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FACTOR ANALYSIS:

Construction of Performance Indexes and their Application in Interdisciplinary Studies

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APRESENTAÇÃO

The book Factor Analysis: Construction of Performance Indexes and their Application in Interdisciplinary Studies is another of the numerous scientific contributions published by the interdisciplinary research group of the advanced program of applied research in health sciences, environment, society and public policies of the Faculty of the Institute of Rio de Janeiro and the Higher Institute of Health and Environmental Sciences of the Amazon in partnership with the group of studies and research in socio-environmental sciences and public policies of the Federal University of Rondônia. The interdisciplinary research group has as its main proposal to develop applied research in the Brazilian Amazon. Additionally, in collaboration with doctor Fabrício Moraes de Almeida - leader of the Innovation and Technology Management Research Group (GEITEC/UFRO). It is important to mention that all the works reported here do not have public financial support or from any research funding agency, that is, they were self-sustaining by their authors and collaborators.

The book presents five chapters resulting from scientific research developed by a team of professionals from different areas of training and academic qualification. The results of the research were originally published in international journals in the form of scientific articles. The importance of this collection is to gather these articles in a single volume to facilitate the reader's access to this set of works within the same theme.

Factor analysis is used to investigate latent patterns or relationships for a large number of variables and determine whether the information can be boiled down to a smaller set of factors. Factor analysis is a method of interdependence, in which all variables are considered simultaneously. Each variable is predicted by all the others. The main objective of factor analysis is to describe a set of original variables by creating a smaller number of variables (factors). The factors are hypothetical variables that explain part of the total variability of the data. With factor analysis, the researcher can first identify the separate dimensions of the structure and then determine the degree to which each variable is explained by each dimension. In a simpler and more understandable way it can be said that factor analysis is a generic name given to a class of multivariate statistical methods whose main purpose is to define the underlying structure in a data matrix.

Despite the effort, the use of factor analysis as an analysis tool in interdisciplinary studies in the academic environment of the Amazon is still incipient and with little practical application. The researchers who are part of the interdisciplinary research group have been

working with many efforts in interdisciplinary research in the Brazilian Amazon based on factor analysis. Among these applied researches, the study on the process of formulation of the Health Condition Performance Index (IDCS) stands out, consisting of the performance indices "environmental, socioeconomic and demographic, financial and administrative", whose scope was to provide information for the process of formulation of public health policies in the Border Range of the Northern and Central Arc of Brazil; "Quantitative methods and analysis of health performance and environmental conditions in the city of Porto Velho: 6 years after the hydroelectric dams of Jirau and Santo Antônio, on the Madeira River"; "Factor analysis as a tool for building the sustainable development index of river basins in Rondônia, Western Amazon"; "Factor Analysis Applied in the Construction of the Socio- Environmental Performance Index (IDRSA) in the Guajará-Mirim Free Trade Area, Brazil / Bolivia Border"; "Quantitative methods and study of the parth dependence effect of Douglass North from the cocoa production índex (CPI) in Rondônia, Brazil"; "Environmental Education Perception Index (IPEA) headed for sustainable development: A study in Elementary Schools in the cityof Guajará-Mirim, Rondônia (Brazil)" and "Factor Analysis and the Social Capital Index: A Study at the Brazil / Bolivia Border".

The first chapter of the book deals with the issue of strategic planning for public security from the construction of criminality rates and social vulnerability. The issue of strategic planning for public security is recent in Brazil. In Rondônia it is no different. The question is whether the strategic planning of the State of Rondônia contemplates approaches that characterize its microregions and mesoregions, from a reading motivated by the construction of the crime rate and social vulnerability. Thus, the general objective of this research was to analyze the criminality rates and social vulnerability of the municipalities of Rondônia, aggregating them in the micro and mesoregional perspective, in order to build a new vision for the strategic planning of public security at the state level. For this, the hypothetical-deductive method was adopted as a line of reasoning. The methodology consisted of data collection in secondary databases from official sources. Data were collected following the municipal logic aggregated by microregions of Rondônia. For data processing, the statistical tool SPSS, version 23, was used as an instrument to calculate crime rates and social vulnerability, based on the multifactorial analysis technique. It was possible to verify that the microregions of Porto Velho and Guajará-Mirim concentrated, on average, the highest rates of crime and social vulnerability, respectively. The two highlighted microregions are part of the Madeira-Guaporé mesoregion. It is considered essential that the strategic planning of

public security in Rondônia adopts micro and mesoregional technical criteria using quantitative and/or qualitative data amenable to comparative analysis in order to facilitate the decision-making process with regard to the establishment of different strategies to be taken in relation to the regions and their specificities that make them unique and specific, requiring different looks at different scenarios. Strategic planning, Criminality, Vulnerability and Microregions are the keywords (descriptors) used in the chapter.

