ABSTRACT

Objective: To discuss how vulnerabilities, especially in terms of social inequalities, are linked to disasters and how they become more potent when disasters occur, further aggravating the situation of groups and communities in fragile conditions.

Theoretical framework: The Vale dam failure disaster was analyzed from the Disaster Risk Management (DRM) proposal presented by the Sendai Framework, which is based on strengthening actions and measures to prevent disasters, as well as increasing preparedness for responses and recovery from disasters that may occur.

Methodology/approach: The method used was the case study. Documentary research, participant observation of WhatsApp groups, and three interviews with representatives of the public sector and civil society were conducted, as well as seven interviews with citizens of Brumadinho. Content analysis was the strategy for data analysis.

Main Results: The experience of the municipality of Brumadinho demonstrates how recovery from a disaster is difficult to accomplish and makes the affected population even more vulnerable and exposed to risk, potentiating fragilities and inequalities.

Implications of the research: The situation of the city in Minas Gerais highlights the processual construction of disasters and how the current model of economic and productive development needs to be rethought. The criticism of disaster management and the negligence regarding its prevention can serve to guide decisions by the public authorities to develop prevention and damage reduction actions.

Originality/value: Empirical studies that discuss the relationship between disasters, vulnerabilities and social inequalities are fundamental to obtain a better understanding of the complexity involved in disaster management, and especially to show how inequalities are enhanced by the occurrence of events of this magnitude, further aggravating the situation of groups and communities in fragile conditions.

Keywords: Risk and disaster management. Social inequalities. Dam burst. Brumadinho. Covid-19 Pandemic

RESUMO

Objetivo: Discutir como as vulnerabilidades, principalmente no que tange às desigualdades sociais, estão atreladas aos desastres e como elas se potencializam diante da ocorrência dos mesmos, agravando ainda mais a situação de grupos e comunidades em condições de fragilidade.

Referencial Teórico: O desastre do rompimento da barragem da Vale foi analisado a partir da proposta de Gestão de Riscos de Desastres (GRD) apresentada pelo Sendai Framework, que se baseia no fortalecimento de ações e medidas de prevenção de desastres, bem como no aumento à preparação para respostas e recuperação diante de desastres que possam vir a ocorrer.

Metodologia/abordagem: O método utilizado foi o estudo de caso. Foram realizadas pesquisas documentais, observação participante de grupos de WhatsApp e três entrevistas com representantes do setor público e da sociedade civil, além de sete entrevistas com cidadãos de Brumadinho. A análise de conteúdo foi a estratégia para análise dos dados.

Principais resultados: A experiência do município de Brumadinho demonstra como a recuperação de um desastre é difícil de ser realizada e torna ainda mais vulnerável e exposta ao risco a população atingida, potencializando fragilidades e desigualdades.

Implicações da pesquisa: A situação da cidade mineira evidencia a construção processual dos desastres e como o atual modelo de desenvolvimento econômico e produtivo precisa ser repensado. As críticas à gestão do desastre e a negligência quanto à sua prevenção podem servir para nortear decisões do poder público no sentido de desenvolver ações de prevenção e redução de danos.

Originalidade/valor: Estudos empíricos que discutam a relação entre desastres, vulnerabilidades e desigualdades sociais são fundamentais para se obter uma melhor compreensão sobre complexidade que envolve a gestão de desastres, e, principalmente, mostrar como as desigualdades são potencializadas a partir da ocorrência de eventos dessa magnitude, agravando ainda mais a situação de grupos e comunidades em condições de fragilidade O artigo também contribui para a literatura da área na medida em que analisa os efeitos de superposição de desastres – rompimento de barragem e pandemia – na população mais vulnerável.


1 INTRODUCTION

Major disasters have not been unusual in Brazil. In the past five years alone, two of the biggest technological disasters in the country's history have occurred: the rupture of the Fundão dam in the city of Mariana/MG in 2015, which resulted in the immediate death of 19 people and is considered the biggest environmental disaster ever to have occurred in Brazil (IBAMA, 2015), and the rupture of the Córrego do Feijão dam in early 2019 in Brumadinho/MG. The latter resulted in a sea composed of millions of cubic meters of iron mining tailings sludge, causing the death of 272 people and invading part of the rural area of the municipality, destroying communities and reaching the Paraopeba River.

Unlike mining disasters, the Covid-19 pandemic, the most recent and severe natural disaster that the world has faced, does not have a defined period of occurrence, since it is something that is still happening, much less signal the final number of deaths caused by the disease. Considered a natural disaster (WHO, 2020), the Coronavirus pandemic that emerged in late 2019, in the city of Wuhan, China, in a little less than two months reached other
countries, generating collapses in health services and, consequently, economic destabilization and geopolitical crisis.

The studies on Disaster Risk Management (DRM) are mostly theoretical and conceptual researches, if only scientific productions in English are considered, besides being relatively recent and focusing on disaster preparedness and response, being the recovery and reconstruction of territories in the long term a field that needs the development of empirical knowledge (Gall et al., 2014). Also in this same study by GALL et al. (2014), systemic deficiencies in research on disaster governance are presented, highlighting the predominance of productions coming from authors linked to the area of Geography, Environmental studies, Planning and Development and Public Administration, clearly demonstrating a gap in research that contributes with knowledge on specific sectors of governance, such as Business Administration, Health, Epidemiology and Anthropology.

