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# Aquatic Biodiversity and Sustainable River Ecosystems: Insights from Gangetic Dolphins and Freshwater Turtles in the Context of NEP 2020

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**ABSTRACT**

Rivers are dynamic ecological systems that support biodiversity, human livelihoods, and cultural traditions. The Ganga River, one of the most significant river systems in India, sustains diverse aquatic fauna, including the Gangetic dolphin (*Platanista gangetica*) and freshwater turtles such as *Batagur baska*. These species are widely recognized as ecological indicators due to their sensitivity to changes in water quality and habitat conditions. However, increasing anthropogenic pressures, including industrial effluents, domestic sewage, and agricultural runoff, have significantly degraded the ecological integrity of the river.[1] This paper presents a secondary data–based analysis to examine the relationship between water quality and the population status of these aquatic species in the middle Ganga basin. Existing studies indicate that elevated levels of biochemical oxygen demand (BOD) and chemical oxygen demand (COD), along with reduced dissolved oxygen, have adversely affected aquatic life.[2] Furthermore, the presence of heavy metals such as chromium in industrial zones has intensified ecological stress.[3] The study also highlights the relevance of these findings in the context of the National Education Policy (NEP) 2020, which emphasizes sustainability, environmental awareness, and multidisciplinary learning. By integrating ecological knowledge into educational frameworks, it is possible to promote conservation-oriented thinking and community

participation.The paper concludes that aquatic megafauna such as dolphins and freshwater turtles serve as effective bioindicators of river health and should be central to conservation strategies aimed at restoring the ecological balance of the Ganga River.

## 1. Introduction

Rivers constitute dynamic and life-supporting ecosystems that play a fundamental role in maintaining ecological balance, sustaining biodiversity, and supporting human civilizations. They regulate hydrological cycles, facilitate nutrient transport, and provide essential ecosystem services such as water supply, fisheries, and habitat provision. Among the major river systems of the world, the Ganga River occupies a unique position due to its immense ecological, economic, and cultural significance. Often regarded as the lifeline of northern India, the river sustains millions of people while simultaneously supporting a diverse assemblage of aquatic flora and fauna. It serves as a habitat for several endangered and endemic species, including the Gangetic dolphin (*Platanista gangetica*) and freshwater turtles such as *Batagur baska*, which are integral components of the riverine ecosystem.[4]

The ecological importance of the Ganga extends beyond its biodiversity, as it also functions as a critical ecological corridor connecting various habitats across the Indo-Gangetic plains. However, in recent decades, the ecological integrity of the river has been severely compromised due to increasing anthropogenic pressures. Rapid urbanization along riverbanks, expansion of industrial activities, and intensification of agriculture have significantly altered the natural characteristics of the river system. The discharge of untreated or partially treated sewage, industrial effluents, and agricultural runoff has led to substantial deterioration in water quality.[5] These pollutants increase the organic and chemical load in the river, resulting in elevated biochemical oxygen demand (BOD) and chemical oxygen demand (COD), which in turn reduce dissolved oxygen levels essential for aquatic life.

The decline in water quality has far-reaching consequences for aquatic biodiversity. Reduced oxygen availability, toxic contamination, and habitat alteration disrupt food chains and affect species at multiple trophic levels. Sensitive species, particularly aquatic megafauna such as dolphins and freshwater turtles, are among the first to be impacted. The Gangetic dolphin, being an apex predator, depends on a stable and healthy aquatic ecosystem with adequate prey availability and suitable hydrological conditions. Similarly, freshwater turtles require specific habitat features such as clean water, undisturbed sandbanks for nesting, and balanced ecological conditions for survival and reproduction. The degradation of these

environmental parameters has led to a noticeable decline in their populations across several stretches of the river.

Aquatic megafauna are widely recognized as **bioindicators** because their presence, distribution, and behavior reflect the ecological status of the river.[6] Changes in their population dynamics often signal broader environmental disturbances, including pollution, habitat fragmentation, and overexploitation of resources. Therefore, studying these species provides valuable insights into the overall health of river ecosystems and helps in identifying critical areas requiring conservation intervention.

