Cultivating Resilience: Women Shaping Agriculture in Sundarbans

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Abstract: Women play a pivotal role in shaping the socio-economic and ecological resilience of the Sundarbans, a region characterized by its fragile environment and climate vulnerabilities. This study investigates the diverse and dynamic contributions of women in agriculture, livelihood diversification, natural resource management, and climate change adaptation across four blocks of the Sundarbans: Gosaba, Mathurapur, Kultai, and Patharpratima. Through a primary survey of 300 households using random sampling, the study captures women's active participation in agriculture, including crop cultivation, home gardens, and the adoption of innovative practices such as saline-resistant crops and floating farms. The findings reveal that 80% of women are actively engaged in agricultural activities, highlighting their critical role in ensuring household food security and experimenting with sustainable farming practices. Furthermore, the study underscores women's proactive role in adapting to climate change, from embracing climate-resilient farming techniques to leading disaster preparedness and management initiatives.

Keywords: Sundarbans, Livelihood Diversification, Natural Resource Management, Climate Change Adaptation, Sustainable Farming Practices, Mangrove Conservation, Resilience

INTRODUCTION

Agriculture, the primary livelihood for a majority of the Sundarbans' residents, has been heavily impacted by these adversities. The Sundarbans region is highly vulnerable to climate-induced risks like cyclones (e.g., Cyclone Aila) and saline intrusion, which adversely affect crop yields and soil health. Studies show that traditional farming methods are increasingly unsustainable under these conditions, necessitating adaptive approaches (Hazra et al., 2020). Women in the Sundarbans are involved in all aspects of agriculture—from sowing and harvesting to managing kitchen gardens, aquaculture, and natural resources. Beyond these roles, they are adopting innovative techniques, such as saline-tolerant crops, floating farming, and organic practices, to mitigate the effects of environmental degradation (Debnath et al., 2021). The role of women in agriculture expansion in the Sundarbans region of India is critical due to the unique socio-economic and environmental conditions of the area. Women play a significant part in ensuring food security, managing natural resources, and sustaining livelihoods in this ecologically sensitive region.

Research underscores that women contribute significantly to agricultural production globally, yet they remain marginalized in decision-making processes. According to the Food and Agriculture Organization (FAO), women account for nearly half of the agricultural workforce in developing countries. In the Sundarbans, their contributions extend beyond labor to include innovation and adaptation to environmental challenges (Doss, 2018). Several studies highlight women's role in promoting sustainable practices, such as organic farming, composting, and mixed cropping, in the Sundarbans. These practices not only enhance soil fertility but also reduce dependency on chemical inputs, making agriculture more resilient to environmental stressors (Rahman & Datta, 2019). Government schemes like Mahila Kisan Sashaktikaran Pariyojana (MKSP) and programs by NGOs like PRADAN and the Sundarbans Development Board have focused on empowering women through skill-building, financial inclusion, and access to sustainable agricultural inputs. These initiatives have begun to transform women into key drivers of agricultural expansion and resilience in the region (Jana et al., 2022). Based on the above discussion, present study evaluates the active involvement of women in agricultural activities, including crop cultivation, aquaculture, and natural resource management, in the Sundarbans region.

STUDY AREA

The Sundarban delta, located at the confluence of the Ganges, Brahmaputra, and Meghna rivers, is the

world's largest tidal halophytic mangrove ecosystem. A significant portion of this delta lies within India, spanning across the southern districts of West Bengal. The region is ecologically rich yet highly vulnerable to climate-induced challenges such as rising sea levels, cyclones, and salinity intrusion. The study focuses on four administrative blocks in the Sundarbans—Gosaba, Mathurapur, Kultali, and Patharpratima (*Figure 1*)—which are representative of the region's agricultural, socio-economic, and environmental diversity. All four blocks are characterized by Frequent cyclones, saline water intrusion, and unpredictable weather patterns. Women are deeply involved in agriculture, aquaculture, and natural resource management but face systemic barriers such as lack of land ownership, financial exclusion, and social constraints.

