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# Artisanal billfish fisheries: gender roles, challenges, and opportunities

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Marine fishery sustainability depends, among others, on broader governance factors affecting fishery value chains, including the division and distribution of gender roles. This study investigates the roles of women in artisanal (billfish) fisheries in Kenya, identifies the constraints to their participation, and makes policy recommendations to enhance women's contribution to the growth and sustainability of this important sector. Qualitative and quantitative data through surveys (n=25), semi-structured interviews (n=75), group discussions (n=104), and observations in the selected study sites on the Kenya coast show that key factors influencing women's involvement are market access, financial resources, and skillsets. From a value chain approach, women primarily engage in secondary activities like processing and trading, while their involvement in primary roles, such as managing fishing crews, is minimal. Historical social, cultural, and economic barriers, including lower education levels and traditional gender roles, contribute to this disparity. Existing gender dynamics reinforce inequalities in resource access and decision-making. This study seeks to fill knowledge gaps regarding women's participation in billfish fisheries in the Western Indian Ocean, using Kenya as a case study. While women are known to participate in sport and recreational fisheries, their roles in artisanal fisheries are underrepresented in research. The analysis underscores the need for context-specific policies to enhance women's roles and for integrating gender considerations into fisheries management, so that women can become crucial stakeholders in billfish fisheries. Overall, the findings have significant implications for promoting gender equity and sustainable fisheries practices in artisanal fisheries in Kenya and beyond.

## KEYWORDS

artisanal fisheries, billfish fisheries, gender roles, Kenya, value chain

# 1 Introduction

Women account for almost half the workforce in fisheries and aquaculture value chains globally, mainly through processing and trade (FAO, 2016a; Gopal et al., 2020; Chepkirui et al., 2023). They make up 28% of the primary workforce in aquaculture and 18% in fisheries, including an estimated 50% presence in the pre- and post-harvest stages (FAO, 2022). Despite women playing crucial roles in fisheries, their participation has often been underestimated and poorly understood (Harper et al., 2017; Szymkowiak, 2020), leading to limited representation in statistical data and management decisions (Kleiber et al., 2015; Harper et al., 2017; Alati et al., 2023; Orth, 2023). Such gaps in their accurate representation (Frangoudes and Gerrard, 2018) undermine the development of gender awareness in policy formation and gender equality in this sector (Williams, 2002; FAO, 2020; FAO, 2022), further preventing the attainment of the Sustainable Development Goals. In this study, we use a gendered value chain approach to fill knowledge gaps regarding women's participation in billfish fisheries in the Western Indian Ocean, using Kenya as a case study. We examine the complex interplay of economic, sociocultural, and environmental factors that influence participation in billfish fisheries along the Kenyan coast, particularly emphasizing the nuanced opportunities and challenges faced by both men and women in this sector.

Cultural, social, and economic factors influence gender roles in fishing communities, resulting in differences in the involvement, constraints, barriers, options, and benefits of men and women in fisheries (WorldFish, 2016; Harper et al., 2017; FAO, 2022; Chambon et al., 2024b). The long-held perception of fishing as masculine (Monfort, 2015; Sornkliang et al., 2018), and the traditional definition of fishing as "going to the sea to collect small fish and invertebrates" (Harper et al., 2013; Harper et al., 2017) can hinder a full understanding of factors associated with the involvement of men and women and therefore limit the recognition of their differential contributions.

A growing body of literature has brought to light the significant and varied roles of women in fisheries and the value chains (Wamukota, 2010; Manyungwa et al., 2019; Thomas et al., 2021; Gideon, 2023; Chambon et al., 2024b; Sariga et al., 2024). In a study conducted in Malawi, women were also involved in the production node of the value chain as gear owners, even though the majority of them participated as processors and traders (Manyungwa et al., 2019). A similar observation was recorded in Fiji, where, besides gleaning for invertebrates and seaweed, women were actively fishing and catching more than 100 species of fish, demonstrating their involvement beyond the traditionally recognized roles. Another study in India confirmed women's involvement in preharvest activities in collecting bait and mending nets in India (Sariga et al., 2024).

However, some studies have highlighted fish value chain activities to be gendered, for example, women's participation in Alaska fisheries was found to be significantly lower than men's and tended to be more sporadic in nature (Szymkowiak, 2020). In Zambia, men predominantly involved in fishing and women primarily involved in processing and trading. This study also

highlighted that the highest losses occurred within the processing node, with women experiencing three times more physical losses than men (Kaminski et al., 2020). In Mexico, women showing the highest participation in activities that were complementary to production while men participated to a greater extent in production activities, yet the women still faced inequality in fisheries cooperatives compared to men (Solano et al., 2021). In coastal Kenya, women play crucial roles in fish processing and marketing, buying fish from the fishers, cleaning, preserving (through drying or pre-cooking), packaging, and sometimes branding the fish before selling it to consumers (Wamukota, 2010; Gideon, 2023). A recent study on Kenya's coast looked at the gendered dimensions of small-scale fishing and found major variations between men and women, with few women participating as fishers (Chambon et al., 2024b), indicating a shift in the traditional gendered roles of men and women in fisheries in the country.

Globally, few studies have documented the participation of men and women in billfish fisheries. A study in the West Atlantic showed that women participate in the consumption of billfish fisheries, consuming them raw, smoked, or cooked (Pinto et al., 2021). Additional studies in the USA have indicated women's presence but limited involvement in recreational fishing as anglers and tournament participants (Ditton and Hunt, 1996; Ditton and Stoll, 2003; Schultz et al., 2006). Some studies on socio-economic aspects of billfish fisheries in the WIO region (Kadagi et al., 2020; Kadagi et al., 2021; Kadagi et al., 2022; Kinyua et al., 2022; Kinyua et al., 2025); one study highlighted primary drivers for conflict potential in billfish fisheries as competing uses, perception of billfish as an open-access resource, and internal and external issues related to fisheries governance (Kadagi et al., 2020). In another study, the importance of artisanal fishers, predominantly male, in billfish fisheries was emphasized, indicating that they pursue billfish through three distinct categories, including opportunistic, occasional, and professional resource exploitation (Kadagi et al., 2021). A recent study identified fishers, traders, and fishmongers as the three key players in the artisanal billfish supply chain along the Kenyan coast (Kinyua et al., 2025). While the study makes a significant contribution by mapping the artisanal billfish supply chain along the Kenyan coast and highlighting the roles, constraints, and market dynamics facing key actors, it does not delve deeply into how gender shapes experiences, power, or access across the supply chain. Building on their work, our study applies a gendered value chain approach, offering sex-disaggregated data and analysis at each node. This approach brings to light the differentiated opportunities and challenges that men and women face, helping to inform more inclusive and equitable fisheries governance in Kenya. Knowledge about the drivers of men's and women's involvement in a fishery is critical to the efforts toward a more equitable, just, and sustainable use of resources (Kawarazuka et al., 2016; FAO, 2022).

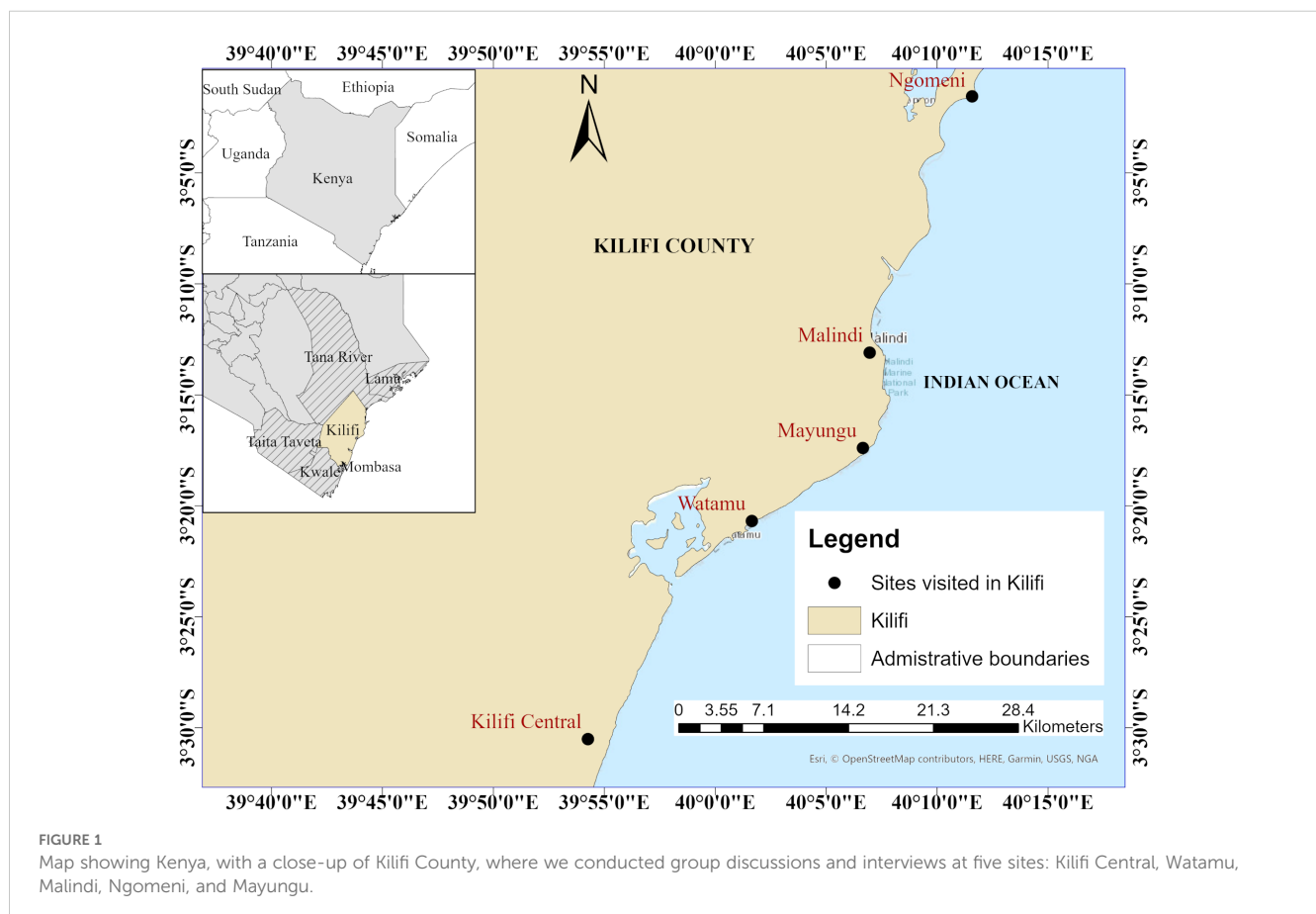
Billfish species in the Western Indian Ocean (WIO) hold significant social, cultural, and economic however, they experience challenges of insufficient data, especially the sport and artisanal sectors (Kadagi et al., 2022). The WIO region hosts six

