



Socioeconomic Vulnerabilities and Adaptive Strategies of Small-Scale Fishers in Developing Country

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Abstract

Background: Small-scale fisheries along the Meghna River in Bangladesh are vital for livelihoods, food security, and economic development, contributing significantly to the national GDP and global fish supply. However, these fisheries face mounting challenges due to overfishing, habitat degradation, climate change, and socioeconomic vulnerabilities. This study aims to assess the socioeconomic conditions of small-scale fishers, their adaptive strategies, and opportunities for resilience enhancement. **Methods:** A mixed-methods approach was employed, including surveys of 300 fishing households, six focus group discussions, and key informant interviews. Quantitative data captured demographic, livelihood, and financial details, while qualitative insights explored adaptation strategies, policy frameworks, and community resilience. The study analyzed data using the DFID Sustainable Livelihoods Framework, identifying key strengths and vulnerabilities. **Results:** Findings revealed that 70% of households earn below the national poverty line, with high illiteracy rates (48%) and limited access to formal financial systems. Declining fish stocks, exacerbated by illegal fishing practices and climate

change, were identified as critical concerns by 85% of respondents. Seasonal fishing bans further strained livelihoods, with only 35% of affected households receiving compensation. Adaptation strategies included alternative income-generating activities (e.g., poultry farming, vegetable gardening), seasonal migration, and community-based initiatives such as shared resource ownership and informal savings clubs. Despite their potential, these measures remain underutilized due to skill gaps, financial constraints, and limited institutional support. **Conclusion:** The livelihoods of Meghna River fishers are shaped by interlinked environmental, social, and institutional challenges. While adaptive strategies demonstrate resilience, sustainable development requires targeted interventions in education, skill development, and resource management. Government policies should prioritize transparent compensation mechanisms, community-based conservation efforts, and livelihood diversification programs. Strengthening climate-resilient infrastructure and fostering collaborations among stakeholders will ensure the long-term sustainability of both fishing communities and the Meghna River ecosystem.

Keywords: Meghna River fisheries, Small-scale fishers, Livelihood resilience, Alternative income-generating activities, Climate change adaptation

Significance | This study determined the understanding of small-scale fishers' socioeconomic challenges and adaptation strategies aids policy development for sustainable livelihoods and riverine biodiversity conservation.

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Introduction

Small-scale fisheries form the backbone of Bangladesh's socio-economic framework, supporting millions of livelihoods and playing a pivotal role in ensuring national food security (Islam et

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al., 2018a). Contributing over 6% to Bangladesh's GDP, the fishing sector is a vital engine for economic development, particularly in rural areas where alternative income opportunities are limited (Sunny et al., 2021). Among Bangladesh's many water bodies, the Meghna River stands out as one of the most biologically diverse and economically significant rivers. For the communities living along its banks, the river is not just a source of sustenance but also a central component of cultural identity, income, and nutrition (Islam et al., 2018b; Sunny et al., 2020; Ifty et al., 2023a).

The Meghna River is a key segment of the Ganges-Brahmaputra-Meghna basin, harboring a diverse array of fish species and providing critical ecological services (Moniruzzaman et al., 2023). Its fisheries play a substantial role in the regional economy, significantly contributing to both local fish consumption and exports. One of the river's most economically important species is the hilsa (*Tenualosa ilisha*), which dominates Bangladesh's fisheries sector and accounts for approximately 10% of the global hilsa catch. Beyond its economic value, the river holds deep cultural importance for the communities that have depended on it for generations (Nahar et al., 2018; Dey et al., 2021; Sarker et al., 2022). Despite its importance, the Meghna River and its fisheries are under considerable pressure from environmental, economic, and social challenges. Overfishing, driven by population growth and increasing demand, has led to the depletion of fish stocks and disruption of the river's ecosystems (Alam et al., 2021; Haque et al., 2021). The use of unsustainable fishing practices, including illegal gear and the indiscriminate harvesting of juvenile fish, has further aggravated the situation (Narula et al., 2017; Natarajan et al., 2022; Guo et al., 2022). Efforts to conserve fish stocks, such as seasonal bans to protect spawning species like hilsa, have proven critical but come at a cost. These bans often leave fishing communities economically vulnerable, as limited governmental support mechanisms fail to adequately mitigate the financial impacts (Sazzad et al., 2024a).

