Ecology of Flamingos: A Review of Distribution, Habitat Degradation, Conservation and Wetland Management

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Abstract: Flamingos are among the most characteristic waterbirds inhabiting saline and alkaline wetlands, where their distribution is strongly influenced by habitat quality, food availability, hydrological conditions, and climatic factors. The present review examines the major ecological drivers governing flamingo distribution in saline wetlands, with particular emphasis on habitat degradation and environmental threats affecting these specialized ecosystems. The review highlights that increasing anthropogenic pressures, including water diversion, excessive salt extraction, industrial and agricultural pollution, urbanization, land-use change, and unsustainable resource exploitation, have substantially degraded wetland ecosystems. The review emphasizes the urgent need for integrated wetland conservation through habitat restoration, sustainable water management, pollution control, continuous ecological monitoring, and community participation.

Keywords: Flamingos; Saline wetlands; Habitat degradation; Environmental threats; Biodiversity conservation; Management.

Introduction: -

Flamingos are one of the tallest wading birds and can be easily identified by their long legs and elongated neck. At present, six species of flamingos are recognized worldwide. Earlier, the Greater Flamingo was considered similar to the American Flamingo, but now it is widely accepted as a separate species. The Greater Flamingo is an important member of the Phoenicopteridae family and is commonly seen in India. Flamingos are very social in nature and are usually observed in groups that may range from a few individuals to thousands; such large gatherings are locally called “Pat.” In different regions of India, flamingos are known by different names such as “Hanj,” “Dev-hanse,” and “Bala.” Their striking pink colour,

along with their long legs and neck, makes them very distinct and easy to recognize. The Greater Flamingo is currently listed under the Least Concern category in terms of conservation status. Among all flamingo species, the Greater Flamingo has the widest distribution. It is found across Africa, Asia, and the Middle East, and its breeding range extends towards regions like Kazakhstan and parts of Europe. Flamingos are known to undertake long-distance movements, which are often observed during night time. These birds mostly inhabit saline environments such as lagoons, mudflats, and salt pans. Their movement patterns are generally influenced by environmental conditions rather than fixed seasonal migration. Flamingos are usually found in shallow saline water bodies, many of which are temporary in nature. The availability of food plays a key role in determining their distribution, while their movement from one place to another depends largely on food availability and climatic conditions (Kumar and Rana, 2020).

In India, two species of flamingos are commonly found: the Greater Flamingo (*Phoenicopterus roseus*) and the Lesser Flamingo (*Phoeniconaias minor*). The Lesser Flamingo is considered the most abundant flamingo species in the world. Both species use the Rann of Kutch as an important wintering ground as well as a major breeding site (Tere, 2005). The pink color of flamingos comes from their diet, which is rich in carotenoid-containing organisms such as blue-green algae (*Arthrospira fusiformis*), diatoms, and small aquatic invertebrates. Flamingos have a special feeding mechanism; their beaks contain fine structures called lamellae, which help them filter tiny food particles from muddy water. They often stir up the bottom sediment with their webbed feet to bring food into suspension, making it easier to filter and consume. This unique feeding behavior is closely linked to the availability of suitable wetland conditions, particularly water depth, salinity, and abundance of microscopic food organisms. Any alteration in these environmental factors can directly affect the feeding efficiency and distribution of flamingos. Therefore, the present study aims to review the ecology of flamingos, with particular emphasis on their distribution, habitat degradation, environmental threats, and wetland management, while highlighting conservation priorities for sustaining flamingo populations.

Review of Literature: -

Kulshreshtha et al. (2021) evaluated the population status of Greater Flamingos (*Phoenicopterus roseus*) and Lesser Flamingos (*Phoeniconaias minor*) at Sambhar Lake, an internationally recognized Ramsar wetland. The study revealed a significant decline in flamingo populations over time, along with serious ecological degradation of the lake habitat.

Both natural factors such as climate change and human-induced pressures have contributed to this deterioration. The authors stressed that immediate conservation measures are required to prevent further damage to this important wetland ecosystem. The study also called for coordinated efforts from government agencies, conservation organizations, researchers, and local stakeholders to develop effective management strategies for the protection of flamingos and their habitat.

Kumar and Rana (2021) investigated the behavioural patterns of Greater Flamingos at Najafgarh Jheel Bird Sanctuary over a one-year period from November 2018 to November 2019. The study used scan sampling and focal sampling methods to record various behaviours such as feeding, resting, preening, movement, alertness, and aggression. A total of 117 hours of observation were conducted. The results showed that feeding, resting, and preening were the most common activities. Flamingos were found to rest more during morning hours, while feeding activity increased during the evening. Overall, feeding occupied the largest proportion of time, followed by resting and preening. This study provided valuable insights into the daily activity patterns of flamingos and their behavioural adaptations.

