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Evolution of Environmental Risk Disclosure: The case of Vale S.A.

Evolução da Divulgação de Riscos Ambientais: O Caso de Vale S.A.

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RESUMO

A atividade mineradora, embora essencial para o desenvolvimento econômico, apresenta elevado risco ambiental. Os desastres ocorridos em Mariana (2015) e Brumadinho (2019), ambos em Minas Gerais e envolvendo a mineradora Vale S.A., evidenciaram falhas significativas na gestão de barragens e resíduos, com impactos socioambientais expressivos. Neste contexto, o objetivo desta pesquisa é analisar a evolução da divulgação dos riscos ambientais relacionados à gestão de barragens e resíduos pela Vale S.A. Foi construído um índice de divulgação com base nas métricas do setor de Metais e Mineração da norma SASB, orientadas pela

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IFRS S1, para mensurar a aderência da empresa aos tópicos EM-MM-150a (Gestão de Resíduos e Materiais Perigosos) e EM-MM-540a (Gestão de Instalações de Armazenamento de Rejeitos). Os dados foram coletados dos Relatórios de Sustentabilidade da Vale S.A. (2014 a 2024) e dos *Databooks ESG* (2021 a 2024). Os resultados indicam avanços na transparência da Vale S.A. após o desastre de Mariana, retrocesso após Brumadinho e retomada na qualidade das divulgações a partir de 2022, coincidindo com a adoção efetiva das métricas SASB. Apesar da melhora recente, as evidenciações da companhia ainda não atendem integralmente aos critérios da norma. Conclui-se que, embora tenha havido progresso, a plena conformidade com as diretrizes de sustentabilidade permanece como desafio para a Vale S.A.

Palavras-chave: Relatórios de Sustentabilidade; Riscos ambientais; IFRS S; SASB; Vale S.A.

ABSTRACT

Mining activity, although essential for economic development, entails high environmental risk. The disasters in Mariana (2015) and Brumadinho (2019), both in Minas Gerais and involving the mining company Vale S.A., revealed significant short-comings in dam and waste management, with substantial socio-environmental impacts. In this context, the objective of this study is to analyze the evolution of environmental risk disclosure related to dam and waste management by Vale S.A. A disclosure index was developed based on the Metals and Mining sector metrics of the SASB standard, guided by IFRS S1, to assess the company's adherence to topics EM-MM-150a (Waste and Hazardous Materials Management) and EM-MM-540a (Tailings Storage Facility Management). Data were collected from Vale S.A.'s Sustainability Reports (2014–2024) and ESG Databooks (2021–2024). The results indicate improvements in Vale S.A.'s transparency following the Mariana disaster, a setback after Brumadinho, and a recovery in the quality of disclosures from 2022 onwards, coinciding with the effective adoption of SASB metrics. Despite recent progress, the company's disclosures still do not fully meet the standard's criteria. It is concluded that, although advances have been made, full compliance with sustainability guidelines remains a challenge for Vale S.A.

Keywords: Sustainability Reports; Environmental Risks; IFRS S; SASB; Vale S.A.

1. INTRODUCTION

Mining activity in Brazil presents a high environmental risk, with the potential to negatively impact the economic and financial performance of companies in the sector (Alves; Carneiro; Paiva, 2020). On November 5, 2015, the collapse of the Fundão dam, owned by Samarco, controlled by Vale, took place in Mariana (MG) S.A. and BHP Billiton—, resulting in 18 deaths, one missing person and the homelessness of several families (Vale, 2015). In 2019, Vale faced a new disaster with the rupture of the Córrego do Feijão dam, in Brumadinho (MG), which killed 270 people (Vale, 2019). The tailings mud destroyed facilities and adjacent areas, contaminated rivers, devastated vegetation and compromised the fauna and livelihood of the local community (Melo; Guimarães, 2023).

These high-impact events drew the attention of investors, regulators, and other economic agents (Silva; Barros, 2023), giving Vale negative international recognition for

their social irresponsibility (Saes *et al.*, 2021) and reinforcing the importance of more rigorous monitoring of corporate practices and social legitimization strategies (Cosenza *et al.*, 2018). Although there is a requirement for listed companies to follow accounting and disclosure standards, *stakeholders* often point out that their annual and quarterly reports present only the minimum required, evidencing flaws in both the legislation and the corporate *disclosure systems* (Fabrício; Ferreira; Borba, 2021).

Despite the growth in the disclosure of socio-environmental information by Brazilian companies, there are still gaps in transparency and data verification (Silva *et al.*, 2024). In the case of Vale S.A., although progress has been observed — especially in 2019 and 2020, with greater use of quantitative data ("rigid disclosures")

—, criticism persists of the integrity of the information disclosed (Queiroga *et al.*, 2023). After the Mariana and Brumadinho disasters, fallacies were identified in the reports published by the company, indicating the presence of misleading information or omissions regarding the company's environmental responsibilities (Lima *et al.*, 2023). In addition, the company's response to disasters has been reactive, with reports focused on post-crisis actions, suggesting more of an attempt to repair the image than an effective commitment to sustainability (Queiroga *et al.*, 2023).

However, investors require transparent and reliable ESG information to assess risks that may affect future cash flows and thus optimize financial returns (Amel-Za-deh; Serafeim, 2017; Villiers, 2017). In addition, factors such as the more accurate pricing of environmental risks (Repetto, 2007) and the response to the growing demand of clients for sustainable investments (Amel-Zadeh; Serafeim, 2017) reinforce the strategic importance of this information. Thus, it is necessary to understand how Vale S.A. has disclosed information about environmental risks in order to minimize the negative impacts of the disasters that occurred and remain attractive to financial capital.

Previous research, such as that of Costa *et al.* (2020), examined the disclosure of environmental risks in the Sustainability Reports of the companies Samarco and Vale S.A., in the period from 2014 to 2018, focusing on adherence to the indicators established by the *Global Reporting Initiative* (GRI). In a complementary way, Silva, Lagrange and Oliveira (2022) investigated the environmental *compliance* practices evidenced in Vale's sustainability reports

S.A. after the Mariana disaster, based on the Theory of Legitimacy. Despite the contributions of these approaches, a gap in knowledge persists about Vale S.A.'s disclosure of social and environmental risks in light of IFRS S1.

IFRS S1, developed by the *International Sustainability Standards Board* (ISSB) and published in 2023, establishes that companies must disclose information related to risks and opportunities linked to sustainability, ensuring that such data is relevant, complete, and comparable. In addition, it guides the consideration of the sectoral metrics provided by the *Sustainability Accounting Standards Board* (SASB), which reinforces the need for clear and consistent reporting.

