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Spatial and Temporal Dynamics of Soil Organic Carbon in an Organic Vegetable Production Area

Maria Gabriela F. Mata[1], Marcos B. Ceddia[1], Érika F. M. Pinheiro[1], Jose G. M. Guerra[2] and Ole Wendroth[3]*

[1]Soil Department, Federal Rural University of Rio de Janeiro, Seropédica-RJ, Brazil ; [2]Organic Farming, Embrapa Agrobiologia, Seropédica-RJ, Brazil ; [3] University of Kentucky, Lexington, KY,USA

* Corresponding author: mgfmata@yahoo.com.br

Introduction

Assessment and Monitoring of agricultural management impact in soil quality is an important issue in agricultural sustainability. Soil organic carbon (SOC) has widely been used as a quality indicator because it is sensitive to soil management besides playing an important role in several chemical, physical and biological processes. Spatial variability of soil organic matter content and its temporal behavior are not well understood at the field scale.

The purpose of this study was to provide insights how soil organic carbon content changes during several years, and whether its spatial distribution pattern remains rather stable or variable over time.

Material and Methods

The experiment was carried out from 2010 until 2014 in the Integrated Agroecological Production System (SIPA), Seropédica city, RJ, Brazil in a 1 ha of organic vegetable production area. This area was subdivided into two areas, one (area 1) with vegetables being grown and the other (area 2) being used for biomass production for organic material applications in the first area.

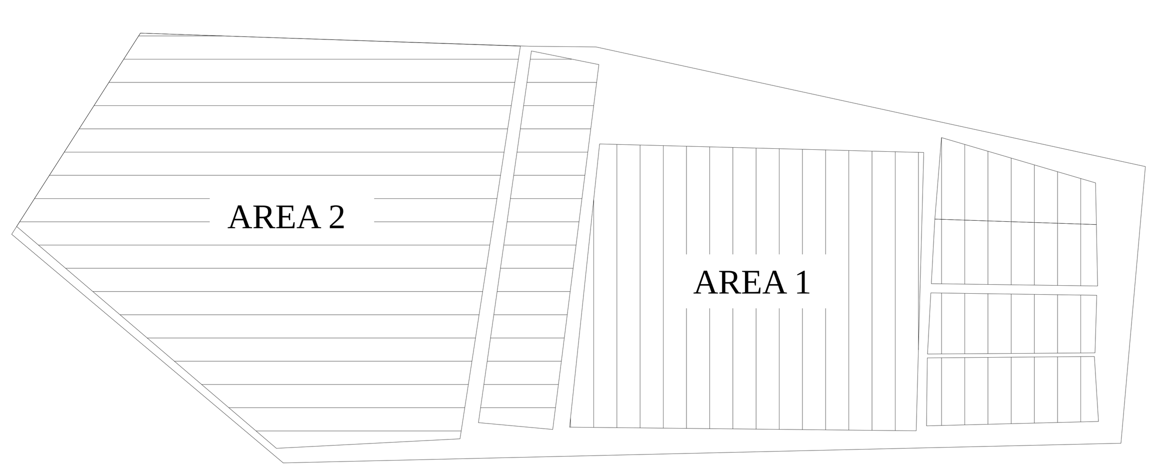

Figure 1: The study site and the experimental layout showing the organization of plant management in SIPA.

The fertilizer sources were composed only of materials of plant origin: Gliricidia leaves, chopped grass (straw), compost produced in area 2, "seed cake" of castor bean (*Ricinus communis*) and fermented compost (Bokashi).

