Infrastructure and Health: An analysis of Atlas date in the city of Petrolina-PE

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Abstract— Analyzing the conditions of infrastructure, health and social vulnerability of a municipality allows to know its weaknesses and enhance decision-making by managers and civil society. Given the above, this article aimed to analyze the conditions of infrastructure and health and their correlations with social vulnerability in the city of Petrolina-PE, in 2010. To this end, the study used quantitative analysis as a methodology through the graphical interface of the Statistical Program R, with data on infrastructure and health from the Atlas of Social Vulnerability being collected. The municipality of Petrolina-PE, currently with 350 thousand inhabitants, is located in the Sertão de Pernambuco, Northeast region of Brazil and is part of the Integrated Administrative Development Region (RIDE) of the Petrolina and Juazeiro Complex. After analyzing the Municipal Human Development Index; per carpita income; the percentage of people in households with inadequate water supply and sanitation; mortality up to 5 years of age; the population that lives in urban households without the garbage collection service; and the vulnerability index of urban infrastructure and human capital, the research findings indicated, in general, that the housing units in Petrolina have a low correlation between the population of each unit and the infrastructure index, thus, it was noted that the management model needs improvement to promote development and reduce inequalities.

I. INTRODUCTION

The Integrated Administrative Development Region (RIDE) Juazeiro - Petrolina has undergone profound changes in its economic and social structure, being responsible for providing a significant financial contribution to the country, however, the RIDE's appear as a mechanism for integration and regional development in the search for the promotion of projects that aim at the economic dynamization of low development territories (BRASIL, 2014).

Thus, strategies can be adopted to promote dialogue with the RIDE communities, with the urban space, issues such as poverty, the implementation of public policies, the participation of civil society in public decisions, the creation of instances of dialogues between society, and the

private sector and the state, in order to provide a basis for this population.

To make community improvement strategies feasible, tools for data collection and analysis can be used, such as the Atlas of Social Vulnerability platform (infrastructure / health) and the R Statistical Program, respectively.

According to the Institute of Applied Economic Research (IPEA), Atlas is a platform for consulting the Social Vulnerability Index and aims to offer instruments that allow the analysis and understanding of social issues related to the development processes of metropolitan regions and Brazilian municipalities.

According to Hornik (2016) the statistical program R is free software for data analysis and was developed in the 1990s by Ross Ihaka and Robert Gentleman, from the University of Auckland who created a new computational language under the influence of pre-existing programming languages.

Thus, the objective of this work was to analyze the conditions of infrastructure and health and their correlations with social vulnerability, delimiting for Polo Petrolina-PE, in 2010.

The choice of the topic is justified due to the need to know information about the city and its population, providing dialogue and the promotion of strategies around possible improvements in infrastructure and health, in order to promote the social inequalities present in the population.

II.   DESCRIPTION OF DATA

The present study allows periodic reviews to be carried out, being able to evaluate the evolution of health conditions according to the works carried out. For the development of this work, the study area is the city of Petrolina located in the region of Vale do São Francisco, between the state of Pernambuco and the state of Bahia.

The city is in an accelerated transformation process driven by the dynamics of the irrigation process. The complementary law of RIDE includes in the state of Pernambuco the municipality of Petrolina, Lagoa Grande, Santa Maria da Boa Vista and Orocó (PE) and in Bahia it includes the municipalities of Juazeiro, Curaçá, Sobradinho and Casa Nova (BA), thus constituting, an experience of horizontal cooperation, both at the intercity and interstate levels; as well as vertical, between subnational entities and the federal government (OLIVEIRA, 2015).

The guarantee of the right to sustainable cities, understood as the right to housing, sanitation, among others, must also be expressed in the municipal Master Plans, according to the order provided for in the City Statute (BRASIL, 2008).

