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## Research Article

# CHANGING LAND USE SCENARIOS AND BIODIVERSITY OF EAST KOLKATA WETLAND OF WEST BENGAL, INDIA

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### ABSTRACT

Every day, the megalopolis of Kolkata generates almost 750 million litres of wastewater and sewage, and the East Kolkata Wetlands act as a fully effective organic sewage management system. It is aptly regarded as the city's kidney. It also serves as the city's natural flood control system. It is odd that there is little concern about the demise of an important wetland habitat on the planet. The survival of East Kolkata Wetlands has become a problem due to growing urbanisation and changes in urban form over the last few decades. The EKW has a total area of 12500 ha, of which approximately 45.93% is water and 38.92% is agricultural land. The methodology comprises the full production of Landsat TM and Landsat Oli TRS landuse maps for 1991 and 2021. The Ramsar-designated East Kolkata Wetland is the world's largest natural sewage treatment system that is biologically productive and supports a diverse ecosystem of flora and fauna. In this light, the primary purpose of the research is to investigate the 30-year temporal land use changes as well as the causes of the rapid transition. A land use and biodiversity study has been developed to investigate temporal changes as well as local people's perspectives.

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### INTRODUCTION

Wetlands are transitional lands between terrestrial and aquatic systems, with the water table usually at or near the surface or the land covered by shallow water. Wetlands are important for maintaining the food chain, maintaining ecological balance, controlling pollution, treating sewage, and meeting the needs of fish. Wetlands encompass 4 - 6% of the Earth's surface and hold around 35% of global terrestrial carbon. Wetlands cover around three percent of India's land area. Wetland conservation has been crucial to long-term planning in recent years. Their preservation is especially important in urban settings because they perform a long-term function in preserving ecological balance in places with large concentrations of pollutants, garbage, and surface removal for infiltration. Many of these significant ecological units are being lost to competing alternative land uses because their economic values (in terms of rent) are well acknowledged. The East Kolkata Wetlands (EKW), located on the eastern outskirts of Kolkata, are one of the largest assemblages of sewage-fed fish ponds, spanning 12,500 ha. These wetlands are part of the Gangetic Delta's large inter-distributor wetland regimes. EKW sustains the world's largest and possibly oldest integrated resource recovery practise based on a combination of agriculture and aquaculture, and provides livelihood support to a large, economically disadvantaged population of around 20,000 families who rely

on wetland products for sustenance, primarily fish and vegetables. Because of its tremendous ecological and socio-cultural importance, India designated EKW as a Ramsar Wetland of International Importance in 2003. The overall wetland area in 1991 was approximately 65.295 km<sup>2</sup>, 49.915 km<sup>2</sup> in 2001, 46.250 km<sup>2</sup> in 2011, and 41.997 km<sup>2</sup> in 2021. The EKW fell by 15% between 1991 and 2001, 4% between 2001 and 2011, and about 3% between 2001 and 2021.

#### What is Wetland

Wetlands are ecosystems that are formed, processed, and characterized by water. Wetlands serve as a transition zone between terrestrial and aquatic habitats. It is an area of land where the soil is permanently or for a long enough season each year to support aquatic vegetation. Even if the terrain is wet, a patch of land that creates pools of water after a rainstorm is not termed a "wetland." Wetlands have distinct characteristics: they are recognized from other bodies of water or landforms by their water level and the types of plants that dwell within them. Wetlands are defined as having a water table that remains at or near the land surface for a long enough length of time each year to support aquatic plants.

**Objectives:** The main objectives are-  
To identify the ecological disbalance of East Kolkata Wetland.

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- To determine the changing land use pattern of East Kolkata Wetland area.
- To identify the importance of East Kolkata Wetland.

**METHODOLOGY**

This study is primarily based on a secondary survey. Earth Explorer was used to download data from 1991 and 2021. The 1991 data product is land sat TM, while the 2021 data product is OLI TRS. The data products were first layer stacked and ready for classification. Unsupervised classification was performed on both photos, followed by supervised classification to extract landuse details. Finally, the supervised categorization was digitised to provide East Kolkata Wetlands landuse or land cover maps between 1991 and 2021.

**Location**

West Bengal is an Indian state in the country's east. The East Kolkata Wetlands are located on the outskirts of Kolkata, West Bengal's capital city. East Kolkata Wetland is located roughly between latitudes 20A°-25 and 22A°-35 North and longitudes 88A°-20 and 88A°-35 East. It is a section of the Ganges' mature delta.

