EFFECTS OF LANDSCAPE STRUCTURE AND BIOCLIMATIC VARIABLES ON POLLINATORS IN AVOCADO PRODUCTION SYSTEMS IN MURANG'A COUNTY, KENYA

BY

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DECLARATION

Declaration by candidate

This thesis is my original work and has not been presented for the award of a degree in any other university or any other award.

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Declaration by supervisors

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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ABSTRACT

One of the most essential ecosystem regulatory services is pollination. It enables the direct production of pollination-dependent food crops such as avocado. Recent climate change and human activities have affected landscape structure by degrading, fragmenting, and interfering with natural pollinator activity (habitats and the foraging sites). The purpose of this research was to determine the impact of landscape structure and bioclimatic characteristics on avocado pollinators in the Murang'a County production system. The study's specific goals were to describe land use/cover (LULC) and assess the impact of landscape structure and bioclimatic variables on pollinators. The random forest (RF) technique was used to categorize LULC using a 2018 composite image generated from the Sentinel 2 (S2) image. Annual croplands, avocado, built-up areas, grasslands, permanent croplands, shrublands, tree cover, and bodies of water were among the mapped classes. The LULC was then refined using pixel and polygon reference data, 70% of which was utilised to train the RF model and 30% as a validation set. For classification, reflectance (Ref), reflectance and vegetation indices (Ref + VIs), reflectance and red-edge-based vegetation indices (REF + RE-VIs), reflectance and vegetation phenology (Ref + Pheno), and reflectance, vegetation indices, red-edge-based vegetation indices, and vegetation phenology (Ref + VIs + RE-VIs + Pheno) were used. The bioclimatic data represent monthly temperature and precipitation values, with the real evapotranspiration and interception variable serving as a humidity proxy. Topographical data was created using a 30 metre digital elevation model (DEM) (aspect and slope). Pollinator data was collected using a global positioning system (GPS). Ref + VIs + RE-VIs + Pheno earned the greatest overall accuracy in the site-specific validation test for both polygon and pixel-based classification, with 80.76 and 70.56 percent, respectively. In the pattern-based accuracy evaluation, Ref + VIs + RE-VIs + Pheno had the highest average similarity (g) of 0.75 for polygon-based classification and Ref + RE-VIs had the highest average similarity (g) of 0.76 for pixel-based classification. The effect of landscape structure and bioclimatic conditions on pollinators was examined using the Maximum Entropy (MaxEnt) model. The data showed that the warmest quarter precipitation (Bio18) contributed the most to the presence of Diptera and honeybee, with 52.4% and 56.5% contributions, respectively. Hymenoptera (other), LULC contributed the most to its prevalence, accounting for 42.7%. Diptera had an AUC of 0.84, Hymenoptera (others) had an AUC of 0.83, and honeybee had an AUC of 0.81. The study demonstrated that using polygon-based training data and integrating Sentinel 2 derived vegetation indices, spectral bands, and phenology metrics, a heterogeneous landscape can be accurately mapped using S2 multi-spectral images. This study employed logistic regression to confirm that landscape structure and bioclimatic variables influence pollinator occurrence and that pollinators such as Diptera, Hymenoptera others, and honeybees were present. Finally, the findings of this study could be used to provide credible information on effective decision-making for long-term pollinator management.