billfish species: blue marlin, black marlin, striped marlin, broadbill swordfish, sailfish, and short-billed spearfish. These species migrate through the waters of ten countries, including Kenya (Pepperell et al., 2017; Kadagi et al., 2022). They are mainly targeted in recreational or sport fishing (Kadagi et al., 2021; Kadagi et al., 2022) and in artisanal and industrial fisheries as a source of food and income (Kadagi et al., 2020). Consequently, the presence of diverse billfish species in the WIO region has increased its prominence as a billfish hotspot, with several countries, including Kenya, Seychelles, Mauritius, Mozambique, La Reunion, and South Africa, considered popular destinations for recreational and sport fishing (Kadagi et al., 2022). The artisanal billfish fisheries in Kenya present a unique first-time case study for providing a baseline to examine the different roles of men and women and the emerging perspectives related to their respective constraints, drivers, and opportunities. Given the importance of billfish as a source of food and income, and a lack of gender analyses in this sector (Kinyua et al., 2025). However, since artisanal billfish is inextricably linked to small-scale fisheries along the Kenya coast, the study of the former was embedded in the broader understanding of the latter.

The coastal area of Kenya is significantly affected by the East African Coastal Current (EACC). This current is impacted by the Southeast Monsoon (SEM) from May to September and the Northeast Monsoon (NEM) from October to April (Johnson et al., 1982; Kimani et al., 2018), which affect fishing activities. Kenya and Tanzania experience the highest fish catch and

reproduction during the NEM when the sea is calm (McClanahan, 1988). Besides the effects of seasonality on fishing, the management of marine resources along the Kenyan coast faces numerous challenges, including the marginalization of local communities, inadequate funding, and conflicts between different management agencies (McClanahan et al., 2005). However, significant progress has been made in increasing community involvement in fisheries management through the adoption of collaborative approaches, particularly the establishment of Beach Management Units (BMUs) (Fauna & Flora International (FFI) and East African Wildlife Society (EAWLS), 2017) and Locally Managed Marine Areas (LMMAs) (Okeyo and Murage, 2023). The BMUs are made up of boat owners, fishers, dealers, and managers who have the authority to create their own bylaws (Cinner et al., 2012). Kenya's (Fisheries Management and Development Act, 2022) explicitly mandates the protection of vulnerable groups, particularly women and youth, and requires that no more than two-thirds of BMU members be of the same gender while ensuring the inclusion of youth and persons with disabilities in leadership roles (Fisheries Management and Development Act, 2022).

This study was conducted in Kilifi County (Figure 1), one of six counties along Kenya's coast (Ojwang et al., 2017), covering 12,609.7 square kilometers (Kilifi Annual Development plan, 2015), and home to 1,453,787 people-about 3% of Kenya's population (KNBS, 2019). Kilifi is a key area for marine activities. It boasts 265 km of coastline and hosts vibrant sectors including



tourism and small-scale fisheries. Notably, Malindi and Watamu are renowned billfish fishing hubs, with annual tournaments and high landings (Kadagi et al., 2020). This study focused on five main billfish landing sites in the county: Kilifi Central, Watamu, Malindi, Ngomeni, and Mayungu (Figure 1). Mijikenda, the predominant ethnic group in the area, engages in livelihoods such as fishing, coconut farming, goat rearing, and trade (Aketch et al., 2022).

The objectives of this study are to: (i) examine the different roles of men and women in artisanal billfish fisheries; (ii) evaluate the challenges and opportunities for men and women involved specifically in artisanal billfish fisheries as influenced by prevailing gender norms, and (iii) provide recommendations for future research on gender in fisheries and for more gender equitable interventions in support of billfish fisheries.

## 2 Theoretical framework and key concepts

In recent years, the Food and Agriculture Organization (FAO), promoted the integration of gender in fisheries and aquaculture toward optimum food production, food and nutrition security, and quality of life (FAO, 2012a). To eliminate inequality towards sustainable fisheries, it has become important to look beyond the simplified picture of men as fishers and women as processors and to examine the more complex picture of multifaceted relationships between men and women as boat owners, processors, sellers, family members, community members, and co-workers, in the value chain (FAO, 2012b). The FAO advocates for the collection of sex-disaggregated data, the development of gender-responsive policies, the implementation of gender-sensitive monitoring and evaluation systems, and the strengthening of women's capacity through targeted training. Together, these strategies provide concrete avenues for advancing gender equality as a foundation for sustainable fisheries development (FAO, 2016b; FAO, 2020; Lu and Zou, 2023). Gender equality refers to a condition in which individuals of all genders have equal opportunities, conditions, and treatment to fully develop their abilities, enjoy their rights and dignity, and actively participate in and benefit from economic, social, cultural, and political progress.

Gender equality is deeply related to feminist theories (Lorber, 1997; Pertiwi et al., 2019; Jaysawal and Saha, 2023). Feminism is a movement that has developed historically, both locally and globally, with social and political goals aimed at liberation and empowerment. It positions women as active subjects who challenge their subjugation and objectification within gendered contexts, striving to eliminate discrimination, advocate for rights, and foster democratic principles (Dietz, 2003; Pertiwi et al., 2019; Jaysawal and Saha, 2023; Ferguson, 2017). Feminists highlight that gender inequality is not merely an individual concern; it is intricately embedded in the fabric of society. This disparity manifests in numerous areas, such as family and marital relationships, the workforce and economic systems, political arenas, religious institutions, the arts, and even the language we employ (Lorber, 1997). Feminist theorists employ the tools of intersectionality, interdisciplinarity, and the intertwinings of

scholarship and activism to challenge oppression and work toward justice (Ferguson, 2017).

Feminism involves two main types of claims: normative and descriptive. Normative claims concern how women should be viewed and treated based on concepts of justice, while descriptive claims address how women are actually viewed and treated, suggesting that current treatment does not align with those justice standards (Jaysawal and Saha, 2023).

Lorber highlights a variety of feminist theories and their contributions to gender equality for example, Liberal feminism advocates for equal rights and opportunities in education and work for both genders, development feminism focuses on global economic inequities, especially for women in the Global South, while Social Construction Feminism views gender as embedded in major social organizations, determining the distribution of power, privileges, and resources (Lorber, 1997). According to the social construction feminist theory, gender roles are reinforced through the division of labor, occupational segregation, and the suppression of non-normative behaviors, making alternative expressions invisible or stigmatized. It asserts that sexuality is socially constructed, varying by gender, culture, and time (Lorber, 1997).

Understanding gender disparities therefore requires examining them alongside factors like culture, religion, economics, age, power, and technology (FAO, 2012a). Cultural, social, and economic factors influence gender roles in fishing communities, resulting in differences in the involvement, constraints, barriers, options, and benefits of men and women in fisheries (WorldFish, 2016; Harper et al., 2017; FAO, 2022; Chambon et al., 2024b). For example, the long-held perception of fishing as masculine (Monfort, 2015; Sornklai et al., 2018), and the traditional definition of fishing as “going to the sea to collect small fish and invertebrates” (Harper et al., 2013; Harper et al., 2017) can hinder a full understanding of factors associated with the involvement of men and women and, therefore, limit the recognition of their differential contributions. Evidently, the recent years' increase in gender studies in fisheries has shown that women are often relegated to the most unstable, low-paid, or unpaid roles, typically requiring lower qualifications, and are concentrated in the post-harvest or secondary segments of the value chain (NOAA, 2020; Szymkowiak, 2020; Solano et al., 2021; Galappaththi et al., 2022; Pedroza-Gutiérrez and Hapke, 2022). In response, the FAO has embraced gender mainstreaming as a central strategy to improve equity and to raise the visibility of women's contributions throughout the fisheries sector (FAO, 2012a; FAO, 2013). Characterizing women within the value chain constitutes a first step toward comprehending their roles, experiences, pressures, and opportunities (Gopal et al., 2020; Pedroza-Gutiérrez and Hapke, 2022). A value chain analysis provides a comprehensive overview of all actors and the value addition process from production to consumption (Kaplinsky et al., 2000; Rosales et al., 2017).

Value chain analysis has gained popularity in fisheries due to the ability to provide a comprehensive overview of all actors and the value addition process from production to consumption (Kaplinsky et al., 2000; Rosales et al., 2017). The core objectives of value chain analysis such as identifying opportunities for upgrading through improved products, processes, or market linkages, and assessing how benefits and decision-making power are distributed among

actors (Kaplinsky et al., 2000) make it a highly suitable approach toward gender equality in fisheries. A value chain refers to the complete sequence of activities and transactions required to produce and deliver a product to consumers (Belton et al., 2017). In fisheries, a value chain comprises various nodes within the pre-harvesting, harvesting, and post-harvesting stages (Torre et al., 2019). Value chain actors are people (including self-employed individuals and entrepreneurs), groups (such as households), companies, and organizations (like cooperatives) participating directly in value chain activities (Kruijssen et al., 2021).

