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Social Protection Challenges: the exposure of Social Assistance Reference Centers to flood and landslide risks

Desafios à proteção social: a exposição dos Centros de Referência de Assistência Social a riscos de inundações e deslizamentos

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ABSTRACT

The Social Assistance Reference Centers (CRAS) are considered the main entry points for Brazil's Unified Social Assistance System (SUAS), which provides basic social protection to families in situations of vulnerability. Given the territorial importance of these services, this article analyzes the exposure of CRAS units to flood and landslide risks. Based on the integration of the CRAS Development Index (IDCRAS) and the Statistical Territorial Base of Risk Areas (BATER), 2,277 CRAS units located in 806 Brazilian municipalities were examined. The methodology considered the proximity of these facilities to BATER-designated areas, as well as a qualitative analysis of the IDCRAS dimensions, which assign scores to each CRAS unit based on its physical infrastructure, human resources, and the services and benefits provided. The pilot area for implementing the methodology was the Paraíba do Sul River Basin, a region historically affected by disasters. The results showed that 12% (n = 273) of the total CRAS units (n = 2,277) are located within BATER areas, while an additional 6% (n = 136) are situated within a 0.1 to 50-meter buffer from BATER boundaries. Of an estimated population of 5.5 million, 9.8% (528,173 people) reside in BATER areas. Among these, 28.63% (151,260 people) live in households without access to a general sewage network. The qualitative analysis of IDCRAS revealed that many exposed facilities exhibit pre-existing structural deficiencies, such as an inadequate number of rooms or limited capacity relative to demand, despite performing well in terms of human resources and services provided. This analysis highlights that these structural shortcomings may further exacerbate the challenges of assisting the population during emergencies. The developed methodology demonstrates potential for intersectoral articulation by integrating the IDCRAS and BATER databases, generating knowledge to support SUAS preparedness and strengthen Brazil's civil protection and disaster risk management systems.

Keywords: Disaster; Vulnerability; Extreme weather events; Unified Social Assistance System; Climate adaptation.

RESUMO

Os Centros de Referência da Assistência Social (CRAS) são considerados a porta de entrada do Sistema Único de Assistência Social (SUAS) no oferecimento da proteção social básica às famílias em situação de vulnerabilidade. Dada a importância do oferecimento destes serviços no território, o presente artigo analisa a exposição dos CRAS a riscos de inundação e de deslizamento. A partir da integração entre o Índice de Desenvolvimento dos CRAS (IDCras) e a Base Territorial Estatística de Áreas de Risco (BATER) foram analisados 2.277 CRAS localizados em 806 municípios brasileiros. A metodologia considerou a distância dos equipamentos às áreas de BATER, bem como uma análise qualitativa dos eixos do IDCras, que atribui pontuação à estrutura física, aos recursos humanos e aos serviços e benefícios de cada CRAS. A área-piloto do estudo foi a Bacia Hidrográfica do Rio Paraíba do Sul, região historicamente afetada por desastres. Os resultados evidenciaram que 12% (n = 273) do total de unidades do CRAS (n = 2277) estão inseridas na BATER e outros 6% (n = 136) estão inseridas no intervalo de 0,1 a 50 metros da BATER. Do total populacional, aproximadamente 5,5 milhões, 9,8% (528.173 pessoas) estão inseridas em áreas BATER. Destas, 28,63% (151.260) moradores não têm acesso ao lançamento de esgoto na rede geral. A análise qualitativa do IDCras revelou que os equipamentos expostos apresentam deficiências estruturais, como número insuficiente de salas ou capacidade limitada diante do número de pessoas atendidas, ainda que com boa qualificação em recursos humanos e serviços oferecidos. Esta análise evidencia que as deficiências estruturais pré-existentes potencializarão os desafios no atendimento à população em situações de emergência. A metodologia desenvolvida demonstra potencialidades de articulação intersetorial para a produção de conhecimento sobre riscos de desastres, e de utilização das bases de dados do IDCras e da BATER na geração de conhecimento para subsidiar a preparação do SUAS e do sistema de proteção e defesa civil na gestão de risco de desastres no Brasil.

Palavras-chave: Desastre; Vulnerabilidade; Eventos climáticos extremos; Sistema Único de Assistência Social; Adaptação climática.

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Introduction

Between 2002 and 2023, the *Secretaria Nacional de Proteção e Defesa Civil* (SEDEC) [National Secretariat for Civil Defense], under the *Ministério da Integração e do Desenvolvimento Regional* (MIDR) [Ministry of Integration and Regional Development of Brazil], recorded 31,080 declarations of Emergency Situation or State of Public Calamity across 4,382 municipalities, representing 78.67% of those in Brazil (Brasil, 2023b). SEDEC registered 179.1 million disaster-affected individuals and 5.09 million displaced persons, that is, people left without housing and whose social protection was at risk. Economic losses were also significant. Between 1991 and 2023, disaster-related economic losses in Brazil were estimated at BRL 570.64 billion (Brasil, 2023b).

According to the Digital Atlas of Disasters in Brazil, disasters associated with hydrological hazards, including urban flooding, heavy rainfall, flash floods, riverine floods, and mass movements, caused 4,286 deaths between 1991 and 2024, affected 92.93 million people, and resulted in economic losses of approximately BRL 150 billion. These hazardous events accounted for 83% of all disaster-related deaths and approximately 92% of the material damage in the country (Brasil, 2023b).

These impacts resulting from water-related disasters and other crises, such as the COVID-19 pandemic, have created growing challenges for social protection systems, prompting scientists and national and international organizations to debate how social protection should be structured in the context of climate change and disaster risks (Costella et al., 2024; Devereux and Solórzano, 2025). These challenges are worsened by additional dynamic pressures such as the lack of urban planning, population growth, and land-use patterns, and require new approaches that engage communities and public authorities in disaster risk reduction, as advocated by international frameworks such as the Sendai Framework for Disaster Risk Reduction (Ferreira et al., 2023; Ferreira et al., 2026). However, these social protection issues have received limited attention in social studies of disasters (Marchezini et al., 2025; Valencio et al., 2025; Wisner et al., 2025), including within the field of social work (Alonso Moro et al., 2025), particularly from a preventive perspective (Boetto et al., 2021).

The Intergovernmental Panel on Climate Change (IPCC) identifies the increasing occurrence of heavy rainfall events in South America as one of the impacts of climate change (IPCC, 2023a). The intensification of these extreme events is likely to increase the frequency of disasters associated with hydrological hazards, further challenging the adaptive capacity of organizations and governments to prepare for and respond to such disasters and to ensure effective social protection. Adaptation strategies aimed at reducing climate-related risks and vulnerabilities can enhance the capacity of communities and households to anticipate and adequately respond to the impacts of climate change, for example, through risk and vulnerability mapping (IPCC, 2023b). Other climate adaptation strategies that can reduce the pressure on infrastructure systems and public services, which is common during disasters, include early warning systems and strengthening intersectoral governance (IPCC, 2023b). Both strategies can use risk mapping to support their implementation.

