Geospatial Assessment of Wetland Changes in the Fringe Area of Dhaka City: Past, Present and Future Scenarios

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ABSTRACT: This study examines the changes in wetlands in the fringe area of Dhaka city using geospatial assessment techniques. The wetland in the area is crucial as they serve as a buffer zone for the Dhaka Metropolitan Area (DMA) and play a significant role in maintaining the region's ecological balance. Thirty-meter NASA Landsat 4-5TM and Landsat 8 OLI satellite imagery were used to extract wetland features in the fringe area of Dhaka city. The Modified Normalized Difference Water Index (MNDWI) was applied to delineate wetland features. Finally, ArcGIS geometric computing was used to detect yearly changes, and a Cellular Automaton (CA) Markov Model was applied to predict future transitions. The research findings reveal that wetlands in the Dhaka Metropolitan Area are declining at a rate of 1.1% between 1991 and 2016, indicating the urgency of addressing this issue to ensure the sustainability of the region's natural resources. The percentage of wetlands in the fringe area has been decreasing significantly over the years, with wetlands making up only 12.98% of the fringe area in 2022, down from 28.22% in 1989. This trend is predicted to continue, with wetlands accounting for only 8.02% of the total area by 2034. The strong negative correlation coefficient between the year and wetland area suggests that the trend of decreasing wetland is likely to continue unless significant measures are taken to protect wetlands. The study highlights the importance of conserving and restoring wetlands in Dhaka's fringe areas to maintain the ecological balance of the region and support the well-being of both humans and wildlife.

Keywords: Geospatial Assessment; GIS and Remote Sensing; CA Markov Matrix Model; Simulation; Wetland

INTRODUCTION

Wetlands are the most invaluable components of the natural environment, primarily the soil covered by water. According to the Environmental Protection Agency (EPA), wetlands are areas where water persistently covers the soil. Wetlands include a diverse array of landscapes, from marshes to peatlands. These ecosystems play a crucial role in ecological balance and provide vital services such as water purification, flood control, and habitat for diverse ecosystems (EPA, 2022; Curie et al., 2007). However, the global landscape has witnessed a concerning trend, with approximately 70% of wetland ecosystems facing destruction since the 1990s, attributed largely to factors like agriculture, urbanization, and industrial development (Everard, 2017).

Due to differences in soil composition, topography, hydrology, water properties, vegetation coverage, and human intervention, wetlands exhibit significant local and regional variations. The climate conditions such as climate change is another important factor that is affecting the wetlands in Dhaka. Rising temperatures and changes in rainfall patterns are causing changes in the hydrological cycle, which is leading to the drying up of wetlands (Siddique et al., 2019). In addition, extreme weather events such as floods and storms are becoming more frequent, causing damage to the remaining wetlands (Zaman et al., 2017).

Undoubtedly, wetlands can be found on every continent except Antarctica, ranging from frigid tundras to steamy tropics (Ramsar Convention Secretariat, 2018). Wetland can be divided into two main groups: (1) coastal or tidal wetland and (2) inland or non-tidal wetland. Wetlands are usually located in areas where water flows with slow velocity, largely because the terrain is relatively flat in these regions (Orme, 1990). As wetlands occupy flat landscapes, their surface area tends to expand and contract as water levels change. Consequently, wetlands can store large volumes of water, allowing them to regulate hydrological

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