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AI-based enhancement for mapping invasive *Prosopis juliflora*

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Abstract

Rangelands in sub-Saharan Africa support over 60 million people through extensive livestock grazing but face significant challenges due to irregular rainfall and the spread of invasive species. Effective pasture management requires timely and accurate vegetation data; however, common remote sensing tools, such as the Normalized Difference Vegetation Index (NDVI), cannot distinguish between palatable forage and unpalatable invasive species, such as *Prosopis juliflora*.

This study aims to improve vegetation analysis by isolating and removing *P. juliflora* from NDVI maps derived from satellite imagery to provide a more accurate representation of usable pastures.

The research site encompasses approximately 100 square kilometers in the northern rangelands of Kenya, near the village of Ngurunit. To achieve a scalable solution, this study combines Sentinel^{-2} satellite imagery with high-resolution multispectral data acquired via unmanned aerial vehicles (UAV) and ground-truth data collected through a smartphone application and geotagged photographs. Different machine learning and deep learning algorithms are utilised to extend a small training dataset via semi-supervised learning, which is then used to train the final deep learning model.

Preliminary results indicate the successful generation of an improved NDVI map that highlights the specific distribution of *P. juliflora* in the area. Analysis of the mean spectral reflectance across Sentinel^{-2} bands revealed distinct signatures for *Acacia* spp. and *P. juliflora*, particularly in the near-infrared (NIR) spectrum, enabling the AI to filter out invasive biomass. While the remoteness of the study area poses challenges for collecting large-scale ground truth data, this AI-based enhancement of NDVI maps provides pastoralists and managers with a critical tool for identifying usable pasture and controlling invasive encroachment.

Keywords: Deep Learning, Drone mapping, NDVI enhancement, Prosopis juliflora, rangelands, Sentinel^{-2}

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