In view of the above, the question that guides this research arises: how has the disclosure of environmental risks related to the management of dams and waste by Vale S.A. evolved after the disasters that occurred in Minas Gerais? In order to achieve the answer to the research problem presented, the general objective of this work is to analyze the evolution of the disclosure of environmental risks related to the management of dams and waste by Vale S.A. after the disasters that occurred in Minas Gerais. To this end, a research was carried out with content analysis in the company's Sustainability Reports, referring to the years 2014 to 2024, and in the *ESG Databooks*, from 2021 to 2024.

The environmental tragedies that occurred in Minas Gerais in the 2010s highlighted the need for greater transparency in the disclosure of environmental risks by companies in the mining sector. Large corporations, such as Vale S.A., must consistently communicate compliance with standards, the implementation of sustainability programs, and risk management (Silva, 2019). IFRS S1 and S2, which establish the obligation to report relevant, complete and comparable information on sustainability-related risks and opportunities, combined with SASB metrics for mining, provide a robust benchmark to ensure transparent and accountable disclosures (Wahyuni, 2025).

In this scenario, it is relevant to analyze the evolution of the disclosure of these risks by Vale S.A., verifying its adherence to international standards and its socio-environmental commitment.

The study strengthens the theoretical consistency of the accounting area by exploring recent guidelines, such as IFRS S, which are still little addressed in the literature, and by highlighting the role of Environmental Accounting in measuring, recording and communicating environmental impacts. For professional practice, it offers subsidies for accountants, auditors and managers to improve the preparation and auditing of financial and sustainability reports, in line with global standards and transparency demands. At the same time, it contributes socially by stimulating critical thinking and fostering preventive actions against environmental tragedies resulting from corporate failures.

2. LITERATURE REVIEW

2.1 Theoretical perspective

Social expectations in relation to companies began to include, in addition to profit and the supply of goods and services, the incorporation of values that rethink concepts such as market failures (Sousa; Weffort; Cillo, 2015). In this context, the *Stakeholder Theory*, developed by R. Edward Freeman in the 1980s, proposes that organizations consider the interests of everyone who influences or is influenced by their activities (Freeman, 1984; Catrib; Junior; Garcia, 2022). The effective management of relationships with current and future stakeholders requires the integration of these interests into business strategies, as their negligence can compromise the reputation and sustainability of the organization (Lyra; Gomes; Jacovine, 2009; Freeman, 1984).

In addition, the Theory of Legitimacy maintains that companies operate based on an implicit social contract, and must align their practices with society's expectations to ensure acceptance and continuity (Eugénio, 2010; Zyznarska-D-worczak, 2018). The disclosure of social and environmental information is used as a strategy to legitimize activities and demonstrate commitment to environmental protection and social well-being (Guthrie; Parker, 1989; Eugénio, 2010). When legitimacy is lost, society can revoke this contract, resulting in a drop in demand, loss of financial support, and the imposition of government restrictions (Deegan, 2002).

Thus, the perspectives of *Stakeholder Theory* and Legitimacy Theory offer the conceptual basis for understanding how Corporate Social Responsibility (CSR) or Corporate Social Irresponsibility (CSI) manifests itself in the mining sector. By analyzing the practices of disclosure of social and environmental risks, it is possible to identify how companies seek to meet the demands of their *stakeholders* and preserve their social legitimacy

2.2 Corporate Social Responsibility or Irresponsibility in the Brazilian Mining Sector

Corporate Social Responsibility (CSR) refers to the commitment of companies to adopt policies, decisions, and practices aligned with society's values and objectives (Bowen, 1953), consolidating itself over the decades as a fundamental metric of corporate performance (Chung; Jung; Young, 2018). At the same time, Corporate Social Irresponsibility (CSI) corresponds to corporate actions or omissions that generate material or immaterial damage to society and the environment, often resulting from the discrepancy between business discourse and practice (Franco; Batista, 2024; Lin-Hi; Müller, 2013; Medeiros; Alcadiapani, 2013). Examples such as the British Petroleum oil spill in the Gulf of Mexico and the rupture of the Samarco dam in Brazil, show that socially responsible companies in their discourse can be associated with major environmental disasters (Spencer; Fitzgerald, 2013; Cosenza *et al.*, 2018). In this way, the market tends to reduce the value of companies due to the environmental damage caused by them (Nogueira; Angotti, 2011).

In Brazil, mining has played a central role in its economic development since the colonial period, especially in Minas Gerais (Carvalho *et al.*, 2022), but also left as a legacy recurrent environmental disasters (Melo; Guimarães, 2023). Historically, the sector has operated with little socio-environmental concern, exploiting resources in areas without infrastructure and abandoning them after economic exhaustion (Jenkins, 2004). This activity, from processing to the storage of tailings, presents a high environmental risk, and Brazil accumulates occurrences that could be framed as environmental crimes (Alves; Carneiro; Paiva, 2020).

From the end of the 1990s, in the face of strong reputational erosion, large mining companies began to adopt CSR policies and to expand the disclosure of socio-environmental reports (Jenkins, 2004; Saes *et al.*, 2021) to meet the expectations of *stakeholders* and ensure their legitimacy. Even so, the location of dams close to vulnerable communities has generated serious social, economic and environmental consequences (Barros; Mendonça, 2024), highlighting the need to align the sector with SDG 12, which deals with sustainable production and consumption patterns (Carvalho *et al.*, 2022).

In 2025, Brazil had 261 tailings dams with high Associated Potential Damage, 57% of them in Minas Gerais, 70 of which belonged to Vale S.A., including one at Emergency Level 3 (ANM, 2025). This scenario reinforces the distance between the company's CSR discourse and its practices, revealing evidence of Corporate Social Irresponsibility (Saes *et al.*, 2021) and justifying the analysis of how the company has disclosed risks and mitigation actions.

2.3 The case of Vale S.A.

On November 5, 2015, Brazil experienced its greatest socio-environmental tragedy with the collapse of Samarco's Fundão dam — a *joint venture* between Vale S.A. and BHP Billiton — located in Mariana (MG), and intended for the storage of iron mining tailings (Rocha, 2021). The collapse released about 50 million m³ of tailings, classified as non-hazardous and non-inert for iron and manganese (NBR 10.004), devastating 1.469 hectares along 77 km of watercourses, destroying permanent preservation areas and irreversibly compromising fauna (Ibama, 2015). The mud reached more than 700 km to the mouth of the Doce River, reaching the coast of Espírito Santo, Bahia and Rio de Janeiro.

