UDESC

Spatial Mobility and Urbanization Trends in Santa Catarina: An Analysis Based on Demographic Censuses

Mobilidade espacial da população em Santa Catarina: Uma análise das tendências de urbanização através dos censos demográficos

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ABSTRACT

This study discusses the use of spatial analysis metrics in a Geographic Information Systems (GIS) environment applied to population census data from the Brazilian Institute of Geography and Statistics (IBGE) from the years 2000 and 2010 to understand the complex and multifaceted spatial mobility in Santa Catherine. For this, quantitative data collected in the different administrative regions of the state of SC were used. The phenomenon, observed in several countries, involves population density in metropolitan regions, motivated by the search for better living conditions and catalyzed by the rural exodus due to technological advances in agriculture and the employment of temporary labor. This movement, generally originating in smaller municipalities and moving towards larger ones, has significant consequences for the economic, social, and environmental dynamics of the places involved, directly affecting the quality of life of individuals. The municipalities of São Pedro de Alcântara, Ituporanga, Campo Alegre and Bom Retiro, in this 10-year period, showed a considerable rural exodus, with a drop in population of -34.48%, -5.24%, -5.29% and -4.03% respectively, while the increase in the urban population occurred in the regions of Norte Catarinense, Vale do Itajaí and Grande Florianópolis, with emphasis on the following municipalities: Massaranduba, Garopaba, Guabiruba, Tijucas, Florianópolis, Blumenau and Joinville, with 64.31% , 42.88%, 41.65%, 38.97%, 22.01%, 21.84% and 19.97%, respectively. This information is useful for public managers in defining ways to provide resources, infrastructure, and services, given the demand for housing, sanitation, education, health, among others.

KEYWORDS: special mobility: spatial analysis: geoprocessing: demography: urbanization trends: GIS.

RESUMO

Este estudo discute a utilização de métricas de análise espacial em ambiente de Sistemas de Informação Geográficas (SIG) aplicadas a dados do censo populacional do Instituto Brasileiro de Geografia e Estatística (IBGE) dos anos de 2000 e 2010 para entender a complexa e multifacetada mobilidade espacial em Santa Catarina. Para isso, foram usados dados quantitativos coletados nas diferentes regiões administrativas do estado de SC. O fenômeno, observado em vários países, envolve o adensamento populacional em regiões metropolitanas, motivado pela busca por melhores condições de vida e catalisado pelo êxodo rural devido ao avanço tecnológico na agricultura e ao emprego de mão de obra temporária. Tal movimento, geralmente originado em municípios menores em direção a maiores, tem consequências significativas para a dinâmica econômica, social e ambiental dos locais envolvidos, afetando diretamente a qualidade de vida dos indivíduos. Os municípios de São Pedro de Alcântara, Ituporanga, Campo Alegre e Bom Retiro, neste período de 10 anos, apresentaram êxodo rural considerável, com uma queda da população de -34,48%, -5,24%, -5,29% e -4,03% respetivamente, enquanto o aumento da população urbana ocorreu nas regiões do Norte Catarinense, Vale do Itajaí e Grande Florianópolis, com destaque nos seguintes municípios: Massaranduba, Garopaba, Guabiruba, Tijucas, Florianópolis, Blumenau e Joinville, com 64,31%, 42,88%, 41,65%, 38,97%, 22,01%, 21,84% e 19,97%, respetivamente. Estas informações são de utilidade para gestores públicos na definição de meios para viabilizar recursos, infraestrutura e serviços, dada a demanda de moradia, saneamento, educação, saúde entre outros.

PALAVRAS-CHAVE: mobilidade especial: análise espacial: geoprocessamento: demografia: tendências de urbanização: SIG.

INTRODUCTION

Since the beginning, human beings have had a tendency to live in society. With sedentarization, the formation of clusters of housing began that evolved into a more complex society, resulting in urban centers. These areas have been able to attract individuals from the most distant and isolated rural areas, where livestock farming, agriculture and extractivism were developed. Commerce, crafts, trade workshops, as well as the search for socialization, were concentrated in urban agglomeration areas, representing an attraction for improving life.

New forms of communication, as well as industrialization, are actively functioning as diffusers, however, they standardize new forms and cultural styles (RIBEIRO 2006). This portrays the standardization of cultural models of inhabitants of urban areas, which mitigates differences between populations that move towards an urbanized region.

