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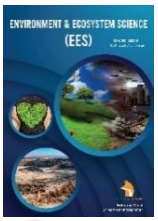

RESEARCH ARTICLE

RIVER ENCROACHMENT IN BARISHAL CITY AND ITS EFFECTS ON AQUATIC BIODIVERSITY AND THE SURROUNDING ECOSYSTEM

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ABSTRACT

River encroachment in Barishal City has emerged as a critical environmental problem, drastically affecting aquatic biodiversity and the native ecosystem. The present study investigates the causes, consequences, and potential solutions to this issue. Barishal, with its extensive network of rivers like the Kirtankhola, Arial Khan, and Tetulia rivers, has traditionally relied on these rivers for transportation, farming, and trade. Despite this, augmented urbanization, industrialization, and unchecked building on riverbanks have led to the encroachment of the rivers. This, in turn, has caused habitat loss, reduced water quality, and disruption in the balance of ecology, severely threatening aquatic life. Added to this, the environmental consequence in the form of increased flood risk, modification of river flow regimes, and loss of important ecosystem services adds complexity to the issue. Preventing this crisis requires sustainable city planning, strict regulatory measures, and increased community awareness to promote the long-term conservation of Barishal's riverine ecosystem and aquatic biodiversity. Urgent recovery measures are necessary to prevent further degradation and ensure the sustainability of the region's riverine ecosystem.

KEYWORDS

River encroachment, aquatic biodiversity, loss of habitat, urbanization, environmental influence, ecosystem sustainability.

1. INTRODUCTION

Barishal, also known as the "Venice of the East," is a city built on the river in the southern deltaic region of Bangladesh. Barishal is crossed by numerous rivers, including the Kirtankhola, Arial Khan, and Tetulia, which have long been integral to the city's transport, cultivation, trade, and overall environmental equilibrium. However, unchecked and haphazard urbanization, coupled with industrial activities and human habitation, has significantly threatened such water bodies, thus leading to severe environmental and socio-economic consequences. River encroachment, the illegal occupation or alteration of the riverbanks and floodplains, has become an increasing trend in Barishal.

Unauthorized landfill dumping, unauthorized construction, industrial encroachment, and uncontrolled waste disposal have resulted in river reduction and pollution, thus endangering aquatic biodiversity and disrupting the accompanying ecosystem. The lowering of the water quality, aquatic habitat deterioration, and decline of native fish species are some of the shocking implications. In addition, encroachment alters the natural flow of rivers, increases flood risks, and decreases important ecosystem services, and thus amplifies the environmental crisis in the region. The impact of river encroachment in Barishal extends beyond environmental degradation; it has socio-economic implications too. Loss of navigable water courses affects fishing and river transport-based livelihood and increased flooding and waterlogging quite critically threaten adjacent communities. Its solution requires a holistic approach, i.e., sustainable urban planning, strict enforcement of rules, and public sensitization in order to preserve Barishal's vital river system and its natural balance. The study will examine the extent of river encroachment in Barishal, its primary causes, and its impact on freshwater biodiversity as well as the environment. Further, it seeks to explore potential mitigation efforts that harmonize urbanization with environmental conservation, rendering Barishal's riverine system sustainable in the long term.

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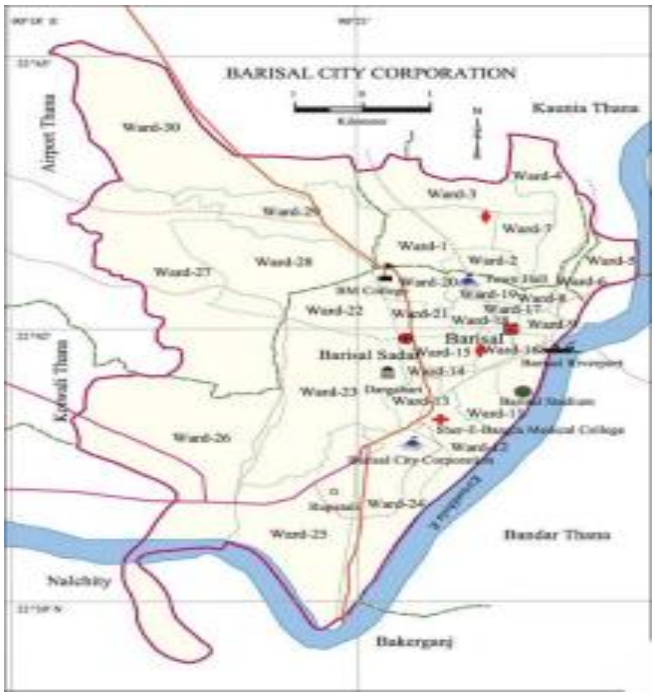

