Derbyana, ISSN 2764-1465, 46: e890, 2025.
DOI: 10.69469/derb.v46.890
Article/ Disaster Risk Management

PROPOSAL FOR INDICATORS AND RESILIENCE INDEX FOR BRAZILIAN MUNICIPALITIES USING MUNIC/IBGE DATA

Vitor Luiz Victalino Galves [1]*, Aline Freitas da Silva [2], Larissa Ferreira da Costa[2]

[1] Climate System Monitoring and Modeling Laboratory (LAMMOC) and Graduate Program in Biosystems Engineering (PGEB), Federal Fluminense University, Postal Code 24220-900, Niteroi, Brazil. E-mail: vitor_luiz@id.uff.br.

[2] State Secretariat for Environment and Sustainability of the state of Rio de Janeiro. Posta Code 20081-312, Rio de Janeiro, Brazil. E-mails: alinefs.seas@gmail.com, larissafcosta.inea@gmail.com

*Corresponding author

ABSTRACT

The increase in climate change–related disasters has driven the need for public policies that strengthen the resilience and adaptation of urban communities. However, the scarcity of consistent data limits the assessment of cities' resilience. This study aims to develop a Preliminary Municipal Resilience Index (IPRM), applicable to all Brazilian municipalities, using questions drawn from IBGE's Basic Municipal Information Survey. The IPRM is composed of 169 indicators, organized into three sub-indices: Disaster Risk Management, Environment, and Social Governance. Each indicator is scored as 1 (favorable to resilience) or 0 (unfavorable), and the index is calculated as the arithmetic mean of the sub-indices. The IPRM was calculated for all 5,570 Brazilian municipalities, revealing an average value of 0.336. The results show performance below the average value of the proposed index for most cities, allowing for the identification of gaps and priorities. The application of the IPRM contributes to the formulation of more effective public policies, promoting the adaptation of municipalities to the demands of climate change.

Keywords: Resilient cities, Public policies, Governance, Brazil.

RESUMO

PROPOSTA DE ÍNDICE PRELIMINAR DE RESILIÊNCIA PARA OS MUNICÍPIOS BRASILEIROS UTILIZANDO DADOS DO MUNIC/IBGE. O aumento de desastres relacionados às mudanças climáticas tem impulsionado a necessidade de políticas públicas que fortaleçam a resiliência e adaptação das comunidades urbanas. No entanto, a escassez de dados consistentes limita a avaliação da resiliência das cidades. Este estudo visa desenvolver um índice preliminar de resiliência municipal (IPRM), aplicável a todos os municípios brasileiros, por meio de perguntas extraídas da Pesquisa de Informações Básicas Municipais do IBGE. O IPRM é composto por 169 indicadores, organizados em três subíndices: Gestão de Riscos de Desastres, Meio Ambiente e Governança Social. Cada indicador é pontuado com 1 (favorável à resiliência) ou 0 (desfavorável), e o índice é calculado pela média aritmética dos subíndices. O IPRM foi calculado para todos os 5.570 municípios brasileiros, revelando um valor médio de 0,336. Os resultados demonstram desempenho abaixo do valor médio do índice proposto para a maioria das cidades,

permitindo a identificação de lacunas e prioridades. A aplicação do IPRM contribui para a formulação de políticas públicas mais eficazes, promovendo a adaptação dos municípios às exigências das mudanças climáticas.

Palavras-Chaves: Cidades resilientes; Políticas públicas; Governança; Brasil.

RESUMEN

PROPUESTA DE ÍNDICE PRELIMINAR DE RESILIENCIA PARA LOS MUNICIPIOS BRASILEÑOS UTILIZANDO DATOS DEL MUNIC/IBGE. El aumento de los desastres relacionados con el cambio climático ha impulsado la necesidad de políticas públicas que fortalezcan la resiliencia y la adaptación de las comunidades urbanas. No obstante, la escasez de datos consistentes limita la evaluación de la resiliencia de las ciudades. Este estudio tiene como objetivo desarrollar un Índice Preliminar de Resiliencia Municipal (IPRM), aplicable a todos los municipios brasileños, mediante preguntas extraídas de la Encuesta de Informaciones Básicas Municipales del IBGE. El IPRM está compuesto por 169 indicadores, organizados en tres subíndices: Gestión del Riesgo de Desastres, Medio Ambiente y Gobernanza Social. Cada indicador se puntúa con 1 (favorable a la resiliencia) o 0 (desfavorable), y el índice se calcula como la media aritmética de los subíndices. El IPRM se calculó para los 5.570 municipios brasileños, revelando un valor medio de 0,336. Los resultados demuestran un desempeño por debajo del valor medio del índice propuesto para la mayoría de las ciudades, lo que permite identificar brechas y prioridades. La aplicación del IPRM contribuye a la formulación de políticas públicas más eficaces, promoviendo la adaptación de los municipios a las exigencias del cambio climático.

