Navigating Inequality: Examining Socio-Spatial Disparities in Coastal and Inland Pernambuco

Aerial view of the South Zone of Recife — Photo: Paulo Lope / Recife City Hall

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Abstract

This bachelor thesis examines socio-spatial disparities in Pernambuco, Brazil, focusing on urban coastal versus rural inland regions. The research utilizes quantitative analyses to explore the subject of socio-spatial disparities and their characteristics and the relationship between urbanization and those disparities. Pernambuco's unique characteristics, historical context, and social vulnerability are also considered. Findings reveal a weak but significant negative correlation between urbanization and the Social Vulnerability Index (SVI), suggesting that higher urbanization in coastal areas is associated with lower social vulnerability. Policy implications include promoting urbanization with infrastructure development and addressing historical inequities. The study underscores the importance of small-scale analysis for tailored policies. While a connection is established, caution is advised in attributing causation, necessitating further investigation into confounding variables.

Keywords: socio-spatial disparities, Pernambuco, rural-urban relations, urbanization, Social Vulnerability Index (SVI), Human Development Index (HDI), Spatial polarization, spatial scale, Land tenure, Health indexes, Social stratification, Brazil.

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1. Introduction

1.1. Background

Foreword

Ever since beginning the study Human Geography & Spatial Planning, I knew that I wanted to use this study to bridge the two versions of my childhood. I have a Brazilian mother and a Dutch father; I have lived mostly in the Netherlands but I have also spent a lot of time in Brazil. What I genuinely want is to use my knowledge, acquired through years of studying, to realize Brazil's potential and help the people. After researching Brazil's challenges, I've come across the quite apparent divide between the coast and the inland regions of the country. Coastal and inland disparities within a region can have profound effects on the well-being and opportunities available to its residents.

Introduction

In the Brazilian province of Pernambuco, socio-spatial disparities have been a subject of interest due to their social, economic, and historical implications. the reason the state of Pernambuco is suited for this research is because it is an interesting case study. Pernambuco has about 10 million inhabitants, is one of the smallest states in Brazil, and consists of 8 different Köppen climate types, including desert areas. Pernambuco is distributed throughout 185 municipalities (184 on the mainland and 1 on the island of Fernando de Noronha) and is divided into five mesoregions: Sertão, São Francisco, Agreste, Mata and Metropolitana do Recife (see Figure 1 in the appendices). Its HDI (Human Development Index) is far below Brazil's national HDI (0.673 vs 0.778), it also suffers from a lack of general sewage systems, intermittent water supply and other problems. There is also a stark contrast between the populous Recife metropolitan region and the inland rural areas. Pernambuco also is a uniquely latitudinally stretched state which has a small coastline but a large area of land that goes west into the Brazilian highlands. Within the archipelago of regional economies within Brazil (Deutsch, 1996) and the focus on trade through coastal regions, Pernambuco was chosen as a case study because of the high chance it could have socio-spatial disparities between its small but important coast and its vast but arid and relatively poor inland region.

This study aims to delve into disparities by examining key metrics, concepts and historical factors that shape them, linking them to the difference between Pernambuco's regions and examining the occurrence of disparities on different levels.

1.2. Research problem

In order to start a quantitative research project on disparities within a region with different characteristics, it is important to determine first if there are any disparities present on a spatial scale, therefore the central research question is divided into two parts: a yes or no part and a how part. This nullifies the existence of presumptions on the current situation in Pernambuco and makes it, therefore, an objective to first prove the existence of socio-spatial inequalities, and gives way to further research into the origins of these disparities and their characteristics. The first sub-question, as said already, will delve into urbanization and its influence on socio-spatial disparities across two different types of regions.

Central research question

- ➢ To what extent do socioeconomic disparities exist between urban coastal and rural inland areas in Pernambuco, and how can these disparities be explained?
    - ○ sub-question: How does urbanization influence the distribution of socio-spatial disparities across coastal and inland areas of Pernambuco?

1.3. Structure

In the initial phase, I will delve into the theoretical framework, elucidating key concepts, theories, metrics and data information that is relevant to the case of Pernambuco. Following this clarification, we will present a conceptual model, drawing upon relevant insights distilled from the existing body of literature.

The literature serves as the cornerstone upon which the hypotheses and expectations are formulated. Within the methodology section, the main quantitative facet of the research will be expounded, accompanied by a discussion on research ethics and positionality. This section will also encompass an assessment of the data's quality in conjunction with pertinent theories.

After addressing the methodology, the results will be delineated by the procedures and methods employed for their collection. Subsequently, a succinct summary and conclusion encapsulating the research findings will be offered together with a discussion where the data and findings will illustrate the argument together with the aid of the sources. Finally, an evaluation of the research's strengths and weaknesses will be presented, along with potential recommendations for future research

2. Theoretical framework

The theoretical framework encompasses the following components: relevant concepts, theories, metrics and information regarding the definition of socio-spatial disparities and their application in our case study of Pernambuco. To understand socio-spatial inequalities, several metrics and methods are used to analyze the distribution of opportunities, resources, and political power in urban spaces. The following key metrics, terms and concepts will be central to this research.

Rural-urban relations

Defining and measuring the extent of disparities between the rural inland regions and urban coastal regions of Pernambuco is central to the relevance and validity of this report. Rural-urban relations are crucial in understanding socio-spatial inequalities, as they reflect and reinforce existing hierarchies (Lichter, 2017). This is particularly relevant in the context of migration from resource-poor rural areas to urban spaces, which can exacerbate inequalities (Vígvári, 2016). In the context of health, while rural location can impact access to services, it is not the sole determinant of health disparities (Smith, 2008). Therefore, when conducting research on socio-spatial inequalities, it is important to consider the dynamic and multifaceted nature of rural-urban disparities. Research suggests that a low percentage of the population living in urban households is associated with social vulnerability. While urban households are also less vulnerable to poverty than rural households, with education qualifications affecting rural residents' vulnerability (Ding, 2022).

Spatial polarization

Spatial polarization within the scope of this report focuses on the unequal distribution of economic activities, resources, or opportunities across different areas within Pernambuco. This polarization can lead to the concentration of wealth, investment, and development in certain regions, while other areas experience decline or stagnation. Spatial polarization is often associated with urban-rural divides, where urban centers experience significant growth and prosperity, while rural areas face economic challenges and limited access to resources and opportunities.

Spatial polarization can significantly impact socio-spatial disparities, It can contribute to the widening gap in economic, social, and political dimensions between different regions by so-called 'Peripheralization', which is the clear delineation of a center and the surrounding space within a region, often a product of centralization processes (Kühn, 2014).

Land Tenure and Distribution

Within the context of this research, an examination of land ownership patterns and land use will provide insights into how land resources contribute to disparities.

Unequal land distribution is not a new problem, it has been at the forefront of agricultural or economic crises for centuries. Especially in Middle and South America, it has long been viewed as the social dynamite that has set off many peasant uprisings in the twentieth century (Seligson, 1995).

