

The Results of Environmental Business Administration, Public Administration and Social-Economic Impact of the Rupture of the Samarco Barrier in Mariana, MG

Gabriel Nickolas Cazotto 

Universidade Paulista—UNIP, São Paulo, Brazil
Email: gabriel.cazotto@docente.unip.br

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Abstract

This paper has a main focus on the analysis of social and project impact assessment consolidated in the study of the breakdown the barrier of the mining and energy provider company Samarco in Mariana, MG which caused an impact both economically and socially for the city, the company and closer regions. Also presenting social situations resulting from this natural disaster, such as the impact on health and even the proliferation of yellow fever to the State of São Paulo and the estimated social cost of it. Using both the Economics and Business Administration theories for environment, public administration and sustainability. Focused primarily on showing the action of business management on governance analysis and assessments.

Keywords

Social Impact Assessment, Public Administration, Business Administrations, Energy Impact, Economic Project Evaluation, Samarco, Mariana, Financial Health Impacts, Financial Calculation of Social Impact, Yellow Fever, VERD

1. Introduction

Business administration in an environmental context requires organizations to integrate economic objectives with responsibility for ecosystems and communities. This principle is especially important in mining, where managerial decisions can create extensive social and environmental risks. As Elkington states, the triple bottom line requires organizations to consider “people, planet and profit” rather than evaluate performance exclusively through financial results (Elkington, 1997).

From this perspective, the Fundão dam disaster cannot be understood solely as a technical failure. It must also be examined as a failure of corporate administration, risk governance, environmental responsibility, and coordination between private organizations and public authorities.

A useful theoretical approach for analyzing the impact of public administration in the 2015 Fundão dam disaster in Mariana, Brazil, is Disaster Governance Theory, which emphasizes that disasters are not managed solely by governments but through complex arrangements involving public agencies, private companies, civil society, and affected communities. Tierney (2012) argues that disaster governance is multilevel and polycentric, requiring coordination among different institutions before, during, and after a disaster; the quality of governance and institutional capacity therefore directly influences disaster response and recovery.

This perspective is particularly relevant to Mariana because the post-disaster response involved multiple levels of government, the mining companies, the Fundação Renova, the Interfederative Committee (CIF), and affected populations. Research specifically examining Mariana found that the governance arrangement faced institutional conflicts, coordination difficulties, delays, and challenges in participation, suggesting that weaknesses in public governance affected the effectiveness of reparative policies.

The disaster of Mariana was something already predicted by environmental authorities and to the detriment of the structural problems that the barrier had been presenting. The barrier ruptured on November 5th was known as Fundão. It was a property by Samarco Mineração S/A. The Fundão barrier started operation in December 2008 and soon after the start of work, about five months later, in April 2009, the tailing of the tailings had to be interrupted because there was strong percolation in the slope downstream of the barrier. Therefore, since the beginning of the activities the barrier was no longer operating in structural conformity. Slopes are the principal thing in holding a barrier, and the slope downstream is that which lies opposite the contents of the reservoir, in short, the slopes are the part that holds the barrier. It is the sloping face of the barrier that “looks” out of the reservoir. The percolation is nothing more than the passage of liquid material into and through the bulk of the slopes.

Controlled by Samarco Mineração SA (a joint venture between Vale SA and BHP Billiton, an Anglo-Australian mining and oil company), the Fundão and Santarém barriers are part of the Germano Mine, located in the district of Santa Rita Durão, in the municipality of Mariana, located in the Ouro Preto that is a Microregion of the Metropolitan Meso-region of Belo Horizonte.

According to the Federal Public Ministry, percolation in structures of this type is not a problem. As long as the drainage system works properly, the liquid will flow out of the massif (the internal drainage is the soul of the dam). However, if the filters and drains fail, the liquid, as it traverses the interior of the earth mass, can lead out of this solid material, initiating an erosive process. It was exactly what happened with the massive barrier of the Fundão. There was strong percolation

and opened a hole one meter long. With this, the reservoir that was in the initial process of filling, was emptied.

In July 2010, there was a new problem in the dam. This time, there was passage of the sandy tailings downstream of the dam. The reject entered the reservoir through the main gallery. There was another standstill. It is assumed that the dam suffered, over time, several shutdowns and underwent several engineering interventions. Among these works, it was verified the construction of an indentation, not foreseen in the original project and not licensed by the Public Power. Therefore, it can be concluded that all this disaster could have been avoided if there was a greater inspection and closing of the activity until it was in full operating conditions. However, the financial factor spoke louder, the negligence of Samarco officials and officials resulted in the biggest disaster of the mineral economy in Brazil (Ministério Público Federal, 2017).