Effective gender analysis tools must address critical questions related to access and decision-making. These include: Who does what? Who controls and has access to resources and assets? And who is involved in decision-making processes? (FAO, 2012a). Incorporating a gender lens into value chain analysis provides a more nuanced understanding of the visible and invisible roles of women and men (Kruijssen et al., 2021). Central to gendered value chain analysis is understanding how gender impacts individuals' capacities to participate in and gain from value chains, by examining four essential aspects of gender relations: the gender-based division of labor, access to resources and benefits, decision-making authority and control, and both formal and informal frameworks (Kruijssen et al., 2021). This study combines gender and value chain frameworks to analyze the differentiated experiences of men and women across the artisanal fisheries in Kenya.

### 3 Conceptual framework

This study adopts a gendered value chain analysis approach, drawing on concepts from WorldFish (Kruijssen et al., 2021). The

value chain illustrates the relevant set of actors, from input provision, through production and processing, to the consumption stage, and the nodes linking them. The framework integrates four key dimensions of gender analysis, including the gender division of labor, access to and control over resources and benefits, decision-making power related to income, assets, and activities, and formal and informal institutions, including cultural and gender norms that shape roles and opportunities. These dimensions are examined across the fisheries value chain to uncover how gendered power relations and social structures influence who participates, in what capacity, and with what outcomes. Figure 2 illustrates the relationship between value chain stages, gendered participation, and influencing factors, including access to resources, power dynamics, and institutional environments. This framework guided the recruitment of participants (ensuring representation of both men and women), the development of interview, discussion, and survey tools (centered on roles, access, and decision-making), and the coding and analysis of data. Key analytical questions included: Who is involved at each node? What roles do they play, and what resources do they control? What factors influence their participation? And how do experiences and challenges differ by gender?

### 4 Methods

This study employed a mixed-methods approach, combining quantitative and qualitative data collection techniques to provide a comprehensive analysis of gendered participation within Kenya's artisanal billfish fisheries. The integration of multiple methods, including structured surveys, semi-structured interviews, group discussions, and non-participant observation, allowed for

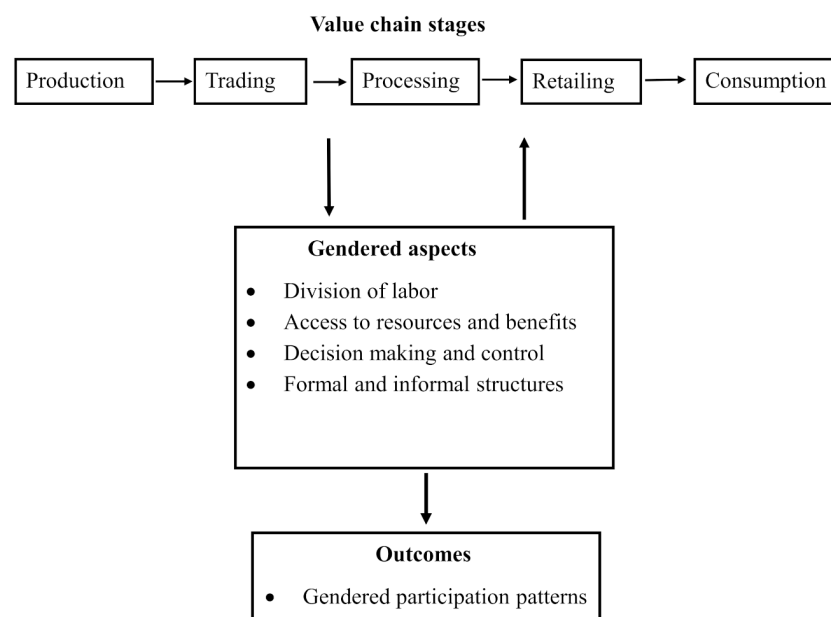


FIGURE 2  
Conceptual framework.

triangulation of findings and a nuanced understanding of both individual and collective experiences across the fisheries value chain.

## 4.1 Participants and sampling

Participants in this study were drawn from two primary categories: (1) fisheries experts and (2) actors within the artisanal fisheries value chain. Fisheries experts included individuals working within the fisheries sector along Kenya's coast, such as government officials, fisheries scientists, data enumerators, and technical observers, who hold positions capable of influencing policy and decision-making. Actors in the value chain comprised individuals directly involved in fishing or fish-related livelihoods, including fishers, fish traders, fish shop owners, and restaurant workers.

A combination of purposive sampling and snowball sampling techniques (Naderifar et al., 2017) was employed to identify participants. Fisheries experts were selected through purposive sampling, drawing on institutional contacts and professional networks facilitated by our partnership with the Kenya Marine and Fisheries Research Institute (KMFRI). At KMFRI, access to internal records was provided, and support was provided in identifying potential participants amongst whom the experts were invited for online surveys.

For actors in the artisanal fisheries value chain, initial contact was made through BMU leaders, whose contact details were also provided by KMFRI. These leaders, who themselves held roles within the value chain, served as entry points to local communities and played a key role in facilitating trust and collaboration. Snowball sampling was then used to expand participant recruitment, as both BMU leaders and initial participants referred the research team to others within their networks.

## 4.2 Data collection

Overall, we reached 25 fisheries experts (17 men, 8 women), 75 individual interviewees (38 men, 37 women), and 104 group discussion participants (75 men, 29 women). These participants represented a broad spectrum of roles within the artisanal fisheries value chain and included diverse genders, occupations, and locations, which was necessary to support a thorough analysis of gender dynamics in coastal artisanal fisheries. Within the larger sample, a smaller set of actors who identified with the billfish fishery was derived for the analysis of challenges specific to this sector.

Quantitative data were collected primarily through structured online surveys administered to fisheries experts using Google Forms. These surveys, delivered in English, included both closed- and open-ended questions, such as Likert scale items and narrative prompts. Closed-ended responses were used for statistical analysis, while some open-ended survey responses were grouped and counted, providing quantifiable insights into shared opinions or patterns. Other open-ended responses that offered rich or unique

reflections were preserved in narrative form and are presented as direct quotes in the results to give voice to participant perspectives.

Additional quantitative data, such as demographic and role-related information, were gathered during interviews and group discussions and organized in Microsoft Excel for analysis. These data enabled sex-disaggregated comparisons of participant characteristics across value chain stages.

Qualitative data were collected through semi-structured interviews and group discussions, which were conducted mainly in Kiswahili to foster comfort and depth of understanding. Interviews took place at landing sites, markets, homes, and workplaces, capturing a broad range of lived experiences. Group discussions were held in informal outdoor settings, often timed around participant routines for example, with women early in the morning and fishers after landing catches between 7 a.m. and noon. Flexibility in scheduling helped accommodate participants, such as women who participated while cleaning or gutting fish.

To enhance the richness of the dataset, non-participant observation (Marliana Nurani and Mei, 2008) was also used throughout the fieldwork. This approach captured contextual information, including gendered task distribution and physical workspaces, which was particularly valuable in documenting activities like boat and net making, whose practitioners were not directly interviewed but were visibly engaged in labor at landing sites and workshops.

The development of data collection tools was informed by the study's conceptual framework, enabling the exploration of gender-specific patterns across key themes such as division of labor, access to resources, decision-making, and institutional influences.

This framing shaped not only the questions asked, such as those related to roles, access, and constraints, but also how findings were coded and interpreted during analysis. Themes such as mobility, workload distribution, access to capital, space, and opportunities, as well as perceptions of fairness and recognition, emerged naturally from this structure and helped guide both the qualitative and quantitative exploration of gender dynamics in the fisheries sector.

## 4.3 Data analysis

A mixed-methods approach was employed to analyze both qualitative and quantitative data, combining descriptive statistics with content (thematic) analysis. These complementary methods were selected to provide both comparative insights through quantifiable patterns and contextual depth through participant narratives. This approach was essential for unpacking the gendered dimensions of participation, access, and constraints across different nodes of the artisanal and billfish fisheries value chains.

Descriptive statistics allow one to organize, summarize, and present the data in a meaningful way. This method is appropriate when seeking to describe and understand patterns within a dataset, particularly when working with sample-based research (Holcomb, 2017). Given that the focus was on identifying trends, frequencies, and variations across variables, descriptive statistics such as

measures of central tendency and variability were suitable analytical tools (Etchegaray and Fischer, 2009). These were computed using Excel, which is a reliable tool for conducting such statistical summaries.

Content analysis was used as it provides a powerful and unobtrusive method for interpreting textual data and symbolic material without interfering with participants or the data source (Klaus, 2004). It is especially suitable for exploring meanings, contexts, and intentions embedded in communication (Prasad, 2008), which aligns with the nature of the qualitative data collected in this study.

By systematically examining interview transcripts and observational notes, content analysis allowed for objective and valid inferences to be drawn based on clearly defined coding (Prasad, 2008) which was guided by the conceptual framework. This method supports a rigorous and transparent analysis process, enhancing the reliability and generalizability of the findings.

The analysis was guided by the study's conceptual framework, which draws on four dimensions of gender analysis: division of labor, access to and control over resources and benefits, decision-making, and formal and informal institutional structures. These dimensions provided the lens through which themes such as gender roles, inequalities, access disparities, and constraints emerged and were interpreted across the value chain. All datasets were cleaned and organized using Microsoft Excel, which also served as the primary tool for data management and analyzing the data.

