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A review of gender inequality and women's empowerment in aquaculture using the reach-benefit-empower-transform framework approach: A case study of Nigeria

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Along the aquaculture value chain, what is the status of gender equality and women's empowerment with a particular emphasis on aquaculture? What can be done to bring about gender equality and women's empowerment in the aquaculture sector? This article explores these questions through a systematic review of the extant literature on gender and aquaculture using Nigeria as a case study. A total of 78 articles are analyzed based on the reach-benefit-empower-transform framework. The findings show that there is gender inequality within the aquaculture value chain. In most cases, women are mainly concentrated at the nodes of the value chain, which require fewer resources to operate; furthermore, in most cases, women earn less profits compared with their male counterparts. Women's empowerment is still at the nascent stages, while gender related transformation has yet to take root. We recommend that pro-equality gender policies in aquaculture be created and implemented. This calls for the collection and use of sex-disaggregated data and for work at the grassroots level to ensure that the manner in which women, men, boys and girls are treated and allowed to live and function in the communities they reside engenders development, harmony, gender equality and prosperity. Finally, we recommend that the reach-benefit-empower-transform framework be expanded to facilitate the evaluation of program/project-based studies.

KEYWORDS

gender, aquaculture, women's empowerment, Nigeria, value chain, fish

1 Background

The aims of achieving gender equality and empowering women and girls are recognized as global priorities, as embodied in the United Nations (UN) Sustainable Development Goal (SDG)5.¹ In addition, SDG14 (life below water), which includes a strong focus on aquatic foods, is central to the livelihoods, food and nutrition security of more than 800 million people in developing countries. While these two SDGs are intrinsically important, they are also critical levers in achieving other SDGs through poverty reduction and enhanced food and nutrition security. The contributions of aquatic food systems (AqFS) to sustainable development include income increases, employment generation, food and nutrition security, family well-being, socioeconomic growth, poverty alleviation, climate resilience and environmental sustainability. (Belton and Thilsted, 2014; Ottinger et al., 2016).

Globally, men and women are not able to equally participate and share benefits in the aquaculture value chain (Kruijssen et al., 2016a). The participation of men and women in the value chain depends on their productive and reproductive roles, gender and social norms, and access and use of productive assets (Kruijssen et al., 2016a). In Myanmar, for example, social norms and traditional gender roles that view men as the main household income providers entitle them to more control and use of household assets such as land, limiting women's participation in aquaculture (Aregu et al., 2017). In Indonesia, women are more involved in aquaculture decision-making together with their male spouses (Sari et al., 2017); this is in contrast to the situation in Bangladesh, where men dominate in the majority of aquaculture-related decision-making (Kruijssen et al., 2016b). As reported by Githukia et al. (2020), access to productive resources is a major constraint among women in aquaculture in Kenya, which also limits their ability to access loans due to lack of collateral. Likewise, Agbebi et al. (2016) noted that women in Rwanda face constraints in accessing technical skills in production systems.

Further on, a pattern in women's empowerment and gender inequality in aquaculture is observed worldwide, differences exist in the extent of disempowerment. Women participate in the aquaculture value chain, although their roles and activities differ across countries, cultural contexts and technologies (Kruijssen et al., 2018; Gonzalez et al., 2021). For example, women in strong patriarchal countries such as Bangladesh and Indonesia are likely to have limited involvement in the aquaculture sector compared with women in countries with weak patriarchy such as Vietnam (Bosma et al., 2019). Therefore, approaches to empowering women that may be applied in Bangladesh will be different from those that may be applied in Vietnam. This finding prompts the need for context-based solutions and

approaches to address gender inequalities in the aquaculture sector. Such studies are particularly important in low- and middle-income countries such as Nigeria, where aquaculture is an important sector for economic development, food security and gender equality.

Nigeria is the second-largest aquaculture producer in Africa, after Egypt (Adeleke et al., 2020; Subasinghe et al., 2021). The nation is a net fish importer (Adeoye et al., 2020) with approximately USD 831 million in annual imports of fish and fish products, as estimated in 2018 (FAO, 2021). Fish play an important role in household food security and provide approximately 40–50% of the overall animal protein intake and micronutrients (Federal Ministry of Agriculture and Rural Development, 2008; Mohammed et al., 2011; Mafimisebi et al., 2015). Nevertheless, while aquaculture production is projected to grow by 4.5 times between 2020 and 2050, the growth will not meet the demand, which is anticipated to grow by 4.0 kg/person/year (Phillips et al., 2020). Low supply relative to demand hinders adequate access to and consumption of fish, thereby aggravating food and nutrition insecurity, with malnutrition still remaining a major concern in Nigeria (Olanike and Gbenga, 2013; ECOWAS and FAO, 2020). Evidently, the current import-dependent situation is unfavorable to Nigeria's socioeconomic development in view of the country's aquaculture sector's potential for food security, employment and promoting gender equality.

Aquaculture is the fastest growing food sector and has the potential to reduce poverty and food insecurity (Toufique and Belton, 2014). The literature indicates that involving women in smallscale aquaculture increases productivity (Barman and Little, 2006; Shirajee, 2013), which is important for countries experiencing fish supply deficits, such as Nigeria. A mutually beneficial relationship exists in increasing production in aquaculture and empowering women in the value chain, which impacts development beyond the value chain. Empowering women gives them intrinsic agency, allowing them to take part in decision-making, act in their own interests, more freedom in mobility and enhances their financial independence (Shirajee, 2013; Aregu et al., 2017). Agency invokes the ability to question, challenge and disagree with oppressive situations (Hanmer and Klugman, 2016). Literature indicates that fish productivity and production increase when women in aquaculture are empowered (Kruijssen et al., 2016a). Women's involvement in aquaculture is beneficial to households and national economies, as it increases household income and fish consumption (Seila et al., 2016; Aregu et al., 2017; Kruijssen et al., 2018).

The Nigerian government recognizes the importance of equality in agriculture and the aquaculture value chain for the country's development. To promote overall gender equality, the government has implemented initiatives and policies such as the National Gender Policy and the National Gender Policy and Strategic Framework (Odoemena, 2020). Gender has also been recognized in development and social

¹ Achieve gender equality and empower all girls and women.

inclusion policy strategies such as Nigeria's National Development Plan and the Affirmative Action (Overseas Development Institute (ODI), 2006; Odoemena, 2020). However, these initiatives have achieved very little success, as extensive gender inequality gaps still prevail in Nigeria (Olonade et al., 2021). In the agricultural sector, the Gender Policy in Agriculture and the Women in Agriculture (WIA) policy directive of the Agricultural Development Programs (ADPs) attempt to promote gender equality and women's empowerment (Ministry of Agriculture and Rural Development, 2016; Odoemena, 2020; Olonade et al., 2021). The WIA policy directive registered significant success in women's empowerment due to groups and access to extension services (Odurukwe et al., 2006; Ovwigho and Ifie, 2014). However, the directive mostly focused on crops and livestock, especially in value addition. In addition, female farmers in remote places and those who did not join groups did not benefit from the directive (Odoemena, 2020). Furthermore, the directive did not take into consideration women's agricultural needs such as land rights and ownership (Odurukwe et al., 2006). There is also a lack of political will to back policies up with legislature, particularly the WIA (Subasinghe et al., 2021). To stimulate growth in aquaculture, the 2008 National Aquaculture Strategy stipulates guidelines to promote the sector (Federal Ministry of Agriculture and Rural Development, 2008) but does not include critical gender equality aspects. Most policies and programs promoting gender equality in agriculture fail to address the underlying cause of women's disempowerment, including customary laws that discriminate women against land ownership (Ghebru et al., 2014; Odoemena, 2020). Addressing gender barriers that inhibit women from fully engaging in the aquaculture sector value chain in Nigeria will increase the number of people participating in and benefiting from the sector, which, in the long run, will increase the supply and accessibility of fish in the country.

