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Gender Roles In Aquaculture Development: Prospects and Challenges

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Abstract
Aquaculture has become an essential industry for ensuring global food security, fostering economic growth, and supporting livelihoods, especially in coastal and rural areas. Although there is a growing acknowledgment of gender as a crucial factor in sustainable development, the roles of men and women in aquaculture are still significantly shaped by socio-cultural norms and institutional biases. This article investigates the diverse roles that both genders fulfil in aquaculture, highlighting their contributions as well as the gender-specific challenges they encounter. While women frequently participate in pre- and post-harvest tasks, their involvement in decision-making processes, ownership rights, and access to resources is often restricted. The paper points out considerable opportunities for advancing gender equity through inclusive policy development, capacity-building initiatives, and the adoption of gender-sensitive technologies. Nonetheless, it also underscores persistent obstacles such as patriarchal systems, restricted access to financial resources and land, and insufficient representation in governance structures. Tackling these challenges is essential for realizing the full potential of aquaculture as a catalyst for equitable and sustainable development. The article concludes with strategic recommendations aimed at closing gender gaps and promoting women's empowerment within aquaculture systems.

Key Words: *Aquaculture, Gender gaps , Decision-making, Sustainable development, Gender equity, Women empowerment.*

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I. Introduction

Aquaculture is the fastest growing agricultural sector globally, addressing food security and income needs for poor households. In Kerala, it is a key option for employment and sustainability, contributing 11.47% to the Gross State Value Added (GSVA) (Economic Review 2024). Beyond its GDP and employment impact, aquaculture drives growth in subsidiary industries and provides low-cost, nutritious food while generating foreign exchange. The sector is crucial for enhancing total fisheries production in the state, offering food and nutrition security to households and essential micronutrients for women and children. However, gender-related challenges persist in aquaculture. Like other industries, it faces gender-based inequalities and discrimination. The United Nations Development Program notes that without tackling biased gender norms, achieving gender equality and sustainable development goals will remain elusive (UNDP, 2024). Likewise, addressing these gender issues in aquaculture is vital for fostering sustainable and inclusive development within the sector.

This article examines the gender-specific aspects of aquaculture, focusing on the opportunities and challenges faced by different gender groups, as well as the social norms and institutional barriers that limit women's participation and benefits in the value chain. It also highlights potential for gender-inclusive development through policy changes, skill enhancement, and innovations aimed at empowerment and equity.

II. Indian Fisheries and Aquaculture Sector – An Overview

India ranks as the third largest fish producer globally, contributing 7.96% to total fish production. In the fiscal year 2022-23, fish production is estimated at 16.25 million metric tons (MMT), with inland and marine sectors contributing 12.12 MMT and 4.13 MMT, respectively. The Fisheries sector has maintained a 7% annual growth rate over the past five years, contributing Rs. 1,37,716 Crores to the Gross Value Added (GVA) for 2022-2023, which is about 1.09% of national GVA and 6.72% of agricultural GVA. India is the second largest contributor to global fish production after China, with inland fish production making up 75% of its output, rising from 5.66 MMT in 2000-01 to 16.25 MMT by 2021-22. The shift from traditional fishing to commercial aquaculture has increased production and created jobs for around 16 million people. The fisher population exceeds 28 million, with over 12 million women, who represent nearly 90% of the aquaculture value chain in India ((Kruijssen, McDougall & van Asseldonk, 2018).

The Fishery and Aquaculture Country Profile- India 2023 reports that total employment rose from 8.15 million in 1995 to 14.14 million in 2020, marking a 73.5% increase over 25 years. The growth in India's fisheries sector is largely driven by aquaculture expansion. Although capture fisheries still provide more jobs, particularly in inland areas, the industry has diversified. The increase in subsistence fishing may indicate economic changes in rural communities, and the inconsistencies in data highlight the need for better monitoring.

Table 1 – Indian Fisheries Employment Statistics

		1995	2000	2005	2010	2013	2020
EMPLOYMENT (thousands)		8,150	8,650	12,196	13,822	12,707	14,140
Aquaculture		1,400	1,900	2,723	4,190	4,284	5,716
Capture		6,615 E	6,615 E	9,467	9,439	8,168	8,168 E
	Inland	5,181 E	5,181 E	8,492	7,775	6,255	6,255 E
	Marine	1,366 E	1,366 E	858 E	1,569	1,658	1,658 E
	Subsistence	68 E	68 E	116	95	255	255 E
	Unspecified	135 E	135 E	7	193	256	256 E

Source : FAO (Fishery and Aquaculture Country Profile- India 2023)

India's fisheries sector has grown significantly, with aquaculture jobs rising from 1,400 in 1995 to 5,716 in 2020, indicating a shift towards fish farming. In contrast, capture fisheries employment peaked at 9,467 in 2005 but fell to 8,168 by 2020, showing inconsistent trends despite still employing more people than aquaculture. Inland capture jobs reached 8,492 in 2005 but dropped to 6,255 by 2020, while marine capture employment increased from 858 in 2005 to 1,658 by 2020. Additionally, subsistence fishing rose from 68,000 in 1995 to 255,000 in 2020, highlighting a growing reliance on small-scale fishing due to economic pressures. The unspecified category shows fluctuating numbers, indicating a need for better data tracking. Overall, aquaculture drives growth in India's fisheries sector, but capture fisheries remain important, and the rise in subsistence fishing reflects economic changes in rural areas.

