08	14%
Small-scale farming/poultry	10	17%

'*most women do business in the evening and they sell small food items. However, these days the salary is unpredictable.*'

During FGD1, women narrated that,

'*Fish is available only in a few seasons (trawling for 6 months, then there will be no work). We therefore engage in other income-generating activities. Other income is from tailoring, livestock, and coconut oil making among others. For one-half litter of coconut oil, we get 100 rupees.*'

3.2.3. Micro-level narratives of women (dis)Empowerment

The complex challenges women face, their ramifications, and possible strategies are given in Table 6 and Fig. 7.

4. Discussion

Critical findings for an in-depth understanding of the complex intersection of WE in the BE are uncovered. First, opportunities for WE in the BE are germane. The possibilities of initially kickstarting WE in long-established BE sectors have been emphasized in ocean-related studies (Juneja et al., 2021; Partelow et al., 2023a, 2023b; Ofosu et al., 2024; Matovu et al., 2024a, 2024b, 2025). This is because, (i) of the huge ocean endowments, (ii) shared histories and knowledge in the use of common resources, (iii) shared vulnerabilities and needs for sustaining existing livelihood benefits in long-established sectors, and (iv) increasing recognition of coastal women as the invisible drivers of coastal activities, and possible stewards in ocean sustainability targets (Sathiadas et al., 2014; Ogden, 2017; IMO, 2023; UNCTAD, 2023; FAO, 2022, 2023, 2024). The benefits of WE could be cascaded into emerging BE sectors, especially renewable energy and bioprospecting in Africa. This is because Africa has the potential to supply 20 to 40 million tonnes of green hydrogen to the global north as early as 2040 (GHO, 2022). Although this has been less explored, it could promote women's stewardship in green and blue transitions (IFC, 2020; Paterson and Chabay, 2024). However, when viewed within the holistic sustainability and WE lens, lackluster progress toward linking women to the BE in the global south is prevalent. There is still limited investment for WE, especially in