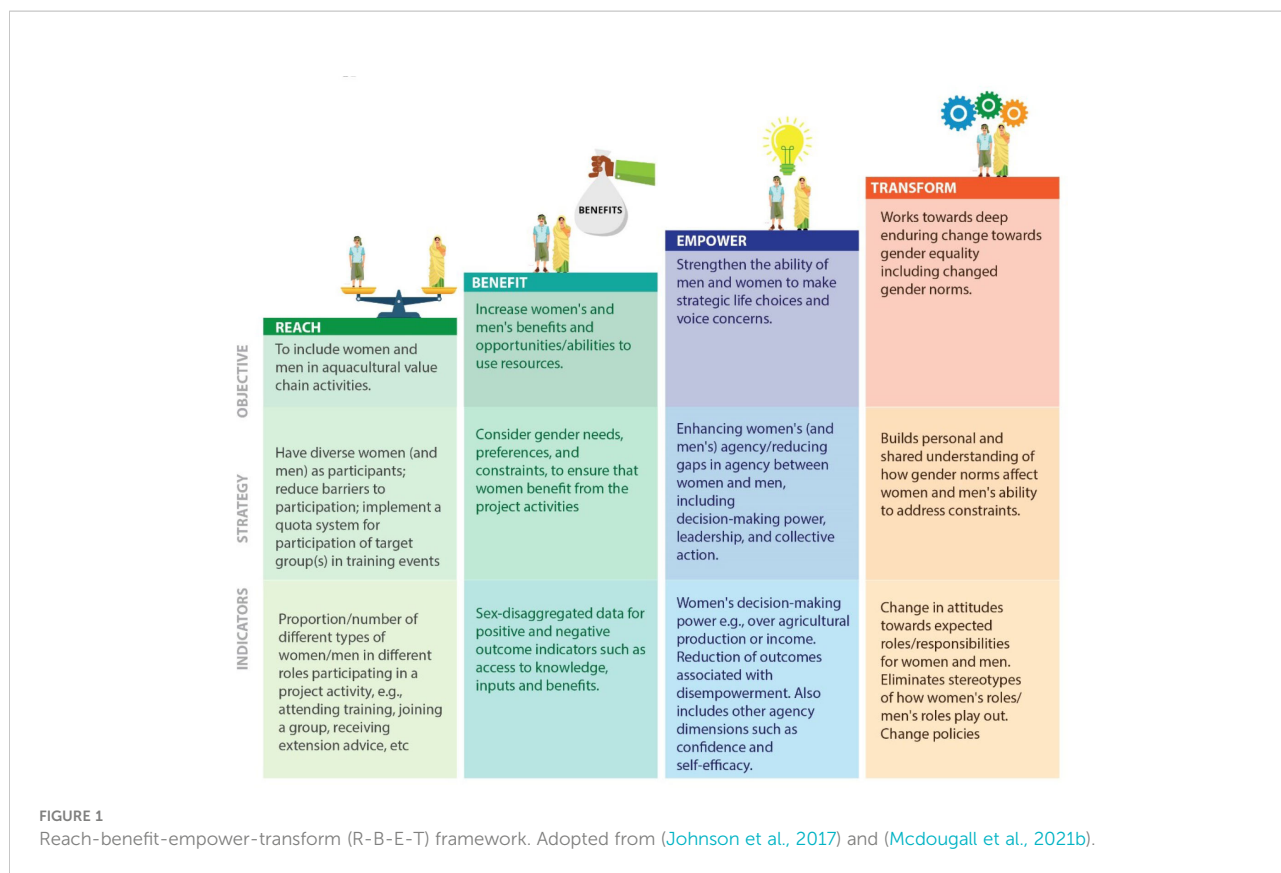
To accelerate gender equality and women's empowerment in the Nigeria aquaculture sector, this paper attempts to answer two questions: (1) What is the status of gender equality and women's empowerment along the aquaculture value chain? (2) What can be done to bring about gender equality and women's empowerment in the sector? We define gender equality as equal access to productive resources and opportunities between men and women (FAO, 2009; Osanya et al., 2020; Federal Ministry of Agriculture and Rural Development, 2019). We use Kabeer's definition of women's empowerment as the "expansion of people's ability to make strategic life choices" (Kabeer, 1999) and operationalize the term by addressing factors that underpin women's disadvantaged position in the aquaculture value chain to advance their access to productive resources and enhance their agency and voice in decision-making processes (FAO, 2018; Leigh et al., 2021). We start by describing the study's methodology and conceptual framework, which is followed by the findings. In the discussion, we present possible solutions to some of the findings and close with the conclusion.

2 Methodology

2.1 Conceptual framework

The paper applies the reach-benefit-empower-transform (R-B-E-T) framework to examine gender equality and women's empowerment in the aquaculture sector (Figure 1). The framework is used to help interventions clarify their objectives (Tavener and Crane, 2022) and to assess whether and how specific agricultural development interventions empower women (Quisumbing et al., 2019). The framework distinguishes between approaches that reach women as project participants, those that benefit them and those that empower them (Meinzen-Dick, 2017). We use the framework to assess whether and to what extent women's empowerment and gender equality have been achieved in the aquaculture value chain in Nigeria. The framework provides an in-depth insight into women's empowerment, but requires that the endogenous framings of empowerment, such as decision making, to be captured and interpreted on context basis (Tavener and Crane, 2022). Though relatively new, the framework has been employed in various studies. The R-B-E-T framework was used to evaluate the impact of IFPRI's agriculture and Assets Project (GAAP2) to women's empowerment (Meinzen-Dick, 2017). Elsewhere, Mensink and Senders (2019), used the R-B-E-T framework in assessing women's empowerment in financial services in Ethiopia, Rwanda and Vietnam.

Reaching women involves engaging them in project activities as participants. Indicators for reaching women include the percentage and numbers either reached or involved in a project (Johnson et al., 2017). Encouraging the participation of women in aquaculture programs targeting women uses various strategies, such as reducing participation barriers, e.g., by ensuring that training schedules are compatible with women's daily routine and responsibilities (Mcdougall et al., 2021b). However, reaching women, although key, is only an initial and facilitative step. Participation alone does not guarantee that benefits will be realized (Kleiber et al., 2019). Benefitting women means improving their circumstances by creating or enhancing their abilities to access and use resources (Lau et al., 2021). Where the goal is to benefit women, intended outcomes such as increased fish consumption must indeed reach them (Quisumbing et al., 2019). Strategies used include considering gendered needs and constraints that do or may hinder both women and marginalized or needy men from benefitting from the interventions. *Increased profits are among the indicators.* Empowering women and marginalized or needy men involves strengthening their ability to make strategic life decisions and having their voices heard. The twin objectives of empowerment and benefits are mutually reinforcing (Johnson et al., 2017). Empowerment strategies include reducing gender gaps in agency, addressing underlying inequities and enhancing decision-making power and leadership. *Empowerment*



indicators include women’s use, control and ownership of assets (Malapit et al., 2020). Transformation objectives involve working toward and achieving profound enduring change toward gender equality, including changed gender norms (Mcdougall et al., 2021b). Transformation strategies involve creating a personal and shared understanding of how gender and cultural norms affect the ability of women and men to address challenges. Indicators of transformation include changes in attitude and the elimination of stereotypes on the roles and responsibilities of women and men, as well as policy changes (Phillips et al., 2020).