In the second chapter, following the factor analysis, it was possible to calculate the quality performance index of the hotel sector – IDQSH. The general objective of the study was to build the quality performance index of the hotel sector in the city of Guajará-Mirim, on the border with Bolivia, based on the Varimax method. The IDQSH questionnaire used was structured with 4 parameters and 15 variables and applied after signing the Free and Informed Consent Form - ICF. Data were collected from guests of ten randomly selected hotels. The IDQSH was calculated following the techniques of Factor Analysis. The results found allow us to point out the classification among the means of hosting. The hotels where the quality performance was considered "Good" are, in descending order of the IDQSH: A (0.542), F (0.529) and D (0.514). In the quality standard considered "Bad" are the hotels, also in descending order of the IDQSH: H (0.483), B (0.467), E (0.452), C (0.433), G (0.393) and J (0.369). Hotel I, with an index of 0.276, achieved the rating that indicates a quality performance "Terrible". In view of the results, it can be considered that the Quality Performance Index in Hotel Services (IDQSH) of the municipality of Guajará-Mirim obtained an index of 0.445, considered "Ruim", according to the adopted classification. Descriptors adopted in the research: Index, IDQSH, Varimax method and Guajará-Mirim.

The third chapter aims to analyze the regional development of the nine municipalities covered by the SUFRAMA policy in comparison with nine other Amazonian municipalities not covered by this policy, in order to identify the municipal performance achieved in the face of the Brazilian Amazon reality. The theoretical foundation of this work is linked to the theory of endogenous development associated with the institutionalist theory of Douglass North and the poles of development of Schumpeter and Perroux. A multivariate factorial model of data was used to extract the scores for the construction of the indices, using the statistical tool SPSS, version 22, using the factor analysis technique developed in a similar way to the main components. It was possible to construct indices of socioeconomic development and, with this, proceed to the proper analysis intrinsic to the epistemological question of this work. The data showed adequacy to the factorial studies that allow to observe the socioeconomic

development (endogenous) of the municipalities of the Free Trade Area (FTA) linked to SUFRAMA. The results showed in general, the low level of socioeconomic development of the municipalities surveyed, however, with a more favorable situation for the municipalities covered by the SUFRAMA policy. Research descriptors: SUFRAMA, Endogenous Development, Indexes, Multifactorial Analysis and Amazon.

The fourth chapter: Multivariate Analysis of Health Indicators in the State of Rondônia, Western Amazon, Brazil. The research aims to analyze the significance of epidemiological, socioeconomic and coverage indicators of health services, applying the multivariate statistical technique and compare indicators with statistical significance compared to the indicators agreed by the State Department of Health of Rondônia, Western Amazon, Brazil, in the period corresponding to one year. This is an exploratory descriptive study applied to epidemiological, socioeconomic and health service coverage indicators in the State of Rondônia, with territorial coverage of 52 municipalities. The procedure adopted was to apply the Factor Analysis Technique (PA) and the statistical method of Principal Component Analysis (PCA) in 121 variables, grouped, and then only in the group of variables with explanation above 95%, divided into two scenarios. In Scenario (1) the epidemiological variables presented an explanation above 70%, while in Scenario (2) they influenced the set of variables with explanation between 99.66% - 99.99%. In Scenario (1) Porto Velho (Capital) contributed with 72.84% of the cases, maintaining the trend in Scenario (2) with 75.67%. In the comparison between the indicators surveyed (121) and the concordant indicators (39), it was noticed that of the 39 indicators, 33 (thirty-three) are included among the indicators with statistical significance in the study. Research descriptors: Indicators, Significance, Multivariate Analysis, Health, Rondônia.