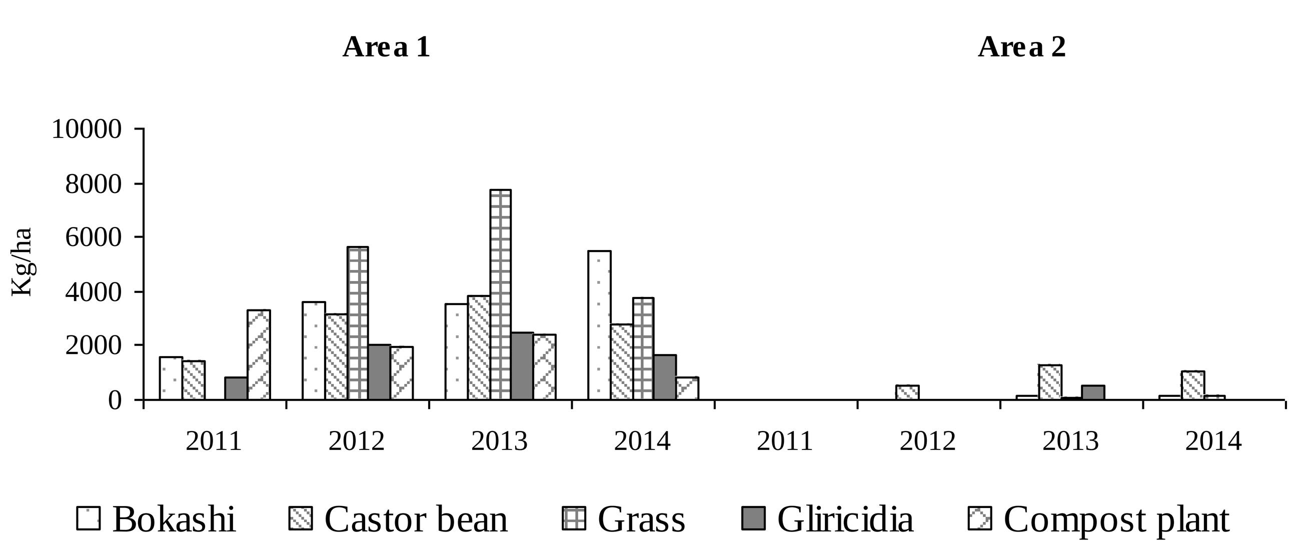

Figure 2. Amount of straw and fertilizers added by area.

A regular 10-m grid was laid out for monitoring soil organic carbon (SOC) resulting in 131 sampling locations. Soil samples were obtained from 0 – 0.20 m depth from year 2010 until 2014.

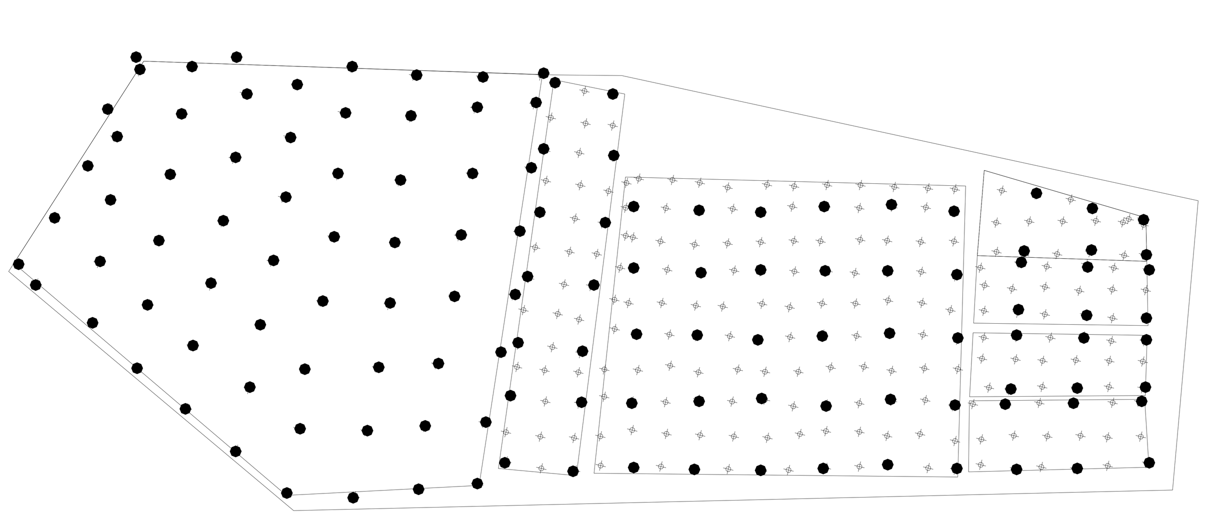

Figure 3: The study site and the experimental layout showing the organization of plant management in SIPA.