2.2 Data collection

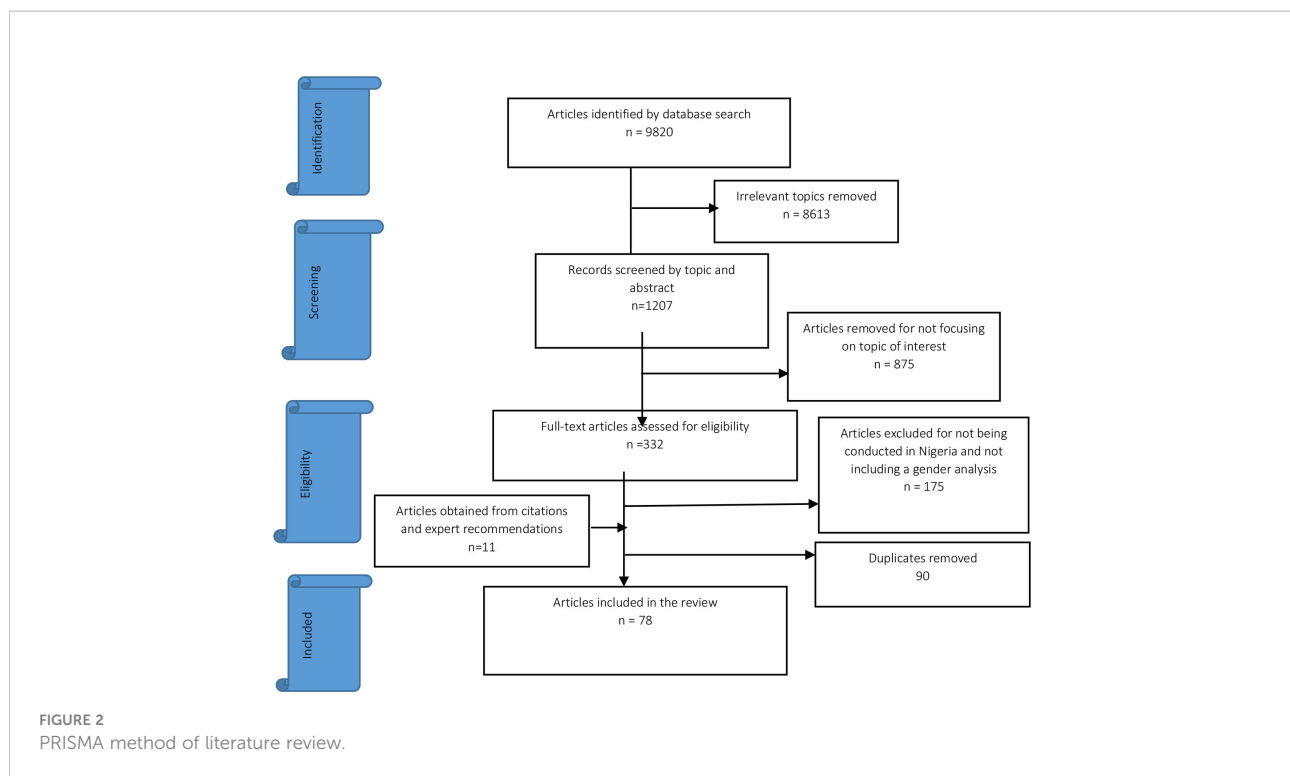
Literature on gender equality and women’s empowerment in the aquaculture value chain in Nigeria was identified through an internet search on electronic databases (Google Scholar, Taylor and Francis and Science Direct). The search strategy was devised to identify relevant literature during the period starting with the September 1995 Beijing World Conference on Women and ending in December 2021. Journal articles, reports, policy briefs and gray literature on the topic were all identified using primary search terms and keywords indicated in Table 1. To identify and select relevant articles for review, the Preferred

Reporting Items for Systematic Reviews and MetaAnalysis (PRISMA) method was used (see Figure 2).

A total of 9,820 publications were identified from the initial search. These publications were screened based on the relevance of the topic, of which 8,613 articles were removed. The articles

TABLE 1 Key word combinations used.

	Key word combinations
-	‘gender and Nigeria’ and ‘fish value chain’
-	‘gender and Nigeria and aquaculture’ and ‘women’s empowerment’;
-	‘gender and aquaculture’ and ‘innovations and Nigeria’;
-	‘gender and aquaculture’ and ‘technological innovations and Nigeria’;
-	‘gender and aquaculture’ and ‘financial innovation’ or ‘financial inclusion and Nigeria’;
-	‘gender and aquaculture’ and ‘social innovations and Nigeria’;
-	‘gender and aquaculture’ and ‘governance and Nigeria’;
-	‘gender norms and practices’ and ‘aquaculture and Nigeria’;
-	‘gender and fish’ and ‘nutrition’ or ‘household diet and Nigeria’;
-	‘gender and postharvest’ and ‘fish processing and Nigeria’; and
-	‘gender and postharvest’ and ‘fish retail and Nigeria’.



eliminated in the initial screening focused on other disciplines, such as medicine, chemistry and other pure sciences. The remaining articles (1,207) were then scanned for eligibility based on the topic and abstract, of which 875 articles that fell outside the topic of interest were removed. The criteria used at this stage were country of study, key words and area of focus. Articles focusing on catch level in artisanal fisheries at the fish production and postproduction levels were eliminated, as well as irrelevant papers that were not eliminated during the first stage and those not conducted in Nigeria. At the postproduction stage, the majority of the articles did not specify the source of the fish (aquaculture of fisheries). We found no gender focused articles that solely focused on the trading of farmed fish. To understand gender constraints in fish marketing, we included all articles that detailed gender issues in fish trading, even when the source of the fish supply was not clear. From the 332 articles that were subjected to full-text eligibility screening, 265 articles were dropped, of which 90 were duplicates and 175 did not include an in-depth gender analysis or at some level of sex data and discussion disaggregation. Furthermore, a total of 11 articles that were identified from citations of the reviewed studies and expert recommendations were included. Some of these additional articles provided a clear picture of the general aquaculture value chain in Nigeria. More details on the selection process are shown in Figure 2. In total, 78 publications were reviewed. While 22 states were represented by at least one article, there were 17 publications that focused on different nodes of the aquaculture value chain in Lagos state. This comparatively

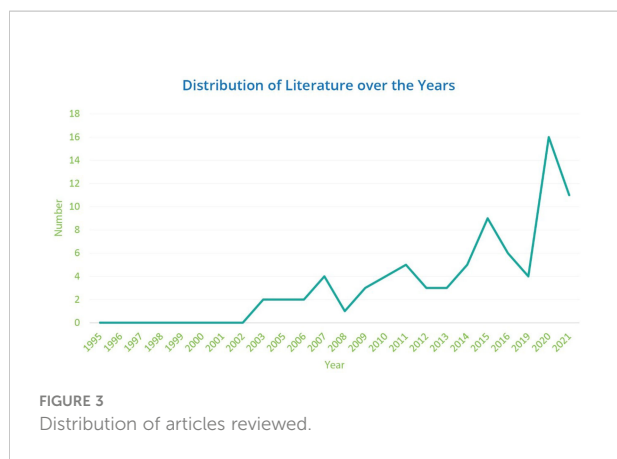
higher number of studies conducted in Lagos may be due to the importance of fish in the state and its long history of aquaculture. Lagos was among the first states to embrace modern aquaculture in Nigeria (Fakoya et al., 2005) and has a high number of fish farms and major fish markets (Bradley et al., 2020). Over time, the state has also benefited from various initiatives and projects, such as Fadama, intended to promote fish farming (Alawode and Oluwatayo, 2019).

