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Continental analysis of climate change impacts on baobab across major climate zones in sub-Saharan Africa

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Abstract

Adansonia digitata L. is a multipurpose savannah tree species widely distributed across sub-Saharan Africa. Although climate change may have only moderate effects on its overall distribution, projected environmental shifts could significantly affect its local populations, ecological dynamics, and long-term survival. However, limited information exists on how regional variation in ecological tolerance influences its resilience under changing climatic conditions. In this study, we used ensemble species distribution models (SDMs) to predict suitable habitats for *A. digitata* under two climate scenarios (SSP 245 and SSP 585) for the years 2050 and 2070, across four major climate zones: humid, subhumid, semi-arid, and arid. We developed both whole-species and climate-zone-specific models to evaluate the role of ecological niche differentiation in shaping future habitat suitability. Isothermality (36.75 %) emerged as the most important variable in the whole-species model, while soil properties (26.41 %) had notable constraining effects. Zone-specific models revealed distinct key drivers: precipitation of the driest month and soil types in the subhumid zone; annual precipitation and soil in the semi-arid zone; maximum temperature and annual precipitation in the humid zone; and mean diurnal temperature range in the arid zone. Niche overlap between climate zones was low (Schoener's D = 0.06–0.13), suggesting substantial ecological differentiation. Whole-species models predicted slight habitat loss (0.5–1.12 %) by 2070, especially under SSP 585, while zone-specific models projected habitat gains (1.48–3.13 %), particularly in the humid zone. These findings emphasise the importance of integrating regional ecological variation in climate impact assessments. Baobab's broad climatic tolerance may promote resilience, though empirical studies are needed to disentangle local adaptation from plasticity.

Keywords: *A. digitata*, climate change, regional variation, species distribution models

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