Adequate basic sanitation directly contributes to the improvement of the population's health (understood as access to sanitary sewage, storm drainage, garbage collection and water supply through the general network), also serving as an indicator of social inclusion. Methodological approach: adaptations and contextualization of the environmental health indicator. Environmental health is fundamental, being understood "as a right for everyone, it is an indispensable condition for health security and for improving the quality of life" (BRASIL, 2008).

Studies carried out at RIDE have shown where there were possibilities for development capable of reducing the weight of large cities, with regard to the concentration of economic activities and progress, the number of inhabitants and meeting their needs (OLIVEIRA, 2015).

Still according to Oliveira (2015) it is important to consider that the initiative to establish a RIDE in the Brazilian semiarid region was very plausible, considering not only the identification of a region with recognized economic potential for growth and development, but also an environment with serious social and economic benefits, which would benefit greatly from the results that RIDE could achieve.

Thus, the evolution of population growth, ended up also being a chain effect in order to diverge with everything that was planned. The evolution of cities occurs through qualitative and quantitative changes in urban activities, transforming the infrastructure of the spaces necessary for these activities (ZMITROWICZ, 1997).

Located in the Semi-Arid Northeast, RIDE Juazeiro - Petrolina is composed of 4 municipalities in the state of Bahia and 4 municipalities in the state of Pernambuco. Its total area is 34 thousand km² and its population is approximately 690 thousand inhabitants (IBGE-Census, 2010), it is totally inserted in the hydrographic basin of the São Francisco River, a Brazilian semiarid region, the Basin is divided into 04 sections: Alto São Francisco, São Francisco, the Submédio São Francisco, where the main reservoirs of the Basin are located and RIDE Juazeiro - Petrolina and Baixo São Francisco. RIDE, at the initiative of Federal Deputy Clementino Coelho (PSB / PE), was created by Complementary Law (LC) 113, of September 19, 2001, and regulated by Decree 4,366, of September 9, 2002.

RIDE Petrolina-Juazeiro is an instrument of planning and public management that makes it possible to identify priority actions in relation to sanitation services, thus guiding the actions of public managers and civil society in decision-making to achieve a better quality of life for the community. population and the environment.

Thus, analyzing the conditions of infrastructure and health and their correlations with social vulnerability, delimited to the Petrolina-PE Pole, in 2010, becomes relevant to know the weaknesses of the municipality and enhance decision-making on the part of managers and civil society.

The study was delimited to the municipality of Petrolina-PE due to its growth in recent years, especially with the strength of irrigated fruit and the provision of coursesin the health area through Higher Education

Institutions, public and private in the health area, being, therefore, relevant to analyze from the perspective of the infrastructure and health variables.

As a strategy for pointing out alternatives for improvement, for the study area and chosen theme, the data included in this study are presented in TABLE 1.

Table 1. Description of the data be analyzed

VARIABLE	BACKGROUND	JUSTIFICATION
Index of Municipal Human Development (MHDI)	According to the United Nations Development Program –PNUD (2020), this index presents a measure composed of indicators of three dimensions of human development: longevity, education and income. The index ranges from 0 to 1. The closer to 1, the greater the human development.	The choice of this variable results from the importance of its pillars (longevity, education and income) that makes it possible to identify some type of deficit / disability and from these establish strategies, actions, plans and public policies that mitigate or remedy the problems found.
Income per carpita	It is an meter development of a country. Per capita income measures the income of each individual within a determined population. calculating an overall average of that value. It is therefore possible to measure your income in relation to your country, your state and your city (MERELES, 2017).	The use of this variable makes it possible to know the socioeconomic conditions of the population and how it is distributed in the perspective of paying attention to regional development in line with the HDI.
Percentage of people in households with inadequate water supply and sanitation	According to the Brazilian Institute of Geography and Statistics – IBGE(2010), in Brazil, one in ten households has inadequate sewage disposal, causing waste to be dumped into nature, whether in ditches dug in the ground, ditches, rivers or in sea.	The services associated with basic sanitation are the subject of several discussions in view of the Brazilian deficit in this regard. There are several waterborne diseases due to lack of access to drinking water, as well as open sewers, which puts this variable as a social problem of the order public health.
Mortality up to 5 years of age	In compliance with the provisions of Article 2 of Decree No. 3,266, of November 29, 1999, IBGE annually discloses, until the first of December of each year, the Complete Mortality Table for the total Brazilian population, referring to the last year.	This variable allows the identification of mortality factors that may result from sanitary conditions in the place where the pregnant woman lives, or the child herself who has repercussions on her physical health, child malnutrition due to lack of financial conditions to purchase food and even violence domestic.
Population	According to the Aurélio Dictionary, it is the group of inhabitants of a specific place, region, country. In the case studied, the population of Petrolina with about 210 thousand inhabitants (IBGE, 2010).	The chosen variable is the starting point for this study, considering that all variables constitute around the socioeconomic and environmental demands that must attend society.

