Assessing community vulnerability with disaster risk mapping: the case of São Paulo, Brazil

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Purpose – The duration of rain can be measured in hours or a couple of days, but sometimes the damage caused by it can take years to repair or be irreparable (Lídia et al., 2009). The Civil Defense (the public organization responsible for reducing the risks and damages in disasters) reported that the summer rains in São Paulo between December 2020 and March 2021 injured 29 people, left four missings, 25 dead, and 4.011 homeless (Defesa Civil, 2021).

Unfortunately, climate events aggravated by global warming tend to occur more frequently and with greater intensities, as evidenced by the Sixth Assessment Report of the IPCC (Intergovernmental Panel on Climate Change), published in August 2021. This report highlighted increasing global warming and the associated risks (IPCC, 2021).

Compared to the pre-industrial period, global warming has already passed the 1°C warmer mark (IPCC, 2021). This climate change affects several climate-related factors, such as rain, intensity, and frequency. It also impacts events associated with rains, such as landslides, floods, or droughts (Ambrizzi, 2013).

A study made by IAG-USP (Department of Atmospheric Sciences, University of São Paulo) reported the significant increase in extreme rainfalls events in the Metropolitan Area of São Paulo. Rainfalls over 100 mm increased nearly four times through 2000-2018 compared with the 1940s or 1960s, highlighting the increase in climate change and extreme weather events in São Paulo (Marengo et al., 2020).

Given the imminent increase in the number of cases of extreme weather events, public managers are faced with the need to create risk management policies capable of producing more resilient places ensuring urban safety during crises, hazards, or disasters (Zhu et al., 2019). Events like this highlight the importance of assessing community vulnerability with disaster risk mapping.

Accurate hazard information is essential for strategic decision-making by authorities. A way to measure the exposure to a community's hazard is by creating a vulnerability index capable of identifying communities with higher risks (Yigitcanlar et al., 2021). The purpose of

this research is to determine how São Paulo vulnerability can be measured and create an Index to identify the areas most exposed to risks.

Design/methodology/approach- The methodology for creating the index for this study is structured in three steps, as shown in Fig. 1, followed by the prior index development work of (Yigitcanlar et al., 2021). The first step for this index building is to identify and list the vulnerability indicators in São Paulo and their sources. The second step is the creation of a composite index with the indicators of step 1. The third step is to use this index to set vulnerability maps using the indicators of São Paulo.

To identify vulnerability indicators in step 1, the Systematic Literature Review will list the knowledge in academic studies about these indicators to the city of São Paulo, Brazil (Tranfield et al., 2003). To perform this test, a script that can be replicated will be created. The expected result is a table with all vulnerability indicators for the City of São Paulo covered in academic studies.

A list with the indicators and sources obtained in step 1 will be created, and the values will go through a normalization process to normalize the values between 0-1 as described (Yigitcanlar et al., 2021). This calculation will follow the formula:

$$I\text{new} = \frac{I\text{raw} - I\text{min}}{I\text{max} - I\text{min}}$$

I correspond to the indicator value; new, raw, min, and max subscripts respectively denote normalized (transformed), original, minimum, and maximum scores of each indicator. The indices obtained in step 2 will create a geographic map indicating the level of vulnerability to disasters in the studied area.

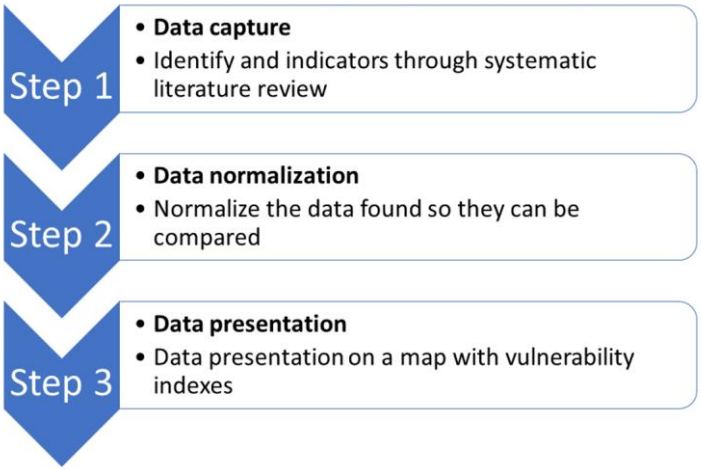

Fig. 1 – Methodology steps

Originality/value- The first step of this study will result in an updated list of vulnerability indicators of disaster risk in São Paulo, using systematic literature review criteria. This list can be used to support future searches. The second step will analyze the possibility of visualizing knowledge about disaster risk vulnerability in São Paulo using the index creation methodology described in the "Design/methodology/approach" section.

The methodology will be adapted to the context of disaster risk vulnerability in São Paulo. The information obtained will be compiled into an original map highlighting the regions most at risk of disasters.

Theoretical implications- The use of data in smart cities provides a favorable scenario for making more accurate decisions, helping public managers to create policies (Silva et al., 2017). Information can be used as a tool to support decision-making associated with disaster management related. (Kankanamge et al., 2020).

In May 2021, the Brazilian federal government published a decree-law establishing the national registry of municipalities with areas susceptible to landslides of significant impact, sudden floods, or related geological or hydrological processes. Mapping vulnerabilities associated with disaster risks in a region provides more accurate information for decision-making and risk management (Decreto n. 10.692, 2021).

Keywords: Indexing model, urban sustainability, risk management, disaster risk mapping

Paper type - Extended Abstract

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