Although the promotion of aquaculture in Nigeria started over 30 years ago, significant growth only started in 2000 (Subasinghe et al., 2021). Research in this subsector began to increase in 2010 and has continued to increase since that time, as indicated in Figure 3, which is based on the findings of the review.

3 Findings

3.1 Reach: Women, youth, men and other actors' participation in the value chain

In Nigeria, women and men are generally involved in all nodes of the aquaculture and fisheries value chain (Veliu et al., 2009) but with varying degrees of gender dominance (Turner et al., 2000; Jaji, 2014; Muhammad et al., 2016; Adeoye et al., 2020; Okwuokenye, 2020). Men and women enjoy different benefits, face varying degrees of challenges and take up

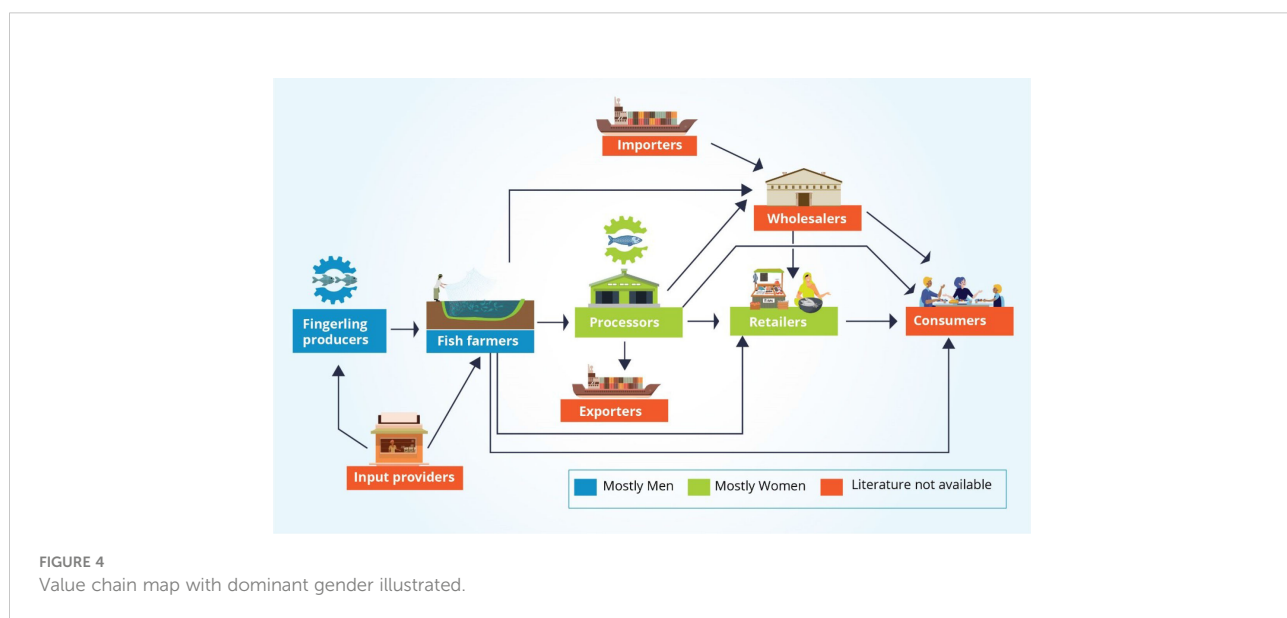


different activities in the fish value chain, which are factors that are reflected in the unequal distribution across the value chain (Figure 4).

Input providers: include hatcheries, nurseries owners, fish feed suppliers and other input suppliers (fertilizers and pesticides, among others). The two main inputs in fish farming are feed and seed or broodstock (BoP Inc and WorldFish, 2019; Omeje et al., 2020a). With the input supplier business, the high capital and sophisticated machinery required in commercial-feed manufacturing hinder women’s and men’s involvement in this segment. (USAID, 2012) Moreover, the gendered literature on input providers is scant and inadequate to make a conclusion regarding gender dominance in this segment. However, according to a study conducted in Ibadan (BoP Inc and WorldFish, 2019), 70% of the 500 input providers in the study are male. In Nigeria, cooperatives and farm-based feed millers produce approximately 50% of the total feed supply; 30% is supplied by the 8 leading corporate commercial feed

manufacturers, and the rest is imported. This contribution is mainly toward catfish feed, which makes up over 90% of the current total aquaculture production in Nigeria (Subasinghe et al., 2021). Despite the significant market share that small-scale and cooperative catfish feed manufacturers have, their feed is of low quality (Veliu et al., 2009). Fish broodstock providers are categorized into large commercial companies and small- and medium-scale catfish breeders. Approximately four and six commercial fish farming companies import catfish and tilapia broodstock, respectively, while small- and medium-scale operators obtain broodstock from fishers in capture fisheries, inbreeding or purchase from other farmers (Subasinghe et al., 2021).

Fish farmers: Aquaculture farming in Nigeria is mainly small-scale (Olaoye et al., 2017), with 90– 100% of fish farming households producing catfish (Nzeh and Adebayo, 2012; Yetunde et al., 2015; Tran et al., 2020). Other species are mostly produced by commercial farmers and enterprises, with small-scale farmers also sometimes including tilapia in polyculture systems (Tran et al., 2020; Adeleke et al., 2020). The most common culture media among smallholder fish farmers are earthen ponds and concrete tanks, although the dominance of these systems varies by state, and households may have more than one production system (Yarhere, 2006; Tran et al., 2020; Umunna et al., 2020; WorldFish, 2020; Subasinghe et al., 2021). Women are underrepresented in table-size fish farming, with men owning 60–100% of the fish farms (Veliu et al., 2009; Olanike and Gbenga, 2013; Omeje et al., 2020a; Subasinghe et al., 2021). For instance, in a recent report, Tran et al. (Tran et al., 2020) reported that only 85% of the fish farmers are male. Similarly, Gbenga et al. (Olanike and Gbenga, 2013) reported that 80% of fish farmers in Ondo state are male. Constraints faced by farmers, especially youth and women



farmers, are accessing land and the technical skills required (BoP Inc and WorldFish, 2019). Unlike younger women, older women are more established in their homes, which gives them an advantage in capital ownership (BoP Inc and WorldFish, 2019).