Table 2 . Marine Fishing Population in India: An Overview

a) Top Contributing States (by Number of Families)

State	Number of Families	Percentage of Total
Tamil Nadu	201,8545	22.6%
Andhra Pradesh	155,062	17.4%
Kerala	121,637	13.6%

b) State-wise Distribution

State	Percentage of Total
Tamil Nadu	21.1%
Kerala	14.9%
Odisha	13.7%
Andhra Pradesh	13.7%

c) Gender Composition (Overall Marine Fishing Population)

Gender	Number	Percentage
Males	19,520,068	51.7%
Females	18,225,509	48.3%

Source: Marine Fisheries Census 2016

In India, 893,258 families are engaged in marine fishing, primarily in maritime states and Union Territories. Tamil Nadu leads with 201,855 families (22.6%), followed by Andhra Pradesh with 155,062 (17.4%) and Kerala with 121,637 (13.6%). About 91.6% of these families are traditional fishermen. The total number of marine fishermen in India is 3,774,577, with 21.1% in Tamil Nadu, 14.9% in Kerala, and 13.7% each in Odisha and Andhra Pradesh. This group includes 19,520,068 males (51.7%) and 18,225,509 females (48.3%). There are 927,081 active fishermen in the marine fisheries sector, with 748,479 working full-time and 153,968 part-time, plus 24,634 involved in fish seed collection.

Table 3. Gender-wise participation in fisheries activities in Kerala

Activity	% Fisherwomen	% Fishermen	Dominant Gender
Fish Seed Collection	58%	42%	Fisherwomen
Marketing of Fish	86%	14%	Fisherwomen
Making/Repairing Net	52%	48%	Balanced
Curing/Processing	90%	10%	Fisherwomen
Peeling	95%	5%	Fisherwomen
Labourer	54%	46%	Fisherwomen
Others	57%	43%	Fisherwomen

Source : Marine Fisheries Census 2016

The percentage distribution of fisherwomen and men engaged in various fisheries-related activities in Kerala (table 3) highlights the significant role women play in this sector, especially in certain critical processing and marketing functions. Women dominate activities such as peeling (95%), curing/processing (90%), and marketing of fish (86%). These roles are often labour-intensive and critical for export readiness. Fish seed collection and general labour work also show higher female participation, at 58% and 54% respectively. Net making/repairing is nearly equally shared, suggesting a collaborative effort in this technical task. The 'Others' category, potentially including ancillary roles, also sees more women (57%).

Table 4 State-wise Details of Fishermen Families Engaged in Aquaculture

State	Type of Aquaculture						Acquired Training
	Fish	Prawn	Crab	Mussel	Others	Total	
West Bengal	761	406	65	0	17	1,249	845
Odisha	1,369	1,383	13	1	84	2,850	663
Andhra Pradesh	365	2,151	460	1	26	3,003	287
Tamil Nadu	47	9	1	0	168	225	553
Puducherry	6	1	1	0	0	8	221
Kerala	129	46	11	29	14	229	52
Karnataka	19	45	0	2	4	70	441
Goa	9	0	13	0	34	56	1
Maharashtra	699	223	296	24	39	1,281	215
Gujarat	89	351	13	0	57	510	1,092
Daman & Diu	0	1	0	0	0	1	44
Lakshadweep	0	0	0	0	8	8	8
Andaman & Nicobar	137	0	3	0	2	142	14
Total	3,638	4,616	876	59	443	9,632	4,428

Source : Marine Fisheries Census 2016 India, CMFRI

A total of 9,632 fishing families are involved in aquaculture, with 4,428 trained. Most (4,616) focus on prawn farming, followed by 3,638 in fish farming, 876 in crab farming, and 443 in other aquaculture types. Mussel culture is rare, with only 59 families participating. Andhra Pradesh leads with 3,003 families, mainly in prawn culture (2,151). Odisha follows with 2,850 families, then Maharashtra (1,281) and West Bengal (1,249). Lakshadweep and Daman & Diu have minimal participants (8 and 1, respectively). Kerala has diverse activities: fish (129), prawn (46), crab (29), mussel (4), and others (34). Prawn farming is strong in Andhra Pradesh and Odisha, while fish farming is more common, and mussel farming is mainly in Kerala. Training programs are effectively implemented in states with high aquaculture activity, like Andhra Pradesh and Odisha.

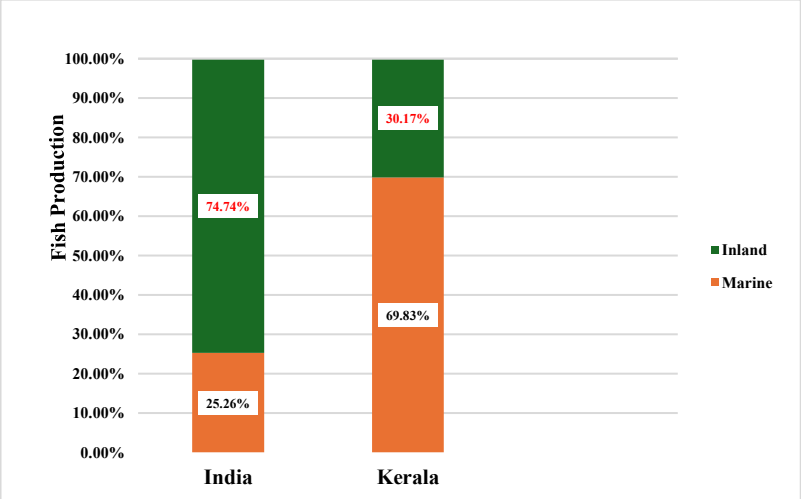
Table 5. Inland and Marine Fishery Resources

