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Assessing fishing gear disposal practices in coastal communities from the Gulf of Guinea and the implications on the sustainability of the blue economy



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We investigated fishing gear disposal practices in coastal communities from the Gulf of Guinea and examined the implications for coastal and marine ecosystems and the blue economy. Using a mixed research method and purposive sampling, data were collected from artisanal fishers in island communities in Nigeria's Niger Delta. Females between 41 and 50 years with secondary education dominated the group compared to males. Gillnets, with an average lifespan of one year, were the dominant gear type. Disposal methods include reuse (66%), open burning (18%) and indiscriminate dumping (16%). Notably, 92% of fishers were unaware of the environmental risks of improper gear disposal, highlighting a significant gap in environmental education. Reported impacts include gear entanglement, navigation hazards, and ghost fishing. These practices contribute to coastal and marine pollution, threaten biodiversity and undermine sustainable fisheries. Addressing these challenges requires targeted awareness campaigns, ocean literacy programmes, recycling infrastructure, and stronger regulatory oversight.

The blue economy, characterized by the sustainable use, conservation and governance of ocean resources has become a central framework for harmonizing economic development, and environmental stewardship with marine conservation¹. Central to the blue economy are fisheries, which provide livelihoods, food security, economic growth, and cultural heritage to coastal populations globally². However, the sustainability of fisheries depends not only on responsible fishing practices but also on the proper management of fishing gear, which often poses environmental challenges when disposed of improperly. In Nigeria's Niger Delta, the blue economy holds particular significance due to the region's rich biodiversity, extensive coastline, and dependence of local communities on coastal and marine resources for their livelihoods³. According to the Food and Agriculture Organization (FAO), the Niger Delta accounts for a significant portion of Nigeria's total fish production⁴. However, alongside the economic benefits, the region faces numerous environmental threats, including coastal and marine pollution from petrochemical production, industrial discharge, and poor waste management⁵. Among these environmental concerns, the disposal of fishing gear emerges as a significant issue with far-reaching implications for the marine ecosystem and the sustainability of the blue economy. Fishing gears are fishing tools generally made of plastic polymers

that are hazardous to coastal and marine environments when they are lost, abandoned or discarded at sea⁶. Fishing gears vary in structure, materials, capture process, and modes of operation^{7–9} and artisanal fishers use more than three fishing gears for fishing operation that may include gillnets, cast nets, traps, hook and line, dragnets and cages¹⁰.

Global fisheries generate an estimated 640,000 metric tonnes of abandoned, lost, and discarded fishing gear (ALDFG) annually^{11,12}, representing the most lethal form of marine pollution to aquatic ecosystems¹³. ALDFG represents 62–86% of all floating microplastics in ocean gyres by weight^{14,15}. Fishing gear can be abandoned, lost, or discarded following environmental, operational, behavioural or management pressures. Common environmental causes of gear loss include severe weather events and gear movement from currents, swells and tides^{16–18}. Furthermore, insufficient fisheries management measures such as inadequate spatial management, enforcement, gear marking and loss reporting requirements, illegal, unregulated and unreported (IUU) fishing activities, and lack of limits on fishing efforts can lead to chains of events that result in gear losses^{19–21}. According to FAO, ALDFG and microplastics represent the two most profound ocean pollution to global fisheries⁶. ALDFG significantly hinders progress towards the United Nations Sustainable Development Goal (SDG)

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14, to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. Improper disposal of fishing gear can result in ghost fishing, reduce fish stocks, harm non-target species, impact coral reefs and other sensitive habitats and act as a hazard to navigation²².

The United Nations Development Programme has re-emphasized the need for protecting the coastal and marine environment for sustainable management of fisheries to ensure the long-term viability of marine ecosystems and the livelihoods of coastal communities²³. However, the improper disposal of fishing gear poses significant environmental, economic, and social challenges, threatening the sustainability of the blue economy. Despite the growing recognition of the importance of responsible waste management in marine environments, little data exists on gear disposal practices in the Gulf of Guinea, particularly among artisanal fishers in remote communities. Proper management of fishing gear disposal is essential for preserving marine ecosystems, protecting marine biodiversity, and ensuring the long-term sustainability of the blue economy, which is vital for the attainment of the United Nations Sustainable Development Goal 14 – sustaining life below water. Hence, understanding land-to-sea sources of plastics and debris entering the coastal and marine environment from the Gulf of Guinea section into the Atlantic Ocean is important. This study addresses this gap by examining the methods, drivers, and ecological consequences of fishing gear disposal in the Niger Delta. The objectives are to (1) describe the demographic profile of artisanal fishers (2) document the types, lifespan and maintenance of fishing gear in use, (3) assess disposal practices and environmental awareness, and (4) explore the policy implications for coastal and marine resource management and the blue economy.