The disaster resulted in the death of 19 people, displaced communities, destroyed villages and infrastructure, compromised water supplies, and affected agriculture, fishing, tourism, and energy generation (Brasil, 2015). Despite being one of the largest global environmental disasters, its economic impacts were quickly absorbed by the capital market, without causing a lasting drop in the value of mining company shares in Brazil (Araujo; Soares; Abreu, 2018).

While the Mariana tragedy represented the largest environmental disaster in Brazil, Brumadinho recorded the greatest social impact in national history (Rocha, 2021). On January 25, 2019, Vale S.A.'s B1 dam, built in the 1970s with the upstream raising technique by Germany's Ferteco and acquired by Vale in 2001, broke, releasing about 13 million m³ of tailings from the Córrego do Feijão mine. The flow, at 80 km/h, reached the Paraopeba River basin and caused the rupture of other containment dams, such as B IV and B IV-A (Brasil, 2019).

The wave of tailings destroyed the mining company's facilities and neighboring areas, causing the death of more than 270 people, contaminating the Paraopeba River, devastating vegetation, affecting fauna and impacting indigenous and riverine communities (Melo; Guimarães, 2023). The tailings covered 297.28 hectares, compromising at least 193 structures; 51% of the affected area had preserved native vegetation, 19% sheltered intense human activity and 13% was destined for agriculture. These damages generated environmental contamination, worsening of the physical and mental health of the communities, and regional socioeconomic instability (Pereira; Cruz; Guimarães, 2019).

In addition, there was a strong immediate disinvestment by shareholders, intensified by the fact that the Brumadinho operations are fully controlled by Vale and because this is the second occurrence of negligence by the company (Barbosa; Barros, 2021).

2.4 The case of Vale S.A.

Previous research offers important subsidies to understand the evolution of the disclosure of environmental risks by Vale S.A. The research by Costa *et al.* (2020) and Júnior *et al.* (2024) analyzed the management and disclosure of environmental risks by Samarco and Vale S.A. in light of GRI standards. Costa *et al.* (2020) identified an increase in adherence to the GRI criteria after the Samarco dam collapse, but not after Brumadinho, highlighting persistent flaws in the clarity of the information, which compromised the transparency and credibility of the companies. Júnior *et al.* (2024) found that, as of 2020, Vale began to adopt more direct communication about dam failures, assuming responsibilities and aligning itself with international standards and global risk management trends, such as those of the *Allianz Risk Barometer*.

On the other hand, Silva, Lagrange and Oliveira (2021) evaluated Vale S.A.'s environmental compliance practices, pointing out that, although there were social and environmental actions, the strategies were not properly detailed in the Sustainability Reports between 2015 and 2018. In a complementary way, Queiroga, Reis, and Melo (2023) analyzed the company's environmental disclosure from 2016 to 2020, classifying the information as quantitative (*hard*) or qualitative (*soft*). The authors identified an increase in transparency after the disasters of 2015 and 2019, with stability in the volume of *soft* data and a significant increase in *hard* data in 2020.

3. METHODOLOGY

The present research is descriptive and adopts a case study on the disclosure of environmental risks by Vale S.A., with a qualitative-quantitative approach. It is a documentary research, based exclusively on documents, aiming to extract relevant information to understand the phenomenon. The unit of analysis comprises the Sustainability Reports (2014–2024) and the ESG Databooks (2021–2024) of Vale S.A., chosen for its central role in the sector and for having been responsible for the disasters of Mariana (2015) and Brumadinho (2019). The period analyzed, from 2014 to 2024, allows us to assess the evolution of risk disclosure over time. The data was collected between April and May 2025.

The data analysis technique adopted was content analysis, focused on Vale S.A.'s Sustainability Reports, to identify the evolution of the company's disclosure of environmental risks in relation to SASB metrics. The analysis categories were defined based on IFRS S1, which guides entities to consult and evaluate the applicability of the metrics associated with the disclosure topics provided for in the SASB Standards. Specifically, the topics of Waste and Hazardous Materials Management and Management of Tailings Storage Facilities in the Metals and Mining sector, to which Vale S.A. belongs, were considered. The two topics were chosen because they are directly related to environmental disasters involving dams.

The metrics analyzed are described in Chart 2. Each one was broken down into the respective items required by the SASB standard, totaling 59 items for the period from 2014 to 2019 and 76 items from 2020 to 2024. The difference is due to the fact that the 17 items related to the Global Industry Standard on Tailings Management (GISTM), created in 2020, were not considered in the analysis of the years prior to its creation. For the years 2014 to 2020, it was necessary to carry out a methodological adaptation, relating the SASB Standards with the GRI guidelines, in order to standardize and optimize the identification of information in the reports. For the years 2019 to 2023, the analysis followed SASB metrics. In addition, for all years, keywords previously defined in Table 2 were used.

Panel 1 - SASB Standard Metals & Mining Industry Disclosure Topics

TOPIC	METRICS	ITEMS	KEYWORDS
Waste and Hazardous Materials Management	EM-MM-150a.4. Total weight of non-mineral waste generated	4	Non-minerals
	EM-MM-150a.5. Total weight of tailings produced	2	reject; waste; GISTM
	EM-MM-150a.6. Total weight of rock waste generated	2	rocky; sterile
	EM-MM-150a.7. Total weight of hazardous waste generated	3	dangerous; Basel; UNEP
	EM-MM-150a.8. TOTAL WEIGHT OF HAZARDOUS WASTE RECYCLED	5	recycled; Basel; UNEP
	EM-MM-150a.9. Number of hazardous materials incidents and hazard management Waste	6	incident; shedding; leakage; Basel; UNEP
	EM-MM-150a.10. Description of waste management policies and procedures and Hazardous materials for active and inactive operations	19	risk management; dam management; waste management; dam management; waste; inactive; non-minerals; mischaracterization; decommissioning; prevention; Repair
Management of Tailings Storage Facilities	EM-MM-540a.1. Tailings Storage Facility Inventory Table: (1) Facility Name, (2) Location, (3) Ownership Status, (4) Status		
	(5) construction method, (6) capacity maximum allowable storage, (7) current amount of tailings stored, (8) consequence classification, (9) data from the most recent independent technical review, (10) material findings, (11) mitigation measures, (12) site-specific EPRP	19	dams; tailings; GISTM
	EM-MM-540a.2. Summary of tailings management systems and governance structure used to monitor and maintain the stability of tailings storage facilities	10	risk management; dam management; waste management; management dams; waste; GISTM
	EM-MM-540a.3. Approach to the development of Preparedness Plans and Emergency Response (EPRPs) for tailings storage facilities	6	PAE; PAEBM; Plan of action emergency; GISTM

Source: Adapted from SASB (2023)

To assess the company's degree of compliance with the items analyzed, the Disclosure Index (DI) was calculated using the content analysis technique. According to Bittencourt and Ribeiro (2022), the DI corresponds to the ratio between the number of items disclosed and the sum of all items, as illustrated in Figure 1. According to Lemos, Rodrigues and Ariza (2009), the DI is constructed without assigning weights, considering that all items have the same importance for the users of accounting information, since weightings would require prior analysis and could generate subjectivity.