The state of Santa Catarina has stood out as one of the most prosperous Brazilian federative units in terms of quality of life. Whether in the countryside or in the city, the evolution of this state has attracted and retained a population that grows with each census, demonstrating extraordinary potential. The Human Development Index (HDI) - which considers per capita income, education and longevity - has improved every year, and its most prosperous cities have advanced in these aspects, increasing their population. However, some municipalities have shown notable population declines (ATLAS BRASIL 2023).

Analyzing these scenarios is essential to understanding the mesoregions of Santa Catarina, with the aim of identifying migrations, their characteristics, causes, consequences, and influences on neighboring areas, forming an effective mapping of the area of influence of each municipality.

MATERIAL AND METHODS

This study was based on data derived from the 2000 and 2010 Brazilian national censuses, carried out by the Brazilian Institute of Geography and Statistics (IBGE) (IBGE 2000, IBGE 2010a). These data offer a technical view of the demographic transformations that occurred during the decade, with current census data not yet being made available for common use.

The data used was acquired from IBGE Table 202, which aggregates fundamental demographic information to understand the population dynamics of Santa Catarina during the period studied. For each municipality, population trends related to variation in the number of inhabitants were investigated. The data for Santa Catarina, considering the Total population and the Total population by household situation, comprise the values presented in Table 1.

Table 1. Total Population (A) and by household situation (B) for 2000 and 2010 at Santa Catarina state. Values between parenthesis for B are the percentage of the total population (A).

(A)				
Population	2000	%	2010	%
Grand total	5356360	100	6248436	100
Male	2669311	49.83	3100360	49.62
Female	2687049	50.16	3148076	50.38
(B)				
Population	2000	%	2010	%
Total rural	1138429	100 (21.25)	1000523	100 (16.02)
Male	593095	52.10 (11.07)	521839	52.16 (8.35)
Female	545334	47.90 (10.18)	478684	47.84 (7.67)

Source: IBGE Census (Table 202).

For spatial analysis using the ArcGIS application, we applied the database of the municipal limits of Santa Catarina (Malha Municipal de 2010), made available by IBGE in *shapefile format* (IBGE 2010b). Using the *'join data' tool,* we link the numerical population data in the Attribute Table to the perimeters of the

respective municipalities using the standard code. During the period from 2000 to 2010, the municipalities of Pescaria Brava and Balneário Rincão were emancipated, previously belonging to the municipalities of Laguna and Içara, respectively (SANTA CATARINA 2003a e 2003b).

However, it was necessary to normalize the data, since negative values could influence subsequent analyses, that is, municipalities that had a population reduction in 2010 when compared to 2000. It is worth highlighting that this normalization does not change the results, as this study is based on population difference values. Thus, adding equal intervals to the data of interest does not change this variation.