In the fifth chapter "Construction of the Sustainable Development Index at the Level of the Hydrographic Basin of Rondônia from the Factor Analysis", the factor analysis method was used as a tool for the construction of environmental, economic, social and institutional performance indexes. The classification scale adapted from FECAM was adopted to express the results obtained by each watershed. The set of current indices of sustainable performance for the Mamoré river basins (0.444) was considered a low index, although the best compared to other basins; Madeira river (0.419, low index); Guaporé river (0.378, low index); Machado river (0.289, low index); the Jamari river (0.307, low index) and the Roosevelt river (0.227, low index). There was a really negligible improvement in the rates from 10 years ago. The factor analysis showed efficiency as a multivariate statistical method in the construction of

sustainable development indices for the hydrographic basins of Rondônia. Watershed management is still very ineffective, despite being regulated by state law. It is highly recommended to institutionalize regional public policies in the form of a Master Plan for the Rondônia river Basin. Descriptors: Watersheds, Factor analysis, Sustainable development, Rondônia, Western Amazon.

Enjoy and have a good reading.

Carlos Alberto Paraguassú-Chaves

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SUMMARY

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STRATEGIC PLANNING OF PUBLIC SECURITY IN THE STATE OF RONDÔNIA FROM THE PERSPECTIVE OF CRIMINALITY RATES AND SOCIAL VULNERABILITY

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1. INTRODUCTION

When starting this work, we sought to analyze the issue of public security in Rondônia based on the logical construction line brought by Cavalcante [2011]**.** This level of understanding allowed the context of the motivating impact of this research to be reached. Thus, based on the mesoregional and micro-regional vision of Rondônia, Cavalcante [2011]

reinforces the existence of two very distinct realities at the state level that, in some way, have been impacting the respective societies linked to each of these regions of Rondônia. But, knowing this scenario, it is necessary a historical synthesis motivated by the author that we consider important to insert the reader in this context. That said, throughout its history, the state of Rondônia has been consolidated as a result of events that marked not only the intrinsic context of its territory, but also the result of a broader scenario, both nationally and internationally. To begin this line of thought, we must first emphasize three moments that, in our view, marked institutional life in this portion of the Western Amazon.

Adopting a temporal and spatial cut, the first moment, with a direct impact from the geopolitical point of view of the country, we can mention the issue of gold exploration in the Guaporé region, in the early 18th century. This fact allowed Spain and Portugal to dispute the possession of these lands, putting in check the political-administrative design brought by the Treaty of Tordesillas, of 1494. In this 15th century Treaty, Spain was sovereign over this territorial portion. However, during the period of the Iberian Union (1580-1640) it delegated to Portugal the right to its lands in the Amazon. But, with the discovery and exploration of gold in Guaporé, under Portuguese administration, it made it possible for Portugal to begin its formal claim to the sovereignty of these lands. The end of this episode was the signing of a new agreement between the two nations, known as the Treaty of Madrid, of 1750. Thus, this event allowed, in fact, the Portuguese dominion over these lands, once linked to Spain. In principle this represented, in some way, the first global geopolitical revision of the modern world, beginning in the 16th century. The symbol of this phase is represented by the Forte Príncipe da Beira, in the municipality of Costa Marques (Vale do Guaporé), built to guarantee Portuguese sovereignty over this large expanse of land on the right bank of the Guaporé River.

Such annexation allowed to arrive at the national territorial design practically to what is known today from maps, with the exception of the current state of Acre, which highlights the historical importance of this period. It should be noted, however, that despite the magnitude of the fact, it is still little explored in terms of cultural identity in the region, thus indicating a fertile field for scientific investments and public policies in this sense. However, the definitive design of the Brazilian territory and, therefore, of the state of Rondônia took place, according to Cavalcante [2011], from the two main institutional changes that took place in the region: a) Madeira-Mamoré Railroad - EFMM; b) Federal Highway BR 364. In summary, the Madeira-Mamoré Railroad, the result of a new international agreement, no longer between

Spain and Portugal, but now between its former colonies, Bolivia and Brazil, allowed the annexation of the current state of Acre to Brazilian territory, due to the signing of the Treaty of Petrópolis in 1903. Rubber, the main economic activity at the time, would have been the motivator of this litigation. From that episode onwards, the boundaries of borders were practically finalized in Brazil.

