frontiers | Frontiers in Sustainable Food Systems

TYPE Review
PUBLISHED 29 August 2024
DOI 10.3389/fsufs.2024.1327798

OPEN ACCESS

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RECEIVED 25 October 2023
ACCEPTED 17 June 2024
PUBLISHED 29 August 2024

CITATION
Adam R, Lam RD, Lozano Lazo DP, McDougall C, Rajaratnam S, Ouko K, Pasani C, Forsythe L and Rossignoli CM (2024) Using a sustainable food systems framework to examine gender equality and women's empowerment in aquatic food systems. *Front. Sustain. Food Syst.* 8:1327798. doi: 10.3389/fsufs.2024.1327798

Using a sustainable food systems framework to examine gender equality and women's empowerment in aquatic food systems

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This article aims to generate novel insights by examining gender dynamics within aquaculture and small-scale fisheries, employing a gendered agrifood systems conceptual framework to comprehensively analyze gender equality and women's empowerment in aquatic food systems. To do this, it evaluates 202 articles using a scoping review methodology. Though additional literature from 19 articles was pulled in to provide the context. The findings are that aquatic foods value chains and food environment are negatively impacted by gender disparities in terms of women's agency, access to and control over resources, gendered social norms, and policies and governance. This hampers the ability of women to engage in and benefit from aquatic food systems. This results in gendered disparities in dietary outcomes, low achievements in relation to gender equality and women's empowerment, and less adaptive capacity in relation to developing resilient livelihoods. The article acknowledges the importance of developing and leveraging women's agency and bargaining power, strengthening their access to and control over key aquatic food systems resources, tackling harmful gender norms, developing gender-sensitive data collection and analysis to inform evidence-based policymaking, and implementing gender-responsive and gender-transformative policies and strategies to create an enabling environment for these interventions to succeed. Investment in multi-level, and multi-layered, gender-responsive and gender-transformative approaches are needed to co-develop – with women and their organizations – positive, gender-equitable norms to strengthen women's agency and decision-making at a variety of levels, ranging from individual to policy level.

KEYWORDS

aquatic food systems, food systems framework, gender inequality, women's empowerment, power dynamics

1 Introduction

Achieving gender equality and empowering women and girls is the aim of United Nations Sustainable Development Goal (SDG) 5. Intrinsically important, gender equality and women's empowerment also leverage the attainment of other SDGs, including no poverty (SDG 1), zero hunger (SDG 2), reduced inequalities (SDG 10), climate action (SDG 13), and life below water (SDG 14) (FISH (CGIAR Research Program on Fish Agri-Food Systems), 2017).

Addressing women's disadvantaged position in the aquaculture and fisheries value chains, in food environments, and in consumer behavior, is essential to improve the functioning of these systems (FAO, 2018; Anderson et al., 2023; FAO, Duke University, and WorldFish, 2023; Njuki et al., 2023). In low- and middle-income countries (LMICs), women in small-scale fisheries and aquaculture are diverse in terms of their socio-economic status, their socio-cultural environments, and in the work, they do. However, they face common challenges. These include restrictions on women's agency – their ability to set goals and act upon them – within households, in community-level decision forums, and at higher levels (Kabeer, 1999; Satapornvanit et al., 2015; Kruijssen et al., 2018; Gopal et al., 2020). It is hard to make meaningful choices and realize goals without resources (Kabeer, 1999), yet typically women have weaker access to, and control over, productive resources such as ponds and fishing grounds, as well as the support systems they need to maximize their benefits – such as credit, extension, new technologies, etc. – than men (Fröcklin et al., 2013; Rajaratnam et al., 2020; Njuki et al., 2023). Gender-based inequalities contribute to less effective agrifood systems – including in aquaculture and capture fisheries – because women, who are significant actors, cannot maximize their entrepreneurial skills and have limited scope to improve and deploy their knowledge in ways that promote adaptive capacity. As such, household, community, national, and regional economies suffer (Kruijssen et al., 2018; Rajaratnam et al., 2020; Harper et al., 2023).

The inefficiencies caused by gender constraints to aquatic food systems are widely recognized. However, although fisheries policy instruments began to incorporate measures to enhance gender equality a decade ago with the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Kurien, (2015) there has been relatively limited domestication by national governments (Biswas, 2017; Gopal et al., 2020). More broadly, aquaculture and small-scale fisheries have been slow to develop, integrate and effectively implement measures to enhance gender equality in investments and programming (Williams and Choo, 2014; Williams et al., 2016; Lawless et al., 2019; Simmance et al., 2022).

The objective of this article is to synthesize research findings regarding the distinct challenges and opportunities that women encounter in aquaculture and small-scale fisheries, while also offering evidence-based recommendations for addressing these issues. We aim to generate novel perspectives and insights through investigation of gender in aquaculture and small-scale fisheries using a gendered agrifood systems conceptual framework (Njuki et al., 2023). We conduct a literature review (202 articles) and structure our findings around the various components of the conceptual framework. But it is important to highlight that 19 articles were added in to provide the rich context needed to illustrate the situations on the ground. The aim is to highlight gender inequalities while highlighting ways to empower women through technical, social, and institutional innovations. The authors hope that the findings presented in this paper will guide governments, non-governmental organizations (NGOs), research organizations, other public agencies, the private sector, and donors in improving gender equality in aquaculture and small-scale fisheries.

2 Conceptual framework

We use the Gendered Food Systems Conceptual Framework (GFS-CF) by Njuki et al. (2023) to examine gender equalities and women's empowerment in aquaculture and small-scale fisheries (Figure 1).

The top line of the GFS-CF shows that food system drivers act iteratively within an already gendered food system shaped by structural gender inequalities as well as shocks and vulnerabilities which affect women and men in different ways, and which shape their opportunities, constraints, and behaviors. The midline of the GFS-CF highlights the three main components of food systems: value chains, the food environment, and consumer behavior.

Moving to the bottom line, the GFS-CF indicates that the "three components of the food system interact with gender equality/inequality in a four-dimensional space: individual and systemic, formal and informal" (Njuki et al., 2023: 167). This is the space where gender transformative change happens. The CFS-CF recognizes that individual empowerment and systemic empowerment are part of an iterative change process. Informal changes closer to the individual level require strengthening women's agency, bargaining power, capacities, and aspirations. Formal changes are needed to promote women's access to, and control over resources. Such changes cannot happen and achieve critical mass unless the wider systemic forces which underpin women's weak agency and access to resources are addressed. Gender-transformative approaches are needed to transform harmful gender norms, and to ensure that policies and governance create a genuinely enabling environment. To help unpack the "empowerment box," we examine the four dimensions of gender relations closely. These are the gender division of labor, access to and control over resources, decision-making, and gender norms (McDougall et al., 2021). The gender division of labor describes how tasks (productive, household and care work) are allocated to a particular gender in fisheries and aquaculture activities. Access describes the ability to use a resource (e.g., knowledge, technologies, ponds, fish seed and inputs, fishing areas and fishing gears) with permission. Control describes having decision-making power over a resource. Gender norms are the informal social rules and assumptions on what men and women should do, how they should conduct themselves, and their relative value in society.

Finally, the right-hand size of Figure 1 highlights four systemic food system outcomes: dietary diversity, gender equality and women's empowerment, economic and livelihood outcomes, and environmental outcomes.

3 Methods

To assist with the literature review, a five-stage scoping review method (Arksey and O'Malley, 2005) was used. The framework employs a transparency approach that makes it possible to replicate the search