The differences between the Total, Total Urban and Total Rural populations were obtained through simple operations performed in the *'Field Calculator' tool* available in the Attribute Table of the vector file. To characterize them, we applied the symbology of quantities to the differences found, using the *Natural Breaks methodology (Jenks)* with four different intervals (Figure 1). For a better visualization and interpretation of the results, it was necessary to apply intervals proportional to the differences for each of the cases, with greater emphasis on those in the Norte Catarinense region, Vale do Itajaí and Grande Florianópolis.
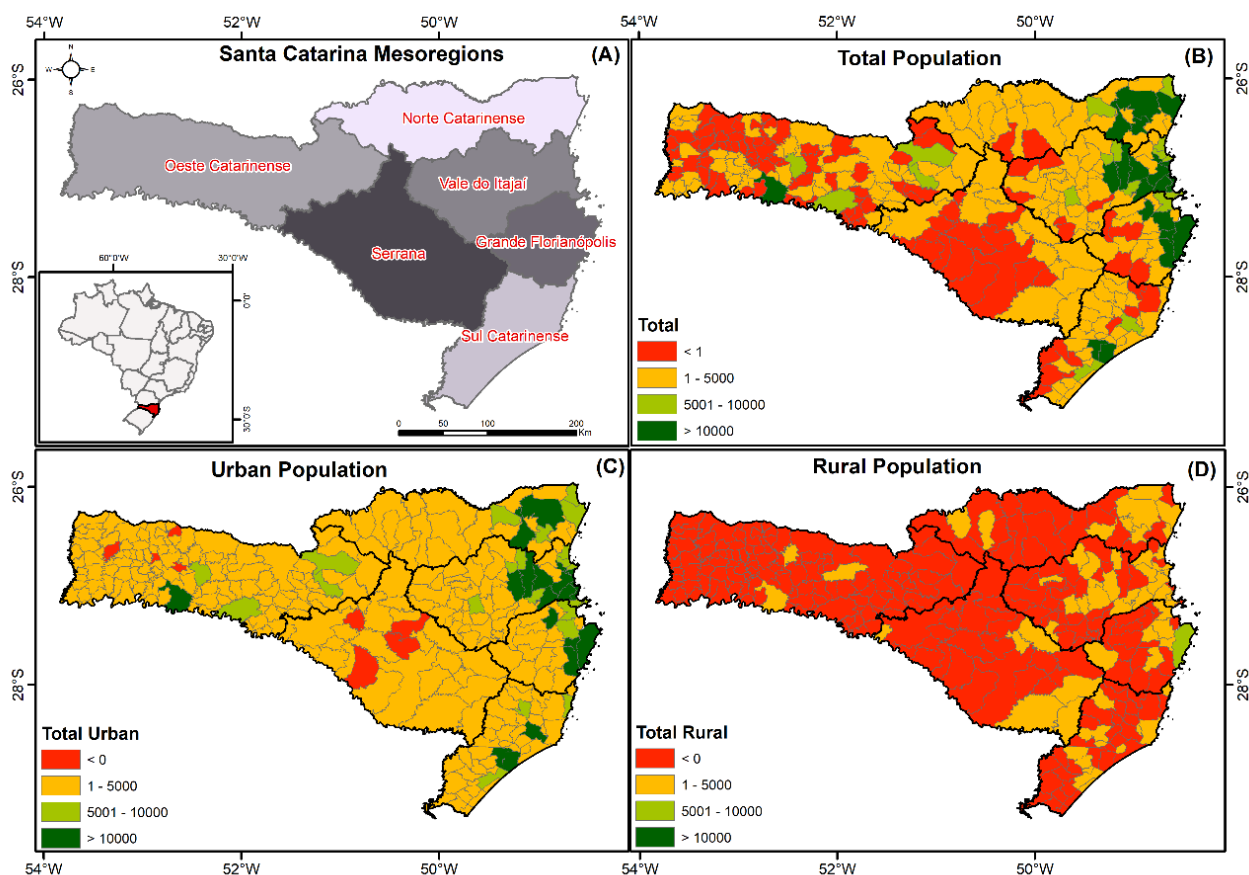

Figure 1. Santa Catarina subregions (A) and absolute population differences for Total (B), Urban (C) and Rural (D).

In addition, with the aim of distinguishing possible population changes that occurred in the state of Santa Catarina between the years 2000 and 2010, an assessment was carried out in the different mesoregions. According to IBGE (2018), physical, economic-social and human characteristics, social processes, natural framework and communication network constitute the delimitation of these regions, expressing a regional identity particular to each area.

Close groupings of data can be identified through *Cluster and Outliers analysis,* patterns that reveal important aspects of the variables under study. When applying the LISA (Local Indicators of Spatial Association) analysis, according to ANSELIN (1995), in the study of population differences in the state of Santa Catarina from 2000 to 2010, significant spatial groupings were identified (Figure 2). The analysis was obtained from the Cluster mapping tool: Cluster and Outlier Analysis (Anselin Local Morans I). Applications of the LISA technique are also reported in several studies in the agro-veterinary sector (LU & CHENG 2019, Li et al. 2021 and ZHANG et al. 2023).

