



## **Preliminary assessment of potential contamination of Paramo soil and downstream water supplies in a coal-mining region of Colombia**

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Paramos are high mountain ecosystems distributed mainly in South America that provide multiple ecosystem services including water storage and purification, providing 70% of the drinking water in Colombia. The Paramos and the water supplies they provide are under threat from agricultural and mining expansion. The municipality of Lenguaque in the Cundinamarca region is of special interest both because is the fourth in coal extraction volume in cundinamarca and because of the presence within its territory of the Paramo of Rabanal. Cundinamarca has the largest number of mining titles Colombia and produces 3% of the national coal<sup>1</sup>. Of the current exploitation sites, only 44% of the mines operate with environmental procedures, be it a license, environmental management plan or environmental impact study. Reduction of the Paramo area, contamination of the water resource as well as subsidence have been reported in the area<sup>2</sup>.

The aim of this study was to characterize the quality of Paramo soils and downstream rivers in the municipality of Lenguaque in order to determine whether there is identifiable contamination due to coal mining and coking, and to provide an improved baseline for future monitoring. Parameters were measured using laboratory tests on water and X-ray fluorescence on soil samples and concentrations were corrected based on parental rock composition. Chemical characterization of the outlets of three mines in the area and the water discharge of the town of Lenguaque reported by the Corporacion Autónoma Regional de Cundinamarca (CAR) was also used to interpret our results.

We observed an increase in electrical conductivity, colour, turbidity, concentrations of dissolved solids, as well as a decrease in dissolved oxygen downstream. The main contaminants found in the area were Fe, Mn and Pb. Concentrations of these elements all increase down the river and in some cases displayed levels above those safe for aquatic organisms or direct consumption, however their concentrations were not elevated at the Lenguaque outlet. Soils showed elevated concentrations only of Fe, probably related to the retention of this element within horizons A and B through redox potential.

Our results suggest that Fe, Mn and Pb contamination is related to mining activity in the area and we recommend adequate treatment of the discharges coming from the coal mines. We also think air quality evaluation should be undertaken in the area.

1. INGEOMINAS. (2004). El carbón Colombiano - recursos, reservas y calidad. Bogotá, D.C.: Ministerio de minas y energía

2. Ospina, J., Manrique, F., & Guío, J. (2010). Salud y trabajo: minería artesanal del carbón en Paipa, Colombia. *Avances en Enfermería*, 107-115.