AMBIENTE & SOCIEDADE
25 anos / años / years

SciELO

Diagnosis and discussions on Municipal Risk Reduction Plans in Brazil

Marcos Barreto de Mendonça [I]
Leandro Torres Di Gregorio [II]
Christine de Oliveira Silva Alfradique [III]

Abstract: The disasters associated with landslides and floods forced the Brazilian Federal Government to launch, in 2003, a program aimed at encouraging the development of Local Disaster Risk Reduction and Management Plans (PMRRs - Planos Municipais de Redução de Riscos). Given the uniqueness of this action and the variety of institutions accounting for executing these plans, which involve different material and human resources, it is important explaining how PMRRs have been built in order to, likely, improve them. The aim of the current study is to gather information about all 33 PMRRs available on the website of the Ministry of Regional Development by focusing on the following items: composition of the technical team involved in them, popular participation, risk mapping, typologies and costs of proposed structural and non-structural actions. Among the herein reached conclusions, it is worth emphasizing the excessive asymmetry observed in PMRRs' approach to physical aspects of this issue to the detriment of its social aspects, a fact that affects both the risk estimation method and the proposed mitigating measures.

Keywords: Disasters; Landslides; Floods; Risk Management; Local Disaster Risk Reduction and Management Plan.

[I] *Departamento de Construção Civil, Programa de Engenharia Ambiental, Programa de Engenharia Urbana. Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.*

[II] *Departamento de Construção Civil, Programa de Engenharia Ambiental, Programa de Engenharia Urbana. Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil*

[III] *Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil*

São Paulo. Vol. 26, 2023

Original Article

DOI: http://dx.doi.org/10.1590/1809-4422asoc20210207r1vu2023L2OA

Introduction

Disaster risk refers to potential losses and damages that may happen in a given community and period-of-time. The risk is estimated based on hazard, exposure, vulnerability and response/recovery capacity (UNDRR, 2022).

Brazil underwent a fast and intense urbanization process in the 20th century, and it was followed by intense irregular and precarious occupations of inappropriate areas, such as slopes and floodplains (QUEIROZ FILHO, 2011), mainly by populations subjected to high socioeconomic vulnerability. The social-inequality environment observed in territory occupation processes has boosted the incidence of hazardous events, with emphasis on those associated with landslides and floods (DA SILVA ROSA et al., 2015; HOLCOMBE; ANDERSON, 2010).

Based on a survey carried out by BRASIL (2022), 1,072 disasters associated with landslides, 5,309 associated with gradual floods, and 8,887 associated with flash floods were officially registered between 1991 and 2019. Altogether, they killed 3,052 individuals and affected approximately 48.5 million people, in total. The association of data from the 2010 Demographic Census with those deriving from mappings carried out in risk areas in 872 Brazilian municipalities monitored by the National Center for Natural Disaster Monitoring and Alerts in 2018 allowed estimating that the population living in risk areas, in these municipalities, back in 2010, comprised approximately 8.3 million inhabitants (IBGE, 2018).

The Sendai Framework for Disaster Risk Reduction (UNISDR, 2015) is the main international instrument guiding action strategies focused on reducing the risk of hazardous events from 2015 to 2030. It was adopted by the UN assembly to succeed the Hyogo Framework for Action (UNISDR, 2005) and the "Yokohama Strategy and Plan of Action for a Safer World" (UN, 1994). The Sendai Framework for Disaster Risk Reduction emphasizes the need of implementing a broader, inter-sectoral, interdisciplinary, and people-centered approach to enable disaster risk reduction (DRR); the need of redoubling efforts to reduce communities' exposure and vulnerability to these events; the need of avoiding the creation of new risk situations; as well as of promoting and demanding the engagement and cooperation of the whole society in the implementation of different policies, plans, rules, and actions.

Accordingly, Miguez et al. (2018) have emphasized that the approach developed for comprehensive disaster risk management should be based on a systemic perspective about the life cycle of disasters, which comprises macro processes associated with prevention, mitigation, preparation, response, and recovery. Disasters have complex nature because the combination of physical and social processes involved in them (WISNER et al., 2003; MALAMUD; PETLEY, 2009) makes tasks, such as planning, designing and executing DRR actions, equally complex and innovative. Thus, they require the application of an inter-sectoral and interdisciplinary approach to the investigated problem. This scenario highlights the need of adopting risk management processes coordinated by public authorities for ecosystems vulnerable to disasters.

Therefore, in 2003, the Brazilian Federal Government - through the Ministry of

Cities (MCID – *Ministério das Cidades*) - instituted the Action to Support the Prevention and Eradication of Risks in Precarious Settlements, at the Program for the Urbanization, Regularization and Integration of Precarious Settlements scope, in order to help the most vulnerable Brazilian municipalities to plan and implement risk prevention and mitigation actions. This instrument articulates a set of actions aimed at mitigating risks in urban areas, namely: training municipal teams in risk diagnosis, prevention and management processes; risk management; financial support for the preparation of both Local Disaster Risk Reduction and Management Plans (PMRRs) and projects focused on stabilizing slopes in risk areas seen as a priority in the aforementioned plans (CARVALHO; GALVÃO, 2006; ALHEIROS, 2006; CAIXETA; MASIERO, 2016).

Local Disaster Risk Reduction and Management Plan (PMRR) is one of the main mechanisms adopted to mitigate the risk of disasters in Brazil, as well as one of the instruments resulting from actions taken by the Federal Government to identify and diagnose risks, as well as to propose structural (engineering works) and non-structural measures to mitigate them. Several municipalities hired specialized institutions to help them use this program to prepare their PMRRs. According to IBGE (2018), 652 municipalities (11.7% of Brazilian cities) had PMRR addressing risks associated with landslides, flash floods and/or gradual flooding events, in 2017. In January 2019, when the new Federal Government took office, MCID was extinguished and the accountability for PMRRs was transferred to the newly created Ministry of Regional Development (MDR, 2022).

The aim of the current study was to generate the profile of contents and methodologies associated with PMRRs prepared by different municipalities, based on a sample comprising all 33 PMRRs available as "examples" on the website of the former Ministry of Cities, between 2016 and 2018. It is worth emphasizing the lack of changes in the set of PMRRs made available by the current Ministry of Regional Development (MDR, 2022). Quali-quantitative analyses were carried out to feature and compare these plans, to address their results and to present suggestions to help improving their construction process. Despite the time frame limitations, discussions held in the current study are expected to work as guideline for public managers dealing with disaster risks at all federation levels, be it by demanding, elaborating, inspecting or implementing PMRRs.

Local Disaster Risk Reduction and Management Plans

Local Disaster Risk Reduction and Management Plans play an essential role in risk management processes implemented at local level, since they shift the focus from post-impact reconstruction to disaster risk reduction. The preparation of this document is divided into eight stages, based on guidelines provided by the Federal Government, namely (ALHEIROS, 2006):

- defining the methodology to be adopted to prepare the PMRR: work planning, with emphasis on the specification of methods, processes, instruments, as well as technical and human resources to be used in all other stages, based on discussions held with municipality representatives who will interact with the PMRR;

- risk mapping: identifying both the risks and their spatial delimitation (zoning), based on qualitative or quantitative methods (CERRI, 2006);
- structural actions' proposition: indicating engineering works to reduce risks, at least for the high- and very high-risk sectors, in order to find high technical and financial viability solutions to be implemented by municipalities, with likely participation of the local population as auxiliary workforce;
- estimating costs with the proposed interventions (engineering works);
- setting the hierarchy of the proposed interventions: defining the priority order of risk sectors to be subjected to structural actions based on cost-benefit criteria;
- identifying programs and fund sources to implement the proposed measures: surveying and defining fund sources, plans, or programs, either directly or indirectly, linked to risk reduction, at all three governmental spheres;
- proposing non-structural measures: indicating measures, without involving engineering works, based on using tools aimed at managing and changing the behavior of public authorities and civil society, to reduce risks;
- making the proposed actions compatible to other governmental programs, as well as to legal, housing, and urban issues addressed in municipal master plans;
- holding public hearings: public meetings encompassing the community directly involved in the process, representatives of organized sectors of society, members of the legislature, public prosecutors' office, and public bodies with interface with PMRR, to enable communications about PMRR preparation, as well as mobilization for the participation of all individuals during its elaboration and, finally, for the presentation of the elaborated plan.

Based on the features that both PMRR and its elaboration process must present, it is possible seeing alignment to the aforementioned international frameworks. It is worth emphasizing that law n. 12,608/2012 (BRASIL, 2012), which enacted the National Civil Protection and Defense Policy, does not textually mention the PMRR, but it establishes the National Register of Municipalities with areas susceptible to large-scale landslides, flash floods, or correlated geological or hydrological processes. This law establishes these municipalities' obligation to plot susceptibility maps and plans to implement works and services to help reduce the risk of disasters associated with such events.

Threats addressed in PMRRs are associated with landslides, flash floods and gradual floods. Landslides are exogenous geological processes involving the downhill displacement of soil, rocks and/or debris due to the action of gravity; they may take place naturally or be induced by man (CRUDEN; VARNES, 1996). Floods, in their turn, are hydrological events resulting from waterbodies overflowing out of their secondary channel; they can be sudden (flash floods) or gradual (MIGUEZ et al., 2018).