In Brazil, the *Sistema Nacional de Proteção e Defesa Civil* (SINPDEC) [National System for Protection and Civil Defense] has mobilized the *Sistema Único de Assistência Social* (SUAS) [Unified Social Assistance System] to organize disaster response actions, including the administration of temporary shelters in schools and sports facilities, the registration of affected families, and the collection and distribution of food parcels and other goods, among other activities. The Protection Service in Situations of Public Calamities and Emergencies, for example, was established by Resolution No. 109, dated 11 November 2009, of the *Conselho Nacional de Assistência Social* (CNAS) [National Council for Social Assistance], which approved the National Classification of Social Assistance Services. The 2008 disaster in Vale do Itajaí region, Santa Catarina state, during which 99 municipalities declared a state of emergency and 14 a state of public calamity (Brasil, 2009), was the first disaster "in which resources from the *Fundo Nacional de Assistência Social* (FNAS) [National Social Assistance Fund] were transferred to a municipality under a declared state of emergency" (Brasil, 2021b, p. 20). In addition to the 135 fatalities registered in this disaster, more than 15,000 people were affected; 9,390 residents were forced to evacuate their homes, while 5,617 people were left homeless after losing their dwellings. In the following year, FNAS, through Ordinance No. 521 of June 28, 2010 of the *Ministério do Desenvolvimento e Assistência Social, Família e Combate à Fome* (MDS) [Ministry of Social Development and Fight Against Hunger] and MDS Ordinance No. 827 of 13 December 2010, transferred financial resources to the flooded states of Pernambuco and Alagoas, "including reductions in counterpart funding requirements for the reconstruction of *Centros de Referência de Assistência Social Social* (CRAS) [Assistance Reference Centers], *Centros de Referência Especializados de Assistência Social* (CREAS) [Specialized Social Assistance Reference Centers], and facilities providing the *Serviço de Convivência e Fortalecimento de Vínculos* (SCFV) [Service for Coexistence and Strengthening of Social Bonds]" (Brasil, 2021b, pp. 20-21). One year later, in the aftermath of the 2011 disaster in the Mountainous Region of Rio de Janeiro, "there was a need to develop, in partnership with other federal agencies, a set of guidelines aimed at ensuring the comprehensive protection of children and adolescents in disasters" (Brasil, 2021b, p. 21).

In recent years, SUAS actions have expanded to include disaster prevention and preparedness. In 2021, SUAS published the Guidelines for the Implementation of the Social Assistance Policy in Contexts of Social Assistance Emergencies (Brasil, 2021b), to deepen the understanding of Social Assistance's role in emergencies by presenting a set of actions to be undertaken before, during, and after emergencies, while assigning responsibilities and competencies to each level of government, such as: (i) the need for "coordinated actions and the strengthening of local capacities: all actions should be defined in accordance with the specific demands of the affected territory and require integration among the different levels of government, to strengthen local capacities and promote coordinated responses to the consequences of emergencies" (Brasil, 2021b, p. 26); and (ii) intersectoral action, that is, the "recognition of the importance of network-based collaboration as part of an integrated emergency response system involving multiple sectors and social actors, including civil society and the institutions that are part of the SINPDEC" (Brasil, 2021b, p. 27). The guidelines also emphasize the need to map families living in disaster-prone areas and to strengthen disaster risk management (DRM) practices (Brasil, 2021b).

Wisner et al. (2025) conceptualize disaster risk as a product of the interaction among hazard(s), vulnerability, capacity for protection, and public policies on risk mitigation. Exposure is part of vulnerability and refers to the location and conditions of people, housing, infrastructure, and public facilities, such as CRAS.

Vulnerability, in turn, encompasses the characteristics and circumstances of individuals and groups that expose them to harm and limit their capacity to anticipate, cope with, resist, and recover from adverse impacts (Wisner et al., 2025). The concept of vulnerability can help explain unequal patterns of exposure to specific hazards. In this study, a hazard is a "process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation" (UNDRR, 2017). Hazards include biological, technological, geological, climatological, and hydrometeorological processes and phenomena (UNDRR, 2017; UNDRR and ISC, 2025). In Brazil, landslides and floods are among the hazards associated with the greatest numbers of fatalities and material losses (Brasil, 2023b).

Some approaches to addressing these hazards include developing flood and landslide risk maps, as defined in the *Política Nacional de Proteção e Defesa Civil* (PNPDEC) [National Policy on Protection and Civil Defense], which was established by Law No. 12,608/2012, and in Decree No. 10,692/2021, which created the National Register of Municipalities with Areas Susceptible to Major Landslides, Flash Floods, and Related Processes, as well as in the SUAS guidelines (Brasil, 2021a, 2021b). Risk areas are those susceptible to natural and/or human-induced phenomena or processes capable of causing adverse impacts (Assis Dias et al., 2018). Consequently, exposed populations are subject to physical harm, material and property losses, and impacts on mental health (Rafaloski et al., 2021).

Information on buildings and facilities in risk areas is essential for assessing the potential impacts of disasters and for supporting preparedness and prevention measures. The identification of housing exposed to hazards has been addressed by several studies (Luo et al., 2023; Fekete, 2026), demonstrating its importance in DRM. Other studies have mapped the exposure of schools to floods and landslides (Marchezini et al., 2018) and of health facilities in disaster risk areas (Silva et al., 2020). However, no studies have examined the exposure of social assistance facilities (CRAS) to floods and landslides, despite the need to operationalize data on disaster risks and social protection (Devereux and Solórzano, 2025; Santos Garcia et al., 2025; Tebaldi, 2025) to strengthen both DRM and social protection (Ed et al., 2023).

This article developed a methodology for analyzing CRAS exposure to disaster risks associated with floods and landslides. The proposed methodology integrates the CRAS Development Index (IDCRAS) with the *Base Territorial Estatística de Áreas de Risco* (BATER) [Statistical Territorial Base of Risk Areas], providing a tool to support the preparedness of SUAS and the *Força Nacional do SUAS* (FORSUAS) [National SUAS Force]. The following section presents the main aspects of IDCRAS.

CRAS development index (IDCRAS)

The municipal-level IDCRAS was developed in 2008 by the *Secretaria Nacional de Assistência Social* (SNAS) [National Secretariat for Social Assistance] and has served as a strategic indicator for evaluating the effectiveness and quality of social assistance services provided to the population, as well as for guiding management and decision-making processes related to social assistance in Brazil. Thus, IDCRAS is used both to assess the performance of CRAS units and to identify areas requiring improvement, contributing to more efficient management of social assistance resources based on data collected through the SUAS Census. According to Technical Note No. 27 of 15 September 2015, three dimensions compose IDCRAS, as presented in Table 1.

Table 2 presents the indicators for the Physical Structure dimension in IDCRAS. Detailed information on the Human Resources and Services and Benefits dimensions is provided in the supplementary material because of the large number of indicators considered.

Despite the relevance of these variables, IDCRAS does not include attributes related to DRM, particularly those associated with the exposure of CRAS facilities to flood and/or landslide risks or their proximity to areas identified in the BATER. The following section provides a brief overview of BATER.