Inland Resource Type	Extent
Area under Reservoirs	3.15 million ha
Area under Ponds & Tanks	2.45 million ha
Area under Brackish Water	1.24 million ha
Flood Plain Lakes	1.2 million ha
Length of Rivers & Canals	0.28 million km
Marine Resource Type	**Extent**
Length of Coast Line	8,118 Km
Exclusive Economic Zone	2.02 Million Sq. Km
Continental Shelf	0.53 Million Sq. Km
Number of Noticed Fish Landing Centers	1457
Number of Fishing Villages	3461

Source: Annual Report 2022-23, Department of Fisheries

India's diverse inland and marine fishery resources present opportunities for sustainable fisheries and effective water management. Currently, inland fisheries account for 75% of the nation's total fish production. Despite growth in absolute terms, their potential remains underutilized. The extensive inland resources include 0.28 million km of rivers and canals, 1.2 million hectares of floodplain lakes, 2.45 million hectares of ponds and tanks, and 3.15 million hectares of reservoirs.

Fig. 1 Fish Production in India and Kerala – Share of Marine and Inland Fishing during 2023



Source : Economic Review 2024

The Economic Review (2024) data compares marine and inland fishing contributions to fish production in India and Kerala during 2023 . In India, inland fishing accounts for about 74.74% of total production, while marine fishing is 25.26%. In Kerala, marine fishing dominates at 69.83%, well above the national average, with inland fishing contributing only 30.17%. Therefore, Kerala relies more on marine fishing, whereas inland fishing is more significant in India's overall production.

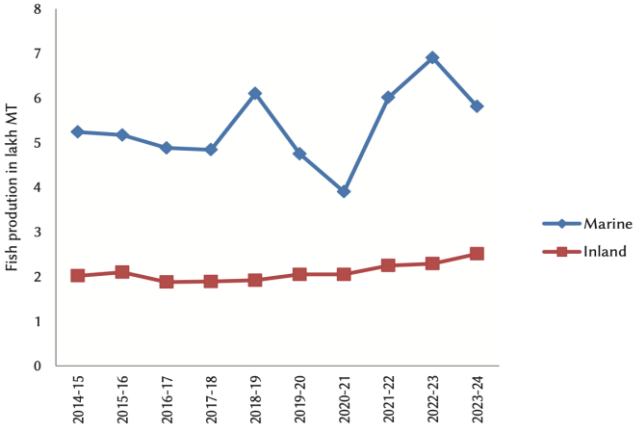
Table 6. Marine, Inland, and Total Fish Production (in Million Metric Tonnes)

Year	Marine (MMT)	Inland (MMT)	Total (MMT)
2010-11	30	52.31	82.31
2011-12	32	54.66	86.66
2012-13	33	57.4	90.4
2013-14	34	61.79	95.79
2014-15	35	67.6	102.6
2015-16	36	71.62	107.62
2016-17	37	77.31	114.31
2017-18	38	89.04	127.04
2018-19	39	96.73	135.73
2019-20	40	101.64	141.64
2020-21	41	106.25	147.25
2021-22	42	120.48	162.48

Source: Annual Report 2022-23, Department of Fisheries

Over the past 25 years, Inland Fisheries have shifted from capture fisheries to aquaculture. India's fish production rose from 82.31 million metric tons in 2010-11 to 162.48 million metric tons in 2021-22, effectively doubling. Inland fishing consistently outproduces marine fishing, with inland production increasing from about 49 million tones in 2010-11 to over 110 million tones by 2021-22. In contrast, marine fishing grew from around 33 million tones to about 52 million tons in the same period. Freshwater aquaculture's share of Inland Fisheries rose from 34 percent in the mid-1980s to approximately 76 percent recently.

Fig . 2 Fish Production in Kerala Over the Past Ten Years



Source : Economic Review 2024

In Kerala, inland fish production has steadily increased from just below 2 lakh MT in 2014-15 to over 2 lakh MT by 2023-24. In contrast, marine fish production has been volatile, peaking around 2018-19 before declining sharply, with some recovery in later years. Although marine production has remained above 5 lakh MT for most years, it lacks consistent growth, likely due to external factors like climate and market changes. The steady rise in inland production indicates advancements in aquaculture, aided by favourable policies and improved techniques. Overall, inland fish production shows a stable upward trend due to innovative aquaculture techniques , while marine production is more affected by environmental and market fluctuations. Over the past five years, Kerala's inland fish production has consistently risen, with aquaculture output at 0.38 lakh metric tons in 2022-23 and 0.41 lakh metric tons in 2023-24.

