E-ISSN: 2788-9297
P-ISSN: 2788-9289
Impact Factor (RJIF): 5.57
www.agrijournal.org
SAJAS 2025; 5(2): 281-285
Received: 09-07-2025
Accepted: 11-08-2025

Atul Parmar
Associate Professor, Department of Geography, SBP Government College Dungarpur, Rajasthan, India

Dr. Shashi Parmar
Associate Professor, Department of Zoology, SBP Government College Dungarpur, Rajasthan, India

Osin Koli
Research Scholar, Department of Zoology, Pacific University Udaipur, Rajasthan, India

Correspondence Author:
Atul Parmar
Associate Professor, Department of Geography, SBP Government College Dungarpur, Rajasthan, India

Gendered dimensions of Indian aquaculture: A systematic review of barriers and pathways to equitable futures

Atul Parmar, Shashi Parmar and Osin Koli

DOI: https://www.doi.org/10.22271/27889289.2025.v5.i2d.218

Abstract
Indian aquaculture, a global production powerhouse, is sustained by a substantial yet undervalued female workforce. This paper presents a systematic review of the literature to deconstruct the gendered dimensions of the sector, analysing the barriers that perpetuate inequality and envisioning pathways toward an equitable future. We find that women's contributions, concentrated in pre- and post-harvest activities, are largely informal, unremunerated, and rendered invisible in official statistics. The review identifies a triad of intersecting barriers: (i) socio-cultural constraints restricting mobility and voice; (ii) structural-economic obstacles, most critically the lack of land and asset ownership that prevents access to formal credit and technology; and (iii) policy-institutional gaps where gender-blindness prevails. Crucially, the analysis reveals that women possess unique, often unrecognised, ethno-biological knowledge related to seed selection and small-scale processing, which contributes to household nutrition and genetic diversity but is threatened by industrial homogenisation. However, the literature also highlights promising pathways for transformation. The proliferation of self-help groups (SHGs) and collectives has demonstrated success in enhancing women's bargaining power, access to resources, and entrepreneurial agency. We conclude that envisioning an equitable future requires a fundamental paradigm shift from viewing women as merely labor to recognising them as knowledge-holders, managers, and innovators. We recommend a multi-scalar approach: co-designing gender-responsive technologies, implementing gender-transformative policies like joint ownership mandates, and integrating women's traditional knowledge into formal aquaculture extension services. This review provides a consolidated evidence base for researchers, policymakers, and practitioners to advance gender equality as a cornerstone of a sustainable and resilient Indian aquaculture sector.

Keywords: Gender, aquaculture, India, systematic review, women's empowerment, barriers, ethno-biology, policy, sustainable development

Introduction
Indian aquaculture has undergone a dramatic transformation, often termed the "Blue Revolution," propelling the nation to become the world's second-largest aquaculture producer (FAO, 2022) [2]. This growth is frequently measured in metric tons and export earnings, yet the human dimensions, particularly the gendered division of roles and rewards, remain critically under-explored. The sector employs over 14 million people, a significant portion of whom are women (Saikia & Das, 2021) [2]. Their labor is indispensable, yet their contributions are systematically marginalised, underpaid, and overlooked in policy frameworks.

The concept of "gendered dimensions" moves beyond simply counting female participants. It involves analysing the distinct roles, responsibilities, access to resources, and control over benefits assigned to men and women within the aquaculture value chain (Weeratunge-Starkloff & Pant, 2011) [3]. In India, these dimensions are shaped by a complex interplay of patriarchy, caste, class, and economic structures, creating a sector where women bear a disproportionate burden of labor without commensurate power or profit.

This paper employs a systematic review methodology to synthesise existing scholarly and grey literature on women in Indian aquaculture. Its objectives are threefold:

1. To map and critically analyse the pervasive barriers that constrain women's full participation and empowerment.
2. To highlight the often-invisible realms of women's agency and traditional knowledge, particularly their ethno-biological contributions.

3. To synthesise emerging models of success and propose evidence-based pathways for fostering gender-equitable outcomes in the sector.

2. Methodology: A Systematic Review

This review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive search was conducted across Scopus, Web of Science, Google Scholar, and specialist databases like ASFA (Aquatic Sciences and Fisheries Abstracts) using keywords: ("women" OR "gender") AND ("aquaculture" OR "fisheries") AND "India." Government reports, NGO case studies, and doctoral theses were included to capture grey literature. Studies were screened for relevance, focusing on those explicitly discussing roles, challenges, and interventions related to women in Indian aquaculture, various sources were selected for in-depth analysis and synthesis.