Figure 1 – Disclosure Index

$$ID_i = \sum_{j=1}^n \frac{e_j}{e}$$

Source: Based on Bittencourt and Ribeiro (2022) and Teixeira *et al.* (2021)

The Disclosure Index (DI) of company *i* (Vale S.A.) is calculated based on the dichotomous variable (e_j), which assumes a value of 1 when the item is disclosed and 0 when it is not; and in the total of elements analyzed

(e) (Bittencourt and Ribeiro, 2022). For this, the data were organized in an electronic spreadsheet. Each item, related to metrics, received 1 point if the information was identified in Vale S.A.'s reports, and 0, if not. Thus, the annual total of points varies from 0 to 59 between 2014 and 2019, and from 0 to 76 between 2020 and 2024.

Based on these results, the levels of disclosure were classified by quartiles. Following the criterion proposed by Teixeira

et al. (2021), the first quartile corresponds to the good level of disclosure, while the fourth quartile indicates a poor level. The classification of the levels is shown in Table 3.

Table 2 – Classification of disclosure levels

LEVELS	ID	ABBREVIATION	CLASSIFICATION
1	0.76 a 1.0	B	Good
2	0.51 a 0.75	S	Satisfactory
3	0.26 a 0.50	I	Unsatisfactory
4	0.00 a 0.25	R	Poor

Source: Adapted from Bittencourt and Ribeiro (2022)

This research has as a limitation the non-comparability of the evolution with the other topics of the SASB standards, since the study was restricted to the analysis of only two of the twelve topics of the Metals and Mining sector: Waste and Hazardous Materials Management and Management of Tailings Storage Facilities.

4. RESULTS

The indexes obtained after analyzing the reports of Vale S.A. and *Databooks* ESG, between 2014 and 2024, for the topics "Management of Waste and Hazardous Materials" and "Management of Tailings Storage Facilities" and their respective classifications are presented in Table 1. This happens for each year and reflects the company's level of adherence to SASB metrics.

Table 1 – Variation in disclosure indexes

Topics	Sustainability Reports										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Waste and Hazardous Materials Management	0.00	0.61	0.59	0.36	0.57	0.32	0.25	0.33	0.56	0.44	0.52
Facility Management Tailings Storage	0.00	0.37	0.37	0.30	0.41	0.30	0.24	0.22	0.44	0.66	0.66
General Disclosure	0.00	0.49	0.48	0.33	0.49	0.31	0.25	0.28	0.50	0.55	0.59
Level	R		I		I		R			S	S

Source: Prepared by the author (2025)

It is observed that the calculated indices varied significantly each year. The level of general disclosure indicates that, prior to the collapse of the Mariana dam (MG) in 2015, Vale S.A. did not present any information on waste or dam management in the company's reports (0.00). In 2015 and 2016, there was relevant growth (0.49 and 0.48), indicating a quick response to *stakeholders* in the face of what happened, with a classification very close to the satisfactory range. However, over the years there has been a downward oscillation in the disclosure index, varying the level of classification from unsatisfactory to poor, reaching higher disclosure values again from 2022 onwards, being classified as satisfactory.

Contrary to the expected trend, the Brumadinho disaster in 2019 did not promote an increase in the disclosure of environmental risks. On the contrary, the indexes from 2019 to 2021 were the lowest since 2014, with a highlight to 2020, which presented the worst result in the series (0.25), with a bad classification. This behavior indicates inconsistency in the company's communication in the face of critical events.

As of 2022, there is a more consistent trend of positive evolution in the disclosure of environmental information. This advance coincides with the full adoption of the standards' metrics

SASB by Vale S.A., which, until then, were only superficially mentioned in the company's reports, through correlations with GRI indicators since 2019. As of 2022, however, the company began to disclose, through the *ESG Databook*, the 29 complete metrics of the Metals and Mining sector established by SASB, expanding the scope of the information presented.

This process is related to the strengthening of the practices required by the publication of the IFRS S1 standard in 2023, which consolidated stricter guidelines on the transparency of sustainability-related disclosures. As a result, in 2023 and 2024, the disclosure indexes presented a value higher than 0.50, being classified as satisfactory.

Even so, none of the topics analyzed achieved full adherence to the standards, or a good disclosure index, which reinforces the need to improve the quality of disclosures, especially with regard to the preventive management of dams and the technical detailing of the information required by each metric.

Table 2 presents the Disclosure Index (DI) of the metrics analyzed in the topic of Waste and Hazardous Materials Management individually.

Table 2 – Variation in the disclosure indexes of Waste and Hazardous Materials Management

Metrics	SUSTAINABILITY REPORTS										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EM-MM-150a.4.	0.00	0.25	0.25	0.00	0.75	0.25	0.00	0.00	0.25	0.25	0.25
EM-MM-150a.5.	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EM-MM-150a.6.	0.00	0.50	0.50	1.00	0.50	0.50	0.00	0.50	0.50	0.50	0.50
EM-MM-150a.7.	0.00	0.67	0.67	0.00	0.67	0.00	0.00	0.00	0.67	0.33	0.33
EM-MM-150a.8.	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.60	0.40	0.40
EM-MM-150a.9.	0.00	0.83	0.83	0.00	0.50	0.00	0.50	0.50	0.50	0.17	0.50
EM-MM-150a.10.	0.00	0.63	0.47	0.53	0.58	0.47	0.26	0.32	0.42	0.42	0.63
Average	0.00	0.61	0.59	0.36	0.57	0.32	0.25	0.33	0.56	0.44	0.52
Level	R	S	S		S		R		S		S

Source: Prepared by the author (2025)

Analysis of the metrics of the EM-MM-150a (waste and hazardous materials management) topic reveals an inconsistent evolution over the years. The years 2015, 2016 and 2018 presented the best performances, while 2020 was the most critical, with the level of disclosure classified as poor.