Table 7 Contribution from aquaculture and capture to inland sector in Kerala (in lakh MT)

Year	Aquaculture (lakh MT)	Capture (lakh MT)
2017–18	0.3	2.0
2018–19	0.35	2.05
2019–20	0.4	2.1
2020–21	0.45	2.15
2021–22	0.5	2.2
2022–23	0.55	2.25
2023–24	0.6	2.3

Source : Economic Review 2024

Over the seven years, capture fisheries have consistently outperformed aquaculture in volume, highlighting its dominance in fish production (fig.6). Both sectors have shown steady growth, with aquaculture rising gradually and capture fisheries increasing more sharply, especially towards the end of 2023–24. Peak production for both is in 2023-24, with aquaculture at nearly 0.5 lakh MT and capture fisheries at about 2.2 lakh MT. The growth trend is stable, indicating consistent development in both areas. In summary, from 2017–18 to 2023–24, both aquaculture and capture fisheries show a positive trend, with capture fisheries making up a significantly larger share of total fish production.

The comprehensive overview of fisheries sector shows that to enhance inland fisheries and aquaculture production, initiatives must focus on improving the quality of seeds and feed, managing farmed species, and ensuring quality water supply. It's also essential to explore different fish farming sectors like integrated fish farming, cold water fisheries, riverine fisheries, capture fisheries, and brackish water fisheries. The government is promoting intensive aquaculture in ponds and tanks, integrated fish farming, carp polyculture, freshwater prawn culture, and riverine fisheries development. Additionally, addressing challenges such as responsible aquaculture, disease management, organic farming, and induced breeding is vital for improving sector productivity. Key challenges hindering cultured fisheries include poor water quality, low-input culture systems, limited cultivation diversity, reduced productivity, weak regulations, rising disease rates, low investment, high borrowing costs, inadequate infrastructure, low technology adoption, and a lack of skilled labour in aquaculture.

III. Why Gender Matters in Aquaculture?

Study of gender is a complex notion which reflects the negotiation of power roles and influence between men and women. Because of this complexity, there has been limited attention to gender in aquaculture value chains. Despite the considerable efforts at promoting gender equality and gender mainstreaming within the

organizational structures of policymakers , there are still considerable gaps in our knowledge of gender relations in the fisheries sector and how these are affected by the change (Bennett, 2004). High levels of investment and adoption of new technology makes the sector male dominated. The ways and degrees in which men and women participate is different in the aquaculture sector. Both men and women occupy separate jobs in aquaculture and are not able to equally participate and share benefits in the aquaculture value chain. Such an existence of gender inequities makes aquaculture value chain under- performing.

FAO (2020) report envisages that gender equality is fundamental in fisheries and aquaculture sector for the achievement of sustainability and inclusiveness. Also FAO Policy on Gender Equality (2015) throws light on gender equality in sustainable agriculture and rural development for the elimination of hunger and poverty. Moreover, recent researches in the aquaculture sector proves that gender equality is central to realizing the potential of fisheries and aquaculture to increase fish production, and to improve livelihoods and enhance nutrition security, especially for the most nutritionally vulnerable. It is also evident that promoting gender equality in aquaculture ensures equal access to resources, opportunities, and benefits for both men and women within the sector.

The importance of gender equality is highlighted in FAO report (2005), that is, equality is a guiding principle in the voluntary guidelines for securing sustainable small-scale fisheries. Though there are several research and studies have gone into solve the gender issues in fisheries and aquaculture, the sector still needs greater recognition. World Economic Forum (2006; 2007) viewed that those countries that have performed well towards achieving gender equity have also reached higher levels of economic growth and/or social well-being in general. According to the Global Gender Gap Index 2021, India ranks 140 among 156 countries. Also World Economic Forum (2021) observed that economic opportunities for women are extremely limited in India i.e. 22.3 per cent and the gender gaps tend to widen together with seniority levels. But at the same time in sectors like fisheries and aquaculture there is no mechanism to count women's work. Data reveals that in India about 50 % of adult population in marine fishing communities are women and about 30 per cent are employed in the sector. Globally, 50 per cent of the 120 million in capture fisheries are women and out of 59.5 million people in the primary sector in fisheries and aquaculture, 14 per cent in marine and 20 per cent in inland sectors are women (close to 15 million women) (Harper et. al., 2022).

IV. How Significant Are Women in Aquaculture?

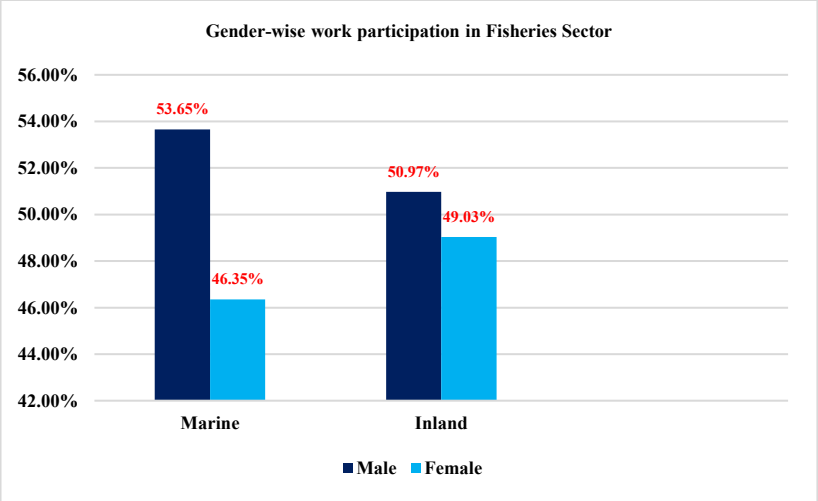
Although the aquaculture sector showing rapid growth in food production and thereby providing food security and poverty alleviation all over the world, women's opportunities in aquaculture have not kept pace with the rapid growth of the sector. Even though the sector intensifies and scales up, and promises various opportunities, women often tend to be demoted to the lowest paid, low grade work. Traditionally women are most common in small scale aquaculture production, post-harvest processing, and marketing and sales. Few women are engaged in large enterprises as owners, managers and executives. While comparing women's roles and the degree of their involvement in aquaculture with capture fisheries, it is much higher in aquaculture especially in Southeast Asian countries like Cambodia, Indonesia and Vietnam, where women carry out 42- 80 percent of all aquaculture activities (FAO, 2007). According to FAO report (2023), overall, women estimate for 21 per cent of those engaged in the primary sector (18 per cent in fisheries and 28 per cent in aquaculture), but they tend to have further unstable employment in aquaculture and fisheries, considering only 15 per cent of full-time workers in 2020. Also the report envisages that women have an important role in the fish value chain, supplying labour and functioning as small-scale entrepreneurs in both commercial and artisanal fisheries. Rural women are more likely to engage in fish farming as a result of family economic pressures thus extends to all aspects of the industry, including making fish feed, feeding the fish, cleaning nets/cages and general pond or cage maintenance and up keep.

