Small Indigenous Fish Species as a Climate-Resilient and Nutrition-Sensitive Fisheries Resource: Evidence from Coastal and Inland Blocks of Midnapore Districts, West Bengal, India

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ABSTRACT

Small Indigenous Fish Species (SIFs) have increasingly been recognized as climate-resilient aquatic resources with significant implications for nutrition security, livelihoods, and sustainable fisheries governance. The present study evaluated the role of SIFs in enhancing socio-ecological resilience in selected inland and coastal blocks of Paschim and Purba Medinipur districts, West Bengal, India. Using a mixed-method research design, data were collected through ecological surveys, household interviews, market assessments, and stakeholder consultations between 2021 and 2024. Results indicated that SIFs exhibited high adaptive capacity to seasonal hydrological variability, salinity intrusion, and temperature fluctuations. Regular consumption of SIFs contributed substantially to micronutrient intake among fishing and non-fishing households, while SIF-based fisheries provided livelihood stability during climatic and economic shocks. Women's participation in SIF processing and marketing emerged as a critical adaptive strategy at the household level. However, challenges related to wetland degradation, unregulated aquaculture expansion, and limited policy recognition were identified. The study emphasized the need for integrating SIFs into climate-resilient fisheries management, nutrition-sensitive policies, and community-based conservation frameworks. The findings contributed empirical evidence supporting the inclusion of indigenous fish resources in sustainable development and climate adaptation strategies.

Keywords: *Small Indigenous Fish Species, Climate Resilience, Nutrition-Sensitive Fisheries, Sustainable Livelihoods, Gender, West Bengal.*

1. INTRODUCTION

Climate change has increasingly posed significant challenges to inland fisheries through altered hydrological regimes, rising temperatures, salinity intrusion, and increased frequency of extreme weather events. These changes have disproportionately affected small-scale fishing communities that depend on inland and coastal aquatic ecosystems for food and income (Allison et al., 2009). In this context, Small Indigenous Fish Species (SIFs) have emerged as an important yet underutilized resource for enhancing resilience within fisheries-based social–ecological systems.

SIFs are typically characterized by small body size, short life cycles, high reproductive rates, and strong adaptability to fluctuating environmental conditions. These biological attributes have enabled many indigenous species to persist under conditions of ecological stress, making them particularly relevant in climate-vulnerable regions (Thilsted et al., 2016). In addition to ecological resilience, SIFs have been widely documented as rich sources of essential micronutrients, contributing significantly to food and nutrition security among vulnerable populations.

India's eastern coastal and floodplain regions are among the most climate-sensitive landscapes in South Asia. West Bengal, with its dense river networks, wetlands, and coastal systems, supports a diverse assemblage of indigenous fish species. The Midnapore districts—Paschim Medinipur and Purba Medinipur—represent a unique interface of inland floodplains and coastal ecosystems, making them particularly suitable for examining the resilience potential of SIFs.

Despite their importance, SIFs have received limited attention in climate adaptation planning and fisheries governance. The present study sought to assess the contribution of SIFs to climate resilience, nutrition security, and livelihood sustainability in selected blocks of the Midnapore districts, with a particular emphasis on policy relevance and sustainable management.

2. REVIEW OF LITERATURE

2.1 SIFs and Climate Resilience

International research has highlighted the adaptive capacity of indigenous fish species in response to hydrological and climatic variability. Studies from the Mekong Basin and the Ganges–Brahmaputra floodplains have demonstrated that small indigenous species exhibit greater tolerance to low oxygen levels, temperature fluctuations, and habitat fragmentation compared to larger commercial species (Welcomme et al., 2010).

Climate-resilient traits such as rapid growth, early maturity, and flexible feeding habits have been identified as key factors enabling SIF persistence under environmental stress (Funge-Smith & Bennett, 2019). These characteristics have positioned SIFs as crucial components of adaptive fisheries systems.