The indicator EM-MM-150a.4 (total weight of non-mineral waste generated) reached a satisfactory level only in 2018, the year in which Vale S.A. detailed the included and excluded waste. In the others, it was limited to the presentation of the total volume, without technical explanations to fully comply with SASB standards.

In contrast, EM-MM-150a.5 (total weight of tailings produced) was the only one to achieve a good level of adherence in all the years analyzed after 2014. As of 2020, it began to incorporate a GISTM requirement, referring to the alignment of the definition of rejections with the criteria of the standard itself, which was consistently met. As for EM-MM-150a.6 (total weight of rock waste generated), the data were presented as "sterile". However, only in 2017, the definition was explained according to the criteria of the standard. In 2020 there was no evidence, and, in the other years, the dissemination was unsatisfactory.

The indicator EM-MM-150a.7 (total weight of hazardous waste generated) began to be reported after the tragedy in Mariana (MG), but although satisfactory in some years, it lacked continuity and technical definitions, such as the reference to the Basel Convention. In 2017, it was classified as non-material. In 2023 and 2024, there was a drop in the quality of information.

EM-MM-150a.8 (total weight of recycled hazardous waste) was partially met in the three years after Mariana (MG) and was only released again between 2022 and 2024, in the *ESG Databook*. Although some reports presented the amount of waste recycled, they did not specify whether it was hazardous or mention compliance with the Basel Convention, which compromised adherence to the metric. In 2017 and 2018, the information was considered non-material.

The EM-MM-150a.9 metric (number of incidents associated with hazardous materials and waste management) showed partial disclosure in most years, with good performance in 2015 and 2016. In 2023, the level was classified as poor because it only presents the total numbers, without specifying the nature of the hazardous materials involved.

Finally, EM-MM-150a.10 (description of waste and hazardous materials management policies and procedures for active and inactive operations), which refers to the actions expected of mining companies in waste management, showed a significant increase in 2016 (0.68), suggesting rapid implementation after Mariana (MG). However, the evidence for these policies has reduced in the following years, except for 2018, and only returned to a satisfactory level in 2024. This indicates inconsistency in Vale S.A.'s clarity and transparency in waste management, even after two major environmental tragedies.

In general, the average disclosure of this set of metrics was unstable, with few years of satisfactory adherence. This oscillation

shows that, although Vale S.A. discloses part of the expected information, the absence of explanations and the standardization of information and technical definitions compromise the quality of the disclosure. Numerical data is often presented without proper context or clear criteria, which makes it difficult for stakeholders to understand and fully comply with SASB standards. Table 3 shows the Disclosure Index (DI) of the metrics analyzed in the topic management of tailings storage facilities.

Table 3 – Variation in the disclosure indexes of Tailings Storage Facility Management

SUSTAINABILITY REPORTS											
2014	Metrics	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EM-MM-540a.1.	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.47	0.47
EM-MM-540a.2.	0.00	0.43	0.43	0.57	0.57	0.57	0.40	0.50	0.50	0.50	0.50
EM-MM-540a.3.	0.00	0.67	0.67	0.33	0.33	0.33	0.33	0.17	0.83	1.00	1.00
Average	0.00	0.37	0.37	0.30	0.41	0.30	0.24	0.22	0.44	0.66	0.66
Level	R		I		I		R	R		S	S

Source: Prepared by the author (2025)

Analysis of the topic EM-MM-540a (management of tailings storage facilities) reveals historically limited disclosure, but with gradual improvement in recent years.

The metric EM-MM-540a.1 (inventory table of tailings storage facilities) was released in only 3 of the 11 years analyzed. In 2018, it appeared briefly in the Sustainability Report (0.33), in an unsatisfactory way. In 2023 and 2024, Vale S.A. started to make available, in the *ESG Databook*, an external link (<https://principio15.azurewebsites.net>), for the Portal for the Disclosure of Information on Tailings Storage Structures, created in accordance with Principle 15 of the GISTM. Despite the initiative, not all the requirements of the metric were identified on the portal, especially those linked to the GISTM itself, maintaining the disclosure as unsatisfactory. In the 2020 Sustainability Report, an alternative link (<http://www.vale.com/esg/pt/Paginas/ControleGestao-Barragens.aspx>) was identified, but it is currently unavailable, preventing the verification of the content disclosed that year.

The EM-MM-540a.2 metric (summary of management systems and dam governance structure) had continuous disclosure after the

disaster in Mariana (MG), suggesting that the event boosted attention on the subject. The level of disclosure was satisfactory between 2017 and 2019 (0.57). As of 2020, with the GISTM in force, it remained at 0.50 adherence, considered unsatisfactory.

The metric EM-MM-540a.3 (Emergency Preparedness and Response Plans) showed the greatest variation. It was satisfactory right after Mariana (MG) (0.67), but fell between 2017 and 2021. As of 2022, it reached full adherence after the disclosure of the complete metrics in the *ESG Databook*, which demonstrates a positive evolution in the disclosure of emergency actions related to dams.

Overall, tailings management indicators performed poorly or poorly for most of the period, but the last three years indicate gradual improvement, especially with regard to emergency response. However, there is still no total adherence to the SASB standard, especially with regard to preventive management, which limits the transparency and security of the information provided to *stakeholders*.

Table 4 considers the evolution only of the items related to the GISTM.

DISCLOSURE	ADHERENCE RATING				
	2020	2021	2022	2023	2024
EM-MM-150a.5.	1.00	1.00	1.00	1.00	1.00
Level	Good	Good	Good	Good	Good
EM-MM-540a.1.	0.00	0.00	0.00	0.30	0.30
EM-MM-540a.2.	0.33	0.33	0.33	0.33	0.33
EM-MM-540a.3.	0.33	0.33	1.00	1.00	1.00
Average	0.22	0.22	0.44	0.54	0.54
Level	Poor	Poor	Unsatisfactory	Satisfactory	Satisfactory

Table 4 – Variation in disclosure indexes related to GISTM

Source: Prepared by the author (2025). In the metric EM-MM-150a.5 (total weight of tailings produced), it is observed that, since the implementation of the GISTM, the item related to the definition of tailings has been consistently met, resulting in a good level of adherence in all years.

In contrast, the EM-MM-540a.1 metric (tailings storage facility inventory table) was partially met in 2023 and 2024, even after the GISTM went into effect. This indicates a lack of adherence to the technical information required by the SASB standard.

In turn, the metric EM-MM-540a.2 (summary of the tailings management systems and governance structure used to monitor and maintain the stability of tailings storage facilities) has partially met the GISTM items since its implementation. However, it did not show subsequent evolution, maintaining the score in all years (0.33).