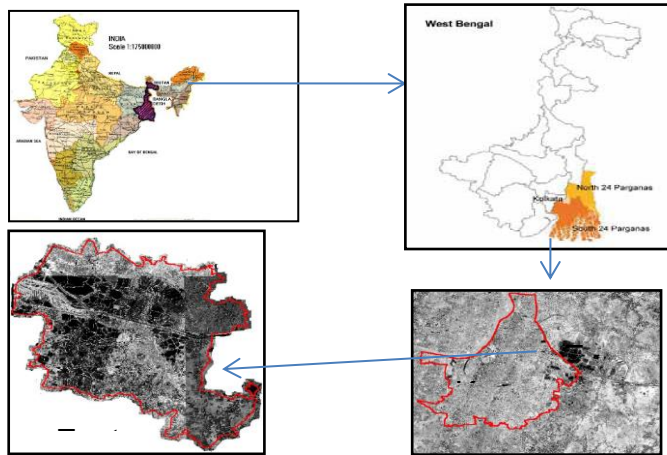


Fig: Location Map of the study area

**Land use**

Over time, the urban expansion of Kolkata causes the decrease of wetlands. Rapid industrialization and urbanization focused on converting land use to built-up areas have a significant environmental impact. The East Kolkata Wetland is a natural sewage treatment system that is rapidly deteriorating owing to urban expansion. East Kolkata wetland land use is 3,898ha, or around two-thirds of the 5,852ha of water area, for 364 sewage-fed fisheries. The remaining one-third of the water area, around 2,000ha or 20km<sup>2</sup>, is used for agricultural purposes such as rice fields, ornamental flowers and vegetables. Natural resource depletion has been a worldwide issue. Over-exploitation and other anthropogenic activities have resulted in changes in land-use and land-cover pattern as a result of growing urbanisation and industrialization. The 30-year temporal change in the east Kolkata wetland reveals that from 1991 to 2021, the built-up area increased rapidly, from 6% in 1991 to 20% in 2021. The biggest conversion to built-up regions has been observed in the north western part of the east marsh, which is near to Kolkata city and the satellite suburb Newtown Rajarhat. Industrialization and industrialization in Kolkata and the Newtown area enhanced the opportunities for real estate development in the east Kolkata wetland. Fisheries have deteriorated during the last 30 years. Fisheries have fallen from

29% to 16%. The main cause of the deterioration is the sale of aquaculture ponds and conversion to built-up areas. The urban landfills have grown in size as the population has grown over the decades. The East Kolkata wetland is used for urban trash disposal. Organic farming is practised in the Dhapa Manpur region of East Kolkata Wetland due to the abundant soil fertility. One of the primary causes of the shifting pattern of land use is the real estate industry. Due to wetland loss and deterioration, the Ramsar conference in 2002 classified 12500 acres of wetland area as protected. The number of land use changes has declined since designation because several regulations have been established to protect the valuable functions supplied by wetlands, but unlawful encroachments have remained. Metro railroads, concrete highways, and residential complexes have all resulted in a reduction of aquaculture farms and open fields. The rural livelihoods that rely on the east Kolkata wetland suffer greatly.

Land use pattern	Area
Substantially water body-oriented area	5852.14 hectares
Agricultural area	4718.56 hectares
Productive farming area	602.78 hectares
Settlements	Urban — 91.53 hectares
	Rural — 1234.99 hectares
241.30 hectares of wetland area have been added to the system to integrate it.	