Palabras Clave: Ciudades resilientes; Políticas públicas; Gobernanza; Brasil.

1 INTRODUCTION

In the current context of increasing disasters associated with climate change across the planet, there is an ever-growing need to develop public policies and other instruments that support the strengthening of climate resilience and adaptation of communities and the urban environment. Moreover, as observed by the Intergovernmental Panel on Climate Change in the Working Group II Summary for Policymakers (IPCC, 2022), increasingly evident social, economic, and environmental inequalities stand out globally, whose repercussions are reflected in environmental racism, especially among populations most vulnerable and exposed to existing hazards.

In Brazil, the situation is noteworthy, since the country ranks 40th in disaster-related deaths and 17th in total damages, whether associated with natural or technological origins (1900 - 2024) (Delforge et al., 2025). In addition, Marchezini and Lampis (2020) highlights, for example, the negligence of public authorities toward the population in situations of heightened vulnerability and exposure to increasingly frequent extreme events, and the need for effective policies and instruments that increase resilience in the state of São Paulo.

In this context, resilience is understood as the capacity of a system, community, or society, when exposed to existing hazards, to absorb, withstand, and adapt efficiently, preserving and restoring essential services through risk management (United Nations Office for Disaster Risk Reduction [UNDRR], 2017). Likewise, climate adaptation is also a fundamental link to adjust society to a changing climate, by exploring opportunities (IPCC, 2018) and “no-regret” actions aimed at reducing the impacts of extreme events. Furthermore, the National Policy on Climate Change (Federal Law No. 12,187/2009) also defines adaptation as the set of measures and initiatives aimed at reducing the vulnerability of natural and human systems to the current and future effects of climate change (Brasil, 2009).

Thus, for the development of planning and effective actions aligned with the reality of each

city, the application of assessment metrics for monitoring and analyzing resilience, as observed in several studies (Coutinho et al., 2024; Cutter et al., 2010; Lam et al., 2016; Lucena, 2023; Suassuna, 2014), is fundamental. However, it is also common to encounter difficulties associated with obtaining data regarding quantity, quality, continuity, and/or coverage for the evaluation and comparison of the diverse conditions that influence the resilience of all Brazilian cities in a more uniform, fair, and equitable manner.

Therefore, the present study aims to identify indicators and develop a preliminary resilience index that can be applied to all Brazilian municipalities, using existing information from the detailed survey of administrative records of the Municipal Basic Information Survey (MUNIC) for the years 2017, 2019, 2020, 2021, and 2023 of the Brazilian Institute of Geography and Statistics (IBGE, 2018, 2020, 2021, 2022, 2024a, b). Thus, the Preliminary Municipal Resilience Index (IPRM) proposes to identify the level of maturity, as well as existing gaps, with respect to governance and institutional capacities in support of resilience at the municipal level. The list of all indicators used in the composition of the IPRM is provided in Appendix at the end of this work.

The index is considered "preliminary" because the intention is to present a starting point in terms of guiding information for the planning and development of public policies in Brazilian cities. Thus, the index is not a definitive or conclusive analysis, since regional and local particularities and realities need to be deepened and examined in order to pursue equity and social and climate justice, to achieve more resilient and sustainable cities.

2 MATERIAL AND METHODS

The proposed Preliminary Municipal Resilience Index (IPRM) was developed using the database of the Brazilian Institute of Geography and Statistics (IBGE), specifically the "*Pesquisa de Informações Básicas Municipais* – MUNIC". MUNIC is a detailed survey conducted periodically, with the unit of analysis being municipal-level data drawn from various themes related to governance, planning instruments, infrastructure, and other relevant issues present in Brazilian cities (IBGE, 2025).