Methods

Study area

The study was conducted in the Warri Southwest Local Government Area of Delta State, Nigeria. The area which lies between latitude 5°37'39.57" N and longitude 5°23'40.005" E comprises several island communities located between the Benin River and Escravos Estuary (Fig. 1). Both aquatic ecosystems drain into the Gulf of Guinea section of the Atlantic Ocean and support significant artisanal fishing activities. Communities in this region

face systemic infrastructure deficits, including limited access to higher education, sanitation and waste management services. Economic activities include fishing, logging for fuel and construction, petty trading and contract labour. Fishers rely on small and medium-sized wooden or fibreglass boats, with some fitted with 40 or 60-hp petrol-powered outboard engines⁹. Fishing has been the means of livelihood for centuries until the early 1960s when oil and gas exploration and production started in the region.

Research design

A mixed research method, combining quantitative surveys and qualitative interviews was adopted for the study. A structured questionnaire which addressed the research question served as the primary survey instrument. The sample size determination for the quantitative study was calculated using the Taro Yamane formula²⁴ according to Eq. (1);

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where n is the sample size, N is the population size, 1 is the constant, and e is the degree of error.

Data collection

The data for this study were collected from both primary and secondary sources. Primary data were collected using a well-structured questionnaire designed with open and closed-ended questions relevant to the objectives of the study and administered purposively to 50 artisanal fishers operating in the study area²⁵. This was complemented by informal interviews conducted among artisanal fishers from selected coastal and island communities. Interviews were recorded with electronic devices for subsequent retrieval. Secondary data were sourced from peer-reviewed literature, policy reports, and development agency publications relevant to the research theme. The questionnaire was pre-tested through a pilot survey among a subset of artisanal fishers to ensure clarity and relevance²⁶. The pilot study provided the opportunity to refine the questionnaire to align appropriately with the scope of the study. All intended participants who did not meet the inclusion criteria were excluded from the study.