We then analyzed the size and dynamics of the population from 2000 to 2010, using the LISA technique, in relation to the Municipal Human Development Index (HDI) in the same period. The HDI, according to the United Nations Development Program (UNDP 2023), is a measure composed of indicators of three dimensions of human development: longevity, education, and income. This index is widely used as a measure of social progress, playing an important role in providing an overview of this progress and helping to compare different regions. The index varies from 0 to 1, and the closer to 1, the greater the human development.
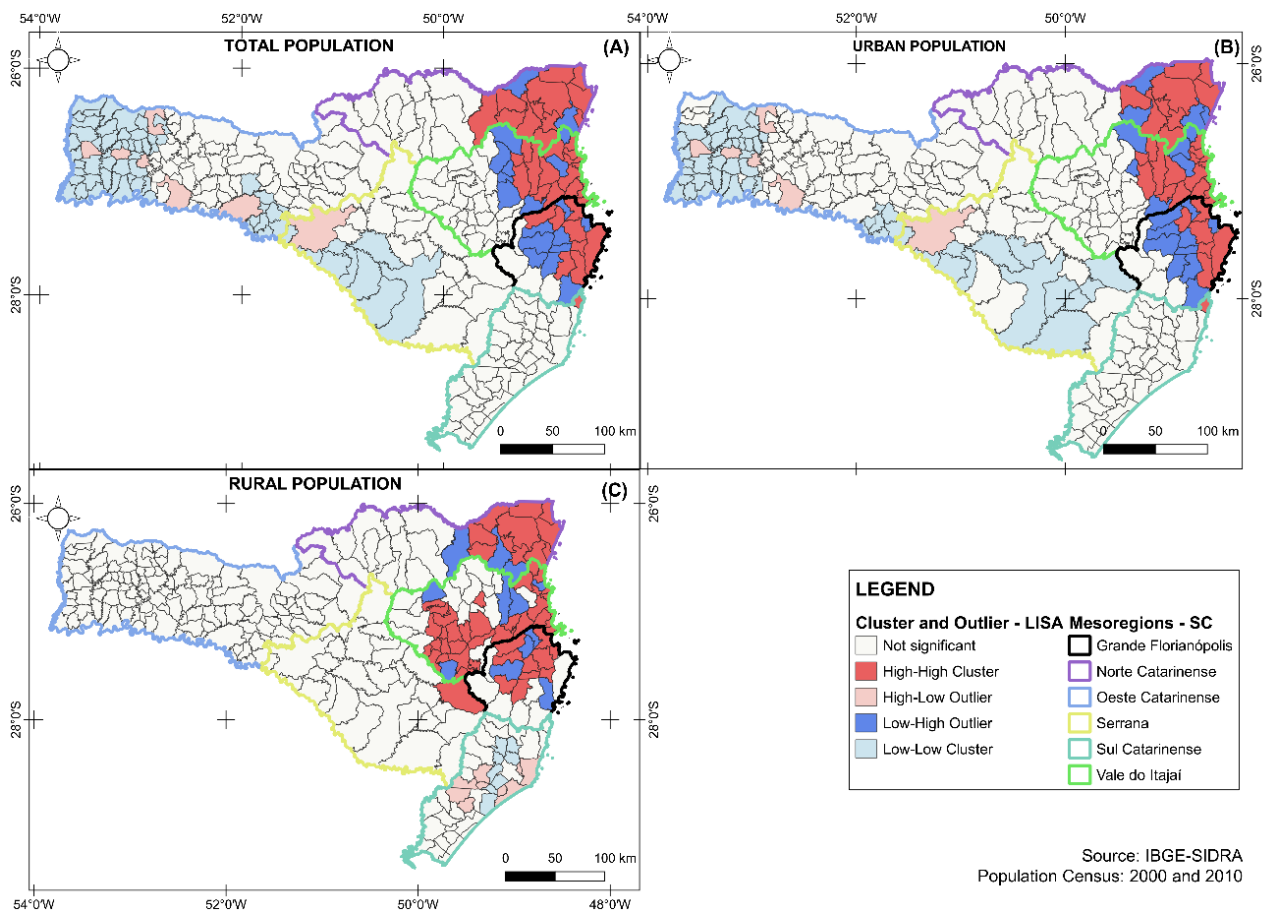

Figure 2. LISA analysis for the mesoregions of the State of Santa Catarina, highlighting in detail Total Population (A), Total Urban (B) and Total Rural (C).

Figure 3 highlights some municipalities classified as High-High groupings, that is, statistically significant areas or clusters. These areas have a high incidence count value and are surrounded by other regions that also have high incidence count values. It is important to highlight that clustering differs from absolute differences, as cluster analysis allows for a more in-depth assessment, taking into account the interrelationship between different municipalities and their characteristics. The incidence count considers the total number of the population residing in these municipalities, including the rural and urban population.

