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ESTIMATION OF REFERENCE SOIL ORGANIC CARBON (SOC) FOR MINERAL SOILS OF COLOMBIA

Neira Fredy[1]

[1]email: fredyhnm@gmail.com. LDN-Consultant

Abstract

Sponsored by FAO, soil organic carbon content (SOC) was estimated for Colombian mineral soils using the IPCC methodology, which involves homologation of national soil and climate maps to the classification systems proposed by the Intergovernmental Panel on Climate Change "IPCC". Initially, Colombian soil map was homologated from USDA taxonomy to IPCC soil types. Consecutively, climatic zones from Caldas-Lang were also homologated to climate types proposed by the IPCC. Based on the integration of soil type maps and climatic zones (IPCC), resulting units were assigned the IPCC proposed content factors of SOC for every type of soil according to its climate unit. As soil units are composed from more than two soils, each unit was weighted with the percentage of soil type. Results indicate that for Colombian mineral soils, ranges vary between 6 and 135 tons of Carbon per hectare. The lowest values correspond to the driest and warmest areas and the highest values for humid and colder zones. The method IPCC classification systems are considered an approximation for Colombia. Some adjustments were required for both homologation systems (soil and climate), due that IPCC system is global and for a national scale in equatorial conditions there are specific characteristics not considered by IPCC.

Keywords: Soil Organic Carbon, Colombia

Introduction, scope and main objectives

The main objective is to estimate lost carbon in tonnes per hectare per year for a depth of 30 cm, taking into account soil types and living areas defined by the IPCC, using factors proposed by the IPCC reference content of Carbon in soils and based on factors of use, management and proposed inputs.

Methodology

The methodology consisted in integrating soil and climate type information for Colombia with the categories of use defined by the IPCC and then taking the reference Organic Carbon values for soils established by the IPCC by climatic zone. Climate zoning for Colombia was based on the scheme proposed by the IPCC (Vol. 4 IPCC, 2006). The life zones determined by the "Forest and Carbon Monitoring System" (SMBYC) project were used, which was presented in the report that corresponds to activity 2. Based on the integration of soil type and climatic zone maps (IPCC), each of the soil units was weighted, taking into account Soil Organic Carbon (SOC) reference factors.

The determination of the SOC of reference for the mineral soils of Colombia was made taking into account the values defined by the IPCC, in Vol. 4, table 2.3 (IPCC, 2006). From this table, reference values were taken for sandy, volcanic, spodic, and low and high activity clay soils. For wetland soils, Table 5.2 of the wetland supplement document (IPCC, 2014) was used.

Due to the general detail scale of the soil map, each soil unit has more than one type of soil, so the reference SOC value is weighted according to the unit content. The objective of the weighting is to give approximate values to each soil unit and avoid either over or under-estimation of carbon content in soils.

The SOC value for each unit (SOCu) was estimated as follows:

SOCu = (SOC*s1* *% s1 + ... + SOCsn *% *sn*) / 100

Where "*s1*" corresponds to soil 1 and "*sn*" to the possibilities of different soil types in the unit.

The weighting was done taking into account only mineral soils. For mixed units, where a portion of the unit corresponds to one or more mineral soils and another part to organic soils, only the mineral soils and the total percentage of them were taken into account.

Results

As product, a map of units each with a SOC value was obtained. The ranges obtained vary between 6 and 135 (tons of Carbon per hectare). Areas in green tones indicate the lowest values of carbon contents while red areas indicate the highest values.

For Colombia, taking into account the reference values for the mineral soils classified by the IPCC system and according to the IPCC climate types, the areas with the highest carbon content are located in the Andean region in the medium to high thermal floors and in the Valleys of the Cauca Rivers and high plateaus. The Caribbean region is the area where most of the soils have less carbon content, especially in Guajira. The Orinoquia, Amazonia and Pacific regions present relatively low carbon contents in mineral soils.

In general, most of the soils of Colombia have medium to low carbon contents, which would indicate that even small carbon losses could have very high impacts on the reduction of soil quality, since organic carbon is associated to the organic matter and is in turn with the properties and characteristics that determine the fertility of the soils.

Once the SOC values for each soil unit were obtained, the area estimate was obtained, obtaining a total of 5.95 Gton of Carbon for the evaluated area of Colombia (1,139,960.4 km2). This value indicates an estimated Carbon content in soils under natural conditions of original coverage, not under agriculture or anthropic use.