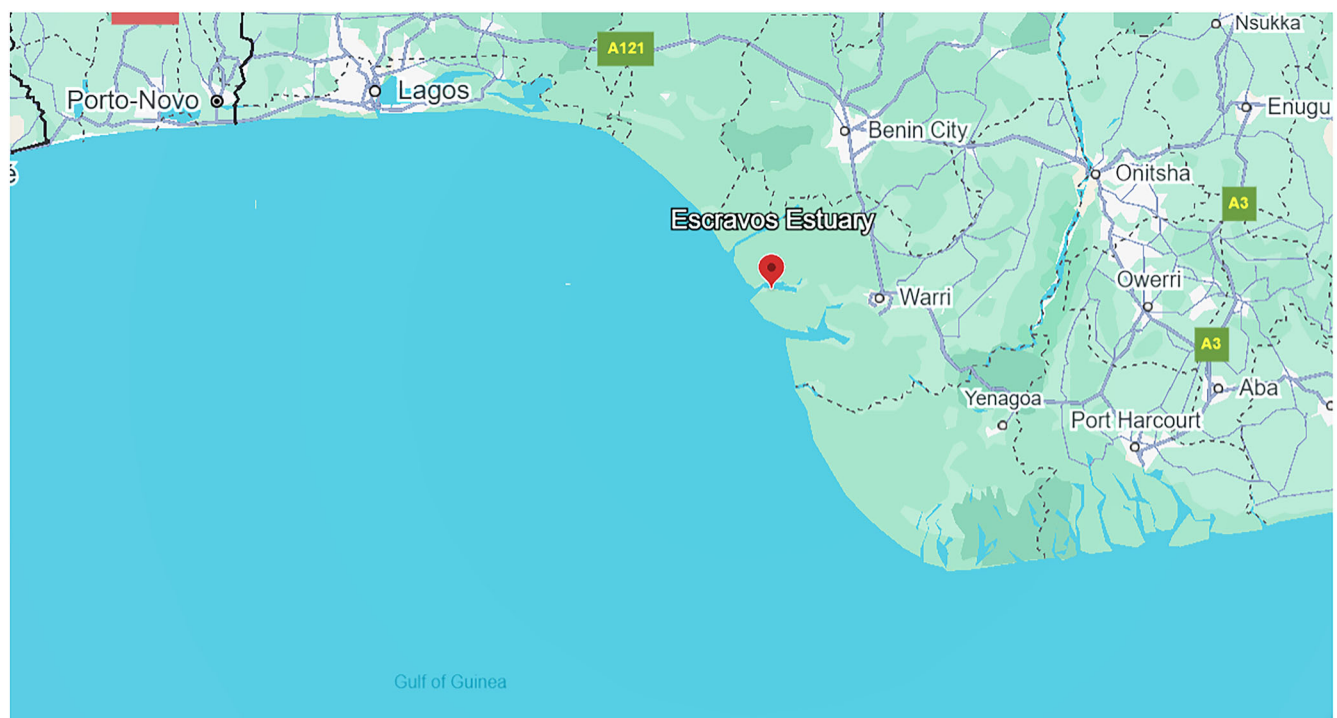


Fig. 1 | Map of the study area showing the Escravos Estuary and the Gulf of Guinea section of the Atlantic Ocean.

Table 1 | Demographic profile of artisanal fishers in the study area

Variables	Frequency	Percentage (%)
Sex		
Male	21	42
Female	29	58
Age		
10–20	1	2
21–30	11	22
31–40	6	12
41–50	14	28
51–60	8	16
61–70	10	20
Education		
No Formal Education	12	24
Primary	12	24
Secondary	23	46
Degree	3	6
Full/Part Time		
Part-time Fishers	28	56
Full-time Fishers	22	44

Data analysis

Quantitative data were analysed using Microsoft Excel 2021 and SPSS version 21. Analysed data were summarised into descriptive statistics such as mean, standard error, frequency distribution and percentages. A one-way analysis of variance (ANOVA) at a 95% confidence level was used to test for the difference between the mean values where necessary. Qualitative data from interview responses were retrieved from recording devices, transcribed and coded into thematic narratives and triangulated with the quantitative data to enrich the interpretation of the results for the study.

Ethical considerations

Ethical approval was obtained through community engagement. Informed consent was secured from participants before their involvement in the study. Participation was voluntary and the confidentiality of participants was ensured by anonymizing data and storing it securely. Participants were informed of their right to withdraw from the study at any time, and their cultural norms were respected throughout the study.

Results and discussion

Demographic profile of artisanal fishers

Among fishers surveyed, 58% were female and 42% were male, reinforcing the significant role of women in small-scale fisheries^{27,28}. This is consistent with observations in Ghana, Togo and Timor Leste highlighting women's contribution to the fishery sector^{29–31}. Fishing is not a gender-exclusive occupation, and males in the region prefer oil and gas-related jobs to artisanal fishing. The dominant age group was 41–50 years (28%), followed by 21–30 years (22%), 61–70 years (20%), 51–60 years (16%), 31–40 years (12%) and 10–20 years (2%) respectively (Table 1). This reflects a multi-generational engagement in fishing. Educational attainment was relatively low, with 46% having secondary education, 24% having primary education, 6% tertiary education, and 24% with no formal education. This is consistent with previous reports reflecting broader trends in low educational levels in coastal and island communities in Nigeria^{32,33}. Most fishers (56%) identified as part-time operators compared to full-time fishers (44%). The shift from full to part-time fishing may be attributed to alternative business opportunities, pollution of the waterways, and a consequent decrease in fish catch and the need to augment income from fishery operations to support livelihood pressures.

Table 2 | Fishing gear acquisition, use and maintenance practices among artisanal fishers

Gears	Frequency	Percentage (%)
Gear Type		
Gillnets	38	76
Dragnets	4	8
Hook and line	2	4
Cages	1	2
Fish traps	5	10
Gear Acquisition		
Shops	1	2
Markets	46	92
Suppliers	2	4
Others	1	2
Gear Quality		
Genuine	35	70
Substandard	15	30
Gear lifespan		
1 year	41	82
3 years	6	12
5 years	2	4
10 years	1	2
Duration/Intensity		
Yes	31	62
No	19	38
Mending/Discard		
Mend	44	88
Discard	6	12
Who Mends		
Self	33	75
Menders	11	25