Research Methodology

Although PMRRs are public documents, their availability, either by municipalities or by companies accounting for preparing them, remains scarce. Given this limitation, and in order to avoid search bias, the set of 33 PMRRs made available by MCID on its official website, between 2016 and 2018, was herein taken as a sample to be investigated. In 2016, this sample accounted for approximately 43% of the 77 municipalities presenting plans supported by this body, which prioritized large municipalities - 84.4% of them had more than 900,000 inhabitants (CAIXETA; MASIERO, 2016). Assumingly, these documents were classified as good standards by the Federal Government, since they were introduced as “examples” on the aforementioned website. The convenience sample accounted for 3.4% of all 959 municipalities monitored by the National Center for Natural Disaster Monitoring and Alerts, in 2020, at National Plan for Risk Management and Response to Disasters scope (CEMADEN, 2020). As previously stated, this set of PMRRs is the same one currently available on the website of the Ministry of Regional Development (MDR, 2022).

PMRRs in this sample were concluded between 2004 and 2009; they referred to municipalities featured in Table 1. There was a prevalence of municipalities in Southeastern Brazil (SP: 40%; RJ: 15%, MG: 15%, ES: 3 %), and in the Northeastern region (PE: 20%, AL: 3%, RN: 3%), whereas municipalities in the Midwestern, Southern and Northern regions were not represented in the sample (Figure 1).

Table 1 – Basic data about municipalities included in the analyzed sample (IBGE, 2018; CEPED/UFSC,2013)

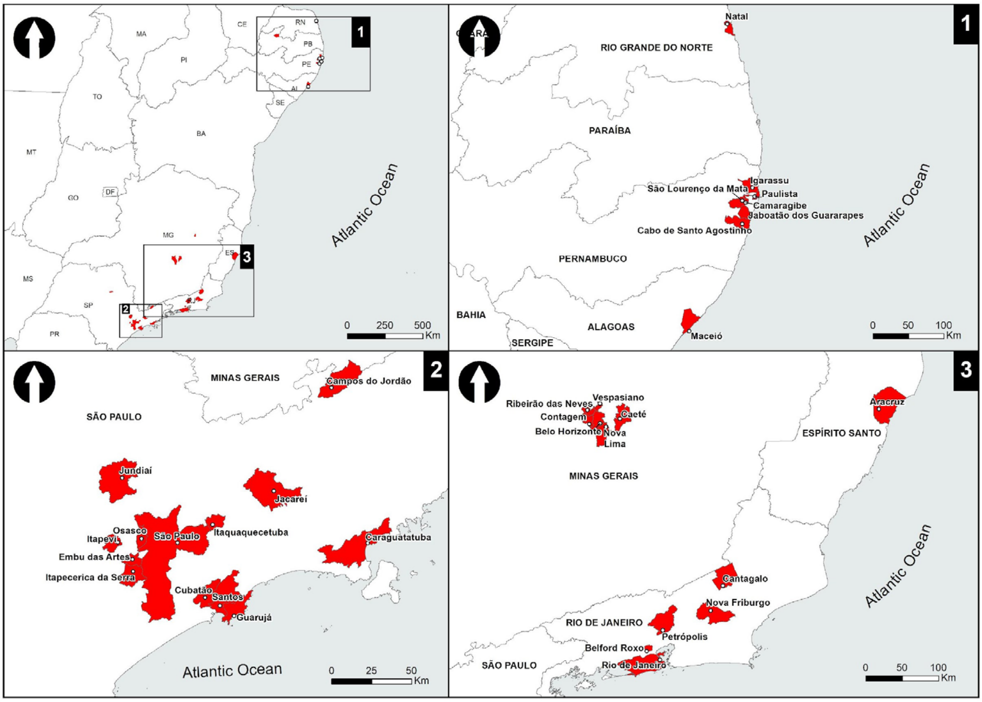
City	FU	Population	Area (km²)	Number of disasters recorded from 1991 to 2012*			Events addressed in the PMRR
				LS	FF	IN	
Aracruz	ES	101,220	1,420.29	0	7	2	LS
Belford Roxo	RJ	469,332	78.985	3	4	3	LS; FF; IN
Belo Horizonte	MG	2,375,151	331,401	5	7	2	LS
Cabo de Santo Agostinho	PE	185,025	445.343	1	5	2	LS
Caeté	MG	40,750	542,531	2	3	1	LS; FF; IN
Camaragibe	PE	144,466	51,257	1	13	1	LS; FF; IN
Campos do Jordão	SP	47,789	290.52	2	2	2	LS
Cantagalo	RJ	19,830	746,928	3	0	1	LS; FF; IN
Caraguatatuba	SP	100,840	484,947	2	2	0	LS
Contagem	MG	603,442	195,045	4	11	3	LS
Cubatão	SP	118,720	142,879	6	1	0	LS
Embu das Artes	SP	240,230	70.398	1	0	2	LS
Guarujá	SP	290,752	2,026.80	3	2	0	LS
Igarassu	PE	102,021	305,782	1	3	0	LS
Itapecerica da Serra	SP	152,614	150,742	1	2	2	LS

City	FU	Population	Area (km²)	Number of disasters recorded from 1991 to 2012*			Events addressed in the PMRR
				LS	FF	IN	
Itapevi	SP	200,769	82.658	0	1	3	LS
Itaquaquecetuba	SP	321,770	8.622	1	2	1	LS; E; IN
Jaboatão dos Guararapes	PE	644,620	258,724	2	11	3	LS
Jacareí	SP	211,214	464,272	1	3	1	LS
Jundiaí	SP	370,126	431,207	3	2	0	LS
Maceió	AL	932,748	509.32	0	5	0	LS
Natal	RN	803,739	167.401	1	2	2	LS; FF; IN
Nova Friburgo	RJ	182,082	935,429	1	4	1	LS; FF; IN
Nova Lima	MG	80,998	429,004	0	1	1	LS
Olinda	PE	377,779	41.3	1	11	3	LS
Osasco	SP	666,740	64.954	1	3	1	LS
Paulista	PE	300,466	96.846	0	3	1	LS
Petrópolis	RJ	295,917	791,144	18	6	6	LS
Rio de Janeiro	RJ	6,320,446	1,200.26	3	1	2	LS
Santos	SP	419,400	281,033	5	2	1	LS
São Lourenço da Mata	PE	102,895	262,106	0	4	0	LS; FF; IN
São Paulo	SP	11,253,503	1,521.11	14	15	8	LS
Vespasiano/Santa Luzia/ Ribeirão das Neves	MG	603,786	461.61	1	8	4	LS

* LS: landslide; FF: flash flood; IN: gradual flood inundation.

Source: Elaborated by the authors, 2023.

Figure 1 – Location of municipalities included in the analyzed sample



Source: Elaborated by the authors, 2023.

Qualitative and quantitative surveys about PMRR methodology and content were carried out based on sample's documentary research. After analyzing and systematizing its constituent elements, and based on the relevance and availability of information, the following data categories were selected and divided into two groups:

- With respect to the method used to prepare the PMRR:

- professionals participating in the technical team;
- popular participation in the plan-elaboration process;
- risk mapping;
- criteria to set the hierarchy of risk sectors to be covered by DRR interventions.

- With respect to results presented in the PMRR:

- territorial extension of risk sectors;
- proposed structural intervention types;
- estimated cost of the proposed structural interventions;
- proposed non-structural intervention types.

Plans' distribution rate was calculated for each data category (e.g., professionals participating in the technical team), based on results observed for different classes of the category in question (e.g., geologists, architects, among others). It was not possible to take into account the entire PMRR sample for some data categories, since some plans did not provide the necessary information to do so. In this case, the observed rates referred to the number of PMRRs that could be taken into consideration in the respective categories, rather than the ones calculated based on the total sample. Arithmetic means, as well as minimum and maximum values observed for the respective results, were calculated for some categories, whenever applicable.

Data about the cost of implementing structural actions (engineering works) were subjected to a correction process, based on their temporal and regional variation, in order to enable analyzing the set of plans. Mean cost values set for m^2 of construction provided by the National System for Research on Civil Construction Costs and Indices (SINAPI - *Sistema Nacional de Pesquisa de Custos e* Índices *da Construção Civil*) of IBGE and *Caixa Econômica Federal* for Rio de Janeiro State, in March 2020 (IBGE, 2020), were selected as monetary correction basis. Prices in place, in Rio de Janeiro State, were adopted as a reference due to easy access to this information and to researchers' familiarity with prices practiced by the civil construction sector, in this State, a fact that enables better assessing the coherence of values resulting from the calculations. The correction process was performed as follows:

$CA = CT \times \left(\frac{CB\_RJ\_2020}{CP\_UF\_DATA}\right)$	**Equation 1**

Wherein:

CA: cost regionally and temporally updated by taking costs with civil construction in Rio de Janeiro State, in May 2020, as reference for comparison purposes;

CT: total cost of interventions presented in the PMRR, i.e., without regional or temporal correction;

CB_RJ_2020: mean cost set for m^2 of civil construction in Rio de Janeiro State, in March 2020, provided by SINAPI;

CP_UF_DATA: mean cost set for m^2 of civil construction, based on state (FU) and on surveyed plan publication date (DATE), provided by SINAPI.