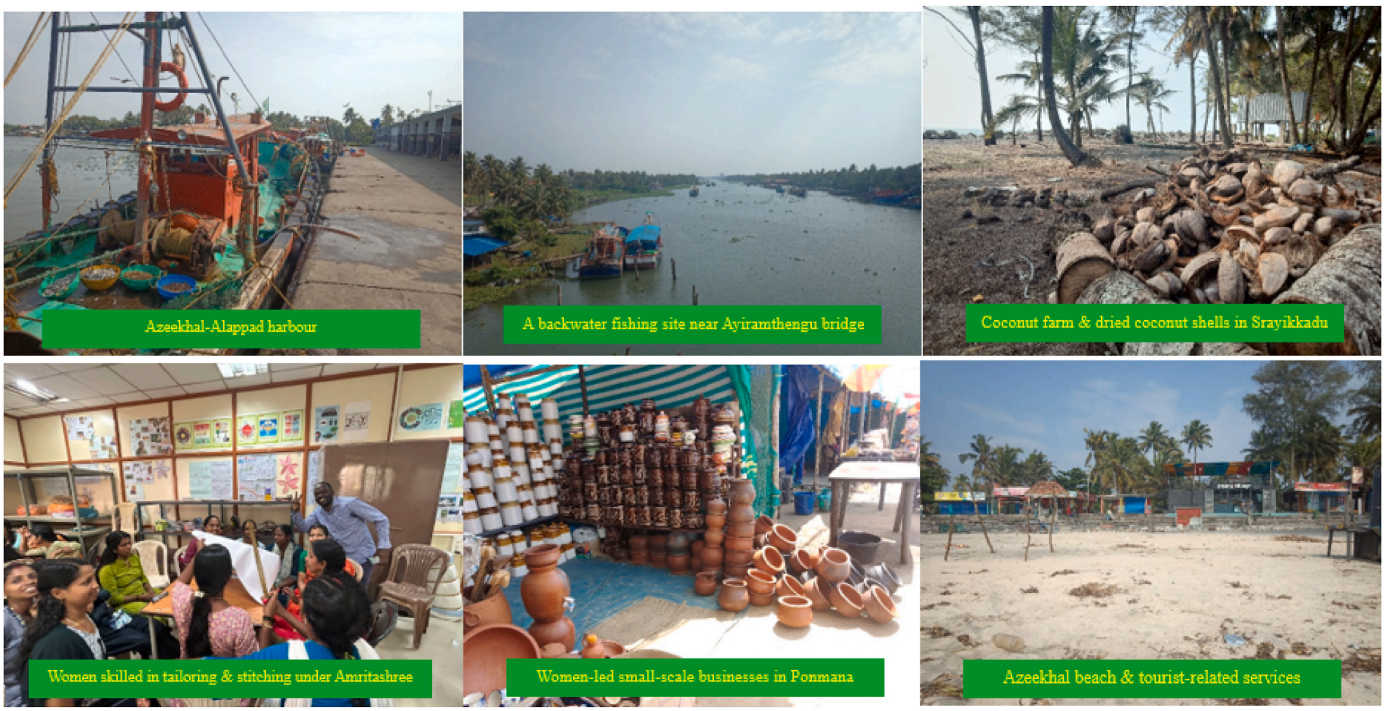

Fig. 6. Visual representation of the coastal-based activities/opportunities for WE as observed across the different wards/regions in Alappad (Field photographs collected by authors).

emerging BE sectors. The annual opportunity cost of low investment in emerging BE sectors is 250 billion USD (European Investment Bank, 2022; KPMG, 2023; IFC, 2020). With the limited investment in renewable energy, the negative ramifications for coastal women are dire, e.g., in reducing expenditure on unclean energy sources, such as fuelwood (Ocean Energy Europe, 2022).

In coastal areas, the participation of women in coastal activities hardly translates into holistic WE. Women still face hurdles in benefiting from existing BE activities; thus, contracting avenues for livelihood survival (Farmery et al., 2021; Croft et al., 2024). In the fisheries sector, for instance, women have been relegated to informal value chain activities. This constrains the socioeconomic benefits that could be harnessed from fisherwomen empowerment (Harper et al., 2020; IOC-UNESCO, 2022; UNCTAD, 2022; UNSDGs, 2023; FAO, 2024, 2024b). A complex paradox engulfing historical injustices, sociocultural norms that shape gendered roles have persisted. In coastal extractive activities, the role of women is still low, and women engage in vulnerable jobs where the benefits are low (Jouffray et al., 2023; Rangel-Buitrago et al., 2023; Asif & Arragon, 2023; Chatham House International Resource Trade Database, 2023). This has created livelihood pressures for survival. In Alappad for instance, the livelihood pressures have increased socio-ecological-economic grief and vulnerabilities. This is partly due to the loss of their livelihood assets, seasonality of jobs, increasing environmental risks, and inadequate access to livelihood safeguards. To participate in BE, women have resorted to highly masculine jobs, where they experience stigma and have limited expertise/knowledge, such as coastal businesses. The documented vulnerabilities of women in Alappad are re-echoed in WE, ocean, and coastal studies (Cisneros-Montemayor et al., 2022; Spalding et al., 2023; Coley et al., 2023a; 2023b; Asif & Arragon, 2023; The Guardian, 2023).

Fortunately, avenues for WE in the BE are emerging. In Alappad, fishermen, due to increasing pressures, arising from declining stocks, and earnings, have increased support for coastal women's employment and participation in BE activities. The increased contributions of working coastal women to household welfare have further interested micro-level women-led support schemes, groups, and government initiatives. These could further be tapped to increase collaborations for WE in the BE, and aid skills development. However, conceptual, theoretical, and practical gaps seem to persist, such as in the definitions/frameworks of what WE should be, how equity should be informed, and how to break historical injustices meted out to coastal women (Matsuda, 2013; Lawrence, 2023). This is partly due to the limited knowledge of how to negate barriers for WE, operationalize WE, or link women to BE sectors, some of which are driven by 'masculine-favoring' policies (Bennett et al., 2021, 2022, 2023; Partelow et al., 2023a; Spalding et al., 2023; Prellezo and Villasante, 2023). These increase vulnerabilities to socioecological risks, and cement historical injustices in decision-making pathways (Ekins and Zenghelis, 2021; Crosman et al., 2022; Bennett et al., 2022; IUCN, 2023; Prellezo and Villasante, 2023; Carpenter et al., 2023; Matovu et al., 2024c; Paterson and Chabay, 2024). Without breaking these century-long barriers, WE, and the key sustainability targets envisioned in the BE might not be met (Brockhaus et al., 2021; Adewumi et al., 2022; Axon & Collier; 2023; Islam et al., 2023; Gerhardinger et al., 2023). This is an audacious undertaking, that requires the co-creation of a micro-level pathway, to operationalize WE in the BE.

