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ANALYSIS OF METHODOLOGICAL INNOVATIONS IN THE MUNICIPAL RISK REDUCTION PLANS, 2020-2021, OF THE MUNICIPALITIES OF SÃO BERNARDO DO CAMPO AND FRANCO DA ROCHA, STATE OF SÃO PAULO, BRAZIL

ANÁLISE DAS INOVAÇÕES METODOLÓGICAS NOS PLANOS MUNICIPAIS DE REDUÇÃO DE RISCOS, 2020-2021, DE SÃO BERNARDO DO CAMPO E FRANCO DA ROCHA, ESTADO DE SÃO PAULO, BRASIL

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Abstract:
This paper present qualitative and quantitative analysis of the methodological innovations implemented in the Municipal Risk Reduction Plans (MRRPs) of São Bernardo do Campo and Franco da Rocha, in the period from 2020 to 2021. One of the main innovations was the incorporation of the evaluation of indicators of social vulnerability on a detailed scale. Pre-field preparation methods were also analyzed using geographic databases, integration with drone overflight for oblique aerial photos, and intervention typologies. Innovations in terms of communication and information are also discussed, through collaborations with municipal departments and communities, workshops, bulletins, and public hearings.
Keywords: disasters, landslides, floods, vulnerability, risk.

Resumo:
Apresenta-se uma análise qualitativa e quantitativa das inovações metodológicas implementadas nos Planos Municipais de Redução de Riscos (PMRRs) de São Bernardo do Campo e Franco da Rocha, no período de 2020 e 2021. Uma das principais inovações foi a incorporação da avaliação de indicadores de vulnerabilidade social em escala de detalhe. Também foram verificados os métodos de preparação pré-campo por meio de análises de bases de dados geográficas, integração com sobrevoo de aeronaves remotamente pilotadas para imagens aéreas oblíquas, e tipologias de intervenção. São discutidas também as inovações em termos de comunicação e informação, por meio de colaborações com departamentos municipais e com as comunidades, oficinas, boletins e audiências públicas
Palavras-chave: desastres, deslizamentos, inundações, vulnerabilidade, risco.

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1. Introduction

The occupation of environmentally fragile areas by low-income families characterized Brazilian urbanization, as in many other countries, especially the poorest or developing ones (Groeschl; Noy, 2020). The geographic sites most prone to occupation were appropriated by the real estate market and provided with urban infrastructure, forming a feedback loop between the accumulation of real estate capital and exclusionary territorial planning (Villaça, 1986). This pattern of urbanization was accentuated by the inconsistency of housing policy in guaranteeing Social Interest Housing (SIH) to low-income families (Bonduki, 2014). Thus, urban peripheries were consolidated, in such a way that the urbanization of precarious settlements became indispensable for housing policy and urban planning (Cardoso; Denaldi, 2018).

The first local public policies for the urbanization of slums emerged amid the redemocratization of the Brazilian State in the 1980s (Bonduki, 2014; Cardoso; Denaldi, 2018), some of them specifically focused on risk management (Nogueira, 2002). At the federal level, slum urbanization programs only gained greater importance in housing policy after the creation of the Ministry of Cities (MCid) in 2003. At that time, the "Prevention and Eradication of Risks in Precarious Settlements" was established as a specific action of the Program for the Urbanization, Regularization and Integration of Precarious Settlements, and one of its main activities was to support the development of Municipal Risk Reduction Plans (MRRP) (Brazil, 2006).

Federal Law 12.608/2012, which established the "National Civil Defense and Protection Policy," and subsequent federal programs, innovated by proposing interfederative public policies that evolved from "disaster response" to "disaster prevention" (Nogueira et al., 2014; Nogueira; Canil, 2018a). In 2019, the Ministry of Regional Development (MRD) (which took over the functions of the Ministry of Cities after its extinction in the same year) signed a Technical Cooperation Agreement with the Federal University of ABC (UFABC) to prepare the MRRPs for Franco da Rocha and São Bernardo do Campo. The methodology and preparation of the MRRPs for both municipalities were developed by the Risk Management Laboratory (LabGRis), which brings together researchers, professors, and undergraduate and graduate students from UFABC, from an interdisciplinary and multidisciplinary perspective.

Since 2014, LabGRis has carried out several teaching, research and extension actions in the areas of social construction of risk (Canil et al., 2022), risk management on local and regional scales (Nogueira et al., 2014) and risk mapping (Sulaiman et al., 2022), including the

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Geotechnical Map of Suitability for Urbanization of São Bernardo do Campo (Nogueira; Canil, 2018b). Based on this accumulated experience, LabGRis identified the need to introduce elements for measuring social vulnerability in the mapping of areas prone to disaster risk on a detailed scale, proposing a methodological review in the preparation of the MRRP (Nogueira et al., 2018), with the municipalities of Franco da Rocha and São Bernardo do Campo as the sites for applying the developed methodology. The objective of this article is to analyze the methodological innovations present in the aforementioned MRRPs.