Results and discussion

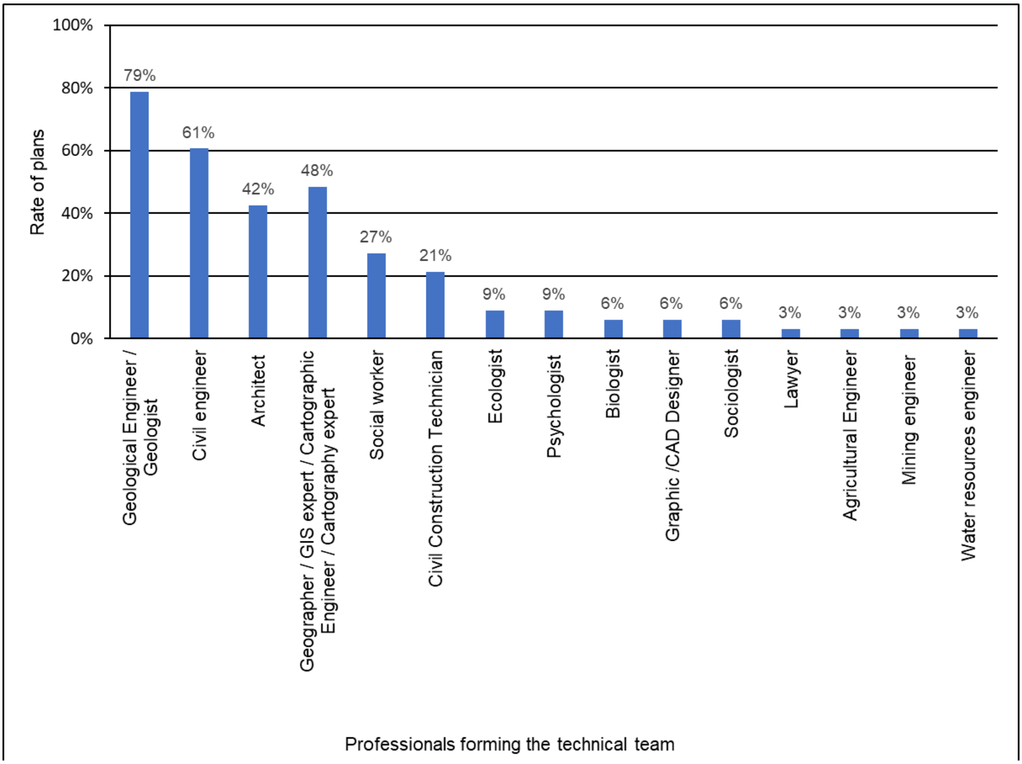
Although the process to elaborate the investigated PMRRs has followed a national guideline (ALHEIROS, 2006), they were expected to present different features based on local specificities, such as risk factors and methods adopted by institutions hired to prepare them. Therefore, results and discussion are presented below, separately, based on data category.

Regarding the method used to prepare the PMRR

a) Professionals participating in the technical team

Professionals from the exact and earth sciences fields prevailed in the technical teams involved in the elaboration of PMRRs, compared to professionals from the humanities and social fields - overall, geographers were the professionals showing ambivalent skills (Figure 2). This prevalence was expected to happen if one takes into consideration the scope of work required to develop PMRRs. However, results have indicated that the process to elaborate the investigated plans has given too much emphasis on physical processes to the detriment of the social ones, although both play key role in risk construction processes. It is worth emphasizing that only 27%, 9%, and 6% of PMRRs had social workers, psychologists, and sociologists in their teams, respectively, although these professionals are essential to achieve an integrated human approach (MALAMUD; PETLEY, 2009; MARCHEZINI, 2017; ROBINSON, 2018; DUTRA, 2021).

Figure 2 - Distribution of PMRRs, based on training provided to professionals joining the elaboration team



Source: Elaborated by the authors, 2023.

The need of stronger human and social science professionals' participation in

PMRRs - in close cooperation with exact and earth science professionals - follows the guidelines set by Sendai Framework for Disaster Risk Reduction (UNISDR, 2015), according to which, DRR policies must adopt a broader people-centered approach, and the interdisciplinary understanding of underlying risk factors, which comprise hazard and exposure, besides several community vulnerability dimensions.

b) Population participation in plans' elaboration

Population participation in PMRRs was divided into:

population's involvement in plans elaboration, basically in those referring to consultation processes taking place in public hearings;

- presentation of PMRRs' results to the population in order to have the plans validated by it.

Although it is not possible stating that there were plans built without popular participation, it was overall possible perceiving little concern in mentioning it, mainly during plans' elaboration, because only 36% of them provided information in this regard. On the other hand, the presentation of PMRR results to the population was mentioned in 61% of cases, although without addressing the effectiveness of this communication, i.e., without providing any information about population's access to, reach and understanding of PMRR results, or about interactivity between technicians and the population.

These findings point towards the secondary importance given to population's participation in the plan elaboration process. This factor goes against one of the guiding principles of Sendai Framework for Disaster Risk Reduction (UNISDR, 2015), according to which, there is the need of having the whole society engaged in, and cooperating to, the design and implementation of policies, plans and standards focused on disaster risk reduction. Several studies have emphasized the need of involving the population in decisions about disaster risk management, although this practice remains a challenge (WEHN, 2015; BEGG, 2018; KLIMES et al., 2019; FORREST et al. 2021). However, in many public policy cases,the population - mainly the one living in risk areas - is mistakenly overlooked and often considered "ignorant", based on the design of governmental plans (VALÊNCIO, 2009).

Accordingly, it is necessary taking into consideration residents' understanding of, and perception of, risks at the time to plan different risk management actions (ALCÁNTARA-AYALA; MORENO, 2016; MENDONÇA et al., 2018; MENDONÇA; GULLO, 2020). This procedure must be one of the stages featuring population's participation in PMRRs' elaboration.

c) Risk mapping

This item was split into the following topics:

- mapping method;
- method used to select the areas to be mapped;
- cartographic scale;

- territorial extension of risk sectors.

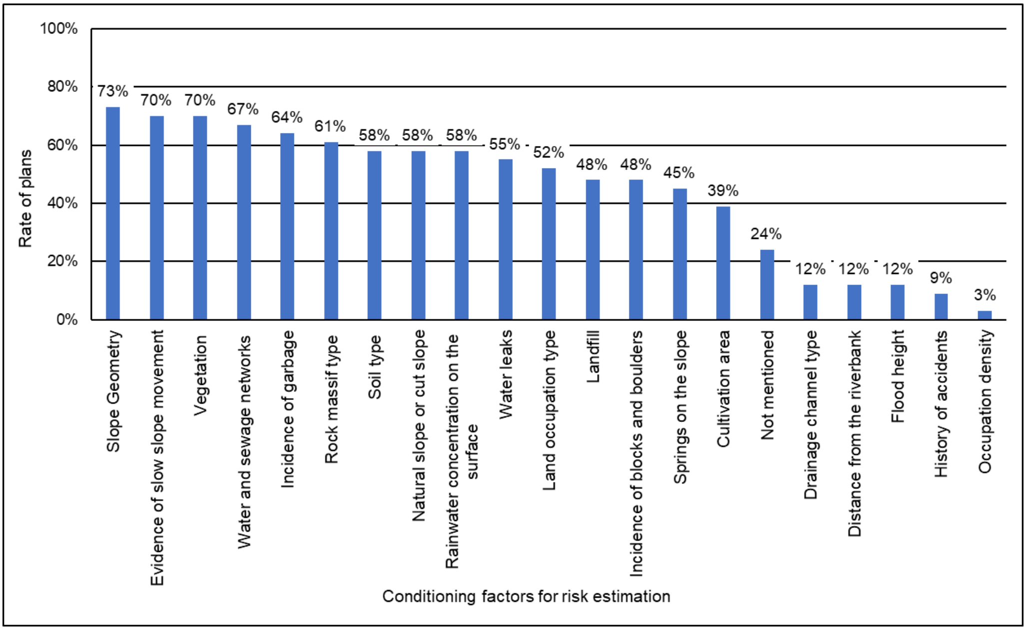
c.1) Mapping method

PMRRs' distribution was calculated based on the mention of the adopted mapping method, namely: heuristic (based on the attribution of parameters and on their respective weightings, according to the vision and expertise of the professionals elaborating the plan), probabilistic (based on the statistical approach applied to the inventory of spatialized incidences and on the historical series of rainfall events) and deterministic (based on the numerical modeling of physical processes). Most municipalities adopted the heuristic method, based on fieldworks (73%), whereas only two (Petrópolis and Rio de Janeiro - 6%) reported to use probabilistic methods associated with multi-criteria and geoprocessing analyses; no municipality reported to adopt the deterministic method - 21% of PMRRs did not mention the adopted mapping method.

Although the Federal Government (Brazil, 2011) encouraged the use of geoprocessing to integrate data for risk estimation purposes, only 2 out of 33 PMRRs expressly alluded to the use of this technology. The current study does not intend to criticize heuristic methods, but to highlight geoprocessing as a tool capable of increasingly contributing to optimize processes focused on optimizing and integrating data, as well as their respective weights, in order to carry out susceptibility and risk estimates, and to reduce both the subjectivity and errors inherent to them, in assessment processes. However, it is worth emphasizing that this data integration process does not dismiss the collection *in loco* of information about features, such as geological details, hillslope springs, landslide imminence signs (e.g., cracks and soil settlements), and anthropogenic actions capable of increasing susceptibility rates.