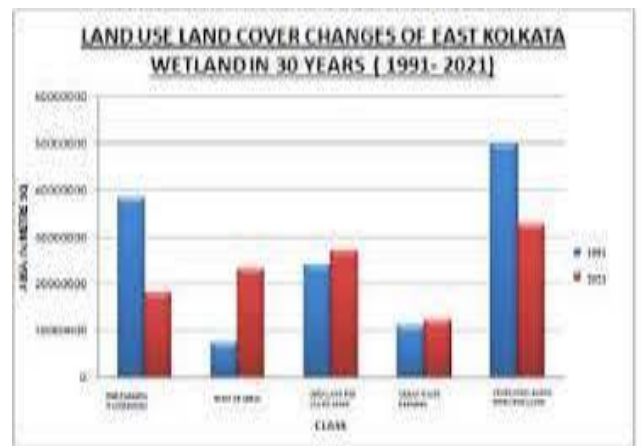
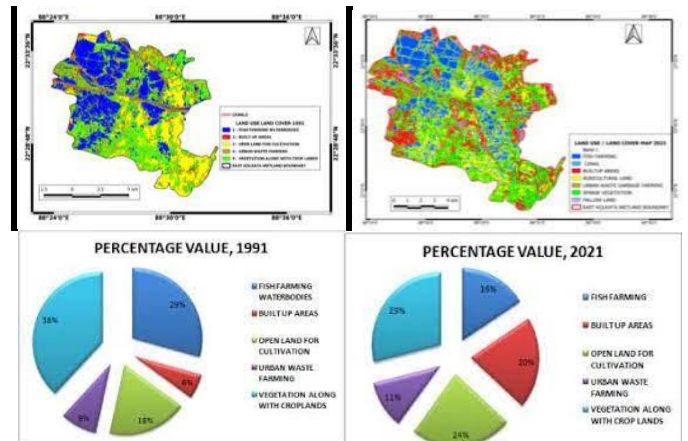


Fig.Land use scenarios

**Causes of Wetland loss and degradation**

The primary threats are the growing urbanisation of Kolkata. A significant portion of the wetland has been developed. The

western and northern parts of the east Kolkata wetland in particular. Thousands of acres of land have been developed. Population increase and rising economic development have been the principal indirect drivers of degradation and loss of rivers, lakes, freshwater marshes, and other inland wetlands (including species loss or population declines in these systems). Infrastructure development, land conversion, water extraction, pollution, overharvesting and overexploitation, and the introduction of invasive alien species are the principal direct drivers of deterioration and loss. Wetland degradation and loss are caused by human activities such as altering water quality, quantity, and flow rates, rising pollutant inputs, and changing species composition as a result of disturbance and the introduction of nonnative species.



Rajarhat area on the reclaimed East Kolkata Wetlands



A tug-of-war goes on between real estate and Kolkata's natural wastewater management mechanism, the East Kolkata Wetlands

**Fig.** Wetland loss and degradation

**Biodiversity:** The East Kolkata Wetlands confirm their appropriateness for the protection of many flora and fauna features. It is the only peri-urban wetland that has a multifaceted profile in terms of both fish requirements and waterfowl habitat. The area is also well-known for its migrating bird population.

**Flora:** This type of vegetation can only be found underwater. Submerged wetland vegetation can flourish in both salty and fresh water. Some species have flowers that may be found underwater, while others have lengthy stems that allow the blossoms to reach the surface. There are over 117 plant species recorded in and around the East Calcutta Wetlands. Water plants that float. Floating vegetation is typically tiny, although it can cover a significant surface area in a wetland system. These hydrophytes have short roots and can only be found in slow-moving, nutrient-rich water. Floating aquatic plants

provide food for bird species. Water lilies, lily pads, and duckweed are other examples.

**Fauna:** Several fish, species are grown in the East Kolkata wetlands' sewage-fed ponds known as bheris. Microbial diversity, which includes bacteria, archaea, fungus, algae, protozoa, and protists, is an important component of biodiversity. East Kolkata Wetland has a huge variety of flora and wildlife at both the macro and micro levels.

**Fish:** Wetland ecosystems are more important to fish than any other sort of habitat. Every freshwater and saltwater fish species spends a portion of their lives in a coastal wetland. Estuaries sustain 75% of the commercial fish and shellfish populations in the United States. Mangroves provide vital hatchery and nursery grounds for tropical fish species, and the coral reef system provides food.

**Amphibians:** Frogs are the most important frog species in wetlands. To reproduce and feed, frogs require both terrestrial and aquatic habitats. Adult frogs eat insects while tadpoles regulate algae populations.

### Changing of Biodiversity

Population increase and consumption patterns that result in threaded The most important drivers are the demand for ecosystem services and energy.



**Fig** Destruction of biodiversity

### Ecological character of Wetland

- The Ramsar Convention defines this as "the sum of the biological, physical, and chemical components of the wetland ecosystem, as well as their interactions that sustain the wetland and its products."
- Wetlands are biological diversity hotspots that are essential for sustainable existence.
- The Ramsar Convention's modifications, particularly the shift from a 'save the waterfowl' strategy to a more holistic nature-human interaction, have greatly mirrored this perspective.