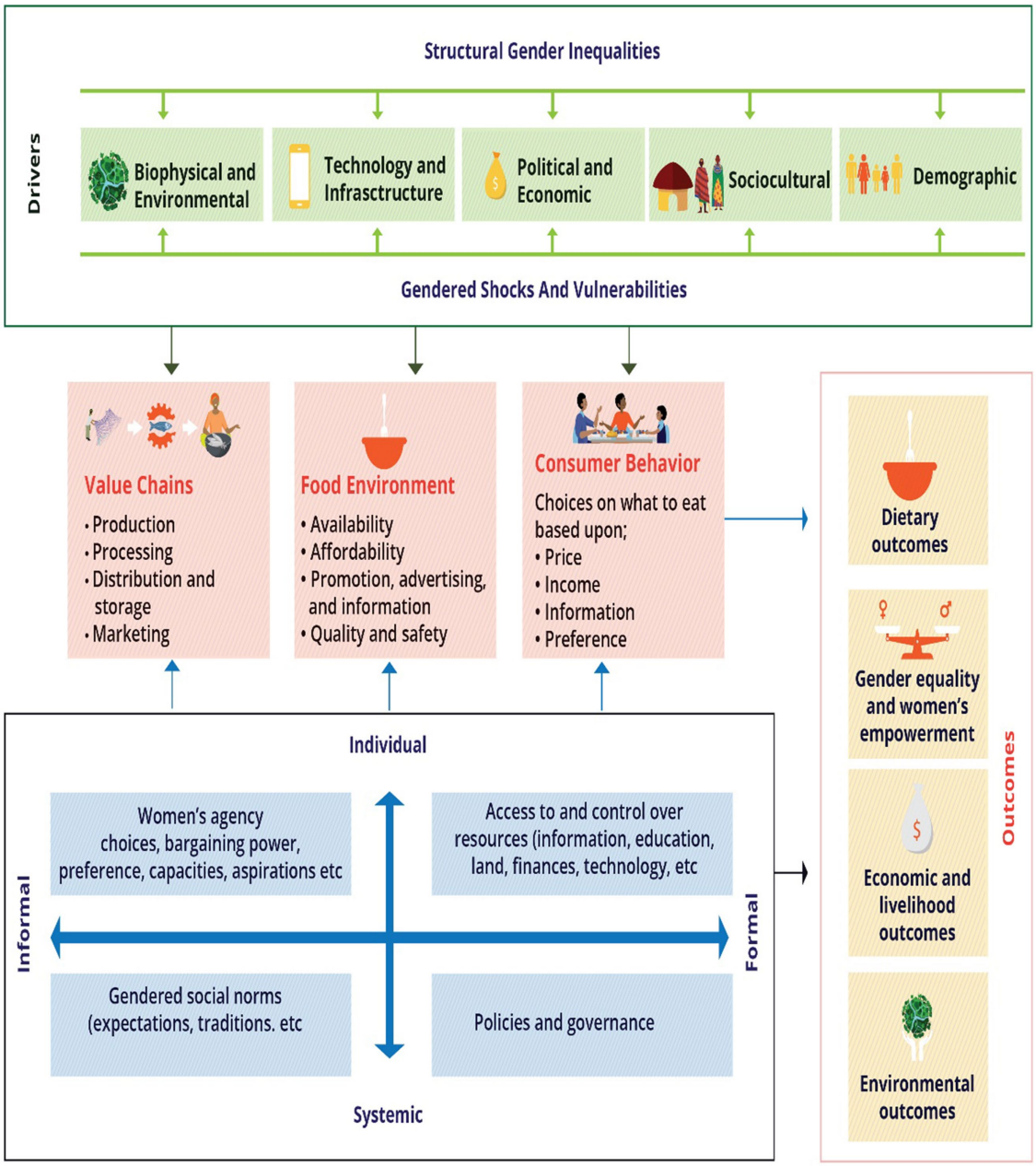

FIGURE 1
Gendered food systems conceptual framework . Adapted with permission from A Review of Evidence on Gender Equality, Women's Empowerment, and Food Systems by Jemimah Njuki, Sarah Eissler, Hazel Malapit, Ruth Meinzen-Dick, Elizabeth Bryan, and Agnes Quisumbing, licensed under Creative Commons Attribution (CC BY), Springer eBook, Springer Nature, Jan 1, 2023. https://doi.org/10.1007/978-3-031-15703-5_9.

approach and improves the reliability of the findings of the study (Levac et al., 2010). The five stages are: (1) identifying the research questions, (2) identifying relevant studies; (3) selecting relevant studies; (4) charting the information; and (5) assembling, summarizing, and reporting the findings. Following the GFS-CF by Njuki et al. (2023) we posed the following comprehensive research questions:

1 How do gendered shocks and vulnerabilities in aquatic food systems impact gender equality and women's empowerment?
2 How do gender dynamics and relations within agrifood system components affect gender inequality and women's empowerment?
3 How do cross-cutting gender issues and outcomes in agrifood systems influence gender inequality and women's empowerment?

To answer these questions, a wide range of keywords were searched in electronic databases (Google Scholar, Research Gate, Science Direct, and Taylor and Francis) to identify published research articles, review papers, technical reports, books, book chapters, and dissertations/theses. Boolean operators ('OR' and 'AND') were used in the databases to refine the search. We searched for articles containing the keywords: ("gender" OR "women" OR "men" OR "gender norm" OR "masculinity") AND ("fish" OR "small-scale fisheries" OR "aquaculture") AND ("equality" OR

"inequality") AND ("empowerment" OR "innovations" OR "financial inclusion") AND ("policies" OR "governance" OR "economic" OR "environmental"). This search produced 1890 articles. Additionally, we assessed research by the Food and Agricultural Organization of the United Nations (FAO), the World-Wide Fund for Nature (WWF), The Nature Conservancy (TNC), the International Union for the Conservation of Nature (IUCN), WorldFish, including Illuminating Hidden Harvests Project reports, and the Consultative Group on International Agricultural Research (CGIAR) Research Program on Fish Agri-Food Systems (FISH) reports. This resulted in the inclusion of an additional 90 articles.

Using the Moher et al. (2009) protocol, inclusion and exclusion criteria were then established to facilitate the final selection of articles for review. These criteria included: relevance to the topic, academic quality (only scientific, technical, and academic studies were included), language (English), and year of publication (between 2000 and 2023). To reduce reporting bias, the full-text and abstract of each article were reviewed by at least two reviewers in accordance with suggested protocols for scoping reviews (Peters et al., 2015). We then removed duplicates and screened the remaining articles, finally including 202 articles as in the Preferred Reporting of Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram (Figure 2). The 202 articles were categorized using the following classification: lead author, year of publication, region, country, methodology, aquatic species focus, gender dimension focus, system, scale of production and type of value chain (see the classification sheet in the Supplementary material for additional information). While 29 of the selected articles used mixed research methods, 173 used qualitative research methods. On the other hand, 71 articles focused exclusively on gender inequality/equality while 63 articles focused exclusively on gender empowerment (Table 1). All the 202 papers were read, analyzed and the results presented as a narrative based on the literature and cases therein.

At this juncture, rather than at the end of the article which concludes with recommendations, we discuss the limitations in our research approach. First, regarding rigor and quality, the literature in our review covered an extensive spectrum. This posed some challenges since scoping reviews do not evaluate the rigor or quality of studies (Hanneke et al., 2017). Second, it was challenging to define the scope of the study due to the heterogeneity in terminology and sometimes unclear definitions of key terms. Third, Arksey and O'Malley (2005) state that the steps in a scoping review are "not linear but iterative. This assertion was supported in our experience of the repetitive nature of our scoping approach. The research questions, search technique, and selection criteria had to be defined and redefined several times leading to an increase in time and resources needed. Fourth, the scoping review resulted in a vast body of data which took considerable time to distill and use appropriately.

4 Findings

The findings are presented according to the components of the GFS-CF (Figure 1). We structure our findings around: (i) food system drivers and levers, (ii) around two of the three core components of food systems (aquatic foods value chains and food environment), and (iii) gender equality and women's empowerment. We discuss outcomes in terms of interventions that have led to changes in gender equality and women's empowerment.

4.1 Food system drivers

Biophysical and environmental, technological, and infrastructural, political, and economic, socio-cultural, and demographic drivers play out in various ways in aquaculture and small-scale fisheries (Calicioglu et al., 2019). Considerable research attention is focused on the ability of food system actors to recover from shocks in ways that reduce vulnerability and promote inclusive growth.

4.1.1 Biophysical and environmental drivers

Aquatic food production depends on maintaining biodiversity and healthy ecosystems (Hoegh-Guldberg et al., 2023). However, changes in the climate, and in biodiversity, are significantly affecting the parameters of aquaculture and small-scale fisheries food systems, and the ways in which these systems function. For instance, climate change is manifesting itself in different ways in fishing environments. Increasingly violent storms are harming fisheries and coastal habitats (WWF, 2019).

Considerable theoretical work has been conducted on framing and understanding resilience in ecosystems (Folke, 2006; Anderies et al., 2013). A key focus is understanding adaptative capacity in socio-ecological systems. This refers to the ability of individuals, households, and communities to adapt to, and transform, their livelihoods (Bryan et al., 2023). To develop adaptive capacity, women and men require agency: the power to make decisions and act on them. However, multiple researchers note that women's low agency at household and community level frequently constrains their ability adapt their fishing and fishing-related livelihoods (such as processing) in the face of climate risks, or to build stronger, more diversified portfolios of livelihoods that could increase their and their families' future resilience to social or environmental shocks (Rabbanee et al., 2012; Morgan et al., 2015; Moser, 2015; Jørstad and Webersik, 2016; Manyungwa et al., 2019; Thomas et al., 2019; WWF, 2019; Treviño and Murillo-Sandoval, 2021; Sultana et al., 2022).