In addition to a wide variety of mapping methods, the literature also provides a wide diversity of data to be taken into consideration in this process (GUZZETTI et al., 1999; FELL et al., 2008; BITAR, 2014). It is possible grouping these data in the following categories: landslide inventory, natural and anthropogenic instability conditioning factors, and signs of instability. It is extremely important understanding the data set to be taken into account at the time to elaborate the mapping process in order to assess the quality of the generated product. Figure 3 presents the parameters mentioned by PMRRs in risk estimates.

Figure 3 - Distribution of PMRRs based on conditioning factors taken into consideration in the risk analysis process



Source: Elaborated by the authors, 2023.

There was high rate (24%) of PMRRs that did not mention the conditioning factors taken into consideration during the mapping process that, in its turn, presented dubious quality, based on this criterion. In addition, important data, such as incidence of landfills, rock blocks and hillslope springs (for geodynamic risks), distance from the riverbank and flood height (for hydrological risks), as well as history of accidents and occupation density (for both risks) were not taken into consideration in more than 50% of the analyzed PMRRs - this finding has evidenced deficiency issues in a large number of plans.

Although several areas pre-selected for mapping purposes often integrate socio-economically vulnerable areas, it appears that a very low rate of plans explicitly pays attention to vulnerability issues. It is necessary taking vulnerability into consideration when it comes to parameters capable of reflecting its different aspects, to enable plotting thematic-risk maps (e.g., risks associated with physical, functional, economic, patrimonial, sociocultural aspects), by combining it to hazard, in order to provide a broad spectrum of applications, at different comprehensive risk management stages (MIGUEZ et al., 2018).

c.2) Method used to select the areas to be mapped

The previous selection of areas to be covered by the mapping process is an important step to spatially drive all activities necessary for the plan elaboration.

Some municipalities used more than one selection method; 42% of them adopted the history of events as a criterion, whereas 39% took into consideration indications by the City Hall / Civil Defense. According to the Federal Government (CARVALHO; GALVÃO, 2006), these areas should be selected based on a prior analysis of the history of events that have taken place in the municipality (landslide and floods inventory); settlements accounting for the largest number of records should be the selected ones. The low rate of plans that took into consideration the inventory of events (42%) reflects the deficiency in creating and maintaining a database on such events. This issue is often observed in most Brazilian municipalities. Indications exclusively made by city halls, without specifying the adopted technical criteria, corresponded to 21% of PMRRs in the current study. However, they should be avoided, since they enable political and economic interest biases capable of affecting the work to be done (VALÊNCIO, 2009). Consequently, they compromise the guideline to fairly meet population's needs.

c.3) Cartographic scale

Only 19 of the investigated PMRRs (57.6%) provided information about the adopted cartographic bases. Most of them (79%) were based on scales equal to, or greater than, 1:5,000, which are considered satisfactory for mapping procedures focused on managing risks at local level (FELL et al., 2008). Smaller scales should be avoided, since they lose details about conditioning factors to be taken into consideration; moreover, they are not suitable for several local management actions, such as for indicating DRR actions. Therefore, results in the current study have shown a significant deficiency in this regard.

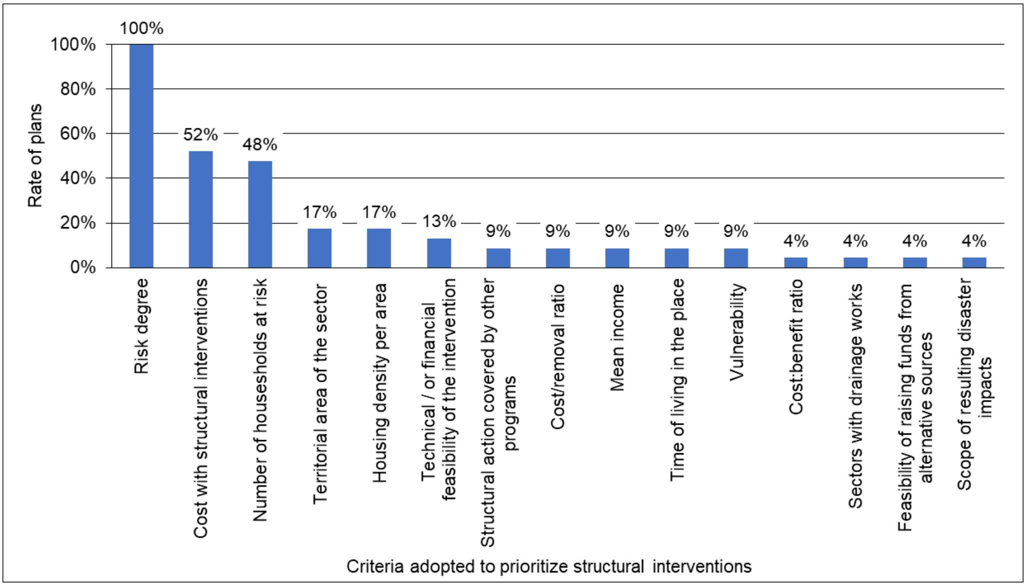
d) Criteria applied to set the hierarchy of risk sectors to be covered by DRR interventions

Figure 4 shows PMRRs' distribution, based on criteria used to rank risk sectors in terms of priority to implement mitigating interventions. Twenty-three (23) of all 33 plans have met such criteria, although there was significant variation among them. As expected, all 23 PMRRs took - at least - risk degree as a hierarchy criterion, besides other criteria associated with it, mainly the ones associated with costs with both the proposed interventions and the number of homes at risk.

Many of the adopted criteria appeared to take into account population's exposure and vulnerability to disasters, which, in conceptual terms, should have been already taken into consideration in the risk assessment itself. Only 4% of the analyzed plans took into account the cost-benefit ratio as a prioritization criterion; this procedure plays a fundamental role in the process to rationalize the use of public resources.

Thus, a prioritization process guided by aspects, such as exposure, vulnerability and cost-benefit ratio, should be implemented based on the identification of high- and very high-risk areas. Furthermore, the use of prioritization methods based on the GUT matrix -*gravidade* (severity), *urgência* (urgency), *tendência* (trend) - (DAYCHOUM, 2007), by simultaneously incorporating the "cost" element to the analyses (not observed among PMRRs), also appears to be promising. Finally, it is necessary standardizing hierarchical criteria, mainly when the implementation of such interventions depends on resources provided by higher governmental spheres, in order to provide fairer services to the population and to avoid biases capable of favoring political and economic interests.

Figure 4 - Distribution of PMRRs, based on criteria adopted to prioritize the proposed structural interventions



Source: Elaborated by the authors, 2023.

Regarding results presented in the PMRR

a) Territorial extension of risk sectors

'Risk sector' is the spatial definition of part of the mapped area showing certain homogeneity in risk degree, which is often classified as low, medium, high and very high. Some PMRRs have only identified high- and very high-risk sectors. Results observed for this category only referred to areas at risk of landslide events. Hydrological risk areas (gradual flooding and flash floods) were not addressed because they are associated with basin behavior, which presents much higher variability and hinders comparisons.

Figure 5-1 presents the mean area of landslide-associated risk sectors; this area was calculated based on the total area:number of sectors ratio. Only 7 of all 33 analyzed PMRRs provided information for this calculation. Figure 5-2 shows the results of calculations applied to the total area of high- or very high-risk sectors associated with landslides, and to the ratio between this value and the total area of each municipality (IBGE, 2018). The mean size of the areas set for each risk sector reached 2.79 ha and recorded standard deviation of 3.31 ha (for medium risk degree), as well as mean size of 0.94 ha and standard deviation of 0.26 ha (for high or very high risk degree). If one disregards the maximum value observed for medium risk degree, because it is much higher than the others, the mean size of areas set for each risk sector reaches 1.47 ha, for this degree.

