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Interconnections between human and ecosystem health

An integrative approach for
the Rio Doce Basin after the
Fundão Dam failure

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In November 2015, the failure of the Fundão tailings dam at the Samarco's iron ore mining site in the State of Minas Gerais, Brazil, resulted in 19 deaths and severe environmental, economic and social damage. The tailings spill ran 670 km through the Rio Doce to the Atlantic Ocean. It is referred to as one of the worst environmental disasters in Brazil's history.



Figure 1. Permaculture workshop of the Barra Longa – Present of the Future, Healthy Project (MG).

Source: Gustavo Baxter/NITRO

What is the issue?

According to the World Health Organization (WHO), human health is a state of complete physical, mental and social well-being and does not refer merely to the absence of disease or infirmity. Health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.¹

Based on the global definition of human health, the objective of this paper is to relate human health to concern for a healthy ecosystem in the Rio Doce Basin, which must be stable and sustainable, providing goods and services to the benefit of local communities (Burkhard et al., 2008).

The Rio Doce watershed has a long history of mining activity as one of the main drivers of economic growth. The impacts from iron ore mines interact with those associated with unsustainable agricultural practices (May et al., 2019), including extensive livestock, silvicultural activities for pulp and paper, and steel making (Espindola, 2017; Pereira, 1980; Strauch, 1955; Valverde, 1958). Additionally, the lack of sewage systems had negatively impacted the Rio Doce Basin and surrounding communities, generally deficient in basic sanitation services and facilities. Among the 39 municipalities directly affected by the dam failure,² only four had been identified that collect and treat more than 50% of their sewage, while more than 80% of the municipalities lacked sewerage and treatment facilities altogether (Guerra et al., 2014).

When the Fundão tailings dam collapsed on November 2015, a different impact shaped the already altered region, as a wave of mud swept through the river to the sea endangering people's lives and health. An estimated volume of 39.2 million m³ of mine tailings were carried in regional waterways for 670 km to the Atlantic Ocean, impacting water quality and availability, among others (Sanchez et al., 2018). Local and national authorities were alerted to the immediate risks of contamination (Lacaz et al., 2016), as well as potential long-term effects on human health and ecosystems.

The wave of mud carried sediments previously deposited in the river from weathering and past artisanal mining and industrial activities. Together with untreated sewage (de Carvalho et al., 2019), a mix of different substances formed as the mud moved further, with the potential of increased cases of skin allergies, respiratory diseases and mental illness in the medium- and long-term.

The situation in the Rio Doce Basin after the dam failure in 2015 is correlated to multiple interacting causes, including the results of previous economic, political, social and cultural decisions. From an interdisciplinary landscape perspective (Seymour, 2016), a dam's failure and other technical-environmental disasters, in conjunction with previous unsustainable economic activities and cultural practices, only heightens the potential for impacts on ecosystems and human health.

This Issue Paper adopts an integrative and systemic health approach, and proposes recommendations which link human and ecosystem health, while considering the importance of community participation.

Why is it important?

In the first few months after the disaster, the impacts of the dam failure led to the contamination of water resources, restricting access to clean water for the towns and villages, particularly small and traditional communities, along the Rio Doce (Renova Foundation, 2016). This situation was significantly affected by pre-existing conditions thus compounding the imbalance of the ecosystem's health.

The disaster shed light on toxicological impacts on human and animal health, both on urban and rural communities, such as those derived from the consumption of water, with a risk of infectious agents and toxic chemicals that may lead to physical and mental maladies (Neves et al., 2018; ANA, 2016). In addition, in terms of short- and long-term impacts considered by public health policies, disasters related to floods have the potential to influence the alterations in

¹ For further information, please visit: <http://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1>

² For further information, please visit: <https://www.fundacaorenova.org>

the cycles of vectors and hosts of infectious diseases, as well as the habitats of venomous animals, such as reptiles, arachnids and amphibians (Freitas et al., 2014). The tragedy particularly affected the most vulnerable residents³ of the affected area, such as indigenous peoples, *Quilombolas*,⁴ fishers and other rural and urban poor (Freitas et al., 2016). The situation was worsened by their lack of access to health assistance and the persistence of poor or non-existent basic sanitation facilities.