In addition to ecological concerns, the conservation of river biodiversity has gained increasing importance in policy and educational frameworks. The National Education Policy (NEP) 2020 emphasizes environmental sustainability, multidisciplinary learning, and the integration of local and traditional knowledge systems into education.[7] The study of river ecosystems, particularly through flagship species such as dolphins and turtles, aligns with these objectives by promoting ecological awareness and fostering a sense of environmental responsibility among learners.

Furthermore, incorporating river ecology into educational and research frameworks can bridge the gap between scientific knowledge and community participation. Local communities, especially those dependent on river resources, possess valuable ecological knowledge that can complement scientific research and contribute to more effective conservation strategies. In this context, the integration of ecological studies with educational policies not only enhances academic understanding but also supports sustainable development goals.

Thus, the present study situates the ecological assessment of aquatic biodiversity within a broader interdisciplinary framework, linking environmental science, conservation biology, and educational policy. By focusing on key indicator species such as the Gangetic dolphin and freshwater turtles, it seeks to provide a comprehensive understanding of river health and highlight the urgent need for sustainable management of the Ganga River ecosystem.

## 2. Review-Based Analytical Framework

The present study is based on a synthesis of secondary data derived from previous research, government reports, and ecological studies related to the Ganga River. Numerous studies have documented the deterioration of water quality due to anthropogenic activities. Elevated levels of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) have been widely reported, indicating high organic pollution loads.[8]

Such conditions lead to oxygen depletion, making the aquatic environment unsuitable for many species. Research on the Gangetic dolphin has shown that pollution, habitat fragmentation, and reduced prey availability are major factors contributing to its population decline.[9] Similarly, freshwater turtles, particularly *Batagur baska*, have been severely affected by habitat loss, pollution, and human interference.[10]

Studies on industrial pollution have revealed the presence of toxic heavy metals such as chromium in river sediments, especially in regions influenced by tannery effluents.[11] These contaminants accumulate in aquatic organisms, posing long-term ecological risks. Agricultural runoff further contributes to nutrient enrichment and pesticide contamination, which negatively affect aquatic biodiversity.[12]

The literature also highlights the importance of integrating scientific research with policy frameworks and community knowledge. Environmental education, as emphasized in NEP 2020, plays a crucial role in bridging this gap and promoting sustainable river management.[13]

## 3. Objectives of the Study

The present research paper aims to:

1. To analyze the relationship between water quality and aquatic biodiversity in the Ganga River using secondary data.
2. To examine the ecological significance of Gangetic dolphins and freshwater turtles as indicators of river health.
3. To identify major anthropogenic factors affecting river ecosystems.
4. To explore the relevance of river biodiversity conservation in the context of NEP 2020.

## 4. Research Methodology

The present study is based on a **secondary data–oriented research design**, aimed at synthesizing existing knowledge on water quality and aquatic biodiversity in the Ganga River. Secondary data were collected from a wide range of sources, including peer-reviewed journal articles, government reports, institutional publications, and previous ecological studies related to river systems in India.

The methodology involves a **systematic review and analytical interpretation** of available data on key water quality parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical

oxygen demand (COD), and heavy metal contamination. These parameters were examined in relation to the habitat requirements and ecological behavior of the Gangetic dolphin and freshwater turtles.[14]

In addition, studies focusing on species distribution, habitat use, and anthropogenic threats were analyzed to identify common patterns and trends. Emphasis was placed on literature related to the **middle Ganga basin**, particularly regions influenced by industrial, agricultural, and urban activities.