MATERIALS & METHODS

The study employs a mixed-methods approach to investigate the role of women in agriculture expansion in the Sundarbans, with a particular focus on their contributions to resilience and sustainability. The research adopts a sample survey methodology, targeting a total of 300 households across four strategically selected blocks in the Indian Sundarbans—Gosaba, Mathurapur, Kultali, and Patharpratima. These blocks were chosen due to their varying socio-economic conditions, dependence on agriculture, and exposure to climate-induced risks, ensuring a representative sample for the study. A random sampling technique was used to identify the participating households, ensuring that the selection process remained unbiased and inclusive of diverse socio-economic groups. The sample includes women actively engaged in agriculture, aquaculture, or allied activities, along with those involved in household-level or community-level decision-making processes.

Data collection involved structured household surveys using a pre-designed questionnaire that was administered during face-to-face interviews. Additionally, focus group discussions (FGDs) and key informant interviews (KIIs) were conducted with local women leaders, SHG members, and agricultural experts to supplement quantitative data with qualitative insights. Secondary data from government reports, NGO documentation, and relevant literature were also reviewed to contextualize findings. The selected blocks—Gosaba, Mathurapur, Kultali, and Patharpratima—represent the ecological and socio-economic diversity of the Sundarbans and provide a nuanced understanding of how women are shaping agriculture in this fragile region. By combining quantitative and qualitative approaches, the study aims to deliver a comprehensive analysis of women's contributions, challenges, and opportunities in agricultural expansion in the Sundarbans.