Economic pressure drive gear acquisition, use and maintenance

Most fishers (92%) reported purchasing their gear from local markets (Table 2), with 70% opting for genuine gears, which underscores the importance of gear quality in their trade, whereas 30% opt for substandard gear due to cost. Gillnets (76%) were the predominant gear type, followed by fish traps (10%), cast/dragnets (8%), and others (6%). Gillnets of varying sizes, depending on the target species are prevalent among artisanal fishers^{9,10,28}. Most fishers (94%) fish within the estuary, reflecting localized, community-based fishing due to boat limitations. This restricted range highlights the potential for overfishing in certain areas, especially in the absence of regulated fishing. Catch rates are reported to be higher in the wet season (78%) compared to the dry season (22%).

The average lifespan of a fishing gear is one year (82%), which is supported by previous studies in the region³⁴. Although, others reported three (12%), five (4%) and ten (2%) years respectively. The durability of fishing gear is strongly correlated with maintenance (62%), rather than intensity of use. This underscores that while quality is important, maintenance also plays a crucial role in gear durability. A significant proportion of fishers (88%) mend damaged gears depending on the extent of the damage, compared to fishers that discard (12%) the gear upon damage. Further analysis shows that 75% of the fishers who mend damaged gear do so themselves, while the remaining 25% rely on experienced menders within the community. Self-repairs of damaged gear suggest a frugality borne from economic necessity, given the rising cost of new fishing gear. This maintenance culture which reflects traditional knowledge systems helps to reduce

waste from gear disposal, but it does not necessarily translate to environmentally responsible gear disposal practice. Experience menders are often retired fishers who now rely on the mending of gears as an alternative source of income.

Disposal practices for end-of-life fishing gears

Gear disposal practices among fishers include reuse (66%), open burning (18%) and indiscriminately dumping (16%) in the environment (Fig. 2a). According to FAO, inappropriate disposal of fishing gear, whether at sea or on land, adds to the problem of ALDFG⁶. Among the 35 fishers who reuse their fishing gear, 63% reuse old gear to mend broken gear, whereas 37% repurpose the gear for domestic uses (Fig. 2b). Recycling and repurposing fishing gear are some of the approaches recommended for reducing ALDFG in the sea and its impact on coastal and marine life⁶. While reuse primarily borne out of cost-saving motives may delay gear entry into the waste stream and coastal ecosystem, it does not constitute environmentally sound disposal practices for fishing gear disposal.

Awareness and environmental impacts of improper gear disposal

The environmental risk associated with improper gear disposal was highlighted under four subthemes which include the perception of fishers on the associated negative impacts from improper gear disposal, the identified negative impacts, the contribution to environmental pollution, and the potential impact on marine life and fisheries. Only 8% of fishers recognized the environmental risk associated with improper gear disposal, while the majority (92%) believed there were no negative impacts associated with the indiscriminate disposal of fishing gear into the estuary (Fig. 3). This result highlights the severe lack of environmental education and ocean literacy among artisanal fishers. This lack of awareness suggests that fishers may not see the connection between their actions and the health of coastal and marine ecosystems and how this could directly or indirectly affect their livelihoods, hinder conservation efforts and sustainable fisheries management.

Among the fishers (8%) who recognised the risk associated with improper gear disposal, when asked “What are the negative impacts associated with the improper disposal of fishing gears into the estuary?” Their responses are highlighted below;

- Gear entanglement with active nets: Fishers indicated that “old net dey hook our net, when we go river”, “instead of fish, we dey see old net they jam our net”. Indiscriminate gear disposal interferes with active fishing gear and disrupts fishing efficiency.
- Environmental and navigation hazard: Gear disposed of indiscriminately “dey scatter for the waterfront”, “e fit affect propeller for

speedboat or barge”. Improper gear disposal defaces the waterfront, affects navigation by entangling speedboats and barge vessel propellers.

c. Ghost fishing: Improper gear “dey kill some fish wey we dey see for river”, “crab dey enter too to go collect fish inside”. Improperly disposed of gear entangles fish (ghost fishing) thereby endangering marine life and resulting in the depletion of fishery resources.

These impacts align with global concerns over ALDFG as a threat to marine biodiversity, fisheries sustainability and maritime safety.