Results and Discussion

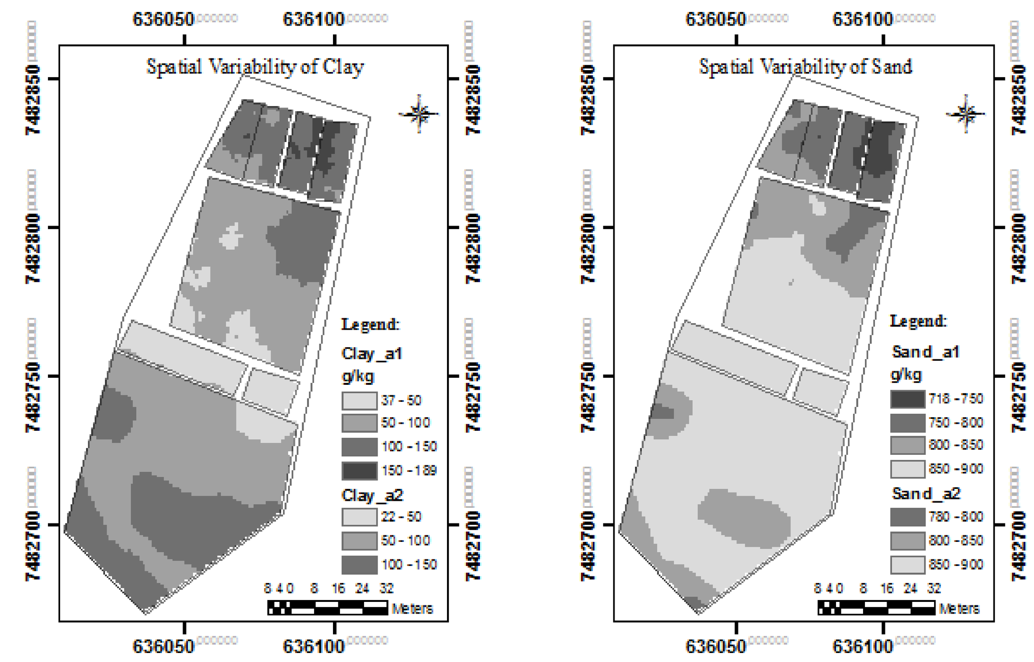

Figure 4. Spatial variability of clay (a) and sand (b).

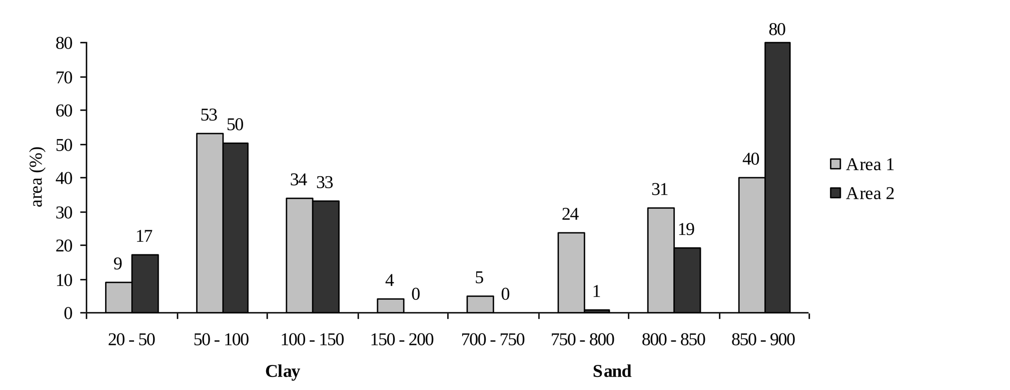

Figure 5. Clay and sand class distribution in spatial variability of clay and sand.