The High-High population grouping was identified involving the municipalities of Araquari, Balneário Barra do Sul, Campo Alegre, Corupá, Garuva, Guaramirim, Itapoá, Jaraguá do Sul, Joinville, Massaranduba, São Bento do Sul, São Francisco do Sul and Schroeder. This grouping indicates a high population density in these regions, in relation to other municipalities in Santa Catarina.
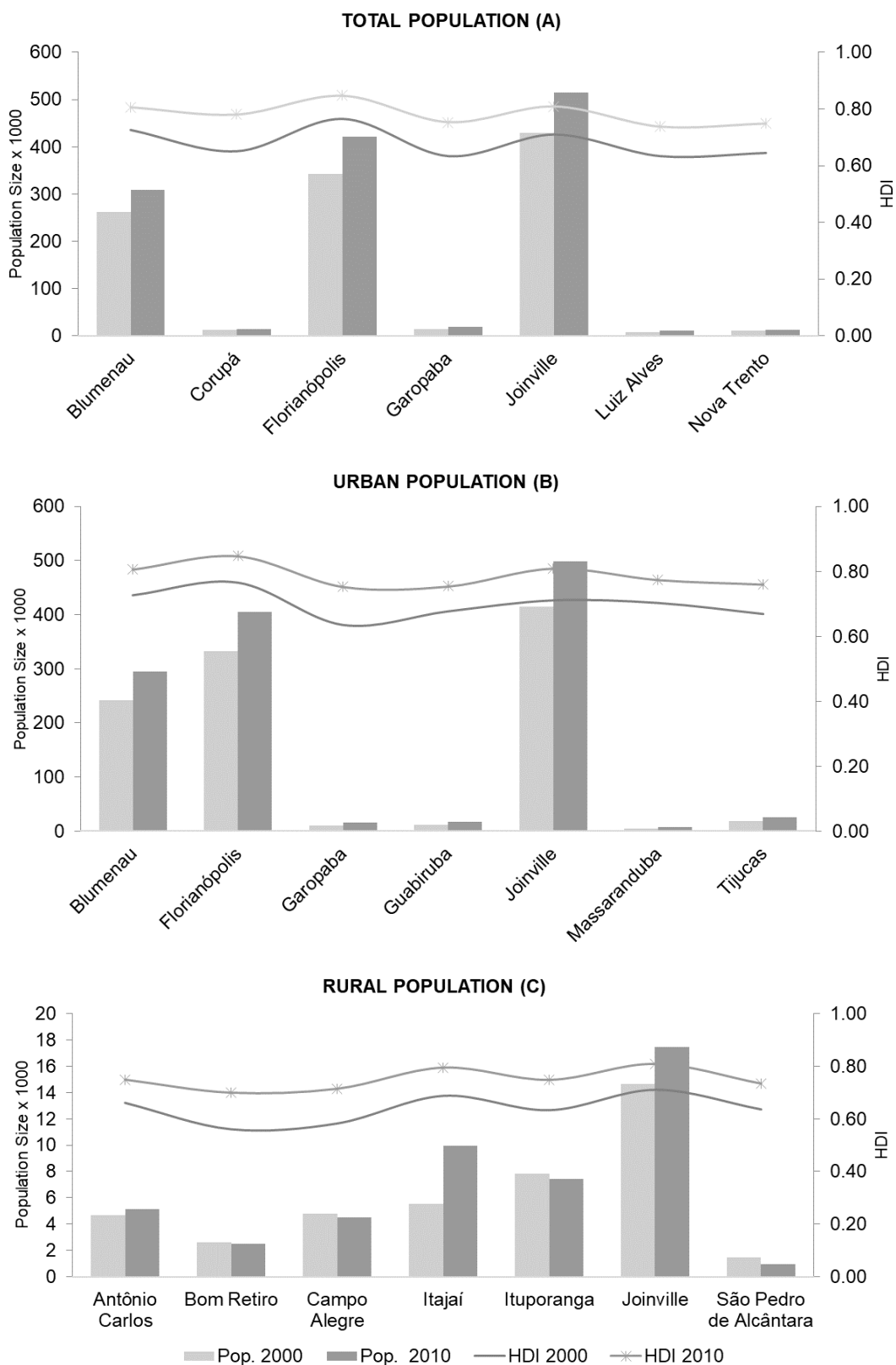
Figure 3. Population growth vs. IDHM at selected municipalities from the coastline with detail for Total (A), Urban (B) and Rural (C) Population.