Figure 1: Location and basic topographic features of

Barishsl City

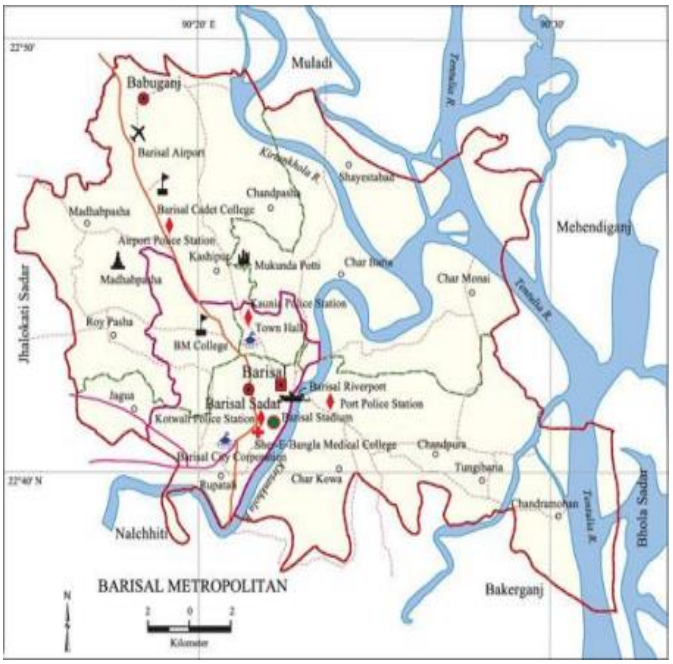

Figure 2: Location and basic topographic features of Barishal Metropolitan

2. Reasons for Encroachment of Rivers in Barishal City

Barishal, a southern city in Bangladesh, has been traditionally dependent on its extensive network of rivers for transportation, commerce, agriculture, and ecological balance. However, high-rate urbanization and human activities have caused alarming encroachment of its rivers, leading to widespread loss of aquatic biodiversity and the surrounding ecosystem. The major reasons for river encroachment in Barishal City are presented below:

2.1 Unplanned Urban Growth

The increased population and urbanization of Barishal City have increased the pressure on land, leading to unauthorized occupation of riverbanks. Residential settlements and commercial

structures have encroached more and more on important waterways such as the Kirtankhola, Arial Khan, and Tetulia rivers, narrowing their width and disrupting natural flow regimes.

2.2 Illegal Landfilling and Infrastructure Development

Unauthorized landfilling is also among the major contributors to Barishal's river encroachment. People and developers use soil, sand, and construction waste to land-scap riverbanks and wetlands in order to create housing, business, and industrial plots. Landfilling alters the river's dynamics, increases the levels of flood risk, and reduces the available habitat for aquatic life.

2.3 Industrial Expansion and Pollution

Industrial growth along riverbanks has resulted in physical encroachment and intensive pollution. All industries discharge untreated wastes, chemicals, and heavy metals into rivers without treatment, deteriorating the quality of water and posing risks to aquatic life. Unrestrained expansion in factories, warehouses, and wharves has also led to the occupation of riverfront areas, further narrowing river channels.

2.4 Solid Waste Dumping

Throwing solid wastage into rivers in an unscientific way is a growing concern in Barishal. Household and industrial waste, including plastic, sewage, and toxic chemicals, find their way into the water bodies, accelerating sedimentation and encroachment. Over time, the wasteland becomes stable enough to be encroached upon by land, leading to the gradual loss of river area.