The effects of climate change further compound these challenges. The Meghna River basin is highly vulnerable to natural disasters such as floods, cyclones, and riverbank erosion. These events damage fishing assets like boats and nets and disrupt fishing patterns by altering river currents and migratory routes of key fish species (Sazzad et al., 2024b). Rising water temperatures and changes in salinity are already affecting fish habitats, leading to fluctuations in catch rates and threatening the sustainability of the river's fisheries.

The socio-economic conditions of fishers along the Meghna River underscore the risks of dependence on such a fragile natural resource base. Many of these fishers live below the poverty line, with limited access to education, healthcare, and alternative economic opportunities (Ashakin et al., 2024; Salam et al., 2024; Khatun et al., 2024a). Financial instability is a persistent issue, exacerbated by

reliance on informal lending systems with high interest rates (Ifty et al., 2024). Fishing bans and off-seasons further deepen financial hardships, forcing many fishers to accumulate debt to meet basic needs. Women and children in these communities face additional challenges, including limited involvement in income-generating activities and reduced access to education (Hakim et al., 2023).

While significant research has been conducted on other regions such as the Padma River and the Sundarbans, focusing on fisher livelihoods and strategies to reduce dependence on overexploited fisheries, studies on the Meghna River remain limited. Research from the Padma River has emphasized community-based fisheries management and income diversification as crucial strategies for enhancing fisher resilience. However, the lack of targeted research on the Meghna River hinders the development of solutions tailored to its unique ecological and socio-economic challenges.

This study aims to address this gap by examining the socio-economic conditions of small-scale fishers along the Meghna River. It seeks to identify key challenges and vulnerabilities, assess existing coping strategies, and explore potential solutions for building resilience. By focusing on community-based management, policy interventions, and alternative livelihood opportunities, this research intends to contribute to sustainable fisheries management and the well-being of fishing communities. In doing so, it highlights the urgent need for a holistic approach that integrates environmental conservation with socio-economic development to secure the future of small-scale fisheries along the Meghna River.

2. Materials and Methods

2.1 Study Area:

The research took place out along the Meghna River, one of the largest and most ecologically important rivers in Bangladesh. The Meghna River sustains several fishing villages whose livelihoods are significantly reliant on its supplies. Three fishing villages such as Anandabazar North, Anandabazar South and Middle Anandabazar of Chandapur District were chosen due to their reliance on small-scale fishing and their vulnerability to socioeconomic and environmental issues, including overfishing, seasonal fishing restrictions, and climate-related effects.

2.2 Study Design

The research employed a mixed-methods approach, integrating quantitative surveys and qualitative techniques, to investigate the socioeconomic situations, livelihood problems, and adaptation strategies of fishing households (supplementary info). We surveyed 300 families using a semi-structured questionnaire to gather data on demographics, livelihood activities, problems, and adaptation solutions (Table 1).

2.3 Data Collection, analysis and formulating:

The research comprised six focus group discussions (FGDs) and key informant interviews (KIIs) to collect qualitative data about the problems and coping mechanisms encountered by small-scale fishers along the Meghna River. The discussions addressed environmental and economic changes, the social and economic effects of seasonal fishing prohibitions, and prospective options for livelihood diversification. The interviews yielded insights into policy frameworks, community governance, and external support systems. Field researchers took notes about fishing techniques, living circumstances, and market infrastructure. The research complied with ethical standards, including informed consent, confidentiality, and authorization from the ethics review board. The data analysis encompassed quantitative and qualitative assessments, cross-validation, and community input. The study's limitations are its geographic coverage, seasonal limits, and self-reporting bias.