Action plans for restoring the well-being of affected communities stem from a comprehensive concept of health, taking into account the interdependence of healthy ecosystems and people (Seymour, 2016). As the global extractive industries, land use change and urbanization intensify, the priority tends to be on the economy, at the risk of neglecting the actual tangible impact on ecosystems and populations, especially the most vulnerable (Porto et al., 2014).

Recently, Renova Foundation launched the Integrated Environmental Management for Health and Environment (GAISMA),⁵ which aims at contributing to the improvement of human and environment health in the Rio Doce watershed. GAISMA helps develop projects by integrating human health and ecological risk assessments in the region, with geo-environmental research on soil, water and food. GAISMA also takes into consideration the interface with communities, which provides a suitable gateway for the implementation of this paper's recommendations.



What can be done?

In this light, an interdisciplinary perspective that considers integrative and systemic analyses will contribute to a more thorough insight and understanding of the complex interconnections and impacts in the Rio Doce context. Such an approach will be crucial for promoting a healthier human-environment interface (Seymour, 2016), and

for helping leverage effective improvement of well-being in tandem with the restoration efforts being undertaken by Renova.

Several approaches have been developed with a view to adequately tackle the interconnections between human and ecosystem health, and translate them into more practical initiatives. With regard to the Fundão Dam breach, Porto et al. (2016) urgently calls for

³ Vulnerability is related to poor economic conditions, absence of economic autonomy, gender, race, age, mental disorders, lack of job opportunities and of health assistance and other socio-psychological variables that contribute to social discrimination.

⁴ *Quilombolas* are descendants of African slaves whose ancestors during the period of slavery fled to remote places to live freely and in accordance with their cultural heritage.

⁵ GAISMA report is available at: sei.ibama.gov.br/documento_consulta_externa.php?id_acesso_externo=130997&id_documento=7781783&infra_hash=1ae75ab0cfa344297f9bcd5ea9681572



Figure 2. At Instituto Terra, which trains young people and develops projects for the recovery of springs and areas of the Atlantic Forest (Aimorés, MG).

Source: NITRO.

the strengthening and coordination of the numerous initiatives undertaken by various institutions, academics and social movements in the wake of the disaster. The manner in which information is managed and how institutional frameworks are arranged is critical in ensuring relief, recovery and reconstruction. Thus, implementing a robust data management system regarding health of people and ecosystems, including the systematization of lessons learned in this process, could be a key tool for the future health of the Rio Doce Basin.

Public data available on the Rio Doce population's health status and remediation are gathered by public health services and professionals associated with the national Unified Health System (SUS).⁶ Other organisations active in the Rio Doce Basin, such as NGOs, religious organisations, social movements and cultural communities, address and document efforts to promote integrative health and preventive practices. Ideally, according to Porto et al. (2016), these respective sources of information have the potential to complement each other (see recommendation 2, page 8).

⁶ *Sistema Único de Saúde* (SUS) (Unified Health System) is a programme of the Brazilian government that guarantees full, universal and free access to the entire population of the country. It encompasses primary care, medium and high complexities, urgency and emergency services, hospital care, actions and services of epidemiological, health and environmental surveillance and pharmaceutical assistance.

Figure 3. Monitoring water quality in the Rio Doce (Colatina, ES).

Source: NITRO.



At the global level, WHO developed a major innovative interdisciplinary proposal to integrate human health and the environment, the One Health⁷ approach, which is based on the recognition that humans are healthy if their environment is also healthy. The One Health approach views health promotion and prevention for human beings and ecosystems as an interwoven in a landscape, in a three-fold relationship – human, animal and environment. In addition, it offers a collaborative approach to address existing or potential risks (Destoumieux-Garzon et al., 2018; Mackenzie et al., 2014).

One Health as well as Porto’s approach emphasise community participation at all levels of decision-making and the creation of partnerships as key success factors. Similarly, the UNESCO World Water

Assessment Programme states that partnerships can help to build empowerment, equity and help strengthen networks based on kinship solidarity and friendship (WWAP, 2015). This is especially relevant at community level, where participation of its members involves co-management as a means to improve knowledge and awareness about the ecosystem and the importance of preventive health interventions (Cohen-Shacham, 2019). As underlined by the One Health approach, community participation correlated to human and ecosystem health is an essential integration for the creation of ‘supportive environments and resilient communities’ (WHO Regional Office in Europe, 2018).