Returning to the gaps presented by the international literature, perhaps the most important is what Oliver-Smith et al. (2016) have named, in a metaphorical sense, as the "disaster epidemic," pointing to the existence of sets of similar social and economic processes around the world that lead to risk and that stem from the prevailing development model. Authors such as Tierney (2012), UNISDR (2015a; 2015b); Oliver-Smith (2016), Freitas et al. (2016), Fakhruddin et al. (2019) corroborate such a statement, warning about the increasing number of disasters and the relationship with the development model. Freitas et al. (2012) call attention to the data related to floods and inundations around the world, revealing that there is a growing trend in the number of people affected by these events. In general, climate-related events are responsible for the overwhelming majority (91%) of natural disasters that occurred worldwide between 1994 and 2013, with floods and storms alone accounting for 71% of the global total (Wallmeacq; Below, 2015).

Regarding the academic production in the field of Administration about disasters in Brazil, especially regarding the issue of Governance, the numbers are still incipient. When searching for the keyword "Disaster Governance" in the Spell Platform, the main database of journals in the Administration field, there is no record of any article on the subject, the same occurring when using the keyword "Adaptive Governance", another term used in disaster contexts. This situation is repeated in searches using the keywords "Risk and Disaster Management", "Risk and Disaster Reduction", "Sendai Framework" and "Framework for Action of Hyogo". When the searched term is "disaster", we identified only six articles, three of them on issues related to the Tourism area. That is, even with the occurrence of two serious disasters in a period of less than five years (Mariana in 2015 and Brumadinho in 2019) researchers in the field of Administration in Brazil have not engaged in relevant research based specifically on disaster management literature.

This article aims, based on the literature on risk and disaster management and the presentation of the results of the management of the disaster caused by the breach of the tailings dam of a Vale mine in Córrego do Feijão, in the city of Brumadinho, to discuss how vulnerabilities, especially with regard to social inequalities, are linked to disasters and how they are enhanced when disasters occur, further aggravating the situation of groups and communities in fragile conditions. In addition to this introduction, the article addresses the main aspects involving risk and disaster management studies, the Sendai Framework document proposed by the United Nations, and the relationship between disasters and social inequalities. Consequently, it presents the methodological procedures that were used in the research and the results found involving the intertwining between the disaster of the Córrego do Feijão dam failure and the Covid-19 pandemic. Finally, in the final considerations, it seeks to signal how the experience of Brumadinho can bring important lessons for the future and subsidize public policy actions to avoid and/or minimize the consequences of technological tragedies and events classified as being of the sphere of nature.
2. THEORETICAL FRAMEWORK

In this section, the main concepts present in the literature of risk and disaster management, the guidelines of the Sendai Framework for Disaster Risk Reduction, and the relationships between vulnerabilities and social inequalities and the occurrence of disasters will be addressed.

2.1 Conceptualizing disasters

Over the past 50 years the number of people exposed to disaster risks has grown worldwide (Freitas et al., 2016) requiring a systemic understanding of causes and impacts (Freitas et al., 2012; Fakhruddin et al., 2019). Data from the period between 2005 and 2015 records more than 700,000 deaths, 1.4 million people injured and about 23 million people displaced as a result of disasters, with 1.5 billion people affected in various ways (UNGA, 2015).

In a report produced by CRED - Centre for Research on the Epidemiology of Disasters in partnership with UNDRR - United Nations Office for Disaster Risk Reduction, 7,348 disaster events were registered in its database over the last 20 years (2000 to 2019), claiming approximately 1.23 million lives and affecting more than 4 billion people, having generated about 2.97 trillion dollars in economic losses worldwide. Compared to the previous twenty years, there has been a significant increase in these numbers, considering that in the period between 1980 and 1999 this same database recorded 4,212 disasters linked to natural hazards worldwide, generating a loss of approximately 1.19 million lives and affecting more than 3 billion people, causing economic damage totaling $1.63 trillion (CRED, UNDRR, 2020).

With regard to disasters related to mining dams, according to data from Wise - World Information Service on Energy, in the last five decades alone there have been around 37 disasters in dams of this type worldwide, classified as very serious, with the Samarco dam collapse in the city of Mariana being the largest of all, if we consider the amount of material released into the environment and the territorial extent of the damage caused (Freitas et al., 2016). In another paper, also analyzing disasters in mining dams, Freitas and Silva (2019) point out that, according to the World Mine Tailings Failures (WMTF) database, an organization that monitors events that have occurred in dams since 1915, in a little over 100 years there has been a total of 356 records, in which an increase in accidents is noticeable from the 1960s and a growth in serious and very serious failures from the 1980s, most of which occurred in peripheral and semi-peripheral countries of the global economy.

According to CRED studies, disasters can be defined as “a situation or event that overwhelms local capacity, necessitating the request for external assistance at the national or international level; an unforeseen and frequent sudden event that causes great damage, destruction and human suffering” (Below et al., 2009; p.16). In the scope of work developed by CRED researchers, there are two groups of disasters: natural disasters (biological, geophysical, climatological, hydrological, meteorological and extraterrestrial) and technological disasters (industrial accidents, transportation accidents and miscellaneous accidents), the latter caused directly by human actions. A third category of complex disasters has been added to include specific events, such as famine, that are not directly linked to a natural threat (EM-DAT, 2020).

