



Climate-Smart Agriculture Practices and Soil Health Dynamics in Semi-Arid South Africa: A Five-Year Perspective

Sipho Mkhize¹, Mpho Khumalo², Tseli Mogobesi², Nomso Mothomoli³

¹ University of the Free State

² University of Pretoria

³ Department of Clinical Research, University of the Free State

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Correspondence: smkhize@yahoo.com

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Author notes

Sipho Mkhize is affiliated with University of the Free State and focuses on Medicine research in Africa.

Mpho Khumalo is affiliated with University of Pretoria and focuses on Medicine research in Africa.

Tseli Mogobesi is affiliated with University of Pretoria and focuses on Medicine research in Africa.

Nomso Mothomoli is affiliated with Department of Clinical Research, University of the Free State and focuses on Medicine research in Africa.

Abstract

Climate-smart agriculture (CSA) practices have been implemented in semi-arid regions of South Africa to enhance soil health and productivity under changing climatic conditions. A total of 20 plots were established across three farming systems: traditional, conservation agriculture, and integrated crop-livestock management. Soil samples were collected annually for analysis using standard protocols. Significant increases in soil organic matter content (SOMC) were observed with the conservation agriculture system compared to the traditional method ($p < 0.05$). The integrated crop-livestock management system demonstrated enhanced soil aggregate stability, though MBC did not show significant differences. Further research is recommended to assess long-term sustainability and potential synergies with climate change mitigation strategies. Climate-Smart Agriculture, Soil Organic Matter Content, Microbial Biomass Carbon, Soil Aggregate Stability Treatment effect was estimated with $\text{text}\{\text{logit}\}(\pi) = \beta_0 + \beta^{-1} p X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: Sahelian, agroecology, soil conservation, sustainable intensification, biophysical modelling, land use change, ecosystem services

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