Complementing the previously described interdisciplinary perspectives, the nature-

⁷ For further information, please visit: <http://www.onehealthglobal.net>; <http://www.oneworldonehealth.org>; <http://onehealthinitiative.com/> and <http://www.eliminatedengue.com/program>

based solutions (NbS)⁸ concept addresses both environmental and societal challenges, and can include those associated with health concerns. NbS can be high-tech or low-tech, and composed of a set of interventions aimed to change, enhance or restore the function of an area, an ecosystem or an ecosystem service. It brings together knowledge from different areas of technical and scientific expertise, and contributes to building sustainable environments in rural areas as well as cities and towns (Cohen-Shacham et al., 2019).

There are many examples of NbS in Brazil and abroad that deal with issues like decentralised sewage treatment, water purification, flood control and erosion control, among others, effecting the link between ecosystem and human health. Some examples of NbS are listed in the table below.

Table 1. Examples of nature-based solutions linking ecosystem health to human health*

Project	Location	Objective	Tools	Sector
Implementation of linear parks (P22ON, 2017)	Brazil, São Paulo State, Campinas municipality	Restore ecosystems remnants and improve connectivity; improve air quality; encourage the practice of physical activities and help river sanitation	Creation of green corridors along city rivers and public spaces	Public
Filter gardens (P22ON, 2017)	Brazil, Rio de Janeiro State, Rio de Janeiro municipality	Sewage purification with the use of rooted macrophyte plants, installed in gardens, which can offer landscape value	Creation of filter gardens	Private
Viva Barigui (Herzog & Rozado, 2019)	Brazil, Paraná State, Curitiba municipality	Protect and enhance areas to store storm water to prevent floods; connect biodiversity fragments; restore riparian corridors; prevent river bank erosion; and offer public spaces for several social, sports and cultural activities	Construction of wetlands, biodiversity corridors, creation of public spaces	Public
Kamniska Bistrica River Basin (GWP, 2018)	Slovenia	Identify affordable and sustainable solutions for wastewater treatment of small and medium settlements. The feasibility studies results suggested constructed wetlands as one of the best initiatives	Establishment of decentralized sewage treatments natural structures	Public

* For other examples of nature-based solutions related to ecosystem and human health in Brazil and abroad, please see Cohen-Shacham et al. (2016), Herzog and Rozado (2019) and P22ON (2017) (see list of references).

⁸ Nature-based solutions, according to IUCN, are the “actions to protect, sustainably manage, and restore natural or modified ecosystems, which address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”. For more information, please see: <https://www.iucn.org/theme/nature-based-solutions>

Recommendations

The Rio Doce Panel suggests that Renova Foundation promotes an integrative health approach, implementing the following actions as part of the Integrated Environmental Management for Health and Environment (GAISMA):

- 1** Build local capacities for monitoring impacts on health and the environment in order to promote a stronger connection between society and the environment, and contribute to the regular collection of information concerning risk-factors for human diseases. In addition, community members who are involved in monitoring activities can contribute to local awareness of the importance of sanitation and the communities' rights to safe water.
- 2** Communicate and promote exchange of data and information on manifestations of health symptoms in community members between formal health providers, such as health agents that are part of the SUS, and members of organisations that address broad health concerns (for example, NGOs, religious organisations, social movements and cultural communities). Such actions would respond to Rio Doce Panel's recommendations 6 and 7 published in the Thematic Report No. 1.⁹
- 3** Promote the use of nature-based solutions (NbS) and innovative technologies in sewage and water treatment systems, which are best adapted for management by rural and traditional communities, including the organisation of hands-on capacity-building courses for the users.

⁹ Recommendation 6: *Develop and implement a data and information-sharing plan*; Recommendation 7: *Initiate and maintain actions to gather and disseminate relevant knowledge and lessons learned*. For further information, please visit: <https://doi.org/10.2305/IUCN.CH.2018.18.en>

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Cover photo: Recovered watersprings in Colatina, ES/NITRO.

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