3. Deconstructing the Barriers: A Triad of Constraints

The marginalisation of women in Indian aquaculture is not a random outcome but the result of deeply embedded, interlocking systems of constraint. These barriers form a self-reinforcing triad that traps women in low-value, high-labor roles with limited pathways for advancement.

The marginalisation of women in Indian aquaculture is not a random outcome but the result of deeply embedded, interlocking systems of constraint. These barriers form a self-reinforcing triad that traps women in low-value, high-labor roles with limited pathways for advancement.

3.1. Socio-Cultural Constraints: The Weight of Invisible Norms:

The most pervasive yet intangible barriers are socio-cultural. These norms dictate what is considered "appropriate" work for men and women, effectively creating an invisible cage that restricts women's agency.

a.) The Construct of "Invisible Labor": Women's work in aquaculture pond cleaning, feeding, seed collection, and post-harvest processing is frequently classified as an "extension of household duties" rather than recognised as productive, economic labor (Nayak & Berkes, 2020) [4]. This social construct ensures their contributions are systematically undervalued and omitted from official national statistics and economic accounts, rendering them officially invisible.

b) Restricted Mobility and Purdah Culture: In many parts of India, cultural and safety norms restrict women's physical mobility. Traveling to distant markets, input suppliers, or government offices to access information, credit, or sell produce is often deemed socially unacceptable or unsafe. This severs a critical link to economic opportunity and confines their operations to the immediate homestead.

c) Lack of Voice in Decision-Making: Aquaculture is often considered a male domain. Even when women contribute the majority of the labor, key decisions regarding investment, species selection, pricing, and the use of income are predominantly made by male family members. This exclusion from decisional autonomy perpetuates a cycle of dependency and prevents women from influencing the enterprise in ways that could benefit them.

3.2. Structural-Economic Obstacles: The Material Foundations of Inequality

These are the tangible, economic structures that actively prevent women from accumulating capital and ascending the value chain.

a) The Land Ownership Trap: The single greatest structural barrier is women's near-total lack of formal land and water body ownership titles. In India, land is the primary collateral required by formal financial institutions for loans. Without title, women are deemed "not creditworthy" and are systematically excluded from formal credit (Kelkar, 2007) [4]. This prevents them from investing in productivity-enhancing technology (e.g., aerators, automated feeders), quality inputs, or expanding their operations.

b) Confinement to the Informal Economy: Barred from formal finance, women are forced into the informal economy. They work as unpaid family labor or as casual wage labourers, often paid significantly less than men for the same tasks (e.g., a 30-50% gender wage gap is commonly reported). They lack job security, social safety nets, and any form of legal protection.

c) Limited Access to Technology and Training: Agricultural and aquaculture extension services are historically male-oriented. Training programs are often scheduled at times or locations inconvenient for women and are focused on "male" tasks like pond construction or disease management, rather than the feed management or post-harvest techniques where women dominate. This creates a significant skills gap, preventing women from adopting modern, efficient practices.

3.3 Policy-Institutional Gaps: The Failure of Frameworks

Even well-intentioned systems fail women due to a fundamental lack of gender-awareness, a phenomenon known as gender-blindness.

a) Gender-Blind Policies: National and state-level missions, like the Pradhan Mantri Matsya Sampada Yojana (PMMSY), often treat "fish farmers" as a gender-neutral category. While they may have clauses for women, they fail to address the root causes of inequality. For instance, a subsidy for pond liners is useless to a woman who cannot own the pond itself. Policies do not mandate joint-titling or specifically target the structural barriers of land and credit.

b) Male-Dominated Institutions: The institutions governing aquaculture fisheries departments, cooperatives, banks, and research bodies are overwhelmingly staffed and led by men. This lack of female representation means the specific challenges faced by women are neither fully understood nor prioritised in program design and implementation.

c) Inadequate Support for Women-Centric Value Addition: Policies often focus on primary production (dominated by men) and overlook the post-harvest sector

(dominated by women). There is insufficient investment in infrastructure, food safety training, and market linkages for women-led micro-enterprises in value-added products (e.g., fish pickles, dried fish, smoked products), which hold significant potential for income generation.