Accordingly, the IPRM was developed through a systemic, interdisciplinary, and collaborative approach, which was carried out in five main stages:

1. literature review on studies addressing resilience indices and indicators;
2. identification of relevant themes and selection of MUNIC questions (from different editions) related to resilience, adaptation, and disaster risk reduction;
3. consultation and evaluation meetings of the initial proposal for themes and indicators relevant to the composition of the IPRM, involving a multidisciplinary team;
4. definition of indicators and sub-indices;
5. calculation of the sub-indices and the IPRM.

The IPRM presented in this paper is an updated version of the work published and presented at the IV National Meeting on Disasters organized by ABRHidro (Galves et al., 2024). Following the aforementioned Stage 5, new data and indicators found in the most recent MUNIC publications (IBGE, 2024a, b) were considered and incorporated.

2.1 Literature review on studies addressing resilience indices and indicators

An analysis of the concept of resilience (UNDRR, 2017) reveals that it is a broad and interdisciplinary subject. Therefore, the first step in defining indicators for the development of a resilience index consisted of conducting a literature review, with the aim of identifying which themes would be most commonly used for this purpose.

Ferenz and Mello Garcias (2020) conducted a bibliometric analysis that examines the profiles of authors, journals, and international collaborations that publish on the topic, as well as the identification of 75 multisectoral indicators, each with unique characteristics and adaptable to the particularities of different localities and the availability of data. In this regard, Cutter et al. (2014), identified as the most frequently cited, developed the Baseline Resilience Indicators for Communities (BRIC), which encompasses themes such as social, economic, institutional, housing/infrastructure, and environmental resilience, in addition to what is referred to as community capital. Other studies, like Lam et al. (2016), consider the social, environmental, economic, and institutional dimensions and further incorporate general demographic and health aspects. The SC Resilient Index (Government of the State of Santa Catarina, 2019), while also addressing economic, social, and

institutional dimensions, includes a theme directly related to risk management. Meanwhile, the NBR ISO 37123 standard (ABNT, 2021) promotes a broader approach, which, in addition to the aforementioned themes, incorporates others such as energy, communication, disaster management, water supply and sanitation, education, solid waste, and food security.

2.2 Identification of relevant themes and selection of MUNIC questions

The previous step highlighted the inter- and multidisciplinary nature of the themes. From this perspective, we identified, across six updated editions of the MUNIC survey, the topics to be considered in the development of the IPRM indicators, namely:

- MUNIC 2017 – "basic sanitation management" edition (IBGE, 2018);
- MUNICs 2019, 2020 and 2021 – "database" editions (IBGE, 2020; 2021; 2022);
- MUNIC 2023 – "database" and "sanitation" editions (IBGE, 2024a; 2024b).

Questions were pre-selected and grouped to be considered as indicators within each of the IPRM themes, following a bottom-up process.

2.3 Consultation and evaluation meetings involving a multidisciplinary team

Based on the pre-selected themes and questions, participatory rounds were conducted involving a joint evaluation of the items by a multidisciplinary team from the Subsecretariat for Climate Change and Biodiversity Conservation (SUBCLIM) of the State Secretariat for Environment and Sustainability (SEAS) of the State of Rio de Janeiro. The team was composed of specialists from civil engineering, environmental engineering, architecture and urban planning, geology, geography, biology, and meteorology.

These meetings enabled the multidisciplinary perspective required for the topic and contributed to the selection of the questions used to construct the indicators, as well as the definition of the IPRM sub-indices.

2.4 Definition of indicators and sub-indices

For the composition of the IPRM, three core themes were developed, referred to as the IPRM sub-indices: Disaster Risk Management (GRD), Environment (MA), and Social Governance (GS).

The GRD sub-index comprised 55 indicators from the themes of "disaster risk management", "communication and information technology", "drainage", "public safety" and "social assistance". The MA sub-index included 60 indicators from the themes of "water supply", "sanitary sewage", "environment", "public safety", "drainage", "solid waste" and "general data". The GS sub-index grouped 54 indicators from the themes of "interinstitutional coordination", "housing", "legislation and planning instruments", "health", "drainage", "social assistance", "food security" and "human rights".

The indicators were selected from specific themes of each MUNIC edition/year, as listed in Table 1.

TABLE 1 – List of MUNIC editions and their respective themes used in the composition of the IPRM.