The development of adaptive capacity relies on inclusion in training and information networks. Knowledge and understanding about the likely effects of climate change on aquatic food systems, for instance, are a prerequisite to changing behavior and evidence-driven livelihood planning.

However, although global policy guidance for aquaculture and small-scale fisheries acknowledges the importance of developing gender-equitable knowledge processes, in practice men rather than women are targeted (Baker-Médard, 2017; Kleiber et al., 2017; FAO, 2018; Rohe et al., 2018; Lawless et al., 2019; Nunan and Cepić, 2020). The marginalization of women is partly driven by gender-blind data acquisition processes. Gender analysis in 17 countries conducted by the Illuminating Hidden Harvest project (FAO, Duke University, and WorldFish, 2023) demonstrates how 'sexist data structures' which do not disaggregate, analyze, and act upon sex-and gender data contribute directly to gender-blind environmental and climate policies. Lack of data on what women do in aquaculture and small-scale fisheries mean women become invisibilized and thus hard to find. This in turn leads to aquatic food systems becoming framed as 'men's domain' (Atkins et al., 2021; Harper et al., 2023).

Another challenge to women's inclusion is the widespread lack of policy and institutional capability to implement gender-equitable policies, strategies, and training. Ministries of Fisheries and other relevant development partners often lack sufficient gender-aware, well-trained staff with responsibilities for implementation, insufficient

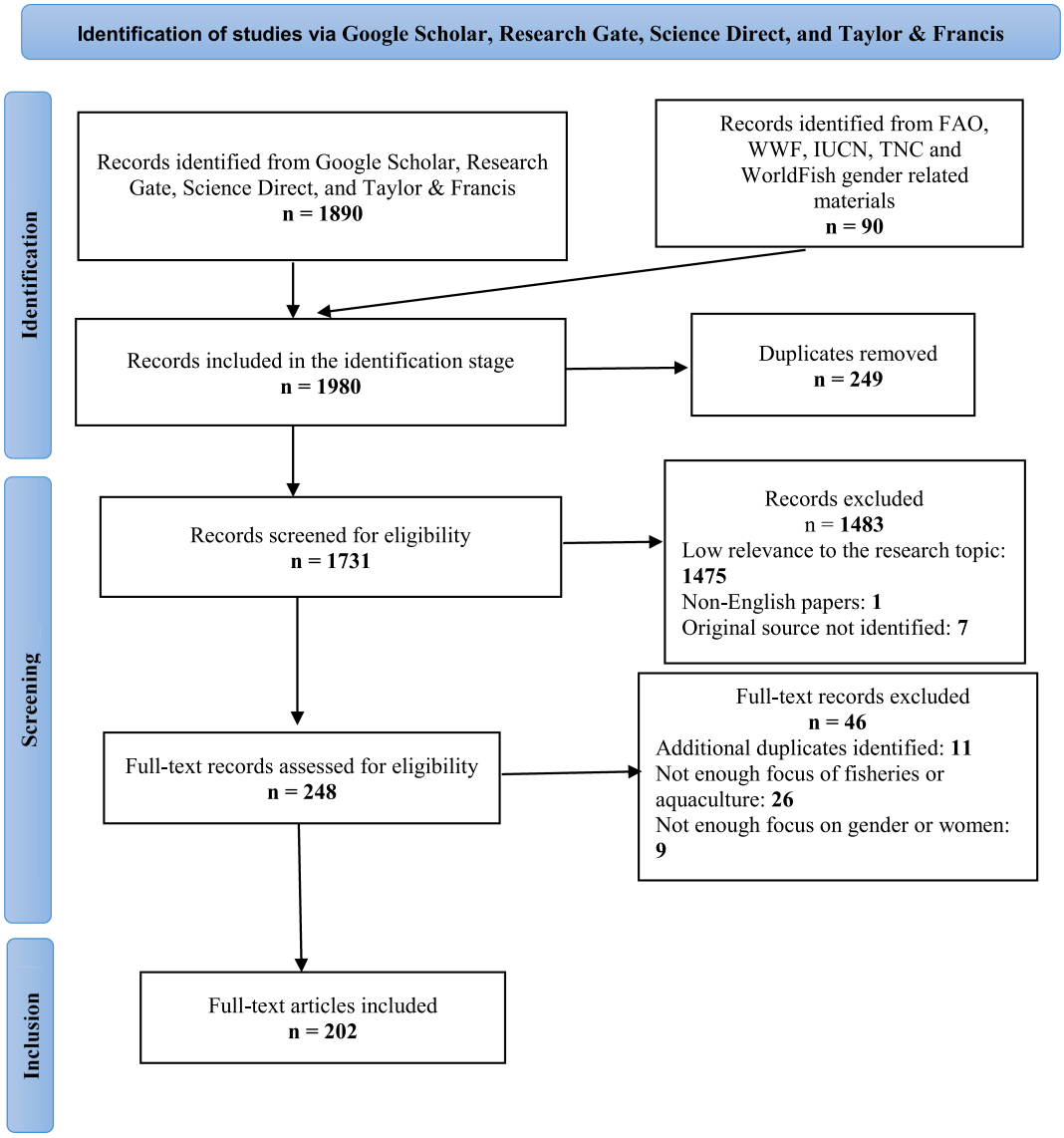

FIGURE 2
PRISMA flow diagram of the selection process of studies that examined gender equality and women's empowerment in aquatic food systems.

funding and a lack of monitoring and evaluation mechanisms (Bryan et al., 2018; Jentoft and Chuenpagdee, 2019).

Although the global picture remains bleak, some policymakers and donors are beginning to integrate gender-sensitive environmental considerations into their fisheries planning processes as evidenced in the Solomon Islands (Lawless et al., 2017), Ghana (Mutimukuru-Maravanyika et al., 2017), and Zanzibar (Gopal et al., 2020). Successes include an evaluation of a participatory climate-smart aquaculture intervention in Bangladesh. Participants indicated that the framing of women as fish farmers facilitated their stronger involvement in decision-making around livelihood planning (Colga et al., 2019).

4.1.2 Technology and infrastructure drivers

Technologies are self-evidently a major driver in food systems and will continue to be so with the advent of climate change, pandemics, and other challenges. Yet the promise of technology is more often reaped by men than women because technologies are more often directed toward men's, rather than women's, roles in aquaculture and small-scale fisheries. Indeed, almost all aquatic food system technologies such as the diesel engines to power fishing vessels, fishing net machinery, and other fishing gears have been primarily developed for tasks normatively undertaken by men in most fishing communities (Williams and Syddall, 2022). Consequently, men typically end up being the main beneficiaries of new technologies, with women often finding it difficult to learn about and access them due to lack of targeting (Kusakabe and Thongprasert, 2022). This leaves women in the position of creating their own technologies, for example using mosquito nets for fishing (Short et al., 2020).

Targeting women with appropriate aquaculture and small-scale fisheries technologies is essential, though they need to be introduced in conjunction with behavioral change approaches that support women as breadwinners alongside men. In the absence of such approaches, men sometimes take control over fish when new technologies boost profitability (Kruijssen et al., 2016). In Bangladesh,

TABLE 1 Distribution of included papers by year of publication, methodology, gender focus, species focus, and focus on fisheries/aquaculture (n = 202).

Paper characteristics	Number of papers (n)	Percent (%)
Year of publication		
2000–2007	8	4
2008–2015	58	29
2016–2023	136	67
Methodology		
Mixed methods	29	14
Qualitative	173	86
Gender focus		
Inequality/Equality	71	35.15
Empowerment	63	31.19
Both dimensions (Inequality/Equality & Empowerment)	38	18.81
Unspecified	30	14.85
Species focus		
Unspecified	189	94
Seaweed	5	2
Tilapia	3	1.5
Rohu fish	1	0.5
Oyster	1	0.5
Shrimp	2	1
Mud crab	1	0.5
Specific to fisheries/aquaculture		
Specific to fisheries	70	57.9
Specific to aquaculture	51	42.1

for instance, women-only fish polyculture programs worsened intra-household gender asset inequalities because men assumed control over the new resources (Scarborough et al., 2017). Conversely, in Malawi men did not protest about women being targeted with solar dryers to reduce post-harvest fish losses. However, most women could not afford to buy the dryers, even when multiple families tried to contribute monies (Chiwaula et al., 2018).