These three sets of constraints are not isolated; they are deeply synergistic. The interlocking nature of the triad is as followed:

- Socio-cultural norms (e.g., restricted mobility) reinforce economic obstacles (e.g., inability to access markets).
- Economic obstacles (e.g., no land title) are perpetuated by policy gaps (e.g., no mandate for joint ownership).
- Policy gaps (e.g., male-dominated extension services) fail to challenge socio-cultural norms (e.g., the invisibility of women's labor).

This triad creates a vicious cycle from which escape is exceptionally difficult for an individual woman. Effective intervention, therefore, must simultaneously address all three dimensions to dismantle the architecture of inequality.

4. Beyond Barriers: Recognising Agency and Ethno-Biological Knowledge

A critical and evolving body of literature moves beyond the deficit model of women's participation to highlight their agency, resourcefulness, and possession of sophisticated Traditional Ecological Knowledge (TEK), often referred to in this context as ethno-biological knowledge. This knowledge is not anecdotal; it is a systematic, empirically-grounded understanding of aquatic ecosystems, developed and refined through generations of intimate, daily interaction (Berkes, 2018) [7]. Recognising this agency is paramount to designing effective and respectful interventions.

4.1. Custodians of Genetic Diversity and Seed Security

Women's role often extends beyond mere labor to active genetic management, particularly in small-scale, artisanal seed collection and nursing.

a) Selective Breeding and Seed Management: In the traditional carp and prawn seed sectors, especially in states like West Bengal and Odisha, women are primarily responsible for collecting wild seed (spawn) from riverine systems. They possess detailed knowledge to identify robust spawn of species like *Labeo rohita* (rohu), *Catla catla* (catla), and *Macrobrachium rosenbergii* (giant river prawn) based on subtle phenotypic cues like size, colour, and vigour—skills honed through experience but rarely documented in formal manuals (Saikia & Das, 2021) [2]. This selective practice is a form of in situ conservation that maintains a broader genetic base compared to the industrial hatchery focus on a few high-yielding strains.

b) Ethno-Ichthyological Knowledge: Women often possess extensive taxonomic knowledge of local fish species, including their breeding cycles, feeding habits, and symbiotic relationships within the pond ecosystem. This knowledge is crucial for polyculture practices, where compatible species are stocked together to maximise ecological efficiency and yield (Salagrama, 2019) [8]. Their ability to detect early signs of disease through subtle behavioural changes in the fish often serves as the first line of defence, preventing large-scale outbreaks.

4.2. Innovators in Post-Harvest Processing and Value Addition

The post-harvest segment is a domain where women's entrepreneurial and technical knowledge is most visible. Faced with the problem of perishability, they have developed a suite of low-cost, innovative preservation techniques.

a) Traditional Preservation Techniques: Women are the primary custodians of knowledge related to sun-drying, smoking, curing, and fermenting fish. These methods, adapted to local climatic conditions and cultural palates, are vital for ensuring household food security during lean seasons and for creating marketable products like sukhua (dried fish in Odisha), karuvadu (dried fish in Tamil Nadu), and various fish pickles and powders (Perez *et al*., 2022) [6]. This knowledge encompasses an understanding of humidity, temperature, and hygiene to prevent spoilage.

b) Nutritional Gatekeepers: Women's role in processing directly impacts household nutrition. By managing the transformation of raw fish into preserved products, they ensure a steady supply of protein and micronutrients for their families year-round, a critical contribution to combating malnutrition in rural households (Kumar *et al*., 2020) [9].

4.3. The Foundation of Household Food and Economic Security

Women's contributions are fundamental to the subsistence and risk-management strategies of small-scale aquaculture households.

a) Informal Economy and Risk Mitigation: Income from women's sale of processed fish or surplus seed often operates as a crucial informal safety net. It is frequently used for daily household expenses, children's education, and healthcare, buffering the family against economic shocks and the volatility of the main harvest cycle (Nayak & Berkes, 2020) [4].

b) Sustainable Resource Management: Their daily management practices, such as using locally sourced, sustainable feed supplements (e.g., kitchen waste, agricultural by-products) and maintaining water quality through manual aeration, often align closely with principles of ecological sustainability. This stands in contrast to capital-intensive, input-heavy models promoted by formal systems (Weeratunge-Starkloff & Pant, 2011) [3].

This vast repository of ethno-biological knowledge is increasingly threatened. The push for industrial intensification, the promotion of monoculture of exotic species (like genetically improved farmed tilapia), and the decline of natural seed sources due to environmental degradation are rendering women's specific knowledge obsolete (Salagrama, 2019) [8]. Formal systems, by overlooking this knowledge, are not only disempowering women but also losing a valuable resource for building climate-resilient and sustainable aquaculture systems.