Statistical territorial base of risk areas (BATER)

Several efforts have been undertaken to improve understanding and application of DRM instruments. One of them is the BATER, which integrates demographic census data from the *Instituto Brasileiro de Geografia e Estatistica* (IBGE) [Brazilian Institute of Geography and Statistics] with flood and landslide risk maps produced by the Brazilian Geological Survey (Assis Dias et al., 2018; IBGE and CEMADEN, 2018; Alvalá et al., 2019). Each BATER polygon represents the smallest spatial unit identified by intersecting risk areas made available to the *Centro Nacional de Monitoramento e*

Table 1 – Dimensions considered in IDCRAS

Physical Structure	Assess the structure of the CRAS facility, considering aspects such as the existence of rooms for individual and group services, accessibility conditions, reception area, bathrooms, and equipment.
Human Resources	Verify whether the size of the reference team is adequate for the unit's capacity, based on the parameters established by the Basic Operational Standard for Human Resources (NOB-RH).
Services and Benefits	Assess activities carried out within the scope of the Family Protection and Comprehensive Care Service (PAIF) at the CRAS unit, the provision of the SCFV, and the number of life-cycle groups covered, as well as whether the unit performs registration and updating activities for the Cadastro Único (Single Registry).

Source: Nunes and Clemente (2015).

Table 2 – Description of SUAS Census variables for the Physical Structure dimension.

Level	Referred Families (2,500 families or 3,500 families)	Referred Families (up to 5,000 families)
Level 5	- Reception area - At least 2 service rooms, with at least 1 room accommodating 15 or more people - At least 1 administrative room - At least 2 bathrooms - Accessibility* - Equipment set including, at a minimum: 2 computers connected to the internet, printer, telephone, and an exclusive or shared vehicle	- Reception area - At least 4 service rooms, with at least 1 room accommodating 15 or more people - At least 1 administrative room - At least 2 bathrooms - Accessibility* - Equipment set including, at a minimum: 3 computers connected to the internet, printer, telephone, and an exclusive or shared vehicle
Level 4	- Reception area - At least 2 service rooms, with at least 1 room accommodating 15 or more people - At least 2 bathrooms - At least partial accessibility* - At least 1 computer connected to the internet	- Reception area - At least 4 service rooms, with at least 1 room accommodating 15 or more people - At least 2 bathrooms - At least partial accessibility* - At least 2 computers connected to the internet
Level 3	- Reception area - At least 2 service rooms - At least 1 bathroom - At least partial accessibility*	- Reception area - At least 3 service rooms, with at least 1 room accommodating 15 or more people - At least 1 bathroom - At least partial accessibility*
Level 2	- At least 2 service rooms - At least 1 bathroom	- At least 3 service rooms - At least 1 bathroom
Level 1	- Fewer than 2 service rooms OR - No bathroom OR - Building shared with an NGO, or sharing of all service rooms	- Fewer than 3 service rooms OR - No bathroom OR - Building shared with an NGO, or sharing of all service rooms

Note: *Accessibility: partial accessibility refers to accessible routes within the CRAS facility, including access to bathrooms. Source: Technical Note No. 27, Ministry of Social Development and Fight Against Hunger (2015).

Alertas de Desastres Naturais (CEMADEN) [National Center for Monitoring and Early Warning of Natural Disasters] through April 2017 using data from the 2010 Population Census. BATER enables the demographic and socioeconomic characterization of populations at risk in flood- and/or landslide-prone areas (IBGE and CEMADEN, 2018).

The BATER polygons provide an estimate of the Brazilian population living in risk areas rather than a definitive count, because BATER's accuracy depends on the spatial overlap between risk polygons and census data (census tracts, street block faces, or subnormal agglomerations) from different databases (IBGE and CEMADEN, 2018). BATER enables identification of social factors that may increase vulnerability within and around risk areas, including literacy levels, income, sanitation conditions, and water supply characteristics.

The adoption of BATER was based on the robustness of its methodology and its established use in the disaster literature (Assis Dias et al., 2018; Alvalá et al., 2019), as well as the difficulties associated with obtaining risk maps from the municipalities included in this study. The following section describes the procedures for organizing and integrating the IDCRAS and BATER databases within a Geographic Information System (GIS) environment and presents the study area.

Materials and methods

This section presents the integration of IDCRAS and BATER data and the methodological procedures adopted for the national-scale analysis. It then discusses a pilot study conducted in a river basin in southeastern Brazil.

Spatial data were obtained from the IBGE and CEMADEN (2018) and the SUAS Census (Brasil, 2023a) and processed in a GIS environment. A geospatial database was developed with polygon features for BATER data, point features for CRAS locations, and polygon features representing municipalities, states, and the river basin boundary. Spatial analyses were then performed using map algebra and by integrating multiple data sources and formats, including shapefiles (.shp) and tabular datasets (.csv and *.xlsx). Data processing and analysis were conducted using QGIS 3.22, ArcGIS Pro®, Microsoft Excel®, and RStudio.

A distance analysis was conducted between CRAS facilities and BATER areas. Distances were grouped into intervals from 0 to 5,000 meters. The first class (0 m) included CRAS facilities located within BATER areas. The remaining classes were defined as follows: 0.1-50 m, 50.1-100 m, 100.1-200 m, 200.1-500 m, 500.1-1,000 m, 1,000.1-5,000 m, and >5,000 m. These intervals were established based on the potential impacts associated with proximity to BATER areas and on mobility conditions in the surrounding area, which may be affected by traffic disruptions, road closures, detours, and other disaster-related impacts. In landslide risk analyses, previous studies have identified 500 m as a safe reference distance (Saha et al., 2005; Singh et al., 2024), the potential trajectory of mobilized material (Fernandes et al., 2024), or damage intensity, which tends to be highest within approximately 50 m of the landslide source and to decrease progressively with increasing distance over a range of several kilometers (Martinez-Carvajal et al., 2018). Intermediate distance classes between 50 and 1,000 m were defined based on the approximate duration of short walking trips (approximately 3-10 minutes) and the typical spacing between bus stops in densely populated urban areas (300-500 m), suburban areas (800-2,000 m), and express corridors (2,000-5,000 m) (Munkhbayar et al., 2025). Distances greater than 5,000 m were assumed to indicate a lower likelihood of adverse impacts associated with disasters in risk-prone areas.

At the national scale, 6,435 of the 8,309 existing BATER polygons were included in the analysis because they contained population data for census tracts in 806 municipalities. Given the requirement for simultaneous BATER and CRAS data, the analysis covered 806 municipalities, representing 14.47% of all Brazilian municipalities. These municipalities contained 2,277 CRAS units, representing 26.37% of the 8,635 units registered in the 2023 SUAS Census (Brasil, 2023a). This study adopts the principles of Open Science to promote transparency, scientific rigor, reproducibility, and knowledge sharing (Foster and Deardorff, 2017; Trinh *et al.*, 2025). Accordingly, the data used in this study are publicly available[1] on the Open Science Framework (OSF) platform.

Study area

The proposed methodology was applied to the Paraíba do Sul River Basin (PSB) in southeastern Brazil. The river basin scale is considered strategic for DRM planning, as highlighted in Articles 4, 6, and 7 of the PNPDEC (Brasil, 2012a). The PSB covers approximately 62,074 km^2 across the states of São Paulo (SP) (14,510 km^2), Rio de Janeiro (RJ) (26,851 km^2), and Minas Gerais (MG) (20,713 km^2), encompassing 184 municipalities: 88 in Minas Gerais, 57 in Rio de Janeiro, and 39 in São Paulo (Figure 1). In terms of territorial extent, the PSB represents approximately 0.7% of Brazil's land area and about 6% of the Southeastern Region.