The colonial exploitation-based economies of the northeastern states in Brazil further strengthened the divide between the resource-producing inland provinces and the trade-rich cities on the coast exporting goods and services. For hundreds of years, Pernambuco was Brazil's key northeastern sugar-growing state, with change coming slowly to the region (Bergad, 2007).

Health Indexes

The IBGE (The Brazilian Institute of Geography and Statistics) is a key source for statistics and research based on socio-economic data and has done some research on the inequality of Brazilian federal districts. There are multiple studies based on the disparities between coastal and inland regions, but they largely focus on the influence of coastal urban centers.

Analyzing health indexes such as the Human Development Index (HDI), Social Deprivation Index (SDI), life expectancy, education indexes and more will help to understand the well-being of the people in different parts of the state.

According to data from the IBGE, the state of Pernambuco does not score high in any of the above metrics (See Appendices). The IBGE has also published data that includes the GINI index.

This index measures the extent to which the distribution of income or consumption among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.
This index is very important when researching inequalities among regions, Pernambuco is among the worst of the federal districts in Brazil concerning this index (Appendices: Figure 2).

This research requires indexes to be studied at a smaller scale than on the state level or national level, there is however limited information when looking at the state of Pernambuco. Kakwani (1997) discusses the measurement and computation of health inequality indices, highlighting their role in analyzing socioeconomic inequalities. Arcaya (2015) distinguishes between unavoidable health inequalities and preventable health inequities and explores various theories and concepts related to health inequalities. These papers underscore the importance of considering real communities, multiple dimensions of social location, and the measurement and computation of health inequality indices in understanding socio-spatial inequalities.

The social vulnerability index (SVI), for instance, is a crucial tool for understanding socio-spatial inequalities, particularly in the context of environmental burdens and benefits. It can help identify "hotspot" areas with high cumulative burdens and high social vulnerability, which is essential for informing environmental justice debates and interventions (Shrestha, 2016). The index can also be used to assess the vulnerability of urban fringe areas, where rapid urbanization can exacerbate social vulnerability (Yang, 2019). Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood (FEMA). In Pernambuco, this SVI seems to differ per municipality but appears to be quite high in a lot of places. The higher the SVI, the more social vulnerability in that area, meaning that area may need more resources to thrive. Clusters of high SVI seem to be in the mesoregion of Sao Francisco and other non-coastal areas (see Appendices: Figure 3).

Social & spatial stratification

Spatial stratification refers to the categorization of people or groups based on their geographic location or spatial distribution such as wealth, income, race, education, ethnicity, gender, occupation, social status, or derived power (Barkan, 2017). It is a concept used in geography and urban studies to describe the spatial organization of social groups and the distribution of resources, opportunities, and outcomes across different regions or areas.

Historical Context and Relevance

When pursuing potential answers relating to the distribution of people, wealth, economic activities etc., it is crucial to look at the historical context of Pernambuco, especially its colonial history. Several valuable secondary data sources come to the fore. Local and regional historical societies, archives, and academic libraries house historical maps, documents, and records specific to Pernambuco's history.
Additionally, national and local museums offer information that can shed light on the historical backdrop of the region. These cultural and historical resources can be instrumental in tracing the evolution of socio-spatial disparities over time.
Furthermore, consulting and interviewing individuals who have studied the history of the region gives valuable insight into the historical context of the distribution of today's socio-spatial inequalities. With this, a more holistic understanding of how historical forces have shaped the socio-spatial landscape of the region can be explored.
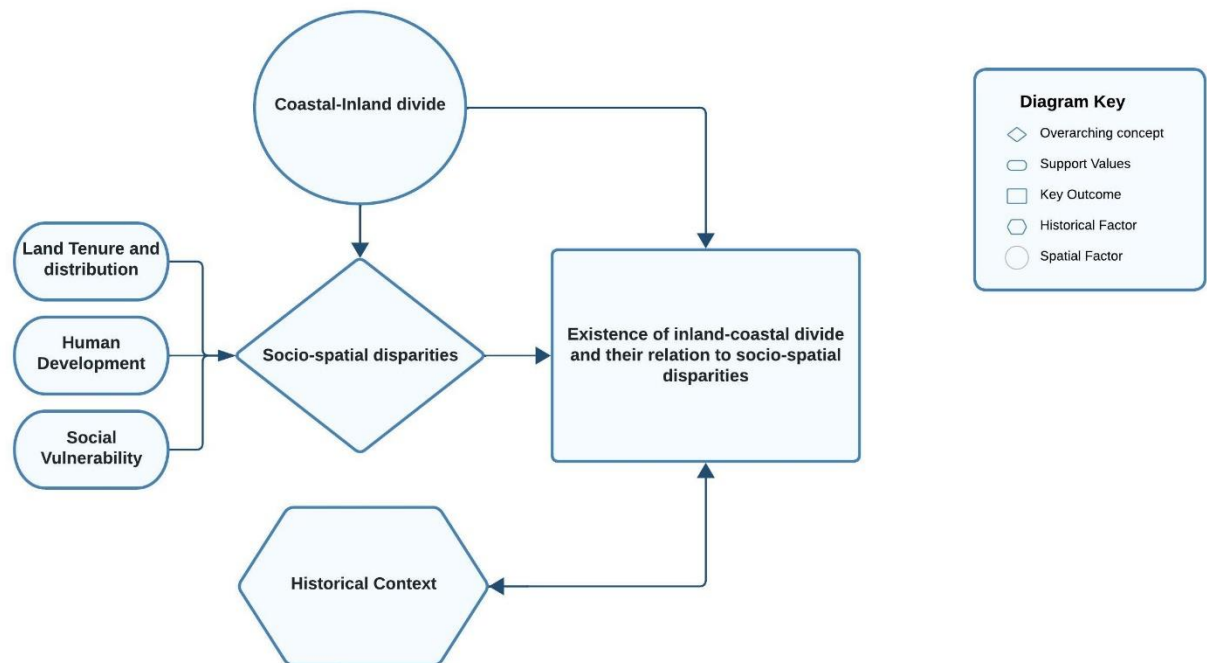
2.1. Conceptual model

Figure 1: Conceptual model made by Djorn Barkmeijer. Explaining the existence of the potential inland-coastal divide and its relation to socio-spatial disparities.

2.2. Hypothesis

Hypothesis: I hypothesize that there are significant socio-spatial disparities between the coastal and inland regions of Pernambuco, with coastal areas generally exhibiting higher levels of development, access to services, greater urbanization and lower social vulnerability compared to inland areas as indicated by higher income levels, better access to education, healthcare, and improved housing conditions compared to their inland counterparts. Whether or not this is influenced by the lingering difficulties of the rural inland geography compared to the 'easy' urban coastal access, is still not sure. I also hypothesize that historical factors, including the colonial history of Brazil, have played a significant role in shaping the current socio-spatial disparities in Pernambuco. Especially the long history of sugarcane plantations and how it shaped the economy, land distribution and spread of development. I expect that this factor will become central in the research problem just like the doctrine of colonization will play an important role in the distribution of the population.