5. Weaving women into the BE for ocean sustainability

Mostly, ocean sustainability is still fragmented or has a limited evidence base for informing robust transformative narratives for WE in the BE (Cohen et al., 2019; von der Porten et al., 2019; Techera, 2019; Swilling et al., 2020; Brockhaus et al., 2021; Merk et al., 2022; Marschke and Rousseau, 2022; Ota et al., 2022; Curran et al., 2023; Galobart et al., 2023). To create building blocks for superimposing WE in the BE, we developed a simplistic *'blue economy and women empowerment framework–BEWE'*, that includes four interconnected steps. (Fig. 8).

The *BEWE* integrates ocean sustainability components based on the literature synthesis (Belcher et al., 2003; Bleischwitz, 2020; Baker-Médard, 2017; Alda-Vidal et al., 2023; Baker et al., 2023; Bausero-Jorcin et al., 2024; Brouwer et al., 2024), and micro-level understanding of coastal women's issues in Alappad. The *BEWE* encompassed

Table 6
Coastal women's narratives of coastal system dynamics in Alappad (Authors' creation from field data) (*the green color represents enabler (increases opportunities for WE) and orange shows inhibitors (decreases opportunities for WE) (The possible interventions were proposed/narrated by coastal women during FGDs and participant interactions).

Coastal dynamic (Enabler/Inhibitor)	Source (Environmental/ Human-induced)	Cause	Impacted WE dimension & Ocean Sustainability pillar(s)	Possible intervention(s)
Lack of support from own Panchayat	Human	- Demotivation & negative talk against women - Lack of family support - Small funding for women's projects - Limited business collateral	- Social, Psychological - Social, psychological - Economic	- Awareness - Financial support - Training on wealth creation - Creation of jobs supporting women's abilities - Formation of women's groups
Seasonal jobs	Human	- Lack of fish resources - Limited knowledge of other job opportunities. - Limited market for the small fish sold by women	- Environmental - Social, Economic, Institutional - Economic, Institutional	- Role allocation in the protection of fish/marine resources, use of big boats, resource management education - Initiation of alternative job opportunities, value-addition (training on making fertilizers/capsules from small fish/bycatch), tourism - Creation of a fish processing unit
Road infrastructure problem	Human	- Reduced catch affects funding for roads - Limited capital - Environmental issues (seasonal waves, pollution) - High fuel prices increase fishing costs - High business expenses	- Economic, Environmental - Economic, Institutional - Environmental - Economic, Institutional - Economic, Institutional - Economic, Institutional	- Waste reduction (plastic removal) - Subsidies (e.g., on fuel and fishing activities) - Local fish marketing incentives
Fish seasonality/ declining stocks	Environmental	- Backwater &seawater pollution	- Social, Environmental, Institutional	- Training & Awareness
Coastal resource contestations	Human	- Discovery of unique sand mining deposits - Formation of private monopolies - Lack of collateral on coastal land/beaches	- Economic - Economic, Social, Institutional - Institutional	- Coastal zoning - Don't know - By-laws on land ownership at *Panchayat*
Climate change-induced vulnerabilities	-Environmental	- Seasonal winds - Increasing monsoon rainfall - Coastal cave-in due to settlement & sand mining - Improper flood/saltwater intrusion control structures - Lack of Panchayat beach management plan	- Environmental - Environmental - Environmental, Scientific (engineering) - Institutional, Scientific - Institutional, Social	- Planting coconuts and traditional (Indigenous) trees - Stopping of mining - Proper coastal structures - Developing an inclusive plan for our coastal area
Increased Psychological issues awareness	-Human	- Domestic violence - Drug addiction and destituteness by men & youths - Loss of jobs by fishermen (husbands) - Previous loss of family members - Limited psychological support - Declining profits/business - Fear of displacement & no compensation	- Social, Psychological - Social, Psychological, Economic - Economic - Psychological, Social - Social, Psychological, Institutional - Economic - Social, Institutional, Psychological	- Reporting to the *panchayat* committee - Working together in small businesses - Seasonal prayers at the temple and visiting the tsunami memorial - Counseling at our school by *Anganwadi (local women coordinator)* - Alternative businesses for men and women
Formation of joint businesses	Human	- Declining catch increased the need for women's engagement in work		- Increased formation of safeguards
Community skills development	Human	- Realization of the role of women in households during COVID-19 - Recognition of coastal women's skills e.g., in tailoring & embroidery - Increased literacy among coastal women - Emergence of micro-level self-help groups e.g., *Amritashree* & Auxiliary - Increased affirmative programs under *Kudumbashree*	- Social, Economic Institutional, social, economic - Social, Economic, Institutional - Social, economic, institutional - Social, economic, institutional, psychological - Institutional, Social, Economic	- Collaborative training - Registration of women under SHGs