MUNIC - Basic Municipal Information Survey	
Year	*Themes*
2017*	- Water supply - Sanitary sewage - Basic sanitation
2019	- Interinstitutional coordination - Communication and information technology
2020	- Disaster risk management - Housing - Environment
2021	- Legislation and planning instruments - Health
2023	- Social assistance - Human rights - Food and nutritional security - Public safety
2023**	- General data - Drainage - Solid waste

*Specific edition: "basic sanitation management".
**Specific edition: "sanitation".
Source: authorship. Database acquired through MUNIC/IBGE for the years 2017, 2019, 2020, 2021, 2023, and 2023 – sanitation.

Thus, the IPRM is composed of a total of 169 indicators, grouped into 3 sub-indices, encompassing 17 distinct themes from the MUNIC surveys.

2.5 Calculation of the sub-indices and the IPRM

For each indicator considered in the calculation of the IPRM sub-indices, a score of 1 (one) was assigned to responses deemed favorable to resilience, and a score of 0 (zero) to unfavorable responses. Partial responses differing from the standard ("Yes" or "No") were evaluated on a case-by-case basis. The catalogue of the indicators

that compose each of the sub-indices, as well as the exceptions to the scoring criteria adopted, is presented in the Appendix.

The IPRM is calculated as the arithmetic mean of each of the sub-indices, as shown in Equation 1.

$$IPRM = \frac{\left(\frac{GRD}{55}\right) + \left(\frac{MA}{60}\right) + \left(\frac{GS}{54}\right)}{3} \quad (1)$$

IPRM = Preliminary Municipal Resilience Index;
GRD = Disaster Risk Management Sub-index (55 indicators);
MA = Environment Sub-index (60 indicators);
GS = Social Governance Sub-index (54 indicators).

3 RESULTS AND DISCUSSION

The IPRM was calculated for all 5,570 Brazilian municipalities. The national average obtained was 0.336, with the highest value being 0.837 (as shown in Table 2) and the lowest value being 0.081. Accordingly, Table 2 highlights the results of the 10 municipalities with the highest IPRM scores.

TABLE 2 – Top 10 IPRM values and their associated sub-indices (GRD; MA; GS).

Municipality (FU)	*GRD*	*MA*	*GS*	*IPRM*
Campinas (SP)	0.891	0.750	0.870	0.837
Belo Horizonte (MG)	0.873	0.708	0.907	0.829
Jundiaí (SP)	0.927	0.733	0.778	0.813
Niterói (RJ)	0.873	0.750	0.815	0.813
Brasília (DF)	0.764	0.842	0.796	0.801
Curitiba (PR)	0.673	0.775	0.889	0.779
Juiz de Fora (MG)	0.782	0.742	0.796	0.773
Vitória (ES)	0.800	0.742	0.759	0.767
Governador Valadares (MG)	0.909	0.633	0.759	0.767
São Paulo (SP)	0.655	0.800	0.833	0.763

Source: authorship. Database acquired for the calculation of the IPRM through MUNIC/IBGE for the years 2017, 2019, 2020, 2021, 2023, and 2023 – sanitation.

Figure 1 presents the results obtained for each municipality, grouped by value range. The intervals 0.70–1.00, 0.40–0.69, and 0.00–0.39 include 28, 1,416, and 4,126 municipalities, respectively.

Table 3 presents the number of Brazilian municipalities distributed across IPRM value ranges.