3. Methodology and Data Analysis

This research employed a quantitative method approach but also tried to include qualitative methods to comprehensively examine the historical context relating to the socio-spatial disparities in Pernambuco state and its possible coastal/inland origin. The analysis involved the interpretation of results to identify patterns, correlations, and causal relationships. It determines the extent to which socio-spatial disparities are being influenced by coastal/inland conditions.

Qualitative Analysis:

Qualitative data from interviews was supposed to be analyzed thematically to extract key insights into historical factors influencing disparities. The aim was to include local experts, government officials or possibly witnesses to the disparities within this research to further conceptualize the many layers of context with people who have firsthand experience.

Three interviews were planned; one with a Brazilian academic who had expertise in disparities, one with an expert on spatial issues in Brazil and one interview with a local citizen of Pernambuco who has travelled to both the inland region and the coastal region. Brazilian contacts were used to find individuals living in the Pernambuco state. Through a journal on disparities in Brazil, I was able to contact experts on different topics related to this research report. This data would have been complimentary to the secondary data, which is the main source of theoretical deliberation within this research report. Regrettably, these interviews were not finalized because of a lack of responses after delivering the consent form and the questions form (Appendix 1 and 2).

Quantitative Analysis:

The data was gathered from official and reputable statistics sources like the World Bank[1], Statista[2], IMF[3], United Nations [4]and the IBGE[5]. The main focus was to determine the existence and strength of the relationship between the percentage of the population living in an urban household and the social vulnerability index in Pernambuco.

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[1] https://www.worldbank.org
[2] https://www.statista.com
[3] https://www.imf.org
[4] https://www.un.org
[5] https://www.ibge.gov.br

The existence and strength of the relationship of these statistics is measured in two different places in Pernambuco: Metropolitana de Recife mesoregion and the São Francisco Pernambucano Mesoregion.

The quantitative data analysis was implemented using a simple linear regression in SPSS[6] (Statistical Package for the Social Sciences) with the SVI (social vulnerability index) as the dependent variable and the Percentage of the population living in an urban household as the independent variable. Using this method, it was possible to analyze the correlation and significance of living in an urban household compared to the social vulnerability of the population in the two chosen locations.

3.1. Ethical considerations and positionality

It is important to understand and acknowledge the ethical considerations and positionality when conducting research on a contemporary social problem that has local implications.

Providing comprehensive and understandable information to participants is crucial, covering the study's purpose, procedures, potential risks and benefits, expected duration, and alternatives to participation. Additionally, researchers must transparently disclose any potential conflicts of interest, funding sources, or affiliations that might influence a participant's decision (Informed Consent 2023).

- Privacy and confidentiality of participants and data were maintained throughout the research process. replacement names or nicknames were given.
- Data was securely stored during and after the research, following the University of Groningen guidelines.

As a Dutch student with Brazilian heritage delving into a bachelor thesis on socio-spatial disparities in Pernambuco, Brazil, my unique position offers both advantages and challenges. I do not have full proficiency in the Portuguese language, but my limited knowledge still enhances communication and understanding of the many sources of information and individuals that I have consulted, but the duality of being both an insider and outsider must be acknowledged.

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[6] https://www.ibm.com/products/spss-statistics

I have been to Brazil many times, but the diverse nature of Brazil and its many different regions means that my knowledge of the country has limited value, especially because I have never been to the state of Pernambuco

(I was closest to it when visiting São Luís in the Maranhão state, which is about 500km northeast). Because of this, I need to be mindful of potential biases that could arise due to my cultural background.

Preconceived notions or expectations based on my heritage may impact the interpretation of data. Navigating global-national-local dynamics requires an awareness of interconnectedness, aiming for research that not only meets academic standards but also considers local impact.

4. Results and Discussion

4.1. Statistical Findings

Data found on the website of the Brazilian Institute of Geography and Statistics (IBGE) was collected and used. The Social Vulnerability Index was used as a variable indicating various disparities between two chosen points in Pernambuco.

The data is divided into two Mesoregions within Pernambuco: the semi-arid inland and rural Mesoregion called São Francisco Pernambucano, consisting of the microregions Itaparica & Petrolina, and the coastal and mainly urban Mesoregion Metropolitana de Recife, consisting of the microregions Recife, Suape, Itamaracá and Fernando de Noronha (Appendices: figure 1. Yellow and grey regions). As stated, the first is an inland arid/semi-arid region and the second is the metropolitan urban coast region of Pernambuco with the capital city Recife. To effectively compare these two regions, it was necessary to use data on the percentage of the population that lives in an urban household. With this data, it is possible to analyze the correlation and significance of living in an urban household compared to the social vulnerability of the population in the two chosen locations. This variable was used in order to demarcate the differences between the coastal urban region of Pernambuco and the less urban inland region.

Linear Regression

Variables	Mean	Std. Deviation	Minimum	Maximum	N
urbanpop% - Recife	99.75	1.26	82.32	100.00	948
urbanpop% - SaoFranciscoPernambucano	94.19	15.07	20.24	100.00	122
HDI - Recife	0.676	0.116	0.349	0.955	948
HDI - SaoFranciscoPernambucano	0.592	0.132	0.268	0.866	122
SVI - Recife	0.417	0.150	0.049	0.870	948
SVI - SaoFranciscoPernambucano	0.389	0.157	0.116	0.646	122

Table 1: Descriptive Statistics.

Correlations

		SVI (social vulnerability index)	Percent of the population living in an urban household
Pearson Correlation	SVI (social vulnerability index)	1,000	-,164
	Percent of the population living in an urban household	-,164	1,000
Sig. (1-tailed)	SVI (social vulnerability index)	.	,000
	Percent of the population living in an urban household	,000	.
N	SVI (social vulnerability index)	1070	1070
	Percent of the population living in an urban household	1070	1070

Table 2: Correlations.

Descriptive Statistics and Correlation

The analysis reveals that the Metropolitana de Recife mesoregion has a consistently high urban population percentage (about 99.75%), indicating predominant urban residency. Recife's Human Development Index (HDI) is approximately 0.676, signifying moderate human development, while the Social Vulnerability Index (SVI) stands at around 0.417, which is moderate. In the São Francisco Pernambucano mesoregion, however, though urbanization is only about 5.5%pt. lower (about 94.19%), there's greater variability (standard deviation 15.07%). Looking at the minimum of both mesoregions, the difference is even more substantial with Recife having 82,32% and São Francisco Pernambucano only having 20.24%. The variability combined with the differences in minimum indicates a substantial difference in urbanization.

The average HDI of São Francisco Pernambucano is slightly lower at 0.592, indicating comparatively lower human development, and the SVI averages around 0.389, implying a somewhat lower social vulnerability than in Metropolitana de Recife, which is surprising. Despite Recife generally surpassing São Francisco Pernambucano in these indicators, the latter exhibits more variability, reflecting diverse socio-spatial conditions.