RESULTS AND DISCUSSION

The results suggest that these municipalities have high values for the analyzed measure (in this case, population) and are surrounded by municipalities with equally high values. This population concentration may indicate the existence of regional attractions, such as employment opportunities, high-quality health and education services, among others, that attract and maintain people in these areas.

The economy of the northern region of Santa Catarina is characterized by the interaction of traditional productive sectors, such as industry, with emerging sectors such as commerce and services. In particular, agro-industries, wholesale trade and the electrical and chemical industries played an important role in generating formal jobs (GARCEZ et al. 2019). According to MATTEI et al. (2021), trade has been a significant vector of employment, promoting the inclusion of a greater number of women in the workforce. This sector is characterized by many small and medium-sized businesses, which may explain the high concentration of formal jobs in lower pay ranges.

As previously seen in Figure 2, the LISA analysis revealed a significantly higher population concentration in the municipalities of Joinville and Jaraguá do Sul compared to the other municipalities in the Northern region of Santa Catarina. This phenomenon, linked to the volume of available employment opportunities, establishes these locations as pre-eminent centers in the northern mesoregion of the state of Santa Catarina. The demographic density in these municipalities corroborates their importance as centers of employment and growth, playing a fundamental role in the regional socioeconomic dynamics.

When focusing on the analysis of urban population data, a significant population concentration can also be seen in the municipalities of Joinville and Jaraguá do Sul. This persistence reinforces the relevance of these municipalities as important demographic centers in the urban structure of the northern region of Santa Catarina.

On the other hand, when considering the data sample referring to the rural population, there is a notable population decrease in the municipalities of Campo Alegre and Araquari. This phenomenon may indicate a migratory tendency of the inhabitants of these locations towards the main urban centers, probably motivated by the search for better socioeconomic conditions. This internal migration reflects an important demographic dynamism in the social composition of the northern region of Santa Catarina that requires additional studies.

The HDI assessment shows a consistent progression in all municipalities evaluated, suggesting socioeconomic growth in the northern region of Santa Catarina and highlighting a scenario of continuous development. Therefore, the classification of these municipalities as an High-High grouping by the LISA method can be explained by the evolution of the economy in the northern region of Santa Catarina, which has diversified and adapted to continue generating formal jobs, albeit at lower salary levels.

When analyzing data from the Vale do Itajaí mesoregion, it is possible to historically highlight the strong industrial presence in this region, as well as the progress of means of transport, exemplified by the relevance of the BR 470 and 101 highways. link between West and East, as well as between South and North. Furthermore, it is important to mention the importance of Porto Itajaí Navegantes and Navegantes Airport, which register large import and export flows (POZO & SANTOS 2020).

Currently, tourist exploitation has caused a characteristic urban real estate advance in the region, considerably increasing the total population of the municipalities that stand out in the analysis carried out.

This scenario has provoked migrations based on urban advancement, with specific areas of attraction for each municipality. Migrations are characterized by rural exodus, leaving the countryside for the city, seeking better living conditions based on a well-defined working day with fixed hours and days, working conditions, such as safe and comfortable environments, more attractive salaries, search for a "Enrichment", a situation favorable to education and health for children, as well as technological advances and cutting-edge machinery, in addition to real estate speculation, end up inducing the aforementioned migration. Still in terms of migration, the urban aspect is also highlighted in the data when there is an outflow from smaller municipalities to larger ones, attracted mainly by industries, the secondary sector and the tertiary sector, in the area of service provision and commerce.

In terms of urban advancement, we can highlight some municipalities in the region, each group with its own characteristics and similar specific development. On the one hand, Itapema, Camboriú and Balneário Camboriú have geographic proximity, including borders, which helps in aspects of population attraction. The fact that Itapema and Balneário Camboriú are bathed by the Atlantic Ocean, having an extremely effective seafront for leisure, means that real estate development and the entire system, especially in the tertiary sector, boosts the city's growth, this condition is noticeable when checking the HDI, in Itapema in 2000 the HDI was 0.705 and in 2010 0.796, Balneário Camboriú in 2000 was 0.777 and in 2010 it rose to 0.845, demonstrating the prospect of improvement, characteristic of these migrations. Camboriú, on the other hand, has an advance based on the territorial stagnation of neighboring Balneário Camboriú, as with real estate investments and the resort city's own high cost of living, the most financially viable opportunities and incentives end up in Camboriú, also proven by the HDI in 2000 it was 0.592 and in 2010 it went to 0.726,

with a noticeable increase in per capita income, longevity and education, investments arising from the neighboring stagnation.