4.1.3 Political and economic drivers

Appropriate leadership and inclusive governance at local and global levels are critical for the development of gender-equitable aquatic food systems. Socially just policies improve livelihoods, reduce poverty, and contribute to ensuring food security at the micro- and macro-levels (Escobar and Puskur, 2014; Aregu et al., 2018a). Globally, several frameworks aim to ensure secure tenure, user and access rights to small-scale fisheries and aquaculture. They include the Committee on Food Security's Principles for Responsible Investment in Agriculture and Food Systems; the Committee on Food Security Voluntary Guidelines for Responsible Governance of Land, Fisheries and Forests in the Context of National Food Security; the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries; and the FAO Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security (FAO, 2020). Even though these instruments support a human-rights-based approach that reinforces good governance, participation, consultation, inclusiveness, and transparency, much remains to be done on the ground to enact the recommendations made by these policies and frameworks.

At community level, for instance, women rarely participate in fisheries or aquaculture management committees. Frequently, local gender norms mean that women are not expected to attend such meetings (Hao, 2012; Solano et al., 2021). Even women who have inherited or otherwise acquired fisheries resources can find it hard to exercise their decision-making rights in community level meetings, for example in Bangladesh (Choudhury et al., 2017).

Turning to economic drivers, aquaculture and small-scale fisheries provide highly nutritious food and have the potential to play an important role in promoting equitable economic growth for the rural poor (FAO, 2020). These sub-sectors support an estimated 250 million people through income and employment, thereby helping to attain SDG 1 (end poverty in all its forms), SDG 2 (zero hunger), and SDG 8 (sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all) (FAO, 2020). It is estimated (see remarks above regarding data limitations) that women comprise 19% of aquaculture and 11% of fisheries workers globally (FAO, 2018). Women contribute to large and small-scale fisheries, as well as commercial and homestead aquaculture. However, most women actors are confined to less lucrative nodes of the value chain. This includes limited fish-farming (particularly in homestead aquaculture), processing and small-scale retail. Men dominate as fishers and as the owners of aquaculture ventures, provide inputs such as fish seed (eggs, etc.) and fish feed, and are more likely to market fish to large buyers (Kruijssen et al., 2018). In South India, gender *per se* is not the main issue in some locations. Rather, competition with more powerful marketing actors is serving to marginalize women in the fish value chain (Aswathy and Kalpana, 2018).

4.1.4 Socio-cultural drivers

Socio-cultural, gender and religious norms influence what women can do and the challenges they face. Women are frequently limited to activities and fishing methods considered to be suitable for women, for example, fishing in small pools of water along rivers, seaweed farming, mud-crab fishing, oyster farming, inland-waters fishing, and gleaning (Szuster et al., 2008; Thorpe et al., 2014; Moser, 2015; Cuaton, 2019; Thomas et al., 2019). Traditional beliefs, taboos, and superstitions can prevent women in some locations from fishing in the sea or entering water bodies. In South Africa these taboos are associated with clothing, as fisher women are expected to cover their bodies extensively regardless of the heat, to be respected by their male counterparts (Cele, 2020). In Kenya women can be banned from fishing during menstruation, as they are considered to not be "clean," which would upset the water gods (Kamau and Ngigi, 2013). Until a few decades ago, in countries such as Norway, France and Greece, the mere presence of women in a boat meant "bad fishing luck" (Frangoudes and Gerrard, 2019). But even nowadays, in many developed and developing countries, the presence of women in fishing activities is still discouraged due to the belief that this "bad luck" would negatively affect harvest (Williams et al., 2005; Monfort, 2015). In Vietnam, this "bad luck" still prevents omen from entering hatcheries or fishing in the sea (Brugere et al., 2001).

Gender norms that frame women primarily as homemakers, rather than as generators of income, mean that women who do work outside the home on fisheries-related enterprises can suffer from negative sanctioning (Cislaghi and Heise, 2020). For instance, in Indonesia, women who work as shrimp operators and milkfish processors benefit financially yet incur negative social judgements. They can find it hard to manage their other responsibilities, such as household and care work, and the personal security risks of their work (Sari et al., 2017).

Gender norms frequently serve to limit women's mobility (Muñoz Boudet et al., 2012). In many countries, women are restricted from traveling to local and regional markets to sell their produce, and thus need to sell from the beach or farm gate. In such cases, they are more likely to be price-takers than price-setters, and thus have lower incomes (De and Pandey, 2014; Deb et al., 2015; Lawless et al., 2019; Githukia et al., 2020; Haque et al., 2020). One way of negotiating around mobility constraints is to use mobile banking apps. A project in Bangladesh strengthened women's agency and control over income during the three-month fishing ban by enabling women to work from home knitting toys and clothing for export (Choudhury and Tanzina, 2020).

4.1.5 Demographic drivers

Population growth, accelerating urbanization, migration, and forced displacement impact food systems. Depending on why people migrate, the outcomes can either advance women's empowerment by increasing their autonomy and decision making, enhancing access to economic opportunities, and exposing them to different cultures and ideas or further constrain household food security by loss of labor or disrupting their social networks (Farnworth et al., 2016; Choudhury et al., 2017; Lawless et al., 2017, 2019).

Seasonal male outmigration can catalyze women's empowerment over the longer-term and it can lead to women taking on some hitherto "male" roles in aquatic foods value chains (Kwashimbisa and Puskur, 2014; Deb et al., 2015; Turgo, 2015). It can also lead to the potential for alternative livelihood options. For instance, in Thailand, parents who migrate to work in the fishing industry send part of their income home to educate their children, thus generating a cadre of educated young women and men with options for better-paying jobs in urban areas (GAF, 2020). In Bangladesh, men's seasonal outmigration can contribute to greater autonomy for women, increased decision-making power, and a relaxation in gender norms as women remaining in the rural areas take on male roles (Farnworth et al., 2015; Aregu et al., 2018b).

In other cases, male outmigration can reinforce traditional gender roles in ways which are detrimental to women's empowerment (Lawless et al., 2019). For instance, male outmigration can leave women overburdened with the responsibility of managing fisheries and aquaculture activities (Brugere et al., 2001; Shibru and Flintan, 2010; Deb et al., 2015; Okyere Nyako et al., 2015). In some cases, men do not return, leaving women to become *de facto* heads of household and turning them into primary breadwinners alongside their time-consuming household and care activities (Williams et al., 2005; Appiah et al., 2020). In other cases, women, and men both out migrate, either seasonally or for longer periods. Yet although outmigration can enable both women and men to pursue professional careers. For instance, in countries like Vietnam daughters are often expected to return at some point to take care of their parents (GAF, 2020). In other cases, women who migrate to live with their husbands' risk losing their often-marginal inheritance rights and decision-making power of the assets they access and control in their communities and suffer further marginalization due to their 'migrant' status (Matsue et al., 2014; Cole et al., 2016; Agarwal, 2018).

4.2 Core components of aquatic food systems

The second part of the findings is centered around two of the three components of food systems highlighted in the CFS-CF: value chains, and the food environment. We do not discuss the third component, consumer behavior, due to the paucity of findings in this analytic domain.

4.2.1 Aquatic foods value chains

A value chain comprises the full range of activities required to bring a product or service from conception, through different phases of production such as processing to final consumers, and final disposal after use. Value chains are not linear, but rather are a complex network of activities and linkages among different actors. The term "chain" should be considered as a metaphor for connectedness. The term "value" refers to the value added to the product at each stage of the chain as well as the value captured by the various actors involved.[1] Women are involved in all aspects of aquatic foods value chains. Globally, an estimated 21% of all workers in the fisheries and aquaculture value chains are women (FAO, IFAD, WFP, CGIAR Gender Impact Platform, 2023).

4.2.1.1 Aquaculture

Aquaculture value chains are expected to grow and generate 76 million new jobs globally between 2010 and 2050 (Waite et al., 2014; FISH (CGIAR Research Program on Fish Agri-Food Systems), 2017). Almost 50% of all workers in aquaculture (including pre-and post-harvest) are women (FAO, 2018; FAO, IFAD, WFP, CGIAR Gender Impact Platform, 2023).

Men predominate in intensive aquaculture systems that require more inputs than extensive systems (Veliu et al., 2009; Satapornvanit et al., 2015; Bosma et al., 2019). In general, very few women are strongly active in aquaculture (Adeoye et al., 2020; Okwuokenye, 2020; Kruijssen et al., 2021). In Bangladesh, women own fish farms when they have capital and laborers (Choudhury et al., 2017; Kruijssen et al., 2021), as do women in Nigeria, when they have capital and technical knowledge (Umunna et al., 2020). Some women indirectly participate in the sector by providing capital to their husbands which in turn gives the opportunity to participate in the decision-making process on fishing equipment purchases (Gustavsson and Riley, 2018; Rohe et al., 2018). Furthermore, in Kenya and Nigeria, men predominate in fish production, input supply, and wholesale fish supply. In contrast, women are mostly involved in roles that yield lesser profits, such as small-scale fish processing (e.g., smoking, sun-drying etc.), fish feeding, and small-scale retail fish sales (Githukia

1 https://a4nh.cgiar.org/2020/01/26/glossary-food-systems

et al., 2020; Adam et al., 2021; Omeje et al., 2021; Subasinghe et al., 2021).

