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Reduction of Fish Biodiversity in Meerut: An Emerging Risk to Natural Aquatic Fauna

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Fish biodiversity is a key indicator of aquatic ecosystem health and ecological stability. In recent years, the freshwater bodies of Meerut district, Uttar Pradesh, have shown noticeable alterations in species composition, abundance, and distribution. Rapid urbanization, industrial discharge, agricultural intensification, and habitat modification have collectively contributed to the decline of indigenous fish fauna. This article critically examines the causes, ecological consequences, and potential mitigation strategies associated with the reduction of fish biodiversity in Meerut. The issue is not merely ecological but also socio-economic, as fisheries contribute significantly to rural livelihoods and nutritional security. A sustainable management framework integrating conservation biology, pollution control, and community participation is urgently required to prevent irreversible biodiversity loss.

Introduction

Freshwater ecosystems are among the most threatened habitats globally, despite supporting a disproportionately high level of biodiversity relative to their geographic area. India is home to a rich diversity of freshwater fishes, with more than 2,500 species reported across rivers, lakes, reservoirs, and wetlands. The Gangetic plains, including regions like Meerut, historically supported diverse fish communities dominated by carps, catfishes, murrels, and small indigenous species. Meerut district, located in western Uttar Pradesh, is influenced by the Ganga canal system and several local water bodies. Traditionally, these aquatic systems supported economically and ecologically important species such as *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Wallago attu*, and various minor carps and indigenous fishes. However, recent trends indicate a gradual reduction in native fish diversity, accompanied by the dominance of pollution-tolerant and exotic species. This shift reflects environmental stress and ecological imbalance within the aquatic systems of the region.

Major Causes of Fish Biodiversity Decline in Meerut

1. Industrial and Domestic Pollution: Meerut is a rapidly urbanizing district with expanding industrial activities, including sugar mills, textile units, paper industries, and small-scale manufacturing units. Untreated or partially treated effluents discharged into canals and rivers elevate biochemical oxygen demand (BOD), chemical oxygen demand (COD), and heavy metal concentrations. Increased organic load reduces dissolved oxygen levels, adversely affecting sensitive fish species. Chronic exposure to heavy metals such as cadmium, lead, and chromium impairs reproductive capacity, growth, and immune function in fish populations. Over time, this results in reduced recruitment and population decline of sensitive species.

2. Agricultural Runoff and Eutrophication: The surrounding areas of Meerut are agriculturally intensive, with high usage of fertilizers and pesticides. During rainfall and irrigation events, runoff carries nutrients (nitrogen and phosphorus) and agrochemicals into

nearby water bodies. Excessive nutrient loading leads to eutrophication, promoting algal blooms. While algae initially increase primary productivity, subsequent decomposition depletes dissolved oxygen, causing hypoxic or anoxic conditions. Such environments favor hardy species while eliminating oxygen-sensitive native fish, thereby reducing overall biodiversity.

3. Habitat Modification and Water Diversion: Canalization, embankment construction, dredging, and sand mining significantly alter the natural hydrological regime of rivers and wetlands. Structural modifications reduce habitat heterogeneity, eliminate spawning grounds, and disrupt migratory routes. Water abstraction for irrigation further lowers water levels, particularly during summer months. Reduced flow velocity and depth negatively impact breeding cycles and larval survival of many native species. Over time, habitat simplification results in biological homogenization.

4. Introduction of Exotic and Invasive Species

The culture and accidental release of exotic species such as *Oreochromis niloticus* (Nile tilapia) and *Clarias gariepinus* (African catfish) have created competitive pressure on indigenous fish fauna. These species often exhibit rapid growth, high reproductive rates, and broad environmental tolerance. Their dominance leads to competition for food and space, predation on eggs and juveniles of native fishes, and eventual displacement of local biodiversity.

5. Overfishing and Unsustainable Harvest Practices

Unregulated fishing using fine-mesh nets captures juvenile fishes before they attain reproductive maturity. This practice disrupts recruitment and reduces breeding stock biomass. Additionally, destructive fishing methods such as poisoning or electrofishing cause indiscriminate mortality, affecting both target and non-target species. Without effective regulation and monitoring, fish populations fail to recover naturally.

Ecological and Socio-Economic Consequences

The decline in fish biodiversity has cascading ecological effects. Fish occupy multiple trophic levels, acting as primary consumers, predators, and prey. A reduction in species diversity destabilizes food webs, alters nutrient cycling, and diminishes ecosystem resilience to environmental stress. From a socio-economic perspective, fisheries support rural communities by providing protein-rich food and income. Loss of native species reduces fishery productivity and threatens livelihood security. Moreover, indigenous species often possess higher cultural and market value compared to exotic species. Biodiversity loss also reduces genetic resources that may be important for future aquaculture improvement, disease resistance breeding, and climate adaptation.

Climate Change as an Emerging Driver

Rising temperatures, irregular rainfall patterns, and extreme weather events further stress freshwater ecosystems. Increased water temperature reduces dissolved oxygen solubility and alters metabolic rates in fish. Climate variability may compound existing anthropogenic pressures, accelerating biodiversity decline in Meerut's aquatic systems.

Conservation and Management Strategies

Addressing fish biodiversity decline requires a multi-dimensional approach:

1. **Strengthening Pollution Control:** Strict enforcement of effluent treatment norms and regular monitoring of water quality parameters.
2. **Promotion of Sustainable Agriculture:** Adoption of integrated nutrient management and reduction of chemical pesticide usage.
3. **Habitat Restoration:** Re-establishment of natural flow regimes, wetland conservation, and protection of spawning grounds.
4. **Regulation of Exotic Species:** Controlled aquaculture practices and prohibition of invasive species introduction.

5. **Community-Based Fisheries Management:** Involving local fishers in conservation planning and promoting awareness programs.
6. **Scientific Monitoring:** Periodic biodiversity assessment using ecological indices such as Shannon-Wiener and Simpson diversity indices.

Integration of ecological science with policy implementation is essential to ensure long-term sustainability.

Conclusion

The reduction of fish biodiversity in Meerut represents a significant ecological warning signal. Anthropogenic pressures—ranging from pollution and agricultural runoff to habitat modification and invasive species—have collectively disrupted aquatic ecosystems. If immediate corrective measures are not implemented, irreversible loss of native fish fauna may occur. Sustainable water resource management, pollution mitigation, community participation, and scientific monitoring must be prioritized to restore ecological balance. Protecting fish biodiversity is not only an environmental obligation but also a socio-economic necessity for ensuring food security and livelihood stability in the region.

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