Credit access is a challenge for both male and female farmers (Oyinbo and Mohammed, 2015; Adeoye et al., 2020), but it is particularly severe among women (Cliffe et al., 2011; Nzeh and Adebayo, 2012; Adeoye et al., 2020; Okwukenye, 2020; Olagunju et al., 2021; Omeje et al., 2021), thereby hindering their participation in fish farming. Adeoye et al. (2020) demonstrated that men have more sources of available credit than women. - According to Okwukenye (2020) credit is more available to older farmers, married men and high-income individuals. In a study among fish farmers in the Kainji Lake Basin area, Omeje et al. (2021) noted that men (59%) and youth (63%) mostly used their personal savings to finance their aquaculture business, while most women (70%) relied on help from a relative or friend, implying heavy reliance by women on family ties and friendship, against the slight autonomy demonstrated for youth (younger adults who are men and women) and men. Banks and other institutional sources are unpopular (Agbebi, 2010; Ibrahim et al., 2011; Udo and Okoko, 2015) due to lack of collateral, high interest, and formalities involved (Orewa and Iteke, 2013; Edet et al., 2014; Udo and Okoko, 2015; Girei et al., 2019). Other barriers such as low levels of educational and financial literacy prevent women from accessing credit from formal institutions (Gbigbi, 2021). Additionally, restrictions in movement limit women's access to credit (Girei et al., 2019). Nonformal sources of capital, such as personal savings, limit the scope of business and profit margins (Orewa and Iteke, 2013).

Market actors (wholesalers, retailers or marketers, and processors): In this segment of the value chain, actors source fish from farmers, fishers and intermediaries. Once in the market, fish follow a similar value chain path regardless of the source, as Grema et al. (2020) noted in Kaduna state. It is common for actors to perform multiple roles (Velu et al., 2009; Okoronkwo, 2016), especially in retailing or marketing and processing sub segments (Orewa and Iteke, 2013). Processing and retailing activities are dominated by women (Orewa and Iteke, 2013; BoP Inc and WorldFish, 2019) who are aged between 20-50 years (Orewa and Iteke, 2013; Anyim et al., 2021). Adequate gendered literature in the wholesale subsegment is lacking, although two studies indicate the low participation level of youths in wholesale trading (Okoronkwo, 2016; Subasinghe et al., 2021). Unlike fish wholesaling, processing and retailing are more accommodative to youth due to the lower capital requirement (Yisa et al., 2011; Okoronkwo, 2016; Subasinghe et al., 2021).

Exporters: The available general literature indicates that approximately 10 percent of the fish produced in Nigeria are exported (Olutumise et al., 2020).

Consumers: Fish play an important role in the dietary diversity of women and children in Nigeria, although the frequency and amount of consumption in low socioeconomic status families in the northern region is low (Gomma and Rana, 2007; Subasinghe et al., 2021). Challenges in access, cultural fish-related perceptions and food taboos affect the consumption of fish (Subasinghe et al., 2021). For instance, Bradley et al. (2020) noted that in some regions, taboos prohibit pregnant women and the babies of expectant mothers from eating fish. The parts and size of fish eaten by different members of a household are dictated by the position of the family member in the household (Gomma and Rana, 2007). Bradley et al. (2020) noted that in some regions, men consume the head, while women and children consume the fleshy parts, while Gomma and Rana (2007) reported that the fleshy parts are consumed by men in Niger and Lagos states, while the head and tail are eaten by the children and mother, respectively.

3.2 Benefits

Input providers: Challenges facing men and women in fish feed manufacturing include high prices and competition for raw materials and fluctuations in the supply and prices of agriculturalbased inputs (Nwabeze et al., 2007). According to BoP Inc. and WorldFish (BoP Inc and WorldFish, 2019), raw material prices may fluctuate by as much as 50-60%, posing a major constraint to actors in the local feed industry. The fluctuations have been exacerbated by the COVID-19 pandemic due to disruptions in the local agricultural products' supply chain (Middleton et al., 2020). Similarly, fluctuations in market prices, demand and supply are a constraint to traders (Babalola et al., 2015; Okoronkwo, 2016). Moreover, technical knowledge and extension services are critical in seed supply, hatcheries, fish farming and trading. However, fish seed producers lack access to good-quality broodstock and knowledge in recognizing and selecting quality broodstock, resulting in poor-quality fingerlings (BoP Inc and WorldFish, 2019). The use of poor-quality inputs, including feed and broodstock, increases the mortality rate of fish, affects the maturity period and ultimately reduces the profits realized in hatcheries and grow-out segments (Velu et al., 2009; Taiwo and Ajiboye, 2011; Olagunju et al., 2021; Gbigbi, 2021). Women in the male-dominated input supply segment are often sexually harassed when attempting to obtain hands-on skills from skilled male suppliers (BoP Inc and WorldFish, 2019). The gap in knowledge and skills is also evident among women in fingerling and table-size production (Velu et al., 2009; Adeoye et al., 2020; Umunna et al., 2020) due to their limited access to training and extension services (Yarhere, 2006; Adebo and Alfred, 2008; Taiwo and Ajiboye, 2011; Ayanboye et al., 2014; Oyinbo and Mohammed, 2015). The small number of female

extension agents and the cultural norms that limit women from interacting with men constrain women's access to training (Adeokun and Adereti, 2003; Velu et al., 2009; Kruijssen et al., 2018). Critically, according to Sadiq et al. (2020), there is a shortage of skilled and experienced extension officers and aquatic veterinarians in Nigeria. Lack of access to extension services (Ibrahim et al., 2011; Udong, 2011; Muhammad et al., 2016) partly contributes to low participation in trading and low economic benefits (Girei et al., 2019; Nmerigini et al., 2020). Information is mostly obtained from other fish traders and social associations (Megbowo et al., 2010; Jaji, 2014), while extension services are more often directed to men (Udong, 2011; Ibrahim et al., 2011).

Fish farmers: The distribution of fish farming benefits portrays wide gender parity in employment opportunities and profits received between men and women involved in fish farming work.

Notably, women's involvement in fish farming employment is minimal compared with that of men. Women provide less than approximately 15% of aquaculture farming paid labor (Tran et al., 2020). Entrenched gender inequality is further demonstrated by the considerably lower profits that women receive from fish farming compared with men (Olanike and Gbenga, 2013; Omitoyin, 2021), as detailed in Table 2.

Successful and beneficial fish production and trading depends on the availability of at least one or more of the enablers to the participants of the node. These enablers can be grouped into four categories: physical assets, financial muscles, and human and social capital. In fish production, factors such as pond size, feed, fingerlings, labor, and stocking capacity determine the economic benefits realized (Taiwo and Ajiboye, 2011; Yetunde et al., 2015; Omeje et al., 2020a; Gbigbi, 2021). Regrettably, gender inequity in the access and use of productive

resources is rife in Nigeria's fish farming. Omeje et al. (Omeje et al., 2021) noted that women have the least amount of fixed assets valued at NGN 1,264,221.42 (USD 3040.24), while men and youth have about NGN 1,889,516.52 (USD 4543.96) and NGN 2,088,667.9 (USD 5022.89) worth of fixed assets, respectively. Additionally, women have substantially fewer fish ponds and smaller areas of land for fish farming compared with men (Ayanboye et al., 2014; Oyinbo and Mohammed, 2015; John et al., 2016; Umunna et al., 2020).