The Pearson correlation coefficient between SVI and the percentage of the population in urban households is -0.164, indicating a weak negative correlation. This implies that as the percentage of the population in urban households increases, the SVI slightly decreases. The p-value (Significance, Sig. 1-tailed) of this correlation is 0.000, signifying that the correlation is statistically significant. With a statistically significant p-value (<0.05), the null hypothesis can be rejected.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,164[a]	,027	,026	,149143	,027	29,445	1	1068	,000

a. Predictors: (Constant), Percent of the population living in an urban household

b. Dependent Variable: SVI (social vulnerability index)

Table 3: Model Summary.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,655	1	,655	29,445	,000[b]
	Residual	23,756	1068	,022		
	Total	24,411	1069			

a. Dependent Variable: SVI (social vulnerability index)

b. Predictors: (Constant), Percent of the population living in an urban household

Table 4: ANOVA table.

Model Summary & ANOVA table

In the Model Summary, we observe that the R for the model is 0.164, corresponding to the correlation coefficient. The R^2 value, indicating the amount of variation in SVI explained by the model, is 0.027 (or 2.7%). This is relatively low, suggesting that the model does not account for a substantial portion of the variation in SVI.

The adjusted R^2 is similar, indicating a stable model across different sample sizes. The standard error of the estimate is 1.49143, informing us of the degree to which our SVI estimates will deviate from actual values.

The ANOVA table reveals an F-value of 29.445, serving as a measure of the total variation explained by the model compared to unexplained variation. The associated p-value is less than 0.001, signifying the statistical significance of the model.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	,860	,082		10,443	,000					
	Percent of the population living in an urban household	-,005	,001	-,164	-5,426	,000	-,164	-,164	-,164	1,000	1,000

a. Dependent Variable: SVI (social vulnerability index)

Table 5: Coefficients.

Coefficients

The coefficient table shows that the constant (intercept) is 0.860 with a t-value of 10.443, significantly differing from 0. The coefficient for the percentage of the population living in an urban household is -0.005, meaning that for every 1%pt. increase in the percentage of the population living in an urban household, the SVI decreases by 0.005 units. This coefficient is also statistically significant with a t-value of -5.426.

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	,40983	,76885	,41380	,024753	1070
Residual	-,360834	,414928	,000000	,149073	1070
Std. Predicted Value	-,160	14,344	,000	1,000	1070
Std. Residual	-2,419	2,782	,000	1,000	1070

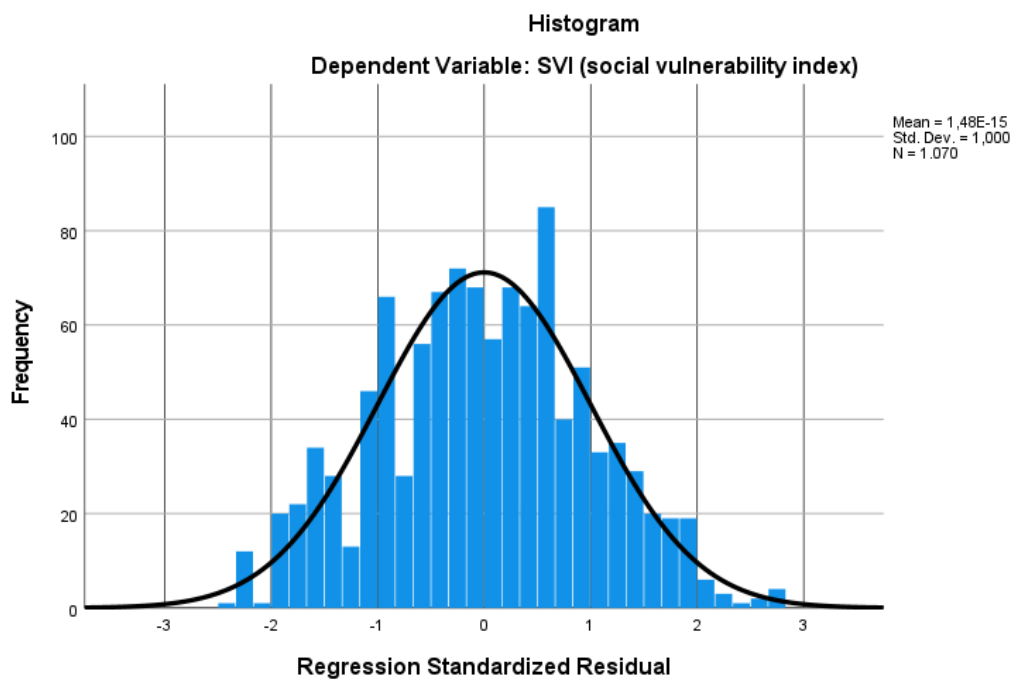a. Dependent Variable: SVI (social vulnerability index)

Table 6: Residuals table.

Figure 7: Histogram.

Residual Statistics and Histogram

The residual statistics reveal an average close to 0, indicating that the model does not systematically overestimate or underestimate. Residuals represent the differences between the observed and predicted values of the SVI.

The histogram of standardized residuals with a superimposed normal curve illustrates that the residuals are approximately normally distributed, a good characteristic for model linearity and homoscedasticity. The graph does not display clear deviations from a normal distribution, suggesting a well-fitting model. The values of standardized residuals fall within the range of approximately -3 to 3, well within expected bounds.

There are no apparent signs of outliers or leverage that could unreasonably influence the model. The standard deviation of the residuals is reasonably consistent with the standard error of the estimate in the model summary.

Conclusion of results

In summary, this simple linear regression analysis demonstrates a weak but statistically significant negative relationship between the percentage of the population living in urban households and SVI. This could indicate that a higher percentage of urbanisation, found in the coastal region in Pernambuco, decreases the SVI. The overall SVI score ranges from 0 (lowest vulnerability) to 1 (highest vulnerability) (HHS, 2020). This could imply that communities in more urbanized areas are more resilient when confronted by external stresses on human health, natural or human-caused disasters or disease outbreaks (TN). However, given the low R^2 percentage, it is evident that there are other factors influencing SVI not accounted for in this model.

The null hypothesis for this test was: In the population, there is no true linear relationship between the percentage of the population in urban households and the SVI. Since the probability value of the model is >0,05, it means the model is significant and the null hypothesis can be rejected. This indicates that there is a significant relationship between the percentage of the population living in urban households and the social vulnerability index.

4.2 Discussion

The statistical data and findings of this research tie well into the theoretical framework discussed earlier in this thesis.

The research has explored the relationship between urbanization and socio-spatial disparities in Pernambuco, Brazil. It highlighted the importance of considering rural-urban relations, spatial polarization, land tenure and distribution, health indexes, social stratification, historical context, local data sources, socio-spatial integration and exclusion policies, and small-scale analysis in understanding these disparities.

The data results indicated a weak but statistically significant negative relationship between the percentage of the population living in urban households and the Social Vulnerability Index (SVI). This suggests that higher levels of urbanization, which are more prevalent in coastal areas of Pernambuco, are associated with lower levels of social vulnerability. This finding aligns with the theoretical concept of spatial polarization, which posits that the concentration of wealth and development in urban areas can lead to a decrease in disparities.