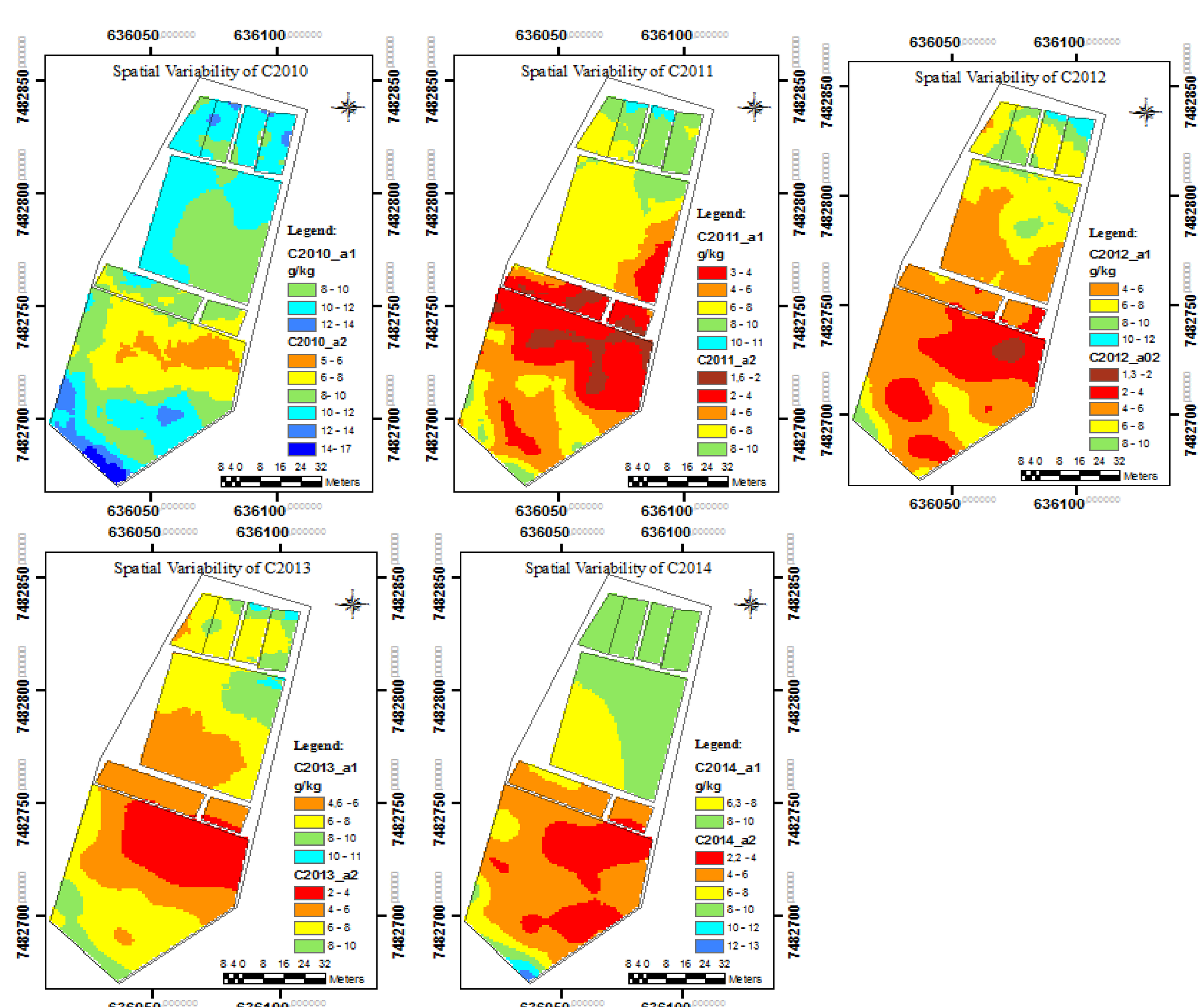

Figure 6. Spatial distribution of soil organic carbon in different years