3. Results

3.1 Population Profile of Fishing Communities:

The study explored 300 residences in three fishing communities next to the Meghna River, yielding critical demographic information.

3.1.1 The Age of the Individual Distribution:

A majority (62%) of fishermen were aged 30–45 years, indicating a predominance of active, working-age persons. A minority (12%) were over 55 years old, suggesting minimal participation from senior fishermen.

3.1.2 Gender Structure:

Fishing activities were predominantly male (96%), while women mostly participated in ancillary tasks such as fish drying, sorting, and selling.

3.1.3 Educational Status:

The rate of illiteracy was high, with 48% of respondents unable to read or write. Merely 15% had attained elementary education, while less than 5% had achieved secondary education.

3.2 Employment Trends and Income Flows:

Fishing constituted the principal activity for 80% of households, while 20% relied on diversified livelihoods encompassing agriculture, small enterprises, or day labor.

3.2.1 Temporal Fluctuations in Earnings:

The mean monthly revenue during the peak fishing season was BDT 13,000, in contrast to BDT 6,000 during the off seasons. Seasonal fishing prohibitions and diminishing fish populations intensified revenue fluctuations.

3.2.2 Additional Activities:

Approximately 18% of families participated in alternative income-generating activities (AIGAs), comprising chicken rearing (9%), vegetable gardening (6%), and fish processing (3%) (Table 2).

3.3 Challenges Experienced by Fishing Communities:

The study analyzes the livelihood problems as follows:

3.3.1 Limited Financial Resources:

More than 70% of households earn below the national poverty threshold of BDT 10,000 per month (Table 3).

3.3.2 Reliance on Debt:

Approximately 64% of families indicated they obtained loans to support themselves during fishing restrictions, with 40% depending on high-interest loans from informal lenders.

3.4 Ecological Pressures:

3.4.1 Decreasing Fish Populations:

Approximately 85% of participants indicated a decline in fish supply during the last ten years, ascribed to overfishing, illicit gear use, and environmental deterioration.

3.4.2 The effects of Climate Change:

Seasonal flooding and riverbank erosion impeded fishing operations and resulted in the loss of fishing equipment, including boats and nets, for 26% of families.

3.5 Social Challenges:

3.5.1 Limited Educational Opportunities:

Elevated dropout rates among youngsters were associated with financial limitations and the necessity for their involvement in fishing-related tasks.

3.5.2 Health issues:

Approximately 72% of families indicated insufficient access to healthcare, predominantly depending on unqualified rural practitioners.

3.6 Adaptive Strategies:

3.6.1 Alternative Income-Generating Activities (AIGAs):

35% of respondents involved in supplemental activities identified poultry farming and vegetable gardening as the predominant AIGAs. 5% of families implemented cage aquaculture in local water bodies with assistance from local NGOs (Table 4).

3.6.2 Migration and Diversification:

During fishing prohibitions, 22% of families engaged in seasonal migration for labor purposes. Fifteen percent of respondents reported diversification into small enterprises, including grocery stores and seafood trade.

3.6.3 Community Initiatives:

Eighteen percent of families reported engaging in cooperative fishing efforts and resource-sharing agreements, such as joint ownership of boats and nets. Informal savings clubs assisted 12% of households in consolidating resources for emergency needs or investment in fishing apparatus.

3.7 The perspectives on policy and Government Assistance:

3.7.1 Fishing Bans and Compensation:

Table 1. Demographic Profile of Fishing Communities

Category	Value
Total Households Surveyed	300
Age Distribution	62% (30–45 years), 12% (>55 years)
Gender Distribution	Male: 96%, Female: 4%
Education Levels	Illiterate: 48%, Primary: 15%, Secondary: <5%

Table 2. Employment and Income Trends

Activity	Percentage of Households	Monthly Income (BDT)
Fishing as Primary Activity	80%	Peak: 13,000, Off-Season: 6,000
Alternative Livelihoods	20%	-
Common AIGAs	Chicken Rearing (9%), Vegetable Gardening (6%), Fish Processing (3%)	-

