A Multi-Model Ensemble Approach

to Assess the Effects of Alternative Management Practices on Soil Properties and Crop Yield

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Background

Decline in agricultural production due to the growing population, change in climate and soil degradation has become a major concern in the Sudan Savannah of West Africa as it threatens food security that reportedly will trigger a change in food habits as well as demanding even more food (Figure 1). To counteract the problem of soil degradation, alternative management practices can be adopted that have the potential to prevent and/or reduce the severity of soil degradation as well as to improve the production system in a sustainable manner. The on-going study uses two approaches to evaluate the effect of soil and crop management options on soil degradation; (1) experimental evaluation (short-term effects), (2) model-based evaluation applying a multi-model ensemble.

Study Aim



The overarching aim of the study is to analyses management options to improve crop productivity and sustain soil quality which will be reached by quantifying the long-term effects of tillage and residue management on soil quality, crop nutrient uptake, and crop yield.



1 Experiment **Proposed Implementation** UPSLOPE 48 sub-plots **Master Processes** Outcome Model Ensemble Recommendation Development Modeling Total 96 plots Tillage **Primary Data** 48 sub-plots AP EX N Dose Secondary Data SA FOOTSLOPE EPI Crop Residue, Sim-component Cotton -2013 & 2015 Tillage: Maize -2012, 14 & 16 Contour Ridge (CR) OUTPUT Slope Reduced (RD) **Crop Residue:** • pH NO, N1=45, N2=90 Kg/ha October June N0, N1=60, N2=120 Kg/ha November June Without **Objective 3 Objective 1 Objective 2** An experiment has been conducted from 2012 to 2016 in the Sudar **Savanna**, Tambiri (11°10´N, To develop a model To conduct ensemble 2°38′W, Dano watershed), Burkina Faso; and Ouriyouri (10°49′N, 1 04'E, **Dassari** watershed) in the



- Soil analysis for:
- Carbon
- Nitrogen
- Phosphorus
- Potassium
- Gravel Content



Significance

Improve estimates of uncertainty and projections or predictions

Figure: Example SimNitrogen Component

Challenges

- Availability of required data in accordance with different models
- Complexity of soil processes
- Importance of gravel content for water fluxes and P sorption

Expected Outcome

- > Improved knowledge on the long-term interactive effects of contour ridge tillage and crop residue management under different soil types
- > Effect of tillage and fertility management on crops and its interaction with soils and changing climate in the Sudan Savanna of West Africa
- > Robust estimations of climate change impacts with reduced uncertainty due to multi-model ensemble approach

Reference: Wallach, D., Mearns, L. O., Ruane, A. C., Rötter, R. P., & Asseng, S. (2016). Lessons from climate modeling. Climatic Change, 139(3-4), 551-564. doi:10.1007/s10584-016-1803-1 Acknowledgement: This research has been funded by the German Federal Ministry of Education and Research (BMBF) within the WASCAL programme (Funding number FKZ 01LG1202A) and the Eiselen Foundation Fiat Panis (Ulm)



Experiment

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