# Thematic cartography as a support for understanding social vulnerability in Porto Alegre region, Brazil

Andrea Lopes Iescheck [a,*], Julia Célia Mercedes Strauch [b], Claudia Robbi Sluter [a], Heleniza Ávila Campos [c], Maithê Warken Jeronimo [d]

[a] Federal University of Rio Grande do Sul, Remote Sensing Postgraduate Programme, Andrea Lopes Iescheck – andrea.iescheck@ufrgs.br, Claudia Robbi Sluter - robbi.sluter@ufrgs.br
[b] Fluminense Federal University, National School of Statistical Sciences, Julia Célia Mercedes Strauch - julia.strauch.pesquisa@gmail.com
[c] Federal University of Rio Grande do Sul, Postgraduate Programme in Urban and Regional Planning, Heleniza Ávila Campos - heleniza.campos@ufrgs.br
[d] Federal University of Rio Grande do Sul, Cartographic Engineering and Surveying, Maithê Warken Jeronimo - maithewj@hotmail.com

* Corresponding author

**Abstract:**

The Social Vulnerability Index (IVS) indicates poverty and social inequality. The IVS of the Institute for Applied Economic Research (IPEA) aims to identify the regions with situations indicative of exclusion and social vulnerability in Brazil. This index comprises sixteen indicators structured in three subindices: a) urban infrastructure, b) human capital, and c) income and labor. The vulnerability of urban infrastructure is related to the conditions of access to basic sanitation and urban mobility services. Human capital concerns health and education, which determine the prospects, current, and future, of social inclusion of individuals. And the vulnerability of income and labor involves indicators of present income insufficiency and other factors that configure a state of income insecurity (IPEA, 2015). The IVS is an essential and strategic analysis tool for urban and regional planning, especially for understanding socio-spatial inequalities.

This work aims to show the methodology used to produce the Social Vulnerability Atlas of Porto Alegre. This atlas is the first result of a research project whose broader scope is to assess conditions of social vulnerability to support studies on Informal Urban Centers (NUIs).

The users of this atlas are specialists in Cartography and Urbanism and researchers of IPEA. We followed the same structure as the composition of the IVS of the IPEA for the definition and classification of thematic information. The data referring to the indicators come from the 2010 Demographic Census of the Brazilian Institute of Geography and Statistics (IBGE) that are available by census sectors. Thus, we considered the census sectors as the main features of the thematic maps. Afterward, we applied the subindices in the context of Porto Alegre.

For urban infrastructure, the indicators are the presence of water supply networks, sewage services, trash collection in the territory, and the time spent commuting between home and the workplace by the low-income employed population. Considering human capital, the indicators are infant mortality, children and teenagers who do not attend school, precocious mothers, low-education mothers, low-education adults, and young people who do not work or study. And for income and labor, the indicators are related to lack of income, unemployment of adults, informal occupation of low-education adults, dependence on the income of older adults, and child labor.

Due to the complexity and variety of indicators, it was necessary to carry out queries by selecting more than one data per residence and generating pivot tables by census sectors. We prepared 20 tables, 16 referring to the indicators, 3 of the subindices that compose the IVS, and one for the IVS itself, and connected them to the cartographic base. We used the choropleth method to make the thematic maps, and due to the number of areas to be symbolized (2433 census sectors), it was necessary to classify the data. We defined a numerical data classification for each indicator using the Jenks method, implemented in the QGIS software.

