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Potential of sediment reuse for soil fertilization and water conservation in drylands

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In dry environments, society has long implemented infrastructure to adapt to water scarcity, but unanticipated feedbacks have threatened the supply-demand balance. For instance, construction of dams increases the water residence time in highly impounded basins, causing sediment and nutrient accumulation in water supply reservoirs. Reuse of reservoirs' sediment as fertilizer sustainably benefits agricultural and water systems by: replacing fine particles and nutrients to soils, previously lost by erosion; recovering water quantity and quality by the removal of nutrient-enriched sediments from reservoirs. In the last 5 years we have assessed the potential of the sediment reuse technique for soil fertilization and water conservation in the semiarid Ceará State (149 000 km²), Brazil, where there is a dense network of more than 20 000 dams with considerable silting and eutrophication. Our previous studies demonstrated that:

- Local features contribute to the adoption of the proposed technique: (i) small reservoirs fall dry frequently, exposing the sediments for excavation without the need for dredging; (ii) in general, soils present nutritional deficit and, under natural conditions, crop production is limited to patches of fertile soils; (iii) small scale agriculture plays a major role for livelihood of the rural population;
- Recycling of nutrients from sediments is technically feasible: an experiment with a mixture of soil and sediment as substrate produced statistically higher growth and enzymes' activity of sunflower plants, compared to the cultivation directly in the soil or with addition of synthetic fertilizers;
- Sediment reuse is economically feasible: soil fertilization through sediments for maize cultivation may reduce costs by up to 29 % compared to traditional fertilization;
- Removal of sediment from reservoirs may improve the water quality: simulation of annual removal of sediments when a reservoir of the study region is completely empty indicates a change on the trophic level, from eutrophic or higher to mesotrophic or lower, in 10 % of the time.

In spite of the recent advances, sediment recycling must go through some phases in order to be

included in the public policy agenda. Our ongoing and planned studies focus on the generation of basic data, real-scale testing, simulations under diverse environmental contexts, elaboration of guidelines and disclosure. Spectroscopy has been successfully applied to characterize sediment and soil properties and reduce the costly laboratory analysis. Additionally, data acquisition will be supported by remote sensing approaches based on hyperspectral satellite images that will become available in the near future (Prisma, EnMAP). Such data will be used to estimate nutrient availability in sediments and deficit in the soils to generate a map of the sediment reuse potential in Ceará. Field scale growth experiments are to be conducted for the main crops cultivated in the study region, in contrast to the indoor controlled conditions of our previous assessment. Furthermore, we are developing a modelling tool to quantify the impacts of the sediment reuse practice on water quality, enabling us to expand our previous study to other reservoirs and to test its effectiveness to water conservation.