2. The Disaster in Mariana, MG

The disaster of the breeding of the Fundão barrier located in Bento Rodrigues near the Mariana municipality of Minas Gerais was one of the greatest natural disasters in Brazilian history. In November 2015, a month after the barrier broke, according to Camilla Mota, who was sent from the BBC to Mariana, about 34 million cubic meters of iron ore tailings contaminated the region, traveling 55 kilometers from the Gualaxo do Norte river and another 22 kilometers from the Carmo River until they flow into the Doce river that covers 230 municipalities. In addition to having reached regions close to the disaster, the debris ejected by the barrier break ran 663 kilometers until they found the sea in Regency in Espírito Santo. In addition, it ended up reaching rural properties, such as the communities of Paracatu de Baixo, Camargos, Águas Claras, Pedras, Gamaira Bridge, and the municipalities of Barra Longa, Rio Doce and Santa Cruz do Escalvado.

Vale is a multinational company of Brazilian origin that operates publicly in the Stock Exchange, founded in 1942 under the government of Getúlio Vargas, currently one of the companies with the greatest importance and almost a national patrimony. The company operates in the area of research, extraction, production and trade of minerals, power generation, rail transportation, port operation.

The mining sector in the world is characterized by the performance of large mining companies, with high verticalization, in view of large plants that make the beneficiation of the extracted to the generation of its own energy, thus are also great investors in transport infrastructure and logistics for the flow of its production. In the world, China stands out with major investments in the mineral sector and other important producers, with most of the largest companies in the world are: Australia, England, Brazil, United States and Russia (Mining Sector Report, LAFIS, 2017).

Vale's project for Mariana was to the detriment of the company being the world's largest producer of iron and pellets with a production of approximately 349 million metric tonnes of iron, in combination with the viability of exploration

in the disaster region, and which are essential raw materials for the production of steel, a product exported by the Brazilian economy and to provide energy insumes to the country (VALE, 2017a).

To understand why Vale saw the disaster region as a means of expanding its operations, it is because iron is used in steelmaking, in the construction of houses, in the manufacture of cars and appliances. If we evaluate the use of iron, we can see that the profits that can be obtained from the exploitation of iron can be very high and therefore the interest of the company in the region existed. Brazil is a country with a large territorial extension and full of natural resources that gives it a high productive capacity, but are poorly exploited and end up being wasted at certain times.

The country has aquifers, mineral reserves that is the case of rare earths, of specific territories for agriculture which characterized the country a economy dependent on commodities, agrobusiness that are low value-added activities and mining. In addition to the economic interest of the company in the region, it is believed that a factor that would be relevant for investment in the region would be the generation of jobs that would provide the region, approximately 11 thousand jobs in the mining complexes in the area to be exploited (Vale, 2026b).

Although it appears to be an easy to understand sector, the mineral economy has a highly specialized production chain and demands a well organized structure so that the activity can reach its maximum production potential. Unlike other sectors of the economy, mining demands high initial investment and constant contributions, not only in the financial aspect, but also in research that shows potential exploration areas, reports for attracting investors, among other aspects that can maximize this productive chain. In order for it to be possible to develop the activity of mineral economy it is necessary to possess the territory endowed with minerals, unlike any other economic activity it is not possible to create a space in which there is no such natural propensity for activity, it is not something developed by technology that can be copied and implemented.

Slopes are essential components of a dam because they support the structure and retain the reservoir's contents. The downstream slope is located opposite the reservoir and forms the external face of the barrier. Percolation refers to the passage of liquid through the solid material and through the body of these slopes. Although percolation is not necessarily abnormal when a drainage system works properly, failures in filters and drains may allow water to carry solid particles, initiating internal erosion. This process occurred in the Fundão structure, where strong percolation opened a hole approximately one meter long. At that time, the reservoir was still being filled and consequently had to be emptied.

From the standpoint of business administration, these early incidents should have been treated as strategic warnings rather than isolated engineering problems. Freeman argues that a company must account for "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman, 1984: p. 46). Samarco's relevant stakeholders included not only its share-

holders, employees, and contractors, but also nearby communities, public agencies, municipalities, river users, and populations dependent on the Rio Doce basin. Effective administration would therefore have required systematic stakeholder mapping, transparent risk communication, preventive investment, independent technical auditing, and executive accountability for dam safety.