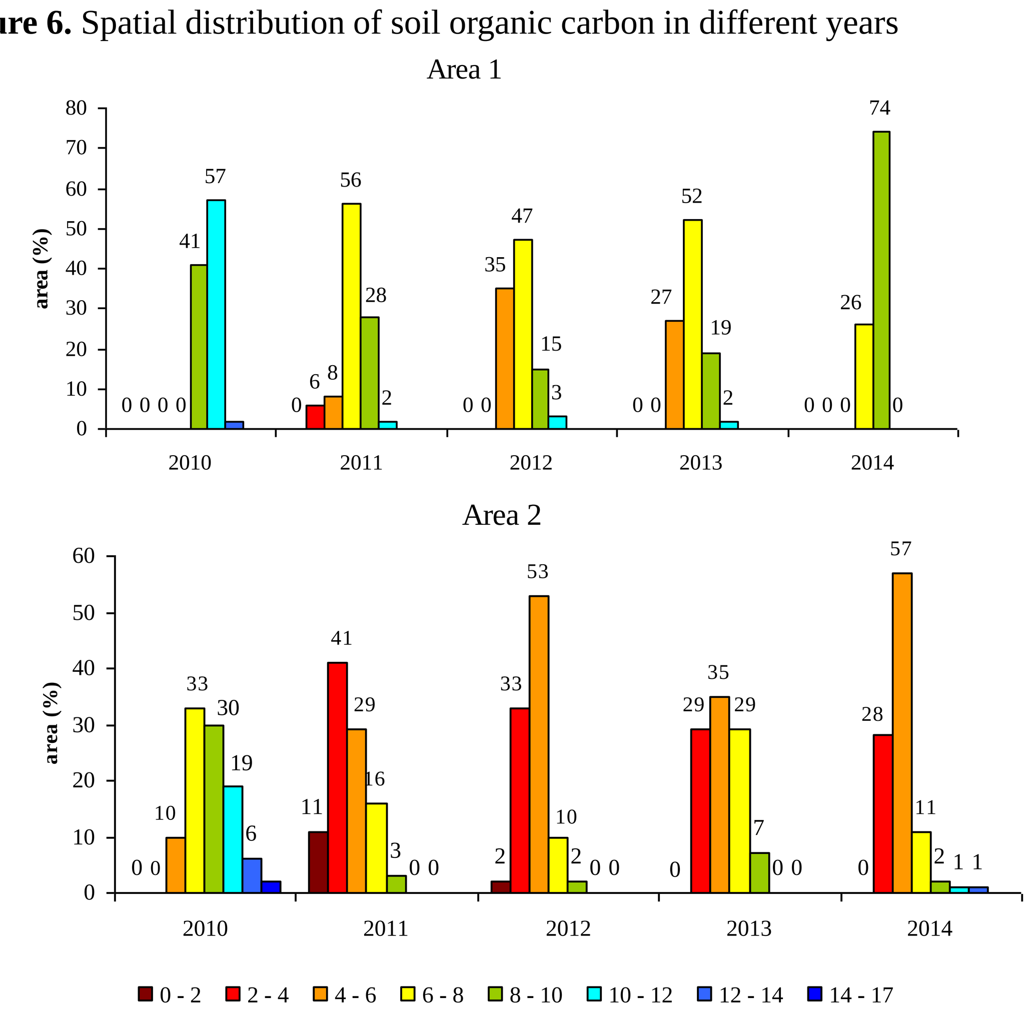

Figure 7. Percentage of area occupied by soil organic carbon classes in area 1 and area 2 .