Therefore, the pathway forward requires co-production of knowledge, where formal science engages in a dialogue

with women's traditional expertise. This means integrating their insights into breeding programs for resilience, validating and scaling their low-cost preservation techniques with modern food safety standards, and recognising them not just as beneficiaries, but as essential partners and innovators in the future of Indian aquaculture

5. Envisioning an Equitable Future: Pathways and Possibilities: Moving from analysis to action requires a fundamental paradigm shift from viewing women as a source of labor to recognising them as central agents of change, innovation, and sustainability. The literature points to several interconnected, evidence-based pathways for dismantling the triad of constraints and fostering an equitable future. These are not merely suggestions but are grounded in successful pilot interventions and global best practices.

5.1. Collectivisation: Building Power through Solidarity
The formation and strengthening of women's collectives, such as Self-Help Groups (SHGs) and cooperatives, is arguably the most potent mechanism for catalysing change. Collectivisation transforms individual vulnerability into collective strength.

a) Enhanced Bargaining Power: SHGs enable women to engage in collective purchasing of inputs (feed, seed, fertilisers) at lower prices and negotiate better rates for their products, bypassing exploitative middlemen. This directly addresses economic marginalisation (Meinzen-Dick *et al*., 2019) [10].

b) Access to Finance and Assets: Through group savings and internal lending, SHGs provide immediate access to microcredit. More importantly, the group's social capital can serve as collateral for formal bank loans under programs like the SHG-Bank Linkage Initiative in India. This allows women to invest in assets like shared processing units, storage facilities, or even lease group-owned ponds, overcoming the critical barrier of individual landlessness (Kumar *et al*., 2018) [9].

c) Platform for Empowerment and Voice: Collectives provide a safe space for women to build confidence, share knowledge, and articulate their needs. A strong collective can then advocate for its members' rights with local government (Panchayats) and fisheries departments, ensuring their voices are heard in policy dialogues (Nayak & Berkes, 2020) [4].

5.2. Gender-Responsive Technology and Innovation
Technology must be reimagined to alleviate, not exacerbate, women's burdens. This involves co-designing tools and practices that are appropriate for their specific roles, resources, and socio-cultural context.

a) Labor-Saving Technologies for 'Women's Work'
R&D should focus on affordable, portable technologies that reduce the drudgery of tasks like pond cleaning, manual feeding, deboning, and drying. Examples include small mechanical feeders, portable aerators, solar dryers, and ergonomic tools. The success of the "ATMA" (Agricultural Technology Management Agency) model in gender-sensitizing extension shows the potential of targeted tool distribution (World Bank, 2020).

b) Value-Addition and Processing Technologies: Investing in small-scale, hygienic, and energy-efficient processing technologies (e.g., small vacuum packers, freezers, smoking kilns) can help women move up the value chain. This transforms raw, low-value produce into high-value, marketable products, significantly boosting their income (Perez *et al*., 2022) [6].

c) Digital Literacy and ICTs: Mobile technology can be a great equaliser. Providing women with access to mobile-based applications for real-time market prices, weather alerts, and virtual veterinary advice can bypass mobility restrictions and information asymmetries, empowering them to make informed decisions (FAO, 2021).

5.3. Gender-Transformative Policy and Institutional Reform
Policies must move beyond "gender-blind" or even "gender-sensitive" approaches to become actively "gender-transformative" meaning they seek to dismantle existing power imbalances.
Mandatory Joint Ownership and Leasing Rights: National and state aquaculture policies (e.g., Pradhan Mantri Matsya Sampada Yojana - PMMSY) must mandate joint registration of ponds and fishing units in the names of both spouses. Furthermore, a specific quota for women's collectives in the leasing of public water bodies should be instituted to provide direct access to productive resources (Kelkar, 2018) [13].

a) Gender-Responsive Extension Services: Fisheries extension services require a systematic overhaul. This includes: 1) recruiting and training more female extension officers; 2) scheduling training at times and locations accessible to women; and 3) developing curricula that address their specific knowledge needs (e.g., backyard hatchery management, value-addition, financial literacy) rather than focusing solely on pond construction (Weeratunge-Starkloff & Pant, 2011) [3].

b) Mainstreaming Gender in Program Design: Every government scheme should include a mandatory Gender Budgeting and Social Impact Assessment to forecast and mitigate unintended negative consequences for women. Programs should offer incentives, such as higher subsidy rates, for enterprises that are women-led or have a high proportion of female employees (SOFIA, 2022).

