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Detecting and Mapping Individual Coconut Tree Crowns Using Deep Learning from UAV Imagery at the Oluvil Coastal Fringe in Ampara District, Sri Lanka

Nijamir, K.^{1*}, Madurapperuma, B.D.^{2,3}

¹*Department of Geography, South Eastern University of Sri Lanka, Oluvil, Sri Lanka*

²*Department of Botany, The Open University of Sri Lanka, Nawala, Sri Lanka*

³*Department of Forestry, Fire, and Rangeland Management, Cal Poly Humboldt, CA, USA*

*nijamirk@seu.ac.lk

Abstract

Large stands of coconut trees (*Cocos nucifera*) are grown at the coastal fringe habitats which are vulnerable to coastal and riverine erosion. Detecting coconut trees using Unmanned Aerial Vehicle (UAV) imagery is a useful way for monitoring coastal habitat vulnerabilities such as coastal erosion and can be used for sustainable land management prior to implement any coastal development program. Therefore, this study proposes a method to identify individual coconut tree, to map their spatial distribution, and to visualize healthy conditions of tree crowns at the Oluvil coast using high-resolution UAV imagery coupling with deep learning (DL). We created a mission plan flying UAV at 100 m above terrain level and flight paths were set with 80% front and 90% side overlap between adjacent images for maintaining high accuracy during the orthomosaic process. A total of 357 images were obtained using a Phantom 4 Pro UAV in a series of parallel flight lines at an average Ground Sampling Distance (GSD) of approximately 3.5 cm/px. The training sample was built by drawing 50 circular crowns of individual coconut trees and DL object recognition models were computed using ArcGIS Pro 3.1 software. Vegetation health of coconut tree crowns was detected using Visible Atmospherically Resistant Index (VARI) and the healthy condition of each coconut tree was mapped. The results showed that the 0.5 km² of the study area consists of 1597 coconut trees. The average accuracy of detecting coconut trees by the DL model is 98%. Out of the detected coconut trees, 174 (10.8%) were indicated as healthy trees, 549 (34.3%) were moderately healthy, 620 (38.8%) showed declining health and 254 (15.9%) needed inspection for the healthy condition. UAV and DL is an excellent platform for identifying individual coconut trees and mapping their healthy state which could be used for sustainable tree planting programs at vulnerable coastal areas.

Keywords: Individual coconut tree, Detection, UAV, Orthomosaic, Deep learning, VARI