Along the same line, fish feed input makes up a significant proportion of the finance cost incurred by the farmer, which affects the profit margins incurred by the farmer, regardless of their gender (Velu et al., 2009; Olaoye et al., 2017; Tran et al., 2020; Folorunso et al., 2021; Olagunju et al., 2021). Exploitation by middlemen is another challenge faced by both male and female fish farmers (Abiona et al., 2011). Due to the scarcity of means of preservation, the high costs and poor means of transportation and the lack of coordinated marketing programs, most farmers sell fish at the farm gate at prices that are exploitatively low compared with the prices of fish sold at the market (Adeogun et al., 2007; Adelakun et al., 2012; Adewumi, 2015; Omeje et al., 2020b). It is estimated that more than 30% of Nigeria's total catch is lost in storage, distribution, and processing (Bradley et al., 2020).

Fish traders: Fish trading provides an opportunity for women to generate income (Yisa et al., 2011; Mafimisebi et al., 2015; Omoruyi and Eronmhonbor, 2017) and achieve psychological well-being (Agbebi, 2010). Fish trading benefits vary by type of fish, gender, age and segment of the chain (Subasinghe et al., 2021), with no clear pattern in these variations (Babalola et al., 2015; Okoronkwo, 2016). However, a comprehensive report by Subasinghe et al. (Subasinghe et al., 2021) indicated that at the retailer and processor levels, male actors make higher profits than women (Subasinghe et al., 2021). The authors opined that the comparatively smaller sizes of women-owned businesses, with respect to profits, may be attributed to lack of access to capital,

TABLE 2 Gendered profitability of fish farming.

Profit among Men	Profit among Women	Standard of Analysis	Species of fish	Author
8,082 NGN (19.24 USD) 2.31 ROI	6,321 NGN (15 USD) 2.22 ROI	Gross margin naira/m ² of pond per production cycle	Catfish	Oyinbo & Mohammed ⁶⁰
270,952.50 NGN (645 USD)	147,500 NGN (351 USD)	Monthly	Catfish	Umunna et al. ⁵⁷
39, 319.35 NGN (94 USD)	16, 544 NGN (39.4 USD)	Gross margin per month	Unclear	Omitoyin, 2021 ⁸⁸
658,832.53 NGN (1567 USD)	472,730 NGN (1,126 USD)	Annual average farm income – method of arriving to the income is unclear	Unclear	Okwuokenye ⁴⁶
6,233,510 NGN (14851 USD) 71.81% ROI	51.05% ROI	Net income after tax per annum	Mostly catfish	Omeje et al., 2021 ⁶³

Conversion rate: 1 USD =420 NGN.

business development and technical knowledge. Male and female youth traders (18-25 years old) make profits in both retail and processor segments of fish but experience losses in the wholesale fish trading business. Despite these wide variances, on balance, fish trading remains profitable, although it should be noted that some small-scale traders earn extremely low returns, i.e., hardly enough to sustain household financial needs (Agbebi et al., 2016). Women who are more educated and those active in cooperative trading obtain higher benefits (Babalola et al., 2015; Muhammad et al., 2016) because they have access to credit that enables them to start with substantial capital for their business (Mafimisebi et al., 2015; Okoronkwo, 2016). Social capital also plays a critical role in women's entry, participation, operation and benefiting from fish trading (Ikporukpo, 2005; Agbebi, 2010), which explains why group or cooperative membership is common in this segment (Muhammad et al., 2016; Girei et al., 2019). For instance, contacts in fish trading are based on verbal agreements and trust (Ikporukpo, 2005; Orewa and Iteke, 2013), and it is common for women to be introduced to or inherit fish trading enterprises and business networks from their mothers (Udong, 2011; Babalola et al., 2015).

It is worth noting the constraints faced by fish traders. Fish traders lack adequate storage facilities and have poor links to cold chains/facilities for cold storage (Imoukhuede et al., 2007; Veliu et al., 2009; Babalola et al., 2015; Omoruyi and Eronmhonbor, 2017).

Their scale of operation and benefits obtained are limited since fresh fish traders have to sell fish within a short period of time, thereby denying them the opportunity to take advantage of favorable changes in the market (Veliu et al., 2009). Moreover, for fish traders selling locally produced fish to be able to compete with imported fish traders, the former lowers their prices, thus reducing their financial benefits (BoP Inc and WorldFish, 2019). Due to the lack of product diversity and value addition in Nigeria's fish value chain, there is tight competition and a high concentration of women in fish trading (Veliu et al., 2009; Jeanel et al., 2020). Benefits from fish trading are constricted by a lack of modern processing facilities (Omoruyi and Eronmhonbor, 2017; Girei et al., 2019). The commonly used traditional methods are laborious (Ibrahim et al., 2011; Oyediran et al., 2016; Anyim et al., 2021), inefficient and expose processors to health hazards (Adelowo et al., 2005; Udo and Okoko, 2015). Lack of awareness, inadequate extension support, high costs, and preference for traditionally smoked fish among consumers inhibit the use of improved processing methods (Veliu et al., 2009; Yisa et al., 2011; Muhammad et al., 2016).

3.3 Empowerment

Input providers: This economic activity is dominated by men since it is capital- and knowledgeintensive (especially the hatchery business). There is a need to strengthen the capacity

and ability of women, marginalized people and needy men to want to engage in this sector.

Fish farmers: Although women participate in all aquaculture farming activities, including land clearing and pond management (Olanike and Gbenga, 2013; Olagunju et al., 2021), the majority are engaged in lighter activities, such as fish management, fish grading and pond liming (Ibrahim and Yahaya, 2011; Omeje et al., 2021). On the other hand, men and youths are more engaged in laborious activities, as well as medium-intensity activities; the former include pond construction and maintenance, and the latter include pond site selection, fingerling stocking, feeding and disease control (Adebo and Alfred, 2008). Decision-making is a key component and a direct measurement to women's empowerment. Studies show that although women provide fish farming labor, men own the ponds and make decisions (Adebo and Alfred, 2008; Kruijssen et al., 2018a). Social norms and gender power dynamics give men dominance over women, such that women's voices are suppressed and men speak on their behalf, restrict their movement and decide how they spend their time (Cliffe et al., 2011; BoP Inc and WorldFish, 2019). This disempowers women by limiting their involvement in fish farming and access to resources such as training (Nmeregini et al., 2020). The movement restriction of women is especially common in northern Nigeria due to the Islam-based purdah system (Veliu et al., 2009). However, a small degree of control in decision-making has been noted (Subasinghe et al., 2021), especially among women who earn higher income from fish farming (Enaikele et al., 2010).

Fish traders: The division of labor and participation of women in the postharvest chain indicate intrasex differences. For example, high-income women engage in full-time, large-scale fish trading and own high-value assets. They are involved in more organized and lucrative trading that guarantees their fish supply, often at lower prices (Usman et al., 2017). In the wholesale segment, women who operate large volumes hold a significant position in the value chain with regard to fish management and handling. They have high-value assets, resources and capital – all of which give them influence in the chain. A woman's social status, wealth and social networks influence her bargaining power, which then influences her access to fish (Bradley et al., 2020). In contrast, women of low economic status have very few or no assets, limited capital, and conduct small fish retail businesses. These women are mostly involved in small-scale part-time fish trading (Girei et al., 2019).

3.4 Transformation

Gendered transformation in aquaculture farming in Nigeria has yet to be achieved. There are several reasons that have led to the slow progress in the gender transformation aspect in the aquaculture sector. These reasons include cultural and social

norms and patriarchy and religious rules, which we discuss below. In addition, we provide solutions to address the problem of lower participation of women in the sector.