In the aquaculture value chain, men and women frequently work together, although specific tasks tend to be skewed toward one gender. Whereas men typically predominate in farming, women are more likely to be engaged in post-harvest processing (Veliu et al., 2009; Adeoye et al., 2020; Okwuokenye, 2020).

4.2.1.2 Small-scale fisheries

The findings here are sequenced according to CFS-CF (Njuki et al., 2023).

4.2.1.2.1 Production

In Nigeria, women participate across the entire production system including fishing, fish processing, and marketing. Women participate in wholesale trade and financially support male fishers by supplying them with fish inputs like nets, engines, and occasionally boats (Girei et al., 2018; Oloko et al., 2022).

4.2.1.2.2 Processing

Women are strongly represented in fish processing. In Kerala, India, women work largely as home-based fish sellers and wage laborers in the fish drying industry, and as workers in the prawn peeling industry (Harper et al., 2023). In Vietnam, women dominate the seafood processing subsector, accounting for 75 to 80% of the workforce (Veliu et al., 2009). In Nigeria, men are primarily responsible for harvesting fish in the predominantly small-scale fisheries in the country, while women oversee post-harvest tasks such as smoking and descaling (Subasinghe et al., 2021).

4.2.1.2.3 Marketing

Women's involvement in marketing varies considerably. In the Philippines, Indonesia, and Lao PDR, marketing is controlled by women (Satapornvanit et al., 2015; Weeratunge et al., 2016). Women in Myanmar conduct sun-drying, salting and smoking activities, and they produce fish balls and fish paste which they market themselves (Aregu et al., 2017). Conversely, a study on gendered social norms and access to and control over resources in Bangladesh found that less than 2% of fish traders and retailers were women (Kruijssen et al., 2016). In parts of Africa, men are more strongly involved than women in marketing. For example, in Kwanza sub-county (Kenya) and Lake Victoria basin (Uganda), men are broadly responsible for marketing, though women in female-headed households take on this role as well (Rutaisire et al., 2010; Kiumbuku et al., 2013). By way of contrast, in Zanzibar, United Republic of Tanzania, the number of women involved in trading fish has increased exponentially over the past 20 years to the extent that they are now as common as men (Fröcklin et al., 2013; Harper et al., 2023). There can be significant differences in profit margins among women depending on the scale of their business. For instance, in Ghana, while 'fish wives' are small-scale operators, 'fish mammies' are usually rich women who can sell in bulk, having processing equipment and the capacity to hire 'fish wives' and sponsor male fishers' trips (Ameyaw et al., 2020).

Women's income gained through paid work in post-harvest activities increases their purchasing power, financial freedom, confidence, and respect from their spouses, as seen in Bangladesh and Indonesia (Choudhury et al., 2017; Sari et al., 2017). Paid work also strengthens women's human and social capital and, consequently their self-esteem. In Malawi's SSFs, post-harvest activities empowered women as value chain participants, and instilled hope and confidence among women that they could improve their supply chain activities for their families (Manyungwa et al., 2019).

4.2.2 Food environment

Food environments at located at the interface of food systems and consumption (FAO, 2016). The food environment encompasses food availability; affordability; promotion, advertising, and information; and quality and safety (Herforth and Ahmed, 2015). It describes the physical, economic, political, and socio-cultural context within which consumers engage with the food system to make their decisions about acquiring, preparing, and consuming food (HLPE (High Level Panel of Experts on Food Security and Nutrition), 2017).

Fish are an important source of micronutrients to counter micronutrient deficiencies, often termed 'hidden hunger'. This refers to a (deficiency in vitamins, minerals, and in some cases essential amino or fatty acids) (Tacon and Metian, 2013). The importance of fish to child and maternal nutrition is widely recognized (Lauritzen and Carlson, 2011; Michaelsen et al., 2011; Sioen et al., 2017).

4.2.2.1 Food availability and accessibility

Food availability refers to the physical availability of food stocks in desired quantities, while accessibility refers to individuals having adequate incomes or means to acquire the food they need for consumption (Gevers et al., 2014; Gebremariam et al., 2017).

Although women tend to obtain lower incomes than men from fish, women are more likely than men to contribute fish to household diets, resulting in important nutritional impacts (Fitriana and Stacey, 2012; Deb et al., 2015). In Nepal, women's groups involved in small-scale aquaculture programs increased their fish production and improved household consumption of fish products (Underwood and Hendrickson, 2014). In some cases, though, gender biases in the distribution of proteins within the household may mean that adult working men, followed by boys and older men, are more likely to consume fish proteins. Adult men are frequently prioritized for fish consumption over adult women due to a belief that men require more nutrients than women because their work is physically more demanding (Jentoft et al., 2017). In Bangladesh, boys are generally prioritized for fish consumption because they are considered the family's future, unlike girls, who usually leave the household after marriage (Deb et al., 2015). Another Bangladeshi study showed that even when women manage household ponds, the improved availability of nutritious fish benefited boys more than girls, with rates of girl stunting remaining higher than that of boys (Aregu et al., 2018a). The outcomes of these inequalities go beyond nutrition alone: inequalities in eating order can put women at a higher risk of food poisoning due to spoiled food consumption (Agarwal, 2018).

4.2.2.2 Food affordability

Food affordability refers to having the means to buy sufficient, safe, and nutritious foods (Capone et al., 2014). As such, the affordability of fish is a key concern. Farmgate sales of aquaculture – particularly when family-run and small-scale – and small-scale fisheries can help households in the community to acquire fish (Rutaisire et al., 2010; Shibru and Flintan, 2010; Aregu et al., 2017; Gibson et al., 2020; Lawless et al., 2020). Women processors and retailers frequently vend fish at a low price because they usually sell

small fish, unlike men who frequently provide bigger fish to bigger markets like restaurants and wholesalers (Longley et al., 2014; Matsue et al., 2014; Farnworth et al., 2015; Kruijssen et al., 2021). In Ghana's Anlo Beach community, where most of the community are classified as poor, fish is a cheap, preferred protein (Mutimukuru-Maravanyika et al., 2017). In Egypt, young women consumers from larger households with children are likelier to purchase and consume smaller tilapia due to their affordability (Murphy et al., 2020).

4.2.2.3 Food quality and safety

Gender norms can be a greater determinant of human health risks than biological differences between women and men (Grace et al., 2016). For instance, women's reproductive role influence fish consumption during their pregnancy. Pregnant women avoid fish in rural Vietnam to reduce the risk of miscarriage and due to local cultural symbolism associated with certain food items (Grace et al., 2016).

In Malawi, improved fish processing technologies have been introduced yet they remain inaccessible to many fishers. Consequently, most fish products processed by both men and women are not subject to quality control (Manyungwa et al., 2019). In Lakes Chilwa and Lake Malawi, poor working conditions for fishers and market participants are a norm. This includes walking in muddy, dirty water and a lack of proper sheds for handling fish (Manyungwa et al., 2019). In India, various health hazards afflict fisheries workers in fish processing plants, mainly related to lack of workplace ergonomics and smoke inhalation (Vipinkumar et al., 2013), while studies in Vietnam and Nigeria also report similar risks in catfish in fish processing plants or areas of work in their homestead (Veliu et al., 2009).

Hygiene measures to strengthen food safety and post-harvest loss reduction strategies also contribute to improved food quality and sales. In Zambia's upper Zambezi catchment, men and women were encouraged to engage in improved fish-processing activities to help reduce unsold fish spoilage because of fish oversupply during the peak fishing season (Cole et al., 2020). In Myanmar, health-centered information and communication programs on the proper handling and preparation of freshwater products (i.e., fish, crabs, shrimp, snails, and frogs) reduced intestinal worm risks, bolstered consumer confidence, and strengthened fish demand within communities (Aregu et al., 2017). Women oyster farmers in Thailand were introduced to new ways of processing oysters safely. This facilitated their sales of oyster (Szuster et al., 2008).

4.3 Gender equality and women's empowerment

The third part of the findings explores the gender equality and women's empowerment box in the CFS-CF (Figure 1). As mentioned above, this is where actions to secure gender-transformative change can actually happen. The box sets out four analytic domains (i) women's agency and decision-making, (ii) access to and control over resources, (iii) gender norms, and (iv) policies and governance.