#### 4.3.1 Quantitative analysis

Descriptive statistics were applied to summarize and visualize trends in the sex-disaggregated data. This method was particularly suitable for exploring the distribution of participants by gender, age, role, and location. Quantitative data from expert surveys, interviews, and group discussions were entered into and organized in Microsoft Excel, where they were cleaned and categorized. Variables were grouped by gender to allow meaningful comparisons between men's and women's roles and access at each stage of the value chain. Frequency and percentages were calculated to represent the proportion of individuals occupying specific roles or reporting particular experiences. In addition, responses from open-ended questions that could be systematically grouped (e.g., commonly cited constraints or enabling factors) were also quantified to show the prevalence of specific themes. Tables and bar charts were used to present the findings in a clear and accessible way, allowing the identification of participation trends and demographic patterns.

#### 4.3.2 Qualitative analysis

Content analysis was applied to the qualitative data collected through individual interviews, group discussions, and open-ended survey responses that could not be meaningfully quantified. This method was selected for its ability to support in-depth exploration of complex, contextual, and gender-focused themes, especially those not easily captured through quantitative measures. The data records were first reviewed to ensure accuracy and to familiarize the researchers with the content. An inductive coding process was

then used, allowing codes and themes to emerge directly from the data rather than being pre-defined. However, the study's conceptual framework focused on the gender division of labor, access to and control over resources and benefits, decision-making power, and formal and informal institutions served as a guide for organizing and interpreting the emerging themes.

The coding process involved identifying patterns in the data related to who does what, why certain individuals are involved in specific roles, and what gendered challenges they face. Thematic patterns were identified, compared, and refined into broader categories that reflected both shared and divergent experiences across gender, role, and location. To capture both the prevalence and depth of these findings, some themes were quantified based on the number of times they were mentioned, while others were supported through rich, direct quotations from participants. Separate discussions with men and women further enabled gender-specific analysis, while observation data added another layer of validation, especially for roles not explicitly described during interviews (such as those involving boat and net construction).

This combination of methods provided both a high-level overview of trends and a nuanced, context-sensitive understanding of gendered dynamics within Kenya's coastal fisheries.

## 5 Ethical statement

The research project adhered to the ethical guidelines set by the University of Florida's Institutional Review Board UFIRB, following the principles for research involving human subjects. Approval from UFIRB (IRB202300514) and from the National Commission for Science, Technology and Innovation (NACOSTI), Kenya (License No: NACOSTI/P/23/28001) was issued before the start of data collection. Participants were asked for prior informed consent, and steps were taken to safeguard the confidentiality of the gathered data and the anonymity of the respondents.

## 6 Results

### 6.1 Demographic and other characteristics of actors in the artisanal fisheries value chain

From this study, the demographic profile revealed some noteworthy gender patterns. The interview sample demonstrated a near gender balance, comprising 38 men and 37 women. However, the group discussions were more male-dominated, with 75 men and 29 women participating. Education and age data were drawn exclusively from interview participants, as these demographic questions were not included in the group discussions. In contrast, information on participants' roles was obtained from both interviews and group discussions. All data are sex-disaggregated to highlight gender-specific differences.

In terms of age, most interview participants were between 21 and 40 years (42.67%), followed by those aged 41 to 60 (32%) (Figure 3). Smaller proportions fell into the youngest (20 years or younger, 2.67%) and oldest (61 years and above, 5.33%) categories. Interestingly, no men were aged 20 or below, while a small proportion of women (5.41%) were in this category. Nearly half of the men (47%; 18 out of 26) and just over a third of the women (37%; 14 out of 37) were aged 21–40. In the oldest age group (61+), both men and women were nearly equally represented, at about 5% each. Additionally, 13 individuals (6 men and 7 women) did not disclose their age, either by choice or due to uncertainty.

Educational levels included “no education,” “madrasah,” “some primary education,” “completed primary education,” “some secondary education,” “completed secondary education,” and “college education or above.” Overall, 25% of participants had no formal education, while 20% had only a few years of primary education, and just 4% had attained college or higher education (Figure 3). A significantly higher proportion of women had no formal education compared to men, with 32% of women and 18% of men falling into this category. Additionally, 7.89% of men had received madrasah (Islamic religious education), nearly three times the rate of women, which was only 2.7% (Figure 3).

More women than men had attained a few years of primary education or had completed primary school (Figure 3). However, only 10% of the participants had completed secondary education, which included 15.79% of the men and 5.41% of women interviewed. Furthermore, 8% of participants did not disclose their education levels.

### 6.1.1 Roles of men and women in the artisanal fisheries value chain

We present the roles of actors along the artisanal fisheries value chain separately for our two sub-samples: interview participants and group discussion participants. In both interviews and group discussions, participants were asked to describe how they were involved in fisheries. Reported roles included boat owners or renters (typically also fishing crew leaders), fishers, dealers or brokers, stock clerks, restaurant owners or managers, fish shop owners, restaurant cooks, and *mama karangas*. In Kiswahili, *mama* means “mother” and *karanga* means “to fry”; *mama karangas* are fish mongers who sell fried fish along Kenya’s coast (Wamukota, 2010; Matsue et al., 2014). We report participants’ primary roles, though many indicated overlapping responsibilities, such as fishers who also acted as traders, or boat owners engaged in fish sales. Among interview participants, most women (26 out of 37; 70%) identified as *mama karangas*, while the majority of men (20 out of 38; 53%) were fishers (Figure 4). Dealers included 8 men (21% of male participants) and 3 women (8% of female participants), while fish shop owners comprised 5 men (13.2%) and 2 women (5.4%). Cooks and fish smokers were exclusively male, whereas restaurant owners were all women (3 participants; 8.1% of the women’s sample). Boat ownership was also reported exclusively by men, with two participants (5.3%) identifying in this role. Stock clerks included one man and two women (2.6% and 5.4% of their respective gender groups).

The distribution of roles among the group discussions’ participants is similar to that seen for the interview sample, but with more marked gender differences (Figure 5). All fishers (n=58)

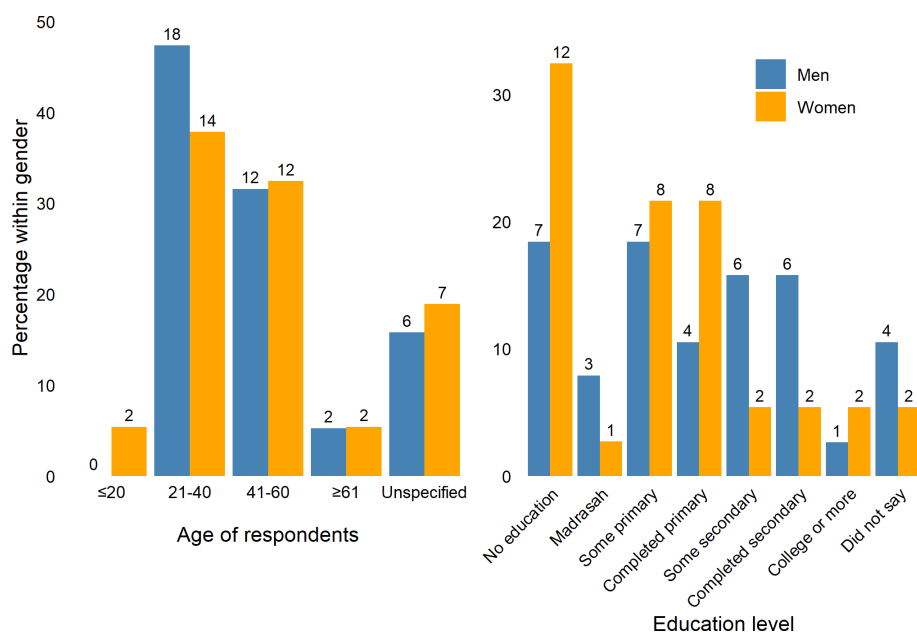


FIGURE 3

Age and education distribution by gender among actors in the artisanal fisheries value chain. The numbers displayed above each bar represent the absolute count of participants in that category, while the axis shows the same values expressed as a percentage of participants within each gender. Source: Interviews with actors of artisanal fisheries value chain activities (n=75; 38 men, 37 women).

were men, reaffirming the exclusive male dominance in direct fishing activities (77.33% of all male group participants). The *mama karangas* role (n=21) was exclusively held by women, highlighting the gendered nature of fish frying and vending. These women made up 72.41% of all female group participants. All dealers (n=9) were men (12% of the male participants), reflecting the male-dominated nature of intermediary trading roles in the value chain. The boat owner/renters group (n=16) was the only gender-balanced group, comprising 8 men (10.67%) and 8 women (27.59%).

Observational data further revealed additional roles such as net making and boat building. Although we did not interview net and boat makers, observational data showed men dominating these roles, except for a fisherwoman in the interviews category, who was also making her own nets. Together, these results underscore the gendered structuring of labor in the artisanal fisheries sector, with men primarily occupying harvesting roles and women engaging in post-harvest and value-added activities.

## 6.2 Involvement in billfish fisheries

The findings related to the billfish fishery were drawn from interviews and group discussions conducted across the five sites visited as well as expert insights gathered through surveys.

Participants' involvement in the billfish fishery was closely linked to their broader engagement in artisanal fisheries, as most did not target billfish specifically. Instead, their interaction with billfish depended on seasonal availability, gear type, and access to appropriate equipment. Overall, 40 interview participants (26 men and 14 women) and 89 group discussion participants (75 men and 14 women) responded "yes" when asked whether their artisanal fisheries work included engagement with billfish fisheries. Information from this (smaller) sample is analyzed together with responses from the expert survey to better understand this segment of artisanal fisheries. The key actors involved in the billfish value chain included the same roles as seen earlier: fishers, boat owners, *mama karangas*, fish dealers, fish shop operators, and restaurant workers and owners.