The preparation of the MRRP of São Bernardo do Campo and Franco da Rocha (Nogueira; Canil, 2021), for the years 2020-2021, took place during the health emergency caused by the COVID-19 pandemic. The isolation and social distancing measures to contain the COVID-19 virus compromised many activities. such as the field assessments training for the LabGRis team, prior to the assessments for sectorization and risk classification. The assessments for sectorization and risk classification were carried out before the start of COVID-19 immunization, requiring the adoption of strict health protocols during the mapping, so that the time spent by the research team on the mapping was limited, as well as their interaction with local residents, Civil Defense teams and managers of the municipal administration, mainly from the areas of Housing, Urban Development, Environment, Health and Social Assistance, among others.

2. Methodology

The development of strategic plans to reduce the risks identified in the precarious settlements of the two municipalities summarized the results of the risk assessment, the structural alternatives and the costs for their eradication or control, making this analysis compatible with current public policies, especially those related to housing and local urban and environmental planning and development. In addition, taking as a reference the four strategies proposed by UNDRO (1991) for risk management (risk identification/analysis; prevention measures; emergency planning; public information and training), a set of non-structural actions was proposed that would enable the sustainability of the risk management and prevention program. Figure 1 presents the methodological steps for developing the MRRPs of Franco da Rocha and São Bernardo do Campo.

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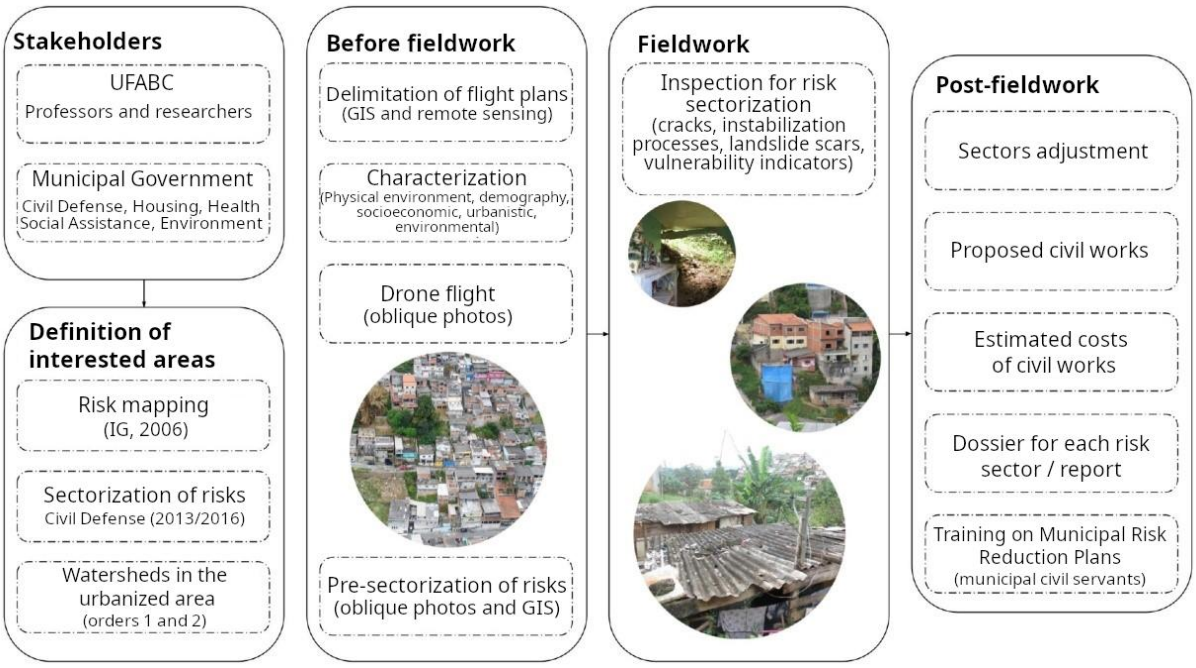
Figure 1. Methodological steps for developing Municipal Risk Reduction Plans (MRRPs)



Source: Adapted from Nogueira e Canil (2021).

Procedures previous to field work

The field activities were planned based on the lists of areas of interest established jointly with the Municipal Governments and validated in joint field inspections, as well as the analysis, in the office, of information about these areas made available by the municipalities or collected from other sources (maps of susceptibility to mass movements and flooding, geotechnical suitability for urbanization, MRRPs and mapping of areas prone to risk from previous disasters, geology, geomorphology, hydrography, land use and occupation, indicators of social vulnerability, occurrence records and other information deemed relevant).