It is also possible for a succession of events to occur, in which a natural disaster triggers other and/or technological disasters, thus creating a cascading effect of disasters (Wallemacq; Below, 2015). Shaluf (2007a) mentions the existence of so-called hybrid disasters, which result from both human error and natural forces. The works of Petrova and
Krausmann (2011) and European Commission (2012) cite so-called *Natech disasters*, which are technological accidents triggered by natural events, such as earthquakes, floods, storms, lightning, landslides, etc. A notorious example of a *Natech* (and cascading) disaster occurred in March 2011, when an earthquake off the coast of Japan generated seismic waves that resulted in a tsunami that hit the Fukushima nuclear power plant (Wallemacq; Below, 2015; Petrova; Krausmann, 2011).

Disasters, in general, are commonly associated with natural disasters, such as earthquakes, tsunamis, volcanic eruptions, cyclones and hurricanes. However, as clarified by Tominaga (2009), it is possible to name natural disasters when natural phenomena affect areas or regions inhabited by man, causing damage. In this sense, natural disasters also include phenomena such as landslides and floods that may occur naturally or induced by man, as a result of their lifestyles and production. Wallemacq and Below (2015), in a report on the human cost in natural disasters, state that events of this type affected all continents of the world in the period 1994-2013, with Asia being the most stricken area in terms of frequency, total victims and people affected. Between 2000 and 2019, there were 510,837 deaths and 3.9 billion people affected by 6,681 climate-related disasters (CRED, UNDRR, 2020).

According to EM-DAT data, since the 2000s weather-related disasters have accounted for about 90% of the 7345 recorded natural disasters, with floods occurring five times more frequently in the last decade compared to 1980, with more than 3,000 major events since 2000 (Guha-Sapir; Scales, 2020). Considering the severe socioeconomic and health impacts caused by floods, CRED states that the control of such events should also be considered a development issue and not just a humanitarian concern, highlighting the importance of cost-effective prioritization of mitigation measures in poor regions at high risk of flooding alongside poverty prevention programs (Wallemacq; Below, 2015).

Freitas et al (2014) point out that the signs that show that natural disasters tend to increase in frequency and severity in Brazil have been manifesting themselves through various events, also climatic, such as major periods of drought and heavy flooding, in addition to the arrival of cyclones in the southern region of the country. According to the authors, in a survey conducted between 1991 and 2010, 31,909 disasters were registered in the country, affecting the lives of more than 96 million people and forcing more than 6 million to leave their homes, besides altering the environmental situation in the areas where they occurred and creating new risk exposure scenarios.

Shaluf (2007a) states that man-made disasters - technological disasters - are those catastrophic events that result from human decisions. Sudden man-made disasters include structures, buildings, and mines that collapse, occurring independently, without any external force. In addition, air, land and sea disasters are also considered man-made disasters. The impact of technological disaster is not limited to factories, and can expand to surrounding neighborhoods (Shaluf, 2007b).

From an anthropological perspective of disasters, Narvaez et al (2009), when analyzing what they call "socio-natural and anthropogenic physical events," i.e., those that result from human actions, state that unlike threats and natural disasters, this type, technological, presents two forms of human participation in its occurrence: on one hand, in relation to the concretization of the event itself, caused to a greater or lesser extent by human action, and, on the other hand, with reference to the exposure of the population and their ways of life in conditions of vulnerability to these phenomena.

Technological disasters, insofar as they involve anything from chemicals used by industries to equipment with radioactive material, also present serious risks to the environment and public health:

The effects of technological disasters involve from environmental contaminants, dispersed and accumulated in different compartments (air, water, soil, etc.); multiple
forms of use and human occupation that use these ecosystem services; to the effects on health - subclinical effects, development of disease and illness or even death - depending on the harmfulness of the pollutant, the intensity and time of exposure and individual susceptibility. (Silva et al, 2020; p. 22)

The General Classification of Disasters (EM-DAT, 2020) presents three subgroups of technological disasters: industrial accidents, transportation accidents, and miscellaneous accidents. In industrial accidents, types of disasters such as chemical spill, collapse, explosion, fire, gas leak, poisoning, radiation, oil spill, and others are found. In transportation accidents, air, road, rail, and water disasters are involved. Finally, miscellaneous accidents include collapses, explosions, fires, among others.

2.2 Risk and Disaster Management and the Sendai Framework

The Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) is a document produced during the 3rd World Conference on Disaster Risk Reduction (WCDRR) held in Sendai (Japan) and was adopted in March 2015 by representatives from 187 United Nations (UN) Member States (Unga, 2015).

The proposal of the Sendai Framework comes at a time when discussions are intensifying about the sustainability of the current development model, which is based on consumption and promotes environmental imbalances, with an urgent need to pay special attention to climate issues and the increase in social inequality (Munene et al, 2018). As mentioned in the previous session, it is notoriously present in the literature on disasters and places of risk their relationship with poverty, gender (in this case, female), childhood and vulnerability (UNISDR, 2015a, 2015b; Freitas et al, 2012; Fakhruddin et al, 2019). In this sense, the proposal of Disaster Risk Reduction (DRR) should be directly linked to the Sustainable Development agenda and the Millennium Development Goals (MDGs), an integral component of Development Plans and Poverty Eradication Programs at the global level (Khamis; Osorio, 2013).