Gupta et al. (2023) conducted an avifaunal survey in two wetland areas—Gogte saltpan and Viva wetland—located in Palghar district of Maharashtra. The study was carried out between November 2021 and January 2022 using line transect and point count methods. A total of 84 bird species belonging to 15 orders and 36 families were recorded. Passeriformes was the most dominant order, while families such as Scolopacidae and Ardeidae were highly represented. The Viva wetland showed higher bird diversity compared to the Gogte saltpan. The presence of near-threatened and vulnerable species, including the Lesser Flamingo and Painted Stork, indicates the ecological significance of these wetlands. However, the study also highlighted that rapid urbanization and human disturbances are major threats to these habitats, stressing the need for proper monitoring and sustainable management.

Bharti et al. (2024) reported the first recorded sighting of the Greater Flamingo (*Phoenicopterus roseus*) in Todgarh-Raoli Wildlife Sanctuary. This observation was supported by photographic evidence and represents an important addition to the avifaunal records of the sanctuary. The study also provided details on the species' identification, distribution, and status, contributing to a better understanding of bird diversity in the region.

Kumar et al. (2024) conducted a similar study on the population dynamics of Greater Flamingos in the same region and time period, also using point count methods. Their findings

closely matched those of the previous study, confirming that Najafgarh Jheel supports a significant population of flamingos. The study again highlighted variations in flock size, age composition, and seasonal population trends. It also reinforced the observation that human activities such as infrastructure development and disturbance around wetlands have a negative impact on flamingo populations. The authors stressed the importance of long-term monitoring and management strategies to protect these birds and their habitats.

Raj et al. (2025) assessed habitat suitability and distribution patterns of flamingos at Sambhar Lake using advanced modelling techniques combined with remote sensing data. The study focused on understanding current and future habitat conditions under changing climatic scenarios. Various environmental indices and climatic variables were used to predict habitat suitability for the years 2021, 2050, and 2070. The results indicated a sharp decline in suitable habitats for flamingos over time, mainly due to reduced water availability, declining algal resources, and increasing human activities such as illegal salt extraction and land-use changes. The study emphasized that without immediate conservation measures, flamingo habitats may drastically shrink in the future. It strongly recommended integrated management strategies and restoration efforts to protect this important wetland ecosystem.

Byju et al. (2025) examined the distribution and population trends of Greater Flamingos (*Phoenicopterus roseus*) and Lesser Flamingos (*Phoeniconaias minor*) in coastal regions of Tamil Nadu. The study used both field surveys and long-term citizen science data to analyse patterns over time. Peak populations were observed during specific months, particularly when environmental conditions such as water levels and food availability were favourable. Greater Flamingos were found to be widely distributed across several sites, while Lesser Flamingos were more restricted in their distribution. The study also identified key threats such as habitat loss, pollution, and expansion of saltpans. It highlighted the importance of coastal wetlands and managed habitats for flamingo conservation and supported the need for declaring protected areas such as flamingo sanctuaries.

Kumar et al. (2025) examined the feeding ecology of Greater Flamingos (*Phoenicopterus roseus*) by studying their feeding behaviour, techniques, habitat use, and prey composition at different sites in Haryana from October 2019 to September 2020. The varied techniques show their ability to adapt to different water depths and environmental conditions. Four main feeding habitats were identified: shallow wetlands, mudflats, deep water areas, and agricultural fields. Most feeding activity was recorded in shallow wetlands, followed by mudflats, while deep wetlands and agricultural fields supported fewer feeding instances. Different feeding techniques were associated with specific habitats—for example,

walk-feeding was common in shallow water and agricultural areas, skimming was mostly observed on mudflats, and grubbing was more frequent in deeper water. Analysis of food composition at Najafgarh Jheel revealed a wide variety of prey items, including phytoplankton, zooplankton, and small fish. Among these, green algae were the dominant phytoplankton group, while rotifers and certain fish groups were also important components of the diet.

Walia and Vanita (2026) studied bird diversity at the Alania wetland near Kota through regular surveys conducted from October 2023 to September 2024 using line transect and point count methods. A total of 89 bird species were recorded, including both resident and migratory birds. Notably, species such as the Greater Flamingo (*Phoenicopterus roseus*) and Sarus Crane (*Antigone antigone*) were observed, highlighting the importance of this wetland for significant bird species. The surrounding landscape includes forests, grasslands, agricultural fields, and water bodies, which together provide a variety of habitats supporting bird diversity. However, agricultural activities in the floodplain area pose a threat to nesting sites and habitat quality. The study suggested that the Alania wetland has the potential to be recognized as an Important Bird Area in the future. It also stressed the importance of long-term monitoring and conservation efforts to protect both resident and migratory bird populations.

