Soil erosion and associated pollution and siltation compromise the food, water energy and security nexus. A river basin study case in central Chile.

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Introduction: Every year, more 24 billion tons of fertile soils are lost due to erosion, with very serious impacts on climate, water sources, biodiversity, agriculture, forestry, urban water supply, energy supply, and a wide range of productive activities [1]. The economic, social, and environmental costs of this destruction is countless. In Chile there are 60 dams, which are widely distributed throughout the national territory. This indeed, has the potential to affect the power generation capacity, as the dams are losing water storage capacity as sediments are being accumulated affecting the water energy and security as well food production due to erosion nexus.

Methods: To tackle this problem, specifically in the 6th Region of Chile (Central Chile) where the erosion problem is a major issue, social and natural science was set into action. The first, was done through a participatory process where it was possible to evidence the main sources subjected to erosion from the main stakeholders of the catchment. The second approach was performed to provide scientific evidence and to confirm or not the prior hypothesis stated by the stakeholders that mining and agriculture activities were the main sources of sediments to an artificial lake that forms a dam. For the second, was developed a sampling campaign that followed a geology approach with three main geologies identified (Andes, Central Valley and Coastal Range). Around 850 samples were taken from the main rivers and tributaries (sediment sources) and samples of the lake (final mixtures). Chemical tracers were quantified by means of XRF were used as fingerprinting method by using MixSIAR as a mixing model [2]. The idea was to generate a watershed-scale measurement model that is applicable to other study sites both nationally and internationally [3].

Results: Results demonstrated that the larger proportions of sediment were derived from agriculture (53%) and mining (34%) compared to natural erosion sources (glaciers 4%, natural mountain erosion 5% and drylands 4%). Results were cross referenced with evidence from a participatory process that delivered both a strategy formulation via mapping of the multiple dimensions of the problem from stakeholder viewpoints and co-designing and implementation of innovations under the guidance of a multi-actor governance framework. The study demonstrates the challenges and opportunities of applied environmental forensic tools in evaluating spatial and temporal patterns of complex erosion problems at the basin scale.

Discussion: Results were according to the previous concept that the stakeholders were expecting. Mining is an important economic activity and even with the efforts to minimise the impact of it is still present in the catchment. The same is true for agriculture, where hilly areas have been cleared from native vegetation to plant avocado, citrus and olives trees leaving the soil bared for a long time until the planted trees grow to protect the soil from intensive rain.

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