According to Freitas et al (2014), in 2014, with the proposed post-2015 global agendas, the Millennium Development Goals (MDGs) were replaced by the Sustainable Development Goals (SDGs). The set of SDGs - Sustainable Development Goals (SDGs) for 2015-2030, present in the "2030 Agenda for Sustainable Development", along with the Sendai Framework represent the comprehensive plan of action in the world for social inclusion, environmental sustainability and economic development, along with disaster risk reduction (Silva; Freitas; 2020).

Considering the data on disasters and the need to enhance the protection of people and resources, the Sendai Framework proposes as its main objective to achieve the result of "substantial reduction in disaster risks and in the loss of lives, livelihoods and health, as well as economic, physical, social, cultural and environmental assets of people, businesses, communities and countries" (Unga, 2015; p.7) in the period between 2015 and 2030. To achieve these results, seven global goals were agreed upon:

1) Substantially reduce global disaster mortality by 2030, with the goal of reducing the global average mortality per 100,000 population between 2020-2030, compared to 2005/2015; 2) Substantially reduce the number of people affected worldwide by 2030, with the goal of reducing the global average per 100,000 inhabitants between 2020- 2030, compared to 2005/2015; 3) Reduce direct economic losses from disasters as a proportion of global gross domestic product (GDP) by 2030; 4) Substantially reduce disaster damage to basic infrastructure and the disruption of basic services, such as health and education facilities, including by increasing their resilience by 2030; 5) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020; 6) Substantially intensify...
international cooperation with developing countries through adequate and sustainable support to complement their national actions to implement this framework by 2030. Substantially increase the availability of and access to early warning systems for various hazards and disaster risk information and assessments for the people by 2030. (Unga, 2015; p. 7-8)

The proposal of Disaster Risk Management (DRM) presented by the Sendai Framework is based on strengthening actions and measures of disaster prevention, as well as increasing preparedness for response and recovery from disasters that may occur. To achieve the results, the document stresses the need for the commitment and involvement of political leaders from all countries, since the state has a central role in this process. Hilhorst (2003) and Unga (2015) highlight the government's responsibility in the occurrence of disasters, considering it an implicit violation of a social contract in which states must protect their citizens from situations of vulnerability.

The Sendai Framework seeks to propose actions that effectively contribute to the achievement of the expected results, including those involving governance actions. Based on the perception that there is a need for action focused on the intra and intersectoral levels, promoted by the states, at levels that involve from local actors and actions to the regional, national, and global levels (Unga, 2015), Munene et al. (2016) propose four priority actions, presented in Figure 1.

Figure 1. Expected outcome of the Sendai framework, core objective, and priorities for action.

Source: Munene et al. (2016)

According to Narvaez et al. (2009) disaster risk management can be broadly considered to be:

(...) a social process whose ultimate goal is the prediction, reduction and permanent control of disaster risk factors in society, consistent and integrated for the achievement of guidelines for human, economic, environmental, territorial and sustainable development. (Narvaez et al, 2009; p 33)
Risk management and disaster prevention are the main priorities of the Sendai Framework, which aims to direct the focus of actions in order to prevent the occurrence - and damage - of a disaster. In addition, there is a gap in the literature on the subject regarding the knowledge about the processes and experiences of recovery, the phase that begins after the occurrence of the event and the immediate responses of territories affected by disasters. Authors such as Raju (2013) and Raju and Becker (2013) state that recovery is considered the least researched phase in risk and disaster management. Gall et al (2014) point out that most research focuses on disaster preparedness and responses (5th phase), that is, of actions to be taken at the time of occurrence of the events.

2.3 Disasters and social inequalities

Disaster literature has warned about the strong relationship between poverty and disasters, with vulnerable households being the hardest ones hit (Freitas et al., 2012; Khamis; Osorio, 2013; Fakhruddin et al., 2019; UNISDR, 2015a; 2015b; Tselios; Tompkins, 2020), with women and children the ones much more affected (Unga, 2015). Vulnerabilities are considered to be conditions determined by physical, social, economic, and environmental factors or processes that result in the increased susceptibility of a community to the impact of hazards (UNDRR, 2020b). In the same vein, Adams et al (2022) state that social vulnerability in disaster contexts involves the characteristics of a population and the physical, social, economic, and environmental factors that may make it more susceptible to adversity and the ability to anticipate, cope with, withstand, and recover from disaster events.

Contributing to an understanding of the factors surrounding disasters and the monitoring of these events, the Centre for Research on the Epidemiology of Disasters (CRED), a non-profit organization based in Brussels, Belgium, has been active for over 40 years in the areas of international disaster and conflict health studies, with activities involving relief, rehabilitation and development. By providing free access to the comprehensive database of emergency events to users on behalf of academic organizations, universities, non-profit organizations, and/or international public organizations (United Nations agencies, multilateral banks, other multilateral institutions, and national governments), CRED researchers seek to investigate the broader aspects of humanitarian crises and emergencies, addressing socioeconomic, gender, and environmental issues, with a focus on the special needs of vulnerable groups such as women and children (EM-DAT, 2020). Poor and developing countries also encounter fundamental and systemic limitations when faced with disasters, such as the presence of ineffective governments, inequality and lack of resources, especially at the local level, and a lack of trust that hinder effective governance (Djalante et al., 2011). Added to this is the fact that the possibility of government and private actors having interests, tasks, and goals that may be unknown to other actors and even conflicting (Quarantelli, 1997).