On the other hand, Brusque, Gaspar, Rio do Sul and Indaial base their growth on the secondary sector, where the textile and metalworking industries have proven to be fundamental for development. Supported by this situation, the area of health and education demonstrates progress above normal, which becomes clear when analyzing the HDI data in Rio do Sul in 2000 it was 0.698 and in 2010 it was 0.802; in Indaial it went from 0.678 in 2000 to 0.777 in 2010. Using mainly industry, Gaspar went from an HDI of 0.670 in 2000 to 0.765 in 2010; In Brusque the index was 0.720 in 2000 to 0.795 in 2010. Thus forming areas of population attraction.

An interesting case regarding cities is to observe Pomerode, in addition to industrial growth, the city sought to increase tourism in the tertiary area through leisure parks or an industry promoted in the food sector such as breweries and chocolate shops. Therefore, it advanced in the HDI, starting from 0.708 in 2000, to 0.780 in 2010.

The HDI of Navegantes in 2010 was 0.606, rising to 0.736 in 2010, such a significant change is reflected in the transport system that is based in the municipality, with the airport being an important means of carrying out air transport for the state of Santa Catarina, already the port that also reaches the city of Itajaí is a large outlet for both imports and exports not only for the state, but for the country, this condition caused Itajaí's HDI in 2000 to rise from 0.688 to 0.795 in 2010.

The region's large urban center is the municipality of Blumenau, a hub in the textile sector, and currently with a diversified industrial park including the development of technopoles. In this way, a favorable environment is created for the advancement of per capita income, encouraging the areas of education with schooling, through trained institutions, and longevity with a reference in health through specialized clinics. As a result, an HDI in 2000 went from 0.727 to 0.806 in 2010.

It is notable to note that some municipalities had an evasion of population to these urban centers, thus causing a population decrease, even changing the population in rural areas. The consequences of such processes in urban centers have been demonstrated through urban macrocephaly, which has been a major challenge for governments and social coexistence. In smaller municipalities, population decline is viewed with concern, as abandonment or demographic emptiness has caused financial losses in relation to fundraising and raises doubts from a sociological perspective (HENRIQUES & MATTEI 2013, GOULARTI 2015).

According to CAVALCANTI (2009), urbanization, despite creating many urban ways of being, contributed to further standardizing Brazilians on a cultural level, without, however, blurring their differences. Industrialization, as a genre of life that creates its own human landscapes, created industrial islands in its regions. New forms of mass communication are actively functioning as diffusers and standardizers of new cultural forms and styles.

In the map presented that presents the LISA Analysis for the mesoregions of the state of Santa Catarina (Figure 2), it was found that, although the High-High municipalities should theoretically present a strong relationship between the HDI and demographic density, this direct relationship does not was observed. It was found that a smaller number of the population has a high HDI rate, except for the municipalities of Florianópolis and São José, considering both the total population and the urban population.

These indices demonstrate the region's dynamism over decades, shaped by external factors ranging from the rural exodus from the interior of Santa Catarina towards the urban centers on the state's coast, the migration of labor from other states to work in state, state and federal bodies and companies, implemented since the 1960s and the migration of those who left large metropolises in search of a better quality of life in smaller cities (Naspolini, sd). In a few years, the population of Greater Florianópolis reached the current rate of 96.86% in an urban situation. For the rural population, the same relationship was also observed, except for the municipalities of Biguaçu, António Carlos, Tijucas and Águas Mornas, respectively.

It should be noted that the region is considered the regional hub for industry, commerce, and services, where the majority of jobs and the highest population density are found. Outside of it, there are several centralities spread across the Island and low-density continental coast, basically residential and services focused on tourism and connected to the central conurbation through state and federal highways, with their banks occupied, forming a dendritic network structure.

It is also interesting to see that in all cases, even with the drop in population density, there was an increase in the HDI from 2000 to 2010. This shows that the municipalities are growing proportionally over the years. The High-Low municipalities also have great potential for changing/improving the HDI, as they have

high HDI values (above 0.50). At the same time, the Low-High municipalities are attractive, as they need more investment for the population to have a high income, longevity and education.