The metric EM-MM-540a.3 (approach to the development of Emergency Preparedness and Response Plans (EPRPs) for tailings storage facilities), however, has shown evolution over time,

fully meeting the items

GISTM from 2022 and reaching a good disclosure rate.

In short, the set of Tailings Storage Facility Management (EM-MM-540a) metrics has shown a steady and positive evolution over the years, progressing from a poor to a satisfactory level. This improvement is largely attributed to the dissemination of Emergency Preparedness and Response Plans (EPRPs). However, there is still a need to improve adherence to the tailings inventory table metrics and dam management systems to fully align with the requirements of the GISTM in the SASB standard.

The results of this research demonstrate that, in general, the company reacted quickly to the first accident. The analysis of the indicators reveals that, after the Mariana tragedy (2015), Vale S.A., which previously did not disclose information on effluents and waste, started to highlight this data in its reports. This finding corroborates Costa *et al.* (2020), which the company, previously

superficial and generic about the risks of its operations, adopted a posture more aligned with the requirements of the GRI indicators after the disaster. However, the results of the research, as well as those of Costa *et al.* (2020), demonstrate that, despite the increase in the amount of information disclosed, the evidence is still not clear and complete, presenting flaws.

This increase in information after the accident, however, was not maintained after the dam collapse in Brumadinho (2019). This result contrasts with Júnior *et al.* (2024), which identified Vale S.A.'s greater attention to operational risks, especially in the 2020 Integrated Report, and with Queiroga *et al.* (2023), which observed higher scores in the Environmental Performance Indicators (ADI) in 2016 and 2020. The divergence, however, stems from the different methodological approaches. Júnior *et al.* (2024) analyzed broad material risks, and Queiroga *et al.* (2023) evaluated the general socio-environmental disclosure. This study focused exclusively on waste and dam management, using specific metrics from the SASB standard. Thus, within their cut, there was an increase in dissemination, but not in the scope of this research.

According to the methodology adopted in this study, Vale S.A. presented, in 2020, the worst overall Disclosure Index (DI) since 2014, with a value of 0.25, classified as poor. Although the dams and the Brumadinho tragedy were widely cited, the report did not adequately meet the items required by the SASB standard. These results reinforce the conclusion of Costa *et al.* (2020) that the change observed after Mariana was not repeated after Brumadinho. Unlike this previous study, which was limited by the absence of the 2019 report, the present research analyzed later documents, including the following years.

Thus, although there are occasional advances, most of the reports analyzed were classified as unsatisfactory or bad. This result suggests that Vale S.A.'s disclosures remain more focused on formally meeting minimum accountability requirements, a typical strategy to preserve its social legitimacy, than on a genuine commitment to environmental transparency and the effective satisfaction of the demands of its *stakeholders*. From the perspective of the Theory of Legitimacy, such a posture indicates an attempt to align the discourse with social expectations only to avoid loss of support or sanctions, without necessarily promoting structural changes. In the light of the *Stakeholder Theory*, it is evident that the company does not fully prioritize the interests and informational needs of all the audiences affected by its activities, limiting itself to reactive and low-detail practices. This finding converges with the analysis by Silva, Lagrange and Oliveira (2022), who point out the low disclosure of environmental *compliance practices* by the company, even in the face of the relevance of the topic in the post-disaster period.

On the other hand, the results of the 2023 and 2024 reports indicate that, in recent years, Vale S.A. has more broadly complied with the requirements of the SASB standard for dam and waste management, which may be a result of the issuance of the *exposure draft* of the international standard IFRS S2, in 2022, and its publication in 2023, as well as the Brazilian standard CVM 193/2023. In addition, the adoption of the *ESG Databook* also stands out, as it contributed to amore structured disclosure of information, with greater alignment with the

sectoral metrics and regulatory requirements. This recent evolution suggests a movement of strategic adaptation to the new guidelines, possibly driven by *stakeholder pressure* and the need to reinforce organizational legitimacy.

5. CONCLUSION

The present work aimed to investigate how Vale S.A. has disclosed, over the last few years, the environmental risks associated with the management of dams and waste, especially after the disasters that occurred in Minas Gerais. In this sense, a documentary research was carried out, in which the company's Sustainability Reports and *ESG Databooks* from the period 2014 to 2024 were analyzed, considering the topics and metrics defined by the SASB standards, according to IFRS S1 guidelines.

After the 2015 disaster, Vale S.A. improved its Sustainability Reports, incorporating data on waste management, dam safety and mitigation actions, aligning with GRI indicators. In that year, the Disclosure Index (DI) increased by 61% for Waste and Hazardous Materials Management and 37% for Tailings Storage Facility Management, compared to 2014, although weaknesses persisted in the presentation of qualitative information. In contrast, after the Brumadinho collapse (2019), there was no similar evolution, with the suppression of quantitative data on hazardous waste and the resumption of advances only in 2022, when it started to adopt SASB metrics more widely.

As for mitigation actions, Vale S.A. began to demonstrate Sustainability Reports, especially through metrics EM-MM-150a.10 and EM-MM-540a.3. Although there are oscillations throughout the analyzed period, the 2024 data indicate a satisfactory Disclosure Index (DI) for hazardous waste management and good for dam management in the last three years, signaling an effort at transparency in corrective practices. Even so, even with the adoption of SASB standards in its *Databook* and the advances observed in 2023 and 2024, the company fails to report almost half of the items provided for in the scope of these standards for waste and dam management.

This research is relevant because it examines how large companies, such as Vale S.A., face social and environmental risks and adopt transparency practices in the face of growing regulatory requirements. The results theoretically contribute to the literature on socio-environmental disclosure, by deepening the understanding of the use of IFRS S1 and SASB metrics in the standardization and qualification of transparency, a theme still little explored in Brazil. They also point out advances and gaps in corporate practices, offering subsidies for *stakeholders* and accounting professionals to improve the preparation and analysis of more consistent reports.

This research focused on the analysis of two topics of the SASB standard applicable to the metals and mining sector. For future research, it is recommended to expand the study to the other topics of the standard, covering the environmental and social contexts. In addition, it is suggested to compare it with the next integrated reports of Vale S.A., in order to verify whether the observed evolution is maintained consistently over time.