The majority of fishers (69%) were unaware of the connection between discarded fishing gear and pollution, with 31% admitting the link to pollution (Fig. 3). Fishing gears, made primarily from synthetic polymer degrades into microplastics and continues to pollute coastal and marine ecosystems. According to FAO, the production, use, maintenance and disposal of fishing gear are major sources of secondary microplastics in the global ocean⁶. Based on annual projections, plastic pollution in the global oceans is estimated to triple by 2040³⁵. Secondary microplastics accumulate in marine ecosystems, disrupting food chains and harming wildlife. The indiscriminate disposal of fishing gear into the estuary will ultimately contribute to the pollution of the estuary, the coastal environment and the Gulf of Guinea section of the southern Atlantic Ocean.

On the effect of improper gear disposal on marine life, 41% were unaware and 33% were uncertain whereas 26% acknowledged potential effects. Similarly, 91% of fishers do not believe that improper gear disposal affects marine fisheries. This strongly correlates with interview responses among fishers who believe that the “ocean is too vast and endless to run out of fish” and declining fish catch is attributed to “chemical waste”, “petrochemical pollution” and “changes in seasons”. Such perceptions are alarming, especially given the known role of ghost gear in reducing fish stocks and harming non-target species^{2,14}. The level of education among fishers and the lack of ocean literacy could influence their understanding of the environmental risk associated with improper gear disposal. There is an urgent need for ocean literacy programmes among fishers in the region.

Fisher's cooperatives and institutional support system

We also investigated the role of a cooperative society and institutional support system among fishers in the area. Sixty-seven per cent (67%) of fishers reported no existing cooperative or union, while 33% confirmed a form of union, with no support or incentives for members. Collective organization among fishers is weak, unlike Togo where women's cooperative organises training courses thereby building capacity and enhancing income sources among fishers³¹. The majority of fishers (88%) reported no government aid while 12% reported receiving government aid. Aid and infrequent donations come from the Niger Delta Development

Disposal practices for end-of-life fishing gears among artisanal fishers

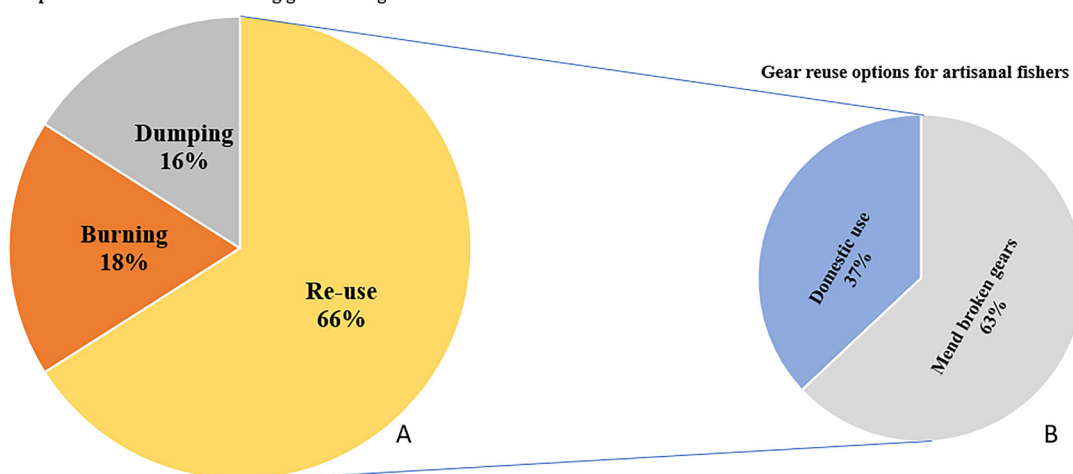
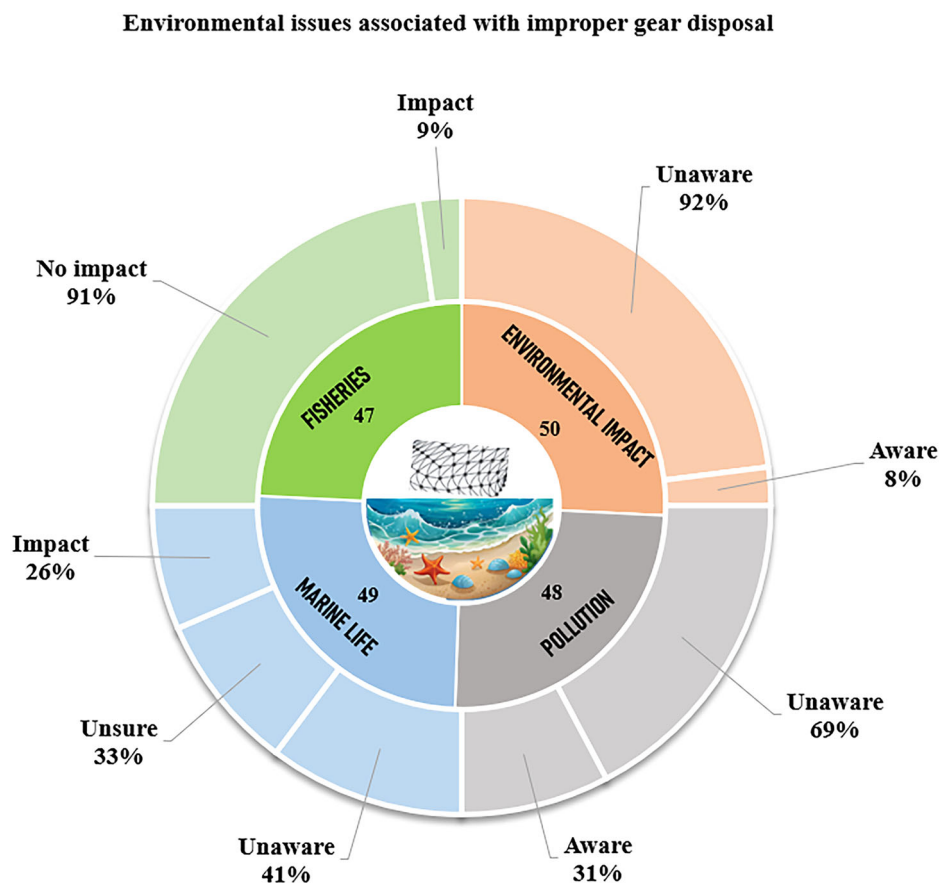