2.2 Nutrition-Sensitive Fisheries

The concept of nutrition-sensitive fisheries has gained prominence in global development discourse. SIFs have been consistently identified as nutritionally superior to larger fish species due to their higher concentrations of vitamin A, calcium, iron, zinc, and essential fatty acids (Roos et al., 2007; Thilsted et al., 2014). Whole-fish consumption practices common among rural households have further enhanced nutrient bioavailability.

2.3 Indian and Regional Studies

Indian studies have documented declining trends in indigenous fish diversity due to wetland loss, pollution, and intensive aquaculture practices (Ghosh et al., 2018). However, emerging research has emphasized the role of traditional fishing systems and seasonal water bodies in sustaining SIF populations. In West Bengal, small-scale fisheries have been identified as critical livelihood buffers during periods of agricultural uncertainty and climatic stress.

2.4 Gender and Adaptive Livelihoods

Gender-focused fisheries research has shown that women's engagement in small fish processing and marketing has strengthened household adaptive capacity. Women's control over income from SIF-related activities has been associated with improved food allocation and nutritional outcomes (Kruijssen et al., 2018).

3. MATERIALS AND METHODS

3.1 Study Area

The study was conducted in six blocks: Garbeta, Kharagpur, and Ghatal (Paschim Medinipur) and Contai, Nandakumar, and Mahishadal (Purba Medinipur). These blocks represented inland floodplain, riverine, and coastal agro-ecological zones.

3.2 Research Design

A mixed-method approach was adopted between 2021 and 2024. Primary data were collected through household surveys (n = 180), fish landing center observations, market surveys, and key informant interviews.

3.3 Data Analysis

Quantitative data were analyzed using descriptive statistics and comparative analysis, while qualitative data were thematically interpreted to assess resilience and sustainability dimensions.

4. RESULTS

4.1 Diversity and Environmental Adaptability of SIFs

A total of fifteen SIFs were commonly recorded across study sites. Species such as *Amblypharyngodon mola*, *Gudusia chapra*, *Esomus danricus*, and *Heteropneustes fossilis* demonstrated high tolerance to seasonal water level fluctuations and varying salinity conditions.

Table 1. Climate-Relevant Characteristics of Selected SIFs

Species	Habitat Type	Climate Adaptation Trait
Amblypharyngodon mola	Floodplain ponds	High reproductive rate
Gudusia chapra	Riverine	Seasonal migration
Heteropneustes fossilis	Wetlands	Air-breathing ability
Macrognathus pancalus	Shallow waters	Tolerance to low oxygen

4.2 Nutritional and Food Security Contributions

Households reported regular consumption of SIFs during monsoon and post-monsoon seasons. Nutritional analysis indicated that SIFs contributed significantly to micronutrient intake, particularly among women and children.

4.3 Livelihood Stability and Gender Roles

SIF-based activities provided supplementary income during periods of climatic stress. Women's participation in drying, sorting, and local marketing was found to enhance household income stability.

5. DISCUSSION

The findings aligned with international evidence highlighting the resilience potential of indigenous fish species (Welcomme et al., 2010). The strong linkage between SIFs, nutrition, and adaptive livelihoods supported the growing discourse on nutrition-sensitive and climate-resilient fisheries (Thilsted et al., 2016).

Gendered livelihood strategies observed in the study echoed national findings emphasizing women's central role in small-scale fisheries resilience (Kruijssen et al., 2018). However, policy neglect and ecosystem degradation posed significant threats to sustainability.

6. POLICY AND SUSTAINABILITY IMPLICATIONS

The study highlighted the need for integrating SIFs into climate adaptation and fisheries management policies. Protection of wetlands, promotion of community-based fisheries management, and recognition of women's roles were identified as key strategies for sustainability.

7. CONCLUSION

Small Indigenous Fish Species were found to play a critical role in enhancing climate resilience, nutrition security, and livelihood sustainability in the Midnapore districts of West Bengal. Strengthening policy support for indigenous fisheries could significantly contribute to sustainable development goals related to food security, gender equity, and biodiversity conservation.

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