The low R-squared value (0.06) suggests that there are other factors influencing the SVI that are not accounted for in this simple linear regression model. These factors could include income inequality, access to healthcare, and education levels. The findings of this study have several implications for policy and practice. First, they suggest that promoting urbanization can be an effective strategy for reducing socio-spatial disparities in Pernambuco. However, it is important to ensure that urbanization is accompanied by the development of adequate infrastructure, services, and opportunities in urban areas to prevent the creation of new disparities since the urban low class is disproportionately vulnerable to food and fuel price crises, as well as the global financial crisis (Ruel, 2010).

Second, the study highlights the importance of considering historical context when addressing socio-spatial disparities. The historical legacy of colonialism and slavery in Pernambuco influenced the current patterns of inequality. The sugar industry concentrated wealth along the coasts among landowners and those involved in the trade, while the region's economy experienced fluctuations due to external factors such as the Dutch occupation and the shift towards other agricultural products like gold and coffee.

The colonial history also led to various rebellions and uprisings, which affected the political landscape of the region. However, the state remained an agricultural-producing resource hub with a large population centre along the coast where almost all of the trade occurred (Arruda, 2019).

Third, the study underscores the need for small-scale analysis when examining socio-spatial disparities. The SVI varies significantly across different municipalities in Pernambuco, indicating that there are local factors that play a role in determining the level of vulnerability. Policies should be tailored to the specific needs of different municipalities in order to be most effective.

In summary, this study has contributed to the understanding of socio-spatial disparities in Pernambuco by providing empirical evidence of the relationship between urbanization and the SVI. The findings have implications for policy and practice, suggesting that promoting urbanization, addressing historical inequities, and using small-scale analysis are important strategies for reducing socio-spatial disparities in the state.

5.   Conclusion

In conclusion, this research report has answered the primary question: "To what extent do socioeconomic disparities exist between urban coastal and rural inland areas in Pernambuco, and how can these disparities be explained?" and the sub-question: "How does urbanization influence the distribution of socio-spatial disparities across coastal and inland areas of Pernambuco?". The study has established a connection between urbanization and socio-spatial disparities in Pernambuco by proving a weak but significant negative correlation between the SVI and the degree of the population living in urban households.

This means that the risk of social vulnerability (natural hazards, including disproportionate death, injury, loss, or disruption of livelihood (FEMA)) decreases when the percentage of the population living in urban households increases. This answers the question on the existence of differences between the disparities of rural inland and urban coastal regions in the state of Pernambuco. It is crucial to acknowledge, however, that correlation does not imply causation. While an association seems to exist, it cannot be concluded that urbanization directly reduces social vulnerability without further investigation into potential confounding variables and the direction of the effect.

Future research

Future research should consider incorporating additional variables into the model to obtain a more comprehensive understanding of social vulnerability. Other variables indicating socio-spatial disparities could be the GINI-index, level of education, personal wealth, hygiene, opportunity and economic freedom. Further research is needed to identify and quantify these additional factors in order to develop a more comprehensive understanding of the determinants of socio-spatial disparities in Pernambuco. A. Neto defines social vulnerability in Cuiabá-MT by factors like low income, black/Pardo population, education deficiency, low life expectancy, and children in the household. This could be applied and/or modified to the case of Pernambuco in order to specify differences in levels of social vulnerability. Future research should also make use of qualitative data obtained through interviews with local experts on the distinctive situation of Pernambuco and delve deeper into the historical aspects that still play a part in the coastal-inland divide in the state.

Reflection

Reflecting on the result and the research process, I acknowledge the limitations set by the statistical evaluation and the decisions taken when considering social vulnerability and socio-spatial disparities. These subjects are very expansive and considering the theoretical framework and my research, they almost always come with limitations since it is very hard or almost impossible to incorporate all variables and aspects into statistical analyses. Choosing the social vulnerability index as the sole variable in my analysis is therefore a limitation in and of itself. The variable I used to indicate the differences between rural inland and urban coastal regions (percentage of the population living in urban households), was also a limitation in and of itself since many more factors could contribute to differences in those two areas.

Regrettably, the failure to incorporate interviews with experts on social-spatial disparities and the state of Pernambuco has decreased the depth of this study in terms of the human aspect of this supposed social problem. Despite these limitations, this study offers a comprehensive understanding of socio-spatial disparities between urban coastal and rural inland regions and contributes to the understanding of the effects of urbanisation on social vulnerability.

6. References

- Amann, E. *et al.* (2020) *Natural Resource Access and Local Economic Growth*, *European Economic Review*. Available at: https://www.sciencedirect.com/science/article/pii/S0014292120300 738 (Accessed: 17 September 2023).
- Andrade, A. W. F., Souza, C. D. F., & Carmo, R. F. (2020). Analysis of spatial clustering, time trend, social vulnerability and risk of human visceral leishmaniasis in an endemic area in Brazil: an ecological study. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *114*(8), 575–584. https://doi.org/10.1093/trstmh/traa024
- Arcaya, M. C., Arcaya, A. L., & Subramanian, S. V. (2015). Inequalities in health: definitions, concepts, and theories. *Global health action*, *8*, 27106. https://doi.org/10.3402/gha.v8.27106
- Arruda, J.J. (2019) *Economy during the colonial period*, *Oxford Research Encyclopedia of Latin American History*. Available at: https://oxfordre.com/latinamericanhistory/display/10.1093/acrefore /9780199366439.001.0001/acrefore-9780199366439-e-693?d=%2F10.1093%2Facrefore%2F9780199366439.001.0001%2 Facrefore-9780199366439-e-693&p=emailAQoRb2VaWzZ9M (Accessed: 22 January 2024).
- Bard, Google AI." Several grammatical and spelling questions" Bard, Google AI. Accessed [2023-2024]
- Bard, Google AI." welke statistische test moet ik kiezen als ik er achter wil komen of de geografische ligging effect heeft op de desbetreffende variabele?" Bard, Google AI, [2023.12.18]. Accessed [10-01-2024]
- Barkan, S.E. (2017) *Sociology: Understanding and changing the Social World*, *Open Textbook Library*. Available at: https://open.umn.edu/opentextbooks/textbooks/38 (Accessed: November 2023).
- Bergad, L. (2007) *The Comparative Histories of Slavery in Brazil, Cuba, and the United States*. Cambridge: Cambridge University Press (New Approaches to the Americas). doi: 10.1017/CBO9780511803970.
- Costa, M.A. and Marguti, B.O. (eds.) (2015) *Atlas da Vulnerabilidade social nos municípios brasileiros*, *ivs.ipea.gov.br*. Available at: http://ivs.ipea.gov.br/images/publicacoes/Ivs/publicacao_atlas_ivs. pdf (Accessed: 29 September 2023).
- de Campos, M.B. *et al.* (2021) *Indigenous migration patterns in Brazil based on the 2010 National Demographic Census: Analysis and Critical Reflection*, *SN social sciences*. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8549969/ (Accessed: 17 September 2023).

