GFZ Helmholtz Centre Potsdam

EGU23-15211

SEDIMENT REUSE FROM TROPICAL RESERVOIRS

Assessing the suitability of sediment material for soil improvements and impacts of the practice on plant growth

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ABSTRACT VISIT OUR APP CONTACT

ACKNOWLEDGMENTS : UFC, Instituto Federal Ceará, DAAD, CAPES, CNPq, Cientista-Chefe Agricultura FUNCAP/ADECE/SEDET-CEARÁ

INTRODUCTION

Due to the high rainfall variability in the Brazilian semi-arid region and the occurrence of long periods without rain, society has adopted techniques to cope with drought, with focus on the construction of surface reservoirs. However, silting is causing a decrease in the water storage capacity of those structures, reducing their depth, increasing water losses by evaporation and contributing to the degradation of water quality by adsorbed pollutants. In a context where mitigating solutions are necessary, removal of the nutrient-enriched sediment from the reservoirs' beds and their subsequent reuse for soil fertilization have been proposed. Findings on the sediment reuse practice have been discussed with stakeholders and disseminated among farmers in the study area by an APP development.

Feasibility of sediment reuse in agriculture production → **Evaluation of sediment properties, financial feasibility and regulation of the practice** → **Soil and sediment mapping by spaceborne imaging spectroscopy**

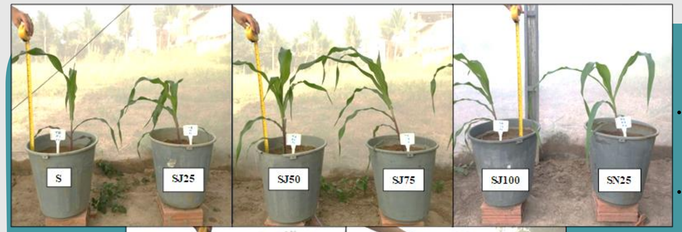

Fig 1. Maize plants at 32 days after sowing (DAS) growing in substrate containing only soil (S), soil + São Joaquim's sediment (SJ), soil + São Nicolau's sediment (SN) and soil + chemical fertilizer (Q). The numbers 100, 75, 50 and 25 correspond to the sediment mass (in tons) per hectare.

Feasibility of sediment reuse in agricultural production

- A higher growth of maize plants, around 25 to 50 %, was observed when sediments were added to the soil;
- Plants macronutrients extraction (NPK) of the treatment SN100 were 60 to 250 % higher when compared to S treatment;

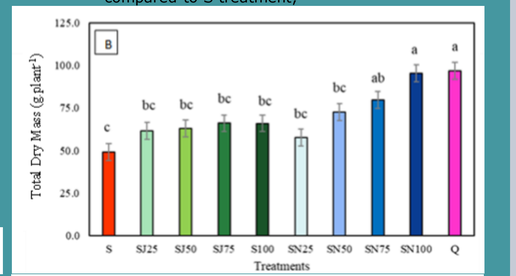

Fig 2 - Total dry mass (B) of maize plants at 96 days after sowing (DAS) growing in substrate containing only soil, soil + São Joaquim's sediment, soil + São Nicolau's sediment and soil + chemical fertilizer. Values are represented by the mean ± standard error. Means followed by the same letter in the column do not differ by the Tukey test (p > 0.05).

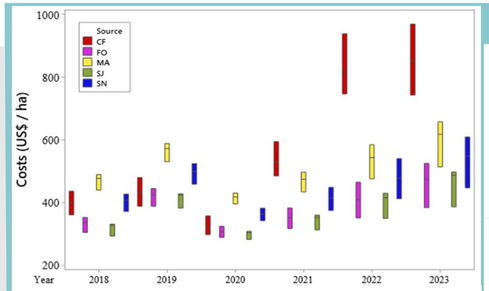

Fig 3. Temporal evaluation of the conventional fertilizer (CF) and sediment reuse costs to meet the nutritional requirement of maize from 2018 to 2023. FO, MA, SN and SJ are sediments from Marengo, São Nicolau, São Joaquim and Fogareiro reservoirs, respectively.