Through the analysis of the cartographic material and available images, the areas of interest initially indicated by the municipal governments were better studied, which allowed the readjustment of the areas, either by expanding the limits or inserting new areas, or by eliminating some due to physical characteristics that were not susceptible to the processes mapped.

Focusing on the areas to be mapped, the following maps were prepared to support field activities: an altimetric map with spatialization of vulnerable sectors in previous mappings and occurrences recorded by Civil Defense; a map of suitability for urbanization, only available for São Bernardo do Campo; a slope map, highlighting permanent protection areas of 30m for

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watercourses; maps of the São Paulo Social Vulnerability Index (Índice Paulista de Vulnerabilidade Social - IPVS); a map of susceptibility to mass movements and flooding; maps of occupation density, occupation stage, urban planning and land use (Homogeneous Land Use and Occupation Units / Unidades Homogêneas de Ocupação e Cobertura da Terra - UHCT); a map of urban environmental legislation; a geological map and a geomorphological map. These maps were used to prepare the support sheets for field activities.

Procedures for preparing and executing Flight Plans

The objective of the flights, carried out with the aid of remotely piloted aircrafts – RPAs popularly known as drones, is to obtain low-altitude oblique images. The procedures for preparing the flight plans consisted of analyzing and delimiting the previous list of spatialized areas, using Google Earth software, area by area, using resources such as "Google Street View", elevation profile, historical images and geospatial data, including sectors prone to disaster risk, occurrences of mass movements and elevation contour lines.

This enabled an integrated analysis of each area of interest, contributing to a more accurate definition of one or more flight plan polygons per area. The maps were shared with the management groups of each of the municipalities for product evaluation, and thus the areas that were inspected and mapped were agreed upon. This entire process, including field validation during the overflights, led to the reassessment of the preliminary lists of areas of interest, together with the municipal agents, and therefore changes were made to expand or reduce the mapped areas.

The executive teams analyzed the oblique images, looking for indicators and evidence of noticeable instability (scars or other evidence of instability, ground cuts, water flows, precarious and fragile building situations, concavities, etc.), indicating points to be observed in the field and delimiting pre-sectors for more detailed analysis in the field.

Mapping of risk-prone sectors

The mapping of areas prone to disaster risk related to natural phenomena in the municipalities of Franco da Rocha and São Bernardo do Campo was carried out with the aim of identifying the potential for processes associated with mass movements on slopes (landslides and related processes) and undermining of stream banks in the municipal territories. Table 1 presents the definitions of risk levels for MRRPs, following the standard of Brazil (2007). The

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mapped sectors were all level 2, 3 or 4, since level 1 sectors were not prioritized for the MRRPs.

Table 1 – Classification of risk sectors.

Risk level	**Description (existing conditions maintained)**
1- Low to non-existent	No destructive events are expected to occur over a period of 1-year.
2 - Medium	The possibility of destructive events occurring during episodes of intense and prolonged rainfall over a period of 1 year is low.
3 – High	It is perfectly possible for destructive events to occur during episodes of intense and prolonged rainfall over a period of 1 year.
4 – Very high	It is very likely that destructive events will occur during episodes of intense and prolonged rainfall over a period of 1 year.

Source: Brazil (2007).

In summary, the procedures adopted for planning and carrying out field activities to map areas susceptible to risks consisted of:

a) Carrying out a field inspection in an area of interest, with the support of oblique photos obtained by drone, with a previously planned route and pre-delimited sectorization, in addition to the support form with various information on physical, urban, environmental and social aspects of the area, a printed checklist to guide the investigation and release of information, and a camera to collect field images;

b) Assessing in detail in the pre-appointed sectors or at suggested points, investigating risk-conditioning factors, based on the physical environment, with an emphasis on morphological, geological and geotechnical characteristics, such as the degree of alteration of the substrate, cohesion of the disaggregated material, structure of the rocks and their stability conditions, slope, surface water flows, vegetation cover, erosion grooves and scars from past landslides, degree of soil saturation, among others;

c) Observing human interventions in the occupation of the sector that may contribute to the construction of the risk (for example: cuts and excavations, landfills, dumping of garbage, rubble, landfills, wastewater, sewage);

d) Identifying any potential for instability or slope rupture, especially through observable evidence such as cracks and fissures in the soil or buildings, subsidence steps, erosion grooves and landslide scars, soil saturation, inclination of walls, posts, trees, among others, assessing the stage of evolution of the process (initial, intermediate, advanced, critical).

e) Understanding the entire area subject to the effects of the destructive process, encompassing the area of mass detachment or the rupture point, the area of passage or displacement and the area of accumulation, deposit or burial. This will be the risk sector, which must then be delimited in the printed oblique image;

f) Assessing the level of exposure and weaknesses (vulnerabilities) of each of the buildings or infrastructures included in the sector that are susceptible to risk and the potential for damage due to the identified destructive process;

g) Identifying and characterizing, if possible, observable indicators of social vulnerability;

h) Assessing the situation to define the level of risk in the sector. To do this, the criteria indicated in Table 1 were used;

i) Low to no-risk situations were not sectorized; and

j) Collecting photographic images that illustrate the conditions and evidence observed in the sector (field photos).