Fig. 2 | Disposal practices for end-of-life fishing gear among artisanal fishers. A Proportion of discarded gear among fishers. B Fishing gear reuse option among fishers.

Fig. 3 | Perception and knowledge of gear disposal among fishers. The vast majority of fishers are unaware of the environmental risk, pollution issues and the impact associated with improper gear disposal on marine life and fisheries.



Commission and the Presidential Amnesty Programme. The lack of institutional support further isolates fishers thereby contributing to reliance on substandard fishing gear and poor management practices for gear disposal.

Institutional oversight and enforcement of fishing regulations

The majority of fishers are unaware of any gear regulation (96%), gear inspection (97.4%), mesh size enforcement (97%) or restrictions on nautical boundaries (93%) by regulatory agencies. The absence of regulatory oversight creates a governance vacuum that encourages unsustainable fishing practices that are detrimental to the coastal and marine ecosystems in the region. There is a need to strengthen the institutional and regulatory framework for the Fisheries Act of 1992 among artisanal fishers in island communities. The Federal Department of Fisheries and Aquaculture in conjunction with the Nigerian Maritime Administration and Safety Agency and sister agencies in nations within the Gulf of Guinea should develop action plans for gear disposal management in the region.

Towards sustainable disposal practices for fishing gears

We further investigated the efforts, if any towards the proper gear disposal among fishers. A vast majority (96%) reported no recycling facility exists for fishing gear. However, 54% of respondents supported such recycling initiatives for proper gear disposal, while 46% opposed the idea, considering such venture as a waste of resources. Furthermore, 91% were unaware of any gear-disposal innovations, with only 9% indicating their awareness of such technologies. These results further highlight the urgency to introduce recycling initiatives and awareness campaigns to prevent further environmental degradation. FAO and partners are working to address fishing gear disposal globally. One such initiative is the Voluntary Guidelines on the Marking of Fishing Gear³⁶. Although voluntary, this initiative could aid in the identification, tracking, reporting and retrieval of lost gear. For this framework to succeed, it requires government backing and contextual adaption to national legislation. Despite this,

implementation in remote islands may be slow without increasing awareness, especially ocean literacy programmes for youths and capacity-building among fishers. We call on the Fisheries Committee for the West Central Gulf of Guinea (FCWC), the Economic Community of West African States (ECOWAS) and the African Union to take proactive steps and include a fishing gear management framework as part of the FCWC action plan, the ECOWAS Integrated Maritime Strategy³⁷ and the African Union Agenda 2063³⁸.