Cultural and social norms: There are sociocultural norms that discriminatively determine gender roles, asset use and ownership (Velu et al., 2009; Cliffe et al., 2011; John et al., 2016). For instance, women are restricted from controlling productive assets, as they are expected to be responsible for reproductive activities (Omeje et al., 2021). The gender division of labor often overburdens women's reproductive roles, hence limiting their participation in fish farming and trading due to time constraints (BoP Inc and WorldFish, 2019; Nmergini et al., 2020; Omeje et al., 2020a).

Patriarchy and religious rules: These rules give men dominance and control of their wives' time and movement (Velu et al., 2009; Nmergini et al., 2020), prevent women from accessing resources and deny them the liberty of making decisions and mobility (Agbebi, 2010; Ayanboye et al., 2014; Tonye and Francis, 2014; Agbebi et al., 2016; Oloko et al., 2021). The privilege to access training and to inherit or control land is given to men, while women are expected to access resources from their husbands (Cliffe et al., 2011; Omeje et al., 2021). Religious rules such as the purdah system interact with cultural norms to further buttress gender inequality in the division of labor and asset control (Ibrahim et al., 2011). In northern Nigeria, for example, non-Muslim women have no right to inherit land and have very limited control over income generated from farms (Velu et al., 2009). The gender disparity is further widened by negative parental attitudes and perceptions toward educating daughters (Olanike and Gbenga, 2013; Sadiq et al., 2020). Strategies employed by female traders to cope with the constraints sometimes inadvertently strengthen the roots of women's disempowerment, for instance, using girls as mother substitutes and sources of labor in fish trading (Tonye and Francis, 2014).

Opportunities to empower women in the aquaculture sector: Despite the glaring gender inequalities in fish farming, there are opportunities available to increase participation and benefits for women. One such opportunity is *bridging the gap in fish demand with increased production instead of imports* (BoP Inc and WorldFish, 2019; Adeleke et al., 2020) while also paying attention to states with very little involvement of women, such as Kaduna (Velu et al., 2009) and Kano (Subasinghe et al., 2021). *Concrete tank production* media are profitable, require less land, have shorter production cycles, have the lowest fish mortality rates, can be built near homesteads and are already popular among women (Yarhere, 2006; Yetunde et al., 2015; Nmergini et al., 2020; Tran et al., 2020; Omitoyin, 2021). Similarly, *plastic tanks near homesteads* provide opportunities for women to earn income and produce fish for consumption while still playing their reproductive roles (BoP Inc and

WorldFish, 2019). These systems are therefore ideal for empowering women in aquaculture, especially when they are located close to homesteads (Gbigbi, 2021). Along with credit facilities and training, promoting concrete and plastic tanks can increase women's participation in fish farming (BoP Inc and WorldFish, 2019).

Similarly, there are *opportunities for diversification* in the trading segment of the value chain. Currently, women are concentrated in the few postharvest activities for fresh, frozen or smoked fish (Velu et al., 2009; Bradley et al., 2020). The development of small-scale fish value addition and processing would create more economic activities for women and diversify their engagement in postharvest fish value chain segments. *Examples* of such opportunities include making fish oil and crackers, which have a high market demand and do not require steady electricity or high investments (BoP Inc and WorldFish, 2019). These products are easy to make and do not require complicated technical skills. For example, fish oil is extracted during the process of deep frying, as fish release a proportion of oil as a result of heating. Crackers are a popular snack among children in Nigerian urban areas while fish oil is popular in the rural areas (Bradley et al., 2020).

Group membership positively influences women's income and participation in fish farming (Omeje et al., 2021; Olagunju et al., 2021) and has the potential to empower women. The Eriwe Fish Village Project in Ogun State demonstrates that the formation of farmer groups and cooperatives improves profits through better access to improved methods of production, cooperative sales for better prices and access to loans (Nzeh and Adebayo, 2012; Abdullahi et al., 2015; Olaoye et al., 2017; Folorunso et al., 2021). Group membership increases the chances of participation in trading, profits, and access to fish supply, capital and credit (Babalola et al., 2015). While collective action in regard to purchasing stock allows traders to enjoy the benefits of economies of scale, group membership is a common income-saving approach among traders, hence providing a good opportunity to empower and transform women's position in society (Babalola et al., 2015).

Moreover, *training in financial literacy* and the formalization of the groups to enhance group borrowing promotes *access to credit* (Abdullahi et al., 2015). Groups and cooperatives are common in the fish trading chain, but there is still an opportunity to promote group operations, especially among low-income and small-scale traders (BoP Inc and WorldFish, 2019). Women's participation level in postharvest fish value chain activities is fair, but there is still an opportunity to reach more women by providing credit and extension services (Velu et al., 2009). Supporting small-scale and low-income women in the chain to obtain low interest and reliable credit is especially critical for women's empowerment, as this reduces dependence on unreliable sources of capital and increases profit margins (Udo and Okoko, 2015).

4 Discussion

Our study shows that women and men are involved in all segments of the aquaculture value chain. However, a majority of women are mostly involved in the less lucrative nodes of the value chain compared with the activities of men. Specifically, women are mostly involved in the processing and retailing/marketing of fish. Men, on the other hand, are involved mostly in fingerling production and grow-out fish farming. Adequate sex-disaggregated data are not available for input providers, exporters and wholesalers, although the sparse available literature highlights a possible dominance of male actors in these segments (Veliu et al., 2009).

Discrimination against women in resource access and the gender division of labor poses a challenge to gendered efforts to reach, benefit, empower and transform the aquaculture value chain. Sociocultural factors and religious rules are the main causes of gender inequality and women's discrimination. When coupled with the general inefficiencies in the value chain, these factors curtail women's empowerment and gender equality.

Along the same lines, dependence on spouses for capital denies women agency and autonomy in the management and operation of their businesses, while dependence on savings limits their scale of operations. Institutional credit sources are inaccessible to women due to the high interest rates, collateral requirements and financial illiteracy (Agbebi, 2010; Ibrahim et al., 2011; Okwuokenye, 2020) present in Nigeria and other countries (Luomba, 2013; Bosma et al., 2019). Solutions include female group membership to access loans and reforming institutional lending policies to include women-friendly terms that accommodate women and enable them to access credit.

Furthermore, there is a need to develop strategies to ensure that gender-accommodative approaches are put in place in order for women to access training, including the proper timing of training activities with respect to domestic responsibilities and the consideration of cultural norms that determine division of labor and resource access. Other strategies includes the training of trainers, i.e., choosing female and male leaders and/or respected (or champion) women and men in specific fish value chain sectors in certain locales to serve as trainers and mentors for women and marginalized or needy men in particular nodes of the value chain. Another effective strategy is pairing women champions with other women in the node for the easy diffusion of ideas, free of cultural encumbrances.

Gender transformation in the fish value chain requires that women (and youth) be reached and that they derive equal benefits as those experienced by men, as well as being economically and socially empowered or enabled to actively participate in and gain from the aquaculture value chain. Participation alone does not guarantee benefits and/or empowerment, and further interventions are needed. We propose some of the interventions, specifically farming in groups, the diversification of fish processed products, the

diversification of fish strains, the use of gender suitable technologies and accommodative and gender transformative approaches (GTAs). The major goal of GTAs is to work on deep structural barriers to reduce or overcome structural constraints from the household to national and even global levels. The goal is to create tangible change that can be observed, felt and lived by women, men, girls and boys. Without transformation, there is no reform. Without reform, there is no gender equality or women's empowerment. Reform is necessary for change to occur. GTAs are recommended for overcoming cultural-based constraints.