Table 3. Challenges Faced by Fishing Communities

Challenge	Details	Percentage of Households
Financial	Earnings < Poverty Line (BDT 10,000)	70%
	Reliance on High-Interest Loans	64%
Ecological	Declining Fish Stocks	85%
	Climate-Related Disasters (Floods, Erosion)	26%
Social	Limited Access to Education	High Dropout Rates
	Insufficient Healthcare	72%

Table 4. Adaptation Strategies

Strategy	Adoption Rate	Examples
AIGAs	35%	Poultry Farming, Vegetable Gardening
Seasonal Migration	22%	Labor Work in Urban Areas
Community Initiatives	18%	Cooperative Fishing, Informal Savings Groups

Table 5. Policy and Government Assistance

Policy/Assistance Area	Key Findings	Percentage of Households
Fishing Bans Awareness	Acknowledged Ecological Benefits	78%
Compensation During Bans	Received Compensation	35%
Training and Development	Received Training	10%

Although 78% of respondents recognized the ecological advantages of periodic fishing prohibitions, barely 35% received compensation or subsidies during these intervals (Table 5). The respondents identified distribution inefficiencies and corruption as significant obstacles to obtaining government assistance.

3.7.2 Training and Development Initiatives:

Merely 10% of respondents said they had received training in alternative livelihoods or sustainable fishing techniques. Community members have shown interest in skill enhancement initiatives, namely in aquaculture and poultry farming.

3.8 Sustainability and Ways of Life:

This study employed the DFID Sustainable Livelihoods Framework to thoroughly examine the assets of fishing communities, emphasizing their significant challenges and strengths. Overfishing and habitat loss severely compromise natural capital, leading to a substantial decline in fish stocks and jeopardizing the community's primary source of income. Insufficient education and a lack of various skills constrain human capital, making community members more susceptible to income swings and less adaptable to economic changes. The deficiency of physical capital, particularly underdeveloped infrastructure like roads and storage facilities, impedes market access, diminishing prospects for economic growth. Conversely, social capital serves as a vital resource, with robust community networks and informal savings groups offering critical assistance and risk alleviation amid financial or environmental crises. The absence of substantial financial capital intensifies the community's vulnerabilities, as dependence on high-interest loans and restricted access to formal credit institutions perpetuates financial instability, leaving households with no sustainable options for economic resilience. This comprehensive research highlights the complex issues confronting fishing communities and the necessity for specific initiatives to enhance their resources.

4. Discussions

This study emphasizes the complex relationship between social, environmental, and institutional factors influencing the livelihoods of small-scale fishers along the Meghna River. The fishing communities around the Meghna River have significant socioeconomic challenges, including low income, high illiteracy rates, and limited access to formal banking institutions (Sunny et al., 2019; Sazzad et al., 2023). Over 70% of the examined households earn below the national poverty line, signifying widespread economic insecurity (Kuddus et al., 2022; Bari et al., 2023). Prior studies of fishing settlements around the Padma River similarly indicated inadequate income and dependence on debt as prevalent issues, consistent with our

findings (Islam et al., 2023). The dependence on high-interest loans from informal lenders is especially common in the Meghna region, exacerbating the cyclical nature of poverty. The high illiteracy rate (48%) severely limits fishermen's ability to diversify their livelihoods or interact with official banking institutions (Sunny et al., 2020; Kuddus et al., 2021). Education is a vital element in livelihood resilience; nevertheless, the lack of educational options perpetuates the vulnerability of these individuals (Chakma et al., 2022). Targeted initiatives, such as community schools and vocational training programs, may interrupt this cycle by equipping younger generations with skills for alternative income-generating activities (AIGAs).