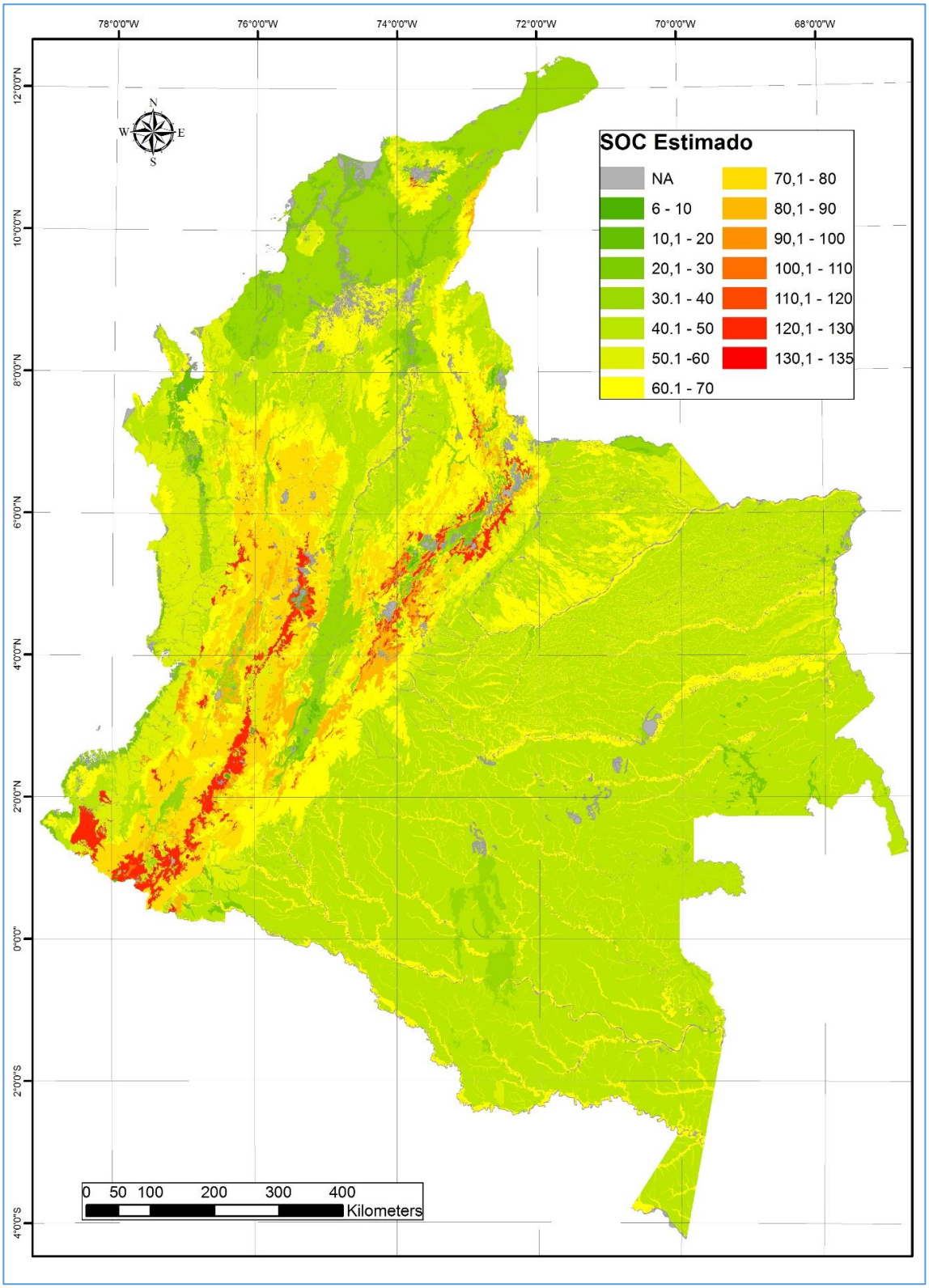

Fig. 1: Reference Organic Carbon (SOC) for Colombian mineral soils in tons of C per hectare

Discussion and Conclusions

The Colombian soil map used corresponds to a general scale, so the classification of the map units takes into account the percentages of each type of soil. This allows more accurate estimations and avoids either over or under estimating calculations such as soil content, loss and carbon emissions.

Based on the classification of IPCC soils for Colombia, organic soils in Colombia are about 0.5% while the remaining 99.5% correspond to mineral soils.

It is necessary to take into account that the Colombian soil map corresponds to a compilation of studies of soils of more than fifty years, reason why many of the soils, especially those used in agriculture have undergone processes of degradation and perhaps at present time correspond to other categories. Also, some soils such as organic or wetlands have undergone changes in the last decades, for activities like the burn and drainage.

The climate zones established by the IPCC are very general, so a proposed adjustment was made based on the ranges established by the SMBYC. However, it is necessary to take into account that the climate zones do not present natural boundaries, due to the interpolation methods used, reason why it is suggested to consider adjustments to the interpolation methods, especially because a great part of Colombia does not have enough meteorological stations. In addition, it should be considered in climatic zoning the values of effective precipitation and not recorded precipitation, due to the fact that for the mountainous areas of Colombia great deal of the precipitation is lost by runoff.