GTAs overcome limitations by working toward addressing the underlying causes of gender inequalities that limit the lives and livelihoods of farmers and fish value chain actors (McDougall et al., 2021a). These structural constraints include formal (policies), semiformal (systems), and informal (norms) constraints. WorldFish and its partners have pioneered several methods of implementing GTAs in aquaculture to address social and gender norms. One example is the savings group program approach, which was piloted in the Barotse Floodplain of western Zambia.

Couples in Zambia were introduced to gender norms and dynamics, financial decision-making, co-creation, and trying out more equitable ways than those used traditionally. Similar saving group programs would be highly beneficial to the low economic status female fish traders, to increase their capital and acquire productive assets. In addition, the groups provide an opportunity for building social networks, which are important in fish trading business in Nigeria. A second example is providing training on technical skills of aquaculture and nutrition. Included in the technical training (homestead food production: vegetable and aquaculture farming) are embedded exercises that engage women and powerful household and community members with regard to gender norms and dynamics and how these affect the wellbeing of women (Kantor et al., 2015; Helen Keller International, 2019; FAO, 2021). The third and last example is participatory technology development through the use of theater to provide reflection (on how the community performs or perceives certain technologies and how it treats women, men, boys and children) and integrating that reflection into participatory action research on testing and refining fish drying and processing technologies to curb postharvest losses (Cole et al., 2020). All these examples show the power of GTAs to encourage men and women to either share some burden of unpaid labor and/or to participate and benefit from the aquaculture value chain and food production system as a whole. In addition to transforming structures, opportunities are also available to reach, benefit and empower women in fish farming, provided that there is an in-depth gender focus, e.g., on cooperatives or farmers' groups.

Accommodative approaches such as increasing the number of women and marginalized or needy men involved in the various nodes of aquaculture (reach); increasing their

opportunities or abilities to use resources and/or benefits (access); and strengthening their abilities to make strategic life choices and voice concerns (empower) are complementary. However, deep and sustainable change that is able to address gender inequalities and constrain gender norms at the local level comes from engaging both women and men in reflexive processes (in a group discussion format) to jointly assess how gender norms and dynamics shape relations, roles, opportunities, risks and experiences ([Promundo-US and WorldFish, 2016](#)).

There are some good benefits for women, youth and men in operating farms collectively or working as a group in fish farming activities. For example, the Eriwe Fish Village Project employs groups and cooperatives to reduce poverty and demonstrates viability for scaling. As noted in this review, belonging to a cooperative and group enables women to access resources such as credit, extension services, land and other inputs. Additionally, collective operations enable women to take advantage of economies of scale and realize higher benefits ([Abdullahi et al., 2015](#); [Olaoye et al., 2017](#)). Given the importance of social capital among women in aquaculture, groups and cooperatives promote women's empowerment through cohesiveness, better networks and relationships. Moreover, there is financial power present when women, men and youth entrepreneurs work in a group, as they are able to access group loans and credit to expand and enrich their business. However, training and financial literacy are critical for the success of groups/cooperatives, as well as a source of credit.

In addition, there is a need for the diversification of processed fish products. In Nigeria, fish are marketed as fresh, smoked or frozen, with very little diversification in value addition, ([Girei et al., 2019](#)) other than by a few large-scale processing industries ([WorldFish, 2020](#); [Gbigbi, 2021](#); [Omitoyin, 2021](#)). To create more opportunities for women in processing, investments should be made in research and training on inexpensive methods of value-addition of fish into other products such as fish oil. Additional products not only increase financial benefits for women but also promote fish consumption.

Likewise, the diversification of fish strains is needed to expand opportunities in the aquaculture value chain. Currently, catfish are the main cultured fish in Nigeria. Nonetheless, studies show that both catfish and tilapia farming is profitable ([Tran et al., 2020](#)). Removing inefficiencies such as inadequate extension services and developing tilapia and catfish breeding and feed manufacturing chains, in addition to intensive aquaculture training for farmers, can provide an opportunity to promote diversification and distribute risks in fish farming. In addition, there is need for further scientific research to develop gender responsive fish strains.

Furthermore, gender-suitable technologies, specifically culture media such as concrete tanks, should be promoted to increase women's participation in fish farming.

5 Conclusion

The R-B-E-T framework provides a platform to comprehensively analyze and diagnose the level of women's empowerment and gender equality. This stage-by-stage approach provides room to examine gender aspects from the short-term gender-responsive impact to the overall long-term final goal and outcomes. Nonetheless, there is an opportunity to expand and make the framework more flexible during the overall subsector situational analysis of gender aspects. For learning purposes of monitoring and evaluation, consideration for a follow-up framework that extends beyond the change that occurred to examine why the change occurred, is recommended.

Our study recommends that researchers conduct further gendered research in Nigeria's aquaculture, with keen attention paid to both quantitative and qualitative data collection methods and sex-disaggregation of data. If proper sex-disaggregated data were available, it would enable the government, investors and other development actors to readily see where gender gaps exist in the aquaculture sector in Nigeria. Investment programs/projects in the aquaculture sector would then capitalize on reaching women in the aquaculture value chain, e.g., women in fish farming, and confer on them the necessary resources (be these financial and/or knowledge) they need to perform well in the sector. In addition, we recommend establishment of data systems by both the government and research institutions. Currently, extent of women's participation and contributions in aquaculture value -chains are not identified or counted in data systems while their needs are not given appropriate attention in extension services. While still in research, it is also recommended that researchers conduct further review of the state of knowledge on affordable small-scale fish value addition methods practiced in Nigeria and the assessment of their viability as an opportunity for the development of the value chain. Nevertheless, we find that the value chain has the potential to empower even more women. Currently, empowered women consist of fish farmers with high income and fish traders who operate at a significantly larger scale, i.e., as wholesalers. There are still major gender inequality gaps, as well as untapped opportunities to empower women, in the value chain.

The National Gender Policy in Agriculture promotes use of gender sensitive and gender statistics for evidence planning, improving cultural practices that hinder women's empowerment, and providing technical skills to women, with respect to financial management, cooperatives formation among others. Urgent implementation of the National Gender Policy, while paying attention to the complexities of the aquaculture value chain is important. It will remove inefficiencies. Further, there is an urgent need for a gender-aquaculture policy in Nigeria to create a conducive environment for investment.

In terms of norms, the burden placed on women due to unpaid household work and the lack of support from their

families, communities and governments blocks their ability to live healthy and productive lives. Special attention should be given to women in the northern region, women in low economic conditions, younger women, women in purdah systems and women in highly patriarchal regions, as they are the most disempowered gender groups in the aquaculture value chain in Nigeria.

Lastly, although there are similarities in women's disempowerment and gender inequality in different parts of the world, as noted in the discussion of the findings, the recommendations made herein may not be generalizable. While the general challenges are similar within Nigeria and other developing countries, the extent of these challenges and the factors that anchor them differ. As such, women empowerment initiatives ought to be context specific.

Author contributions

RA - Conceptualization, Analysis and Writeup. LN - Literature review summarization, Analysis and Writeup. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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