2.5 Encroachment by Commercial Establishments

Markets, fish landing sites, and other business centers spread to riverbanks without the appropriate permits. Enterprises and traders put up temporary and permanent structures on river land, further congesting waterways and contaminating the environment. Many of these ventures end up being permanent settlements, worsening the issue of encroachment.

2.6 Poor Urban Planning and Regulation

Inadequate enforcement of land and environmental legislation has played a significant role in Barishal river encroachment. Despite legal action, the majority of the encroachments go unchecked due to a lack of monitoring, political pressure, and corruption. Insufficiently planned urban development that includes river conservation exacerbates the issue.

2.7 Lack of Awareness and Community Involvement

One of the main causes of river encroachment is a lack of awareness among the local population and authorities regarding the long-term implications. Several individuals and businesses engage in encroachment unknowingly of the impact on the environment. Lack of proper community engagement in river conservation schemes also makes way for uncontrolled encroachment.

3. Effects of River Encroachment

River encroachment in Barishal City, like in the majority of cities in Bangladesh, has brought forth catastrophic negative impacts on the environment and the population. River encroachment exerts a number of negative impacts on the surrounding environment including hindrance of the natural flow of rivers, water pollution, adverse impact on public health, impact on the ecosystem, etc. according to (Mahmood et al., 2017). The satellite image analysis shows that, since 2002, the river encroachment has steadily increased, and by 2019, the river width in the three unions has significantly declined (Rahman et al., 2022; Hoque et al., 2021). During the study period, the river width was reduced from 90 feet to 6 feet due to the encroachment by construction houses and other infrastructure (Fattah et al., 2021). This significantly reduced natural water flow and water velocity, resulting in waterlogging problems during the monsoon season and a water crisis during the summer and winter seasons. Zhang et al. state that morphological changes in the channel resulting from siltation or encroachment will result in changes in the channel's elevation and slope (Zhang et al., 2019).

River encroachment through landfilling, unauthorized buildings, and industrialization is creating a chain of negative impacts that harm aquatic life, destabilize the ecosystem, and erode the sustainability of natural resources. The most significant impacts of river encroachment in Barishal are as follows:

One of the most obvious effects of river encroachment in Barishal is the obstruction of natural water flow. River encroachments in the guise of illegal constructions, landfilling, and dumping of wastes reduce river width and alter river courses, causing a loss of natural hydrologic processes. These alterations cause reduced river flow rates, which increase waterlogging during monsoons and water scarcity during dry periods. Constricted rivers lose their ability to flush out pollutants, and hence, water quality reduces significantly. Industrial effluent pollutants,

domestic waste, and chemicals get accumulated, and the rivers become unfit for drinking, agriculture, and other domestic uses. River encroachment leads to river channel narrowing, which directly affects flooding and waterlogging. In Barishal, due to ongoing encroachment, rivers such as the Kirtankhola and Arial Khan have been losing their stormwater runoff retention capacity.

Blockage of these natural water channels increases the vulnerability of the area under heavy rainfall. Stagnant water in urban and rural areas due to waterlogging, as a usual phenomenon in the city, causes obstacles to daily life, damages crops, and promotes unsanitary conditions. Riverbank and wetland encroachment significantly reduces aquatic habitat. With the river channels constricted and the quality of water reduced, living organisms that thrive in clean running water, such as fish and other aquatic organisms, have deteriorated living conditions. Habitat loss, coupled with pollution, threatens the existence of indigenous aquatic organisms and compromises the stability of the ecosystem. Living organisms that rely on healthy riverine ecosystems for breeding, foraging, and hiding are the most impacted. This results in loss of biodiversity and potential extinction of some organisms. River encroachment also threatens the livelihood of farmers and fishermen. Encroachment and river pollution reduce water for irrigation, hence crop yields. Farmers are becoming more and more forced to struggle with water level fluctuation and pollution of water sources, resulting in a drop in agricultural production. Similarly, fishing communities dependent on fishing for livelihood are facing a reduction in fish stock, and this translates directly to a drop in their income levels and food security. Wetland and floodplain destruction, which is significant in flood regulation and nutrient cycling, also hinders natural soil replenishment, leading to a drop in agricultural production. Water pollution caused by encroachment in the Barishal rivers has serious health consequences for the inhabitants. Contaminated water is an ideal breeding ground for waterborne diseases like cholera, dysentery, and typhoid. The poor quality water also creates a suitable condition for the growth of hazardous pathogens and bacteria, causing the outbreak of diseases, particularly in areas where the inhabitants use river water for household purposes. The issue is further complicated by the presence of poisonous chemicals from industries with long-term health consequences for humans and wildlife.

