Tropentag, September 18-20, 2019, Kassel

"Filling gaps and removing traps
for sustainable resource management"

10 m x 10 m Map of Soil Organic Carbon and Major Nutrients: Towards Plot Level Soil Fertility Management

Powell Mponela[1], Grace Villamor[1], Lulseged Tamene[2], Sieglinde Snapp[3], Quang Bao Le[4], Christian Borgemeister[1]

[1] *University of Bonn, Center for Development Research (ZEF), Ecology and Natural Resources Management, Germany*
[2] *International Center for Tropical Agriculture (CIAT), Agroecosystems and Sustainable Landscapes Research Area, Malawi*
[3] *Michigan State University, Plant Soil and Microbial Sciences, United States of America*
[4] *International Center for Agricultural Research in the Dry Areas (ICARDA), Jordan*

Abstract

Much as the declining trends of soil fertility is recognised as a major threat to food production for the rural smallholder farmers in Africa; the knowledge of the status and gaps at the management scale of a managed plot is limited. This study uses measured soil attributes collected from 219 locations within 10×10 km land degradation surveillance site in rural Malawi in 2013 and 2018 to predict major plant nutrients and carbon in soils. We used randomForest regression model in R with rain and dry season Sentinel2 imagery, Shuttle Radar Topography Mission (STRM) terrain attributes, geo-coordinates, and soil lithological classes as predictors. the prediction accuracy using out of the bag error was around 90 %. Findings suggest that there are pronounced spatial variations with most soils deficient in soil organic carbon (SOC) and total nitrogen (TN) but have low to adequate phosphorus (P) and potassium (K). The predicted mean±sd for SOC and TN of 1.06±0.27 % and 0.07±0.01 % are lower than the critical levels of 2.0 and 0.15 whilst for P and K, 35.99±33.04 mg kg^{-1} and 132.87±23.15 mg kg^{-1} are within the low to high (>11 and >17) and deficient to moderate (<125 and >190), respectively. The C:N and C:P stoichiometry and structural stability index show that the limited SOC could potentially affect retention and availability of both N and P but also lowers soils physical stability. Hence, organic input sources should be integrated in the currently inorganic fertiliser dominated soil management to minimise soil degradation risk and ensure agricultural sustainability.

Keywords: Plot level, predictive soil mapping, randomForest, soil fertility, soil nutrient limits, soil structural stability

Contact Address: Powell Mponela, University of Bonn, Center for Development Research (ZEF) - Ecology and Natural Resources Management, Genscherallee 3, 53113 Bonn, Germany, e-mail: powell.mponela@uni-bonn.de