The first major finding is the marked gender difference in participation in the billfish sector than in artisanal fisheries. Specifically, 68.42% of interviewed men, compared to only 37.84% of interviewed women, reported involvement in billfish fisheries. In the group discussions, all male participants (n = 75) indicated their involvement in billfish activities, whereas only about half of the women (14 out of 29) reported being active in billfish fishery. These data were supported by expert's perceptions as revealed by survey responses. Almost all experts (92%, n = 23) agreed that men are more involved than women in the billfish sector, even if a large proportion of experts (84%) reported awareness of women's participation in billfish fisheries in Kilifi County.

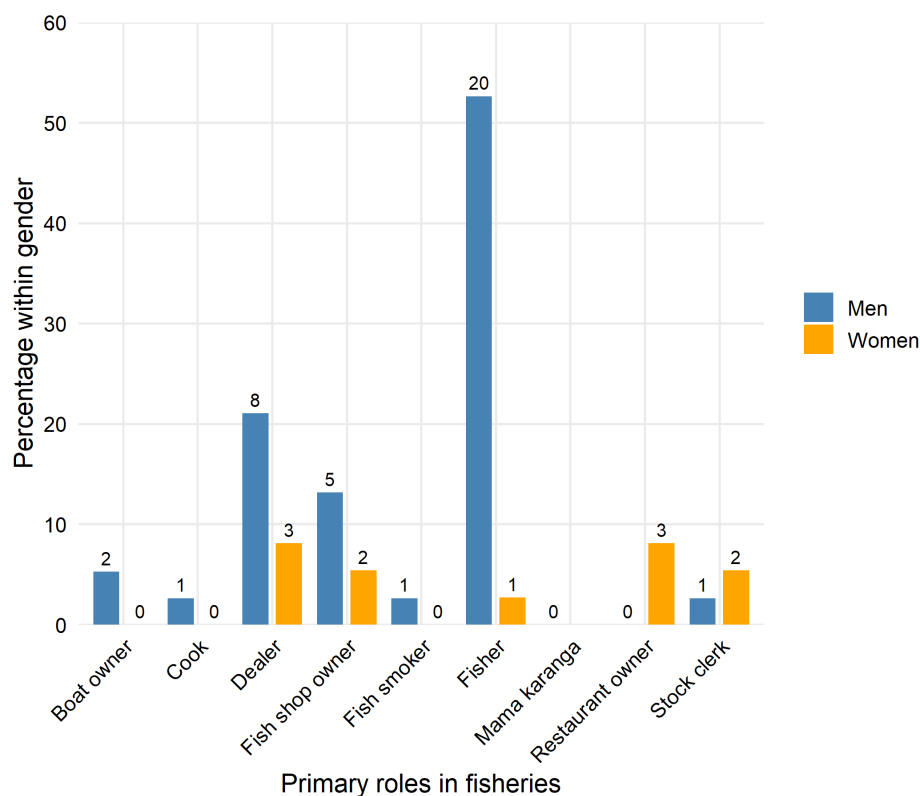


FIGURE 4

Gender distribution across various roles in the value chain. The numbers displayed above each bar represent the absolute count of participants in that category, while the y-axis shows these same values expressed as percentages within each gender. Source: Interviews with actors of artisanal fisheries value chain activities (n=75; 38 men, 37 women).

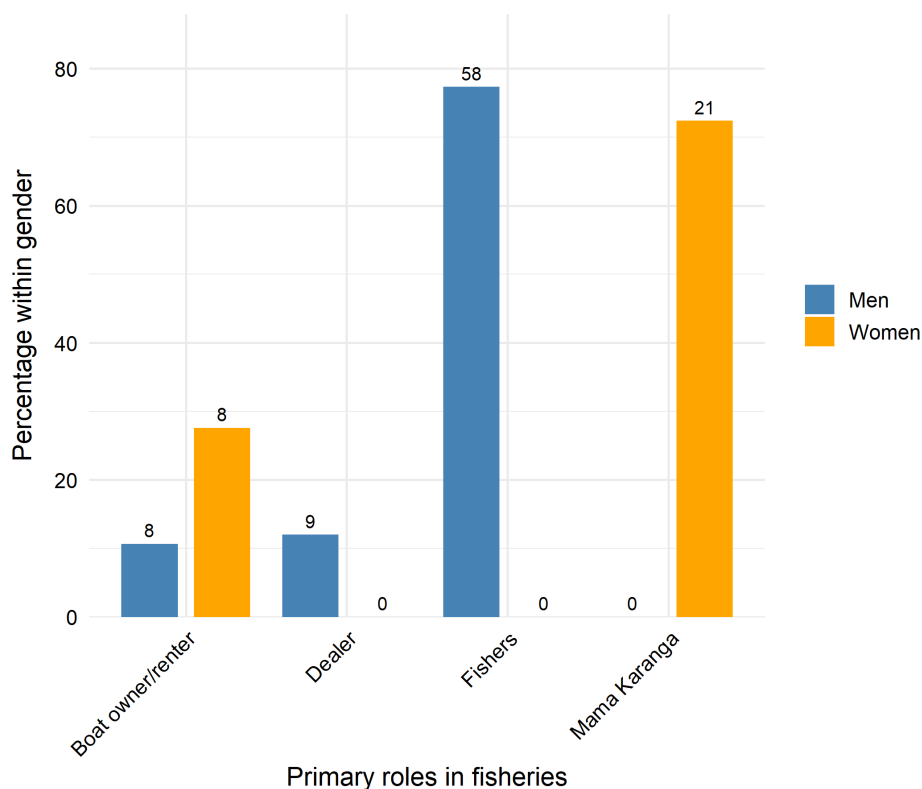


FIGURE 5

Gender distribution across various roles in the fisheries value chain. The numbers displayed above each bar represent the absolute count of participants in that category, while the y-axis shows these same values expressed as percentages within each gender. Source: Group discussions with actors of artisanal fisheries value chain activities (n=104; 75 men, 29 women).

Based on interview data, participants who reported involvement in billfish fisheries were primarily from Kilifi Central, which had the highest number of respondents (n = 15; 9 men and 6 women). This was followed by Malindi with 13 individuals (9 men and 4 women), Ngomeni (n = 8; 7 men and 1 woman), and Watamu, which had the lowest number of participants (n = 4; 1 man and 3 women) (Figure 6).

Group discussion results showed a slightly different geographic distribution. The highest number of participants involved in billfish fisheries came from Watamu (n = 32), all of whom were men (Figure 7). Kilifi Central had the highest number of women (n = 8), in addition to 18 men. Mayungu recorded 22 participants (16 men and 6 women), while Ngomeni had the lowest participation overall (n = 9), all of whom were men (Figure 7).

Expert survey results supported these findings to a large extent. Survey respondents identified Watamu (n = 8) and Kilifi Central (n = 7) as the areas where women's involvement in billfish fisheries was most prominent, followed by Ngomeni (n = 5), Malindi (n = 2). Surprisingly, Takaungu, which was initially part of the study sites was also mentioned by one expert. Takaungu is located about 9.7 km from Kilifi town.

In terms of role distribution along the billfish value chain, interview data show that fishing was the most common role among respondents,

accounting for 32.5% of the 40 participants involved in billfish fisheries (Figure 8). This included 12 men (46.15% of the men) and only one woman. Most women (57%) were *mama karangas*, a role representing 20% of all billfish-related respondents. Dealers comprised 25% of the sample (8 men and 2 women), while fish shop owners made up 12.5% (4 men and 1 woman). Although women were underrepresented in dealing and fish ownership, one female dealer worked alongside her husband, a fisher, and co-owned a boat with him. Similarly, the female fish shop owner jointly owned the shop with her husband, also a fisher. These cases may reflect how marriage can facilitate women's participation in billfish-related activities, opportunities that remain limited for most women. Other roles- boat owner, fish smoker, restaurant owner, and stock clerk were reported by only one individual each, with varied gender representation (Figure 8).

Within group discussions, fishers were again the most prominent group (Figure 9). This role was male-dominated, with 58 men and no women. While the number of men and women in the boat owner/renter role was equal (8 men and 8 women), this role represented 57% of the women involved in billfish fisheries, indicating its significance for female participation in this context. *Mama karangas* accounted for 43% of the women. Like fishing, the dealers were also exclusively men, who made up 12% of the 75 male participants engaged in billfish fisheries (Figure 9).

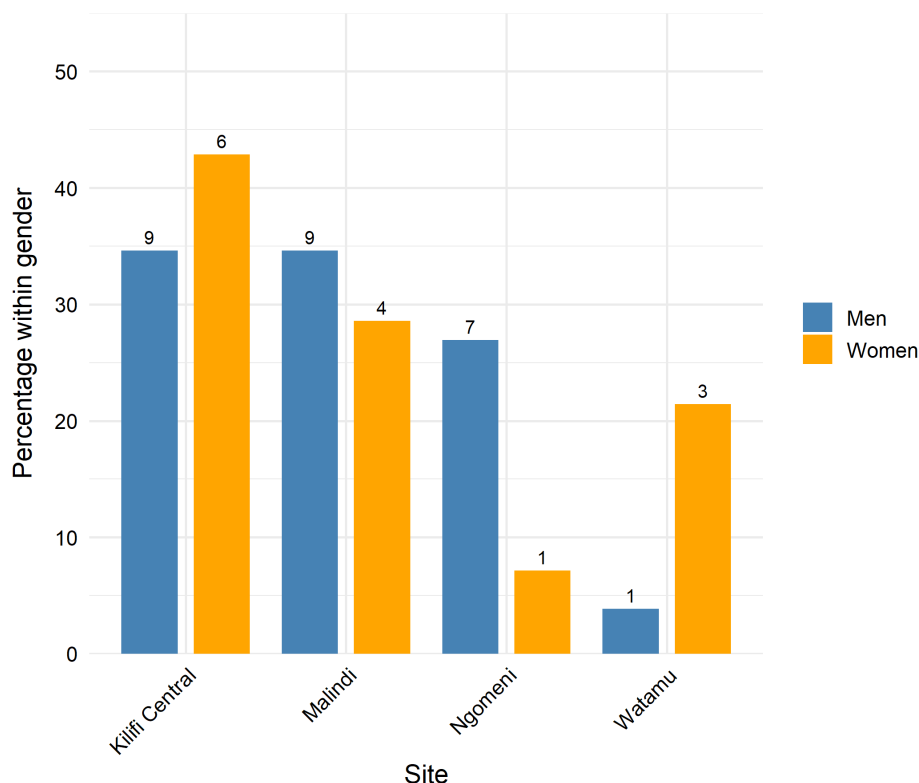


FIGURE 6

Geographical distribution of men and women involved in billfish fisheries. The numbers displayed above each bar represent the absolute count of participants in that category, while the y-axis shows these same values expressed as percentages within each gender. Source: Interviews with actors of artisanal fisheries value chain activities (n=40; 26 men, 14 women).