Groundwater depletion Rivers and canals are also principal means of groundwater recharge because they facilitate stormwater runoff to permeate and recharge groundwater aquifers. When rivers, however, are encroached and their natural drainage choked, the ability of such water bodies to recharge groundwater is gravely undermined. Barishal River and canal encroachment are leading natural drainage systems to deteriorate, and this is also aggravating groundwater resource depletion. This is further being accelerated by rising water demand as a consequence of the speedy urbanization of the city, leading to chronic water scarcity issues. The encroachment of the Barishal River has negative consequences for the valuable ecosystem services that rivers provide. Wetlands, floodplains, and river banks are naturally occurring filters for purifying water, regulating flooding, providing a habitat for flora and fauna, and sustaining domestic agriculture. Gradually, if the encroachment goes unchecked, the role of the wetlands and the rivers in the delivery of such crucial services and the overall condition of the ecosystem reduced.

Additionally, the devastation of such natural places increases the exposure of the city to climate related disasters in the form of floods and droughts.

4. Effects of Aquatic Species Extinction by Encroachment

River grabbing in Barishal City resulted in the loss of considerable aquatic biota, with the disturbance in the ecosystem balance. The major impacts are:

Illegal dumping in landfill sites and illegal constructions and industrialization shrink the aquatic fauna's natural habitat and lead to a reduction in fish populations and other aquatic fauna. Encroachment promotes industrial effluent releases, sewage, and solid waste disposal into water bodies and leads to toxic contamination with the following effects on aquatic life: Pollutants and increased sedimentation lower the amounts of dissolved oxygen, making it difficult for aquatic animals like fish and other organisms to breathe. The majority of fish species rely on floodplains and riverbanks for spawning, which are being destroyed due to encroachment, hence the rate of reproduction is reduced. The decline of native fish populations affects the local fishermen's livelihood and sidelines the socio-economic feasibility of fishing communities. Pollution and deforestation cause the extinction of local species but create vacancies for the invasive species which in turn upset the balance of the ecosystem. The extinction of big aquatic animals impacts the predators and the prey in the food chain and causes a disturbance in the ecosystem around it.

5. Conclusion

Barishal City's river encroachment seriously threatens aquatic biodiversity and the ecosystem through habitat destruction, water contamination, and disturbance to the natural hydrological regime. Irresponsible development in the form of uncontrolled expansion in private land use, industrialization, and thoughtless landfilling badly damaged the health of the rivers and impacted

the local fisheries and water quality along with the ecological balance.

The environment will be made sustainable through the implementation of emergency steps to recover encroached rivers and check for further deterioration. The proper implementation of the

legal code protecting rivers, frequent inspections, and periodic wetland conservation is needed. A multidimensional plan including the reinstatement of the natural flow of water, illegal land seizure ban, and sustainable urban planning can check the negative impacts of encroachment. Conservation of not less than 40% of the drainage catchment area proposed in the past conservation policies on the urban pattern [Wetland Conservation Act 2000] may be taken as an example for the Barishal River administration.

The future of Barishal's aquatic bio-diversity is in the balance. Without taking ultimate steps with urgency, the devastation of valuable riverine ecosystems will continue, and economic and environmental catastrophes will be recurring in nature. Public awareness, government intervention, and sustainable conservation strategies are the most significant inputs to ensure the integrity of Barishal's rivers and ecological balance.

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