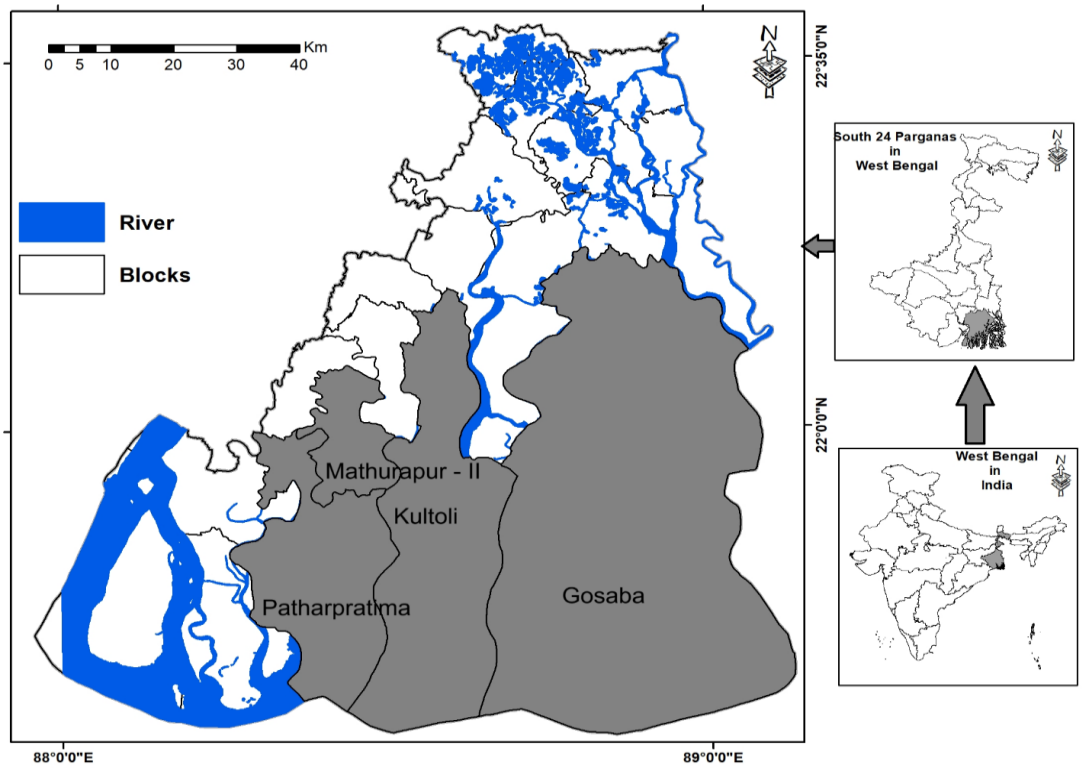

Figure 1: Location map of the study area

RESULTS

Active Participation in Agriculture

The *table 1* provides a comprehensive overview of women's active participation in agriculture across 300 surveyed households in the Sundarbans, highlighting their contributions to crop cultivation, home gardening, and innovative agricultural practices. In terms of crop cultivation, paddy cultivation emerges as the most dominant activity, with 70% (210 women) actively involved, reflecting its staple role in the region's agricultural economy. Vegetable farming accounts for 45% (135 women), contributing significantly to household income and food diversity, while betel leaf cultivation, a high-value cash crop, involves 30% (90 women). Home gardens also play a crucial role, with kitchen gardening practiced by 55% (165 women), ensuring household food security and resilience during periods of economic and environmental stress. Additionally, medicinal plant cultivation by 20% (60 women) highlights the preservation of traditional knowledge and its integration into daily lives. In the domain of innovative practices, saline-resistant crop adoption leads with 35% (105 women) actively utilizing these climate-resilient methods to combat soil salinity. Other sustainable practices include organic farming (25%, 75 women), mixed cropping (30%, 90 women), and the emerging concept of floating farms (20%, 60 women), particularly in waterlogged and cyclone-prone areas.

Table 1: Results of a primary survey on the active participation of women in agriculture in the Sundarbans

Category of Activity	Number of Women Involved	Percentage (%)
Crop Cultivation		
- Paddy Cultivation	210	70%
- Vegetable Farming	135	45%
- Betel Leaf Cultivation	90	30%
Home Gardens		
- Kitchen Gardening	165	55%
- Medicinal Plant Cultivation	60	20%
Innovative Practices		
- Saline-Resistant Crop Adoption	105	35%
- Organic Farming	75	25%
- Mixed Cropping	90	30%
- Floating Farms	60	20%

Livelihood Diversification

50% of women (150 individuals) actively participate in small-scale fisheries, which is a crucial livelihood option in the water-rich Sundarbans. Shrimp and crab farming, which require specific skills and investment, engage 30% (90 women), reflecting its profitability as an alternative income source (Table 2). Fish drying and processing, practiced by 25% (75 women), showcases their involvement in value addition to aquaculture products. 40% of women (120 individuals) are engaged in poultry farming, often as a supplementary source of income and food security. Livestock rearing, particularly cattle and goats, involves 30% (90 women), contributing to household resilience and economic diversification. Traditional handicrafts, such as making ornaments, baskets, or household items, engage 25% (75 women), while jute craft and mat weaving involve 20% (60 women), emphasizing the preservation of cultural practices and creative skills.

Table 2: Reflects the multi-dimensional economic contributions of women in the Sundarbans

Category of Livelihood Activity	Number of Women Involved	Percentage (%)
Aquaculture and Fisheries		
- Small-Scale Fisheries	150	50%
- Shrimp and Crab Farming	90	30%
- Fish Drying and Processing	75	25%
Animal Husbandry		
- Poultry Farming	120	40%

- Livestock Rearing (Cattle/Goats)	90	30%
Handicrafts		
- Traditional Handicrafts	75	25%
- Jute Craft and Mat Weaving	60	20%

Natural Resource Management

45% of women (135 individuals) actively engage in planting and maintaining mangroves, which is crucial for protecting the Sundarbans from erosion, storm surges, and rising sea levels. 30% (90 women) participate in awareness campaigns aimed at educating their communities about the importance of mangroves in maintaining biodiversity and mitigating climate impacts (Table 3). Maintenance of ponds and canals, practiced by 35% (105 women), plays a key role in ensuring water availability for irrigation, livestock, and domestic use. 25% (75 women) take part in awareness programs on water conservation, helping to instill sustainable water use practices in their communities.