- Deutsch, R. (1996) *"Bridging the Archipelago: Cities and Regional Economies in Brazil, 1870–1920," The Journal of Economic History*. Cambridge University Press, 56(2), pp. 461–463. Available at: https://www.cambridge.org/core/journals/journal-of-economic-history/article/abs/bridging-the-archipelago-cities-and-regional-economies-in-brazil-18701920/FBCF5DBDEBAFF61E7AC6C81FC0E94897# (Accessed: 15 September 2023).
- Ding, S., 2022. A Comparative Analysis of Vulnerability to Poverty between Urban and Rural Households in China. *Economies*. https://doi.org/10.3390/economies10100243.
- HOELSCHER, K. (2017). Institutional Reform and Violence Reduction in Pernambuco, Brazil. *Journal of Latin American Studies, 49*(4), 855-884. doi:10.1017/S0022216X17000748
- Hofslot van, M., 2000. Correspondence via Whatsapp, (2023-2024)
- *Informed consent* (2023) *University of Groningen*. Available at: https://www.rug.nl/digital-competence-centre/privacy-and-data-protection/gdpr-research/informed-consent?lang=en (Accessed: 14 December 2023).
- Kakwani, N., Wagstaff, A. and Doorslaer, E.V. (1998) *Socioeconomic inequalities in health: Measurement, computation, and statistical inference*, *Science Direct*. Available at: https://www.sciencedirect.com/science/article/pii/S0304407696018076?via%3Dihub (Accessed: 14 December 2023).
- Kanouse, S. *et al.* (2022) *What makes justice spatial? what makes spaces just? Three interviews on the concept of Spatial Justice Critical Spatial Practice Reading Group*, *Academia.edu*. Available at: https://www.academia.edu/71225857/What_Makes_Justice_Spatial_What_Makes_Spaces_Just_Three_Interviews_on_the_Concept_of_Spatial_Justice_Critical_Spatial_Practice_Reading_Group (Accessed: 06 October 2023).
- Kantor, P., & Nair, P. (2005). Vulnerability among slum dwellers in Lucknow, India: Implications for urban livelihood security. *International Development Planning Review, 27*, 333-358.
- Kühn, M. (2014) *Peripheralization: Theoretical concepts explaining socio-spatial ...*, *Taylor & Francis Online*. Available at: https://www.tandfonline.com/doi/full/10.1080/09654313.2013.862518 (Accessed: 14 December 2023).
- Lichter, D.T., & Ziliak, J.P. (2017). The Rural-Urban Interface: New Patterns of Spatial Interdependence and Inequality in America. *The ANNALS of the American Academy of Political and Social Science, 672*, 25 - 6. Available at: https://journals.sagepub.com/doi/10.1177/0002716217714180
- Nehring, R. (2022) *The Brazilian Green Revolution*, *Political geography*. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7612294/ (Accessed: 17 September 2023).

- OpenAI. (2023). ChatGPT 3.5 (December) [SPSS Linear Regression Guide]. https://chat.openai.com
- OpenAI. (2024). *ChatGPT 3.5* (25-01) [Weak correlation, significant relationship]. https://chat.openai.com

- *Overview* (2023) *World Bank*. Available at: https://www.worldbank.org/en/country/brazil/overview (Accessed: 17 September 2023).
- Passarelli-Araujo, H. and Souza, G.M. de (2023) *Urban-Rural Health Disparities in Brazil: Do sociodemographic attributes play a role?*, *National Library of Medicine (NIH) National Center for Biotechnology Information*. Available at: https://pubmed.ncbi.nlm.nih.gov/37625652/ (Accessed: 15 September 2023).
- Perplexity.ai (2023) [how is social vulnerability measured in relation to land distribution]. https://www.perplexity.ai/ Accessed [11-2023]
- *Regiões de influência das Cidades* (2022) *biblioteca.ibge.gov.br*. Available at: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101987.pdf (Accessed: 28 September 2023).
- Ruel, M. *et al.* (2010) *The food, fuel, and financial crises affect the urban and rural poor disproportionately: A review of the evidence*, *The Journal of Nutrition*. Available at: https://pubmed.ncbi.nlm.nih.gov/19939990/ (Accessed: 22 January 2024).
- Ruiz-Tagle, Javier. (2013). A Theory of Socio-spatial Integration: Problems, Policies and Concepts from a US Perspective. International Journal of Urban and Regional Research. 37. 10.1111/j.1468-2427.2012.01180.x.
- Seligson, M., 1995. Thirty Years of Transformation in the Agrarian Structure of El Salvador, 1961–1991. *Latin American Research Review*. https://doi.org/10.1017/s0023879100017532.
- Shrestha, R. *et al.* (2016) *Environmental health related socio-spatial inequalities: Identifying 'hotspots' of environmental burdens and social vulnerability*, *International Journal of environmental research and public health*. Available at: https://pubmed.ncbi.nlm.nih.gov/27409625/ (Accessed: 14 December 2023).
- Smith, K. B., Humphreys, J. S., & Wilson, M. G. (2008). Addressing the health disadvantage of rural populations: how does epidemiological evidence inform rural health policies and research?. *The Australian journal of rural health*, *16*(2), 56–66. https://doi.org/10.1111/j.1440-1584.2008.00953.x

- *Social vulnerability index* (no date) *TN*. Available at: https://www.tn.gov/health/cedep/environmental/data/communityda ta/social-vulnerability-index.html#:~:text=Social%20vulnerability%20refers%20to%20re silience,caused%20disasters%20or%20disease%20outbreaks. (Accessed: 23 January 2024).
- Souza, H.G. de, Tabosa, F.J.S. and Araujo, J.A. (2019) *Income elasticities and inequality of poverty in urban and rural areas of the Brazilian states: A spatial approach*, *CEPAL.org*. Available at: https://www.cepal.org/en/publications/45410-income-elasticities-and-inequality-poverty-urban-and-rural-areas-brazilian-states (Accessed: 15 September 2023).
- Souza, P.Z., Herschmann, S. and Assunção, J.J. (2020) *Rural credit policy in Brazil: Agriculture, Environmental Protection, and Economic Development*, *CPI*. Available at: https://www.climatepolicyinitiative.org/publication/rural-credit-policy-in-brazil-agriculture-environmental-protection-and-economic-development/ (Accessed: 17 September 2023).
- Vígvári, A. (2016). 'Rural poverty' in urban spaces of Budapest Research proposal for examining spatial inequality in contemporary Hungary. DOI: 10.18030/socio.hu.2016en.47
- Venhorst, V. (2023) Correspondence via Gmail from Barkmeijer, D. (v.a.venhorst@rug.nl)