- Sediments should meet the minimum contents of macro and micro-nutrients required for fertilizers;
- The sediments evaluated presented N, Ca, Mg, Cu, and Fe contents markedly lower than required, only for Mn was observed values close to the minimum content required by the normative;

Evaluation of sediment properties, financial feasibility and regulation of the practice

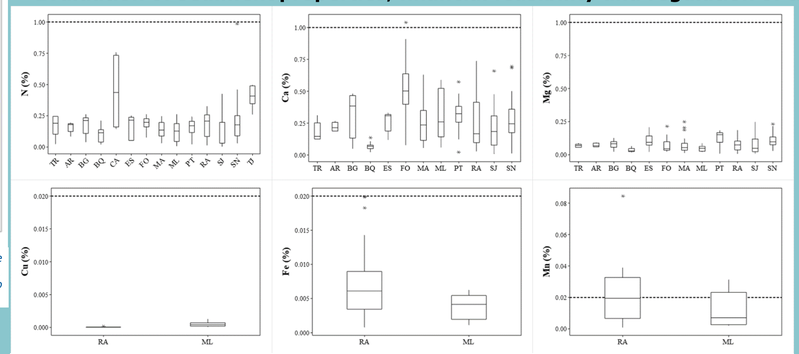

Fig. 4. Nitrogen (N), Calcium (Ca), Magnesium (Mg), Copper (Cu), Iron (Fe) and Manganese (Mn) concentrations in the sediments. TR, AR, BG, BQ, CA, ES, FG, MA, ML, PT, RA, SJ, SN and TJ refer to sediments of Três, Araras, Benguê, Boqueirão, Castanhão, Escola, Fogareiro, Marengo, Mel, Pentecoste, Raiz, São Joaquim, São Nicolau and Tijuqinha, respectively. The lines represents the limits established for organo-mineral fertilizers applied to the soil (IN n° 61/2020).

- However sediments are slightly heterogenous in its composition, unlike mineral fertilizers, and their nature can vary depending on the source of the sediment (Braga et al., 2017; Braga et al., 2019);
- For this reason, it is fundamental, to spread the sediment reuse practice, establish specific regulations for its use in agriculture. By setting regulations, it is possible to ensure that sediments are properly tested, treated, and applied, thus reducing the risk of negative environmental impacts and maximizing their potential to increase the crop production.

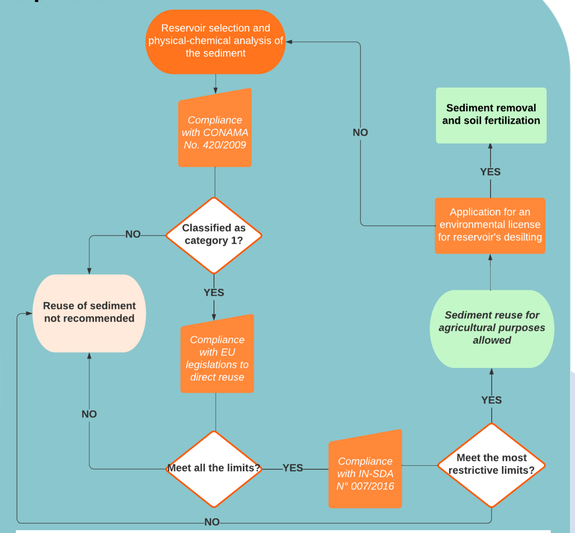

Fig 5. Suggested steps for regulating the reuse of uncontaminated sediments for agricultural purposes in Brazil.

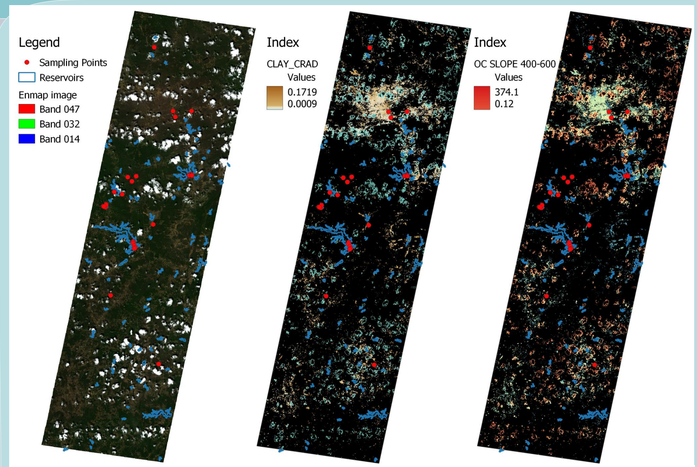

Fig. 6. EnMAP image acquired for 12/04/2023. The first graphic on the left is a true color representation. The index shows high-low values, not real property values.

Soil and sediment mapping by spaceborne imaging spectroscopy

- It is relevant to map the spatial distribution of the sediment characteristics. Recently, we demonstrated that diffuse reflectance spectroscopy might be useful to characterize sediments at lower costs and efforts than by laboratory analyses: for instance, regression models for electrical conductivity and clay content performed in the range of good to very good in the study region (Carvalho et al., 2022);
- A further promising approach is the application of spaceborne imaging spectroscopy to estimate the concentration of elements such as sodium, the electrical conductivity, the content of clay and organic matter in the sediment. The derived information can be used for informed decisions in the application of sediment reuse practice.

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