In Rio de Janeiro State, the basin covers approximately 63% of the state's total area; in São Paulo, 5%; and in Minas Gerais, 4% (CEIVAP, 2025a, 2025b). About 5.5 million live in the PSB basin, including 1.8 million in São Paulo, 2.4 million in Rio de Janeiro, and 1.3 million in Minas Gerais. According to the SUAS Census (Brasil, 2023a), municipalities within the PSB are predominantly classified as Small I (up to 20,000 inhabitants) and Small II (between 20,000 and 50,000 inhabitants). These categories include 125 and 27 municipalities, respectively, for a total of 152 (82.60%) of the 184 municipalities within the PSB.

Results and discussion

This section presents and discusses the results of the integrated analysis on CRAS and the BATER at the national scale. Subsequently, a pilot study of the Paraíba do Sul River Basin (PSB) illustrates the results on IDCRAS across its three dimensions.

National context

The simultaneous presence of BATER areas and CRAS locations at the municipal level was needed to conduct an integrated analysis. Under this criterion, the analysis was conducted in 806 municipalities, corresponding to 14.47% of all Brazilian municipalities. These municipalities contained 2,277 CRAS units, representing 26.37% of all CRAS facilities. Figure 2 illustrates the spatial distribution of CRAS units and BATER polygons across Brazil. The orange points represent all CRAS units, the light green points indicate the CRAS units included in the analysis, and the gray polygons correspond to municipalities with BATER areas.

Figure 2 shows a greater concentration of CRAS units in the Southeast, Northeast, and South regions of Brazil, whereas the Central-West and North regions exhibit a more dispersed spatial distribution of these facilities. This pattern is primarily associated with differences in municipal area, particularly in the North Region, as

[1] The files supporting this study are available at: https://osf.io/tp2xv/overview?view_only=6c982fe812c64d9c9b738c930eeb8b61

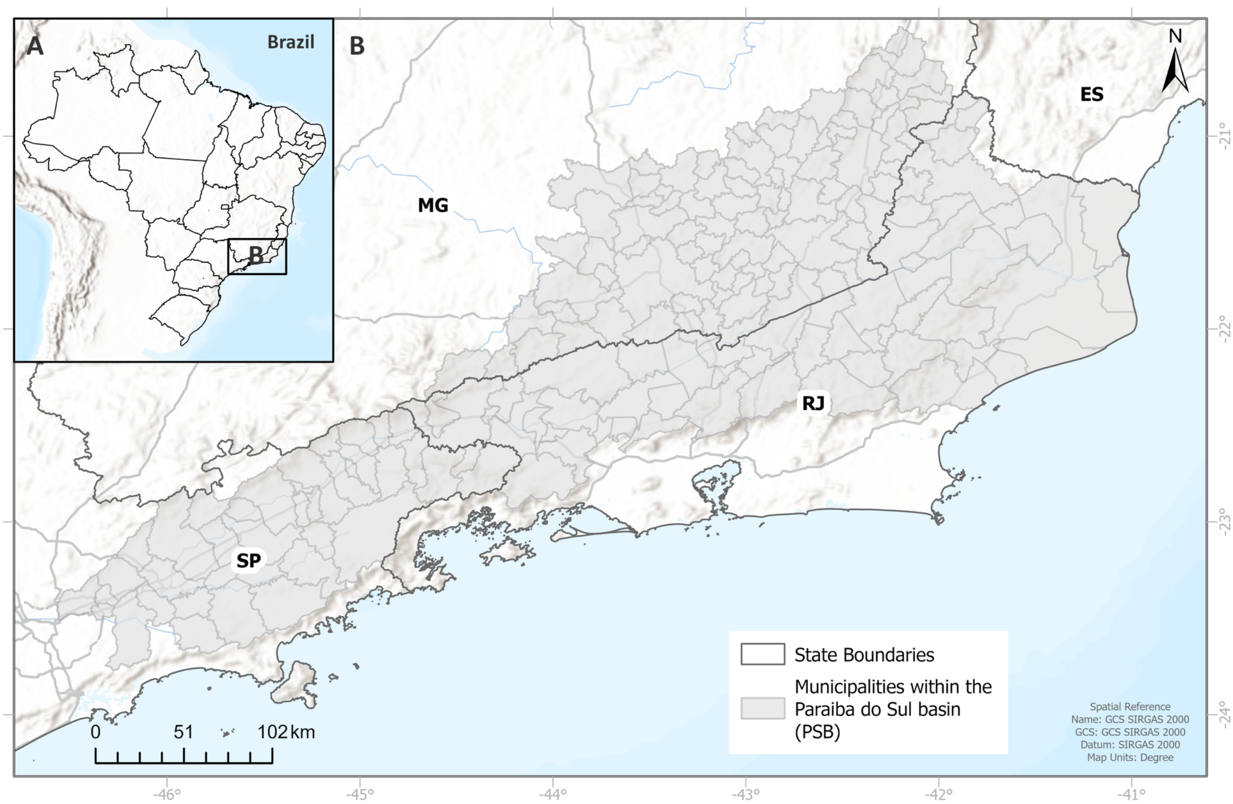

Figure 1 – Location of the Paraíba do Sul Basin (PSB) and its municipalities.
Note: (A) Location of the PSB within Brazil; (B) PSB and its municipalities.
Source: Authors' elaboration based on CEIVAP (2025a, 2025b).

well as with variations in population density across the country. Complementing Figure 2, Table 3 presents the distance classes established between CRAS units and BATER boundaries (in meters), the corresponding number and percentage of CRAS units in each class, and the number of municipalities by region.

The analysis of distance intervals revealed distinct patterns across the country's regions. The Central-West Region, for example, had the fewest municipalities included in the analysis (17), representing 2.11% of the 806 municipalities considered. This region also had only one CRAS unit located within a BATER area, while 54 units were located within the 1,000.1-5,000 m distance class from the nearest BATER boundary.

In the Brazilian Northeast, 90 of the 759 CRAS units analyzed were located within BATER areas, corresponding to 11.86% of all CRAS facilities in the region. A distribution was observed across the nearest distance classes, with 45 units (5.93%) located between 0.1 and 50 m from a BATER boundary and 44 units (5.80%) situated between 50.1 and 100 m. Together, these three classes account for 179 CRAS units located either within BATER areas or within 100 m of their boundaries, representing 23.59% of all facilities in the region. In contrast, 320 units (42.16%) were located more than 1,000 m from the nearest BATER area.

In the North, 169 of the 216 CRAS units (78.24%) were located at distances greater than 200 m from the nearest BATER boundary. Only six units were situated within BATER areas. In contrast, 41 CRAS units (18.98%) were located within 200 m of a BATER boundary.

The South region contained 336 CRAS units distributed across 130 municipalities. Of these, 31 units were located within BATER areas, corresponding to 9.23% of all CRAS facilities in the region. A noteworthy pattern was observed in the 1,000.1-5,000 m distance class, which concentrated 106 CRAS units, representing 31.55% of the regional total.

