Kamolwan Laopoolkit 2011: Carbon Sequestration of Major Upland Agricultural Soils in Northeast Plateau, Thailand. Doctor of Philosophy (Soil Science), Major Field: Soil Science, Department of Soil Science. Thesis Advisor: Professor Irb Kheoruenromne, Ph.D. 183 pages.

Fifteen major upland agricultural soils in Northeast Plateau, Thailand representing soils that cover approximately 26,849 $km^2$ were used in this carbon sequestration ($C_{seq}$) study. These soils have ustic soil moisture regime. They include Oxisols, Ultisols and Alfisols. Land uses at the time of sampling were uncultivated lands, corn fields, tree and forage crops and cassava fields. In this study the Ap (D1), base of Ap to 0.6 m (D2), 0.6 to 1 m (D3) and 1 to 2 m (D4) sections of the soil profiles were used to examine the mechanisms and factors controlling $C_{seq}$. Soils of this region are generally well developed and some of them are sandy. The variation of physical and chemical properties of these soils with depth mainly reflects the different nature of their parent materials.

The water aggregate stability (WAS) of Oxisols, Ultisols and Alfisols are 41-93, 20-84 and 32-84 %, respectively. The size of WAS is largest in Oxisols > Ultisols > Alfisols (1.2, 0.42 and 0.23 mm, respectively). Small macroaggregate in Oxisols (250-2000 µm) makes up the largest proportions ranging from 37-73 g 100 $g^{-1}$ soil whereas Ultisols have microaggregate (53-250 µm) as the dominating fraction (2.3-70 g 100 $g^{-1}$ soil). Land use and management affect aggregate size distribution in Ap horizons whereas clay, sesquioxide and calcium concentration affect aggregate size distribution in subsoils.

The total carbon with depth of these soils is strongly correlated with organic carbon. High decomposition rate of these soils tend to lower C/N to near 10:1. The sequestration of carbon ranges from 6.7-52, 3.0-37, 2.2-28 and 7.5-52 Mg C $ha^{-1}$ in D1, D2, D3 and D4, respectively. Oxisols sequester higher carbon (C) than do Alfisols and Ultisols averaging 112, 85 and 64 Mg C $ha^{-1}$, respectively. The extreme value of C stored in D1 is in uncultivated lands (52 Mg C $ha^{-1}$). In surface soils, coarse aggregates have a higher C/N than do the fine aggregates in contrast with the condition in subsoil horizons. Aggregate hierarchy includes microaggregate bound together into macroaggregate by organic binding agents in Ultisols and in surface soils of Oxisols. A relationship between the C enrichment in microaggregate and C in bulk soils of each genetic horizon indicates that stabilization of organic carbon is physical protection in these soils that occurs in the fine aggregates. Carbon in silt and clay fraction has a positive relationship with silt plus clay content.

Topography and land use affect $C_{seq}$ in these soils, while the importance of parent material is shown only in younger soils. The $C_{seq}$ is positively related to silt plus clay content and it is more evident in Oxisols with predominance of iron oxides in the mineral fraction or in Ultisols and Alfisols with predominance of illuviated clay. The estimated carbon stored in D1 is affected by land use, texture and soil aggregation. The estimated carbon stored in D2 and D3 sections reflects their organomineral complex and transformation. The sequestered carbon in D4 section accounts for 51% (28 Mg C $ha^{-1}$) relative to the carbon storage in the first meter and the carbon stored in the D4 section is related to surface soil management, soil parent material and both transformation and translocation in pedogenesis.

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