Women's involvement in aquaculture especially in production-related activities is more significant. Women contribute in many ways to the overall well-being of households. But in many developing countries women are commonly excluded from aquaculture governance and management of aquatic resources. Also they are often excluded from the transfer of aquaculture technology and large-scale production, and thereby confined to small scale production. Such an exclusion creates problems like lower labour productivity, inefficient allocation of labour and women often get very little returns. Moreover, women faces social, economic and technical constraints in aquaculture activities. Earlier studies (Shyam et al., 2011) reveals that the major constraints faced by women in fisheries are various such as limited access and control over resources like water, land, boat, crafts and gear, knowledge, training, finance, tools, technologies, information technologies, little or no influence on the decision-making process especially in the public sphere, lack of proper infrastructure and support facilities for marketing and processing etc.

Based on the most recent data published by FAO,ICSF,ICAR and other national fisheries and aquaculture organizations from 2018 to 2024 , in 2022, women constituted approximately 25% of the worldwide aquaculture workforce. This figure has seen a modest increase in recent years, indicating a rising participation of women in the aquaculture sector. Among women in aquaculture, 53% held full-time positions, in contrast to 57% of their

male counterparts. Women comprise 62% of the workforce in aquaculture processing positions, demonstrating significant dominance in post-harvest activities including sorting, packaging, and distribution (FAO 2024). Also women account for approximately 72% of the total fisheries workforce in India, with a notable presence in aquaculture activities. While it is challenging to provide specific annual breakdowns for aquaculture, it is evident that women play a crucial role in pond and tank aquaculture, particularly in states such as West Bengal, Kerala, and Odisha (Indian Council of Agricultural Research – ICAR, 2023). State wise details shows that in Gujarat, more than half of the aquaculture workforce consists of women, primarily located in coastal regions. In Kerala, women account for almost 40% of the labour force in aquaculture. In Tamil Nadu, the involvement of women is essential in the farming of pearl oysters. Odisha has seen a significant 20% rise in female participation in aquaculture between 2015 and 2020. (seafoodofindia.com, ICSF).

Fig.3 Gender-wise work participation in Fisheries Sector



Source: Handbook of Fisheries Statistics 2024

As per Fisheries statistics 2024, about 46.35 per cent of workforce in marine sector is comprised of women, while in inland sector male and female workforce share an equal participation ratio (Handbook of Fisheries Statistics 2024).

V. Gender Participation in Aquaculture – Kerala Experience

Generally, aquaculture has been an essential component of Kerala's fisheries sector, contributing significantly to the state's economy and livelihoods of coastal communities. About half the total fishermen population of more than 200 thousand in the inland sector in Kerala is concentrated in Alappuzha, Ernakulam and Kottayam districts. 72 per cent of the workforces in the inland fisheries sector were women (Mishra 2011). Fisherwomen had diverse roles in the inland sector which involves grading and segregation, selling, drying, and prawn and fish seed collection. Besides they are also engaged in net mending and carrying food to the river banks for the fishermen engaged in fishing activity (Chandra and Sharma 2014).

Women are not only involved in aquaculture but also in many other activities, such as raising poultry and livestock, home gardening and family welfare work at home. As a result, the total time engaged by women in aquaculture production and household chores was found to be generally higher than that of men. It was also noticed that women are actively involved in direct marketing of fresh fish and dry fish.

Earlier reviews (Kappen et al. 2016; Joseph et al. 2016) shows that other activities involving women in cage culture in Kerala , once involved in cage farming, women were ready to expand cage farming further with their own efforts and expenditure. Another study (Imelda Joseph and A. Gopalakrishnan, 2017) revealed that the decision making power of the women was remarkably improved because of the enhanced income the families could achieve through cage farming. The five empowerment variables such as the women's decision making ability within the family, spending ability, social participation, access to assets, and access to resources had significant positive relationships with the women's sense of empowerment. Furthermore, apparently important variables such as education, family size, previous experience in aquaculture and family annual income did not show any significant relationship with these women's empowerment.

