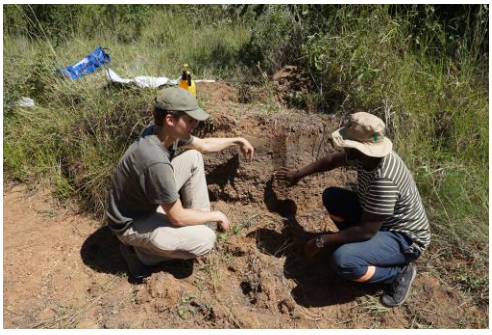
Water Use Efficiency in Rainfed Cereal-Legume Farming Systems in Southern Africa



This PhD project aims to support the development of precision farming approaches in rainfed soybean and maize production systems in Southern Africa, focusing on Zambia (Lusaka, Kalomo, and Katete), Malawi (Kasungu and Chitedze), and Mozambique (Angonia). It examines soil conditions, water availability and use, and availability and use, crop development with a combination of ground-based observations and remote sensing to enhance productivity and resilience in rainfed farming systems.

The research is conducted in three phases. The first evaluates satellite-derived and reanalysis products for monitoring heat and water stress, comparing them with limited ground-based precipitation and temperature measurements. The second validates pedotransfer functions for estimating soil physical parameters like saturated hydraulic

conductivity, permanent wilting point, and field capacity with sampling and observations. The third investigates the potential of UAVs and Earth observation satellites and knowledge of soil physical parameters to predict crop health. Data from 40 fields per location is being collected using the Land Degradation Surveillance Framework (LDSF) for soil sampling in combination with soil moisture sensors and crop measurements.

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Preliminary findings reveal significant spatial variability in soil physical properties, with smallholder fields in Kalomo and Katete showing scope to improve practices that can strengthen soil health, in line with large-scale farms that employ better management practices, leading to higher soil hydraulic conductivity despite higher clay content. Climate challenges, including droughts and floods, exacerbate soil degradation and may limit pedotransfer function accuracy.

The study highlights the need for sustainable soil and water management practices, combined with precision management to improve food security amid climate variability in Southern Africa.