Table 3: Women's contributions to maintaining ecological balance, mitigating climate risks, and supporting sustainable development in the Sundarbans region

Category of Natural Resource Management Activity	Number of Women Involved	Percentage (%)
Mangrove Conservation		
- Planting and Maintaining Mangroves	135	45%
- Awareness Campaigns for Mangrove Protection	90	30%
Water Resource Management		
- Rainwater Harvesting	120	40%
- Maintenance of Ponds and Canals	105	35%
- Awareness Programs on Water Conservation	75	25%

Adapting to Climate Change

40% of women (120 individuals) are actively adopting saline-tolerant crops, a critical adaptation strategy in the Sundarbans where soil salinity is a major challenge. 30% (90 women) practice crop diversification, reducing risks from climate variability and improving household resilience. 25% (75 women) rely on traditional farming knowledge, blending age-old practices with modern techniques to enhance productivity under changing climatic conditions (Table 4). yclone preparedness sees the participation of 50% of women (150 individuals), as the Sundarbans is frequently hit by cyclones, making their involvement in early warnings, evacuation planning, and relief measures essential. 35% (105 women) are involved in community-based flood management, such as building embankments, clearing drainage channels, and sharing flood-related information. 30% (90 women) participate in awareness campaigns for disaster risk reduction, spreading knowledge on safety measures and strategies to minimize damage from natural disasters.

Table 4: Representing the results of a primary survey on women's involvement in adapting to climate change in the Sundarbans

Category of Activity	Number of Women Involved	Percentage (%)
Climate-Resilient Farming		
- Adoption of Saline-Tolerant Crops	120	40%
- Crop Diversification	90	30%
- Use of Traditional Knowledge for Farming	75	25%
Disaster Management		
- Participation in Cyclone Preparedness	150	50%
- Community-Based Flood Management	105	35%
- Awareness Campaigns for Disaster Risk Reduction	90	30%

DISCUSSION

The primary survey highlights the significant contributions of women in the Sundarbans across various dimensions, including agriculture, livelihood diversification, natural resource management, and climate change adaptation. Women's active participation in agriculture demonstrates their central role in sustaining rural economies. Their involvement in crop cultivation such as paddy and vegetable farming, home gardening, and the adoption of innovative practices like saline-resistant crops, organic farming, and floating farms reflects their resilience and adaptability in the face of ecological challenges. This finding aligns with previous studies emphasizing that women in the Sundarbans actively engage in subsistence agriculture, contributing to household food security while addressing climate-related vulnerabilities (Dasgupta et al., 2019). In the domain of livelihood diversification, women have successfully extended their roles to aquaculture, fisheries, animal husbandry, and handicrafts. These activities not only provide supplemental income but also act as buffers against agricultural uncertainties caused by erratic climatic conditions. The survey revealed that nearly half of the women participated in aquaculture and fisheries, and a significant number were involved in animal husbandry and handicraft production, demonstrating their ability to explore alternative income-generating avenues. Similar findings were noted by Mukherjee et al. (2020), who highlighted women's active participation in small-scale aquaculture and value-added craft industries as critical for economic resilience in the Sundarbans. Natural resource management, particularly in the conservation of mangroves and water resources, emerged as another area where women have played an instrumental role. Nearly 45% of women actively engage in planting and maintaining mangroves, which serve as natural barriers against cyclones and storm surges, while 40% contribute to water resource management through rainwater harvesting and pond maintenance. These activities corroborate findings from Chacraverti (2018), which emphasized that women in the Sundarbans are key agents of ecological preservation, ensuring the sustainability of shared resources through traditional and community-based practices. In climate change adaptation, women's roles were particularly significant, with 40% adopting saline-tolerant crops and 50% actively participating in disaster management efforts like cyclone preparedness. These efforts underscore their critical role in safeguarding their families and communities from the increasing threats of climate change. Prior studies, such as the work of Bera and Saha (2021), have documented the indispensable role of women in integrating traditional knowledge with innovative practices to mitigate the impacts of climate change, particularly in vulnerable regions like the Sundarbans.

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