Women in Kerala actively engage in various aquaculture activities, contributing significantly to the sector's growth and diversification. Their involvement encompasses both traditional practices and modern innovations. Clam picking and processing is an important means of livelihood for women of certain coastal communities while clam picking serves as a subsistence activity for a significant number of women residing along

the banks of backwaters. In Alappuzha district , clam collection and their processing are mostly undertaken as a family venture wherein children and other relatives work under the supervision of women. Women predominantly take part in peeling, marketing, processing, and other activities related to post-harvest fisheries.

In coastal regions such as Moothakunnam and Vadakkekkara in Ernakulam, women engage in the farming of mussels and oysters, supported by Self-Help Groups (SHGs). They cultivate these shellfish, which are then sold to local markets and hotels. This initiative not only improves their economic status but also empowers them within their communities. Additionally, cage farming has emerged as a significant aquaculture practice in Kerala, particularly advantageous for women, as it provides them with sustainable livelihood options and entrepreneurial prospects. The success of women in cage farming have resulted in the establishment of self-help groups that promote community support and knowledge sharing . These groups are involved not only in fish farming but also in value-added activities like processing and marketing, which improve their income and social status. A notable instance is the 'Puzhayoram' self-help group located in the Maradu - Nettoor backwaters, which realized a profit of ₹2.73 lakh from a 10-month cage farming initiative, highlighting the economic viability of this practice (The New Indian Express, 2025). The inclusion of women in cage fish farming in Kerala serves as a notable example of effective rural development and gender empowerment . By participating in training programs, taking on leadership roles, and engaging with their communities, women have enhanced their economic well-being while also playing a vital role in the sustainable advancement of the aquaculture industry in the area.

In Kerala, the social protection initiatives implemented by the Government, such as widow pensions, low-interest loans, educational grants for children, and housing support, have significantly contributed to enhancing the social and economic welfare of fisherwomen. The Society for Assistance to Fisherwomen (SAF), dedicated to the social and financial empowerment of fisherwomen, has been conducting capacity-building training programs and skill development initiatives to enhance the operational effectiveness of entrepreneurial ventures led by fisherwomen. As per the data published in Kerala Economic Review 2024, during the financial year 2023-24, a total of 852 fisherwomen beneficiaries transitioned into entrepreneurship, while 1,777 fisherwomen beneficiaries received training through various Capacity Building programs. Additionally, 615 activity groups comprising 1,774 beneficiaries were supported with an interest-free Working Capital Revolving Fund. In an effort to provide solidarity funding for struggling enterprises, 31 units with 91 beneficiaries received assistance for technology enhancement. As a part of the Joint Liability Groups (JLGs) initiative, a total of 1,033 JLGs, benefiting 5,165 fisherwomen across the districts of Thiruvananthapuram, Kollam, Alappuzha, Ernakulum, Thrissur, and Kasaragod, were provided with an interest-free revolving fund amounting to Rs 1 lakh/JLG.

In order to understand the gender integration in aquaculture sector in Kerala, a field survey was conducted in Ernakulam district. 200 aquaculture farmers were selected as the respondents through simple random sampling. An extensive field survey was conducted among the respondents. The survey results shows that aquaculture farming is male dominant in Ernakulam district. Since the ownership of farms is still largely male dominated, women's contribution to aquaculture and the benefits from their involvement in aquaculture activities are often under-estimated.

From the field survey it could understand that women participates in aquaculture activities in the study area. But women does not have ownership of land. Aquaculture farmers either heir women labors or their women family members provide labor throughout the production cycle of aquaculture. Women do activities like attending to fish ponds, feeding and harvesting fish, collecting prawn larvae and fish fingerlings, processing and marketing. Women are involved in all types of cultural practices like integrated rice-fish farming, cage farming, pond farming, bio-floc farming etc. It was evident that women engages both in traditional and modern aquaculture farming practices. The respondents argued that ponds in homestead areas are important resources for fish culture and had a high potential for successful participation by women. In the case of cage fish farming women have been found to be directly involved in fabrication of cage and its maintenance, management of cage farms like seed procurement, nursery rearing, feed scheduling, feeding, marketing etc.

The field survey data is summarized in the below table, shows the type of activities and extent of women's participation in various aquaculture production stages.

Table 8 Women Participation in Aquaculture

Stage of Aquaculture	Type of Activities	Women's Participation (Extent)
Pre-Production	Seed collection from natural water bodies, site preparation	Moderate (traditional involvement in seed collection)
Seed Production & Hatchery	Operations in shrimp hatcheries, seed sorting, and packaging	High (women are actively involved in hatchery operations)
Feed Preparation	Homemade feed preparation, pellet feed mixing	Moderate to high (common in small-scale fish farms)
Feeding and Caring	Regular feeding, cleaning tanks, water quality monitoring	High (especially in homestead and small aquaculture units)
Harvesting	Collecting fish or shrimp during harvest, manual labour assistance	Low to moderate (typically less involved in harvesting)

Processing and Value Addition	Cleaning, drying, salting, packing, value addition of fish/shrimp	Very high (women dominate post-harvest processing activities)
Marketing and Sales	Local market sales, retail, small-scale trade	High (significant role in local fish markets and trade)
Ornamental Fish Culture	Tank cleaning, feeding, breeding management	High (many women engaged in this sector)
Research and Extension Services	Participating in government and NGO-led training programs	Moderate (growing participation through SHGs like Kudumbashree)
Supportive Roles (logistics, etc.	Transporting fish to markets, assisting in maintenance	Low

Source: Field Survey

The survey data reveals that women often have significant participation in aquaculture, particularly in seed production, feed preparation and post-harvest processing. While their roles are limited in heavy physical labour like harvesting and logistics due to social norms and physical demands. Programs like Kudumbashree have empowered women in to take up aquaculture activities like ornamental fish culture and small-scale fish farming.