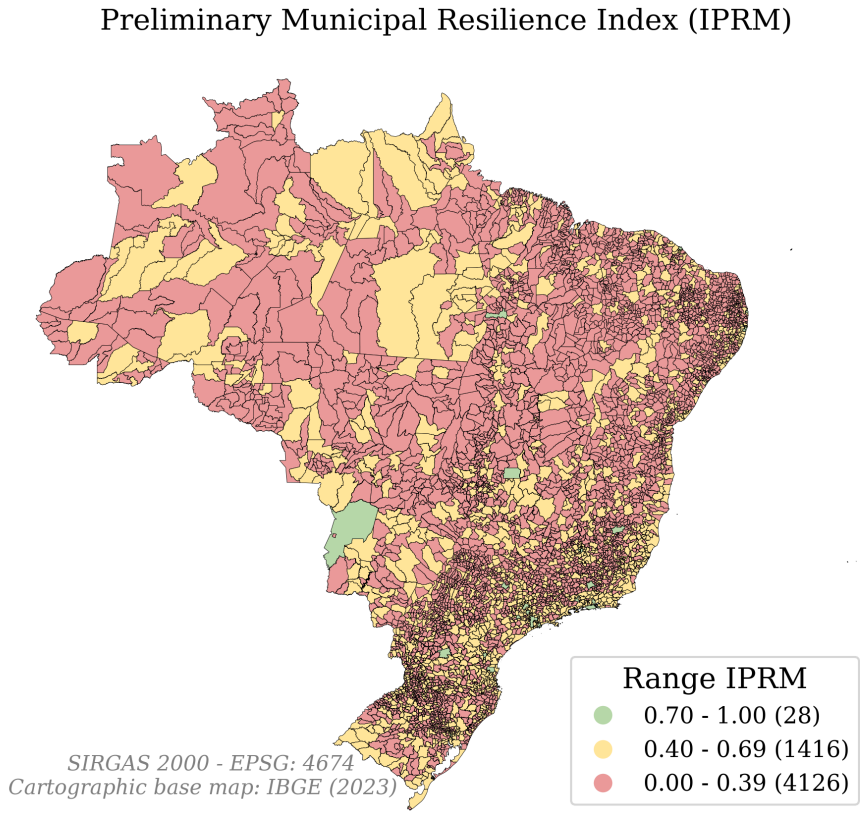

FIGURE 1 – IPRM value ranges for each Brazilian municipality. The numbers in parentheses indicate how many cities fall within each value range. IBGE cartographic base (2023a). Source: authorship.

TABLE 3 – Number of Brazilian municipalities by IPRM value range.

Range of IPRM	*Number of Municipalities*	*Percentage (%)*
≧ 0.9	0	0.000
0.8 - 0.9	5	0.090
0.7 - 0.8	23	0.413
0.6 - 0.7	137	2.460
0.5 - 0.6	342	6.140
0.4 - 0.5	937	16.822
0.3 - 0.4	1807	32.442
0.2 - 0.3	1769	31.759
0.1 - 0.2	540	9.695
< 0.1	10	0.180

Source: authorship. Database acquired for the calculation of the IPRM through MUNIC/IBGE for the years 2017, 2019, 2020, 2021, 2023, and 2023 – sanitation.

As shown in Table 3, only 0.5% of Brazilian cities reached an IPRM above 0.7. The largest share of municipalities, approximately 65%, are concentrated within the 0.2 to 0.4 range. This high number of municipalities within such a low value range reveals a rather harsh reality. Considering that the IPRM is intended to assess how developed a municipality is with respect to resilience, particularly regarding disaster risk management, environmental issues, and social governance, this data serves as a warning.

For the sub-indices that comprise the IPRM, the highest and lowest values observed were: 0.927 and 0.000 for Disaster Risk Management; 0.867 and 0.050 for Environment; and 0.907 and 0.130 for Social Governance (Table 4). The average value found for each sub-index was: 0.202 (GRD), 0.399 (MA), and 0.407 (GS). Table 4 presents the number of Brazilian municipalities distributed across value ranges for each sub-index.

It is observed that the Disaster Risk Management sub-index has the lowest average among the three sub-indices, with nearly 90% of Brazilian cities scoring below 0.4. It is also worth noting that 72 Brazilian municipalities obtained a score of zero in GRD, meaning they have no policies, actions, or infrastructure in place for disaster response or risk prevention. Such data are understood to be essential for informing public policies at the municipal, state, and national levels.

The IPRM was also calculated for each Brazilian state and the Federal District by averaging the values of their respective municipalities, as shown in Figure 2.

It is observed that eleven states and the Federal District are above the national IPRM average, with the Federal District achieving the highest index and the state of Piauí the lowest.

Figure 3 presents the results from a regional perspective. The average IPRM and the average of each sub-index were calculated for each of Brazil's regions based on the mean values of the states that comprise them.

It is observed that all values, the averages of the IPRM as well as of the sub-indices for all regions of Brazil, are positioned in the lower half of the graph. As also shown in Table 4, it is evident

TABLE 4 – Number of Brazilian municipalities (Mun) by value range for each sub-index that composes the IPRM.

