# Distribution of nutrient elements within water-stable aggregates of two tropical agro-ecological soils under different land uses

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Abstract

This study evaluated carbon and nutrient distributions within water-stable aggregates (WSA) of soils of two contrasting ecosystems under different land uses. Surface soil samples were collected from uncultivated and cultivated land in rainforest and savannah agro-ecological areas and separated by wet-sieving technique into 4.76–2.0, 2.0–1.0, 1.0–0.50, 0.50–0.25 and <0.25 mm aggregate fractions. The results show that irrespective of the agro-ecological area, cultivation significantly ($p < 0.05$) reduced the macroaggregate fractions (>0.25 mm) to smaller diameters. Distribution of organic carbon (C), total nitrogen (N) and available phosphorus (P) within the WSA showed preferential enrichment of these elements in the large macroaggregate fraction (4.76–2.0 mm) for the uncultivated soils and microaggregate fraction (<0.25 mm) for the cultivated soils. The overall pattern indicates higher accumulation of C, N and P in the WSA of the uncultivated soils over the cultivated soils. Average distribution of total exchangeable bases (TEB), i.e., sum of Ca2+, Mg2+, K+ and Na+, within WSA of the uncultivated soils of the rainforest region were 7.35 and 7.39 cmol/kg for 4.76–2.0 and <0.25 mm fractions, respectively. The distributions of TEB for cultivated soils of the rainforest region were 2.76 cmol/kg (4.76–2.0 mm fraction) and 7.73 cmol/kg for <0.25 mm fraction. This showed that cultivation significantly ($p < 0.05$) led to 62% reduction in these nutrients in the 4.76–2.0 mm fraction and 5% increase in concentrations of these cations in <0.25 mm fraction. For savannah soils, distributions of TEB were 7.44 and 6.77 cmol/kg for 4.76–2.0 and <0.25 mm fractions, respectively, in uncultivated sites, whereas TEB were 2.19 cmol/kg (4.76–2.0 mm) and 6.35 cmol/kg (<0.25 mm) for cultivated savannah. This indicated that cultivation significantly ($p < 0.05$) led to 71% and 6% reductions in Ca2+, Mg2+, K+ and Na+ concentrations within the 4.76–2.0 and <0.25 mm aggregate fractions, respectively. However, there were 18% and 50% increase in these elements in the 2.0–1.0 and 1.0–0.50 mm fractions of the cultivated soils of the savannah region, respectively. The general trend showed that in uncultivated soils, the 4.76–2.0 and <0.25 mm fractions were preferentially enriched with Ca2+, Mg2+, K+ and Na +; whereas, cultivation led to redistribution of these elements into the smaller aggregates. Since smaller aggregates are preferentially removed by erosion, this study underscores the need for sustainable soil management practices that would minimize nutrient loss when forest or fallow lands are converted to cropland.

Keywords: Available nutrients; Aggregate stability; Rainforest and savannah ecosystems; Tillage practices; Erosion