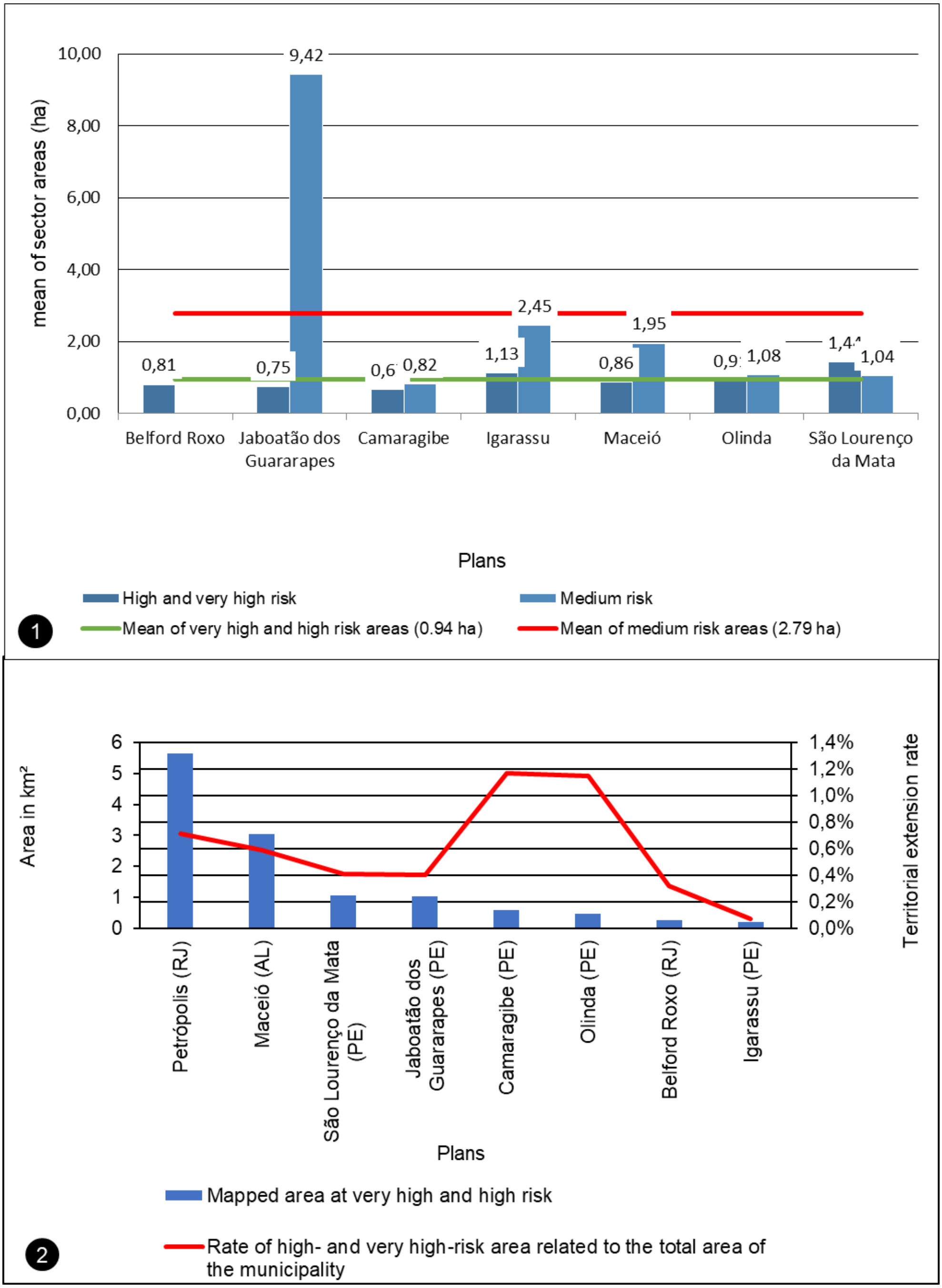
It is worth analyzing some aspects, although they are based on data from only 8 municipalities. Mean territorial area per sector has decreased as risk degree increased. In addition, the sum of areas of high- or very high-risk sectors per municipality ranged from 0.20 km^2 to 5.65 km^2, and it corresponded to approximately 0.1% to 1.2% of the total municipality area. It is important knowing these values, since they can be used as reference in plans developed for other municipalities, and to follow their evolution overtime.

b) Proposed structural intervention types

Typologies of structural interventions proposed by the investigated PMRRs and the ways they were presented in the respective plans are shown in Figure 6.

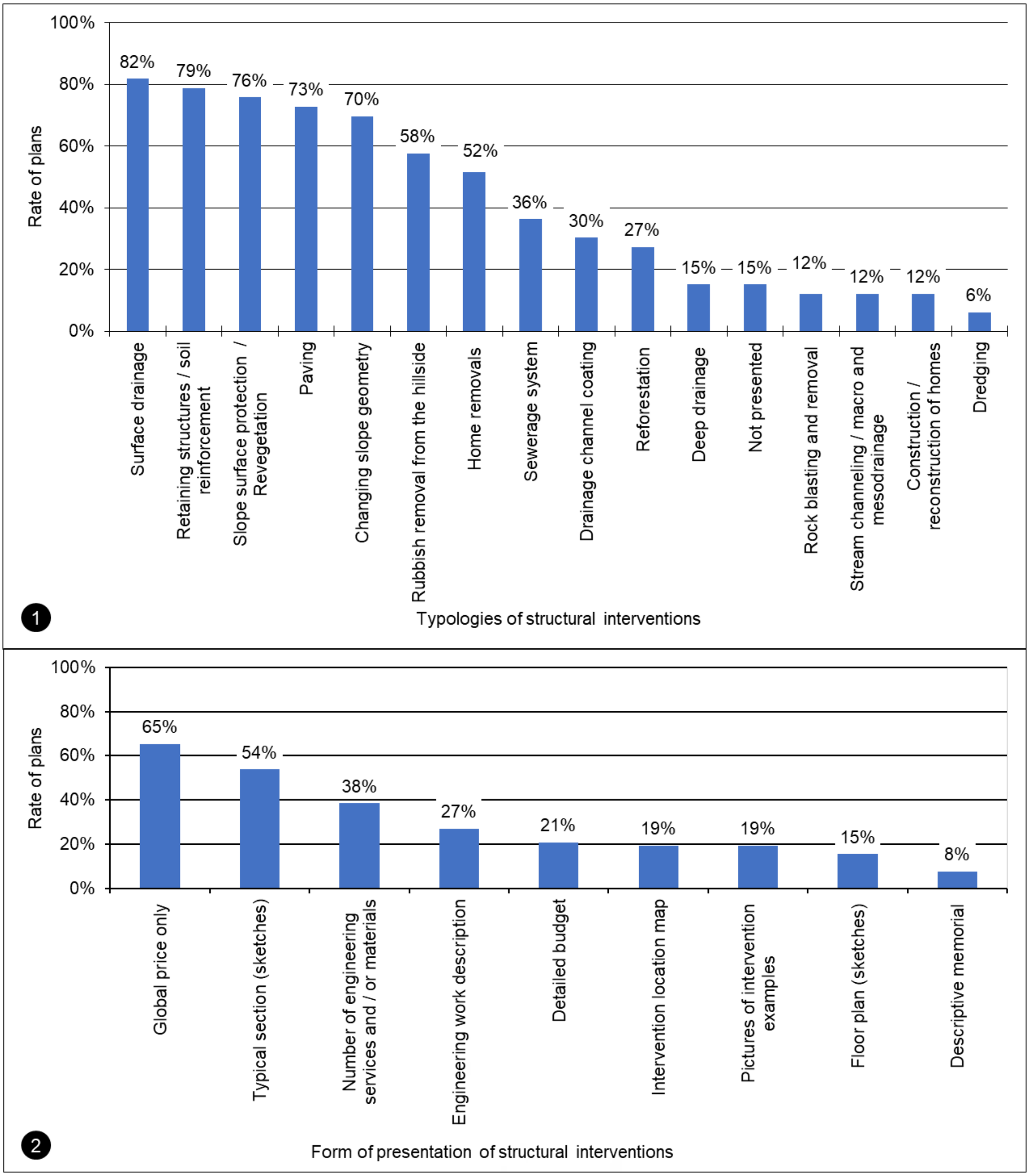
Results have indicated the prevalence of interventions focused on landslides, and it has evidenced greater demand from the investigated municipalities to deal with this type of threat by implementing structural actions. In addition to traditional interventions to promote immediate slope stabilization, such as building retaining walls, the assessed PMRRs proposed actions to deal with underlying factors, such as implementing sewage networks and paving. This factor is a true progress in this field, since these plans addressed the physical issue in a more comprehensive way. It is also noteworthy that, although housing removals were predicted by approximately 50% of PMRRs, only 6% of them predicted the construction of new houses. This finding has evidenced a fragmented approach to what comprehensive risk management should be, a fact that led to delayed housing provision for homeless families. Thus, in its turn, this process led to severe social consequences (MARCHEZINI, 2011).

Figure 5 - Area of risk sectors. 1) Distribution of PMRRs, based on individual mean area of landslide-risk sectors; 2) total area of high and very high landslide-risk sectors and their rate, in comparison to the total extension of the investigated municipality



Source: Elaborated by the authors, 2023.

Figure 6 – Distribution of aspects associated with the proposed structural actions; 1) typologies of structural actions; 2) action presentation forms



Source: Elaborated by the authors, 2023.

The elaboration of basic projects for the proposed structural interventions is not part of PMRRs' scope, which actually encompasses conceptual projects to inform intervention type and location, as well as basic data to enable budget estimates. However, less than 50% of PMRRs presented sketches of the proposed interventions, less than 25% of them showed the location of the construction works in the plan and only 25% presented the budget composition; it opened room for technical and economic uncertainties about the interventions (Fig. 6-2). These uncertainties affect the following process stages, mainly resource provision, capture and use at the time to plan executive projects and construction works, as well as the hiring, implementation and supervision of interventions to be done.

c) Cost estimates of proposed structural interventions

It is essential estimating the costs of structural interventions, not only to define the amount of money necessary to carry out this DRR action type, but also to set one of the hierarchical criteria used to prioritize sectors, as previously addressed.

Indicators, such as total cost of interventions, divided by the number of homes in the sectors, were established to enable comparing municipalities with different numbers of homes and risk sectors. This calculation was performed for 19 municipalities whose PMRRs provided the necessary information to do so (Figure 7). Five (5) of these municipalities presented geodynamic and hydrological risks (LS+FF+IN: landslides, flash floods and gradual floods), whereas the other 14 only presented risks associated with geodynamic processes (LS). It was not possible separating the cost of measures focused on mitigating geodynamic and hydrological risks in municipalities presenting both process types. As previously mentioned, values were corrected, based on using Rio de Janeiro State's prices from March 2020 as a reference, to enable the joint analysis of the investigated PMRRs.