The approach adopted in this study is qualitative and interpretative in nature, aiming to establish **ecological linkages** between environmental degradation and species decline. The methodology aligns with interdisciplinary research practices, combining ecological science, environmental policy, and sustainability perspectives.[15]

## 5. Discussion

The analysis of secondary data reveals a strong relationship between **water quality degradation and declining aquatic biodiversity** in the Ganga River. Several studies have consistently reported that high levels of organic pollution, reflected in elevated BOD and COD values, lead to reduced dissolved oxygen, thereby creating unfavorable conditions for aquatic organisms.[16]

The Gangetic dolphin, being an apex predator, is highly sensitive to such environmental changes. Declining fish populations, caused by pollution and habitat degradation, directly affect its survival. Habitat fragmentation due to barrages and reduced water flow further limits dolphin movement and breeding opportunities.[17] Similarly, freshwater turtles, particularly *Batagur baska*, are affected by both water pollution and physical habitat disturbances. The loss of sandbanks due to sand mining and riverbank modification reduces nesting sites, while contamination of water and sediments affects their feeding and reproductive success.[18] Industrial pollution, especially from tannery and chemical industries, introduces heavy metals such as chromium and lead into the river ecosystem. These substances accumulate in aquatic organisms and disrupt physiological processes, leading to long-term ecological consequences.[19] Agricultural runoff contributes additional stress through nutrient enrichment and pesticide contamination, which can alter food chains and ecosystem dynamics.[20]

The discussion also highlights the importance of considering **human dimensions** in river ecology. Local communities, particularly fishermen, have observed changes in species occurrence over time, indicating a gradual decline in aquatic biodiversity. Such observations align with scientific findings and emphasize the need for integrating local ecological knowledge into conservation strategies.[21]

## 6. Findings

Based on the synthesis of secondary data, the following key findings emerge:

1. **Water quality degradation is a major driver of biodiversity loss** in the Ganga River. Elevated BOD, COD, and heavy metal contamination significantly affect aquatic habitats.[22]

2. **Gangetic dolphins serve as reliable bioindicators**, reflecting changes in water quality, prey availability, and habitat continuity. Their declining population indicates increasing ecological stress.[23]

3. **Freshwater turtles are highly vulnerable** to both chemical pollution and physical habitat disturbance, particularly the loss of nesting sites due to sand mining and riverbank alteration.[24]

4. **Anthropogenic activities such as industrial discharge, agricultural runoff, and unregulated fishing** are the primary contributors to ecological degradation.[25]

5. **There is a strong need for integrated conservation approaches** that combine scientific research, policy intervention, and community participation.[26]

## 7. Relevance in the Context of NEP 2020

The findings of this study have significant implications in the context of the National Education Policy (NEP) 2020, which emphasizes **environmental sustainability, multidisciplinary learning, and experiential education**.[27]

The study of river ecosystems and aquatic biodiversity provides an opportunity to integrate ecological knowledge into educational curricula. By incorporating case studies on the Ganga River, dolphins, and freshwater turtles, educational institutions can promote awareness of environmental issues and encourage critical thinking among students.

NEP 2020 also highlights the importance of **local knowledge systems and community engagement**. In this context, the experiences of river-dependent communities can be incorporated into educational and conservation programs, thereby bridging the gap between scientific knowledge and practical understanding.[28]

Furthermore, promoting environmental education aligned with sustainability goals can contribute to long-term conservation outcomes by fostering responsible behavior and ecological sensitivity among future generations.[29]

## 8. Conclusion

The present study demonstrates that aquatic biodiversity in the Ganga River is closely linked to water quality and environmental conditions. The Gangetic dolphin and freshwater turtles serve as important indicators of river health, reflecting the cumulative impact of anthropogenic activities on aquatic ecosystems.

The degradation of water quality due to pollution and habitat disturbance has significantly affected these species, highlighting the urgent need for conservation measures. The study emphasizes the importance of adopting an integrated approach that combines scientific research, policy implementation, and community participation.

In the context of NEP 2020, the integration of environmental education and sustainability into academic frameworks can play a crucial role in promoting conservation awareness and responsible resource management. Protecting aquatic biodiversity is not only essential for ecological balance but also for ensuring the long-term sustainability of river ecosystems such as the Ganga.

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