Finally, the Southeast accounted for 901 CRAS units across 291 municipalities, the largest concentration of facilities in the country. Of these, 145 units (16.09%) were located within BATER areas, while 69 (7.66%) and 54 (5.99%) were situated within the 0.1-50 m and 50.1-100 m distance classes, respectively. Together, these three classes account for 29.74% of all CRAS units in the region, including those located within BATER areas and those situated up to 100 m from their boundaries. Other distance classes, particularly those ranging

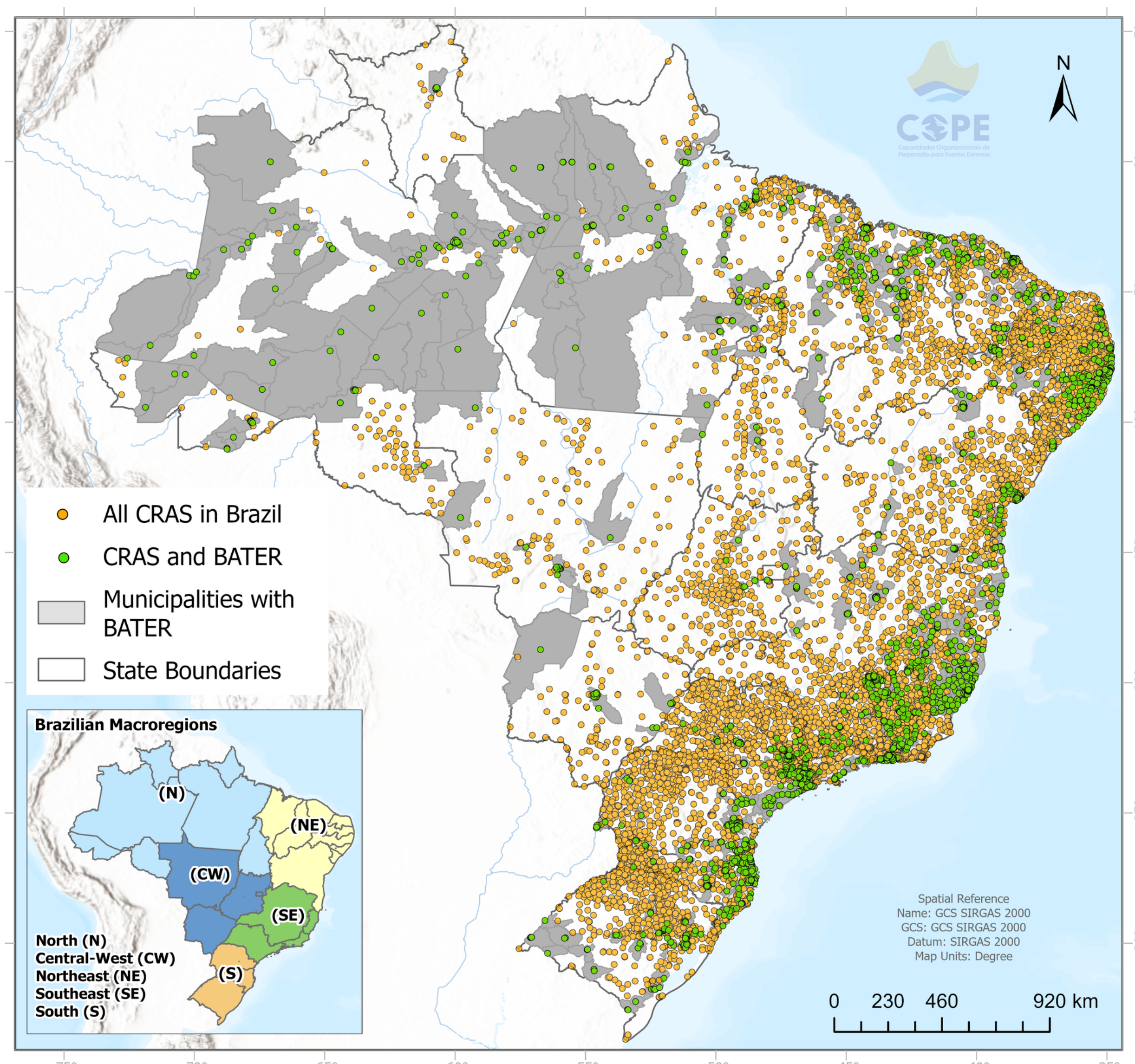

Figure 2 – Spatial distribution of CRAS units and municipalities containing BATER areas in Brazil.
Source: Authors' elaboration based on Brasil (2023) and Assis Dias et al. (2018).

Table 3 – Distribution of CRAS units according to distance classes from BATER areas, by region.

Region	Distance class (m)	CRAS (n)	CRAS (%)	Municipalities (n)
Central-West	0	1	1.54	17
	0.1 - 50	0	0	
	50.1 - 100	0	0	
	100.1 - 200	1	1.54	
	200.1 - 500	4	6.15	
	500.1 - 1,000	5	7.69	
	1000.1 - 5,000	31	47.69	
	> 5,000	23	35.38	

Region	Distance class (m)	CRAS (n)	CRAS (%)	Municipalities (n)
	Total	65	100	
Northeast	0	90	11.86	265
	0.1 - 50	45	5.93	
	50.1 - 100	44	5.80	
	100.1 - 200	56	7.38	
	200.1 - 500	120	15.81	
	500.1 - 1,000	84	11.07	
	1000.1 - 5,000	215	28.33	
	> 5,000	105	13.83	
	Total	759	100	
North	0	6	2.78	103
	0.1 - 50	10	4.63	
	50.1 - 100	11	5.09	
	100.1 - 200	20	9.26	
	200.1 - 500	41	18.98	
	500.1 - 1,000	34	15.74	
	1000.1 - 5,000	51	23.61	
	> 5,000	43	19.91	
	Total	216	100	
Southeast	0	145	16.09	291
	0.1 - 50	69	7.66	
	50.1 - 100	54	5.99	
	100.1 - 200	92	10.21	
	200.1 - 500	169	18.76	
	500.1 - 1,000	119	13.21	
	1000.1 - 5,000	170	18.87	
	> 5,000	83	9.21	
	Total	901	100	
South	0	31	9.23	130
	0.1 - 50	12	3.57	
	50.1 - 100	7	2.08	
	100.1 - 200	23	6.85	
	200.1 - 500	47	13.99	
	500.1 - 1,000	55	16.37	
	1000.1 - 5,000	106	31.55	
	> 5,000	55	16.37	
	Total	336	100	
	CRAS (n°)	2277	Municipalities (n)	806

from 100.1 to 1,000 m, comprised 380 CRAS units, representing 42.18% of the regional total.

The analysis of exposure through distance classes assessed the proximity between CRAS units and BATER areas, highlighting that, in many cases, CRAS facilities are located either within these areas or at very short distances from them. Such proximity may affect access to, or the functioning of, these facilities during disasters. This situation was evidenced during the 2024 disaster in Rio Grande do Sul, when severe flooding disrupted services in more than 69 SUAS facilities across several municipalities, including Porto Alegre, Canoas, and São Leopoldo. Among the affected facilities were CRAS units, CREAS, and Specialized Reference Centers for Homeless People[2] (Centro POP). Other examples of disaster impact on SUAS facilities include the emergencies that affected northeastern Brazil in 2010. According to the MDS (2024), both CRAS units and branches of Caixa Econômica Federal were swept away by mudflows, necessitating the establishment of alternative territorial arrangements to ensure continued access to social benefits. These factors should be considered when developing contingency plans and other DRM instruments, while also accounting for the levels of CRAS development as measured by IDCRAS.

