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Effects of geological and climatic conditions on the enrichment of nutrients in sediments accumulated in Tavera and Sabana Yegua tropical dam lakes (Dominican Republic)

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This study aims at determining the viability of the application of bottom sediments from two tropical dam reservoirs in Dominican Republic (Tavera and Sabana Yegua) as soil fertilizers. In both cases weathering is very strong due to the wet tropical climate, steep slopes and geological nature of the feeding basins, dominated by fine-grained volcanic rocks, causing a major input of sediments into the reservoirs. Most of these sediments result from over-erosion of the soils of the drainage basins, representing complex problems: beside the soil impoverishment in nutrients, it causes excessive dam silting, and consequent decrease of the water quality, turning the lakes into eutrophic systems.

Since this island has evolved from an island-arc, the majority of the geological suites produce fine-grained particles, which have high ionic retention potential. Nutrients and organic compounds are more easily retained by finer particles, enhancing an enrichment of nutrients in the bottom sediments. The sampling methods for sediments included, (i) a Shipeck dredge to study the spatial distribution, and (ii) a UWITEC corer to study the distribution of nutrients in depth. For soil sampling a manual stainless steel probe was used, considering the most representative lithotypes of each drainage basin.
Sediments and soils were subjected to the same array of methods to test their potential of fertility: grain size analysis; total and organic carbon and total nitrogen (elemental analyser for CHNS-O); bioavailable forms of major macronutrients (P, K) by UV/VIS and ICP-OES (ascorbic acid-ammonium molybdate extraction), Ca, Mg and metallic micronutrients (Fe, Cu, Zn, Mn) by ICP-OES (extraction with ammonium acetate, acetic acid, EDTA); potential CEC and exchangeable cations contents were estimated by leaching with ammonium acetate, followed by, acid-base volumetric quantification and ICP-OES analysis, respectively.

The analytical results evidence highly homogenized nutrients contents throughout both reservoirs and in depth, as a result of the high sedimentation rate subsequent to the input and mixture of eroded particles in a region characterized by identical lithotypes and high hydrodynamics. The median values for the main nutrients indicate an enrichment of available forms of P, Ca, Mg, Fe and Cu in the bottom sediments for both dams. However, in Sabana Yegua a few data is opposite of what was expected: N ranges from 0.2% in soils, to 0.11% in sediments, and Corg from 2.33% in soils and 1.64% in sediments. Tavera exhibits an enrichment of these organic nutrients in sediments, denoting a higher biological activity. The high CEC values (41.43 cmolc/kg in Tavera; 32.93 cmolc/kg in Sabana Yegua) and the high exchangeable Ca and Mg contents in the sediments, express that sediments have good qualities as soil amendment, due to high capacity for retention and exchange of nutrients.

The accumulated materials in the bottom of Tavera reservoir display a slightly enrichment in Ctotal, Corg, H, N and S when compared to the soils of origin, in opposition to Sabana Yegua. However, the global values of nutrients indicate that sediments have good potential to be used as fertilizers in the surrounding eroded soils for both dams.