Population living in urban households without garbage collection service	The National Household Sample Survey (PNAD) is a survey conducted by the Brazilian Institute of Geography and Statistics (IBGE). The survey is carried out annually and points out Characteristics of Households and Residents in a given region.	The issue of waste production is one of the major problems facing the society that integrates the economy, the environment and society. Urban waste management also integrates basic sanitation services and creates several problems when absent or deficient. The accumulation of waste that constitutes dumps has consequences such as: release of gases, pollution of ground and surface water (rivers), the concentration of waste in cities causes proliferation of insects, transmission of diseases, visual pollution, clogging of manholes, among others.
Index of Vulnerability in Urban Infrastructure	Urban infrastructure is the set of works that serve as a basis for the functioning of cities, formed by the basic distribution and driving networks. This index seeks to signal the access, the absence or the insufficiency of "Assets" that should be available available to every citizen, for force of State action (IPEA, 2020).	The variable constitutes a fundamental basis for this study, considering that the demands for health, education, employment and income, security, food, permeate the infrastructure present in cities and directly imply the quality of life for their population.
Human capital	For Viana and Lima (2010), in the socioeconomic context, capital human, dimensioned by the level education and knowledge population, is a variable important as an alternative to reducing social disparities and economic.	This index adds to the study as point of understanding possible factors that lead to inequalities in time that makes it possible to know how society appropriates and validates this knowledge in the direction of strategies for reducing socioeconomic differences existing.

In this way, the complex of socio-demographic data demonstrated so far explains the vulnerability of the area in both directions. These local characteristics are an important point to be taken into account in studies on the area

III. RESULTS AND ANALYSIS

For data analysis, the UDH- Housing Unit worksheet was used, in which cities are subdivided into housing units, which function as microregions.

The data was imported through the R graphical interface, and then some filters were made to select only the information relevant to the study, which were: The HDUs only in the cities of Petrolina, year 2010, for this purpose, the package was installed. Dplyr and the filter command is used.

The data analysis was based on a correlation matrix between the variables, mentioned in topic 2 (Data description). Correlation is an interrelation between variables, that is, in a context of two variables x and y, it is possible to state that there is a correlation between x and y when there is a variation in the variable x and a variation in the variable y, in close or equal proportions.

In the types of correlation we have: Weak and strong, what will dictate whether it will be strong or weak is the proportion that this variation occurs. That is, if the proportion that occurs in the variation of variable y is the same as the proportion of variable x we will have a perfect correlation, when this variation is quite different we will have a weak correlation.

As for the sign, the correlation can be positive (direct correlation) or negative (inverse correlation). Correlation coefficient: it is a number that measures the degree of correlation between two variables. This coefficient normally only assumes values between -1 and 1. In this study, Pearson's coefficient was used.