Having described the national context of the analysis, the following section focuses on the Paraíba do Sul River Basin (PSB), examining its municipalities and the portions of the basin located within the states of Minas Gerais, Rio de Janeiro, and São Paulo.

Study area: Paraíba do Sul River Basin

The importance of the river basin scale as a unit of analysis has been evidenced during major disasters in Brazil, including those that occurred in the states of Rio Grande do Sul (2024) (Alvalá et al., 2024), Acre (2015) (Silva et al., 2023), Alagoas and Pernambuco (2010) (Batista and Ribeiro Neto, 2022), Paraíba (Dantas and Paz, 2021), in the Mountainous Region of Rio de Janeiro State (2011) (Alves et al., 2023), and in Vale do Itajaí, Santa Catarina (2008) (Vestena et al., 2026).

Between 2003 and 2022, a total of 1,698 disasters were recorded in 173 of the 184 municipalities located within the Paraíba do Sul (PSB) river basin. Approximately 70% of these disasters occurred in municipalities with fewer than 50,000 inhabitants (Pacheco et al., 2023).

Across the 184 municipalities that comprise the PSB, a total of 421 CRAS units were identified. However, when considering only the 39 municipalities containing BATER polygons, 106 CRAS units were included in the integrated analysis. The spatial distribution of CRAS facilities in municipalities with and without BATER areas is presented in Figure 3A. In addition to the 39 municipalities shown in Figure 3A, detailed views of portions of the municipalities of Juiz de Fora, Minas Gerais (Figure 3B), and Petrópolis, Rio de Janeiro (Figure 3C), illustrate urban areas where CRAS units and BATER areas coexist.

Classified as a large municipality (population between 100,000 and 900,000 inhabitants), Juiz de Fora, in Minas Gerais state, ranks among the municipalities with the highest number of disasters associated with intense rainfall, flash floods, and flooding (16 disaster records between 2003 and 2022), together with Campos dos Goytacazes (12) and Aperibé (14), both in Rio de Janeiro state (Pacheco et al., 2023). The latter two municipalities do not contain BATER areas and are therefore not highlighted on the map. Regarding disasters associated with mass movements, such as landslides[3], large municipalities such as Petrópolis (17) and Volta Redonda (15), both in Rio de Janeiro state, stand out.

Beyond population size, other important demographic and socioeconomic characteristics can be highlighted across the 39 municipalities that contain BATER areas within the PSB. This aspect is particularly relevant because the value of BATER lies in its ability to provide population-level data to identify potential beneficiaries of social assistance policies and to guide interventions in emergency contexts. For example, the data indicate an estimated population of 528,173 people living in BATER areas, representing approximately 9.8% of the PSB's total population. Additional details are presented in Figure 4, which summarizes the characteristics of the population residing in BATER areas within the PSB.

Among the residents of these 39 municipalities, 130,093 were children and adolescents aged 0-14 years, while 53,005 were aged 60 years or older. Together, these groups accounted for 183,098 residents belonging to age groups generally considered more vulnerable to disaster impacts, representing approximately one-third of the population living in BATER areas. Regarding socioeconomic conditions, 178,851 residents (33.81%) lived in permanent private households with a monthly per capita household income of up to half the minimum wage (USD 150). In addition, 83,637 individuals (15.83%) lived in households headed by women within the same income bracket. Another important aspect concerns the proportion of residents living in permanent private households without access to the public sewerage network. These findings highlight the presence of vulnerabilized populations within BATER areas of the PSB, in both socioeconomic conditions and exposure to disaster risks.

Juiz de Fora (Minas Gerais) and Petrópolis (Rio de Janeiro) have 128,946 and 72,070 residents living in flood and/or landslide-prone areas, respectively. Together, these two cities accounted for approximately 38% of the population residing in BATER areas within the PSB, as well as nine CRAS units located either within BATER areas or less than 100 m from their boundaries. The recurrence of disasters in these cities highlights the importance of prioritizing these facilities in DRM actions, considering both their institutional capacities (Oda et al., 2025) and vulnerabilities, as well as their potential role in preparing for and responding to emergencies. Such efforts may also strengthen local social assistance systems and reduce service interruptions during disasters. The absence of contingency plans is another concern. Although hazard maps and BATER data are available in some of these municipalities, their existence does not ensure that such information is incorporated into contingency planning. Among the 39 municipalities containing both CRAS units and BATER areas,

[2] For further details, see: https://mup.rs.gov.br/

[3] For further details on disaster classification, see the Brasil (2012b).

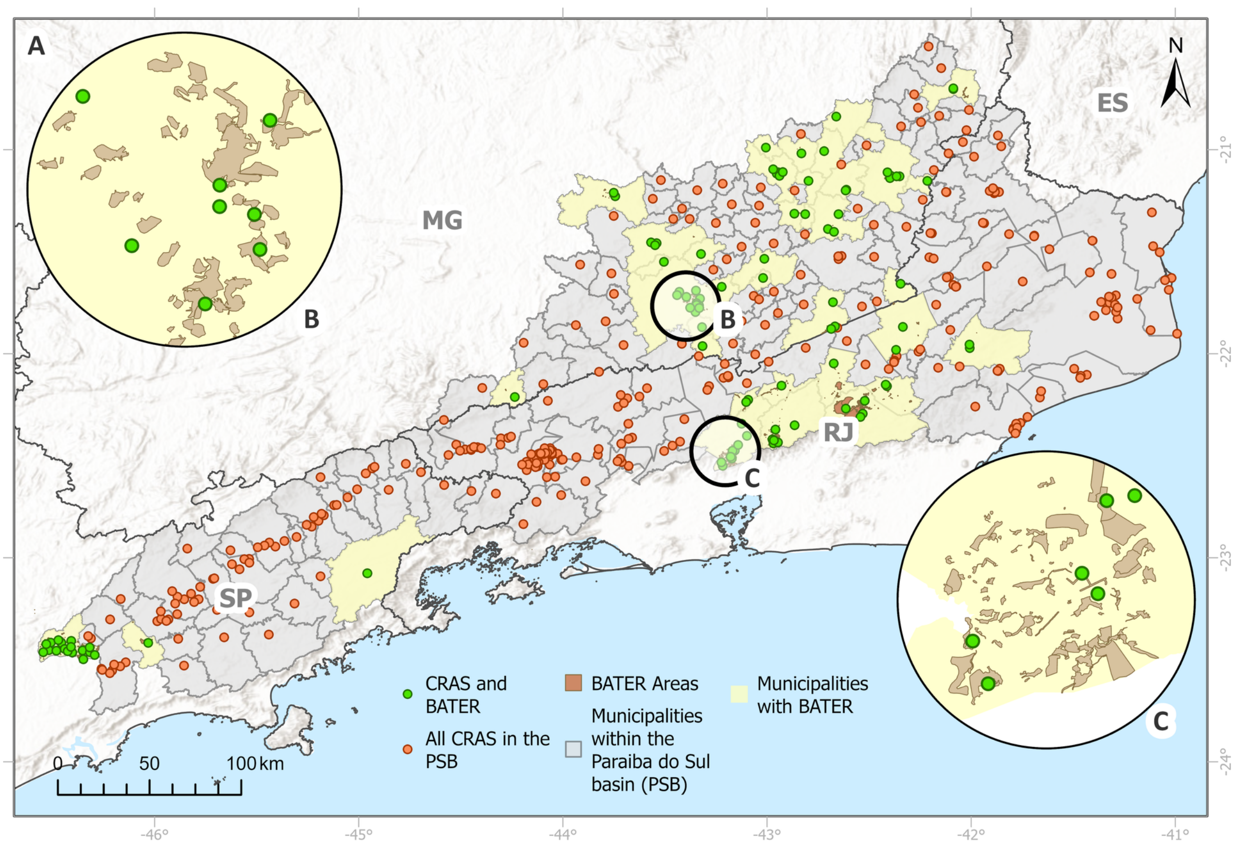

Figure 3 – Spatial distribution of CRAS units in the Paraíba do Sul Basin (PSB), Brazil, and municipalities containing BATER.
Note: (A) Overview of the PSB; (B) Juiz de Fora, Minas Gerais; (C) Petrópolis, Rio de Janeiro.
Source: Authors' elaboration based on Brasil (2023) and Assis Dias et al. (2018).

only 10 reported having contingency plans for floods and 19 for landslides.