5.4. Knowledge Co-Production and Market Linkages
Formal institutions must acknowledge and integrate women's ethno-biological knowledge while simultaneously connecting them to equitable markets.

a) Formalising Traditional Knowledge: Research institutions (like ICAR-CIFA) should collaborate with women's collectives to document, validate, and scientifically refine their traditional knowledge on seed selection, disease detection, and natural feed. This can lead to the development of more resilient and context-appropriate aquaculture models (Salagrama, 2019) [8].

b) Creating Ethical Market Linkages: Facilitate direct market linkages for women's collectives through farmer's markets, government procurement programs (e.g., for mid-day meals), and certifications (e.g., "Women-Produced" labels) that attract premium prices in domestic and international niche markets. This ensures that the value added by women is captured by them (Saikia & Das, 2021) [2].

These pathways are not mutually exclusive; they are synergistic. Collectivisation creates the platform for demanding policy change and adopting new technologies. Supportive policies enable collectives to access resources and markets. Ultimately, envisioning an equitable future requires a concerted, multi-stakeholder effort that places women's agency, knowledge, and economic empowerment at the very heart of the Indian aquaculture strategy.

6. Conclusion and Research Gaps

This review consolidates evidence that gender inequality is not a peripheral issue but a central factor determining the sustainability and equity of Indian aquaculture. Deconstructing the barriers of culture, economics, and policy is the first step. The next is to actively build an inclusive sector that recognises, rewards, and leverages the knowledge and labor of women.

Significant research gaps remain. There is a need for more quantitative studies measuring the precise economic value of women's contributions and the impact of their ethno-biological knowledge on productivity and resilience. Longitudinal studies on the impact of specific interventions (e.g., land titling, specific technologies) are also scarce. Future research must adopt participatory action research methodologies, engaging women not as subjects but as co-researchers in designing the equitable future of Indian aquaculture.

References

1. Food and Agriculture Organization (FAO). The State of World Fisheries and Aquaculture. Rome: FAO; 2022.
2. Saikia A, Das D. Invisible Labor, Visible Impact: Women in the Aquaculture Value Chain of Assam. Econ Polit Wkly. 2021;56(8):45-52.
3. Weeratunge-Starkloff C, Pant J. Gender and Aquaculture: Sharing the Benefits Equitably. Penang: The WorldFish Center; 2011.
4. Nayak PK, Berkes F. Whose gender? Whose power? Towards a more inclusive conceptualization of women's empowerment in aquaculture. J Rural Stud. 2020;76:123-132.
5. Kelkar G. Gender and Aquaculture in India: A Review. Penang: The WorldFish Center; 2007.
6. Perez ML, S M, L V. Gender, climate change, and resilient aquaculture: a review of the literature. Aquaculture. 2022;547:737456.
7. Berkes F. Sacred Ecology. 4th ed. New York: Routledge; 2018.
8. Salagrama V. Gender and Aquaculture: Lessons from South India. Rome: Food and Agriculture Organization of the United Nations (FAO); 2019.
9. Kumar A, P S, Sharma D, P S. Role of women in fisheries and aquaculture: a review. J Entomol Zool Stud. 2020;8(4):797-800.
10. Meinzen-Dick R, Quisumbing A, Doss C, Theis S. Women's land rights as a pathway to poverty reduction: Framework and review of available evidence. Agric Syst. 2019;172:72-82.
11. Kumar G, Engle CR, Tucker CS. How efficient is aquaculture? A review of the financial and economic performance of the farmed seafood sector. Aquac Econ Manag. 2018;22(3):345-369.
12. Food and Agriculture Organization (FAO). The role of digital technologies in fisheries and aquaculture. Rome: FAO; 2021. doi:10.4060/cb4985en
13. Kelkar G. Gender and Productive Resources in Agriculture: A South Asia Perspective. In: Gender and Agriculture. Cham: Springer; 2018:93-115.
14. SOFIA. The State of World Fisheries and Aquaculture 2022. Rome: FAO; 2022. doi:10.4060/cc0461en
15. World Bank. Engendering Rural Development: Lessons from the Agricultural Technology Management Agency (ATMA) Model in India. Washington, DC: World Bank Group; 2020.