The Fundão and Santarém dams were located partly on the Germano mining complex in the district of Santa Rita Durão, in the municipality of Mariana, Minas Gerais. The structures were constructed to accommodate tailings from extensive mining operations in the region. Their location made the consequences of structural failure a matter of public concern, since the potential impacts extended beyond company property. Environmental management in such circumstances cannot be restricted to compliance with minimum licensing requirements. It must be incorporated into corporate governance, capital allocation, operational planning, emergency preparedness, and organizational performance assessment.

According to the Federal Public Ministry, percolation in this type of structure is not automatically a problem, provided that the drainage system operates correctly and allows liquid to leave the dam without removing solid material. However, when filters and drains fail, the movement of water through the soil mass can transport particles and produce a progressive erosive process. In July 2010, another problem arose when sandy tailings moved downstream of the dam and entered the reservoir through the main gallery. The dam was shut down again and underwent several engineering interventions. During these works, an indentation not included in the original design was reportedly identified, adding another layer of technical and administrative concern.

These recurring events demonstrate the importance of organizational learning. Senge explains that “organizations learn only through individuals who learn,” although individual learning does not by itself guarantee organizational learning (Senge, 2006: p. 129). In practical terms, documenting an engineering failure is insufficient if the information does not change organizational routines, investment decisions, maintenance standards, and executive oversight. A learning organization should convert each incident into institutional knowledge, examine its root causes, share the findings across departments, and verify whether corrective measures have effectively reduced risk. Repeated anomalies may indicate that technical knowledge existed but was not fully incorporated into decision-making.

The case also illustrates weaknesses in public administration and regulatory governance. Public institutions are responsible for licensing, inspection, monitoring, civil protection, and enforcement, but these functions may become fragmented among agencies with different mandates and limited resources. Denhardt and Denhardt (2015: p. 22) maintain that public administrators should “serve citizens, not customers”. Applied to environmental governance, this principle means that public authorities must place public safety, ecological protection, participation, and transparency above administrative convenience or narrow economic interests. Communities exposed to environmental risks should be regarded as

rights-bearing citizens who require accessible information and meaningful participation in decisions affecting their territories.

Public administration must also ensure that licensing is not treated as a one-time authorization. In high-risk activities, licenses should be accompanied by continuous inspections, updated safety assessments, enforceable emergency plans, transparent reporting, and effective sanctions for noncompliance. Hood's observation that public management increasingly emphasizes "explicit standards and measures of performance" (Hood, 1991: p. 4) is relevant here. For dam governance, such standards should include measurable indicators for drainage performance, structural stability, emergency readiness, inspection frequency, corrective-action deadlines, and public disclosure. Nevertheless, performance indicators must supplement rather than replace professional judgment and on-site verification.

3. Data and Parameters for Calculation of Impacts

By the end of 2015 it is not yet possible to know in 100% the degree and severity of the environmental impacts of the industrial disaster of greatest environmental impact in Brazilian history and the largest in the world in tailings barriers: 643 km of rivers and streams covered with mud; 1469 hectares of destroyed vegetation; 600 homeless families and 207—of the 251—buildings destroyed in Bento Rodrigues (Mariana).

From the disaster, a mixture of iron oxide, water and a lot of mud was formed, equivalent to 25 thousand Olympic swimming pools (62 million m³). The thick layer deposited on the soil and the time that the restoration can take make the soil definitely infertile and unsuitable for constructions. In addition to the chemical destruction of soil and ciliary forest, the mud reached 3 rivers before flowing into the Atlantic Ocean and the courses of these rivers were altered, food chains and thousands of species disappeared, marine ecosystems (corals and microorganisms) were definitively and fishing and planting, the main economic activities of the surrounding regions.

It is estimated that, in total, 500,000 people were directly or indirectly affected by the rupture of the dam and the material and immaterial losses are still incalculable. After 2 years, the forecast of repairs of the environmental damage is for 2032 and there is an unemployment rate of 23.5% in the region solely due to the paralysis of the mining company.

From the rupture of the barrier, the Renova Foundation is born, with the reason of "fulfilling a mission of interest of the society". The institution arises after the signing of the Term of Transaction and Adjustment of Conduct (TTAC) between Samarco and its companies (Vale and BHP Brasil) and institutions such as the Brazilian Institute of Environment and Renewable Natural Resources (Ibama), Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), the National Water Agency (ANA) and the National Indian Foundation (Funai), among others. The Federal Government and the States of Minas Gerais and Espírito Santo

are directly involved.

