Spatial Variation of Soil Organic Carbon in Linear Simultaneous Agroforestry System.

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Abstract

Variations in soil characteristics tend to be correlated over space, both vertically and horizontally. When such heterogeneity and interactions occur, it is necessary to describe the existing spatial structures. Geostatistics has been widely applied in soil sciences to quantify the spatial features of soil parameters and carry out spatial interpolation. Using geostatistics, the spatial variation of a soil property within a region can be quantified and summarized by the variogram.

Most research on spatial variability of soil organic carbon (SOC) has been conducted in forest and grassland soils, but no research has been conducted on agroforestry soils. Knowledge about the variability of SOC can assist in generating effective sampling designs and can help to scale-up carbon inventories. The aim of this study is to investigate the spatial variation of SOC concentrations in linear simultaneous agroforestry systems and recommend a suitable sampling design.

The study was conducted at Kifu Forest Research Station in Mukono district in Central Uganda. The field work was conducted within an existing experiment, established in 1995 as a randomized block design with a multi factor factorial treatments structure. This site has been under fallow since the last agroforestry experiments in 1995-1998 and 2000. Soil samples consisting of soil cores collected at three depths; 0-25 cm, 25-50 cm, and 50-100 cm, and at two times; before clearing the site and planting the maize crop and after harvesting.

Geostatistical tools were used to describe and predict spatial variation using semi-variograms, and to conduct spatial interpolation. Visual examination of 2D and 3D-semivariogram plots exhibited no obvious differences in the spatial structure in any direction, for both sampling times. Results indicate that there are spatial dependencies among neighboring cores at all soil depths. However, results indicated a short distance of spatial continuity of SOC varying from 5 to 13.5 m. For statistical independence, soil samples should be taken further from each other than the range of spatial dependence. Implications on the influence of spatial autocorrelation in SOC on soil sampling designs are discussed.