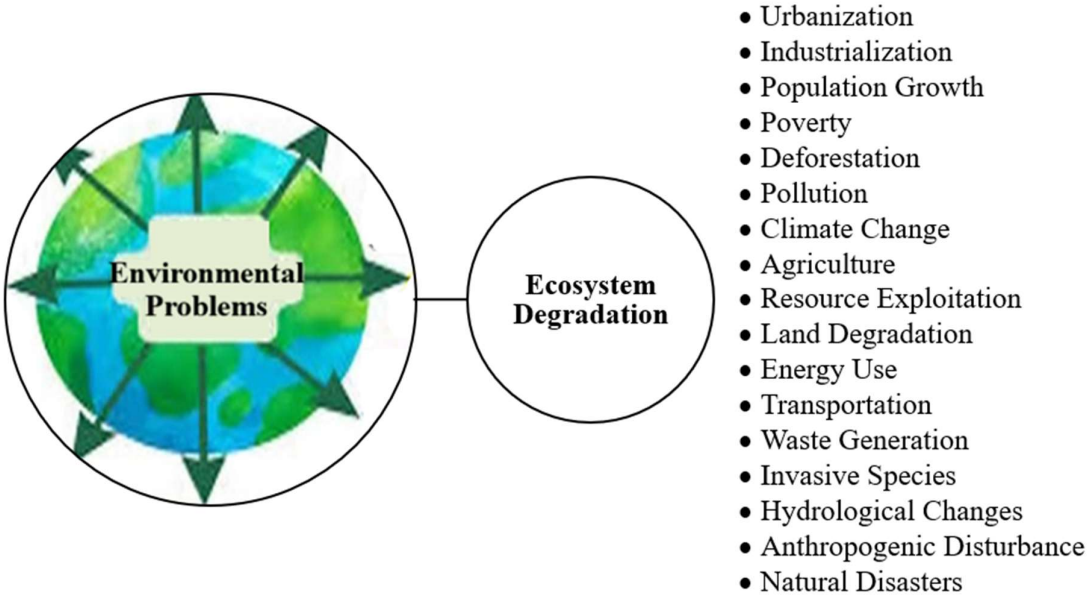
Ecosystem Degradation: Factors Affecting Biodiversity Loss: -

Ecosystems are complex and dynamic systems that support a wide variety of living organisms and maintain ecological balance. They provide essential services such as nutrient cycling, climate regulation, and habitat for biodiversity. However, these systems are increasingly being disturbed by both natural processes and human activities, leading to ecosystem degradation and biodiversity loss. Wetlands are highly productive ecosystems that act as a transition zone between land and water. They play a crucial role in maintaining biodiversity, supporting conservation, and recycling nutrients within ecosystems. Wetlands also function as natural protective systems by reducing the impacts of floods, droughts, and tidal surges, and they contribute significantly to climate change adaptation. These ecosystems provide ideal habitats for both resident and migratory birds. Birds depend on wetlands mainly for feeding and breeding purposes and often migrate from different regions to find suitable habitats during different seasons. The shallow, vegetated areas of wetlands support a rich variety of organisms such as molluscs, crustaceans, and fish, which form the primary food source for many water birds. India’s diverse climate and geographical features support a wide

variety of wetlands, ranging from high-altitude lakes in the Himalayas to floodplain wetlands in the Gangetic region. These wetlands differ greatly in size and characteristics, from small ponds to large lakes, and include freshwater, saline, and brackish systems. Because of this diversity, Indian wetlands attract a large number of migratory birds every year. These birds not only enhance the ecological value of wetlands but also contribute to tourism and the economy. Moreover, bird diversity is widely used as an indicator of ecosystem health and water quality (Singh et al., 2025). Therefore, any changes in bird populations or diversity can reflect underlying alterations in environmental conditions. In this context, the term "degradation" refers to any deviation from the natural or ideal condition of an ecosystem. Any process or activity that reduces the functioning of an ecosystem or decreases biodiversity is known as ecosystem degradation.

Factors that cause such changes are called ecosystem drivers, which can be either natural or human-induced. Natural drivers such as earthquakes, wildfires, and volcanic eruptions can have strong but one-directional impacts on ecosystems, as they do not respond to the changes they create. In contrast, human activities can cause multiple changes in ecosystems, and since humans live within or near these ecosystems, they experience the consequences of these changes. Over time, natural and human-induced drivers often interact. For example, human activities may initially cause species loss, which can make ecosystems more vulnerable to further damage from natural disasters (Sharma and Soni, 2024).