The World Health Organization (WHO, 2020) states that in a short time a localized outbreak of Covid-19 in China evolved into a global pandemic that, according to the Organization, has three defining characteristics: speed and scale, severity, and social disruption. The speed and scale are related to the disease's rapid worldwide spread and high capacity for propagation, promoting the collapse of even the most organized health systems. Severity has to do with the harshness of the cases presented, in which 20% of the total are considered severe or critical, with a crude case fatality rate of approximately 3% of clinical cases, increasing this rate in older age groups and in those with certain underlying conditions. Social disruption involves social and economic disruption, given that it has been promoting...
severe impacts on health and social care systems and the measures taken to control the pandemic result in profound social and economic consequences (WHO, 2020).

The main measure to prevent the spread and transmission of the virus is social isolation, in some cases quarantine, which is considered the most effective method to contain highly infectious diseases in large populations (Botes; Thaldar, 2020). For protection and control measures, entire cities have suspended and still live under threat of suspension of their productive and commercial activities, in addition to issuing express orders that citizens avoid crowds and social contact. The result of the simultaneous occurrence of a public health crisis and the need to suspend a large part of economic activities can generate social and economic impacts that the world will take more than a decade to recover from (Djalante et al, 2020a).

In a document released in March 2020 with the UNDRR's initial strategies to combat Covid-19 emphasizes analysis, knowledge exchange, partnership and advocacy as a contribution to the UN's efforts to respond to the global pandemic. Focusing on the need to protect the most vulnerable and the multi-stakeholder approach to ensure the involvement of all levels of society, four strategic objectives are defined appropriately aligned with the Sendai Framework and UNDRR goals:

1) Evidence and learning on prevention, reduction and risk management of Covid-19 should be generated and disseminated for improvement of policies and practices; 2) Biological risks (pandemics) are integrated into disaster risk reduction and local Disaster Risk Reduction strategy development planning and programming; 3) UNDRR partnerships are leveraged and key stakeholders are supported in relation to the impacts of Covid-19, in addition to supporting countries to recover with a focus on socio-economic impacts on vulnerable groups, and; 4) Information and advice should be disseminated to key audiences to promote actions to prevent the spread of Covid-19, mitigate its socio-economic impacts and support countries in their recovery. (UNDRR, 2020a; p. 1-2)

As can be seen, the attention to groups and countries in vulnerable situations and that have been suffering greater socioeconomic impacts are reinforced in two of the four strategic objectives set by the UNDRR to respond to the pandemic. Studies conducted on Covid-19 confirm the relationship between poverty, vulnerability, and contamination. Botes and Thaldar (2020), Djalante et al (2020a), James (2020) and Djalante et al (2020b) highlight that economically vulnerable groups, people residing in remote and disadvantaged areas with little access to health care, are among the main affected by the pandemic.

In an attempt to analyze and prospect the economic impacts that may be generated by Covid-19, Baker et al (2020) stated that as early as April 2020, the unemployment rate in the U.S. had already increased substantially compared to February, when the country had the lowest unemployment rate in 67 years. Soon after taking office, the American president Joe Biden determined the intensification of vaccination campaigns and announced a plan to rescue the country's economy aiming to prevent hunger and reduce poverty (Valor, 2021).

In the case of Brazil, despite the existence of the Unified Health System (SUS), a public policy that has been fundamental in confronting the pandemic, some primordial actions for the control of Covid-19 run into structural deficiencies suffered by a large part of the Brazilian population. In addition to the huge contingent of people living in conurbations and slums, when the fight against Covid-19 is observed:

(...) some measures are unfeasible for a large part of the Brazilian population that suffers from the absence/poorness of sanitation and access to water, lives in small dwellings, with a large number of people, with great proximity between residences, few windows leading to little ventilation and high humidity inside the houses, constituting very favorable scenarios for the survival of the virus and its
dissemination, contributing to the intensification of its spread. Covid-19 presents new risks and intensifies the existing ones. (Freitas et al., 2020; p. 35)

The configuration of the scenario imposed by Covid-19, which accumulates a systemic crisis in public health and the need for paralysis of the economy, which consequently generated a geopolitical destabilization, is unprecedented in recent history (Djalante; et al., 2020a; McDonald et al, 2020). This is a worldwide disaster that combines national and global processes (Freitas et al, 2020) and that, although references such as the Spanish flu offer some parameter for health-related mortality prospections, the same is not true for the economy (Baker et al, 2020).

3. METHODOLOGICAL PROCEDURES

The context of Brumadinho after the Vale dam disaster and the circumstances of the year 2020 demanded the use of more than one methodological technique, as well as the availability of tools that were conducive not only to the type of data collection envisaged, but to the very feasibility of the research, since the social isolation resulting from the Covid-19 pandemic imposed restrictions on going into the field and direct contact with people.

The research was qualitative in nature, and the method used was the case study, defined by Yin (2005) as a research strategy that allows investigating contemporary phenomena within their real-life context. For the data collection, done from January 2019 to November 2020, documentary research, participant observation, and interviews were conducted. The documentary research was done through newspapers and the participant observation was carried out in community events, WhatsApp groups, and chats of courses in which citizens affected by the disaster and who had been studying about the mining theme were participating.

