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Soil organic carbon in Apolobamba (Bolivia): Quantity and quality of the reservoir

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Global carbon cycle mainly depends on the soil organic matter (SOM). Some reducction of climatic impact techiques are related to the increase of the soil organic carbon (SOC) contents in order to elevate atmospherical carbon inputs. Kinetic mechanisms of the SOC are differents due to the complex interation between biological, physical and chemical processes in the soil. For a full understanding of the SOM contribution to the carbon cycle in the soil, the SOC contents should be addressed.

The vicuna (Vicugna vicugna) is an endangered species which belongs to camelid family. Its natural habitat is located in highland grasses in the Andes Montain Range, above 4,000 m.a.s.l. In Bolivia the vicuna is distributed around some andean regions such as Apolobamba. It is a protected area located in the Northwest of Bolivia where native inhabitants carry out a sustainable management of the vicuna. This activity is considered within a programme to improve economical conditions in the area. The vicuna lives in the same habitat than other cattle camelid like alpaca (Lama pacos). The soil is an essential natural resource in the vicuna development and the biodiversity conservation due to its role to support the native vegetation in Apolobamba.

The objectives of this research were: (i) the quantification of SOC contents, (ii) the study of the SOC quality and (iii) the determination of the soil degradation degree in some zones in Apolobamba.

Eight zones or census places, separated areas with geographic accidents, with different vicuna and alpaca densities were selected: Ulla-Ulla and Killu (low density), Ucha-Ucha and Wakampata (medium density), Sucondori and Caballchiñuni (high density) and Puyo-Puyo and Japu (very high density). One soil profile was taken and three sampling plots were determined in each zone. Three sampling points were selected in each plot and surface (0-5 cm) and subsurface samples (5-15 cm) were collected. Total carbon, total organic carbon (TOC) and water soluble organic carbon (WSOC) were messure. In addition, 13C MNR technique was used in surface samples in each plot in order to determine the main carbonide groups: alkyl, O-alkyl, aromatic and carboxilic. Results were discussing through statistical analyses.

Soil profile datas exhibited very low TOC in Ulla-Ulla zone including the surface horizon. Sampling plot results showed maximum TOC contents in Wakampata and Puyo-Puyo surface samples; on the other hand, Sucondori, Caballchiñuni and Ulla-Ulla presented minimum contents. Generally speaking, low and medium WSOC inputs were determined in surface and subsurface samples, respectively, in studied areas. Moreover, Wakampata and Japu zones presented high O-alkyl percentages; it could be related to highest polysacharide concentrations and the easiest SOM degradation, taking into account alkyl/O-alkyl ratios. On the contrary, Ulla-Ulla and Caballchiñuni exhibited highest carboxilic percentages pointing out a SOM oxidation increase.

In conclusion, Apolobamba soils presented different SOC conditions. There were some zones which could be characterized as excellent carbon reservoirs due to high SOM quantity and quality; however, in other census places could be identify a certain soil exhaustion degree, as a consequence to the soil overexploitation due to the cattle camelid concentrations both the natural wind erosion in these zones. It should be carried out conservation actions in order to improve the carbon sink and to preserve the soil and the biodiversity in Apolobamba.