EM 04

Spatial Variability of Soil Properties Using GIS-Based Geostatistic in Myanmar

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Abstract: Precise information on the spatial variability of soil is a crucial component for intensive agriculture, sustainable development, and the management of natural resources. The primary purpose of the study was to investigate the spatial variability of soil properties at Yezin Agricultural University Field, Myanmar using geostatistic. A total of 94 composite soil samples were collected from the depth of 0 to 20 cm in a systematic grid (50 x 50 m2) on the field in May 2019. Soil pH, electrical conductivity (EC), soil organic matter (SOM), total soil nitrogen (TSN), available phosphorus (Ava-P), and available potassium (Ava-K) were measured by using standard analytical methods. Data were analyzed geostatistically based on semivariogram. The exponential model best fitted the semivariogram for pH, EC, Ava-P, and Ava-K; SOM was adapted from the Gaussian model while TSN was adapted from the spherical model. The nugget/sill ratio showed a strong spatial dependence for EC, Ava-P, and Ava-K and a moderate spatial dependence for pH, SOM, and TSN. Most of the soil was found to be strongly acidic in the soil reaction. It was also found that EC, SOM, and Ava-P are very low in most of the study area. Most of the areas were found to have low TSN levels, while Ava-K appeared low content in the entire area. With such an analysis, it is possible to plan better nutrient management practices for agricultural production and environmental protection. Therefore, geostatistical analysis with ordinary kriging is a useful tool for studying the spatial variability of soil properties.

Keywords: Spatial variability, soil properties, geostatistic, semivariogram, kriging

INTRODUCTION

An understanding of the distribution of soil properties is essential for intensive agriculture, sustainable development, and natural resource management. Based on the geostatistical analysis, several studies have been carried out to characterize the spatial variability of various soil properties (Weindorf and Zhu, 2010). Therefore, it is important to extend the soil resource information maps to plan appropriate soil management practices, including fertilization for agricultural production and environmental protection.

Methodology

The study area was carried out in Yezin Agricultural University Field, Nay Pyi Taw Union Territory, Myanmar. A total of 94 composite soil samples were collected from a depth of 0 to 20 cm in a systematic grid (50 x 50 m^2) on the field with the help of a hand-held GPS device in May 2019. Soil pH, electrical conductivity (EC), soil organic matter (SOM), total soil nitrogen (TSN), available phosphorus (Ava-P), and available potassium (Ava-K) were measured by using standard analytical methods. Later these soil properties were process and analyzed in Arc GIS to produce distribution maps of soil properties using a semivariogram model through ordinary kriging.

Results and Discussion

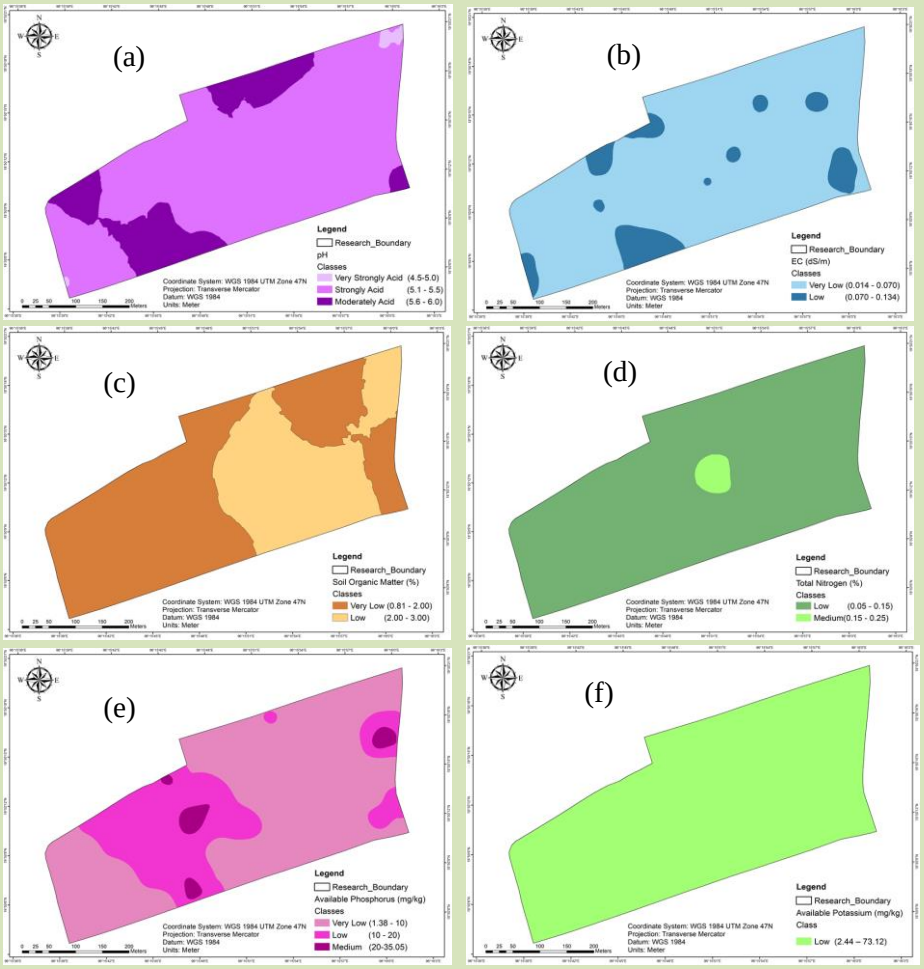

Fig. Spatial distribution maps for (a) pH, (b) EC, (c) SOM, (d) TSN, (e) Ava-P and (f) Ava-K

The distribution of the predicted soil pH map (Fig. a) showed that 0.77%, 80.92%, and 18.31% of the study area were very strongly acid, strongly acid, and moderately acid, respectively. The predicted map of EC (Fig b) showed that 89.22% and 10.78% of the soil of the study area were found to be very low and low. The distribution of SOM (Fig c) ranged from very low (62.73%) to low (37.27%), but low levels were most prevalent. Majority of the soils were found to be low (97.75%) in total nitrogen content, whereas 2.25% of the study area were rated as medium level (Fig d). Ava-P map (Fig e) shows that, in terms of area coverage, 68.83%, 28.42%, and 2.75% of the study area were found to be very low, low, and medium levels respectively. The whole of the study area was distributed with a low rating for Ava-K content (Fig f).

Conclusion

The generated spatial distribution and fertility maps can serve as a powerful tool for farmers, decision-makers, and planners to understand the existing soil conditions and make sensible decisions to better manage the soil for sustainability and productivity.

Reference

Weindorf, D.C., and Zhu, Y. 2010. Spatial variability of soil properties at Capulin volcano, New Mexico, USA: Implications for sampling strategy. Pedosphere 20 (2): 185-197.