Assessment of Ecological Quality Indicators in the Ligawasan Marsh Complex, Mindanao, Philippines through the Remote Sensing Ecological Index (RSEI) Framework

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ABSTRACT

The Ligawasan Marsh Key Biodiversity Area (KBA) consists of various habitats that support rich biodiversity and is also considered the largest intact wetland in the Philippines. Field assessments in the complex have been intermittent and limited in both spatial and temporal coverage, due to the geopolitical situation in the Bangsamoro region. In turn, the extent of environmental degradation caused by various threats to the complex remains unclear amidst the growing regional population. In this regard, remote sensing techniques provide complementary information to the independent field assessments conducted in the complex. As such, this study aims to evaluate the ecological quality of the Ligawasan Marsh complex from 2001 to 2025 using the Remote Sensing Ecological Index (RSEI). Satellite images from the Landsat 7 and 8 collections were processed to extract spectral and thermal bands relevant to calculating the four ecological quality indicators that comprise the RSEI. Principal component analysis (PCA) was employed to determine the relative weights of the greenness, dryness, wetness, and heat indicators to the overall RSEI. Results indicated that the complex had undergone an alternating cycle of ecological degradation and improvement over five-year periods. The average RSEI of the KBA increased, albeit non-significantly, from 2001 to 2025, with most areas within the three marshlands exhibiting relatively higher RSEI values. Moreover, municipal centers and their outgrowths were hotspots of low RSEI values, although no significant relationship was found between population density and RSEI at the municipal level. Throughout the study period, the impacts of anthropogenic and natural drivers were linked to the observed changes in ecological quality in the Ligawasan Marsh KBA.

Keywords: Ligawasan Marsh, Key Biodiversity Area, Remote Sensing Ecological Index, Landsat, Principal Component Analysis