In the West Santa Catarina region, cluster patterns are different from those in coastal regions. The results of the LISA analysis are significant only for the Total and Total Urban population differences, that is, for the rural issue there was no significance in the municipalities of this mesoregion (Figure 2). For the absolute difference in Total Rural, only three municipalities showed population growth – Nova Itaberaba, Paial and Capinzal – (Figure 1), however, it should be noted that these values are not significant for groups.

There is a presence of clearly highlighted High-Low discrepancies and Low-Low Groupings in parts of the mesoregion for both significant variables. The result differs in some municipalities, highlighting the presence of Concordia as High-Low discrepancies only for the Total population. This characterization is due to the grouping given to its neighboring municipalities, there is a greater number of Low-Low Groupings in its surroundings in the Total population scenario.

In this way, Concórdia is a significant municipality, with high values, surrounded by others, with lower values for the difference in total population. This indicates the potential for population growth in Concórdia, highlighting that its growth does not occur precisely in urban areas, given its insignificance for the difference in the Urban Total (NASCIMENTO & SANTOS 2023). This growth factor, not limited to urban advancement, can be explained by the growing sector of livestock production. According to the Santa Catarina Association of Pig Breeders (ACCS 2023), the municipality of Concórdia had the fifth largest pig herd in Brazil in 2019. Another point related to this is the presence of the Pig and Poultry hub of the Brazilian Agricultural Research Corporation (EMBRAPA 2023) in the municipality, which is responsible for boosting the agricultural sector in the region since 1975.

The other notable municipalities (High-Low) for significant observations were the following: Chapecó, Pinhalzinho, Maravilha, São Miguel do Oeste and São Lourenço do Oeste. These municipalities can be listed as having the greatest potential for population growth in the urban area of western Santa Catarina. A characteristic of these municipalities is the growing HDI, expressing human development. Among these, the municipality of Pinhalzinho showed the greatest variation in this index, increasing its 2000 HDI from 0.663 to 0.783 in 2010.

The main federal highways in western Santa Catarina are BR-282, BR-163, and BR-480. These roads play a crucial role in the development of the region, connecting the listed municipalities. It is interesting how easier access to the flow of people, goods and services allows for greater economic development, a fact that allows progress in the western region of the state. Analyzing Figure 2, the results obtained indicated that the Serrana and Sul regions did not indicate, in general, significant population concentrations.

CONCLUSION

This technical note presents the development of an index system to evaluate aspects of migration of the rural population to urban centers, using as a basis the analysis of quantitative data collected in the different administrative regions of the state of Santa Catarina.

The proposed analysis offers a robust empirical basis to identify the process of evolution of rural emptying in the state of Santa Catarina, considering two dimensions of space-time. It also explores the driving forces behind this evolution that may be fleshed out once information from the new census becomes available.

The results of the indexes obtained indicate a general tendency of negative selection in urban/rural flows, a positive one in rural/urban flows and longer migration steps. It can be inferred, therefore, that the North and Vale do Itajaí regions presented the highest rates of population growth and became the main destination for the population, motivated by factors such as climate, economic development of cities, employment opportunities, quality of life, provided by the proximity of the sea, and public policies.

On the other hand, the mountainous region and the extreme west of the state showed a high rate of rural exodus, possibly motivated by the lack of economic opportunities, the adverse climate and the limitations of infrastructure and basic services that directly affect the quality of life and available opportunities. Thus, the need for specific public policies such as those reported in FERRARI et al. (2007).

It is crucial to highlight that the rural exodus is intrinsically linked to the goals of the Organizations for Sustainable Development (SDGs), notably goal 11, which aims to make cities and communities inclusive, safe, and sustainable. The massive displacement of the rural population to urban areas directly impacts sustainable development, causing problems such as overpopulation, lack of adequate infrastructure and environmental degradation in cities. Furthermore, it is also related to goal 1, which seeks to eradicate poverty

in all its forms, as many rural migrants seek better economic opportunities in cities due to the lack of employment and precarious conditions in the countryside.

It is essential to promote the reduction of rural exodus and develop strategies to strengthen rural communities as essential elements for achieving the SDG goals and ensuring sustainable and equitable development.

The analysis carried out has high applicability, offering valuable insights for urban and rural planning, and can influence strategies to minimize rural exodus and promote sustainability. Although our study is comprehensive, we see potential for expansion: we suggest that future research explore data segregation by gender, as migration can impact men and women differently, allowing for even more targeted strategies for sustainable development.

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