4.3.1 Women's agency and decision-making

As noted in the introduction, women's roles and contributions to small-scale fisheries and aquaculture have historically been overlooked and undervalued (Harper et al., 2013; Lentisco and Lee, 2015; Alonso-Población and Siar, 2018), though recognition is increasing. It remains the case, though, that women are poorly integrated into governance systems – such as community meetings, cooperative societies, and policy-making bodies. As a consequence, women are often weakly represented as participants and leaders in such forums (Kruijssen et al., 2018; Cole et al., 2020). For instance, in many countries' fisheries governance bodies do not include women harvesting seafood. This is because they are not considered 'fishers' due to the species they harvest (e.g., mussels, seaweed, snails) or the fishing methods they use (e.g., gleaning). Leaving women out means it is difficult for them to comply with fishing regulations, to properly understand the rationale behind them, and indeed to provide evidence of their own needs (Diei-Ouadi et al., 2015; Short et al., 2020).

In Malawi, studies by Manyungwa et al. (2019) and FISH (CGIAR Research Program on Aquatic Agricultural Systems) (2015) found that women's participation in decision making committees on fisheries resource management is minimal since men often hold most of the leadership positions due to normative power relations that privilege men's voice, and the underlying cultural attitude that fishing is a "*macho*" activity for men. Given their general lack of participation, or lowly positions that women hold in such committees, they do not have much influence on decisions made by beach village committees (BVCs) (Manyungwa et al., 2019). This finding is echoed by Biswas (2017), who finds that women's low-level positions in formal governance structures often make it difficult for them to influence key decisions affecting their environment and livelihoods. Another reason for women's exclusion can be their weak access to, and control over, key fisheries resources. This in turn restricts their voice because they are not considered fisheries players without these resources. In Homabay County, Kenya, for instance, women do not own such resources and therefore men dominate decision-making processes around how to manage fisheries resources (Abwao and Awuor, 2019).

However, in some location's women have secured participation in decision-making spaces through strengthening their skills and knowledge about aquaculture and small-scale fisheries. In Bangladesh, including women in farmer field schools around aquaculture production in household ponds strongly improved their decision-making power (Farnworth et al., 2016; Colga et al., 2019). In other cases, women workers in fishing industries engage in collective action and mobilization through their participation in social networks, unions, cooperatives, and self-help groups to improve working conditions, advocate for their rights, and increase their participation in decision making (Sogbesan et al., 2016; Alonso-Población and Siar, 2018; Gallardo-Fernández and Saunders, 2018). For instance, a study in Ghana identified the importance of the formation of social networks among women involved in post-harvest fishing activities to increase their access to financing opportunities and improve governance schemes (Appiah et al., 2020). In Mexico, women's participation in small-scale fisheries organizations was found to be closely linked to an increase in gender equality and the improvement of leadership capacities of other women in the sector (Torre et al., 2019).

Although women can be penalized by their families and communities for their participation, many women gain confidence, leadership, and public speaking skills by engaging in these initiatives (Veuthey and Gerber, 2012; Nunan and Cepić, 2020).

In some cases, men accept the presence of women in decision-making committees provided women participants are fewer than men.

This is the case in fishing communities around Lake Victoria (Kenya and Tanzania) (Nunan and Cepić, 2020). Around Lake Malawi, Beach Village Committees have traditionally been dominated by male fishers. Efforts to broaden representation of actors across the value chain has helped to improve the representation of women, who dominate fish processing and trading. Their participation is helping to improve discussion around the adoption of fisheries regulations, licensing and record keeping of fishing gear and boats, and management of their beach and fishing area (Hara and Njaya, 2016).

4.3.2 Access to and control over resources

Access to and control over resources are intimately connected with the ability of women to exercise their agency and to participate effectively in aquaculture and small-scale fisheries (TNC, 2020; Elias et al., 2023).

Studies show significant gender discrepancies in the ownership and access to assets and resources (Olufayo, 2012; Johnson et al., 2016; Kruijssen et al., 2018).

Women require access to fishing grounds and aquaculture ponds. Yet they may encounter barriers due to socio-cultural matters that restrict their mobility, thereby limiting their involvement in fishing activities (Bradford and Katikiro, 2019). In some cases, access to fishing and aquaculture zones are controlled by male-dominated community structures or commercial interests, resulting in women's exclusion (McClenachan and Moulton, 2022). This in turn closes an income-generation opportunity for women and thereby can reduce their household's well-being as well as reducing women's overall resilience to the wider drivers of change discussed above (Sadiq et al., 2020).

Women in aquaculture and small-scale fisheries often face difficulties in obtaining credit to invest in their businesses (Lentisco and Lee, 2015). Financial institutions generally favor men because they view women as higher-risk borrowers. Women's limited control over property and land ownership can hinder their access to collateral and thus to sources of credit (Nabayunga et al., 2021).

Access to, and control over, boats, fishing gears, and processing facilities, is a core challenge for women (Mutia et al., 2020). In many cases, these assets are controlled by men or held collectively by fishing communities, with limited opportunities for women to own or manage them (Torell et al., 2021). For instance, in the Homabay region of Kenya most boat owners are men (FAO, IFAD, WFP, CGIAR Gender Impact Platform, 2023). Women's lack of access and control hampers their ability to obtain sufficient product, negotiate fair prices for their products, and generally limits their ability to secure a larger share of the value chain benefits.

Finally, women have weaker access to training and extension services they need to build their technical knowledge and skills – such as in fish culture, hatchery management, and marketing (Salazar et al., 2023). Apart from their general invisibility in the sector, gender norms may directly hamper women from engaging with male extension personnel. Gender biases in the Ministries of Fisheries and Aquaculture frequently contribute to a shortage of female extension personnel (Veliu et al., 2009; Quisumbing and Pandolfelli, 2010).

4.3.3 Gender norms

Gender norms are systemic and pervasive. They frequently frame women's contributions to aquaculture and small-scale fisheries as part of their domestic responsibilities rather than as professional, income generation tasks (Gopal et al., 2014; Kruijssen et al., 2016; Legros and Cislaghi, 2020; Jayachandran, 2021). Women's invisibilization may be reinforced by gender norms which privilege male-dominated decision-making at the household as well as community level (Cornwall, 2003; Dyer, 2018). Therefore, women are often denied a chance to voice their gender needs and ideas, and to talk about their concerns, and potential ways forward. This in turn not only reduces their potential benefits from their participation in aquatic food systems, but it can also limit their adaptive capacity.

Socio-cultural and religious norms can differ between communities in the same geographic space. Divergent norms regarding the roles and responsibilities of women in Hindu and Muslim communities of Bangladesh had an impact on their participation in the aquaculture value chain (Kruijssen et al., 2016). In Melanesia, harmful gender norms increase the likelihood that women, youth, and other economically disadvantaged groups in small-scale fisheries are disregarded in community discussions, and when incentives like funding, training, and employment opportunities are provided (Mangubhai and Lawless, 2022).

4.3.4 Policies and governance

Gender equality policies and governance are crucial in promoting equitable and inclusive development in aquatic food systems (Mangubhai and Lawless, 2022). However, several challenges exist in implementing and ensuring the effectiveness of these policies. One challenge is the lack of gender-responsive policies and regulatory frameworks (Adam et al., 2021). Gender considerations are often overlooked or insufficiently integrated into fisheries and aquaculture policies, plans, and regulations. This contributes to gender-blind approaches that fail to address the specific needs, roles, and challenges faced by women (Bradford and Katikiro, 2019). Gender-blind policies hinder women's access to resources, decision making power, and economic opportunities, perpetuating gender inequalities (Adam et al., 2022).

4.4 Aquatic food system outcomes

As noted above, this section does not focus on gendered aquatic food system outcomes *per se* because it is difficult to draw robust conclusions from the heterogeneric, often small-scale studies reviewed for this article. Rather, this section examines and highlights initiatives that appear to have strengthened gender equality and women's empowerment in key domains. These are (i) dietary outcomes, (ii) gender equality and women's empowerment, (iii) economic and livelihoods outcomes and (iv) environmental outcomes.