- Wejsa, S. and Lesser, J. (2022) *Migration in Brazil: The making of a multicultural society*, *migrationpolicy.org*. Available at: https://www.migrationpolicy.org/article/migration-brazil-making-multicultural-society (Accessed: 17 September 2023).
- Yang, X.-J. *et al.* (2018) *Research on social vulnerability evaluation of urban fringe based on ...*, *IOP Science*. Available at: https://iopscience.iop.org/article/10.1088/1755-1315/242/5/052018 (Accessed: 14 December 2023).
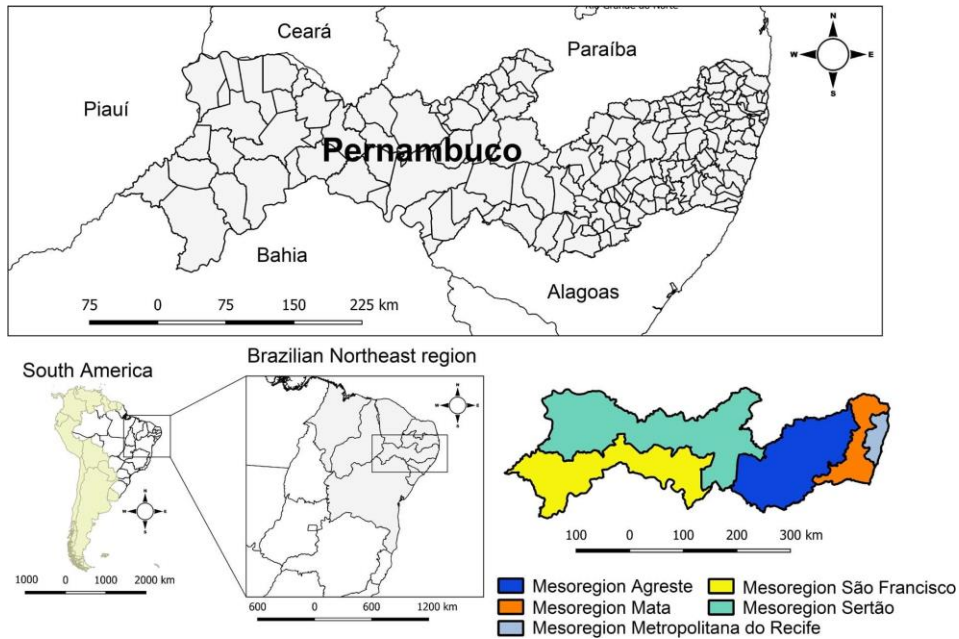
7. Appendices

Figure 1: Geographic location of the study area: Pernambuco, Brazil (Andrade et al., 2020)

Figure 2: the Gini indexes of the federal districts of Brazil. Pernambuco is indicated with the blue arrow (IBGE, Continuous National Household Sample Survey 2021).
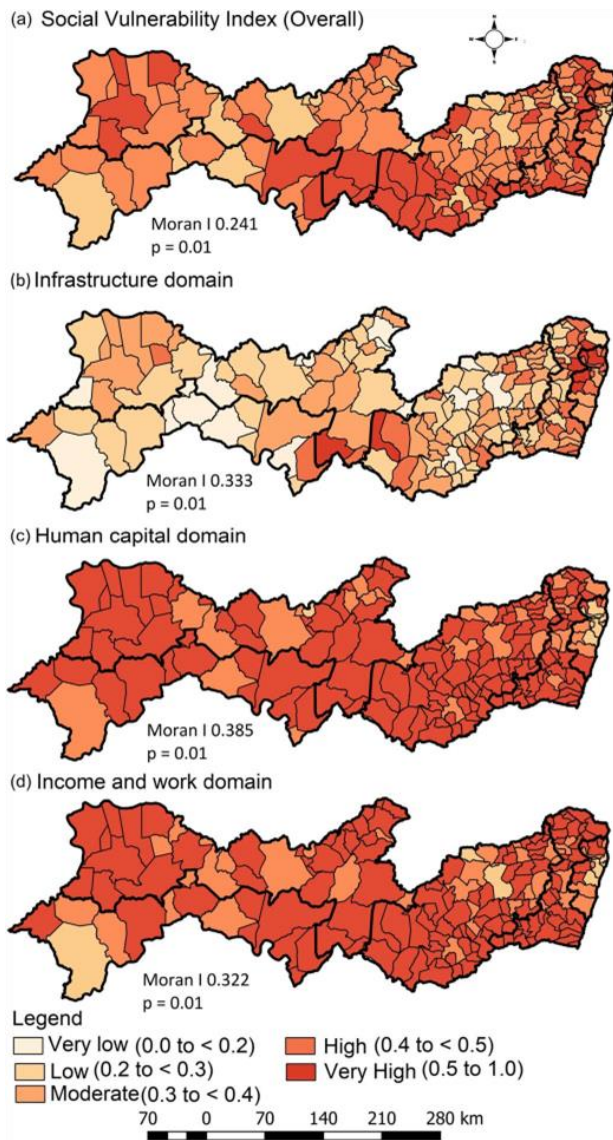
Figure 3: Spatial distribution of SVI and its components—Pernambuco, Brazil, 2010. (Andrade et al., 2020)
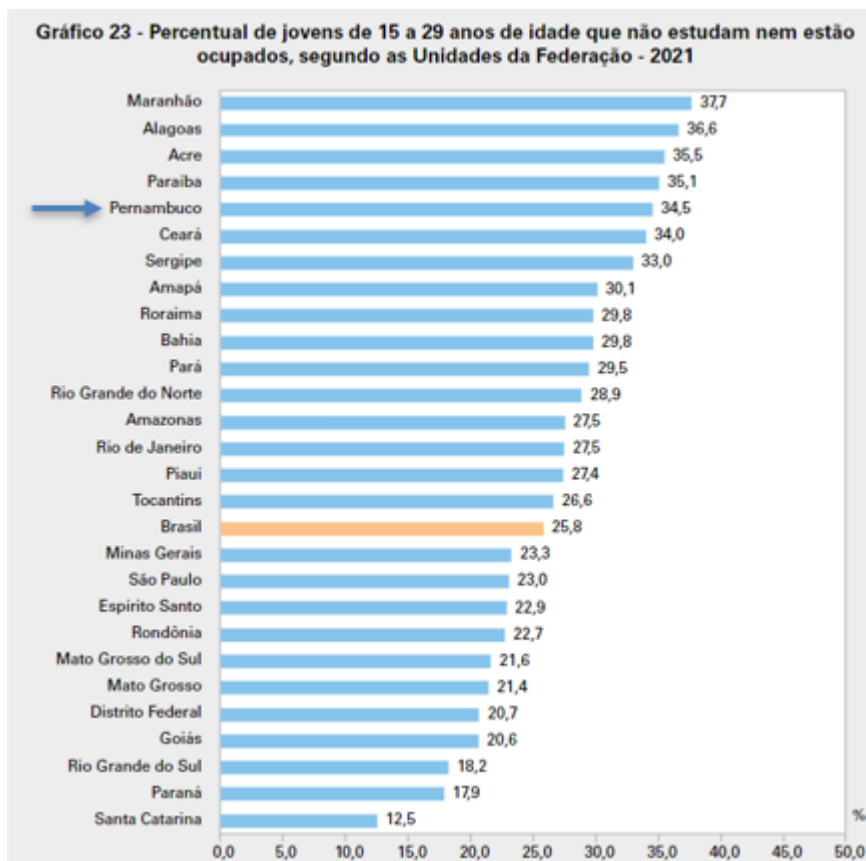
Figure 4: Percentage of young people aged 15 to 29 who are neither studying nor occupied, according to the Federation Units (IBGE, Continuous National Household Sample Survey 2021)
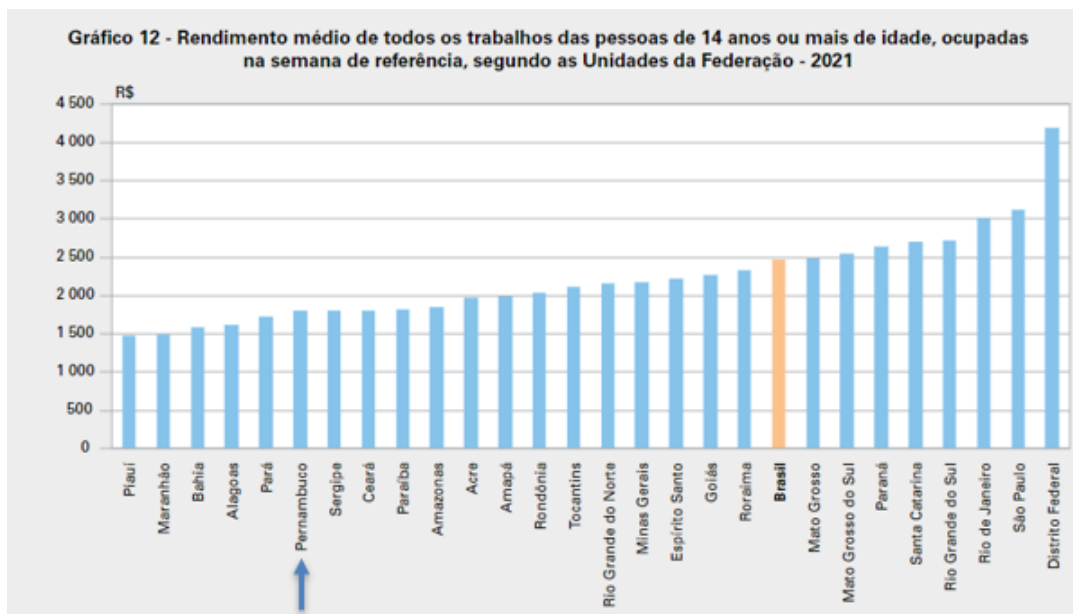