the principles of co-equity, system mapping, human-ecological systems, and inclusive spaces in co-designing sustainability, using different tools, techniques, and methods (Cabral Pinto et al., 2014; Tàbara et al., 2017; Burkett & Carter, 2020; Nuno et al., 2021; Shimabukuro et al., 2022; Curran et al., 2023; Galobart et al., 2023; Matovu et al., 2024c; Curran et al., 2023). By integrating transdisciplinary research components, we are mindful of the systematic symbiosis of the system interactions in the BE. Thus, each step in the co-developed *BEWE* becomes a building block that could be leveraged or refined (at a given scale and in each system), to identify and develop actions for WE/equity (Ota et al., 2022; Dahlberg & Sandstrom, 2024). Subsequent paragraphs highlight the relevance of the developed framework.

In *step 1*, we argue that as marine human-ecological systems are complex and always evolving, the primary focus should be on compartmentalizing micro-level system indicators (Christiani et al., 2019; Divisek, 2023; Ehler, 2021; Partelow et al., 2023a; Matovu et al.,

Fig. 7. The main human and environmental challenges in Alappad (Authors' creation from participant observations and interactions).

2024c). In coastal communities, this can be through (i) pre-screening of the inclusion/exclusion dimensions, (ii) determining the intentions of a given social group (i.e., coastal women), and (iii) indicators of holistic WE (DeGregori, 1988; Engels and Dietz, 2017; Environmental Finance, 2023, FAO, 2022; Gressel et al., 2020; FAO, 2023). This aids the kick-starting of WE narratives coiled around micro-level ocean sustainability targets (WOA II, 2021; World Bank, 2022). This should be done in a phased, area-specific manner as narratives for transformative change vary even in micro-coastal settings (Ota et al., 2022). Early integration of social perspectives (i.e., on systemic risks and opportunities), is key to sustaining and delivering tangible WE benefits that could be scaled up at later stages (Partelow et al., 2023a). To sustain transformative perspectives, collaborative mechanisms using different tools, methods, and approaches can be designed (Dahlberg & Sandstrom, 2024). This helps align key social sustainability interventions with related WE dimensions and equity perspectives, such as in environmentally prone zones (Birara, 2021; Lawrence, 2023; Shimabukuro et al., 2022).