4.4.1 Dietary outcomes

4.4.1.1 Interventions to improve women's fish consumption

Several nutrition intervention projects are improving women's consumption of fish in LMIC. A project which deployed gender transformative approaches alongside technical and nutrition training in Bangladesh resulted in powerful improvements to gender equity in food distribution. A woman participant reported: "*Usually, we do not have much on our plates. In the past, men did not notice this. They were happy as long as they got a big piece. Now, following this exercise, men check what we are eating. They acknowledge that we work hard all day*

and make sacrifices and should eat equally." (Farnworth et al., 2015). A different project in Bangladesh noted that large tilapia and other big fish such as carp are typically sold, or consumed, by men. To challenge this, a project promoting the rearing of highly nutritious, small indigenous fish (mola) facilitated women in these households to create a positive nutritional impact for their families. As with the first project mentioned, activities to ensure male and community buy in accompanied technical and nutrition training (Fiedler et al., 2016). In Peru, efforts have been undertaken to raise the awareness of anchoveta as a nutritious food including a national initiative called A Comer Pescado (Eat Fish), encouraging the consumption of anchoveta by offering subsidies for school meals and producing high-quality canned anchoveta (Bavinck et al., 2023).

In Myanmar, improvements in child health were observed after six months when new consumption practices were incorporated into the household diet (i.e., advice to consume whole fish with head-on and gutted) (Aregu et al., 2017). Gender-informed nutrition and agriculture (GINA) programs in Mozambique, Nigeria and Uganda reduced the number of underweight children and increased availability, knowledge, and consumption of nutritious foods (Underwood and Hendrickson, 2014). GINA's other benefits included improvement in women's status in their communities through transforming gender roles in agricultural production and processing and increasing women's power in financial decision making. In Zambia and Vietnam integrated fishponds – crop system projects led to increased household income and a decrease in malnutrition. The project was accompanied by trained health advocates who counteracted male-dominated decision-making over purchasing decisions (Underwood and Hendrickson, 2014). In Malawi, the improved participation of women in small-scale fisheries contributed to improved household nutrition as a greater proportion of the incomes being spent on buying food for the household (Manyungwa et al., 2019).

4.4.2 Gender equality and women's empowerment outcomes

In Bangladesh women with shaded household ponds (which are challenging to work with) were trained in groups to become citizen scientists alongside technical training. They learned about different fish species and how they interact with each other, stocking densities, feed, pond management and other skills. Women then decided upon their management strategies for their individual ponds, and shared lessons and challenges regularly in group meetings (Farnworth et al., 2015). In Myanmar, the inclusion of poor young women in sustainable small-scale aquaculture interventions addressed their need for more cheap, nutritious food. The project promoted an integrated polyculture system where non-traditional fish species with high nutritional value were incorporated into their ponds. Training on stock management was provided together with integrated vegetable farming on the bunds. This strengthened household food availability and reduced seasonal food insecurity by providing year–round access to fish and vegetables (Aregu et al., 2017).

In Zambia, training programs to teach women together with men in technologies to reduce post-harvest losses was accompanied by gender-transformative approaches to address harmful masculinities in the fish value chain. The project worked with men and women fishers, processors, and traders using participatory action research methods – drama skits to provoke discussion around gender norms and their effects. Baseline research was conducted with participants to explore gender differences in their involvement in value chain activities, asset ownership, income generation, and attitudes about gender roles and responsibilities in the value chain. This information to develop and test improved fish processing technologies as well as significant attitudinal and behavioral changes and contributed to important women's empowerment outcomes (Kaminski and Cole, 2017; Cole et al., 2020). In Melanesia, some organizations partner with men and boys to tackle detrimental gender stereotypes and foster gender transformative approaches in aquatic food systems (Mangubhai and Lawless, 2022).

In the Caribbean, the Gender in Fisheries Team (GIFT), a group of individuals interested in gender issues in Caribbean small-scale fisheries – including officers from governmental agencies, scientists, and fisher group leaders – aim to integrate gender perspectives into national and regional fisheries policies (Chuenpagdee and Jentoft, 2019).

Interventions to strengthen women's collective action are important. Women frequently form networks, associations, and cooperatives to collectively address challenges and pursue common goals (Alonso-Población and Siar, 2018). These collective actions have proven effective in enhancing women's bargaining power, improving access to resources and markets, and fostering social solidarity. Through collective action, women have been able to challenge gender norms, advocate for their rights, and promote gender-responsive policies and practices in aquatic food systems (Torre et al., 2019).

Gender inequalities in value chains can be redressed through partnerships and collaborations. Action research in Egypt found that horizontal integration among poor, illiterate women retailers is effective in bolstering their bargaining power (Kruijssen et al., 2018). Women and men in Malawi are increasingly using new Information Communication Technologies (ICTs) such as mobile phones to negotiate prices with potential buyers located in markets far away, to order fishing equipment from suppliers, and to develop a stronger understanding of how to manage supply and demand (Haambiya et al., 2020).

4.4.3 Economic and livelihood outcomes

Aquaculture expansion is anticipated to drive the creation of approximately 76 million new jobs worldwide between 2010 and 2050 (Waite et al., 2014; FISH (CGIAR Research Program on Fish Agri-Food Systems), 2017). However, this growth trajectory should prioritize socio-environmental sustainability. Fisheries should strive for equitable resource distribution among vulnerable populations while advocating for sustainable practices that safeguard marine biodiversity (Cole et al., 2014; Mutimukuru-Maravanyika et al., 2017; GAF, 2019). Avadí et al. (2022) conducted a study revealing the positive economic impact of the aquaculture value chain in Zambia. Notably, large-scale cage producers were found to contribute significantly to direct value added (67%) and the creation of salaried positions (constituting 70% of total wages) in the country. Economic growth and jobs depend on the large players, and the larger-scale commercial sector can continue to grow and generate economic benefits for the country. In Korea, the aquaculture sector has larger employment-inducing effects than the capture fisheries (Lee and Yoo, 2014).

Men benefit more than women in access and perceived value of fish when harvesting aquatic foods implying a gender gap in opportunities and benefits within the fishing industry (Rajaratnam et al., 2015). Furthermore, men tend to alter their primary occupation

to diversify their income sources while relying on women's livelihood strategies when fish catches decrease (Mozumder et al., 2018). Women's income gained through paid work in post-harvest activities increases their purchasing power, financial freedom, confidence, and respect from their spouses, as seen in Bangladesh and Indonesia (Choudhury et al., 2017; Sari et al., 2017). Paid work also strengthens women's human and social capital and, consequently their self-esteem. In Malawi's SSFs, post-harvest activities empowered women as value chain participants, and instilled hope and confidence among women that they could improve their supply chain activities for their families (Manyungwa et al., 2019).

4.4.4 Environmental outcomes

Aquatic food system growth needs to be socially and environmentally sound. Fisheries should be able to provide equal access to resources among vulnerable groups while promoting sustainable practices that protect marine biodiversity (Cole et al., 2014; Mutimukuru-Maravanyika et al., 2017; GAF, 2019).

Co-management schemes in marine protected areas aim to create buy-in from local communities to enforce and regulate coastal and marine resources while generating a positive perception of the marine protected areas are important for protecting fish stocks (Kleiber et al., 2018). To improve the gender-responsiveness of their environmental work, the Danajon Bank [2](key to the management of marine protected areas) in the Central Philippines involved men and women from local communities as part of a national strategy to conserve coastal and marine resources. However, despite some achievements, women were less likely to actively participate in meetings (Kleiber et al., 2018).

At a global level women leader have been instrumental in initiating and implementing projects focused on environmental conservation. Women were actively involved in Mexico's long-standing efforts to prepare for the Rio Earth Summit through the Cancun Conference and Declaration, which resulted in the FAO Code of Responsible Fisheries, alongside other international initiatives. Women attained ministerial positions during this time (Williams et al., 2005).

5 Discussion

This article is the outcome of a comprehensive literature review focused around three research questions:

1 How do gendered shocks and vulnerabilities in aquatic food systems impact gender equality and empowerment?
2 How do gender dynamics and relations within agrifood system components affect gender empowerment?
3 How do cross-cutting gender issues and outcomes in agrifood systems influence gender inequality and empowerment?

To answer these questions, the article adapted a conceptual framework developed by Njuki et al. (2023) which provided a useful structure within which findings could be placed and analyzed. The Discussion briefly highlights key learning points before making recommendations.

The overall learning point is that women are active across aquatic food systems yet experience low visibility and weak support. A persistent problem is that the sector is viewed as fundamentally male. This mindset makes it difficult to see what women are already doing, and what they could do. Ambitious ideas and ambitious partners are needed to empower women: to strengthen legislation, to improve women's access to resources, to develop developing new institutional arrangements, to build on empirical lessons from research, and to develop capacity at all levels to understand and address gender equality and women's empowerment. This will include creating a cadre of women professionals to take gender equality and business development forward. Socio-cultural and gender norms form a major barrier. Adopting innovative gender-transformative methodologies including household methodologies such as GALS (Gender Action Learning System) and working with men's organisations for women's empowerment like MenEngage is critical.