### 6.3 Challenges and opportunities for participation in artisanal fisheries

The interview data revealed a complex web of interrelated challenges experienced by diverse actors across the artisanal fisheries value chain. These challenges were shaped by role-specific responsibilities, gender dynamics, and contextual differences across locations. Six broad themes emerged from the data: asset-related constraints, seasonality, market and financial limitations, governance and management issues, competition, and health and safety concerns. While some challenges cut across roles and genders, others were distinctly gendered or tied to specific activities within the value chain.

Asset-related constraints stood out as a major barrier, particularly for fishers, boat owners, *mama karangas*, and fish shop owners. Fishers frequently reported lacking appropriate gear and equipment, struggling with high maintenance costs for boats, and experiencing frequent engine breakdowns. Traders such as dealers and fish shop owners highlighted limited access to markets and the absence of cold storage facilities. Similarly, *mama karangas* cited both the lack of market access and inadequate preservation or storage equipment as key constraints. Restaurant workers including owners, cooks, and stock clerks noted limited access to storage, inadequate equipment, and financial strain as key obstacles to their operations.

Seasonality was another recurring and cross-cutting theme. Participants, especially fishers, boat owners, dealers, and *mama*

*karangas* explained how seasonal variation directly affects fish availability and profitability. In peak seasons, fish may be abundant, but low market demand and limited storage options often lead to post-harvest losses and reduced earnings. Conversely, off-seasons present scarcity, making it harder for traders and processors to sustain operations.

Other shared challenges included market saturation and competition, especially among *mama karangas*, fishers, and dealers; insecurity; and poor governance and management. Participants cited misunderstandings between stakeholders, along with health concerns stemming from working conditions. For example, some *mama karangas* mentioned health issues due to prolonged exposure to heat and smoke from frying fish.

Gender-specific experiences also emerged clearly. A fisherwoman reported facing similar constraints to male fishers such as theft of gear and lack of proper equipment but also described cultural exclusion, stating that male crews often refused to let her join them. Male fishers, by contrast, commonly mentioned the risk of drowning when fishing in rough waters an issue rarely mentioned by women, who were less likely to engage in offshore fishing. Several *mama karangas* noted transportation challenges, such as having to walk long distances to reach the landing sites.

While both men and women faced significant operational expenses, the nature of these expenses differed. Men's costs were largely linked to fishing operations, boats, gears, and fuel, whereas

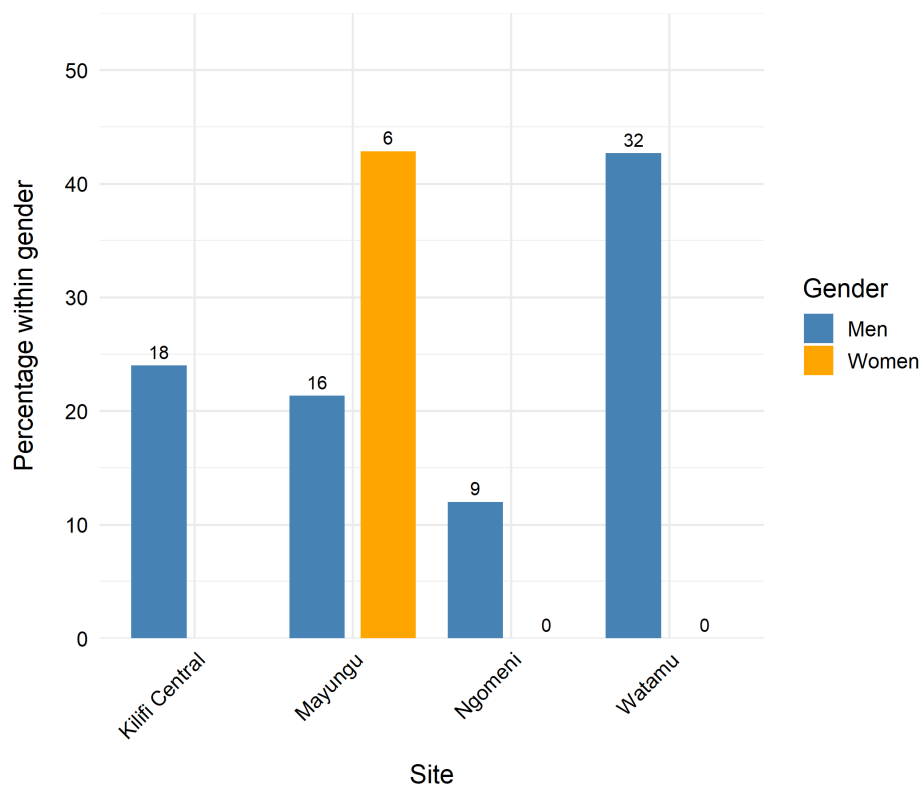


FIGURE 7

Geographical distribution of men and women involved in billfish fisheries. The numbers displayed above each bar represent the absolute count of participants in that category, while the y-axis shows these same values expressed as percentages within each gender. Source: Group discussions with actors of artisanal fisheries value chain activities (n=89; 75 men, 14 women).

women's expenses were concentrated in post-harvest activities such as oil, firewood, salt, and packaging materials.

Findings from the group discussions closely mirrored those of the interviews, further reinforcing the presence of structural and institutional challenges across the artisanal fisheries sector. Again, key themes included asset constraints, market and financial limitations, seasonality, governance and management issues, misunderstandings, and competition.

Asset-related challenges were extensively discussed. Fishers reported major losses due to inadequate or substandard gear. Specific issues included losing hooks and fish because of the large size and weight of billfish, short nets that couldn't reach deeper waters, and general lack of fishing gear, weighing scales, and storage. One group explained that "sometimes fish are too heavy they cut their gears." Dealers and *mama karangas* similarly described challenges such as spoilage from a lack of storage and high costs of essential tools. One *mama karanga* explained that "a *karai* costs 3,000 KES (about 23 \$)" a prohibitive amount for some. Male and female boat owners also raised concerns about storage limitations.

Market access and pricing issues varied by location. In Ngomeni and Kilifi Central, fishers spoke of unstable prices that undermined profitability. In Watamu, dealers described supply-demand mismatches and cancelled orders when customers changed their minds. *Mama karangas* shared their struggles with long wait times for fish, sometimes leaving empty-handed, and noted that they

often had to hawk fish door-to-door when customers failed to show up. Female boat owners in Kilifi Central reported that they had to sell fish at very low prices due to a lack of steady market access, especially during the high season. One *mama karanga* from Darakasi landing site (which is in Kilifi Central) state, "April and May are not good".

Seasonality again surfaced as a universal issue. Across roles, participants described how fluctuations in fish availability led to oversupply during certain periods, reducing prices and profits. For fishers, this also increased physical risk: some shared stories of losing gear or nearly drowning during rough sea conditions. Interview respondents were asked whether there were specific months during which they were actively involved in their work, and why. Of the 75 respondents, 35 (47%) reported being most active during the high season, often citing the increased availability of fish as a key reason. Among these 35 respondents, 46% were men (16 individuals) and 54% were women (19 individuals). This trend was observed across a range of roles, including fishers, boat owners, dealers, fish shop owners, *mama karangas*, fish smokers, and restaurant owners. December was the most frequently mentioned month for active involvement, cited by 86% of the 35 high-season respondents (30 individuals). October and November followed closely, each mentioned by 83% (29 individuals), while January was cited by 69% (24 respondents) and September by 60% (21 respondents). March and August were mentioned by 51% (18