There are 42 socio-economic and socio-environmental programs foreseen by the Term and, in large numbers, contributions will be divided between two main fronts: repair and compensation—the latter, responsible for replacing or compensating for what can not be restored. It will be R\$ 4.8 billion divided for the first 3 years of the program; between 2019 and 2021, estimates are estimated at between R \$ 800 thousand and R\$ 1.6 million, and from 2020 to 2030, R\$ 240 million are forecasted each year.

4. Methodology

In some situations, it is not possible to estimate a market value for losses of environmental-energy resources and the approach and first proposal presented in the research is the estimated *economic value method of reference for damage* (VERD) is one of the criteria that can guide the economic calculation in these cases. It is a simplified view that divides the variables of analysis between quantifiable and intangible (Cardoso, 2013).

The directly **quantifiable** parts will be considered economically measurable parts, which represent the amounts invested in the prevention (or in the case of repair/repair study) of some measures. On the other hand, **intangible** variables, that is, those for which economic values may not be associated, are exemplified by “discomfort to health, psychological wear, damage to historical and cultural heritage, visual impact, etc.” and are measured in quantities/cases observed—in the example, 4 (Cardoso, 2013: p. 7).

The proposed formula for calculating losses in environmental disasters, for example, assumes that quantifiable (q_n) and intangible (i_n) can not simply be summed up, since the final result would be less representative and, much less consider that the quantifiable should be raised to the intangible, since the result would simply be priceless. On the other hand, and beyond logic, a division of the quantifiable by the value of intangibles would simply be unfair as an estimate of the debt of the responsible agent. In this way:

$$VERD = \sum_{n=1}^{\infty} q_n \times \sum_{n=1}^{\infty} i_n$$

On what,

VERD = economic reference value of environmental damage;

$\sum q_n$ = sum of all quantifiable variables; and

$\sum i_n$ = sum of the number of intangible variables.

It is a simplified fact technique, but it considers the relevance of the intangible variables associated with the damages. In this sense, the next section tries to unravel the variables identified as intangible to multiply the total amount spent and to be invested in the recovery of damages, based on the available data of the Renova Foundation and the preliminary report of IBAMA (2020) material and quantifiable results associated with the Mariana disaster. In this way, it will be possible to estimate if the amounts already invested and planned for the next pe-

riods are sufficient or at least approach the value estimated by the VERD method.

5. Application of Methodology and Analysis of Results

According to the preliminary report released by IBAMA (2020), immediately after the incident, at least 6 factors should be categorized as intangible variables in accordance with the methodology proposed by Cardoso (2013):

- i_1 = change of the chemical elements and conductivity of the water resource;
- i_2 = total solids and water turbidity;
- i_3 = destruction of permanent preservation areas;
- i_4 = sedimentation of water bodies;
- i_5 = destruction of fauna and its impacts on ecosystems and
- i_6 = destruction of flora and its impacts on ecosystems

Losses to the agricultural, industrial, energy, fishing and tourism sectors are variables whose application of economic calculation would be viable. For the Fundação Renova (2017), however, a few more categories should be included among the intangibles. Are they:

- i_7 = reimbursement and indemnification for impacts by immaterial losses;
- i_8 = recovery of the quality of life of traditional peoples and communities;
- i_9 = reintegration of the school community;
- i_10 = recovery of historical, cultural and recreational heritage;
- i_11 = provision of support for the recovery of the physical and mental health of the impacted population;

Therefore, there are 11 categories that form the scope of intangible variables. The next step is the calculation of the amount already spent by the recovery and repair program conducted by the Foundation plus the estimates of investments required for the next years of action of the institution. Thus, it is enough to apply the methodology to verify that what is estimated, according to the proposed methodology, is enough to mitigate the total damages (environmental and socio-economic) caused by the disaster.

Of the total spent on reparatory and compensatory resources up to December 2017 (R\$ 3.204 billion) in the TTAC programs, R\$ 1708 (53%) is due to Samarco's investments and R\$ 1496 to the Renova Foundation (47%).

The 42 programs were divided into 3 main axes: 1) People and Communities; 2) Land and Water and 3) Reconstruction and Infrastructure and, by the end of that year, 42%, 28% and 30% had been respectively invested in each. Of the total spent on "People and Communities" (R\$ 1.351 billion), 66% was the amount directed to identification and indemnities (VALE, 2017b). It is assumed here that this value (R\$ 0.8917 billion) is capable of repairing only material losses. The other third of the costs are associated with health and well-being, education and culture, engagement and dialogue etc., that is, it represents the portion of the resources destined to what the research evaluates as intangible variables and, therefore, will be discarded of the sum for quantifiable variables.