To incubate key indicators related to the resource nexus, web-based tools and BE evaluation toolkits focusing on coastal livelihood assets are needed (Taguta et al., 2023; Maskaeva et al., 2024). Tools can help create indexes for WE, such as the Women's Empowerment in Fisheries and Aquaculture Index (WEFI) (McDougall et al., 2021). The indicators generated from such tools can be used to track Reach-Benefit-Empower-Transform (RBET) outcomes for WE in fisheries (McDougall et al., 2021; FAO, 2024a; FAO, 2024). The Abbreviated WEFI (A-WEFI) has five (5) domains (resources, production, income, time, leadership) with six (6) indicators, and these crucially align with the proposed empowerment arenas in WE frameworks (Deshmukh-Ranadive, 2006; Gressel et al., 2020; Coley et al., 2023a; Coley et al., 2023b). Thus, if the developed perspectives and targets are considerate of the critical systemic issues that hinder WE and community resilience, foundational avenues for stakeholder collaboration toward short-term and long-term equity become more cemented (Halpern et al., 2017; Hannah and Roser, 2021; Kitada, 2021; Bennett et al., 2021; Helgeson et al., 2022; Louey, 2022; Villasante et al., 2022). This offers new entry points to address specific WE problems, including ethical norms and ocean sustainability in each BE sector (IOC-UNESCO, 2020; Manyilizu, 2023; Matovu et al., 2023; Misra, 2006; Mutta et al., 2009; Pike et al., 2021; McKinley et al., 2023). This is because coastal communities have different perspectives on how to drive equity (Mondal et al., 2022; Mulalap et al., 2020; Mutta et al., 2009; Spalding et al., 2023). The key outputs should however be able to direct equity practices to develop key indicators and matrices to assess, measure, and evaluate progress toward equity (Sathiadas et al., 2014; Ofosu-Kusi and Matsuda, 2020; Poplawsky, 2022; Scott et al., 2024; Dahlberg & Sandstrom, 2024; Maskaeva et al., 2024). Matrices are critical starting points for creating localized inventories (Bleischwitz et al., 2023; Matovu et al., 2024c; Lukambagire et al., 2024; McDougall et al., 2023).

In *Step 2*, the key baseline indicators in *Step 1* help scale up evidence to show urgency for WE. It is also critical to incorporate crucial ocean account dimensions, such as macroeconomic, and social dimensions, to gain a general understanding of how to build resilience among women (Shaw et al., 2019; Tian et al., 2019; Stefanoudis et al., 2023; UN, 2023; Spalding et al., 2023; Global Mangrove Alliance, 2023). In social science, five key aspects are emphasized: ethical use of perspectives in decision-making, collaborative governance, aligning local community behavior with set goals and values, addressing impacts on women, and co-developing transdisciplinary partnerships and pathways (Partelow et al., 2023a, 2023b; Matovu et al., 2025). The key outputs could then be collated with global outlook indicators to hatch new engagement strategies (UNESCO, 2023; UNESCO-IOC, 2023). These strategies help define collective efforts for the WE we want (Veniswari and Revathy, 2020; Voyer et al., 2021; Winkelmann et al., 2022; WMU, 2023; OECD, 2023; WEF, 2023). This perspective has yielded benefits in areas threatened with contestations and multi-risk trade-offs from overfishing and sand extraction, such as in Cape Verde on Maio Island and Santiago (Cabral Pinto et al., 2014; Dancette & Brethes, 2019). This is through the leveraging of women's knowledge in resource co-management, and visual mapping of micro-level socioecological systems (Dancette & Brethes, 2019). This perspective has been applied in SIDS, such as in Kiribati, where the increased loss of eco-tourism hotspots, due to pollution and mining, led to the formation of advocacy groups, attracted funding for ecosystem projects, e.g., women-led sand turtle hatcheries, and created risk insurance mechanisms (Techera, 2019; Matovu and