VI. Gender Roles in Fishing – Some Reviews

Women's contributions to the fisheries sector are significant, yet often unrecognized. In Indian states like Gujarat, Kerala, Andhra Pradesh, Odisha, and Tamil Nadu, women are marginalized in fishing activities, only becoming visible when the catch is landed (Asir Ramesh, Bindu and Karthi, 2019). A fisherwoman in India spends over 90% of her working hours on fishing and related tasks, making it a full-time job. Many engage in dried fish production for about 225–250 days a year and work as labourers in processing firms, peeling factories, net weaving, or agriculture during off-peak seasons. Additionally, some participate in part-time fish seed collection, while around 20% of fisherwomen in coastal areas are involved in fish marketing, net making or repairing, and other fishing-related labour.

A study on low-income families near Tonle Sap Lake in Cambodia found that women handle net mending, bait preparation, and financial management (UNIDO, 2021). In Narial district, Bangladesh, during the monsoon, many villagers can fish in flooded fields, allowing women from 90% of households to fish with men. Women also fish for household use using gillnets, traps, cast nets, and hooks (Sultana and Thompson, 2017).

Both women and men fish for various commodities. In the Philippines, women collect shells, invertebrates, and seaweed from intertidal areas (Parcon, 2016), while men in regions like the Calamianes Island Group and Southern Negros focus on high-value species such as lobster and tuna for export (Torell et al., 2021). In Viet Nam, women gather limpets and snails from intertidal zones (Khuu, Jones and Ekins, 2021). Climate change may affect the species targeted by each gender differently, suggesting that women may need unique diversification strategies to adapt (Williams et al., 2019).

Women's roles in fisheries differ by region. In West Bengal, they mainly engage in retail marketing and net mending (Salim and Geetha, 2013). In contrast, Odisha's fisherwomen are involved in net making, fish marketing, and shrimp processing. In Andhra Pradesh and Tamil Nadu, women primarily collect seeds, gather clams, and catch fish by hand, but they also significantly contribute to sorting, grading, salting, drying fish, and retail marketing (Jadhav, 2018). In Cambodia, despite the belief that men dominate the sector, women actually represent 57% of the fishery workforce (Kusakabe, 2016).

In Philippines, seaweed collection is mainly done by women (Williams et al., 2019), while in Bangladesh, it is mostly men, though women also participate (Rani et al., 2020). In Palawan, women have shifted from sea cucumber gleaning to seaweed farming due to dwindling sea cucumber resources (Jontila et al., 2018). In Tanjung Luar, Indonesia, shark fishing is a vital income source for women (Eriksson, Johansson and Blicharska, 2019). In India, men catch fish and crustaceans, while women collect bivalves (Apine et al., 2019). In Cambodia, men prepare fishing gear, and women sort fish, clean and prepare crabs for sale, maintain equipment, and dry fish and shrimp (Sornkliang et al., 2018).

Women's involvement in fisheries varies by life stage. In India's Vimana estuarine system, women typically start fishery work after marriage when they move to their marital home (Ruthin, Jayla and Gopal, 2016). In contrast, girls in the Bangladeshi floodplains engage in fishery tasks like sorting and drying fish only before puberty, often working with family or neighbors (Deb, Hague and Thompson, 2014). After puberty, they face restrictions on mobility due to concerns about sexual harassment, which is believed to affect their marriage prospects (Deb, Hague and Thompson, 2014). Conversely, research in Mindanao, Philippines, shows that older women involved in tuna processing have more economic power and decision-making authority than men (Prieto-Carolina et al., 2021).

Economic downturns can push women into fishing (Paulus et al., 2019; Torell et al., 2021). As fish catches and incomes drop, women and children often take on fisheries and other jobs to support their families (Paulus et al., 2019). A survey in Indonesia revealed that over 83% of women in Wonogiri and 87% in Teal were

unhappy with their family income, leading them to assist their husbands in fishing (Fitrianggraeni, 2019). Research in small-scale fishing communities in Cambodia, the Philippines, and the Solomon Islands indicates that women are increasingly participating in productive activities due to economic pressures. In the Isaias Region of the Philippines, men are encouraging women to take on more roles in fisheries, such as marketing and home processing (Locke et al., 2017). Anna (2012) notes that during the low fishing season on Java's North Coast, women often take on supplementary work, such as domestic roles, to support their families. Some families also send daughters or relatives to work in Malaysia, China, Singapore, Hong Kong SAR, and Taiwan, expecting them to send money home.

Both men and women share roles in the fishery sector. Paulus et al. (2019) found that in the border areas of Indonesia and Timor-Leste, family members, including wives and children, engage in alternative income-generating activities as part of fishing households' diversification strategies. Fishing is the primary occupation, while grilled fish, shredded fish, and sea salt production serve as secondary ventures. Shredded fish, mainly produced by women, yields the highest income among these side businesses. Gibson et al. (2021) noted that in Indonesia, men participated in ten different capture fishery activities, while women focused on non-fish income sources, such as making and selling traditional cakes or working as health volunteers for a small fee.