Range	*Disaster Risk Management*		*Environment*		*Social Governance*	
	Mun	*%*	*Mun*	*%*	*Mun*	*%*
≧ 0.9	2	0.036	0	0.000	2	0.036
0.8 - 0.9	7	0.126	5	0.090	25	0.449
0.7 - 0.8	31	0.557	63	1.131	139	2.496
0.6 - 0.7	100	1.795	391	7.020	299	5.368
0.5 - 0.6	175	3.142	1043	18.725	899	16.140
0.4 - 0.5	339	6.086	1435	25.763	1251	22.460
0.3 - 0.4	546	9.803	1217	21.849	1611	28.923
0.2 - 0.3	1184	21.257	839	15.063	1278	22.944
0.1 - 0.2	1580	28.366	547	9.820	66	1.185
< 0.1	1606	28.833	30	0.539	0	0.000

Source: authorship. Database acquired for the calculation of the IPRM through MUNIC/IBGE for the years 2017, 2019, 2020, 2021, 2023, and 2023 – sanitation.

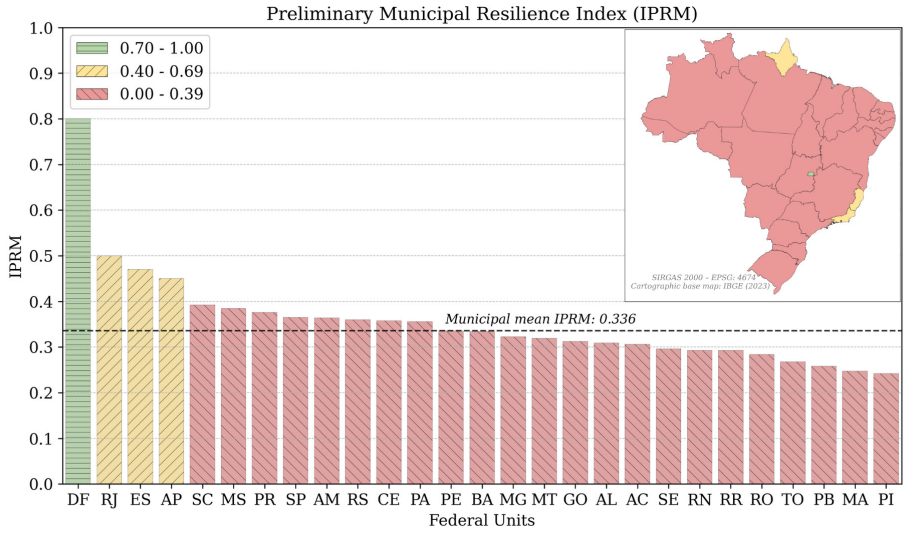

FIGURE 2 – Average IPRM values for each of Brazil's federative units. The black line represents the national municipal average (0.336). IBGE cartographic base (2023b). Source: authorship.

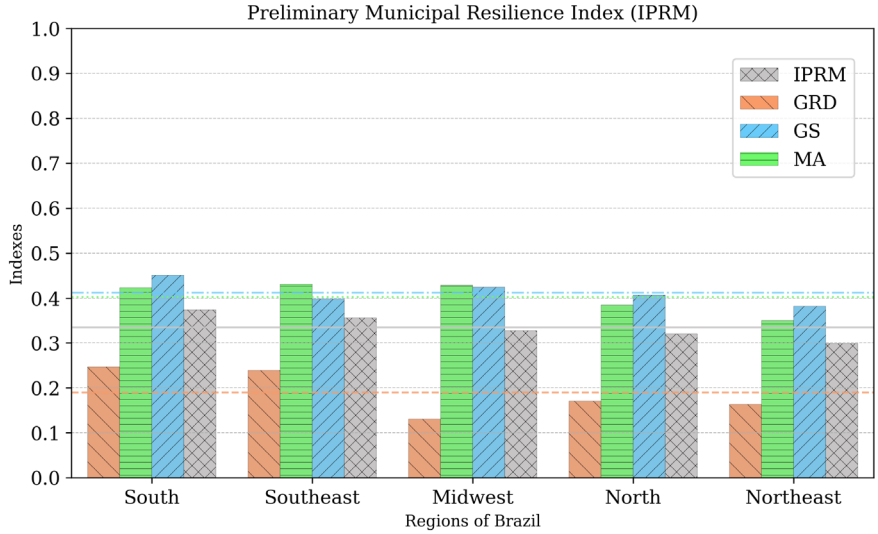

FIGURE 3 – IPRM values and GRD, MA, and GS sub-indices for each region of Brazil. The lines represent the municipal mean values of the IPRM (0.336) and the GRD, MA, and GS sub-indices (0.202; 0.399; and 0.407, respectively), considering all 5,570 municipalities. Source: authorship.

that the Disaster Risk Management sub-index is the least developed among the three sub-indices across all regions of Brazil.

