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## Full Length Article

# Spatially explicit agricultural vulnerability assessment to climate change and variability in agroecological zones of Uganda



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## ABSTRACT

Climate vulnerability assessments in Uganda are constrained by administrative-scale analyses and the limited availability of long-term agroecological climate assessments, restricting the identification of localised agricultural vulnerability hotspots and the development of targeted adaptation strategies. This study presents a geospatial assessment of agricultural vulnerability to climate change and variability across Uganda's Agroecological Zones (AEZs). Climate variability and trends were analysed using CHIRPS rainfall and ERA5 temperature data for 1981–2024, employing anomaly analysis, the Mann–Kendall test, and Sen's slope estimator. Agricultural vulnerability was evaluated by integrating biophysical and socioeconomic indicators using a multi-criteria approach. Results show that climate exposure is characterised by substantial hydroclimatic variability, marked by alternating drought and exceptionally wet conditions, alongside persistent warming. Droughts were most frequent in northern Uganda and West Nile, while exceptionally wet conditions occurred in 2012, 2018, and 2019. Rainfall trends increased across eastern AEZs, although substantial interannual and spatial variability was evident across the study period. Significant warming occurred across all AEZs, with the highest rates observed in the cattle corridor. Agricultural vulnerability was highest in northeastern, northwestern, and northern Uganda, as well as in parts of the cattle corridor. The Northeastern Semi-Arid Short Grass-Plains (Karamoja) exhibited the greatest vulnerability, driven by low adaptive capacity, high sensitivity, prolonged dry spells, and erratic rainfall. Additional vulnerability hotspots were identified in the West Nile Farmlands. These findings highlight the need for geographically targeted adaptation strategies to address continued warming, climate variability, and extreme events, thereby strengthening long-term agricultural resilience.

## 1. Introduction

Climate change poses a considerable global threat, manifesting as rising temperatures, unpredictable rainfall, and more frequent extreme weather events. These changes pose substantial risks to agriculture, food security, water resources, ecosystem functioning,

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