The methodology proposed in this article enables the characterization and assessment of CRAS units, providing information to support SUAS in developing contingency plans for social assistance. IDCRAS and its three dimensions also provide insights into the conditions and capacities of exposed facilities. The following section discusses IDCRAS dimensions in relation to CRAS units located within BATER areas.

CRAS exposure: IDCRAS, BATER, and disaster occurrences

The analysis of the 39 municipalities containing BATER areas and 106 CRAS units identified 17 facilities located within BATER areas, distributed across 15 cities. These municipalities encompass different population size categories, ranging from Small I (up to 20,000 inhabitants) to Large (100,000-900,000 inhabitants). Such population categories are relevant because they often influence both the demand for and the scale of social assistance services. Figure 5A presents the spatial distribution of CRAS units within the PSB and the corresponding IDCRAS levels for the 106 facilities analyzed.

Within the Minas Gerais portion of the PSB, 10 CRAS units were located in BATER areas across nine municipalities. These facilities, situated in the large municipalities of Barbacena, Juiz de Fora, and Muriaé, exhibit distinct IDCRAS conditions. While the CRAS units in Juiz de Fora (Figure 5B) and Barbacena achieved high IDCRAS scores, with the dimensions of physical infrastructure, human resources, and services and benefits all classified within the highest interval, Muriaé, despite having the capacity to serve 5,000 registered families, presented a physical infrastructure score classified within interval 2, indicating the need for improvements in this dimension.

The facilities located in Small I municipalities (up to 20,000 inhabitants), such as Chácara, Guidoval, Matias Barbosa, Simão Pereira, and Miraí, exhibited considerable variation across the IDCRAS dimensions. In Chácara, the services and benefits dimension was classified within the highest interval, indicating performance close to the desired standard. In contrast, the physical infrastructure and human resources dimensions scored below this level. In Guidoval, the pattern was reversed: the human resources dimension was classified within the highest interval, while the services and benefits dimension was classified within the lowest interval. Similarly, in

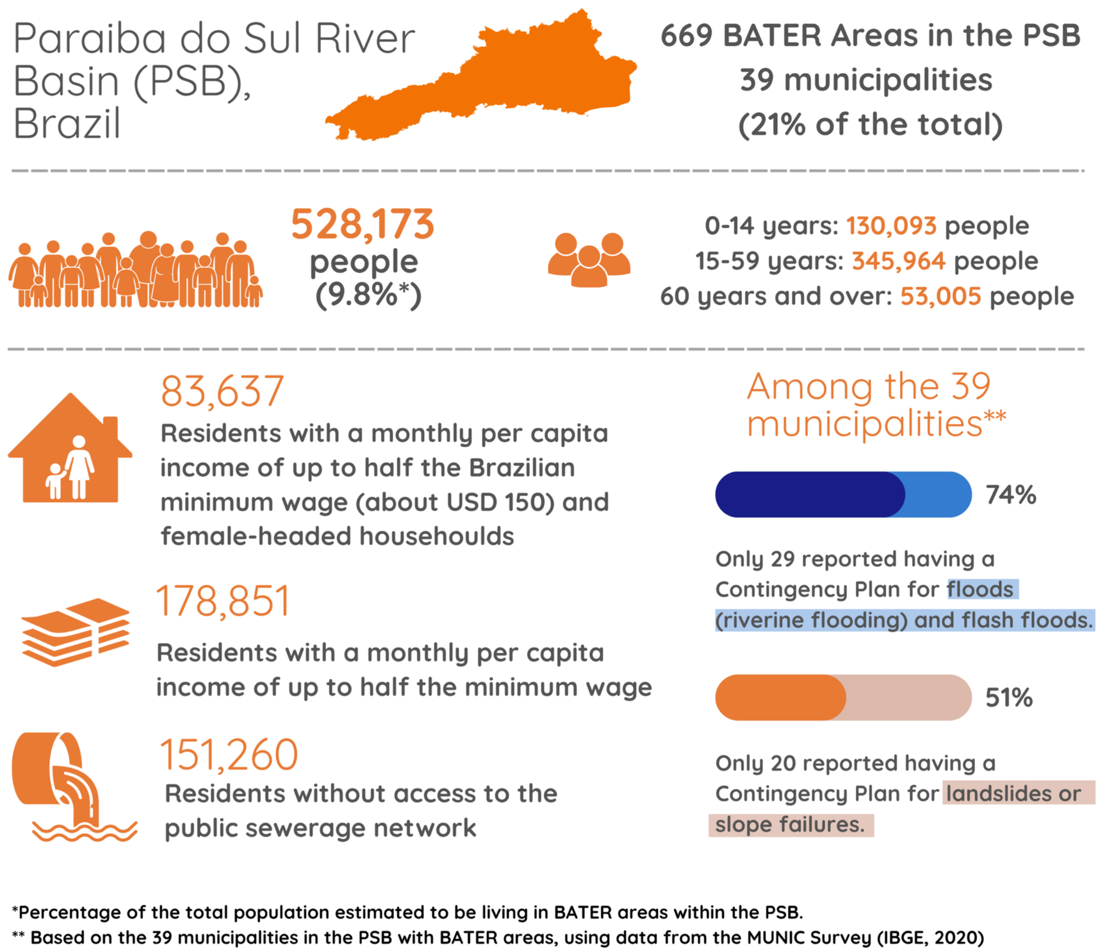

Figure 4 – Characteristics of the population residing in BATER areas within the Paraíba do Sul River Basin (PSB), Brazil.
Source: Authors' elaboration based on IBGE and CEMADEN (2018) and IBGE (2020).

Matias Barbosa, although the human resources, services, and benefits dimensions showed relatively strong performance, the physical infrastructure dimension was classified within the lowest interval.

The seven CRAS units analyzed in Rio de Janeiro State were also in cities with different population sizes, ranging from large municipalities, such as Petrópolis (Figure 5C), Teresópolis, and Nova Friburgo, to Small I and Small II municipalities, including Bom Jardim, São José do Vale do Rio Preto, and Areal. An important aspect is that all of these municipalities were affected by the 2011 catastrophe in the Mountainous Region of Rio de Janeiro, in which more than 1,000 people died in floods and landslides.