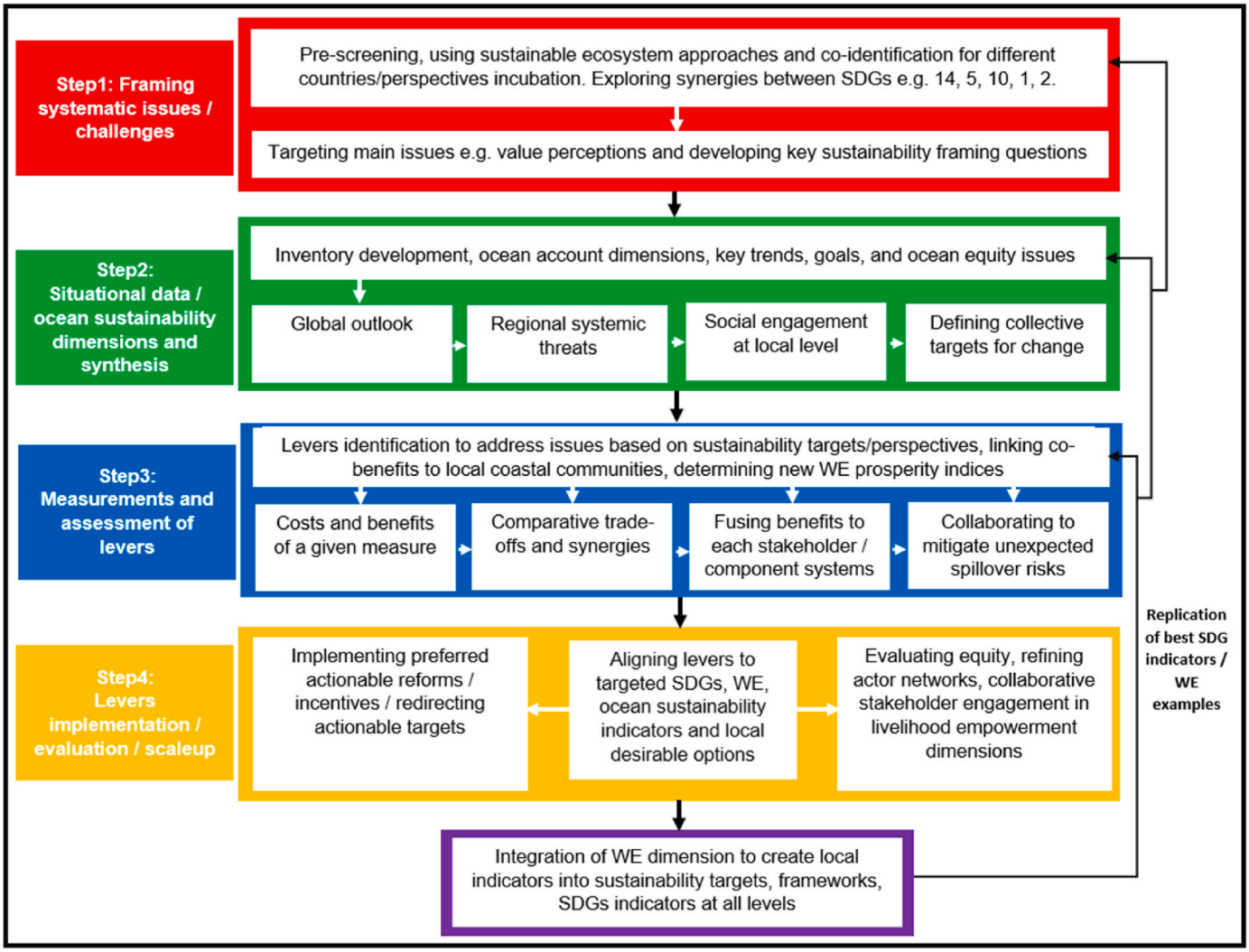

Fig. 8. The co-developed *BEWE* (Authors' creation) (*The framework was co-developed with coastal women in Alappad through mapping vulnerability issues and viability options).

Raimy, 2022).

Such initiatives could be more germane in the Pacific regions experiencing resource mining contestations and a target for future ocean sustainability research, such as in the Clarion Clipperton zone (Arbeloda, 2020; Engels and Dietz, 2017; UNEP FI, 2022a; ISA, 2021; 2023). As ocean sustainability envisions equity and the need for natural ocean processes to be rejuvenated (including the life of microbial organisms in the deep sea), a proactive synthesis of the looming threats becomes crucial (Spalding et al., 2023). This enhances consensus building and strengthens policy guidelines, e.g., the Deep-Sea Mining Code as well as the 2023 High Seas treaty which, *inter alia* requires precaution in ocean activities and the building of new pathways for ocean justice (Razak et al., 2024; Matovu, 2024). This could further reduce the unbridled over-exploitation of resources that are crucial for Indigenous coastal communities (Nuno et al., 2021). Additional benefits include the laying of foundations for women's inclusion and equity as guided by the Ocean 2050 strategy (Quevedo et al., 2024; Cisneros-Montemayor et al., 2019; Campbell et al., 2021).