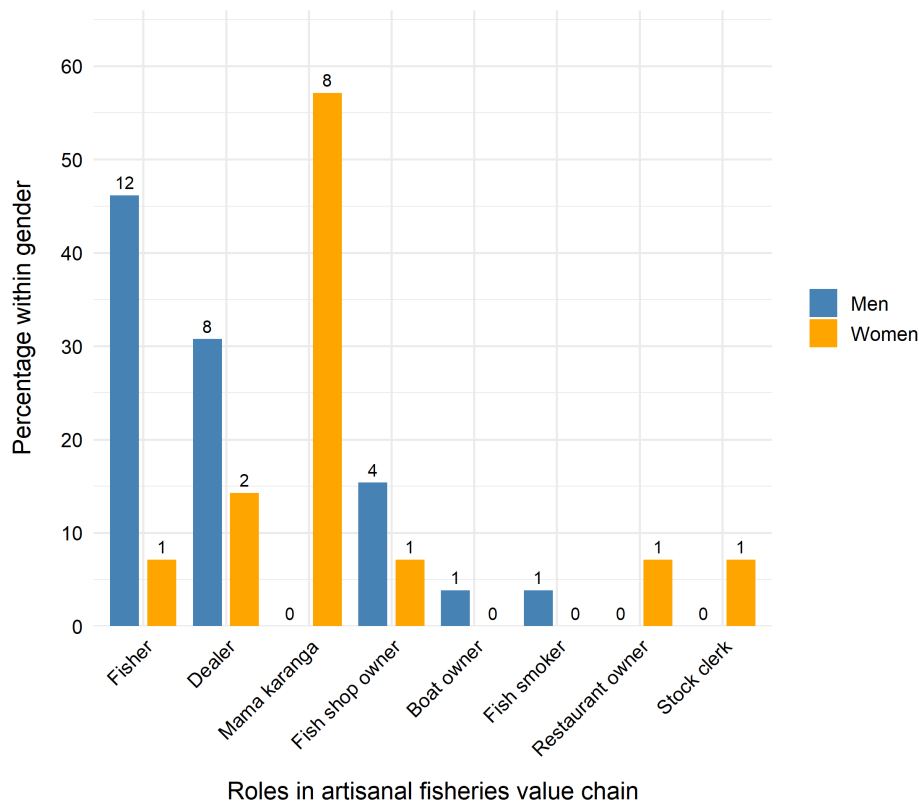


FIGURE 8

Gender distribution in the roles of men and women in billfish fisheries. The numbers displayed above each bar represent the absolute count of participants in that category, while the y-axis shows these same values expressed as percentages within each gender. Source: Interviews with actors of the artisanal fisheries value chain (n=40; 26 men, 14 women).

individuals) and 40% (14 individuals), respectively. May and July were mentioned infrequently—6% (2 individuals) and 3% (1 individual), respectively—while June was not mentioned at all.

Governance and management issues featured prominently in group discussions. In Kilifi Central, fishers expressed frustration with the multiple licenses required by institutions like the Kenya Maritime Authority (KMA), the Coast Guard, and Kenya Fisheries Service (KFS), which they described as unaffordable and overlapping. In Ngomeni, fishers reported insufficient support from the government and BMUs, while *mama karangas* felt excluded from BMU benefits altogether.

Gender bias in fish access and pricing was also noted. In Mayungu, *mama karangas* reported that fishers prioritized male customers, offering them fish more readily and at lower prices, making it harder for women to compete.

While these challenges impact general participation in artisanal fisheries, they are also evident in the artisanal billfish fishery. Most artisanal fishers did not target billfish specifically and, when conditions allowed, billfish were caught alongside other species. For actors involved in post-harvest activities, such as processing and selling, access to billfish depended on what the fishers brought ashore. This meant that post-harvest actors shared many of the same constraints as fishers, including inconsistent supply, but also faced additional challenges related to cost, as billfish are sold at higher prices due to their large size. Moreover, handling and

processing billfish required specific skills and equipment, such as preservation and storage facilities that were not always available to these actors.

During both interviews and group discussions, participants described major constraints including lack of appropriate gear and equipment, and inconsistent supply due to seasonality. Some challenges were role- or gender-specific. For example, male fishers reported risks when handling billfish, noting that their sharp bills could cause injury something not mentioned by women, as most were not directly involved in fishing. Conversely, *mama karangas* frequently said that billfish were too expensive for them to purchase, and that fishers favored men when selling billfish.

Survey respondents echoed these themes, identifying a wide range of structural and institutional limitations in the billfish sector. These included inadequate modern vessels and gear, insufficient post-harvest infrastructure, poor handling, and unclear governance frameworks. Environmental concerns such as climate change, trawling, and resource depletion were also raised, alongside data gaps, and limited training and access to capital. According to the surveys, gendered experiences shape how these challenges are encountered; production-related challenges (e.g., offshore fishing) were mostly associated with men, while post-production constraints were disproportionately borne by women. Some illustrative quotes from respondents include:

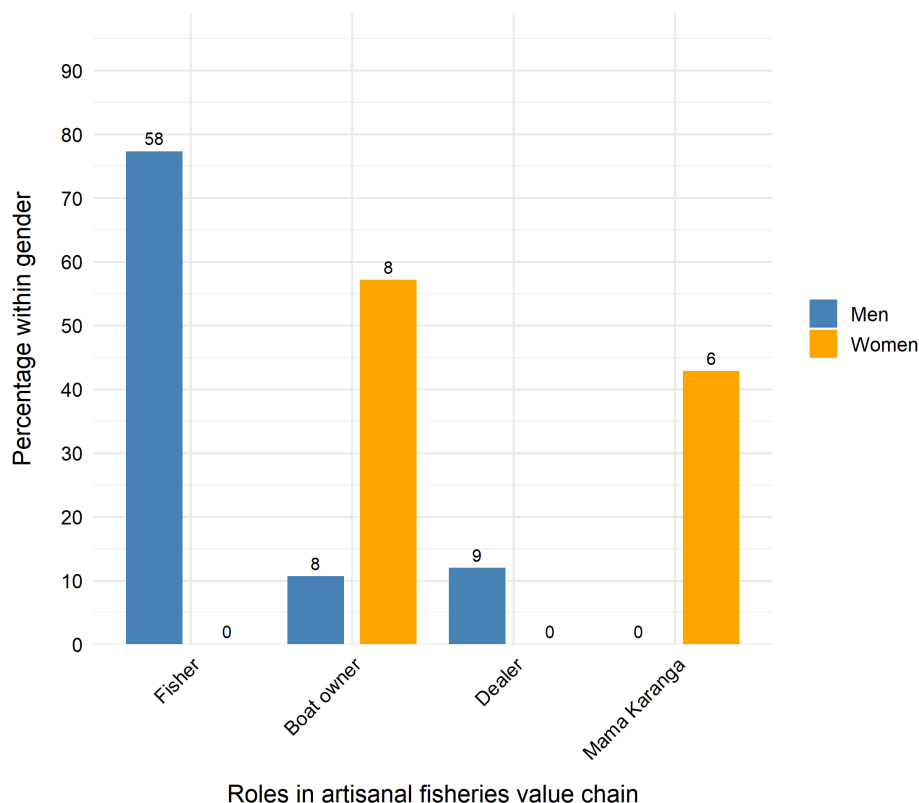


FIGURE 9

Gender distribution across roles held by men and women in billfish fisheries. The numbers displayed above each bar represent the absolute count of participants in that category, while the y-axis shows these same values expressed as percentages within each gender. Source: Group discussions with actors of the artisanal fisheries value chain (n=89; 75 men, 14 women).

- "Only men in moderately modernized motorized boats and gears are able to access waters with billfish." -Research scientist.
- "Men get little income from fishing activities given that they get little catch from the use of small crafts and artisanal gears." - Fisheries officer.
- "Men are not able to fish offshore because the vessels cannot go into deeper waters." – Research scientist.
- "Women mostly deal with small pelagics and demersals because their capital outlay is small, and their target markets, particularly for frying, do not favor billfish due to the high cost of the end product." -Research scientist.
- "The demand for fish by women is not met due to the little catch and hence cannot meet the market demand." - Fisheries officer.

Despite these multifaceted constraints, several opportunities emerged from stakeholder consultations that could enhance the resilience and sustainability of billfish fisheries in Kilifi. One promising area is the expansion of women's participation across the value chain. Women expressed a strong interest in roles beyond traditional processing and small-scale trading, including aspirations to engage in value addition, transportation, and boat ownership. During an interview, a female fisher stated, "What I need most is capital- I want to buy my own boat and run my business

independently." While savings groups (chamas) and microfinance institutions were frequently mentioned as pathways to empowerment, gaps in awareness, accessibility, and financial literacy remain significant barriers.

Improved access to modern fishing equipment and cold chain infrastructure was another commonly cited opportunity: Limited access to modern gear and cold chain infrastructure was repeatedly identified as a constraint on productivity and profitability. Fishers and traders in Watamu and Mayungu emphasized the need for fiber-reinforced boats, deep freezers, life jackets, rescue equipment, and improved communication tools. "If we had better gear and cold storage, our fish would fetch better prices, and spoilage would be less." -Trader, Watamu. BMUs were seen as potential facilitators for technical training and gear acquisition, though their current effectiveness varies.

Access to capital emerged as a cross-cutting issue. Women traders in Ngomeni called for enhanced credit facilities, larger marketplaces, and cold storage boxes. They also highlighted the need for better market organization to reduce reliance on intermediaries. Although some traders participate in chamas, others noted that financial services often exclude informal actors or require collateral they cannot provide.

Training and capacity-building opportunities were emphasized across the value chain. Fishers requested support in navigation, engine repair, and sustainable fishing practices, while traders and

processors prioritized skills in hygiene, value addition, and entrepreneurship. Women stressed the need for training targeting youth and new entrants, particularly in business management and leadership.

Improved market access was a shared priority. Many women traders cited the need for better-equipped, gender-inclusive marketplaces and stronger linkages with both local and export markets. Several participants also called for more transparent governance by BMUs, particularly in budgeting, licensing, and data sharing. These were seen as essential for restoring trust and promoting accountability in fisheries co-management.

Finally, stakeholders advocated greater institutional coordination. Survey respondents emphasized the need to harmonize overlapping mandates among fisheries agencies and promote locally led, data-informed management approaches.

The interdependence of actors across the billfish value chain presents a vital opportunity for collaborative growth. Enhancing the sector will depend not only on material inputs but on strengthening relationships among fishers, traders, processors, and institutions through shared knowledge, skills, and coordinated support. By fostering cooperation among men and women, across landing sites, and between communities and government actors, the fishery can become more inclusive, resilient, and sustainable.

