(225)

Landscape-Level Degradation Mapping of Invasive Plant Species in the Central Highland Cloud Forest of Bopaththalawa, Sri Lanka

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Abstract

Montane cloud forests in Sri Lanka's Central Highlands are among the most threatened ecosystems due to various anthropogenic activities, including the spread of Invasive Alien plant Species (IAS), forest fires, illegal tree felling, gem mining, and poaching. This study assesses the spatial variation of invasive plant species in the Bopaththalawa cloud forest landscape, in relation to native species composition. This study aimed at developing a landscape-level degradation map quantifying the spatial extent both through field-based citizen science observations and aerial mapping (remote sensing). Drone-derived orthomosaics were integrated with Sentinel-2 satellite imagery processed in Google Earth Engine (GEE) to derive vegetation indices. Field observations and geo-tagged photographs compiled over 120 ground-truth points for supervised classification. The classification model combining spectral, textural and topographic variables achieved an overall accuracy of 82% in distinguishing invasive-dominated areas from the present native vegetation. Eight invasive plants (*Solanum mauritianum, Dicranopteris linearis, Koenigia mollis, Cymbopogon nardus, Austroeupatorium inulifolium, Ludvigia peruviana, Cenchrus purpureus* and *Tithonia diversifolia*) dominated the landscape, while 15 invasive plants were found within the location. The resulting degradation map reveals that approximately 67% of the 32-hectare degraded landscape remains under moderate to severe invasion. These invasions spread across irrigation channels, forest fire-affected land, slopes and abandoned farming sites regardless of the previous vegetation presence. Forest fires accelerated the encroachment of invasive species into previously undisturbed areas, thereby threatening the natural regeneration potential of native vegetation. Overdominance of invasives such as *S. mauritianum* was primarily due to seeds dispersed by birds, resulting in approximately 0.8 ha spread with a mean height of 3 m recorded over an 11-month period. Such degradation continues to impair montane ecosystem integrity and often remains undetected without field validation. These findings highlight the need for prioritizing invasive removal, replanting, and ecological restoration. Citizen science actions demonstrated that low-cost drones, open satellite data, and community ground validation can provide scalable information to guide nature-based restoration strategies in Sri Lanka's high-elevation ecosystems.

Keywords: *Invasive species, Remote sensing, Landscape degradation, Cloud Forest, Bopaththalawa*