**(119)**

# A Novel Approach to Assess Biocapacity, A Case Study from the Pundalu Oya Valley, Sri Lanka

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## Abstract

This study evaluates the biocapacity of five distinct land use types: Tea cultivation, abandoned tea land, commercial forest, forest border, and estate bungalow compound gardens, using a novel Ecological Value Score (EVS) framework to address the critical gap in tools for holistically assessing ecosystem health in modified landscapes. Biocapacity refers to the capacity of an ecosystem to regenerate biologically productive resources and absorb waste, essential for sustaining biodiversity and human well-being. Biocapacity evaluation is critical for understanding ecological resilience, conservation priorities, and sustainable land management. Biocapacity assessment was conducted in the Pundalu Oya Valley, which is a part of the Central Highlands of Sri Lanka (Elevation ranges from approximately 1,200 to 1,800 meters above sea level), recognized as a UNESCO World Heritage Site and a biodiversity super-hotspot by the International Union for Conservation of Nature (IUCN). The EVS model integrates 14 weighted ecological parameters, incorporating biodiversity (species richness, evenness, rarity, endemism, uniqueness, conservation status), ecosystem services (water quality), soil health (soil nutrient content, % microbial biomass carbon), land use type (Scenic value) and anthropogenic pressures (invasive species, pesticide use). Each factor was assigned a weight based on its ecological significance with positive contributors enhancing biocapacity and negative factors (e.g., pesticides) diminishing it and normalized on a 0-5 scale, with the final score calculated using the formula $EVS=\sum(Wi\times X_{\_normalized})$, where Wi is the assigned weight and $X_{\_normalized}$ is the value normalized to a 0-5 scale. Results revealed the Forest Border as the highest-value ecosystem (EVS:4.41), functioning as a critical biodiversity ecotone. Estate bungalow compound gardens followed closely (3.75), their structural complexity making them unexpected biodiversity reservoirs. Commercial Forest (2.73) showed a moderate biocapacity, while Tea plantations (2.57) and Abandoned Tea Land (2.52) scored the lowest. The findings highlight the ecological significance of forest edges and compound gardens as key conservation zones, revealing significant variations in biodiversity and ecosystem functions across different land use types. Beyond conservation, the study reveals the valley's untapped potential for nature-based tourism, scientific research, and carbon-offset initiatives. The EVS provides a robust, scientific tool to guide targeted ecological restoration and direct sustainable land-use planning, emphasizing the protection of high-capacity ecosystems to enhance landscape-scale resilience in this critical biodiversity hotspot.

**Keywords:** *Biocapacity, Land-use assessment, Biodiversity conservation, Sustainable land management, Ecological restoration.*