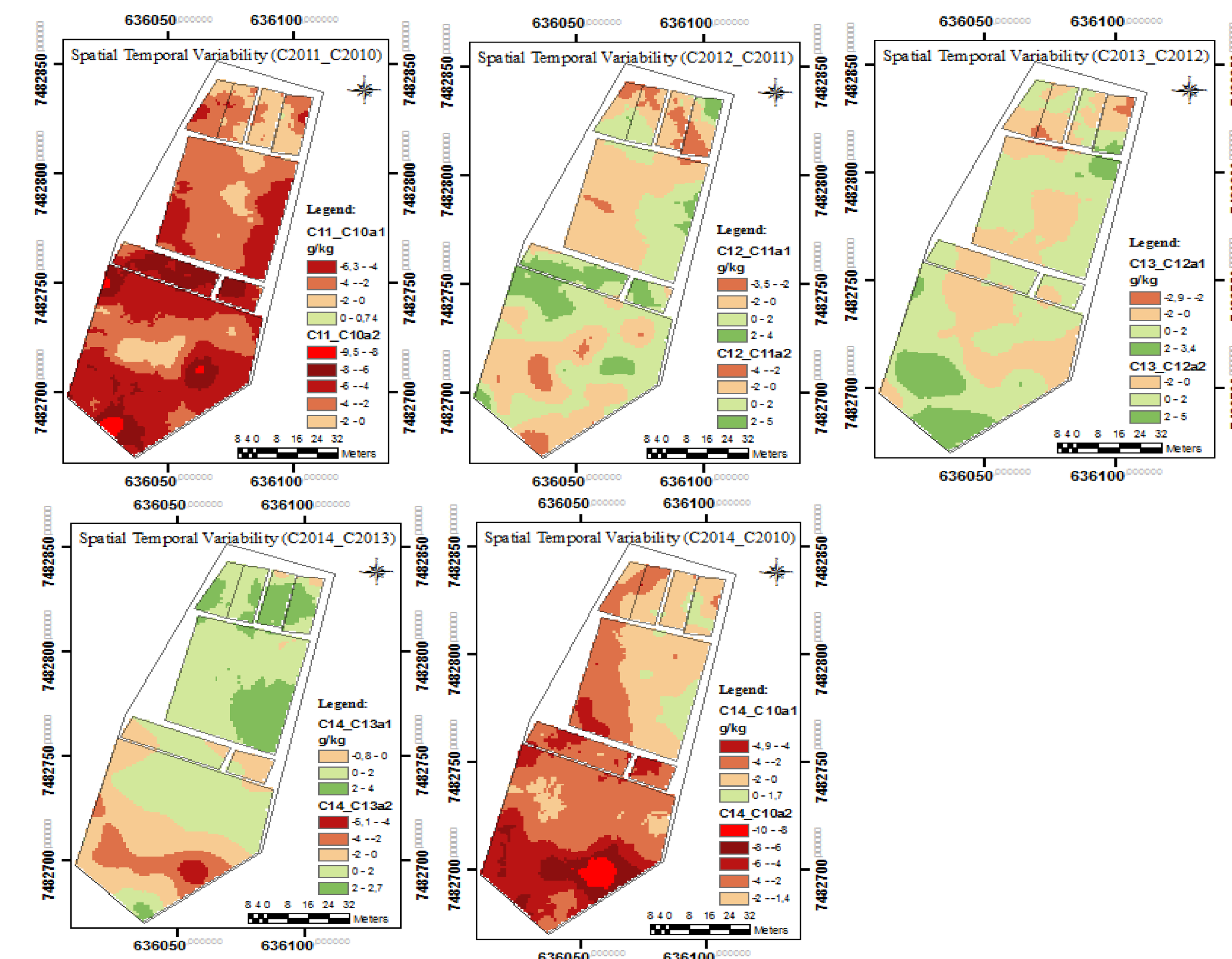

Figure 8. Spatial and temporal variability of soil organic carbon

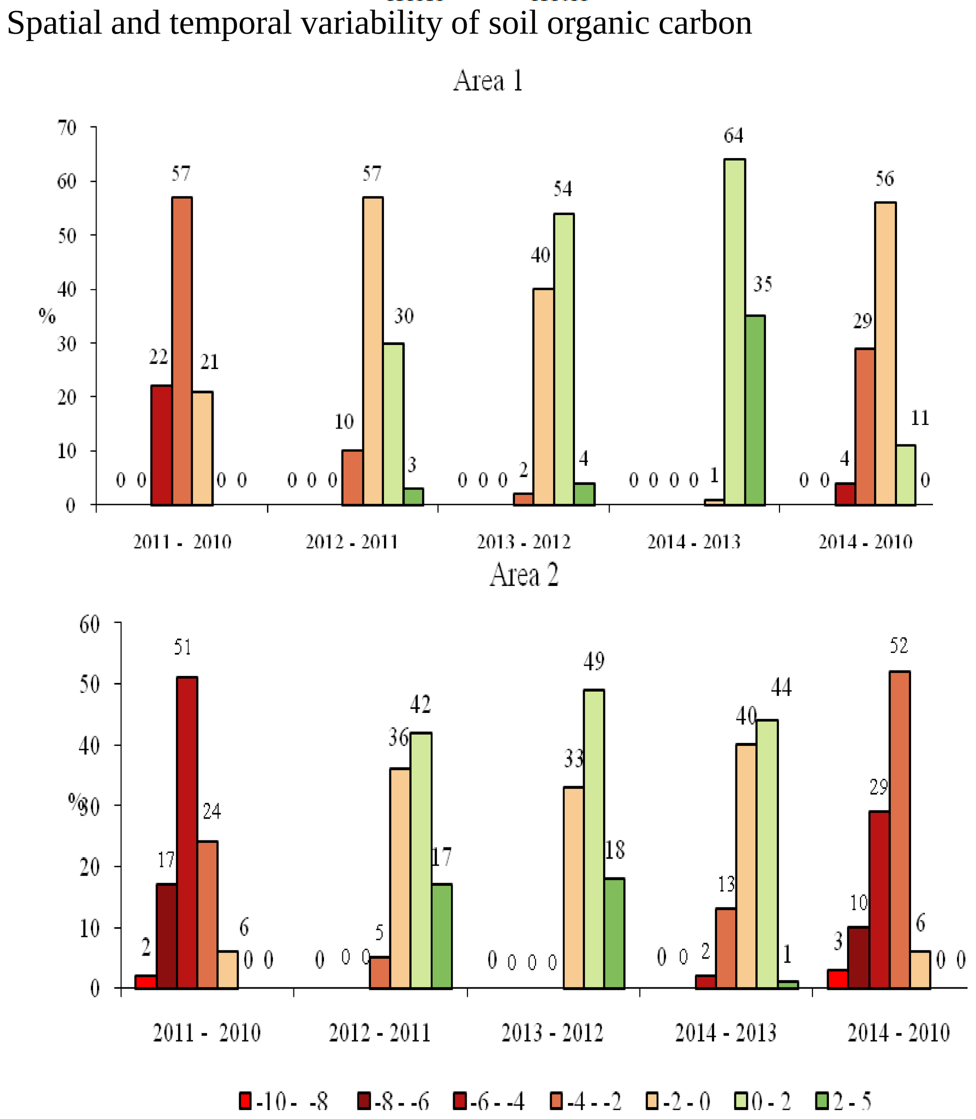

Figure 9. Distribution of soil organic carbon variation over years.

Conclusion

- The SOC monitoring showed a significant decrease of soil carbon values in one year. This result manifests the fragility of sand soil in carbon maintenance when it is used as an intensive soil management. Beyond show the high rate decomposition of SOC in tropical condition.
- The spatial and temporal monitoring allowed to detect changes in SOC values as well as spatial and temporal trends. After the first year (2010-2011) of soil management the mean of SOC decreased abruptly in both areas. After the second year of monitoring (2011-2012) the SOC remained constant in area 1, where in the third (2012-2013) and fourth (2013-2014) year, it increased. In area 2 the mean of SOC increased in the second and third year but decreased in the fourth. Larger amounts of straw added in area 1 may have contributed to the increase of SOC despite high sand contents in the soil. The dynamic of carbon was different between areas.
- Semivariograms of texture and SOC showed a spatial structure allowing make maps. The spatial correlation distance for SOC in area 1 increased over time, indicating that the soil management changed the spatial relationship of this attribute.

Acknowledgment