Figure 5: Average income from all jobs of people aged 14 or over, employed in the reference week, according to the Federation Units (IBGE, Continuous National Household Sample Survey 2021).
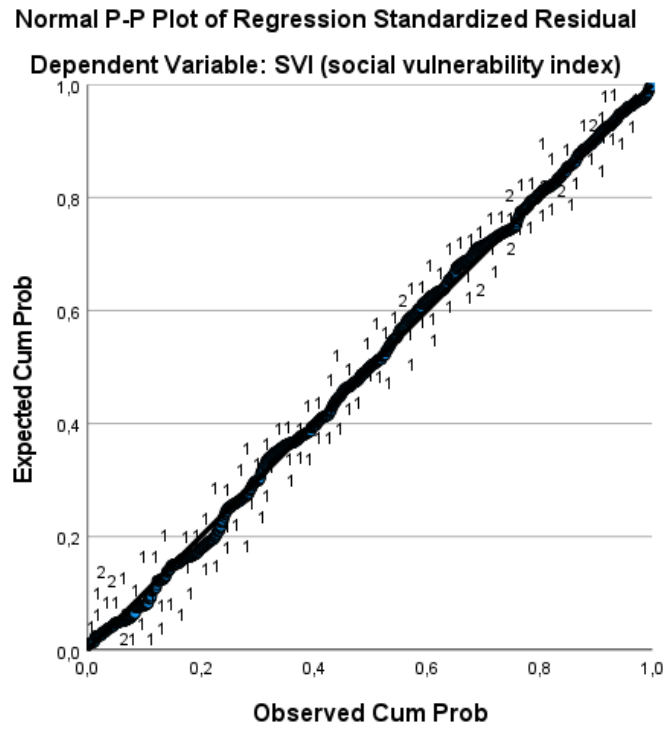
Figure 7: Normal P-P plot of regression standardized residual

Appendix 1: consent form

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Interview Consent Form

Title of Research Study: Socio-spatial disparities between coastal and inland regions in Pernambuco.

Principal Investigator: Djorn Barkmeijer.

Introduction:

You are invited to participate in a research study conducted by Djorn Barkmeijer, a researcher from the faculty of Spatial Sciences. The purpose of this study is to provide a better understanding of possible socio-spatial disparities between the coast and inland areas in the federal state of Pernambuco, Brazil.

Voluntary Participation:

Participation in this study is entirely voluntary. You have the right to withdraw from the study at any time, without any consequences. Your decision to participate or not will not affect your relationship with the University of Groningen.

Purpose of the Study:

The aim of this study is to define socio-spatial disparities, find out whether they are present in a socio-spatial context within the state of Pernambuco and understand which factors have contributed to these disparities. Your participation will involve a semi-structured online or textual interview with a couple of predetermined topics, regarding socio-spatial disparities, Pernambuco and coastal-inland relations. If an online option is chosen, the participant may choose whether or not he/she wants it to be recorded.

Confidentiality:

Your identity will be kept confidential to the maximum extent allowed by law. Any information obtained during the interview will be used for academic research purposes only.

Data Use and Storage:

The information collected during this study will be securely stored and used solely for research purposes. Data will be anonymised and aggregated to ensure confidentiality. The results may be published, but no personally identifiable information will be disclosed.

Contact Information:

If you have any questions about the study or your participation, you may contact Djorn Barkmeijer: d.barkmeijer.1@student.rug.nl.

Consent:

I have read and understood the information provided in this consent form. I voluntarily agree to participate in the research study and understand that I can withdraw at any time without penalty.

Participant's Name: _____

Signature: _____

Date: _____

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Appendix 2: Textual interview questions form

Interview Questions:

Understanding the socio-spatial disparities between coastal and inland areas in Pernambuco, Brazil.

Who are you? (skip if you want to remain anonymous).

_____

In which country do you live?

_____

Do you give consent to be textually or digitally interviewed?

_____

What is your profession?

_____

What is your area of expertise?

_____

How do you see the role of geography in shaping socio-spatial disparities in Pernambuco, and how does it compare to other regions in Brazil?

_____

Can you provide insights into the colonial history of Brazil and its impact on the current socio-spatial disparities in Pernambuco?

_____

How have historical factors, such as the long history of sugarcane plantations, influenced the economy, land distribution, and development in Pernambuco?

_____

What role do you see for interdisciplinary approaches in understanding and addressing socio-spatial disparities in Pernambuco?

_____

How do you think the doctrine of colonization has played a role in the distribution of the population in Pernambuco?

_____

Can you discuss the importance of examining socio-spatial disparities in Pernambuco, and how this research can contribute to a better understanding of regional inequalities in Brazil?

_____

How do you envision that the research could inform policy and practice in Pernambuco, and what recommendations would you make based on the findings?

_____

What challenges do you foresee in conducting research on socio-spatial disparities in Pernambuco, and how do you think researchers can overcome these challenges?

_____

How do land tenure & distribution play a role in the inequality between coastal in inland regions in Pernambuco?

_____

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