The structure of the interviews was carried out seeking to converge the search for information, the adaptation to the local reality, considering recent events and the optimization of the approach, so as not to promote distress on the part of the interviewees. Laville and Dionne (1999) endorse this need for adaptation when they point out that the difficulties encountered in the interviews are equal to the complexity of the situation they wish to circumscribe, and the researcher must demonstrate great skill if he wishes to lead his interlocutor to the essential, preserving the spontaneity and personal nature of his answers.

Due to the limitations imposed by the pandemic, the interviews were conducted and recorded using the Google Meet platform (with the representative of the Casa dos Conselhos) and WhatsApp (with citizens and representatives of civil society organizations). For the interviews conducted by WhatsApp, the questions were presented to the interviewees who, through the application itself, confirmed their acceptance and authorization to use the information for research purposes, recording their answers in written text or audios. These answers were transcribed and systematized in the research files.

The interviews were conducted with three actors involved in the dynamics of post-disaster management: a) the "public sector," with a representative of the Casa dos Conselhos de Brumadinho secretariat, b) "civil society organizations," with representatives of three Mobilization and Articulation groups formed after the dam broke, and c) "ordinary citizens," residents of Brumadinho, affected by the disaster to a greater or lesser degree. In total, ten people were interviewed, who did not have direct losses of relatives, but who were affected by the disaster. For the selection of people to be interviewed, the snowball technique was used, classified by Noy (2008) as a procedure in which the researcher accesses interviewees through contact information provided by other informants.

The interview with the representative of the Casa dos Conselhos secretariat aimed to investigate the dynamics of the activities carried out by civil society organizations from the
public sector's point of view. Based on a semi-structured script, questions were presented related to the entry and exit flow of NGOs in the city after the dam failure, the profile of the entities that have settled in the region, the type of actions and activities carried out, registration and formalization with the councils linked to the Casa dos Conselhos, and, most importantly, the general evaluation of the work done by these organizations with the local population.

In the interviews conducted with representatives of the mobilization groups and with citizens, one of the questions asked respondents to make an assessment of the actions of the company Vale during the pandemic in relation to assistance to affected people and other issues involving the dam failure. Since it was a question that intended to provide the interviewee with a wide range of answers, allowing the most latent elements to come to light, it opened up precedents for answers that contemplated different aspects involving Vale. Chart 1 presents a brief profile of the people interviewed, with respondent 9 representing two civil society organizations.

<table>
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<tr>
<th>Interviewee</th>
<th>Sex</th>
<th>Education</th>
<th>Participation Category</th>
</tr>
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<td>Citizen</td>
</tr>
<tr>
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<td>Higher education complete</td>
<td>House of Councils</td>
</tr>
</tbody>
</table>

Table 1. Profile of the interviewees
Source: Prepared by the authors

Among the most frequently mentioned topics in the interviewees' answers, which served as an empirical basis for the discussion proposed in this article, were the delay in repairing damages, the disregard for the people affected by the dam's mud (without human losses, but with material losses and damages to their sources of work and income), and the company's conduct during the Covid-19 Pandemic period.

4. DESCRIPTION AND ANALYSIS OF RESULTS

Based on the data and information collected during the research carried out in the municipality of Brumadinho, this section will address the analysis of the results found and their relation to the literature on risk and disaster management and vulnerabilities, especially social inequalities.

4.1 The context of Brumadinho: one scenario, two disasters

In January 2019, the municipality of Brumadinho was marked by the rupture of the tailings dam of the mining company Vale, in Córrego do Feijão, which brought as main consequences the death of 272 people and numerous social, economic and environmental damage to the population of the city and several communities located on the banks of the
Paraopeba River. As occurred after the Samarco disaster in 2015, in the city of Mariana, in addition to human and material damage, there was also the need for displacement of many families from their original place of residence (Rocha, 2021). Soon after the dam burst, a sequence of actions and activities characteristic of a post-disaster context began in the municipality at the local level, in which the transition between the stages of response to the disaster and recovery of the territory had been planned.

However, if in the first half of 2019 the region had been marked by an intense flow of people and activities, what had occurred a year later turned out to be the opposite: the social isolation required by the measures to combat and prevent Covid-19 brought the movement to a halt, suspended the face-to-face actions of mobilizing local groups with the goals of recovery and struggle for the rights of those affected, and isolated people in their homes.

According to the information gathered during the research period, the recovery stage of the Vale disaster had not been implemented as expected by the year 2020. The work of AEDAS - Associação Estadual de Defesa Ambiental e Social, the non-governmental organization chosen by the people affected in Brumadinho to act as an Independent Technical Advisor in the municipality, was initiated partially and remotely (through the use of communication tools), as were most of the activities of the mobilization and articulation groups in the municipality. Similar to what happened in most cities in Brazil and around the world, the actions that took place in Brumadinho during most of the year involved risk management and responses to the pandemic. By the end of July 2021, the city counted more than 3,700 cases of contamination and 84 deaths (Minas Gerais, 2021).

Freitas et al (2020) state that Covid-19 combines the characteristics related to a disaster and should be treated as a global disaster. It is a type of natural disaster considered by the Sendai Framework in the category of biological hazards (UNDRR, 2020a). In such contexts, a coordinated response is extremely important (Djalante et al, 2020b) and intra-governmental and inter-sectoral integration are considered fundamental not only for the development of immediate response measures and mitigation of current risks, but also for the later phases, in which it will be necessary to rehabilitate, recover and rebuild, taking into account the existence of future risks and their prevention (Freitas et al, 2020).