Based on the risk identified, analyzed and spatially delimited by sectorization, possibilities of structural intervention (engineering works) and non-structural actions were suggested to reduce the identified risk.

Vulnerability Assessment

In areas of precarious urban settlements, many types of environmental risks can be recorded due to their high vulnerability, determined in most cases by the inadequate form or location of the occupation, the lack of urban infrastructure (drainage, paving, sanitation) and basic services (garbage collection, electrical and hydraulic networks, etc.), and the associated degradation of the environment. This situation leads to accidents of various scales, often resulting in loss of life and injuries and, frequently, in material damage that constitutes a serious impact on the development capacity of the poor population living in these areas.

One of the innovations of the MRRPs under study was the incorporation of the assessment of social vulnerability aspects, which were not usually focused on in previous MRRPs. Vulnerability can be defined as the set of physical, social, environmental, economic and institutional factors that determine the magnitude of damage to a given environment, exposed to a specific threat delimited in space and time. It corresponds to the predisposition to suffer damage or losses (Moura et al., 2019).

Even in rapid risk analyses, it is possible to visually identify elements of vulnerability. Thus, the survey of the following easily observable vulnerability indicators was included in the field protocols (Nogueira et al., 2018):

1 - Elderly, disabled, drug or alcohol dependent residents;

2 - Evidence of construction fragility, structural instability or significant degradation of the building;

3 - Significant accumulation of garbage around the house;

4 - Clear evidence of danger or impact or damage to the home due to a past occurrence, without any observable repair or mitigation measures taken by the resident;

5 - Spatial disorganization and/or excessive density of buildings in the inspected area, affecting surface drainage flows; and

6 - Disorganized discharge of wastewater over slopes.

Indications for interventions

The appropriate type of intervention for each risk-prone sector was selected according to the characteristics of the geological-geotechnical process identified at the site. This implied the need to adapt the understanding of the type of geological-geotechnical process and the intervention chosen, as well as the combination of suggestions for localized works with general interventions proposed for the settlement, urban improvement projects and regularization underway or in the design phase by the municipalities. Simpler, lower cost works that are more compatible with the municipalities' managerial and financial capacity were also indicated.

The costs required for the recommended structural interventions were estimated for each of the mapped sectors, with the aim of supporting public decision-making. The values for each sector/intervention were also detailed and summarized by area, as this procedure helps to prioritize interventions for all the settlements studied, which gave materiality to the MRRP. Most of the proposed interventions can be considered general infrastructure and, for this reason, the values of services and materials were provided by the National System for Researching Construction Costs and Indices (Sistema Nacional de de Pesquisa de Custos e Índices da Construção Civil - SINAPI), maintained by Caixa Econômica Federal and updated periodically.

Quantities (such as extensions, areas and/or volumes) were surveyed in the field and/or graphically, based on the photographic scale, arriving at the individualized budget of the interventions for each sector susceptible to risk. Complementary services (10%), benefits and

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indirect expenses - BID (23%) and basic or executive design (3%) were included in the total of the individualized budgets.

The following criteria were used to prioritize the interventions:

a) Risk level (R4 > R3 > R2);

b) Degree of complexity in implementing the intervention on a scale ranging from 1 to 5, where 5 is the highest complexity and 1 is the lowest complexity and highest intervention priority;

c) Intervention cost per building: defined by the quotient of the value of the total intervention cost by the total number of dwellings in each sector. The lower the intervention cost, the higher the intervention priority;

d) Number of buildings in the sector: the higher the number of dwellings, the higher the priority for intervention;

e) Total cost of intervention in the sector: the lower the total cost of intervention in the sector, the higher the priority for intervention;

f) Vulnerability indicators at the scale of detail: whether there are observable vulnerability indicators during risk mapping. The absence of indicators shows a lower priority for intervention compared to sectors where such an indicator is present; and

g) Interventions previously planned or in progress.