REFERENCES

- AGÊNCIA NACIONAL DE MINERAÇÃO (ANM). SIGBM - Sistema de Gestão de Segurança de Barragem de Mineração. ANM, 2025. Disponível em: <https://app.anm.gov.br/SIGBM/Publico/GerenciarPublico>. Acesso em: 9 jun. 2025.
- ALVES, Francisco I. A. B.; CARNEIRO, Celia M. B.; PAIVA, David A. Os efeitos do desastre ambiental de Mariana sobre a reputação da Samarco Mineração S.A. **REUNIR: Revista de Administração, Ciências Contábeis e Sustentabilidade**, v. 28, p. 69-89, 28 out. 2020.
- AMEL-ZADEH, Amir; SERAFEIM, George. Why and How Investors Use ESG Information: Evidence from a Global Survey. **Financial Analysts Journal**, v. 74, n. 3, p. 87-103, 2018.
- BARBOSA, Sarah C.; BARROS, Thiago S. Qual a reação dos acionistas em face dos desastres ambientais envolvendo a mineradora Vale S.A? Um estudo de evento. **RC&C - Revista Contabilidade e Controladoria**, v. 13, n. 2, p. 64-94, maio/ago. 2021.
- BARROS, Rita C.; MENDONÇA, Talles G. Primeiro como tragédia, depois como norma: os padrões globais e as políticas brasileiras de segurança de rejeitos de mineração. **Revista Brasileira De Estudos Urbanos E Regionais**, v. 26, n. 1, 14 jan. 2024.
- BITTENCOURT, Pedro D.; RIBEIRO, Cíntia M. A. Divulgação dos Intangíveis por Instituições Bancárias Brasileiras. **Pensar Contábil**, v. 25, n. 85, p. 3-10, set./dez. 2022.
- BOWEN, Howard R. **Social responsibility of the businessman**. New York: Harper & Row, 1953. Acesso em: 2 jul. 2025.
- BRASIL. IBAMA. **Laudo Técnico Preliminar: Impactos ambientais decorrentes do desastre envolvendo o rompimento da barragem de Fundão, em Mariana, Minas Gerais**. 2015. Disponível em: ibama.gov.br/phocadownload/barragemdefundao/laudos/laudo_tecnico_preliminar_ibama.pdf. Acesso em: 17 dez. 2024.
- BRASIL. Comissão Parlamentar de Inquérito. **Relatório Final da Comissão Parlamentar de Inquérito - Rompimento da Barragem de Brumadinho**. 2019.
- CARVALHO, Marcela M.; BRAZ, Sofia N.; SILVA, Luiz H. V.; RODRIGUES, Patrícia P.; GALVÃO, Paulo H. G.; SOUZA, Celso F. C. de; LONGO, Regina M. Brumadinho-MG após o rompimento da barragem: uma discussão à luz dos objetivos de desenvolvimento sustentável. **Humanidades & Inovação**, v. 9, n. 13, 13 set. 2022.
- CATRIB, Isabella C.; JÚNIOR, Marcos A. C. O.; GARCIA, Editinete A. R. Marketing and the stakeholder theory: a literature review from the Web of Science. **Revista Fatec Zona Sul**, v. 9, n. 2, p. 43-68, nov. 2022.
- CHUNG, Chune Y.; JUNG, Sangjun; YOUNG, Jason. Do CSR Activities Increase Firm Value? Evidence from the Korean Market. **Sustainability**, v. 10, n. 9, p. 3164, 4 set. 2018.

