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Assessment of The Dynamics of Wetland Fragmentation in Bellanwila-Attidiya Wetland

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Abstract

Wetlands are ecologically sensitive landscapes that provide essential ecosystem services. However, rapid urbanization has accelerated wetland fragmentation, threatening their ecological integrity. This study focuses on assessing the spatial dynamics of wetland fragmentation in the Bellanwila-Attidiya Wetland from 1995 to 2024, emphasizing the temporal evolution of fragmentation patterns. Landsat satellite images from 1995, 2011, and 2024 were analyzed using GIS and remote sensing techniques to identify spatio-temporal changes in wetland fragmentation. Fragmentation indices including Number of Patches, Patch Density, Mean Patch Area, and Edge Density were used to quantify extent of fragmentation in Bellanwila-Attidiya Wetland. Additionally, field observations and household surveys were conducted over a four-month period, and households were selected using a stratified random sampling method to ensure spatial representation across the study area. A total of 55 households and 10 semi-structured interviews with key informants such as the local wildlife officers were included to identify community-observed wetland fragmentation dynamics. Spatial analysis of wetland fragmentation revealed that fragmentation initially occurred along the peripheral zones between 1995 and 2011, followed by expansion towards the central and southern sections by 2024, indicating a clear outward-to-inward pattern of encroachment. Results of the analysis of fragmentation indices revealed a significant reduction in wetland cover, with continuous wetland in 1995 replaced by smaller, isolated patches by 2024. The number of wetland patches increased from 16 in 1995 to 28 in 2011 and 141 in 2024, while mean patch area declined by 91,245.54 m^2 between 1995 to 2011 and 38,022.06 m^2 between 2011 to 2024. Edge density increased sharply, increasing edge effects and loss of core wetland habitat. The increase in patch number and edge density, along with the reduction in mean patch area, shows a transition from a continuous wetland to a fragmented landscape. Change detection analysis indicated that approximately 105.85 ha of wetland area has been lost, primarily converted into built-up areas such as residential areas, road infrastructure, and commercial establishments due to unplanned urban expansion and encroachment. These findings clearly demonstrate the progressive intensification of wetland fragmentation and loss of spatial connectivity over the past three decades. Effective restoration of fragmented habitats and regulation of urban expansion are urgently needed to protect core wetland areas and maintain the ecosystem integrity of the Bellanwila-Attidiya Wetland.

Keywords: *Ecology, Fragmentation, GIS, Remote sensing, Wetlands*