Fig 1: Key Drivers of Environmental and Ecosystem Degradation



The degradation of natural resources and loss of biodiversity, including both flora and

fauna, is a global concern that affects society and slows down economic and social development. In developing countries like India, environmental degradation poses a serious challenge to sustainable development. Urban areas, especially large metropolitan cities, face significant environmental issues due to rapid development. For instance, Delhi has been experiencing environmental degradation since the 1980s (Saxena et al., 2021). Environmental degradation results from both human activities and natural processes. The major factors responsible for this degradation are outlined below (Ali and Rahman, 2024):

1. **Urbanization & Industrialization** – Rapid and unplanned urban and industrial growth leads to excessive use of natural resources and increased pollution, resulting in environmental degradation and habitat loss.
2. **Poverty & Population Growth** – Growing population and poverty increase dependence on natural resources for livelihood, leading to overexploitation and increased environmental stress.
3. **Deforestation** – Large-scale clearing of forests for agriculture, urban expansion, and development activities causes soil erosion, climate imbalance, and significant loss of biodiversity.
4. **Pollution** – Contamination of air, water, and soil due to industrial emissions, waste disposal, and chemical use adversely affects ecosystems and human health.
5. **Climate Change** – Global warming and changing climatic patterns lead to rising temperatures, altered rainfall, and extreme weather events, disturbing ecological balance.
6. **Economic Activities** – Expansion of industries, mining, and agriculture leads to unsustainable extraction of natural resources and environmental degradation.
7. **Land Degradation** – Soil erosion, desertification, and loss of soil fertility reduce land productivity and negatively impact ecosystems.
8. **Energy Use & Transportation** – Increased use of fossil fuels for energy and transportation results in greenhouse gas emissions and contributes to habitat fragmentation.
9. **Unsustainable Agriculture** – Excessive use of fertilizers, pesticides, and irrigation practices pollute water bodies and degrade soil quality.
10. **Waste & Landfills** – Improper waste management leads to accumulation of solid waste, release of toxic substances, and emission of greenhouse gases like methane.
11. **Natural Causes** – Natural disasters such as floods, droughts, earthquakes, and wildfires also contribute to ecosystem degradation and biodiversity loss.

Wetlands are under threat from both natural factors and human activities such as changes in hydrology, soil conditions, climate, and landforms. While these natural factors play a role in shaping ecosystems, human interference has significantly disturbed wetland environments. Activities such as agriculture, urban development, industrial operations, tourism, deforestation, and changes in land use have led to serious ecological impacts. These disturbances result in habitat loss, water pollution, and a decline in biodiversity, thereby threatening the long-term sustainability of wetlands. Wetlands are also affected by various pressures including agricultural expansion, soil erosion, sewage discharge, dam construction, industrial pollution, aquaculture, and climate change. Intensive farming practices and diversion of water resources disrupt ecological balance and reduce biodiversity, particularly affecting fisheries and soil health. Pollution from domestic waste and agricultural chemicals further accelerates degradation by causing nutrient imbalance in water bodies. Additionally, declining water quality and the spread of invasive species increase the risk of species extinction and negatively impact human health, agriculture, and water systems. In India, wetlands are shrinking due to factors such as conversion of land for agriculture, deforestation, and alterations in natural water flow caused by dams and water diversion. Other major threats include flooding, vegetation loss, changes in watershed patterns, excessive extraction of water, pollution, and gradual reduction in wetland area (Jena et al., 2025).

Conclusion: -

Flamingos are highly specialized wetland birds whose occurrence and distribution are closely associated with the ecological integrity of saline and alkaline wetlands. Their dependence on suitable water depth, salinity, food availability, and undisturbed breeding habitats makes them particularly sensitive to environmental changes. The present review demonstrates that habitat degradation resulting from water diversion, excessive salt extraction, pollution, urbanization, industrialization, agricultural intensification, and climate variability has emerged as a major threat to flamingo populations and the sustainability of saline wetland ecosystems. These anthropogenic pressures alter hydrological regimes, reduce food resources, degrade water quality, and fragment critical habitats, thereby affecting flamingo feeding efficiency, breeding success, and migratory behaviour. Indian wetlands continue to serve as important breeding and wintering habitats; however, their ecological condition is increasingly compromised by multiple interacting environmental stressors. Because flamingos respond rapidly to changes in wetland conditions, they serve as valuable bioindicators of ecosystem health and environmental quality. Their conservation is therefore

closely linked with the protection of wetland biodiversity and the ecosystem services these habitats provide. Long-term conservation of flamingos requires an integrated management approach that combines wetland restoration, sustainable water resource management, pollution control, regulation of developmental activities, continuous ecological monitoring, and community participation.

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