Communication and information activities

Once a hazard has been recognized, the willingness and capacity of the local government to mitigate the problem or the resilience of the residents to face it can reduce the risk. This is the objective of public information and risk education. The communication and information activities had the following objectives:

- To obtain qualified, up-to-date and, above all, contextualized information reflecting technical and social knowledge that would contribute to the preparation of the MRRP for São Bernardo do Campo and Franco da Rocha;

- To disseminate the results of the MRRP and encourage its use in urban planning and management in São Bernardo do Campo and Franco da Rocha;

- To raise awareness among key players in the public administration of São Bernardo do Campo and Franco da Rocha and the population in general, especially people at risk, with a

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focus on mobilizing and engaging them.

In order to maintain the flow of communication and information with municipal management teams, especially during the COVID-19 pandemic, the project team produced newsletters on the data collection stages for the MRRPs. To present the results of the MRRPs to the management groups, two technical seminars were organized, one for São Bernardo do Campo (on August 23, 2021) and another for Franco da Rocha (on August 19, 2021). The events were attended remotely by the municipal management teams and other municipal representatives relevant to public management, a representative of the Ministry of Reginal Development and the project execution team. With the aim of guiding the understanding, analysis and incorporation of the MRRPs results into municipal planning and management, two technical workshops were organized, one for São Bernardo do Campo (09/09/2021) and the other for Franco da Rocha (10/09/2021), attended remotely by the municipal management teams. Finally, a public hearing was held in each municipality, remotely, due to the COVID-19 pandemic, to present the results of the MRRPs. The hearings were widely publicized in advance by the municipal governments. An executive summary of the results of the MRRPs was also made available on the municipalities' websites for the prior information of participants.

3. Results and discussion

Figures 2 and 3 show the sectors prone to disaster risk mapped in Franco da Rocha and São Bernardo do Campo, with their respective level of risk assigned. This database was shared with the Civil Defense departments of São Bernardo do Campo and Franco da Rocha. With this database, the professionals in these municipalities will have more autonomy to visualize and update the data of their sectors susceptible to disaster risk.

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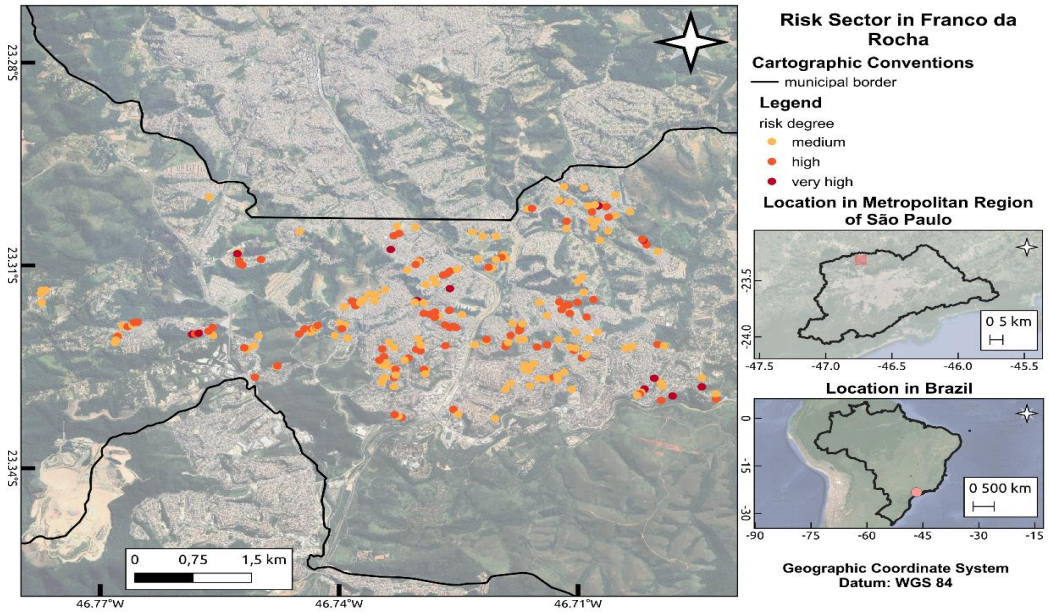
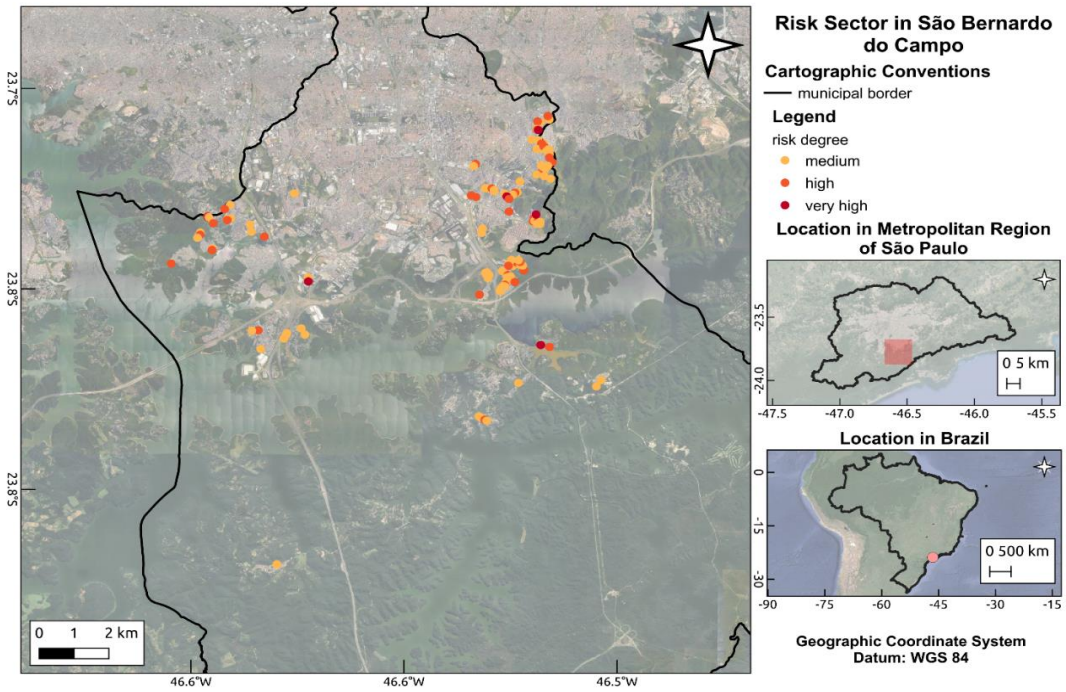
Figure 2: Sectors at Risk of Disasters in Franco da Rocha.