The Social Vulnerability Atlas of Porto Alegre consists of 21 maps: a location map, 16 maps referring to the indicators of each subindex, three maps referring to the subindices of the IVS, and one map with the visualization of the IVS. The IVS is the result of the arithmetic average of the urban infrastructure, human capital, and income and work subindices, each of which enters the calculation of the final IVS with the same weight. The IVS is an index that varies between 0

and 1, and the closer to 1, the greater the social vulnerability. Regions that present IVS between 0 and 0.200 have very low social vulnerability. Values between 0.201 and 0.300 indicate low social vulnerability. Between 0.301 and 0.400 are of medium social vulnerability, and between 0.401 and 0.500 are considered high social vulnerability. Any value between 0.501 and 1 indicates regions with very high social vulnerability. Figure 1 shows the IVS map.
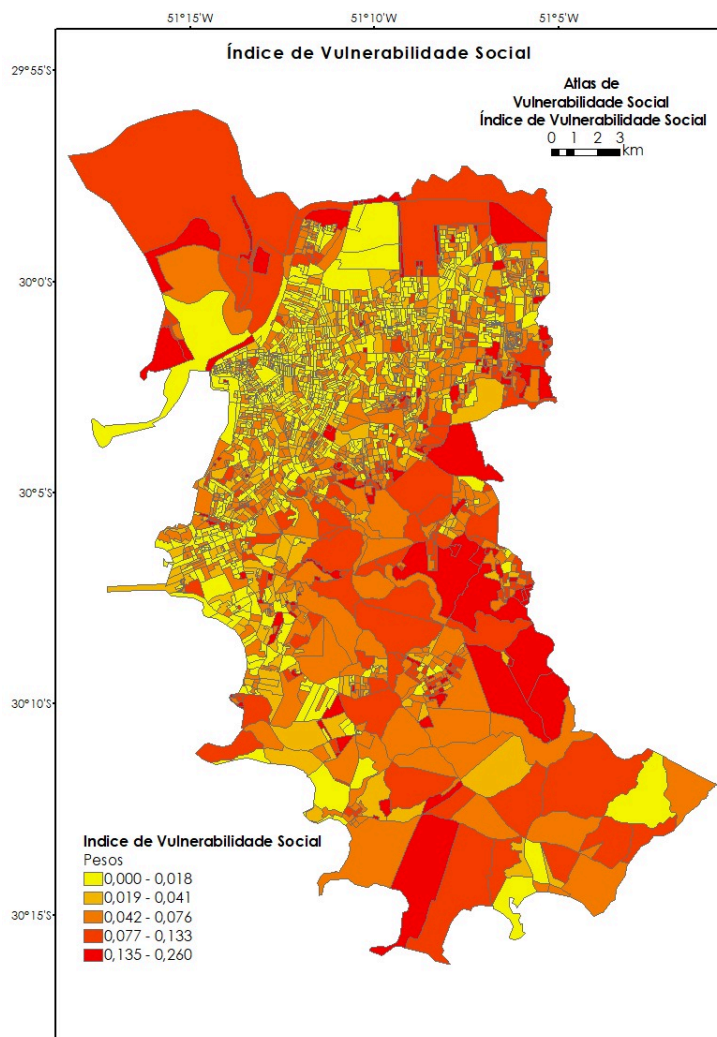


Figure 1. Social Vulnerability Index Map.

Analyzing the IVS map, we have 2412 census sectors with very low social vulnerability and 33 with low vulnerability. No census sector with medium, high, or very high social vulnerability exists. The results show that social vulnerability in Porto Alegre city in 2010 was not so alarming. The worst aspect is urban infrastructure, the only index presenting regions with medium, high, and very high social vulnerability. However, considering the time lag of 12 years since the last census and the COVID-19 pandemic in the previous two years, a factor that directly affects social vulnerability, we cannot affirm that this is the current reality of the municipality. The atlas is available at < https://issuu.com/maithewj/docs/atlas_de_vulnerabilidade_social_de_porto_alegre>.

The next stage of this research project is to understand the NUIs in the context of the city's urban space related to access to urban infrastructure, urban mobility, and social facilities. Also, we will apply the same methodology with the 2022 census data and analyze the change in social vulnerability in this period.

**References**

IPEA – Instituto de Pesquisa Econômica Aplicada, 2015. Atlas de Vulnerabilidade Social nos Municípios Brasileiros. Brasília.