VII. Gender Issues in Aquaculture

The fisheries and aquaculture sector is not free from the gender based differences between men and women. Gender issues in aquaculture comprises all the apprehensions associated with men and women such as their lives and situation in society, interrelations with each other, decision making, fisheries activities, differences in access to and control over resources, services, information, technologies, finance, interventions and policies. Gender discrimination is most common in aquaculture activities. Traditionally men are involved in construction of ponds, farm management, and land ownership, own and manage large boats. Whereas women are commonly engaged in postharvest activities, marketing, processing, manage small boats, net making and mending. In aquaculture value chain process, those who have weak bargaining power and little control over prices paid for goods and services remains the poor members of the chain.

Regarding women's participation in aquaculture activities, their work is often undervalued. Women have less access than men to formal sources of credit. Financial services and loans are often less available to women due to insufficient collateral or lack of financial literacy. Also women rarely receive technical advice directly from fisheries officers and are commonly marginalized from technical training and access to contemporary aquaculture technologies. Moreover, women facing constraints such as limited time, labour burdens of unpaid work and barriers to sustaining entrepreneurship. As a result of these constraints women having fewer opportunities and getting smaller returns from fisheries and aquaculture than men including lower income and being left in positions of poverty. Women frequently lack ownership or control over land and water resources, which are essential for aquaculture. Women encounter restricted access to transportation and market spaces. They may also experience discrimination, leading to exclusion from wholesale markets or a reliance on intermediaries, which diminishes their profit margins.

Another common issue in aquaculture is gender based division of labour i.e. the division of labour based on gender typically results in women being relegated to low-status, labour-intensive, and underpaid positions such as cleaning, processing, and marketing, while men predominantly occupy decision-making roles and engage in high-income-generating activities, including production and trading. Women employed in processing facilities or the informal fish trade frequently face hazardous working conditions, exploitation, and insufficient social protections. Additionally, gender-based violence and harassment may arise, particularly in unregulated or informal aquaculture settings. Furthermore, the absence of gender-responsive policies in national aquaculture frameworks results in a failure to acknowledge and address the unique challenges faced by women, as these policies tend to be gender-neutral. Also the lack of gender-disaggregated data hampers the ability to assess inequality and develop targeted interventions.

Globally men and women are not able to equally participate and share benefits in the aquaculture value chain. 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., 2016). While considering the gender issues in aquaculture, gender equality is central to realizing the potential of fisheries and aquaculture to increase fish production, and to improve livelihoods and enhance nutrition security, especially for the most nutritionally vulnerable.

VIII. Strategic Recommendations for Gender Equity in Aquaculture

To create a more inclusive aquaculture sector, a robust policy framework is essential. Gender-responsive policies must address the specific needs and rights of women. Governments and development organizations should collect and analyse gender-disaggregated data to inform targeted interventions. Legal frameworks must ensure women's rights to land, water resources, and productive assets, enabling their full participation in aquaculture.

Many women still face challenges accessing essential inputs like seed, feed, and financing, making equitable resource distribution crucial. Extension services should cater to women by offering flexible training, supportive learning environments, and hiring female extension workers. Additionally, forming women-focused cooperatives can enhance collective bargaining, reduce input costs, and improve market access.

Empowering women in aquaculture requires focused investment in their skills and leadership. Training should emphasize business development, technical skills, and digital literacy. Leadership programs can enable women to assume decision-making roles in community organizations, promoting inclusion and respect. Women often encounter market access barriers that hinder their income and entrepreneurial growth. Supporting women-led businesses through mentorship, incubation, and financial incentives can help address these challenges. Connecting women to aquaculture value chains and opportunities for value addition, such as processing and packaging, can significantly boost their economic empowerment. Ensuring fair labour practices is vital for equitable pay and safe working conditions for women. Achieving gender equity in aquaculture also necessitates a change in societal attitudes. Cultural norms that restrict women's mobility and decision-making should be challenged through awareness campaigns highlighting their contributions. Engaging men and boys as allies is essential for fostering shared responsibilities in households and communities. Furthermore, investing in infrastructure like childcare and access to clean water and energy can alleviate women's unpaid care work and encourage their active participation in the sector. A strong system for monitoring gender outcomes is critical for progress, including regular assessments of women's participation, income, and decision-making influence. Participatory evaluation methods can ensure that interventions address the evolving needs of women in aquaculture.

IX. Conclusion

Gender roles in aquaculture are diverse, ranging from seed production and feed preparation to harvesting and post-harvest activities. Women contribute significantly to the sector, particularly in value addition and processing, where they dominate in both small-scale and commercial setups. However, their roles are often under recognized due to socio-cultural norms, limited access to resources, and a lack of representation in decision-making processes. Addressing these challenges requires a gender-sensitive approach, emphasizing equitable access to training, credit, and technology. Policies should aim to dismantle structural barriers while promoting capacity building and leadership opportunities for women. By fostering inclusivity, the aquaculture sector can enhance productivity, improve livelihoods, and contribute to broader goals of gender equality and sustainable development. Recognizing women's contributions and empowering them is essential for unlocking the full potential of aquaculture globally. By identifying and addressing the challenges, aquaculture can become a transformative sector for empowering women, enhancing livelihoods, and contributing to sustainable development.

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