We now highlight selected recommendations, knowing that many more could be made. They are structured around the four concepts highlighted in the gender equality and women's empowerment box in the CFS-CF.

5.1 Strengthen women's agency and bargaining power

5.1.1 Recommendation 1: empower women as individuals and collectively, at all levels, and in different roles

Gender-transformative change requires building individual and collective agency. At the individual level, it is about strengthening people's critical awareness and dignity (power within) and their capabilities and aspirations (power to). Transformation requires that these grow together into cooperative forms of action (power with) to challenge and transform harmful gender norms, unequal power relations, and discriminatory structures (Hillenbrand et al., 2015; Alonso-Población and Siar, 2018). These activities need to be backed up with investments in women's capacity at all levels in aquatic food systems. Otherwise, power relations will not change in any meaningful way. Specific recommendations include:

- Making national investments in primary and secondary education to prepare girls to take STEM (science, technology, engineering, maths) subjects. This is the foundation for a long-term change in women's capacity and their ability to take on a variety of roles in aquatic food systems, whether directly (for example as traders) or indirectly as facilitators (for example in capacity development)
- Strengthen girls' access to vocational colleges. Encourage the private sector (e.g., aquaculture farms) to become involved in curriculum development, teaching, mentorship and to offer internships to fisheries and aquaculture students. As part of this, encourage colleges to develop ambitious quotas for women students, together with requisite support packages (financial, personal).

2 The *Danajon Bank* is the only double barrier reef in the Philippines, which is a very rare geological formation, which is located in the Camotes Sea. Found off the northern coast of Bohol Island, central Philippines, Danajon expands over an area of 272km^2. It comprises two sets of large coral reefs that formed offshore on a submarine ridge due to a combination of favorable tidal currents and coral growth in the area.

- Involve formal sector banks and other financial providers in curriculum development, teaching, mentorship and offering internships to students (including ambitious quotas specifically for women).
- Broaden training curriculum to appeal to women students and to enable them to take professional onshore occupations associated with aquatic food systems (e.g., book-keeping, business planning, transferable skills), as well as in public sector administration of fisheries.

To strengthen women's capacity through other mechanisms:

- Develop and federate women's fisheries groups.
- Facilitate group networking nationally and internationally (in Africa, for example, through joining the African Women Fish Processors and Traders Network).

5.2 Create gender equitable norms

5.2.1 Recommendation 2: use gender-responsive and gender-transformative approaches to create gender-equitable norms

The literature review shows that business as usual is failing women. Simply introducing new technologies, or creating gender-equitable guidelines, will not lead to change. Gender-transformative approaches are an important way forward. They work with men and women to develop gender-equitable norms (Farnworth et al., 2018; FAO, IFAD, WFP, CGIAR Gender Impact Platform, 2023; Rietveld et al., 2023). Gender-transformative approaches are best introduced in combination with innovation bundles (e.g., new fish species, improved feed, solar tent driers, fish salting, and fuel-efficient smoking). It is important that participants see associations between improved gender equity in their communities and homes, and improved technical outcomes (Cole et al., 2020; OECD, 2021).

5.3 Strengthen women's access to, and control over, aquatic food system resources

We focus on recommendations for strengthening women's access to finance because this is one of the most important resource constraints.

5.3.1 Recommendation 3: improve women's access to finance

- Development partners and relevant government ministries should partner with international women's banking experts to develop a comprehensive analysis of the key sources of gender bias in fiscal instruments in fisheries, and measures to mitigate them.
- Build on the existing experience of development partners on training women entrepreneurs on financial and business management skills, identifying and retaining customer's and customizing products for women entrepreneurs.
- Learn from financial institutions (for example, Kenya Women's Finance Trust, Finance Trust Bank Uganda among many others) on how to develop banking products suited to low, middle, and higher-income women.
- Engage with effective, gender-responsive business development providers to target and support businesswomen to develop good business plans and improve their financial literacy, including digital literacy.
- Develop innovative ways to support women entrepreneurs at all levels through removing the need for collateral. These might include: (i) Redirect a percentage of revenues obtained from fisheries to support funds for women, (ii) work with fisheries companies to provide loans in kind to businesswomen (the machinery – such as refrigerators – is the collateral) which are repaid over an agreed time-frame, and (iii) co-finance women's equipment with businesswomen paying an agreed percentage.

5.4 Develop gender-responsive policies and governance

5.4.1 Recommendation 4: engender fisheries policies and strategies

- Create a gender-responsive institutional environments at Ministries of Fisheries and their partners through preparing (or rigorously updating) a Gender Equality Policy. This should be a short document which sets out the Ministry's ambition for its work on gender, how it will promote gender-responsive work with partners, and how it will support and promote its staff professionally and to help them develop gender skills. Institutional agreement on these issues underpins all other work on gender.
- Prepare or update a Gender Mainstreaming Strategy for Fisheries and Aquaculture and ensure it is generously funded.
- Update Fisheries Master Plans using the latest research data on gender and develop ambitious, creative strategies to involve women in all aspects (including business women).
- Pro-actively engage businesswomen to invest in aquatic food systems, for example through alerting them to new opportunities such as ecotourism, producing fish food, creating new fish-based products, ocean aquaculture, training, and scientific research. As part of this, quotas could be developed accompanied by capacity development and funding packages developed with partners.

5.4.2 Recommendation 5: build capacity in government and among development partners to implement gender-responsive policies and strategies

Work needs to continue strengthening institutional capacities and promoting gender-sensitive data collection and analysis to inform evidence-based policymaking (Golo and Erinosho, 2023).

- Start by making businesswomen visible. Women are strongly involved in fisheries and aquaculture as collaborating spouses, boat owners, traders, fishers (including in the intertidal zone), processors, in aquaculture, and in the aquatic food system more broadly. Commission country studies on how regulations affect women in the sector, and how regulations could be improved.

- Work with governments to domesticate (sign and ratify) key legislation aiming to improve gender equality and women's empowerment in aquatic food systems.
- Partner with key civil society actors to develop gender-responsive, and gender-relevant legislation. Partners could include women's lawyer organizations, women's federations, and others, both within the country as well as regionally and internationally. Dialog with global actors with experience in promoting women in other male-dominated occupations (such as tanneries) to build on their lessons rather than reinventing the wheel.
- Develop communication materials using gender-neutral / women- positive language and use images showing women as active in small-fisheries and aquaculture.
- A special government advisory board for women's business development services could be constituted with a range of partners as members.

6 Conclusion

This article, drawing upon 202 papers, demonstrates that aquatic food systems are characterized by systemic disparities in gender. Harmful gender and socio-cultural norms impede the ability of women to secure benefits for themselves and their families from their participation in aquatic food systems. Structural gender inequalities are shaped by biophysical and environmental, technology and infrastructure, political and economic, socio-cultural, and demographic drivers. We show that the discrimination women face in aquatic food systems has its structural roots in weak women's agency, access to and control over resources, gendered social norms, and policy and governance. Finally, we show that it is through tackling these structural roots, through being innovative and daring to do things differently, that gender equality and women's empowerment can be achieved.

While this article provides a summary of the current state of gender disparities within aquatic food systems, future research could use longitudinal studies tracking changes over time and intersectional approaches to contribute to more inclusive, contextually grounded, and impactful efforts to promote gender equality and empower women in aquatic food systems.

Author contributions

RA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. RL: Conceptualization, Data curation, Formal analysis, Validation, Writing – original draft. DL: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. CM: Conceptualization, Funding acquisition, Writing – review & editing. SR: Methodology, Project administration, Writing – review & editing. KO: Formal analysis, Writing – review & editing. CP: Formal analysis, Writing – review & editing. LF: Formal analysis, Writing – review & editing. CR: Funding acquisition, Project administration, Resources, Supervision, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was carried out under the FISH. This is the acronym for the CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish in partnership with the International Water Management Institute, Wageningen University & Research, James Cook University, and the University of Greenwich. The program is supported by contributors to the CGIAR Trust Fund.

Acknowledgments

We thank Dr. Cathy Farnworth for providing us with guidance on how to improve the paper, contributing to the paper revisions and her editorial support. We thank the One CGIAR research initiatives Resilient Aquatic Food Systems for Healthy People and Planet (RAqFS) for providing us with the platform to conduct the research presented. Lastly, this work was also carried out under the CGIAR GENDER Impact Platform, which is grateful for the support of CGIAR Trust Fund contributors: www.cgiar.org/funders.

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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2024.1327798/full#supplementary-material

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