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REUSE OF NUTRIENT-ENRICHED SEDIMENT FROM A TROPICAL RESERVOIR: assessing the impacts on plant growth and the lake water quality

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Sediment inflow to surface reservoirs impacts the water availability quantitatively, by reducing the storage capacity, and also qualitatively, by accelerating the eutrophication process due to nutrients adsorbed to the sediment. With the RESED project, we aimed to assess the use of sediment deposited in a tropical reservoir in Northeast Brazil as a substrate for agriculture, modelling the effect of sediment removal on the trophic level of the reservoir and quantifying the impact of the sediment as substrate on the growth of sunflower plants. A bathymetric survey indicated that the siltation process in the Tijuquinha reservoir (originally with $0.97x10^5$ m^3 storage capacity) accounted for $0.39x10^5$ m^3, reducing its storage capacity by 40% in approximately 100 years. In addition to the reduction of water availability, the silted material is enriched in total phosphorus and organic matter, equivalent to approximately 3.5 and 2.4 times those found in soils of the catchment, respectively. The reservoir is mostly mesotrophic to super-eutrophic (80% of the time), and resuspension of phosphorus from the sediment to the water column seems to hamper the lake recovery to better trophic states, as indicated by the observation that the water sampled closest to the reservoir bottom tends to present higher concentrations of total phosphorus. A model of phosphorus balance, based on the principle of mass conservation in the reservoir and semi-empirical formulation for the phosphorus flow at the water-sediment interface, was used to simulate the interaction of the water and sediment over a period of 40 years, indicating that an annual removal of sediments when the reservoir is completely empty (occurring annually and representing roughly 1/3 of the time), may change the trophic level from high (eutrophic or above) to acceptable (mesotrophic or below) in 10% of the time when the reservoir is not empty. To assess the impact of the sediment as fertilizer, sunflower plants (BRS 323) were cultivated under controlled conditions in a greenhouse considering: i) sand (inert material), substrates containing sand with 100% of the nitrogen recommendation supplied by organic fertilizer (ii) and by the Tijuquinha sediment (iii), as well as a mixture with the sediment accounting for 200% of the nitrogen recommendation (iv). In the experimental conditions tested, the addition of sediment provided improvements in the relative chlorophyll content and the dry matter in relation to the plants growing in substrate containing sand or sand with organic fertilizer. The addition of sediment also caused a higher activity of the enzymes of the sunflower defence system, increasing the capacity of these plants to face extreme events such as droughts, which are common in the highly temporal variable rainfall regime of Northeast Brazil. The overall results indicate that reusing sediment as a nutrient source in the agriculture sector seems a promising practice contributing to a circular economy, by transferring the sediment, eroded from the catchment, to its origin as a soil compound.