The exposed CRAS unit in Teresópolis achieved an average ID-CRAS score in the highest interval, indicating performance aligned with the highest quality standards. In contrast, the exposed units in Nova Friburgo and Petrópolis exhibited lower scores in specific dimensions. In Nova Friburgo, the physical infrastructure, human resources, and services and benefits dimensions were classified within intervals 2, 1, and 1, respectively. In Petrópolis, the physical infrastructure dimension was classified within interval 1, while the services and benefits dimension was classified within interval 3. Thus, despite serving up to 5,000 registered families and being located in large municipalities, these facilities appear to face challenges related to their physical infrastructure.

In the Small II municipalities of São José do Vale do Rio Preto and Bom Jardim, the former exhibited challenges related to the services and benefits dimension, which was classified within interval 2, while the latter showed limitations in services, benefits, and human resources. The municipality of Areal, which has two exposed CRAS units, presented physical infrastructure classified within interval 1 in both facilities, human resources within the highest interval, and services and benefits classified within intervals 1 and 2. These results

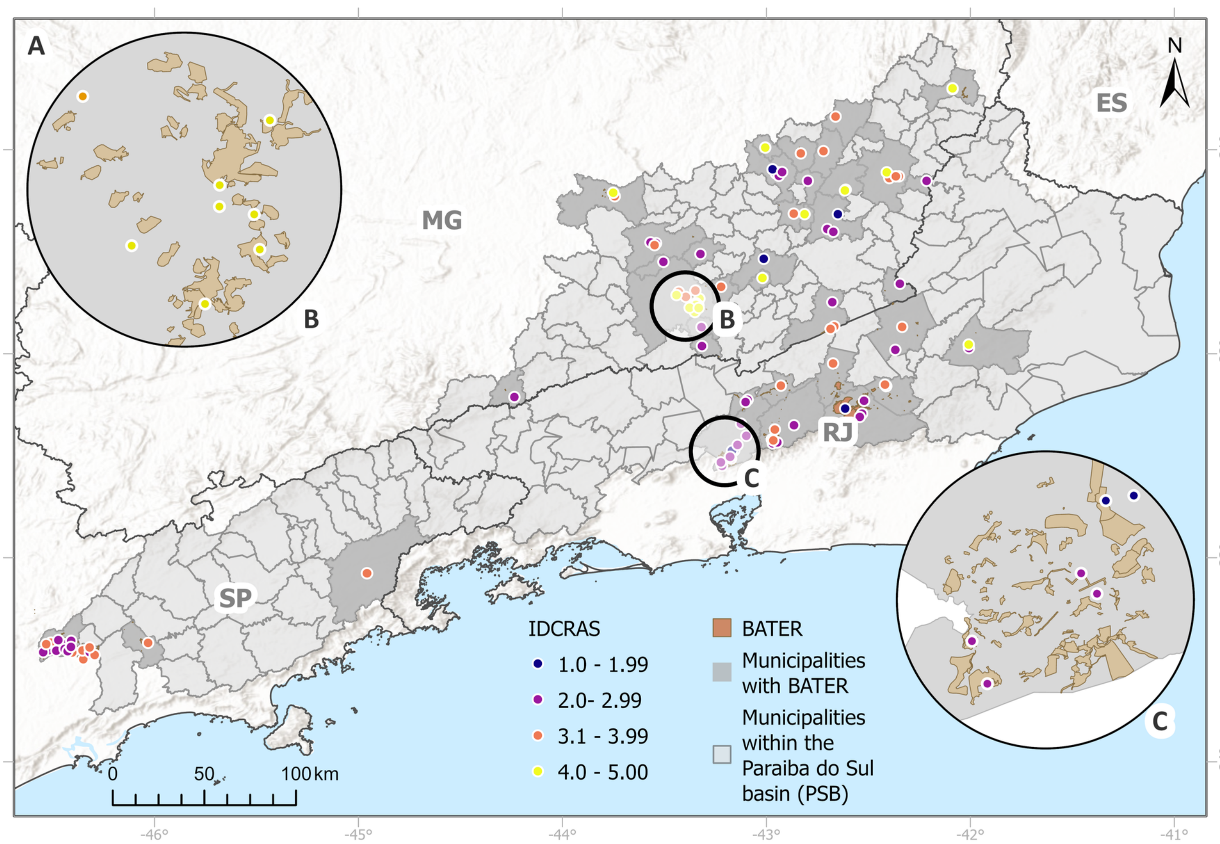

Figure 5 – Spatial distribution of CRAS units in the Paraíba do Sul River Basin (PSB), Brazil, and IDCRAS score intervals for the 106 facilities analyzed.
Note: (A) Overview of the PSB; (B) Juiz de Fora, Minas Gerais (MG) state; (C) Petrópolis, Rio de Janeiro (RJ) state.
Source: Authors' elaboration based on Brasil (2023) and Assis Dias et al. (2018).

suggest the need for structural improvements, as indicated by the IDCRAS assessment.

There is also a concentration of CRAS units associated with BATER areas in the western portion of the PSB, close to the São Paulo megacity. In Guarulhos (São Paulo state), IDCRAS scores varied considerably across dimensions, ranging from interval 1 to interval 5, indicating substantial heterogeneity among the facilities assessed. Only one of the twelve CRAS units included in the sample was located within 50 m of a BATER area. This facility had an average IDCRAS score of 2.3, indicating challenges with physical infrastructure and human resources. The remaining facilities were located more than 200 m from BATER areas; however, these distances do not necessarily mean these CRAS units are free from disaster-related risks.

Conclusion

The analysis highlights the importance of integrating the planning of the National Social Assistance Policy with disaster risk mapping and management in Brazil. A total of 273 CRAS units were identified as being located within areas exposed to flood or landslide risks, while at least 136 additional units were situated within 0.1-50 m of a BATER area. These figures may underestimate the actual extent of exposure, as the analysis covered 2,277 CRAS units, corresponding to 26.37% of the 8,635 facilities operating nationwide. Furthermore, the study included 806 municipalities with BATER areas, representing 14.47% of all Brazilian municipalities. The Southeast and Northeast regions exhibited the highest concentrations of exposed CRAS units, with 145 and 90 facilities located within BATER areas, respectively.

Within the PSB, the analysis of exposure among the 421 CRAS units identified 106 facilities in the 39 municipalities with BATER areas, of which 17 were situated in risk-prone areas across municipalities of varying population sizes. One particularly important dimension identified was physical infrastructure. In several cases, CRAS units achieved relatively high scores in the human resources and services and benefits dimensions, while exhibiting lower performance in the physical infrastructure dimension. This dimension is fundamental to the effective implementation of social assistance policies, especially in emergencies, when public facilities are expected to provide protection and shelter to affected populations while remaining resilient to extreme weather and climate-related events. In addition, CRAS personnel should be trained to understand and use risk maps, develop contingency plans, and support preparedness activities for the populations served by the PAIF and the SCFV.

Although IDCRAS was originally developed as an instrument to assess the performance of CRAS units and identify dimensions requiring improvement within the social assistance policy framework, its combined use with disaster records and other DRM instruments, such as risk maps and contingency plans, can provide valuable contributions toward the development and strengthening of organizational capacities to cope with extreme weather and climate-related events.

Updated versions of both the SUAS Census and BATER may incorporate new variables that support intersectoral approaches to social protection, thereby contributing to DRM by strengthening the territorial perspective. Future research should expand these analyses by incorporating other hazard types and additional cartographic products.

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