Tropentag, September 11-13, 2024, hybrid conference

"Exploring opportunities …
for managing natural resources and a better life for all"

Understanding spatial variability of soil physical properties to better inform rainfed soybean and maize cultivation in Southern Africa

Emmanuel Ngonga[1], Yannic Janal[2], Jennie Barron[3]

[1] *International Institute of Tropical Agriculture, LEG4DEV, Zambia*
[2] *BOKU University, Inst. of Soil Physics and Rural Water Management, Austria*
[3] *Swedish University of Agricultural Sciences, Dept. of Soil and Environment, Sweden*

Abstract

The absence of comprehensive soil data in Sub-Saharan Africa's rainfed agricultural systems presents a significant challenge to sustainable farming practices. This challenge is further compounded by the lack of systematic soil monitoring systems and the dynamic nature of soil conditions influenced by agricultural practices and climate change. These limitations hinder the development of precise tools and strategies for agricultural management in this region. This study addresses these gaps by investigating the spatial variability of soil physical properties in southern Africa and its impact on soybean and maize yield. Specifically, we focus on three distinct agroecological zones in Central, Southern, and Eastern Zambia, where we conducted soil analyses to assess key parameters such as bulk density, texture, organic carbon content, cation exchange capacity, base saturation, and water retention characteristics.

Additionally, we carried out *in situ* water infiltration measurements in selected fields to inform soil pedotransfer functions for estimating saturated hydraulic conductivity, a critical parameter for understanding water movement in soils.

Our preliminary findings reveal significant insights into the soil characteristics of these regions. In Kalomo, consistently sandy loam soils were observed, characterised by a lack of vertical structure. Katete, on the other hand, exhibited a wide range of soil textures, structures, and infiltration rates attributed to its diverse topography and microclimates. The fields sampled in Lusaka, predominantly cultivated by large-scale farmers, displayed higher clay composition but surprisingly showed the highest infiltration rates, likely due to their significantly higher soil organic matter content. The data collected in this study hold immense potential for informing future precision farming strategies in the region. By coupling our understanding of ground-based soil properties with remote sensing techniques to monitor crop productivity, we aim to develop tools and models that can enhance agricultural management practices. This holistic approach will contribute to more sustainable and efficient agricultural systems in sub-Saharan Africa's rainfed regions, ultimately improving food security and livelihoods for farming communities.

Keywords: Africa, maize, pedotransfer, rainfed, soil, soybeans

Contact Address: Emmanuel Ngonga, International Institute of Tropical Agriculture, LEG4DEV, Ngwerere Road Chongwer District, 310142 Lusaka, Zambia, e-mail: emmanuel.ngonga@slu.se