In the process of elaborating the correlation matrix, the color function was used to generate the correlation matrix, followed by the command GGCORPLOT to plot the correlation matrix, obtaining the following result.
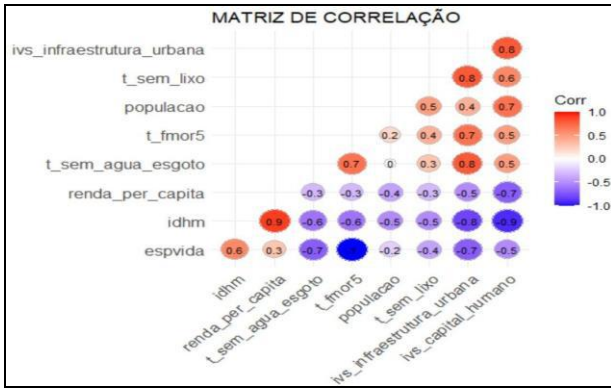
Graph 1: correlation matrix of the selected variables.
Source: Study data.2020

In this correlation matrix the values in blue represent a negative correlation, the values in red represent a positive correlation. In order to achieve the objective proposed in this study, strong correlations (positive and negative) and a weak correlation to complement the results were analyzed, thus the following correlations were analyzed: ivs_infrastructure and ivs_capitalhuman with 0.8 correlation; ivs_infraestrutura_urbana and idhm with -0.8 correlation, lastly ivs_infraestutura_urbana and population with correlation 0.4.

For a better understanding of the ivs_infrastructure and ivs_capitalhuman correlation, it is necessary to understand the composition of these indices. It is important to note that the descriptions of the indexes reported here were obtained from the dictionary in the RIDE data sheet. The ivs_infrastructure is an index that in its composition considers the following aspects: Percentage of the population that lives in urban households without the garbage collection service; Percentage of people in households with inadequate water supply and sanitation; Percentage of people in households vulnerable to poverty and who spend more than one hour to work in the total number of employed, vulnerable people who return daily from work.

Thus, we can conclude that a growth in this index signals that less infrastructure has the housing unit. For example: We highlight two housing units in the city of Petrolina, the Areia Branca unit and the Cosme Damião / João de Deus unit, the first is a more centralized region, while the second is a more peripheral region, according to the UDH worksheet. ivs_infrastructure of Areia Branca is 0.004 while Cosme Damião / João de Deus is 0.219.

The second index, ivs_capital humano, in its composition considers the following aspects: Mortality up to one year of age; Percentage of children from 0 to 5 years old who do not attend school; Percentage of children aged 6 to 14 who do not attend school; Percentage of women aged 10 to 17 years who had

children; Percentage of mothers who are heads of household, without complete elementary school and with at least one child under 15 years of age, in the total of mothers who are heads of household; Illiteracy rate of the population aged 15 or over; Percentage of children living in households where none of the residents have completed elementary school; Percentage of people aged 15 to 24 who do not study, do not work and are vulnerable to poverty, in the total population of this age group. So, The growth of this index signals a bad condition for the development of the HDU. For example:

We highlight two housing units in the city of Petrolina, the Areia Branca unit and the Cosme Damião / João de Deus unit, as mentioned above, which is a more centralized and a more peripheral region, which have the following ivs_capitalhumano: 0.172 e 0.566, respectively.

In order to complement the analysis of this correlation, a scatter plot between these two variables will be presented below:
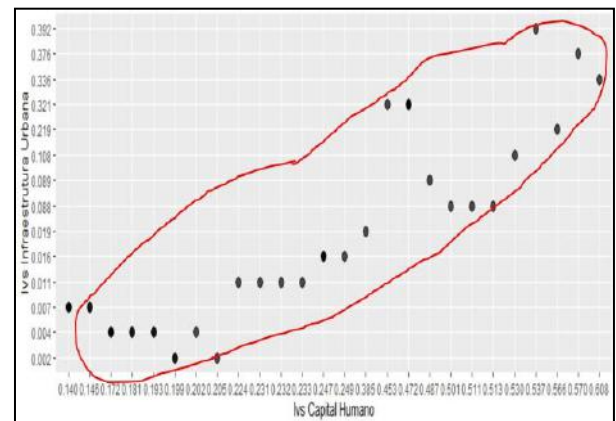
Graph 2: dispersion graph that relates urban infrastructure indexes and human capital.
Source: Study data.2020