Source: the authors, based on data from Nogueira and Canil (2021).

Table 2 shows an example of the forms produced for sector SBC23_S1R4 - Montanhão, in São Bernardo do Campo, while Figures 3 to 7 show the aerial (satellite), oblique (drone) and field images, as well as the spatialization of the intervention proposals for the respective sector.

Figure 3: Sectors at Risk of Disasters in São Bernardo do Campo



Source: the authors, based on data from Nogueira and Canil (2021).

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Table 2 - General data sheet for sector SBC23_S1R4 – Montanhão

Municipal Plan of Disaster Risk Reduction – São Bernardo do Campo – General data sheet		
Name: Montanhão nucleus	**Location:** SBC23	
Reference address: Passagem Anita Garibaldi	**Latitude:** 7373818.771	**Longitude:** 344733.494
General location photo: FG-SBC23		
Local characterization Polygon with an approximate area of 17.1 hectares. The relief is made up of high hills (100%), with a range of up to 114 m, with a substrate of migmatites and granitic gneisses (75%) and medium-grade metamorphic mica schists and/or meta-sandstones (25%). Most slopes in the polygon are between 30 and 45%, exceeding 45% in some places. Susceptibility to mass movements is divided between low (10.6%), medium (59.2%) and high (30.2%). It is a location with consolidated urban occupation and high building density. The area's vulnerability, according to the São Paulo Social Vulnerability Index, varies between 18% low, 20.4% medium and 61.6% very high (subnormal agglomerations). Within a radius of 1 km, there are 2 health facilities and 4 educational facilities.		

Sector ID	**Process type**	**Degree of risk**	**Number of dwellings**	**Alternatives of intervention(s)**
SBC23_S1	landslide of cut slope, embankment and hillside deposit	**R4**	**23**	Removal of dwellings (8) Canal (160; 140 = 300m) Hydraulic ladder (90; 50; 45; 20 = 205 m) Cleaning (1700 m^3) Restoration of vegetation cover (2200 m^2)

Source: Adapted from Nogueira and Canil (2021)

