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Soil organic matter dynamics at the paramo and puna highlands in the Andean mountains

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Mountains and uplands represent the most diverse and fragile ecosystems in the world, cover about 20% of the terrestrial surface and are distributed across all continents and major ecoregions. The Andean Plateau is the main mountain range of the American continent and one of the largest in the world with more than 7,500 km. The soil organic matter is a corner stone in the fertility management of the Andean agriculture as well as in the erosion control. However, its role is still much unknown in these ecosystems. Moreover, the influence of current global climatic change on soil organic C reservoirs and dynamics is still not clearly understood. The aim of this work was to review the soil C dynamics and the implication of the soil organic matter in the fertility management, erosion control, conservation of biodiversity and global climate change to improve the knowledge on the mountain Andean highlands. Climate, landscape, soil C pools, biomass and management were studied. In general, the Andean climate is affected by three main factors: ocean currents, winds and orography characterized by an abrupt topography. The entire Andean belt is segmented into the Northern, Central and Southern Andes. Northern Andes are called paramo and are characterized by humid climate while Central and Southern Andes dryer zones are called puna. Most of the region is tectonically and volcanically active. Sedimentary rocks predominated in the paramo while sedimentary, igneous and metamorphic ones prevailed in the puna. The most common soils were Andosols, Regosols, Umbrisols and Histosols. The cold and wet climate and the low atmospheric pressure favored organic matter accumulation in the soil. The accumulation of organic matter is further enhanced by the formation of organomineral complexes strongly resistant to the microbial breakdown mainly in the paramo. High organic C contents were observed in the paramo (10%) oppositely to the low contents found in the dryer puna (1%). The C/N ratio showed the equilibrium between humification and mineralization processes although the aluminum likely could decrease the organic matter mineralization. Some zones presented high recalcitrant C and Alkyl C percentages. The ratio between soil respiration at 15 ºC and 25 ºC (Q10) showed that the temperature increase could impose a negative impact in the C reservoirs. The highest species richness was found in the paramo, generally adapted to high UV radiation, moisture stress and grazing disturbances. Dominant plant vascular genera in the paramo were Acaena, Aciachne, Carex bonplandii, Espeletia, Hypericum, Niphogeton, Sisyrinchium. In the Northern puna were Aciachne, Festuca, Deyeuxia, Stipa, Pycnophyllum, Tarasa, Azorella and Lachemilla. Andean ecosystems are subjected to accelerated transformations with intensified cultivation and grazing. As a consequence, further studies on preventing soil C reservoirs, grazing overexploitation and changes on soil management are essential to protect the Andean mountain highlands.