When analyzing the matrix and the dispersion graph, it is observed that the urban infrastructure index has a very strong positive correlation with the human capital index. Considering that the infrastructure is the set of works that serves as a basis for the functioning of cities, formed by the basic distribution and driving networks. This index seeks to signal the access, the absence or the insufficiency of "assets" that should be available to the citizen due to the State's action (IPEA, 2020).

For Cruz et al. (2017), the expansion of infrastructure and human capital can contribute to better socioeconomic opportunities for the population, with a fairer distribution of income, with an increase in the returns on the generated capital and labor inputs, and further states that the expansion and appreciation of human capital is a "determining factor for technological progress", given that

it is assumed that with greater education, more opportunities and possibilities of choices are realized in the individual's life.

In theory, a good human capital ratio provides greater awareness and demand for citizens' rights. In the perspective of Viana and Lima (2010) "education makes people more productive, increases their wages and influences economic progress", however the quality and quantity in which education is offered may establish an antagonism, considering that "even with a possible continuous increase in education, it may not reflect a qualitative level sufficient to boost productivity and the economic and social progress of the population" which implies a possible insufficiency in this regard and should also exercise its citizenship in charging public managers for the appropriate conditions on this issue.

This reflection demonstrates that investments in human capital and infrastructure must be continuously evaluated in order to improve the services provided, investments with optimization of public resources, with reflections on the quality of life of the population.

The next correlation that will be analyzed refers to ivs_infraestutura_urbana and IDHM, for a better understanding it is important to understand that the IDHM index considers in its composition the following aspects: Income, education and longevity. Thus, we conclude that an increase in this index signals a good development of the housing unit. As highlighted in Graph 3, we conclude that a good municipal human development index (IDHM) leads to a good urban infrastructure index.
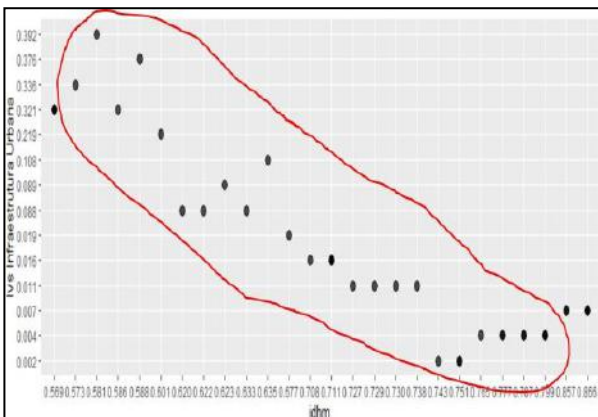
Graph 3: dispersion graph that relates the urban infrastructure and human development indexes municipal
Source: Study data.2020

The next correlation analyzed deals with the relationship between the Urban Infrastructure index and the Population, in this sense we identified a weak correlation of 0.4 highlighted in the correlation matrix, it is also observed, in graph 4, that there is no linear trend between the points shown in the graph .
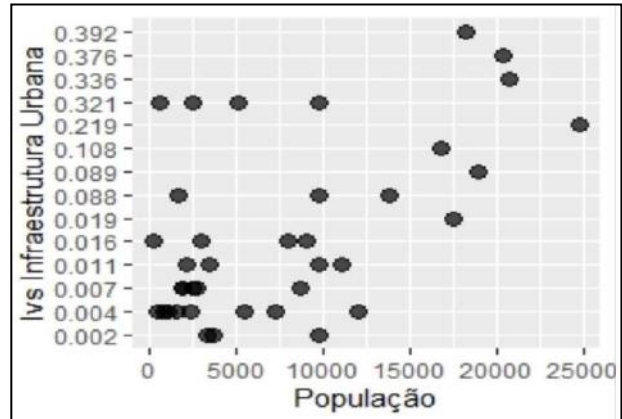
Graph 4: Dispersion graph that lists the urban infrastructure indexes and the population of housing units.
Source: Study data.2020