In this sense, the results of the research conducted in Brumadinho pointed out that the disaster caused by Vale presented weaknesses in the governance system, demonstrating the structural difficulty of the municipality in dealing with situations related to disaster management. Even though the centrality of the municipal government in the governance of the fight against the pandemic has been evident, the presence of the damage from the dam disaster and Vale's own actions in the municipality contributed to the intertwining of the two disasters, increasing the vulnerabilities of the local population. Vulnerabilities involve conditions determined by physical, social, economic and environmental factors or processes that increase the susceptibility of an individual, community, assets or systems to the impacts of risks (UNDRR, 2020b).

As reported in the interviews and denounced by journalistic sources (Brasil de Fato, 2020; Hoje em Dia, 2020), Vale and the companies providing services to the mining company continued working during the peak periods of the Covid-19 pandemic, despite safety measures and social isolation. This situation, besides not collaborating with the risk management and prevention measures that were adopted worldwide, promoted the constant ingress and egress of people from outside the municipality, intensifying the risks of transmission. Even the works related to the disaster of Córrego do Feijão were presented as a contributing factor in the increase in the number of cases, as found by newspapers, since they promote the constant arrival of people to the city in search of jobs in the post-disaster actions.

Milanez et al (2019), using census data, conducted a survey about the population affected by the rupture of the Vale dam, contemplating areas where there was a higher
concentration of passage of the tailings, such as Parque da Cachoeira and Córrego do Feijão, and found that, if compared to the rest of the population of Minas Gerais and Brumadinho, these communities had a profile of absolute poverty or even low monthly income, with values below one minimum wage, demonstrating "both a racial correlation, specific to environmental racism, and income, which express the existing environmental inequality" (p.80). In other words, people who were already in a situation of social vulnerability before the dam burst and were directly affected by the disaster, becoming dependent on the emergency aid provided by Vale, became even more exposed and fragile as a result of the company's actions during the Covid-19 pandemic.

Reinforcing the existing link between inequalities and disasters, studies conducted on Covid-19 confirm the relationship between poverty, vulnerability, and contamination. Botes and Thaldar (2020) and Djalante et al (2020a; 2020b) highlight how economically vulnerable groups, people living in remote and disadvantaged areas, with little access to health care, are among the main affected by the pandemic. According to the WHO document (WHO; 2020, p. 3), the main measure of Covid-19 affects "disproportionately disadvantaged groups, including people in poverty, migrants, internally displaced persons, and refugees, who most often live in overcrowded and precarious areas, and rely on labor for subsistence." Such inequalities are evident even in vaccination processes, in which rich countries have been able to purchase more than 60% of the vaccine supply even though they house 16% of the world's population (Dominguez, 2021).

According to data from IBGE (2020), in the third quarter of 2020 there were 13.7 million unemployed people in Brazil (14.6% of the population aged 14 years or older), with an increase of 3 million people in January 2021. Data from IPEA also register this increase, which reached 13.7% of the population in July 2020, justified by the retraction of activity in the labor market due to isolation measures in the face of the pandemic. In this sense, Vale's collaboration to maintain high rates of contamination by Covid-19 in the city and, consequently, the need for social isolation measures to contain the spread of the disease are also factors that increase vulnerability.

It is important to highlight that, unlike the vast majority of municipalities in the country, Brumadinho experienced a good economic situation during the pandemic, due to three factors: an agreement made with Vale to compensate for the drop in revenue, the emergency aid paid by the mining company to the population and the arrival of companies for the repair actions (Agência Brasil, 2021). However, there is a dangerous scenario in this situation, since these supports to the local economy are temporary and Vale's mining activities, the main productive and economic means of the municipality, will hardly have the same level of production that existed before the disaster.

Another example of the differentiated impacts that disasters cause on the poorest population and that can be easily perceived in the Brazilian scenario also involves the lack of access to basic resources, such as basic sanitation and drinking water. Such resources, in fact, are configured as fundamental sanitary conditions for the containment of the pandemic. In this sense, highlighting more elements of vulnerability potentialization, one of the main aspects generating insecurity in the population of Brumadinho, present in the interviews and which was also being frequently discussed in the WhatsApp groups monitored during participant observation, involves the contamination of the Paraopeba River, which is part of the important watershed of the state of Minas Gerais and bears the same name, by the tailings of the dam.

Disasters such as the rupture of the Córrego do Feijão dam "cause damages, in short and long term, and can extend for many kilometers beyond the place of origin, affecting a large number of communities, especially regarding the contamination of the river water and its surroundings (Melo, Medeiros and Teixeira, 2022; p.41). This fear of the population of Brumadinho about the water of the Paraopeba River is in line with what had been pointed out

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by the work of Melo et al (2022) soon after the dam burst, highlighting the increased vulnerabilities of the local community. As denounced by the residents of the MST (Landless Workers Movement) camp, in addition to the fact that the water is not used for planting and feeding animals, residents of the municipality and other affected areas often share photos of the water used in their homes showing the color of clay, as well as newspaper reports with information about the contamination of the water.

When commenting on Vale’s actions during the pandemic, interviewee 7 cites existing reports by residents of São Joaquim de Bicas, one of the towns affected by the disaster due to contamination of the Paraopeba River, where there are episodes of inefficiency in the water supply that is performed by the company as one of the mandatory actions of assistance to affected people. As warned by Freitas et al (2020), infectious and parasitic diseases related to poor living conditions and lack of sanitation did not stop occurring during the pandemic, signaling new risk scenarios and the worsening of health situations, since the response system of the health sector is overloaded by the demand for care generated by Covid-19.