### The Ramsar Convention on Wetlands

The Ramsar Convention on Wetlands of International Importance is an intergovernmental convention that establishes a framework for national and international action to conserve and wisely utilise wetlands and their resources. The Ramsar Convention is the only international environmental convention that addresses a specific ecosystem. The convention was signed in the Iranian city of Ramsar in 1971 and the Convention's member countries span the entire globe.

## East Kolkata Wetlands: Ecological services

The wetlands occupy an area of 125 square kilometres and comprise salt marshes, agricultural areas, sewage treatment plants, and settling ponds. The wetlands are also utilised to cleanse sewage in Kolkata, and the nutrients in the wastewater support fish farms and agriculture. Wetlands, far from being useless, disease-ridden areas, give benefits that no other ecosystem can. These include natural water quality improvement, flood protection, coastline erosion prevention, recreational and aesthetic opportunities, and free natural products.

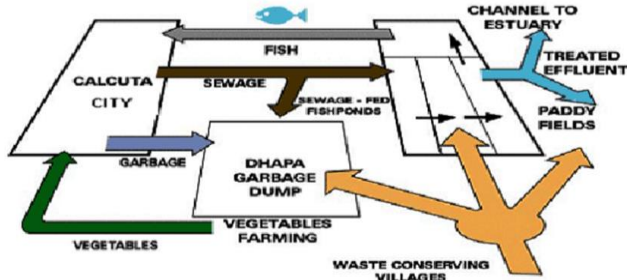


Fig Technologies for waste water & storm water management of East Kolkata Wetland (UNEP 2000)

**Problems in Biodiversity:** The main problems of East Kolkata Wetland is-

- Decrease in biological diversity
- Endemic and
- Endangered species
- Deterioration of water quality.
- Sedimentation and shrinkage in the area.
- Decrease in migratory bird population, fish and other faunal productivity.

## Importance of Wetland

The wetlands provide habitat for a wide range of biological species and are one of the most productive areas. The shifting pattern of wetlands for urban construction or other uses constitutes a severe danger to the global environment and deserves special attention from all sectors. The EKW ecosystem has a significant impact on people's daily lives in Kolkata. It is used to cleanse sewage and waste water in Kolkata that contains nutrients that benefit fisheries and agriculture. This is the location for the preservation of various flora and animal features. The wetlands are home to about 40 different bird species.

- These natural bodies of water, known simply as fisheries, supplied the solution. These wetlands, designed by local fishermen and farmers, operated as the city's natural sewage treatment system. The East Kolkata Wetlands are home to the world's largest sewage-fed aquaculture.
- Wetlands, like rain forests and coral reefs, are among the most prolific ecosystems on the planet.
- They provide a diverse habitat for a wide range of bacteria, plants, insects, amphibians, reptiles, birds, fish, and mammals.
- Many bird and animal species rely on wetlands for food, water, and shelter, particularly during migration and breeding.



Fig Wetland's biodiversity

## CONCLUSION

The preceding discussion focuses on the significance of East Kolkata Wetland protection and management. The government has begun to manage this ecologically and socioeconomically vital territory. The formation of the East Kolkata Wetlands Management Authority (EKWMA) for the conservation and management of the EKW is a positive step towards land use change. It is governed by the East Kolkata Wetland Act of 2006. East Calcutta wetlands serve as one of the world's best examples of integrated resource recovery systems and water recycling through the use of peripheral wetlands around towns. It is the world's largest collection of sewage for fish ponds in one location. However, it is being lost as cities expand without taking into account the ecological, environmental, and economic benefits of sewage-fed aquaculture systems. It is critical to comprehend the science underlying the management practises developed by fishermen themselves. When evaluating the value of the world's ecosystem services, Costanza et al. (1997) determined that wetlands are 75% more valuable than lakes and rivers, 15 times more valuable than forests, and 64 times more valuable than grasslands and rangelands. Five steps must be performed to protect the East Calcutta Wetlands and enhance the living conditions of the people who live in the wetland's interior. Development programmes that are focused and directed must be developed. Before any developmental funds are granted for these sectors with stakeholder participation in the plan, areas and target groups must be determined, and specific requirements must be identified based on priorities. The treatment system, which is rapidly deteriorating owing to urban encroachment. The 30-year temporal change in the east Kolkata wetland reveals that from 1991 to 2021, the built-up area increased rapidly, from 6% in 1991 to 20% in 2021.

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