However, 85% of participants identified diminishing fish populations as their foremost worry, attributing this issue to overfishing, habitat degradation, and climate change (Sunny et al., 2018). These findings align with research from other riverine fisheries in Bangladesh, where overexploitation and illegal fishing gear have disrupted natural balance (Islam et al., 2018a). Seasonal fishing limitations, vital for the conservation of fish populations, impose significant economic burdens on fishermen lacking alternative revenue sources during these periods (Islam et al., 2018a). This underscores the imperative for robust compensation mechanisms and effective enforcement to align conservation goals with livelihood needs. Climate change exacerbates issues since increased flooding and riverbank erosion threaten both natural resources and infrastructure (Islam et al., 2017). Twenty-six percent of households indicated the loss of boats and nets, demonstrating the ripple impact of climate-induced disasters on fishing communities (Islam et al., 2016; Sunny et al., 2017). Adaptation strategies, such as the advancement of climate-resilient infrastructure and the diversification of livelihoods, are essential for risk mitigation.

Despite these constraints, the study highlights many adaptation mechanisms employed by fishermen, including AIGAs, seasonal migrations, and community-based initiatives (Sunny et al., 2018). Inadequate skills and financial resources hinder the adoption of chicken husbandry and vegetable cultivation, which are common agricultural income-generating activities (AIGAs), by 18% (Islam et al., 2017). This study underscores the need for capacity-building activities and tailored financial support for fishing communities. 22% of families report seasonal migration as a technique to mitigate challenges during fishing bans or times of scarcity (Sunny et al., 2017). This method often destabilizes family units and exposes migrants to heightened hazards, including exploitative labor conditions. Policies that enhance local employment opportunities may reduce reliance on migration and its associated risks (Islam et al., 2016). Community-orientated

initiatives, such as shared ownership of fishing resources and informal savings groups, are crucial for enhancing social capital and reducing individual risk. These initiatives adhere to the best global practices in fisheries management, where cooperative models have shown improvements in resource sustainability and economic outcomes. Enhancing these activities with institutional support might amplify their efficacy (Sazzad et al., 2023). The study also identified significant shortcomings in governmental and institutional support for fishing communities. Despite 78% of respondents acknowledging the environmental benefits of fishing limitations, only 35% received compensation during these periods. This discrepancy signifies inefficiencies in resource allocation and distribution, often seen as barriers to sustainable fisheries management in Bangladesh. Enhancing transparency and accountability in these systems is crucial for cultivating trust and ensuring equitable support.

5. Conclusion

The livelihoods of small-scale fishers along the Meghna River are affected by environmental, social, and institutional issues. These groups are susceptible owing to little income, restricted education, and dependence on informal loan mechanisms. Overfishing, habitat deterioration, climate change, and seasonal fishing prohibitions intensify these vulnerabilities. Notwithstanding these problems, they have demonstrated resilience through adaptation tactics such as alternative income-generating activities (AIGAs), seasonal migration, and community-based projects. The restricted implementation of these initiatives underscores the necessity for focused interventions to enhance skills, offer financial assistance, and promote sustainable resource management. Government policies and institutional assistance are essential for enhancing the lives of small-scale fishermen. The DFID Sustainable Livelihoods Framework highlights substantial deficiencies in the natural, human, physical, financial, and social assets of fishing communities. It is imperative to address these gaps through a comprehensive strategy that integrates conservation initiatives with socioeconomic development to enhance resilience and guarantee the sustainability of both communities and the riverine ecosystem. Future initiatives must concentrate on region specific difficulties, augmenting educational access, diversifying revenue streams, and strengthening climate adaptation strategies. Cooperative initiatives involving governmental bodies, non-governmental organizations, and local stakeholders are crucial for establishing a supportive framework that promotes fisher welfare while preserving the biodiversity of the Meghna River.

Author contributions

All authors made equal contributions to the study design, statistical analysis, and drafting of the manuscript. The corresponding author,

along with the co-authors, reviewed and approved the final version of the article prior to submission to this journal.

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Competing financial interests

The authors have no conflict of interest.

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