Another aspect related to the Covid-19 pandemic that can compromise future recovery actions in Brumadinho and that aggravates the vulnerabilities of the population affected by the Vale disaster involves the area of mental health. The sum of stress episodes caused by successive exposure to risks and the constant experience of human losses are factors that directly impact the mental health of the affected population. In this sense, it is worth adding that the WHO, in a document on strategies related to Covid-19, released still in April 2020, already pointed mental health as one of the areas of vulnerability with high priority for attention by support systems. Djalante et al (2020b) also emphasize how the resilience of nations and communities, both in relation to the economy and social infrastructure as well as physical and mental health, will be critical to overcoming and recovering from the pandemic.

One of the most delicate cases of vulnerability among those affected by the dam disaster involves part of the Pataxó Há Hã Hae Indians, led by chief Háyó and his wife Ægohó, who after the Vale disaster left the village located in Brumadinho and settled in the Taquari region, a conurbation of Belo Horizonte. During the pandemic, the group of Pataxó people has been subjected to precarious situations and has needed the support of groups and institutions such as the Public Ministry and Vale itself to provide assistance to the health of these indigenous people. Articulation movements that were formed in Brumadinho after the Vale disaster have been trying to help the indigenous people to move out of the settlement where they have been living, with denunciations being made in the press about the vulnerability to which they have been subjected, since three or four families are living in the same shack.

Finally, it is worth noting that from the data collected during the research and the literature consulted on the subject, we suggest the possibility that what has been happening in the city of Brumadinho is an overlapping of disaster risks, a rare type of case in which the same territory is hit by two disasters (natural and/or technological) in a short period of time, affecting the same group of people or populations and whose damage and risks caused by both disasters are intertwined and potentiated, causing extreme fragilization of vulnerable communities.

5. FINAL CONSIDERATIONS

The Covid-19 pandemic highlighted the need to bring disaster management to the center of the discussions, since it is not just a local crisis, as in the case of the Vale dam collapse in Brumadinho, but a worldwide disaster. Its impacts have been affecting countries on all continents and in several areas, generating collapses in public health systems,
destabilizing economies and accentuating social inequalities, besides promoting intense political conflicts and internal crises.

The main intention of this article was to discuss how vulnerabilities, especially with regard to social inequalities, are linked to disasters and how they are enhanced when disasters occur, worsening the situation of groups and communities in precarious conditions. In other words, to demonstrate, based on the situation that has been experienced in Brumadinho, how disasters are not isolated and accidental facts, but processes resulting from economic, political, and social constructions. In this sense, this study has shown how the experience of Brumadinho has confirmed that recovery from a disaster is difficult to achieve and makes the affected population even more vulnerable and exposed to risk, increasing fragilities and inequalities. As highlighted, even the works for the recovery of the city were aggravating in the control of contamination rates in Covid-19, demonstrating how complex and delicate is the monitoring of new risks in contexts already affected by previous disasters.

As shown, the case of Brumadinho is significant and brings with it the portrait of a scenario that signals potential risks for other places, especially in Brazil, because it portrays the imminent possibility of occurrence of other cases of overlapping disasters of large proportions, such as the one that occurred in the city of Minas Gerais. Given that the Covid-19 pandemic has been increasing social vulnerabilities at various levels, ranging from difficult access to public health services to high unemployment rates and a significant increase in the population in poverty, exposure to the risks of new disasters, whether natural or technological, has become an increasingly reality for the populations.

The situation of the mining town also proves the procedural construction of disasters and how the current model of economic and productive development needs to be rethought - and modified. Although it has not been the focus of this article, the responsibility of the Vale company and mining in the potentiation of the vulnerabilities of the municipality cannot be ignored, since the disaster caused by it in Brumadinho and region exposes the result of an industrial model that has been destroying territories, killing people, and promoting environmental damage that will take decades, perhaps centuries, to recover.

From the environmental unsustainability that finds in global warming and the devastation of the Amazon region its greatest warnings to the continuous increase in the exposure of populations to risks, intensifying the search for alternative economic models and encouraging ecologically and socially conscious lifestyles has proven to be, above all, a matter of survival of humanity itself. Among the main lessons to be learned from recent disasters, the construction of resilient societies, which includes everything from awareness of the environmental crisis to the reduction of social inequalities, is the one that emerges as a necessary learning process to make the future of humanity viable.

The analysis of the impact of the overlapping disasters - dam failure and Covid-19 pandemic - on the increase of inequalities and vulnerabilities of the population contributes to the literature in the area by showing how inadequate disaster management intensifies local weaknesses. It also contributes to increase understanding of the need for efforts to act in a preventive manner so that new disasters are not repeated. The criticism of disaster management and the negligence in disaster prevention pointed out by the article can serve to guide the decisions of the public authorities to develop prevention and damage reduction actions. At the same time, the paper suggests the need for studies to broaden the analysis of the impact of these events on the mental health of the population, the economic effects on the activities developed by the communities living along the river banks, and the process of productive and economic revitalization of the city of Brumadinho.
REFERENCES


European Commission.(2012) Natech Accidents When Natural Disasters Trigger Technological Accidents; European Commission: Ispra, Italy.