Producer responsibility and ocean literacy

Over half of the fishers (53%) did not believe producers share responsibility for gear disposal, while the rest were uncertain about the producer's role in gear disposal management. On the willingness to attend programmes for proper gear disposal, 52% of fishers were unwilling to attend citing time constraints and domestic duties, whereas 48% were open to participating, based on availability. Targeted awareness programmes using a community-based approach to ocean literacy including risk communication for disposal of fishing gear should be organised for artisanal fishers and young people. This should also apply to small-scale fisheries worldwide facing similar constraints. Risk communication should be a priority measure for primary engagement and consultation for ecosystem-based risk management processes for island communities³⁹.

Conclusion and recommendations

Improper disposal of fishing gear in the Gulf of Guinea contributes to marine pollution, ghost fishing, and habitat degradation, threatening coastal livelihoods and regional sustainability. In the absence of institutional support, artisanal fishers rely on unsustainable disposal practices driven by economic necessity. A critical finding is the widespread lack of awareness among fishers regarding the ecological impacts of improper gear disposal. Most fishers do not perceive any threat to marine life or fisheries from improper gear disposal, despite clear evidence linking fishing gear to ghost

fishing, habitat degradation, and navigational hazards. These unsustainable disposal methods increase the local and regional burden of marine debris and litter entering the Gulf of Guinea and ultimately contribute to discarded fishing gear and plastics in the global ocean with far-reaching implications for the sustainability of the fishery sector and the blue economy. Addressing these challenges requires a multifaceted strategy: regulatory enforcement, gear recycling programmes, and grassroots education on ocean literacy and marine ecosystem stewardship. Strengthening the environmental governance of small-scale fisheries is essential to realizing the goals of the blue economy and sustaining life below water. To address these challenges, the following actions are recommended:

1. Awareness and Education

Develop and implement targeted ocean literacy campaigns for artisanal fishers and youth in island communities. These should focus on the ecological and economic consequences of gear disposal, emphasizing the link between sustainable practices and long-term fishery productivity.

2. Policy and Regulatory Reform

Strengthen and enforce existing fisheries regulations, including gear marking, mesh size standards, and spatial restrictions. National legislation should incorporate global initiatives such as FAO's Voluntary Guidelines on the Marking of Fishing Gear, adapted to the realities of small-scale fisheries, especially in remote areas.

3. Recycling and Waste Management Infrastructure

Establish localized recycling or gear collection programmes in fishing communities, possibly through public-private partnerships or cooperatives. Pilot projects should test low-cost, scalable models tailored to local contexts.

4. Community Engagement and Capacity Building

Promote the formation of fisher cooperatives and provide training on sustainable fishing practices, waste reduction, and alternative livelihoods. Incentivize participation through microgrants or gear exchange schemes.

5. Producer Responsibility and Innovation

Encourage manufacturers to take greater responsibility for end-of-life gear disposal through take-back programmes or biodegradable gear development. Government policy should support innovation and partnerships with academic and private sectors.

In summary, achieving a sustainable blue economy in the Gulf of Guinea requires coordinated interventions that combine policy reform, environmental education, and local empowerment. By addressing the knowledge and infrastructure gaps revealed in this study, stakeholders can mitigate the impacts of marine debris, safeguard biodiversity, and strengthen the resilience of coastal livelihoods while ensuring the sustainability of the blue economy.

Limitation of the study

A suitable limitation to note in this study is the narrow geographic and demographic scope of the data collection. The study focuses on 50 purposively sampled artisanal fishers from island communities in Warri South-west LGA, Delta State and informal interviews from two locations across the Niger Delta. This may not adequately represent the full diversity of fishing gear disposal practices across the broader Gulf of Guinea region.

Data availability

The data analyzed during this study are included in this published article and its supplementary information files, with the exception of raw interview transcripts and complete workshop discussion texts. These contain personal information and were excluded to protect the privacy and anonymity of the participants.

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Author contributions

A.O.E. Conceptualisation, Project Design, Project Administration, Supervision, Data Analysis, Review of manuscript A.M. Project Administration, Project Design, Review of manuscript G.C.M. Fieldwork, Data Analysis, Wrote the draft manuscript.

Competing interests

The authors declare no competing interests.

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