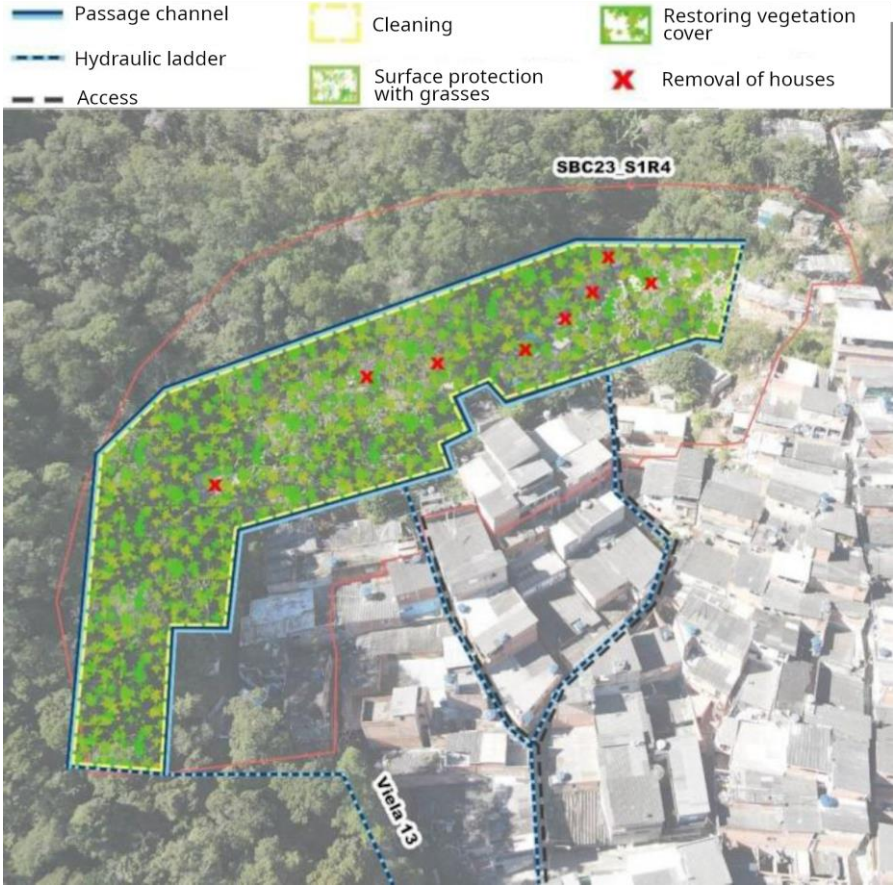
Figure 4 - Aerial view of the sectors at risk of disasters in the Montanhão nucleus

Source: Adapted from Nogueira and Canil (2021).

Figure 5 - Oblique image of sector SBC23_S1R4 - Montanhão, taken by drone.

Source: Nogueira and Canil (2021).

Figure 6 - Intervention proposals for sector SBC23_S1R4 – Montanhão.



Source: Adapted from Nogueira and Canil (2021).

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Table 3 - Detailed form for sector SBC23_S1R4 – Montanhão

Municipal Risk Reduction Plan – São Bernardo do Campo – Sector Form		
Name: Montanhão Nucleus	**Local:** SBC23	**Sector:** SBC23_S1
Access reference: Alley 13	**Latitude:** 344791.382	**Longitude:** 7373974.496
UFABC team: Fábio Campos and Rodolfo Moura	**Date:** 4/12/2020	
Sector diagnostic		
A group of houses at mid-slope. The slope on the left and right borders of the sector is in the shape of an amphitheater (concave), with tree vegetation, undergrowth and exposed soil in some places. It is supported by mica schist, has a maximum slope of 35 degrees and a range of 20 meters (range relative to the sector). The landslide processes operating in the sector are related to cutting slopes, resulting in the deconfinement of soil/rock or movements of the earthy/rocky massif, and poorly compacted embankments in the upper part of the sector or slope deposits (soil). Houses have already been removed from this sector, but it is currently being reoccupied. Steep slopes, cracks in the terrain, leaning trees and landslide scars were noticeable. It is suggested that the most precarious buildings in the upper part of the sector, where the slope is steepest, should be removed. Eight houses were identified in this condition. A further seven houses should be monitored by the Civil Defense Preventive Plan. In addition, the lack of a drainage system, sewers and gutters, together with the morphology of the terrain, favor the flow of water over the surface of the slope.		
Description of the instabilization process		
Evidence of constructive fragility, structural instability or significant degradation of the buildings		
Description of the vulnerabilities observed		
Evidence of constructive fragility, structural instability or significant degradation of the building. Spatial disorganization and/or excessive densification of buildings in the inspected area, affecting surface drainage flows		
Observations (photos)		
FC-SBC23_S1-01 – Focus on the the left edge of the sector and the precariousness of the house FC-SBC23_S1-02 – The green wall house in the right-hand corner of the photo is one of those recommended for removal FC-SBC23_S1-03 – Focus on fallen trees in the sector. The house in the left-hand corner of the photo is one of those earmarked for removal. FC-SBC23_S1-04 – The house in the right-hand corner of the photo is one of those recommended for removal		

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Risk level: R4 – Very High	**Estimated number of buildings in the sector:** 23
Indications of interventions	**Costs (Brazilian Reais)**
Channel (160; 140 = 300m)	R$78,854.00
Hydraulic ladder (90; 50; 45; 20 = 205 m)	R$168,154.05
Cleaning (1700 m^3)	R$454,451.00
Restoring vegetation cover (2200 m^2)	R$46,772.00
Charges (Complementary services / Project / Benefits and indirect expenses)	R$269,381.18
Removal indications	
Bulding removal (8)	**R$ 712,000.00**
Total	**R$ 1,729,662.23**

Source: Adapted from Nogueira and Canil (2021).