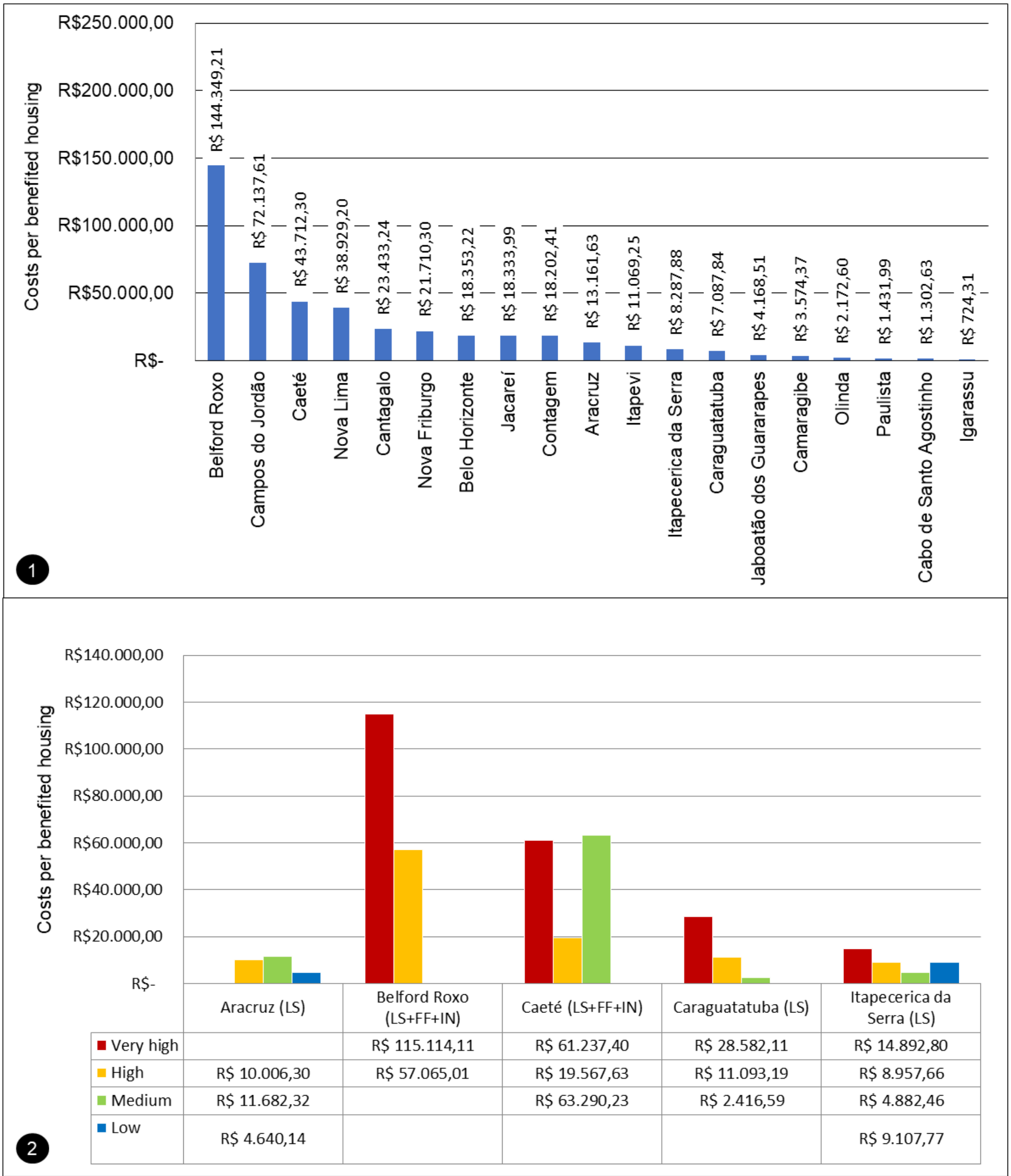
Based on the comparative summary shown in Figure 7, the mean cost of interventions per household (R$ 15,383.08) associated with the risk of landslides was significantly lower than the one associated with landslide-associated and hydrological risks (R$ 53,767.28). If one assumes that the mean value of interventions per household, in areas only at risk of landslides, is the same in both areas, the mean value of interventions per household in areas at hydrological risk can be estimated as the difference between the aforementioned values - i.e., R$ 38,384.20. Based on this estimate, it is possible seeing that the mean cost of structural interventions proposed for areas at hydrological risk per household is approximately 2.5 times the mean cost of structural interventions proposed for areas presenting geodynamic risks. It is worth emphasizing the high variation observed in the cost of structural interventions per household between municipalities, which recorded standard deviation higher than the mean value. The causes for this variation may be associated with differences among local physiographic specificities, solution types adopted by designers, different household densities in the risk areas, and inaccuracies in intervention cost estimates, among others.

These calculations were also carried out to portray cost parameters based on degrees of risk. It was only possible finding these parameters for five PMRRs because they were the only ones providing information on costs per risk degree, separately (Figure 7). Because it was a small sample, municipalities presenting geodynamic and/or hydrological processes were included in the same survey; only two of them (Belford Roxo and Caeté) presented both process types. However, these two municipalities presented cost per household significantly higher than that of municipalities with exclusively geodynamic processes, at all risk degrees, as expected from the previous results. The mean cost of structural interventions per household was approximately R$ 14.7 thousand in sectors at high and very high risk of landslides; this value was very close to the mean value observed for the sample comprising 19 municipalities. As for the sectors at high and very high risk of geodynamic and hydrological processes, the mean price of structural interventions per household was R$ 63.2 thousand; it was 18% higher than the mean value observed for the aforementioned sample.

Moreover, the cost of interventions per household in very high-risk sectors was higher than that observed for households in the high-risk ones, in all cases - the cost ratio (cost in very high-risk sectors / cost in the high-risk ones) ranged from 1.7 to 3.1. However, the cost of interventions per household in medium-risk areas (whether it was only geodynamic risk, or geodynamic and hydrological risk) can be equal to or exceed the cost observed in high-risk areas (Aracruz and Caeté). In addition, interventions in low-risk areas in Itapecerica da Serra exceeded those performed in high-risk areas.

Results in the current study enabled estimating the order of magnitude of costs per household under different risk conditions. On the other hand, the variation observed between these costs is yet another result indicating the need of improving and standardizing technical criteria adopted for risk mapping and for structural intervention design.

Figure 7 – Mean cost of structural interventions per household located in geodynamic- and/or hydrological-risk areas (reference prices - RJ - March 2020)



Comparative summary				
	Mean	Maximum	Minimum	Standard deviation
Total cost / n. of households (LS)	R$ 15,383.08	R$ 72,137.61	R$ 724.31	R$ 19,318.64
Total cost / n. of households (LS + FF + IN)	R$ 53,767.28	R$ 144,348.21	R$ 3,574.37	R$ 62,571.75

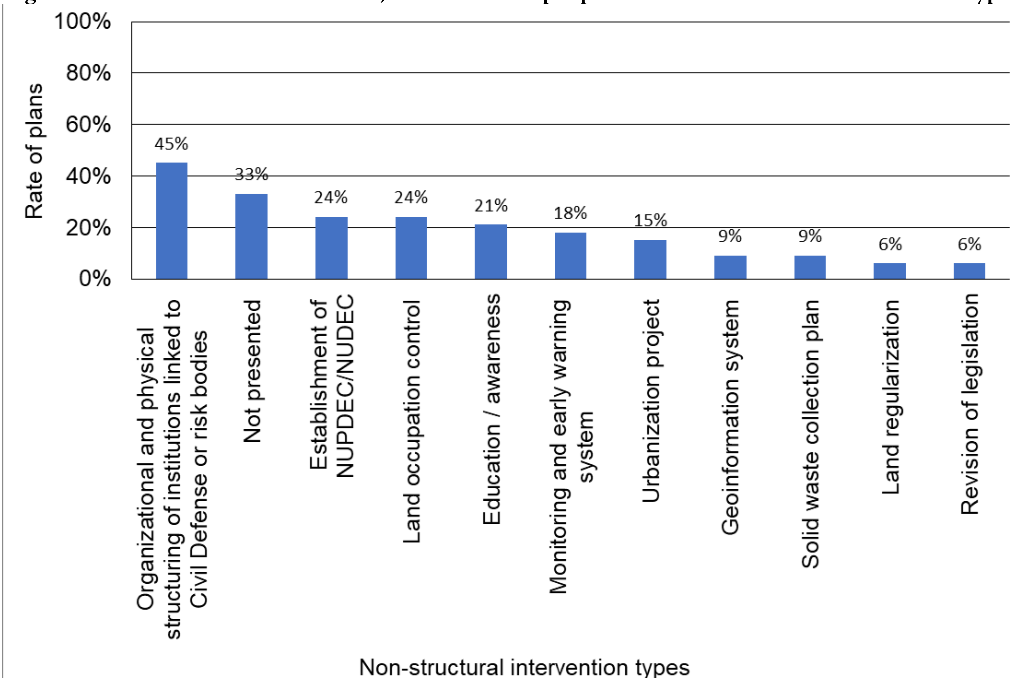
Source: Elaborated by the authors, 2023.

d) Proposed non-structural intervention types

Figure 8 shows the distribution of proposed non-structural intervention types. Almost a third of PMRRs did not mention these actions, despite the essential role played by them in communities' vulnerability reduction processes and, consequently, their key role as necessary as structural interventions. Although 67% of PMRRs have mentioned a wide variety of these actions, if one analyzes each of these actions, in separate, the rate of PMRRs proposing them is very low. No PMRR presented the estimated costs for the execution of non-structural actions, a fact that evidenced a precarious way of proposing these actions in comparison to the structural ones.