In *Step 3*, the proactive inventories and perspectives of different stakeholders can be used as a transformative loop for the assessment of different levers of change. This depends on the synthesis of the comparative BE trade-offs and synergies, such as in marine fisheries (Worm et al., 2006; World Bank, 2017). This fuses benefits based on actor mapping, preferred components of change, and collaborative mechanisms to mitigate future pain points (Shimabukuro et al., 2022; Herrera et al., 2023; Razak et al., 2024). This perspective has been applied in the Caribbean and Spain to develop new pathways for equity, that decouple marine pollution from coastal activities (Patil et al., 2016; Herrera et al., 2023). In tropical unique marine diversity zones, such as along ocean gyres (Thiel et al., 2018), such mechanisms can help in the geospatial identification of pollution sources, pollution cost valuations, and operationalize regional frameworks based on MARPOL guidelines (UNCTAD, 2023; IMO, 2023; Herrera et al., 2023). By aligning micro-level assessments to global or regional frameworks, integrated policy, and governance mechanisms are born (including those on financing roadmaps for BE and WE investments) (UNEP FI, 2022a; Global Mangrove Alliance, 2023). These initiatives also aspire to create sound locally developed models (based on High-Quality Blue Carbon Principles and Guidance), that create enabling guardrails for women's inclusion (Global Mangrove Alliance, 2023). This streamlines women's environmental governance stewardship, finance, risk insurance levers, and holistic conditions to drive equitable solutions, just innovations, and investments in the BE (UNEP FI, 2022a; IOC-UNESCO, 2022).

To enhance WE, financial obligations are being committed, such as under the Common Fisheries Policy (CFP) (Bennett et al., 2021; Prellezo and Villasante, 2023). Redistribution mechanisms to mitigate ocean grabbing are being integrated into ocean sustainability discussions (IFC, 2020; Bennett et al., 2023). The redistribution mechanisms emphasize

five key tenets primed to drive holistic ocean sustainability outcomes including (i) the development of area-specific measures for protecting coastal ecosystems; (ii) increasing resilient and mitigating actions emanating from terrestrial impacts on coastal environments (IOC-UNESCO, 2022; Ocean Panel, 2022). The targeted BE sectors include maritime shipping and transport, research, and renewable energy, especially in Africa (UNCTAD, 2021, 2023; OECD, 2023). Investments in renewable energy in Africa from 2017 to 2021 increased to a record 21.1 billion USD (KPMG, 2023; IFC, 2020). This has led to an increase in Africa's renewable energy capacity from 28,445 in 2012–55863 in 2021 (IRENA, 2022). This could reduce the energy woes facing vulnerable women (IRENA, 2022).

Step 4: The implementation of positive synergies for WE and possibilities of holistic equity are emphasized. These involve the implementation of evidence-based livelihood options that benefit all, or the refining of actor networks to boost collective development, justice, and co-ideation of sustainable WE initiatives (Techera, 2019; Brockhaus et al., 2021; Lawrence, 2023). The focus should be on linking SDG indicators and targets to baseline data/targets (Ocean Panel, 2020). Here, indicators crucial in sustaining WE actions and not compromising the functioning of coastal ecosystems can be refined (WOA II, 2021). The refinement of actor networks is a new dimension that has been successfully implemented in Africa (Nagy and Nene, 2021). This dimension creates new frontiers for change in actors' ability to participate and gain recognition and benefits in the distribution of costs and justice (Temper et al., 2018; Brockhaus et al., 2021; Nagy and Nene, 2021). This analytical lens is vital in empirically assessing equity dimensions in the ocean space as it respects local knowledge systems, ameliorates sociological system identities and cultures related to indigeneity, legitimacy, and processes for rights, responsibility, and sharing of burdens (Temper et al., 2018; Farmery et al., 2021; Bennett et al., 2023). The latter could help in reducing structural violence that coastal women face emanating from exclusion from BE sectors (Ogden, 2017; Spalding et al., 2023).