According to IBGE (2020), the population topic comprises information on size and structure (by age and sex), color or race, population distribution, density and urbanization, information on fertility levels and characteristics, migration and mortality of the population. population, as well as births and deaths. According to the Aurélio Dictionary (2002), population is the group of inhabitants of a specific place, region, country. The city of Petrolina has approximately 210 thousand inhabitants (IBGE, 2010) and this variable was chosen as a starting point for this study, considering that all variables are based on the socioeconomic and environmental demands that must meet society.

The housing units in Petrolina have a low correlation between the population of each unit and the infrastructure index, so it was noted that the management model needs improvements to promote development and reduce inequalities. There are densely populated neighborhoods in Petrolina, such as João de Deus and Areia Branca, but with different infrastructure rates. The former has more deficient conditions such as open sewage, residents with low per capita income and the latter with a more organized structure.

According to Malpas (2004 apud ZOGHBI et al, 2007), housing is one of the five fundamental public services for the population, followed by education, health, social security and personal social services and is related to the state of social well-being. The deficit of infrastructure in housing units can generate precarious situations for the population, implying poverty, irregular land occupation (invasions, slums), informal economic activities, environmental problems, which reinforces the importance of the existence of adequate conditions for collective well-being.

For Monteiro and Veras (2017) conditions that imply "human development must include policies consistent with sustainable economic growth, such as a more equitable distribution of resources, linked to interventions that improve the essential conditions of the population" regarding the infrastructure-population correlation in Petrolina, becomes worrying, given that for human development, there are fundamental elements that come together in a fundamental way directly dependent on the conditions of the inhabited environment that reflect on the health of the population, considering, according to the World Health Organization, as a state of complete physical, mental and social well-being, and not just as the absence of illness or infirmity.

Glimpses the perspective of quality of life as a result of the condition of the state of integral well-being of the population, demands from public management attention to the demands that are not being met, as well as the monitoring of existing ones to promote and consolidate local development regional.

IV. CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORKS

The Juazeiro - Petrolina Integrated Development Region (RIDE) was implemented by Complementary Law No. 113, of September 19, 2001, and regulated by Decree No. 4,366, of September 9, 2002, with the main objective of reducing existing inequalities between different Brazilian regions and develop local economic and social potential.

Through the R Statistical Program, the data collected through the information obtained from the spreadsheet RIDE_Petrolina_Juazeiro, from the Atlas report, were processed. A correlation matrix was established with the MHDI variables; Renda_per_carpita; T_sem_agua_esgoto; T_fmor5; Population; T_without garbage; Ivs_infraestrututra_urbana and Ivs_capital_humano.

In graph 1, it was noted that the red color, the stronger, the more the variable has a correlation (statistically significant). Take as an example the variables IVS_infraestrutura_urbana which has a high correlation with ivs_capital_humano, it means that when you have human capital you tend to have greater urban infrastructure. In theory, a good human capital ratio provides greater awareness and demand for citizens' rights.

On the other hand, it is noted that human capital had a low correlation with life expectancy, that is, there is no statistically significant relationship. The data showed that life expectancy has a high relationship with MHDI, in general, the higher the Municipal Human Development Index has a level considered, the better the life expectancy of the individual.

The housing units in Petrolina have a low correlation between the population of each unit and the infrastructure index, so it was noted that the management model needs improvement to promote development and reduce inequalities.

As suggestions for future work, it is recommended that a comparative analysis be carried out with the other municipalities that make up the RIDE, in order to contribute to the development of each city that makes up the hub, thus contributing to the discussion and improving the measures that are positive in one municipality to another, in addition to minimizing their possible weaknesses.

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