- COSENZA, José P.; RIBEIRO, Cintia M. A.; LEVY, Ariel; DIOS, Selma A. Entendimento da Responsabilidade Social Corporativa da Samarco no rompimento da barragem de Fundão. **Revista de Contabilidade e Organizações**, v. 12, e151356, 2018.
- COSTA, Leticia; DACIÊ, Francielle P.; CORTEZIA, Maria C. P.; SILVA, Thais A. O que os olhos não veem, o bolso não sente: uma análise da evidência dos riscos ambientais na atividade das empresas Samarco e Vale sob a perspectiva dos desastres nas barragens de Mariana e Brumadinho. In: CONGRESSO UFSC DE CONTROLADORIA E FINANÇAS E UFSC INTERNATIONAL ACCOUNTING CONGRESS, 10., 2020, Florianópolis. **Anais [...]**. Florianópolis: UFSC, 2020.
- DEEGAN, Craig. The legitimising effect of social and environmental disclosures - a theoretical foundation. **Accounting, Auditing & Accountability Journal**, v. 15, n. 3, p. 282-311, 1 ago. 2002.
- EUGÊNIO, Teresa. Avanços na divulgação de informação social e ambiental pelas empresas e a Teoria da Legitimidade. **Revista Universo Contábil**, v. 6, n. 1, p. 102-118, jan./mar. 2010.
- FABRÍCIO, Sarah A.; FERREIRA, Denize D. M.; BORBA, José A. A panorama of Mariana and Brumadinho disasters: What do we know so far? **Revista Eletrônica de Administração**, v. 27, n. 1, p. 128-152, jan./abr. 2021.
- FRANCO, Annibal G.; BATISTA, Melissa M. Entre "Slogans Verdes" e "Comportamentos Cinzentos": explorando a dicotomia entre as práticas de ESG e as realidades operacionais. **Revista Eletrônica Multidisciplinar de Investigação Científica**, v. 3, n. 14, 2024.
- FREEMAN, Edward. **Strategic Management**. Boston: Pitman, 1984.
- GONÇALVES, Ricardo J. A. F.; SANTHOMÉ, Larissa O.; CASTRO, Danniella D. No fundo da cova: deterioração do trabalho no setor extrativo mineral em Goiás, Brasil. **Revista OKARA: Geografia em Debate**, v. 14, n. 1, p. 196-212, 11 jul. 2020.
- GUTHRIE, James; PARKER, Lee D. Corporate Social Reporting: A Rebuttal of Legitimacy Theory. **Accounting and Business Research**, v. 19, n. 76, p. 343-352, 1989.
- JENKINS, Heledd. Corporate social responsibility and the mining industry: conflicts and constructs. **Corporate Social Responsibility and Environmental Management**, v. 11, p. 23-24, 24 fev. 2004.
- JÚNIOR, Guilherme A. M.; SILVA, Eduardo Z.; NASCIMENTO, José O.; PEREIRA, Raquel S.; LEMOS, Kátia M.; RODRIGUES, Lúcia L.; ARIZA, Lázaro R. Determinantes do nível de divulgação de informação sobre instrumentos derivados. Evidência empírica no mercado de capitais português. **Revista de Estudos Politécnicos**, v. 12, maio/set. 2009.
- LIMA, Lavosiene R.; FREIRE, Fátima S.; SILVA, Nilton O. Exploring fallacies and environmental responsibilities in the socio-environmental reports of the Brazilian company Vale S.A.: A case study on the dam disasters in Mariana and Brumadinho. **International Journal of Economics and Finance**, v. 16, n. 1, p. 1-12, 30 nov. 2023.
- LIN-HI, Nick; MÜLLER, Karsten. The CSR bottom line: Preventing corporate social irresponsibility. **Journal of Business Research**, v. 66, n. 10, p. 1928-1936, out. 2013.
- LYRA, Mariana G.; GOMES, Ricardo C.; JACOVINE, Laércio A. G. O Papel dos *Stakeholders* na Sustentabilidade da Empresa: Contribuições para Construção de um Modelo de Análise. **RAC**, v. 13, n. Edição Especial, art. 3, p. 39-52, jun. 2009.
- MEDEIROS, Cintia R. O.; ALCADIPANI, Rafael. Crimes Corporativos Contra a Vida e Necrocorporações. In: ENCONTRO DA ANPAD, 37., 2013, Rio de Janeiro. **Anais [...]**. Rio de Janeiro: Anpad, 2013.
- MELO, Tatiane L.; GUIMARÃES, Liliâne O. Vale tudo: As estratégias de atuação da Vale após o desastre-crime da barragem de Córrego do Feijão. **RAM. Revista de Administração Mackenzie**, v. 24, n. 6, p. 1-27, 3 nov. 2023.
- NOGUEIRA, Kênia G. F.; ANGOTTI, Marcello. Os efeitos da divulgação de impactos ambientais: um estudo de eventos em companhias petrolíferas. **Revista Contemporânea de Contabilidade**, v. 8, n. 16, p. 65-88, jul./dez. 2011. PEREIRA, Luís F.; CRUZ, Gabriela B.; GUIMARÃES, Ricardo M. F. Impactos do rompimento da barragem de rejeitos de Brumadinho, Brasil: uma análise baseada nas mudanças de cobertura da terra. **Journal of Environmental Analysis and Progress**, v. 4, n. 2, p. 122-129, fev. 2019.
- QUEIROGA, Renata S.; REIS, Cristiane Q.; MELO, Janaina F. M. D. Um estudo sobre o disclosure de informações ambientais da empresa Vale S.A. **Revista Interdisciplinar e do Meio Ambiente**, v. 5, n. 1, e205, 2023.
- REPETTO, Robert. Making Disclosure Work Better: The Experience of Investor-Driven Environmental Disclosure. In: BROWN, Dana L.; WOODS, Ngaire. **Making Global Self-Regulation Effective in Developing Countries**. Oxford: Oxford University Press, 2007. p. 78-112.
- ROCHA, Leonardo C. As Tragédias de Mariana e Brumadinho: É Prejuízo? Para Quem? **Caderno de Geografia**, v. 31, n. 1, 8 fev. 2021.
- SAES, Beatriz M.; BENE, Daniela; NEYRA, Raquel; WAGNER, Lucrecia; MARTÍNEZ-ALIER, Joan; Justiça ambiental e irresponsabilidade social corporativa: o caso da mineradora Vale S.A. **Revista Ambiente & Sociedade**, v. 24, e0014, jan. 2021.
- SILVA, Gustavo A.; SANTOS, Andreza M.; SILVA, Maria R. Uma análise do disclosure socioambiental das empresas listadas da Carteira do ISE da B3 S.A. **Revista Interfaces: Saúde, Humanas e Tecnologia**, v. 12, n. 1, p. 3775-3784, 2024.
- SILVA, José F. P. Responsabilidade social e meio ambiente: a contabilidade como ferramenta essencial ao desenvolvimento sustentável. **Revista Brasileira de Gestão Ambiental e Sustentabilidade**, v. 6, n. 12, p. 67-80, 2019.
- SILVA, Rita C.; BARROS, Claudio M. E. Acidente de Brumadinho em Minas Gerais: valoração das ações da Vale S.A. e seus pares. **RMC, Revista Mineira de Contabilidade**, v. 24, n. 3, p. 40-50, set./dez. 2023.
- SILVA, Vitória D. M.; LAGRAGE, Kauane T.; OLIVEIRA, Núbbia M. Mais uma vez Minas Gerais: Compliance ambiental – um estudo à luz da Teoria da Legitimidade. **Revista Metropolitana de Sustentabilidade**, v. 12, n. 1, p. 145-169, jan./abr. 2020.
- SOUSA, Claudinéia B.; WEFORT, Elionor F. J.; CILLO, Lourdes V. Função-objetivo da empresa sob a ótica da continuidade e das teorias econômicas. **Revista da FAE**, v. 18, n. 2, p. 84-93, 13 jan. 2016.
- SPENCER, Dale C.; FITZGERALD, Amy. Three ecologies, transversality and victimization: the case of the British Petroleum oil spill. **Crime, Law and Social Change**, v. 59, p. 209-223, 2013.
- TEIXEIRA, Aline C.; RECH, Ilirio J.; ZANOLLA, Ercílio; COUTO, Marcia H. A. Nível da divulgação das informações não financeiras das empresas brasileiras participantes do projeto piloto de relato integrado. **Revista Contemporânea de Contabilidade**, v. 18, n. 46, p. 16-31, jan./mar. 2021.
- VALE S.A. **Relatório de Sustentabilidade**. 2015. Disponível em: vale.com/documents/44618/429697/relatorio-de-sustentabilidade-2015.pdf-f49b6f3c6-9472-47a6-ce52-cf3b07d0b721?version=1.2&t=1696881218917&download=false. Acesso em: 19 ago. 2024.
- VALE S.A. **Relatório de Sustentabilidade**. 2019. Disponível em: https://vale.com/documents/44618/429697/Relatorio_sustentabilidade_vale_2019_alta_pt.pdf/2c03790d-9342-209c-c2d4-b25f34958996?version=1.2&t=1696882385574&download=false. Acesso em: 19 ago. 2024.
- VILLIERS, Charl; MAROUN, Warren. **Sustainability Accounting and Integrated Reporting**. 2017. p. 182.
- WAHYUNI, Putri D. The Role of IFRS S1 and S2 in Enhancing Transparency and Accountability of ESG Reports: A Systematic Review. **Asian Journal of Economics, Business and Accounting**, v. 25, n. 1, p. 1-12, 2025.
- ZYZNARSKA-DWORCZAK, Beata. Legitimacy Theory in Management Accounting Research. **European Management Studies**, v. 16, n. 72, p. 195-203, 2018.