## 7 Discussion

The findings of this study highlight the complex interplay of environmental, economic, and socio-cultural factors that influence participation in artisanal fisheries, including billfish fisheries along the Kenyan coast. Through gender analysis and a value chain approach we reveal not only the different roles of men and women along the nodes of the artisanal (and billfish) value chain, but also how the challenges and opportunities along the value chain are influenced by prevailing gender norms. Overall, at our study sites, only a few women were involved in managing fishing crews as boat renters, while the majority participated in secondary nodes of the value chain as processors and traders. Our results align with a recent supply chain analysis of the billfish fishery along Kenya's coast, reinforcing similar patterns and challenges (Kinyua et al., 2025). Historical social, cultural, and economic factors have proven to shape gender roles in other settings (Kawarazuka et al., 2016; Solano et al., 2021; FAO, 2022). Despite Kilifi being the hotspot of billfish fisheries, not all have the luxury of getting involved in the fisheries. This is due to the interaction of many factors.

Environmental factors affecting the availability of billfish, such as climate change (Chambon et al., 2024a) and fluctuating fish stocks, pose significant challenges. The declining availability of target species threatens the livelihoods of those dependent on them, while the seasonality of billfish also makes things more difficult. The challenges of climate variability complicate fishing operations, as unpredictable fish availability leads to inconsistent income flows, thereby heightening economic stress for all actors involved in the value chain.

Economic factors such as women's limited access to markets, financial resources, and low skill sets significantly influence their involvement in the billfish sector, but variations across different sites are notable. For instance, some women's groups in Kilifi Central have managed to organize better monthly savings throughout the year. This enabled them to use the saved funds to hire boats and employ fishers to catch billfish during the high season. This finding suggests that interventions supporting self-help groups and facilitating access to financing could potentially increase women's participation in billfish fisheries.

Processors and traders, particularly women in the industry, pointed to the difficulties posed by limited market access and high operational costs. Women highlighted significant barriers to entry, such as inadequate storage facilities and insufficient capital. These challenges often force them to sell fish at lower prices or incur losses when unsold fish remains from the previous day. The pressure of rising living costs and input expenses, coupled with a lack of financial resources, underscores the need for targeted economic support and investment in infrastructure. Moreover, reported experiences of fish spoilage due to inadequate storage during peak seasons indicate a pressing need for improved preservation techniques and facilities to minimize waste and enhance profit margins.

Financial resources are not the only factors affecting women's ability to conduct business in fisheries (Aloo, 2000; Atkins et al., 2021), as the socio-cultural context further complicates these economic challenges. Traditional roles and expectations within communities can limit women's agency, particularly in decision-making processes related to fishing practices and market participation. Although women may access financial resources as boat renters, our findings indicate that the skills required to catch billfish are often perceived as masculine. Existing gender dynamics, which are shaped by prevailing norms about women's and men's roles, can exacerbate inequalities in resource access and decision-making. Studies show that women are often viewed as occupying an "inferior" social role in fisheries (Deb et al., 2015; WorldFish, 2016; Fesanrey et al., 2020). Men typically dominate roles in harvesting and pre-harvesting (Williams et al., 2002; Adam and Njogu, 2023), although their fishing activities depend on women's unpaid labor in maintaining households and community networks (Williams et al., 2002; Delgado-Gustavson, 2011). Some respondents noted that fishers' spouses contribute by cleaning fishing gear, yet these contributions are often overlooked (Harper et al., 2017). Interestingly, the perception of women's "inferior" social roles in artisanal billfish fisheries in Kenya contrasts with their active participation in sport and recreational fisheries, where they compete as anglers in tournaments (Ditton and Hunt, 1996; Ditton and Stoll, 2003; Schultz et al., 2006). Still, the contributions of women in billfish sport and recreational fisheries remain understudied in global fishery scholarship. Billfish species in WIO attract a variety of user groups, including artisanal, commercial, and recreational fisheries (Kadagi et al., 2020) emphasizing the opportunity to create inclusive spaces for both men and women. Therefore, understanding the context-specific socio-cultural factors is essential for recognizing women's contributions in billfish

fisheries and for developing policies that accurately reflect gender dynamics in the sustainable management of these fisheries.

Barriers such as limited fishing experience and knowledge compound existing gender roles and limit women's involvement in these fisheries. Men typically begin fishing at an early age, learning from family traditions, while traditional gender roles restrict women's engagement (Santos, 2015; Murunga, 2021). Additionally, extensive time spent at sea allows male fishers to build strong bonds, a factor that most women lack as mixed-gender fishing crews are not culturally acceptable, which poses a challenge to women interested in fishing as part of a crew. Gender norms have been found to influence women's agency and mobility, ultimately amplifying their challenges in fisheries involvement (Lawless et al., 2019). Transforming the fisheries sector will take time due to the complex systems that embed gender inequalities (Bradford and Katikiro, 2019). To shift cultural norms, it is crucial to eliminate economic barriers, ensure equal access to fisheries resources for both men and women, and effectively implement gender-based policies in fisheries and aquaculture (Bradford and Katikiro, 2019).

Our findings suggest that despite facing numerous obstacles, women exhibit strong resilience and adaptability, seeking innovative solutions to offset their challenges. Promoting gender inclusivity and empowering women could lead to better practices and greater access to resources, benefiting the community.

## 8 Conclusions and recommendations

This study provides a first study of men's and women's roles and contributions within the artisanal fisheries value chains along the Kenya coast and significantly enhances the understanding of gendered participation in billfish fisheries in WIO. It argues that women provide important but undervalued contributions to fisheries in Kenya, especially through processing and selling fish, but also by playing non-negligible roles in the harvesting stage through crew management and boat ownership. Collective acknowledgment of the challenges faced by both men and women in billfish fisheries is critical. While women are significantly impacted due to socio-economic and normative constraints, men articulate struggles such as the high costs of fishing equipment and the financial burden of debt to boat owners. Addressing these shared challenges through collaborative approaches could help foster a more robust and equitable fishing community. Engaging with gender issues in fisheries, therefore, requires careful, inclusive communication, particularly when focusing on women's roles. It is crucial to explain the rationale behind a gender lens to male actors, who also play essential roles and whose livelihoods are interdependent with those of women. For instance, traders often rely on fishers, and challenges faced by one group can easily spill over to others, compounding vulnerabilities across the value chain.

Despite ongoing efforts to promote inclusive participation in fisheries management at the local level, gender-related barriers persist. Women, in particular, must navigate entrenched cultural norms in a male-dominated fisheries sector, while also facing economic constraints, such as the inability to afford BMU

registration fees (Matsue et al., 2014). These challenges significantly limit their participation in BMU governance and reduce their access to the benefits derived from co-management structures. A recent study along the Kenyan coast revealed that women's involvement in LMMAs remains substantially lower than that of men, highlighting a gender gap in access to decision-making and resource use (Okeyo and Murage, 2023). Given that BMUs serve as the foundational units of co-management, including within LMMAs, addressing these gender disparities is critical for achieving equitable and effective marine resource governance. Integrating women's roles in fisheries for effective management and conservation requires tailored empowerment interventions and strategies that consider the unique needs of both men and women.

Gender-responsive approaches in fisheries require quality, convincing data that can inform policy decisions (FAO, 2012a). Recent studies on Kenya's coast fisheries indicate the dearth of sex-disaggregated data leading to women being overlooked in research and management (Chambon et al., 2024a; Kinyua et al., 2025). The collection of sex-disaggregated data and the identification of key leverage points are foundational steps in gender mainstreaming. This study offers important baseline insights that future research and policy initiatives can build upon. Given the transboundary nature of billfish fisheries, addressing both sustainability and gender inequality will require regional collaboration, particularly through data sharing and joint monitoring initiatives. Forums such as WIOMSA conferences, which convene stakeholders from across the Western Indian Ocean (WIO) region, offer valuable platforms for advancing these goals.

Sustained progress will depend on ongoing monitoring, supported by both research institutions and fisheries-related organizations. Regular tracking of gendered trends, roles, and constraints can inform adaptive and inclusive policy responses. While this study sheds light on the cultural, social, environmental, and economic factors that differently affect men and women in artisanal billfish fisheries, it does not fully capture the interconnectedness of these factors. Future research should explore how these dimensions interact, potentially amplifying inequalities or creating new forms of exclusion. Comparative studies across other billfish sites in Kenya and the broader WIO region are also recommended to validate findings and support regionally coordinated, evidence-based policy action. Additionally, there is scope for integrating more quantitative methods to complement the qualitative depth of this study.

This study also acknowledges certain limitations. Fieldwork was conducted during Kenya's low fishing season, which may have influenced participation patterns and the availability of respondents. Therefore, follow-up studies during peak fishing seasons as well as in additional areas across the WIO region are necessary. Improving data on gender dynamics in billfish fisheries remains crucial, particularly given the global shortage of detailed information on these fisheries (Uozumi, 2003; Thoya et al., 2022). Recognizing and mapping women's involvement in billfish fishing will aid in identifying key stakeholders, an essential step for sustainability, especially as some billfish species are highly vulnerable to overfishing (Kitchell et al., 2006) and have already

been classified as overfished in parts of the WIO (Kadagi et al., 2020). Future research could examine more closely the environmental and ecological factors at play. For instance, billfish are predominantly caught as bycatch in tuna fisheries (Thoya et al., 2022) which adds complexity to their management and has implications for who engages with the species, and how. Understanding these connections is important for developing more holistic and gender-responsive approaches to fisheries management in Kenya and beyond.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by University of Florida Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## Author contributions

SAd: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. NK: Conceptualization, Project administration, Resources, Supervision, Writing – review & editing. SAt: Investigation, Resources, Writing – review & editing. NW: Conceptualization, Investigation, Project administration, Resources, Supervision, Writing – review & editing. MO: Investigation, Writing – review & editing. RS: Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing.

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## Conflict of interest

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

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