The priority action areas can include leveraging the potential of self-organized or group collectives such as self-help groups (SHGs) and pursuing coastal models inclusive of women (Matovu et al., 2024b). Inclusive models help leverage engagement arenas that foster cooperative efforts in all groups, and aggregate information for setting inclusive priorities that promote transformative change (Newell, 2005; Newell and Mulvaney, 2013; Narayanan, 2017; de Juan et al., 2023). Additional benefits include the creation of novel communication pathways for knowledge sharing, structural participation in the discursive framing of BE action plans, and checking of perpetual women disempowerment threats, such as historical injustices (Newell, 2005; Dominguez & Luoma, 2020; Campbell et al., 2021; Brockhaus et al., 2021; Lawrence, 2023). This can amplify coastal women's voices across geographies and policy levels (Farmery et al., 2021; Dana et al., 2023).

6. Conclusion

The global south is well-positioned to drive WE in the BE. This is because of the numerous BE endowments and comparative benefits e.g., huge coastal population, and historical coastal women's engagement in long-established BE sectors, such as fishing. With an increasing engagement of women in activities such as coastal mining, trade, and transport, an opportunity for WE has emerged. This can begin with increasing WE in long-established BE sectors, and later emerging BE sectors. However, the participation of women has not translated into comprehensive WE indicators. In fishing, women are still engaged in informal, vulnerable, and less profitable value chains. In the mining sector, most women are artisanal miners and lack socio-economic safeguards. In marine transport, women seafarers are still few. In micro-level coastal zones, women are shifting to more masculine and vulnerable employment, where they work for long hours. The earnings in the livelihood activities are meager, creating livelihood survival pressures. This has been worsened by patriarchal norms, social stratification of gender roles, seasonality of jobs, lack of livelihood security assets, and increasing environmental threats. This has led to increasing socio-ecological, and economic grief. Although women demonstrate knowledge of key transformative strategies, these have not been fully tapped or harnessed.

Fortunately, micro-level vulnerabilities facing fisherfolk have been a blessing in disguise for coastal women. Declining catches, increased resource nexus contestation, and economic vulnerabilities have created positive perceptions of women's engagement in coastal activities. This has led to increased WE spaces, e.g., in engagement in micro-level SHGs, skills development, and collaborations in joint businesses. This has made coastal women critical drivers for household welfare and community livelihoods. This presents a valuable starting point for creating avenues for WE. To build momentum and lay avenues for increasing WE in the BE, a simplistic framework–*BEWE* has been developed. The BEWE highlights four key steps for WE in the BE. Operationalizing the BEWE could create multiplier benefits that link the critical needs for coastal WE with the global SDG agenda and ocean equity (including the Sustainable Blue Economy Finance Principles), which aim at increasing financing pathways for coastal women in blue projects. As research on WE in the BE is just evolving, participatory studies in different coastal regions are needed. This can increase scholarship and add evidence for WE, leading to sustainable ocean equity outcomes.

CRediT authorship contribution statement

Baker Matovu: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Raimund Bleischwitz:** Writing – review & editing, Writing – original draft, Validation, Resources, Project administration. **Isaac Lukambagire:** Writing – review & editing, Writing – original draft, Visualization, Software. **Linda A. Etta:** Writing – review & editing, Validation, Resources, Project administration, Investigation. **Meltem Alkoyak-Yildiz:** Writing – review & editing, Validation, Supervision, Resources, Project administration. **Rashed Tarek:** Writing – review & editing, Validation, Supervision, Project administration, Conceptualization. **Ming-An Lee:** Writing – review & editing, Validation, Resources, Formal analysis. **Mubarak Mammel:** Writing – review & editing, Validation, Formal analysis. **S. Anusree:** Writing – original draft, Investigation, Formal analysis, Data curation. **Ammu S. Suresh:** Writing – original draft, Investigation, Formal analysis, Data curation.

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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.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.

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Data availability

Primary data supporting the findings (participant interactions) have been attached as supplementary material. Analyses from FGDs can be provided by the corresponding author upon request

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