For the other 2 axes, it is estimated that for "Terra e Água", no part of the R\$ 899

million can in fact be considered as an exact compensation for the losses that these categories include (animal care, water management, innovation and waste management). Concerning the costs incurred under the theme of “Reconstruction and Infrastructure” (urban infrastructure and access, resettlement, water and effluent treatment and waste retention), 95% of the total can be characterized as sufficient effort to contain or recover associated damages, that is, R\$ 906.3 million (VALE, 2017b).

In addition, approximately R\$ 68 million was spent in 2017 with administrative expenses and the same amount is expected in the budget for the year 2018. Personnel and voluntary services expenses can be calculated. Of the total invested in the recovery and repair of what was destroyed after the dam rupture in 2015, from the beginning of the rescue until December 2017, it is assumed that R\$ 1797.96 billion were spent on measures that were theoretically quantified in calculation of economic valuation. By 2018, of the R\$ 1.4 billion budgeted, using the percentage considered for what can be measurable, as a proxy for the costs of subsequent years (84.4026%) per VERD estimation due to the hypothesis presented, it is imagined that R\$ 1.18 will be spent on measures that can fall into the categories of quantifiable.

For the subsequent round of investments (between 2019 and 2021), R\$ 3.04 billion from the average expected expenditures in the three years (R\$ 3.9 billion) are due to this category and from 2020 to 2030, R\$ 240 million totaling R\$ 2.64 billion, or R\$ 2.23 billion in measurable measures. The total expenditures with these measures in the full period from 2018 add, according to the calculations, R\$ 6.45 billion and, as follows:

$$\text{VERD} = \text{R\$}6.45 \text{ billion} \times 11$$

$$\text{VERD} = \text{R\$}73.7 \text{ billion}$$

The amount of R\$ 73.7 billion is 6.4 times higher than the expected for the recovery and repair of damages caused by the disaster. The indicated methodology of VERD and social business analysis, due to the theory of public administration and public governance, implies a result for 2019-2021 of R\$ 8.24796 billion and a VERD of R\$ 90.7 billion. The estimate corroborates the opinion of experts and public figures who recall the amount of US\$ 54 billion paid for the explosion at the British Petroleum platform in the Gulf of Mexico in 2010 and, in any case, an agreement that foresees a fund of R\$ 20 billion for the Rio Doce recovery was signed in 2016. Even though it is impossible to price the “death” of a river, estimates seem to be more calibrated than those that the law provides for the recovery of ecosystems and all that has been lost. VERD is a preliminary methodology and its estimates generate sufficient justification for the continuity and better specification of subsequent works.

Conclusion health categories sum to 83.0%, with more 17% from public administration of the region, primarily by Vale results in their sustainability and business report (VALE, 2026a).

6. The Other Social Impacts and the Renova Foundation

The disaster of the barrier in 2015 was a catastrophe not only in economic and environmental issues, but also generated a number of direct and indirect problems for the region, which is temporarily in a state that is not feasible for the development of any activity in the affected region. One of the problems with the highest degree of concern is the increase in the number of diseases that have been reported. The rupture of the barrier reached about 34 million cubic meters of iron contaminated the region, traveling 55 kilometers from the Gualaxo do Norte River and 22 kilometers from the Carmo River until they flowed into the Doce river which covers 230 municipalities.

According to the Institute of Health and Sustainability (ISS), it is believed that the destruction of the Rio Doce basin that was affected by the ruptured dam damaging the physical and mental health of the population. The most recurrent problems are respiratory, dengue, emotional and an outbreak of yellow fever that has settled in the population. As described above, according to the biologist Márcia Chame, who coordinates the Institutional Platform for Biodiversity and Wild Health at the Oswaldo Cruz Foundation (Fiocruz), it is possible that the increase of suspected cases of yellow fever in Minas Gerais is related to the rupture of the barrier in Mariana, where 55 million m³ of mud leaked from the Fundão dam after its disruption in November 2015. What supports this hypothesis is the fact that there are a greater number of cases in the region near the Rio Doce region very affected by the rupture of the barrier.