The organizational and physical structuring of Civil Defense bodies was the non-structural action mostly cited (45%) in plans including this action type. It is worth emphasizing the relevance of this institution, since, in local risk management processes - the scope the PMRR is directed to -, "it is up to the main body of the Municipal Protection and Civil Defense System to manage the demands for protection and civil defense and to work together with sectoral bodies in order to plan and define their performance in integrated prevention, mitigation, preparation, response and recovery actions" (BRASIL, 2017). It is also worth emphasizing the low indication rate observed for educational actions (21%), which are a vital instrument used to engage the population in reducing disaster risks (MENDONÇA; VALOIS, 2017; MARCHEZINI et al., 2019), besides being strongly recommended by the Sendai Framework for Disaster Risk Reduction.

Figure 8 - Distribution of PMRRs, based on the proposed non-structural intervention types



Source: Elaborated by the authors, 2023.

Conclusions and final remarks

The current study enabled defining the typical profile of Brazilian PMRRs, which are one of the main risk management instruments used in the country, as well as highlighting their typical features and gaps. Despite the time frame and the limited number of analyzed documents (33 PMRRs available on the website of the Ministry of Regional Development), assumingly, conclusions in the present research can be used by public managers and specialized companies for PMRR elaboration purposes.

The analyzed plans have evidenced bias in the approach to risks, since they mainly focused on issues associated with the physical process of threats, to the detriment of social aspects. In fact, there was high prevalence of professionals who act on physical processes (susceptibility) to the detriment of those who work in the social field (vulnerabilities). Thus, a significant number of plans did not mention non-structural actions focused on reducing risks and, whenever they did so, the described actions were poorly detailed and did not have their implementation costs estimated. The low population participation in the process of elaborating the plans also stood out.

With respect to the adopted risk mapping method, it was possible observing little mention to the cartographic scale, low use of landslide and floods inventory, high variation in the set of physical conditions taken into consideration on the hazard estimation, rare inclusion of the vulnerability component and a wide variety of hierarchical criteria applied to risk sectors.

There was high prevalence of proposition plans providing little details about risk reduction actions.

Despite the high variation among PMRRs, the current study has found some quantitative parameters associated with risk areas that, altogether, can contribute to different estimates for public policies, namely: territorial extension of high- and very high-risk sectors showing geodynamic (landslide) and/or hydrological processes (flash floods and gradual flooding) ranged from 0.1% to 1.2% of the total area of the investigated municipalities; the mean cost of structural interventions per household in geodynamic risk areas was approximately R$ 15,000.00, whereas the one observed for hydrological risk areas was approximately 2.5 times this amount; the mean cost of structural interventions per household observed for areas at high or very high geodynamic and hydrological risks was approximately R$ 63.2 thousand.

Based on these observations, the authors of the current study believe that PMRRs can be improved as follows:

- by requiring the team accounting to elaborate the plans to be formed by professionals capable of approaching - in a balanced way - physical and social aspects necessary to estimate and reduce risks, as well as for guaranteeing the incorporation of population's vision and needs to the process;

- by standardizing and regulating the risk mapping method;

- by encouraging the use of geoprocessing tools to spatialize and integrate data about different risk factors, preferably the ones associated with quantitative methods, to reduce subjectivities;

- by holding municipalities accountable for building and maintaining a database on the occurrence of such events, regardless of their impacts;

- by demanding better details about structural interventions, mainly about the non-structural ones;

- by requiring a budgetary estimate of structural and non-structural interventions separated by risk sector;

Despite the important role played by PMRRs in integral disaster risk management processes, it is worth emphasizing that they must "interact with" other equally important instruments, such as the Aptitude to Urbanization Geotechnical Chart, the Contingency Plan / Response Operations Plan, the Pre/Post-Disaster Recovery Plan, the Master Plan, and the Integrated Metropolis Development Plan (whenever applicable), among others.

Finally, given the innovative nature of PMRRs in the Brazilian public policy, the challenge of practicing interdisciplinarity required by this topic, as well as changes in geodynamic and hydrological disaster scenarios that have been observed overtime, surveys, such as the one performed in the current study, should be often carried out, and their results should be discussed with different actors involved in this field, in order to help improving plan elaborations.

Acknowledgments

The authors thank the support by the National Council for Scientific and Technological Development (CNPq).

References

ALCÁNTARA-AYALA, I; MORENO, A.R. Landslide risk perception and communication for disaster risk management in mountain areas of developing countries: a Mexican foretaste. Journal of Mountain Science, v.13, n. 12, p. 2079-2093, 2016.

ALHEIROS, M.M. O Plano Municipal de Redução de Risco. *In*: CARVALHO, C. S.; GALVÃO, T (eds). **Prevenção de riscos de deslizamentos em encostas: guia para elaboração de políticas municipais**. Brasília: Ministério das Cidades, 2006.

BEGG, C. Power, responsibility and justice: A review of local stakeholder participation in European flood risk management. **Local Environment**, 23(4), p. 383–397, 2018.

BITAR, O. Y. **Cartas de suscetibilidade a movimentos gravitacionais de massa e inundações. Nota técnica explicativa**. São Paulo: IPT–Instituto de Pesquisas Tecnológicas do Estado de São Paulo; Brasília: CPRM–Serviço Geológico do Brasil, 2014.

BRASIL. Ministério das Cidades / Instituto de Pesquisas Tecnológicas – IPT. **Mapeamento de Riscos em Encostas e Margem de Rios** / Carvalho, C. S.; Macedo, E. S.; Ogura, A.T. (orgs) – Brasília: Ministério das Cidades; Instituto de Pesquisas Tecnológicas – IPT, 2007

BRASIL. Ministério das Cidades. **Orientação Operacional** N°. 01/2011, Brasília, DF: Ministério das Cidades, 2011.

BRASIL. Lei N° 12.608, de 10 de abril de 2012. Institui a Política Nacional de Proteção e Defesa Civil [...]. **Diário Oficial da União**, Brasília, DF, 10 abr. 2012.

BRASIL. Ministério da Integração Nacional. Secretaria Nacional de Proteção e Defesa Civil. **Módulo de formação: noções básicas em proteção e defesa civil e em gestão de riscos: livro base**. Brasília, DF, 2017.

BRASIL. Ministério do Desenvolvimento Regional. Secretaria de Proteção e Defesa Civil. Universidade Federal de Santa Catarina. Centro de Estudos e Pesquisas em Engenharia e Defesa Civil. **Atlas Digital de Desastres no Brasil**. Brasília: MDR, 2022.

CAIXETA, K. F.; MASIERO, D. O apoio do governo federal à elaboração de planos municipais de redução de riscos (PMRR´s). *In*: ENCONTRO NACIONAL DE ESTUDANTES DE ENGENHARIA AMBIENTAL, 14., 2016, São Paulo. **Anais** [...]. São Paulo: Blucher, 2016.

CARVALHO, C. S.; GALVÃO, T. Ação de Apoio à Prevenção e Erradicação de Riscos em Assentamentos Precários. *In*: CARVALHO, C. S.; GALVÃO, T (eds). **Prevenção de riscos de deslizamentos em encostas: guia para elaboração de políticas municipais**. Brasília: Ministério das Cidades, 2006.

CARVALHO, C. S.; GALVÃO, T. (Ed.). **Prevenção de riscos de deslizamentos em encostas: guia para elaboração de políticas municipais**. Brasília: Ministério das Cidades, 2006.

CEPED/UFSC - Centro de Estudos e Pesquisas em Engenharia e Defesa Civil/ Universidade Federal de Santa Catarina. **Atlas brasileiro de desastres naturais 1991 a 2012**. Florianópolis, 2013.

CEMADEN - Centro Nacional de Monitoramento e Alertas de Desastres Naturais. São José dos Campos. **Municípios Monitorados**. Available at <http://www2.cemaden.gov.br/municipios-monitorados-2/> Access on Oct. 31st, 2020.

. Mapeamento de Riscos. *In*: CARVALHO, C. S.; GALVÃO, T (eds). **Prevenção de riscos de deslizamentos em encostas: guia para elaboração de políticas municipais**. Brasília: Ministério das Cidades, 2006.

CRUDEN, D. M.; VARNES, D. J. Landslides: investigation and mitigation. **Transportation research board special report**, Washington, n. 247, 1996.

DA-SILVA-ROSA, T. et al. Environmental education as a strategy for reduction of socio-environmental risks. **Ambiente & Sociedade**, São Paulo, v. 18, n. 3, p. 209-228, 2015.

