Tropentag, September 15-17, 2021, hybrid conference

"Towards shifting paradigms in agriculture
for a healthy and sustainable future"

Understanding the Determinants of Soil C Stocks and Water-Use Efficiency in the Semi-Arid Tropics of India Using APSIM

Margarethe Sophie Karpe[1], Andrew Smith[2], Thomas Falk[2], Klaus Dittert[1], GV Anupama[2], Dakshina Murthy[3]

[1] *Georg-August University of Göttingen, Dept. of Crop Sciences, Germany*
[2] *International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Innovation Systems for the Drylands, India*
[3] *ANGR Agricultural University Guntur, Agronomy, India*

Abstract

Low soil organic carbon (SOC) concentrations and variable rainfall are major limitations to Indian dryland agriculture that threaten yield stability and food production for a growing population. However, increasing SOC sequestration has the potential to positively influence soil productivity, improve farmers' food security and livelihoods, and mitigate climate change. The impact of management on SOC depends on a wide range of factors. Trends in shifting towards more water-intensive cash crops such as cotton and rice and changing climatic patterns necessitate the exploration of site-specific management options.

Our study focuses on the state of Maharashtra, India, and uses output data from the crop model APSIM. The model input for 92 grids ($0.25° \times 0.25°$) was obtained from observed climate data, global circulation models (GCMs at RCP 8.5), crop and soil maps, and crop production surveys (160 households). The data represent an agro-ecological gradient in terms of temperature and precipitation (610 – 998 mm annual average precipitation on district-level over 30 years). Simulations were constructed to compare different cropping systems under five management scenarios that included the use of inorganic and organic fertilisers as well as irrigation management. Simulations were run for three climate scenarios.

We used conditional inference tree analysis (CTree) for data mining. The results concur with findings of other studies that soil type together with land use management are influential determinants for changes in SOC stocks. SOC concentrations can be significantly influenced by management, especially through changes in systems (crop rotation choice). The two systems that sequestered most SOC were sorghum-chickpea (viz. rainy season crop then post-monsoon crop) and sorghum-wheat. Under rising temperatures, mungbean-sorghum gained in importance.

Keywords: APSIM, classification and regression tree, site-specific management, soil degradation, soil organic carbon

Contact Address: Margarethe Sophie Karpe, Georg-August University of Göttingen, Dept. of Crop Sciences, Göttingen, Germany, e-mail: margarethekarpe@gmail.com