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ASSESSMENT OF SOIL CARBON STOCKS UNDER DIFFERENT LAND USES IN JAFFNA DISTRICT, SRI LANKA

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Introduction

Carbon dioxide is a major greenhouse gas responsible for global warming. Soil is an important sink for atmospheric CO_2 . Soil carbon stock assessment under different land uses helps to determine the land use, which has a pronounced effect on CO_2 emission. Enhancing carbon sequestration in agricultural soil is increasingly important for improving soil productivity, reducing net emissions of greenhouse gases and for mitigating the projected global climate change. Currently there are no records available of soil carbon stocks for north Sri Lankan soils. The objective of this research was to quantify the effect of different agricultural land uses on soil carbon sequestration.

Keywords: Soil carbon, Labile carbon, Carbon sequestration, Organic fertilizer

Materials and Methods

The study was carried out on a calcic red yellow latosol (Moormann and Panabokke, 1961)soil in the Jaffna district of the northern province of Sri Lanka. Six main land use types studied were: annual crop rotations with organic manure only, inorganic fertilizer only, combined use of organic manure and inorganic fertilizer, abandoned home gardens, maintained home gardens and the perennial crop lands. Soils from each land use type was sampled in triplicate. Samples were taken at two depths (0-15cm and 15-30cm), using the random stratified sampling procedure. Those were subjected to soil moisture, pH and bulk density determinations. Microbial biomass carbon and microbial biomass nitrogen were extracted by using the chloroform fumigation and extraction method and quantified using the TOC and TN analyzer (multi N/C 2100, Analytikjena, Germany). Soil samples were air dried, passed through 2 mm sieve ground and tested for total organic carbon using 'wet' oxidation by acidified dichromate of organic carbon (Baker, 1976). The labile fractions of soil organic carbon, mainly from the active carbon pools, were determined by the $KMnO_4$-oxidizable carbon estimation (Weil *et al.*, 2003) and the water labile organic carbon estimation (Ghani *et al.* , 2003). The samples were analyzed spectrophotometrically. The litter fall contribution for soil C was estimated by measuring the dry weights of litter within 1m x 1m areas in each replicated site. Litter dry weight and litter carbon analysis were also done. Endemic, indigenous and exotic plant species in different land uses were identified as well.

Results and Discussion

Analyses of mean and variance were performed with statistical software (SAS Institute Inc.,1993). This study has shown that within the agricultural land use patterns, application of organic manure causes substantial differences in carbon content and the undisturbed abandoned home gardens also have higher amounts of soil organic carbon contents than that of other land use patterns and have shown significant differences between the means. Much of this loss in soil organic carbon can be attributed to reduced inputs of organic matter, increased decomposability of crop residues and tillage effects that decrease the amount of physical protection to decomposition. Top soil layers (0-15cm) had higher organic carbon content and active carbon. In agricultural soils, above ground inputs and most roots are mechanically mixed in the surface layer. In the abandoned home gardens, the litter dry weight was higher compared to the other land uses. Microbial biomass C and N data reflected that the microbiological situation in agricultural fields with only organic fertilizer application is better compared to the fields with no intense soil management.

Conclusions

Land uses with only organic fertilizer application have shown the highest amount of organic carbon as well as microbial biomass carbon. The abandoned home gardens showed the next highest amount of organic carbon as well as microbial biomass carbon.

Table 1. Effects of annual cropping, perennials and home-garden systems on total C stock of top-soil layers of Jaffna, Sri Lanka in 2011.

Faming system	Topsoil TOC (%)	Litter TOC (%)
	Annual crops	
	(cash crop and vegetable crop rotation)	
Organic manure and inorganic fertilizer inputs	$0.36^{b} \pm 0.07$	$42.75^{bac} \pm 4.24$
Only organic inputs	$0.53^{a} \pm 0.05$	$36.39^{bc} \pm 3.55$
Only inorganic inputs	$0.25^{c} \pm 0.14$	$34.10^{c} \pm 5.66$
	Perennial	
Banana fields	$0.30^{bc} \pm 0.03$	$44.91^{ba} \pm 4.09$
	Home gardens	
Maintaining home gardens	$0.40^{b} \pm 0.15$	$47.71^{a} \pm 12.10$
Abandoned home gardens	$0.58^{a} \pm 0.03$	$46.87^{ba} \pm 1.01$

Means with different lowercase letters within columns are significantly different. ($p \leq 0.0001$)

References

Ghani, A.D.,M. Dexter and K.W.Perrott.2003.Hot water extractable carbon in soils: a sensitive measurement determining impacts of fertilization, grazing and cultivation. Soil Biology and Biochemistry. 35(99): 1231 – 1243.

Weil, R. R. Islam, K. R. Stine, M. A. Gruver, J. B. and Samson-Liebig, S. E. (2003). Estimating active carban for soil quality assessment: A simplified method for laboratory and field use. American Journal of Alternative Agriculture. 18(1): 3 – 17.

Baker, K.F., 1976. The determination of organic carbon in soil using a probe-colorimeter. Laboratory Practice 25: 82 – 83.

Moormann, F.R. and C. R Panabokke,1961, Tropical agriculturalist, Soils of Ceylon, CXVH: 21-23