DUTRA, A. S. **Gestão de Desastres e Serviço Social: o trabalho de assistentes sociais junto aos** órgãos **municipais de proteção e defesa civil**. 2. ed. Curitiba: Appris, 2021.

FELL, R. et al. Guidelines for landslide susceptibility, hazard and risk zoning for land use planning. **Engineering Geology**, v. 102, n. 3-4, p. 85-98, 2008.

FORREST, S. A. et al. Emerging citizen contributions, roles and interactions with public authorities in Dutch pluvial flood risk management. **International Journal of Water Resources Development**, v. 37, n. 1, p.1–23, 2021.

GUZZETTI, F. et al. Landslide hazard evaluation: a review of current techniques and their application in a multi-scale study, Central Italy. **Geomorphology**, v. 31, p. 181-216, 1999.

HOLCOMBE, E.; ANDERSON, M. Tackling landslide risk: Helping land use policy to reflect unplanned housing realities in the Eastern Caribbean. **Land Use Policy**, v. 27, n. 3, p. 798-800, 2010.

IBGE - INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Perfil dos municípios brasileiros: pesquisa de informações básicas municipais 2017**. Rio de Janeiro, RJ, 2018.

IBGE - INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Sistema Nacional de Pesquisa de Custos e** Índices **da Construção Civil SINAPI – Resultados de Março de 2020.** Available at <https://biblioteca.ibge.gov.br/visualizacao/periodicos/242/ind_sinapi_2020_mar.pdf> Access on May 31st, 2020.

KLIMEŠ, J. et al. Community participation in landslide risk reduction: a case history from Central Andes, Peru. **Landslides** , v. 16, 1763–1777, 2019.

MALAMUD, B. D.; PETLEY, D. Lost in translation. **Public Review: Science and technology**. n. 2 p. 164-169, 2009.

MARCHEZINI, V. As ciências sociais nos desastres: um campo de pesquisa em construção. **Rev. Bras. de Informação Bibliográfica em Ciências Sociais - BIB**, São Paulo, n. 83, p. 43-72, 2017.

MARCHEZINI, V. Temporary shelters in disaster: strategies and symbolic meanings of displaced people to survive in quasi-public spaces in Brasil. In: INTERNATIONAL CONFERENCE OF YOUNG URBAN RESEARCHERS, 2011, Lisboa. **Anais** [...]. 2, v. 3, p. 47-58, 2011.

MARCHEZINI, V. et al. Educação para Redução de Riscos de Desastres: Experiências Formais e Não-Formais no Estado do Rio de Janeiro. **Anuário do Instituto de Geociências**, Rio de Janeiro, n. 42, p. 102-117, 2019.

MDR - Ministério do Desenvolvimento Regional. Brasília, 2022. Available at < **https://www.gov.br/mdr/pt-br/assuntos/desenvolvimento-regional/acoes-e-programas**> Access on May 31st, 2022.

MENDONCA, M. B.; GULLO, F.T. Landslide risk perception survey in Angra dos Reis (Rio de Janeiro, southeastern Brazil): A contribution to support planning of non structural measures.

Land Use Policy, v. 91, 2020.

MENDONCA, M.B.; SILVA, D. L.; ASSIS, L. E.; SOUZA, L. A.; SILVA, U. M.; ROQUE, L.; MARQUES, E. A. G.; FREITAS, A. C. Percepção de Risco Associado a Deslizamentos por Parte da População do Município de Além Paraíba, Minas Gerais. *In*: SIMPÓSIO PANAMERICANO DE DESLIZAMENTOS, 5., 2018, Salvador **Anais** [...].Associação Brasileira de Mecânica dos Solos e Engenharia Geotécnica. 2018.

MENDONÇA, M. B.; VALOIS, A. S. Disaster education for landslide risk reduction: an experience in a public school in Rio de Janeiro State, Brazil. **Natural Hazards**, v. 89, n. 1 p. 351-365, 2017.

MIGUEZ, M.; VERÓL, A.; DI GREGORIO, L.T. **Gestão de riscos e desastres hidrológicos**. Rio de Janeiro: Elsevier Brasil, 2018.

QUEIROZ FILHO, A. P. Sobre as origens da favela. **Mercator**, v. 10, n. 23, p. 33-48, 2011.

ROBINSON, S.J. How can psychology inform disaster research? **Procedia Engineering**, v. 212, p. 1083-1090, 2018.

UN. **Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation**. Conference on Natural Disaster Reduction. 1994. Available at <https://www.preventionweb.net/publication/yokohama-strategy-and-plan--action-safer-world-guidelines-natural-disaster-prevention > Access on Jul. 20th, 2021.

UNDRR - United Nations Office for Disaster Reduction. **Terminology**. Available at < https://www.undrr.org/terminology> Access on Sep. 16th, 2022.

UNISDR. **Hyogo framework for action 2005–2015: Building the resilience of nations and communities to disasters**. World Conference on Disaster Reduction. Geneva: United Nations International Strategy for Disaster Reduction, 2005.

UNISDR. **Sendai framework for disaster risk reduction 2015–2030.** Third UN World Conference. Sendai, Japan, 2015.

VALENCIO, N. et al. **Sociologia dos desastres - construção, interfaces e perspectivas no Brasil**. São Carlos: RiMa Editora, 2009.

WEHN et al. **Participation in flood risk management and the potential of citizen observatories: a governance analysis. Environ. Sci. Policy**, v. 48 , p. 225-236, 2015.

WISNER, B. **Vulnerability as concept, model, metric, and tool.** Oxford research encyclopedia of natural hazard science. 2016.

WILCHES-CHAUX, G. La vulnerabilidad global. *In*: MASKREY, A. (ed.) **Los Desastres no son naturales**. Colombia: Tercer Mundo Editores, Colombia, 1993. p. 11–44.

Marcos Barreto de Mendonça

✉ mbm@poli.ufrj.br

ORCiD: https://orcid.org/0000-0002-0708-9728

Submitted on: 15/09/2020
Accepted on: 07/12/2022
2023;26e:02072

Leandro Torres Di Gregorio

✉ leandro.torres@poli.ufrj.br

ORCiD: https://orcid.org/0000-0001-8140-4151

Christine de Oliveira Silva Alfradique

✉ christine.alfradique@poli.ufrj.br

ORCiD: https://orcid.org/0009-0006-5014-3319

AMBIENTE & SOCIEDADE 25 anos años years

Diagnóstico e discussão sobre Planos Municipais de Redução de Riscos no Brasil

Marcos Barreto de Mendonça
Leandro Torres Di Gregorio
Christine de Oliveira Silva Alfradique

São Paulo. Vol. 26, 2023
Artigo Original

Resumo: Em 2003, mediante o cenário de desastres associados a deslizamentos e inundações, o Governo Federal Brasileiro iniciou um programa de incentivo à elaboração de Planos Municipais de Redução de Riscos (PMRRs). Diante do ineditismo da ação e da variedade de instituições responsáveis pela sua execução, envolvendo diferentes recursos materiais e humanos, é importante dar-se a conhecer como os PMRRs vêm sendo construídos para, possivelmente, se buscar seu aperfeiçoamento. O presente trabalho realizou o levantamento de informações sobre os 33 PMRRs disponibilizados no site do Ministério do Desenvolvimento Regional, focando-se nos seguintes itens: composição da equipe técnica envolvida; participação popular; mapeamento de risco; tipologias e custos de ações estruturais propostas; ações não estruturais. Dentre as conclusões, destaca-se a observação de uma excessiva assimetria de abordagem dos PMRRs a favor dos aspectos físicos do problema em detrimento dos sociais, influenciando o método de estimativa do risco e as medidas mitigadoras propostas.

***Palavras-chave*:** Desastres; Deslizamentos; Inundações; Gestão de Riscos; Plano Municipal de Redução de Riscos.

AMBIENTE & SOCIEDADE
25 anos años years

SciELO

Diagnóstico y discusiones sobre Planes Municipales de Reducción de Riesgos en Brasil

Marcos Barreto de Mendonça
Leandro Torres Di Gregorio
Christine de Oliveira Silva Alfradique

São Paulo. Vol. 26, 2023
Artículo Original

Resumen: En 2003, ante los escenarios de desastre asociados a deslizamientos e inundaciones, el Gobierno Federal de Brasil inició un programa para incentivar el desarrollo de Planes Municipales de Reducción de Riesgos (PMRRs). Dada la novedad de la acción y la variedad de instituciones responsables de su ejecución, que involucran diferentes recursos materiales y humanos, es importante dar a conocer cómo los PMRR se han construido para, posiblemente, buscar su mejoría. El presente trabajo investigó los documentos de los 33 PMRR disponibles en el sitio web del Ministerio de Desarrollo Regional, enfocándose en los siguientes ítems: composición del equipo técnico involucrado, participación popular, mapeo de riesgos, tipologías y costos de las acciones estructurales propuestas, y acciones no-estructurales. Entre las conclusiones, se destaca la observación de una excesiva asimetría en el abordaje de los PMRR a favor de los aspectos físicos del problema en detrimento de los sociales, influyendo en el método de estimación del riesgo y las medidas mitigadoras propuestas.

Palabras-clave: Desastres; Deslizamientos de tierra; Inundaciones; Gestión de riesgos; Riesgos socioambientales.