Figure 7 - Field images of the disaster-prone sector SBC23_S1R4 - Montanhão

Source: Nogueira and Canil (2021)

In São Bernardo do Campo, the estimated cost of the proposed interventions was R$55,668,462.94, with an estimated cost per home of R$27,695.75. In Franco da Rocha, the estimated cost of the proposed interventions was R$22,809,927.43, with an estimated cost per home of R$19,379.72. In comparison, the unit cost of household removal in São Bernardo do Campo and Franco da Rocha is R$89,000.00, not including the values of relocation or housing resettlement. The graph in Figure 8 summarizes the intervention proposals in Franco da Rocha.

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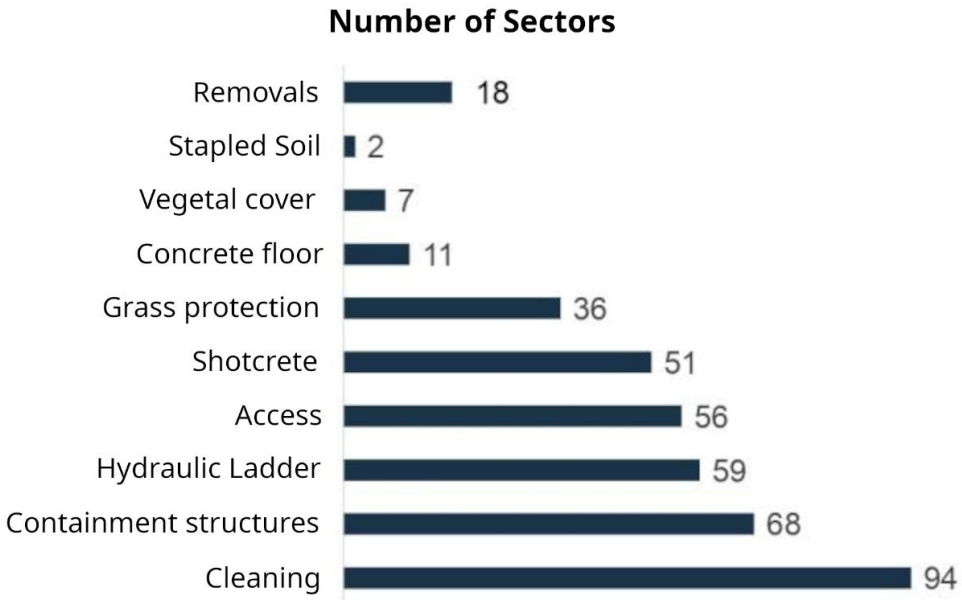
Figure 8 - Proposed interventions in disaster-prone sectors in Franco da Rocha



Source: Adapted from Nogueira and Canil (2021).

4. Final considerations

The MRRPs presented should be seen as medium- to long-term action plans. They serve to support other projects and policies, such as land regularization programs, adaptation to climate change, and integration with urbanization and urban-environmental qualification projects. They are an important tool in municipalities' strategies for raising funds.

Developing a MRRP is an investigative process, but it is also a process of informing and educating all the stakeholders involved:

- the executive team itself learns new techniques and ways of analyzing, communicating and planning;

- the residents, when they participate together with the technical team in the inspection of their home and surroundings, exchanging knowledge and, afterwards, when they receive the result of this analysis and can act in the management of the risk that threatens them;

- public agents, following the definitions of the methodological procedures, actively monitoring the surveys and risk diagnoses in the field, discussing the results, planning short, medium and long-term actions.

It should be noted that more of time for mapping and the participation of the local community and municipal management in the MRRP would better qualify the risk assessment and eradication, prevention and mitigation actions. It would also be possible to more closely assess the resilience of residents exposed to risks, which in general mitigates social

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vulnerabilities and exposure to threats from the physical environment. It is therefore very important to expand the resources and timeframes for developing MRRPs.

Despite their limitations, the São Bernardo do Campo and Franco da Rocha MRRPs (2020-2021) were developed by an interdisciplinary team, with the participation of students and professionals from different areas of knowledge. This result underpins the importance of interdisciplinarity in academic and professional training in the preparation of MRRPs. Likewise, strategies to deepen collaboration with other municipal departments besides Civil Defense and the Housing and Urban Planning departments, such as Health and Social Assistance, can broaden the perspectives and knowledge relevant to a better assessment of social vulnerability in the MRRPs.

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