Thus, the IPRM enabled a better understanding of the municipalities' potentials and challenges and an overview of the states and regions of Brazil, in addition to allowing the identification of current and future gaps and priorities.

Moreover, the results presented in this work can be analyzed together with other studies, such as data from the Digital Atlas of Disasters in Brazil, scenarios from the AdaptaBrasil MCTI platform, or specific research at the local scale, enabling a more detailed assessment of each reality. Finally, the proposal also allows for periodic updates as new editions of MUNIC are published. These updates may involve both the updating of existing questions and the inclusion of new questions (indicators), whenever pertinent, as occurred in the 2024 version (Galves et al., 2024) and the version presented in this study.

4 CONCLUSION

This work aimed to present an assessment metric for resilience, particularly considering the challenges associated with disasters driven by climate change, at the municipal level, which can be applied to any Brazilian city.

Additionally, it is emphasized that the IPRM constitutes a preliminary analysis, since regional and local particularities and realities need to be further explored and examined, and the index is calculated using information obtained from consultations with municipal public authorities. Thus, its use is highlighted mainly in scenarios of data scarcity and as a unified criterion for the assessment of Brazilian municipalities.

Thus, the data obtained indicate reduced resilience levels for the vast majority of municipalities in the country. A small share shows an IPRM above 0.7 (0.5%) or even above 0.5 (9.1%). The Disaster Risk Management sub-index stands out negatively, with about 90% of Brazilian cities presenting values below 0.4. On the other hand, the municipalities that achieved better results can serve as examples of good practices, which can be replicated by other cities with similar realities and characteristics.

Finally, the application of the IPRM contributes to the improvement of public policies aimed at resilience, assisting in the adaptation of municipalities to the new realities imposed by climate change. It is important to emphasize that the continuity and expansion of studies in this area are essential to ensure that the strategies adopted become increasingly efficient and aligned with the specific needs of each region.

5 ACKNOWLEDGEMENTS

We extend our gratitude to the State Secretariat for the Environment and Sustainability of the State of Rio de Janeiro (SEAS/RJ) and, in particular, to all colleagues from the Sub-secretariat for Climate Change and Biodiversity Conservation (SUBCLIM) who participated in the consultation and evaluation meetings and contributed with their knowledge and expertise, especially in selecting the indicators that composed the index. We also thank the Derbyana reviewers for their helpful comments to the manuscript.

6 REFERENCES

Associação Brasileira de Normas Técnicas. (2021). *NBR 37123: Cidades e comunidades sustentáveis — indicadores para cidades resilientes*. (Norma técnica).

Brasil. (2009). *Lei nº 12.187, de 29 de dezembro de 2009*. Institui a Política Nacional sobre Mudança do Clima (PNMC) e dá outras providências. https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l12187.htm

Cutter, S. L., Ash, K. D., & Emrich, C. T. (2014). The geographies of community disaster resilience. *Global Environmental Change*, *29*, 65–77. https://doi.org/10.1016/j.gloenvcha.2014.08.005

Cutter, S. L., Burton, C. G., & Emrich, C. T. (2010). Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management*, *7*(1), Article 51. https://doi.org/10.2202/1547-7355.1732

Coutinho, R. Q., Lucena, R., Henrique, H. M., & Souza Neto, D. P. (2024). Indicadores de resiliência institucional em situações de emergência: o caso de Jaboatão dos Guararapes–PE. *Caderno Pedagógico*, *21*(6), Artigo e4723. https://doi.org/10.54033/cadpedv21n6-088

Delforge, D., Wathelet, V., Below, R., Sofia, C. L., Tonnelier, M., Loenhout, J. A. F., & Speybroeck, N. (2025). EM-DAT: the Emergency Events Database. *International Journal of Disaster Risk Reduction*, *124*, Article 105509. https://doi.org/10.1016/j.ijdrr.2025.105509

Ferentz, L. M. S., & Garcias, C. M. (2020). Indicadores de resiliência a riscos e desastres. *DRd – Desenvolvimento Regional em Debate*, *10*, 490–511. https://doi.org/10.24302/drd.v10i0.2842

Galves, V. L. V., Silva, A. F., Moll, F., & Costa, L. F. (2024). Proposta de indicadores e índice de resiliência para os municípios brasileiros utilizando dados do MUNIC/IBGE. *Anais do IV Encontro Nacional de Desastres da ABRHidro*, Curitiba, PR.

