

## On Top of a Mining Disaster, Coping with Ethical Issues



View of the remains of a public school completely destroyed by the Fe ore waste (Photo: Rodrigo Aguiar).

Six months ago, the collapse of a mining dam flooded the village of Bento Rodrigues in the State of Minas Gerais, causing the death of 19 people, and transforming more than 700 km of rivers, which were the primary source of water and food for several communities, in a “sea” of red mud. Samarco Mineração SA, a joint venture between mining giants Australian-based BHP Billiton Ltd. and Vale S.A., operates the Fe ore extraction and the dams of Fundão, Germano and Santarém in the State of Minas Gerais, Brazil. It has been estimated that more than 40 million m<sup>3</sup> of mining residues slid down a mountainside when Fundão tailing dam failed. At least 1,500 ha of natural reserves (Rio Doce State Park, Sete Salões State Park, and Goytacazes National Forest), and Krenak indigenous land were adversely impacted.<sup>1</sup>

Regardless the cause of the problem, it is time to deal with a huge amount of Fe ore waste’s mud that covers the river bed of Gualaxo do Norte, Ribeirão do Carmo and Doce rivers, and the completely devastated village of Bento Rodrigues. The mud accumulated in riverbanks, hillslopes, and soils will be a source of mining residues for a long period of time.

Evaluation of environmental impacts reported by Environmental Agencies and Samarco, so far, were mostly performed and paid by Samarco. The Brazilian society has been questioning the authenticity of the results. That reflects the frequent absence of negative evaluations in the environmental impact assessments (EIA) of all sorts of enterprises in Brazil. In general, these studies do not rule out the option proposed by the entrepreneur. The operation, licensing studies and EIA of any enterprise are paid by entrepreneurs. Typically, these studies do not follow the scientific process, based on data-tested hypotheses; they have flaws and limitations frequently highlighted by the scientific community. As a result, government decisions regarding the environment are not based on the “best available science”. Moreover, reports usually present results in order to exploit the advantages of the intended project, commonly associated with short-term increases of employment, to the detriment of the long-term negative socio-environmental aspects. Obviously EIAs are typically restricted in terms of time and budget, but the problem goes well beyond that.

The environmental agencies become hostage to poorly supported studies provided by entrepreneurs and immense

political pressure. To put the latter in perspective, the taxes generated by Samarco, alone, represent 54, 35 and 29%, respectively, of the total revenues of the cities of Mariana and Ouro Preto, in the State of Minas Gerais, and of Anchieta in the State of Espírito Santo.<sup>2</sup> The importance of Samarco for the regional economy is largely advertised. Besides, the local population is very concerned with the developments of all investigations because thousands of jobs are at stake if the Samarco operations come to a halt. Consequently, when reports suggest that fish and shellfish collected in the region affected by the Samarco plume are not contaminated, the society starts to question the veracity of the data, regardless of by whom or where the results have been produced. This suspicion will linger on until impact assessments are published in the peer-reviewed scientific literature.

We are missing a joint perspective of an ongoing major environmental disaster. There is now an urgent need for unification of expertise directed at advancing knowledge, where the full synergistic effects of the accident is investigated across the more than 700 km that span between the busted dam and the Atlantic Ocean. This will require a coordinated approach, employing methods that include detailed laboratory and field studies, manipulative experiments and large-scale monitoring and modeling.

A formal multidisciplinary network of researchers is needed to integrate the understanding of continental, coastal and, perhaps, oceanic processes and to focus effort on the common threat of contamination jeopardizing a number of ecological services along the continuum continent-ocean. This should be done independently of the actions developed by the entrepreneurs, which are required by law. By forming a research and monitoring network, scientists can better advance knowledge, and advocate for directing resources to research on prevention, and potential mitigation actions. Moreover, a network of mining related environmental issues that reaches from continents to the open ocean, the last frontier of mining,<sup>3</sup> will provide the holistic approach needed to address the Anthropocene<sup>4</sup> pressures in the environment.

At the same time, we need to develop strategies to cope with the changes that may lie ahead. This includes

not only the anthropogenic stressors and contamination we are already exposed to due to the Samarco disaster, and past environmental inputs from mining operations, but also those that are still to come. Furthermore, it is difficult to foresee a future without a substantial additional increase in the concentration of technological critical contaminants, such as the rare earth elements,<sup>5</sup> the platinum metal group and that of other emerging contaminants. The effects of Samarco's disaster in the chemistry and ecological services of the affected ecosystems need to be measured accurately and consistently to monitor and understand the biogeochemical and ecological processes, and modeled to evaluate future scenarios and mitigation alternatives.

Last but not least, the complex interdependence between technological developments and the rampant need for natural resources have generated ethical conflicts between scientific, societal and business values. We will all suffer when politicians, scientists and entrepreneurs ignore ethical standards. Having said that I can only hope that through education, the next generations favor the ethics not only in science and environmental decisions but also promote ethical conduct in the everyday life.

**Vanessa Hatje**

*JBCS Associate Editor  
CIENAM - LOQ/IQ - UFBA*

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