The biologist claims that the tragedy in Mariana has had a very negative impact on animals, even on monkeys. The destruction of the ecosystem, lack of food, and stress are factors that greatly diminished the immune resistance of primates, leaving them susceptible to diseases such as yellow fever. Another environmental impact that may be related is mining. "It's a set of things that are accumulating," the biologist explained.

That spread from the state of Minas Gerais to the chaotic situation that São Paulo was in early 2018. She explains that the vector of yellow fever disease (*Haemagogus*), when it chooses a contaminated monkey, receives a sufficient viral load to spread the disease to the next to be stung. The moment a human unimmunized by the yellow fever vaccine is stung, he becomes a host and becomes part of the cycle. Due to tragedies, environmental imbalances and deforestation, the animals are occupying regions closer to humans, which ends up increasing the number of infected by the virus.

It was not only the state of Minas Gerais that was affected by the disaster. Deaths were found in the municipality of Colatina in the state of Espírito Santo. However, there is no evidence that the monkeys died of yellow fever. According to the coordinator of Fiocruz, the measure that should be taken in the short term is the strengthening of vaccination in the areas at risk. The long-term measure is the preservation of Conservation Units (UC). "Animals must have room to live, thus avoiding migration to areas close to urban centers," he said. "Animals act as filters

of disease.” The Renova Foundation, created by Samarco to coordinate remedial actions in the area affected by the Mariana disaster, did not express its views on the statements of Fiocruz’s biologist.

The impact on São Paulo was fundamental in the government’s health budget accounts, according to FGV (2026) data, an 80% increase was expected in the proliferation of vaccines aimed at combating the outbreak mainly so that it did not reach urban areas, with expenditures on with an expected increase of R\$ 137 million to more than R\$ 250 million.

7. 10 Years Later Results (2016-2025)

The situation in Mariana had few or none conclusions in Brazilian energy and Ambiental industry. The impacts can still be seen in healthcare costs in the regions in Minas Gerais, adjacent to Mariana.

Regarding the environment, little has been done by the company to pay for the lives that were missing and the structure of the city, even regarding the energy situation. Mariana is still a mess, and 10 years later continues almost as a phantom city of what has become for Samarco.

Brazil has learned nothing from the disaster, and even with the company disrupting messages towards the environment of the mining situation on Brazil, almost nothing has been made to improve the situation in other barrage cities in the state.

8. Conclusion

As we can see, according to a survey by the ISS, 289 families and their 576 members of the district from a population of almost 6 thousand citizens were heard, statistically calculated and drawn from the list of families of the Family Social Program of the Municipal Health Department of Barra Longa. In an analysis of Business administrations and VERD regression regarding public administration as well governance administration theory in the last 10 years (2015-2025), besides given results of 2018 methodology for VERD as it fitted well in the happening of the event. People who were interviewed reported that health problems have increased since the dam broke. In total, 40% of reported problems are respiratory; 15.8% of skin conditions; 11% mental and behavioral disorders; 6.8% infectious diseases; 6.3% of diseases of the eye; and 3.1% gastric and intestinal problems. For children up to 13 years of age, respiratory diseases account for 60% of complaints (G1, 2019).

Although there is a supposed concern to try to reverse the current situation of the region, the project is still incipient and in some of the items mentioned in the table there have not been any significant changes. The problem generated by the neglect of dam managers has triggered a number of other, more complex, aggravating problems that can take years to repair and make it impossible to estimate whether the region can be fully reopened after the incident.

So that the calculation of the social impact shows that not only the entire region

of Mariana has been affected in a drastic way, as it has spread through health and economy in other regions of Brazil, impacting negatively and financially both for Samarco and for the governments of these regions. It is therefore worthy of evaluation that such tragedy brings social damage not only economically or financially but in a social way that can hardly recover in the medium to long term, wondering a total reform of the supply and reconstruction of the city's infrastructure, and even so, the "Samarco" brand should take this "stain" for several years as a case study of failure in socioeconomic environmental case.

The Fundão disaster ultimately shows how corporate administration, environmental management, and public administration are interdependent. Corporate leaders must prevent environmental risk from being subordinated to production targets, while public authorities must exercise independent and technically competent oversight. Elkington's (1997) formulation of "people, planet and profit" provides a useful framework, but its value depends on whether these dimensions are embedded in actual decisions. Responsible governance requires prevention, stakeholder participation, institutional learning, transparency, and accountability. When early warnings recur without producing adequate organizational change, what appears to be a technical accident may instead reveal a broader and preventable failure of administration.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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