Governo do Estado de Santa Catarina. (2019). Índice SC Resiliente: análise dos resultados. Relatório técnico, UFSC.

Instituto Brasileiro de Geografia e Estatística (IBGE). (2018). *Pesquisa de Informações Básicas Municipais (MUNIC) 2017 — gestão do saneamento básico*.

Instituto Brasileiro de Geografia e Estatística (2020). *Pesquisa de Informações Básicas Municipais (MUNIC) 2019*.

Instituto Brasileiro de Geografia e Estatística (2021). *Pesquisa de Informações Básicas Municipais (MUNIC) 2020*.

Instituto Brasileiro de Geografia e Estatística (2022). *Pesquisa de Informações Básicas Municipais (MUNIC) 2021*.

Instituto Brasileiro de Geografia e Estatística. (2023a). *Malha Municipal Digital do Brasil — Municípios (Brasil), escala 1:250.000*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística (2023b). *Malha Digital do Brasil — Unidades da Federação (Brasil), escala 1:250.000*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística (2024a). *Pesquisa de Informações Básicas Municipais (MUNIC) 2023 - Saneamento*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística. (2024b). *Pesquisa de Informações Básicas Municipais (MUNIC) 2023*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística. (2025). *Pesquisa de Informações Básicas Municipais (MUNIC) - O que é?*

Intergovernmental Panel on Climate Change. (2018). Annex I: Glossary. In J. B. R. Matthews (Ed.), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (pp. 541-562). Cambridge University Press. https://doi.org/10.1017/9781009157940.008

Intergovernmental Panel on Climate Change. (2022). *Summary for Policymakers*. In H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller & A. Okem, *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 3–33). Cambridge University Press. https://doi.org/10.1017/9781009325844.001

Lam, N. S. N., Reams, M., Li, K., Li, C., & Mata, L. P. (2016). Measuring community resilience to coastal hazards along the northern Gulf of Mexico. *Natural Hazards Review*, *17*(1), Article 04015013. https://doi.org/10.1061/(ASCE)NH.1527-6996.0000193

Lucena, R. (2023). *Gestão integrada de riscos e desastres associados a movimentos de massa com ênfase nas resiliências institucionais e comunitárias: uma análise sobre os indicadores de resiliência em áreas do município do Jaboatão dos Guararapes – PE* [Tese de Doutorado, Universidade Federal de Pernambuco]. Biblioteca Digital de Teses e Dissertações. https://repositorio.ufpe.br/handle/123456789/53292

Marchezini, V., & Lampis, A. (2020). Vulnerabilidades e resiliência no território da macrometrópole: enfrentando riscos e desastres. *Diálogos Socioambientais*, *3*(8), 15–18. https://periodicos.ufabc.edu.br/

Suassuna, C. (2014). Cidade resiliente: sistema de indicadores dos aspectos institucionais [Tese de Doutorado, Universidade Católica de Pernambuco]. https://doi.org/10.13140/RG.2.2.13034.34242.

United Nations Office for Disaster Risk Reduction. (2017). *Disaster Risk Reduction Terminology*. Relatório técnico. https://www.undrr.org/terminology/resilience.

Manuscript submitted on 18 June 2025, accepted on 10 November 2025.

Portuguese version available at https://doi.org/10.69469/derb.v46.869

How to cite: Galves, V. L. V., Silva, A. F., & Costa, L. F. (2025). Proposal for indicators and resilience index for Brazilian municipalities using MUNIC/IBGE data. *Derbyana*, *46*, Article 890.

Authors' contribution: V.L.V.G.: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, validation, visualization, writing – original draft, writing – review and editing. A.F.S.: Conceptualization, formal analysis, investigation, methodology, project administration, validation, visualization, supervision, writing – original draft, writing – review and editing. L.F.C.: Methodology, project administration, validation, supervision.

Competing interests: The authors declare no competing interests.