The symbol of this process is in the railway stations between Guajará-Mirim and Porto Velho and their remnants, such as trains (locomotives), rails and iron bridges that struggle with time to remain firm on the horizon, despite the tropical climate. Thus, the map of Brazil owes much to these two historical moments that occurred in the region of the valleys of the Guaporé, Mamoré and Madeira Rivers. Finally, the last of the episodes refers to the change from rail to road after the definitive deactivation of the EFMM in 1972.

With the federal highway BR 364, according to Cavalcante [2011], a new axis of development is strengthened, no longer in the Madeira-Guaporé mesoregion (under the influence of the EFMM), but in the Eastern mesoregion of Rondônia (under the influence of the federal highway), which begins to concentrate political and economic power, influencing strategic decisions at the territorial level, culminating, in 1981, with the institutionalization of the state of Rondônia with the current 52 municipalities in Rondônia. In this way, the rules of the game quickly began to be dictated by the influence of the relationship of space and power conducted by the East Rondoniense mesoregion, which became the main economy of the State. The Madeira-Guaporé mesoregion, on the other hand, lost economic power and began to absorb a period of strong socio-environmental policy that, in both cases, ended up generating distinct cultures among the societies of Rondônia [Cavalcante, 2011]; [Cavalcante; Silva, 2011]; [Cavalcante, 2015]. Thus, allowing the construction of the assumption that the economic model observed in the consolidation of the state of Rondônia, as a result of the developmentalist policies of the integrated colonization projects, idealized by the federal government, was agriculture and that this model has, over time, characterized the economic power of the State with a strong participation in the state GDP. With a few exceptions, the Madeira-Guaporé mesoregion, with greater environmental weight, watches the advance of this economic segment without directly participating in the process [Cavalcante, 2011].

Based on this context, are the realities observed in the two mesoregions, from the point of view of criminality rates and social vulnerability, consistent with this view presented? What new can this approach indicate in terms of strategic planning in public security management

in Rondônia? Thus, there is no doubt that strategic planning in the public sector has been gaining more and more space in the Brazilian scenario in view of the need for greater efficiency and effectiveness in the conduct of its public policies in favor of improving the quality of life of the population in general. However, the context for the elaboration and discussion of a strategic vision to be implemented is preceded by technical studies capable of allowing the public manager and his team responsible for the discussion and construction of the general guidelines to be inserted in the plan, a scenario that allows decision making, as far as possible, in the face of a complex and unequal environment. The general objective of the present research is to analyze the criminality rates and social vulnerability of the municipalities of Rondônia, aggregating them in the micro and mesoregional perspective, aiming to build a new vision for the strategic planning of public security at the state level. As specific objectives, it is intended to:

a) Determine the municipal indices of criminality and social vulnerability;

b) Determine the average performance of the indices for each of the eight micro-regions of Rondônia;

c) Graphically construct the relationship between crime and social vulnerability at the municipal and micro-regional levels of the State.

It is also worth mentioning the hypotheses that guide this study: If the crime and social vulnerability rates identified by the research point to a scenario of greater impact in the microregions of Porto Velho and Guajará-Mirim, then in the context of the approach motivated by the research and is grounded and makes logical and coherent the inequalities brought within one of the mesoregions of Rondônia, which must be taken into account for the strategic planning of the State's public security; If the criminality and social vulnerability indices identified by the research point to a dispersed micro-regional scenario, with no trend related to mesoregional aspects, then the logic of approaching the regions with greater environmental weight is not sustainable, which makes it consistent with the current strategic planning of public security in Rondônia.

2. THEORETICAL FOUNDATION

2.1. STRATEGIC PLANNING IN THE PUBLIC SECTOR: CONCEPTS AND FUNDAMENTALS

Strategic planning is a management technique of fundamental importance, which allows the organization to know the environment in which it operates, providing a sense of direction and avoiding risks in its actions [Porter, 2001]. Planning is a process that precedes and presides over action [De Toni, 2014]. For Pfeiffer [2000] strategic planning has two purposes:

1) concentrate and direct existing forces within an organization in such a way that all its members work in the same direction;

2) analyze the organization's environment, and adapt it to it, so that it is able to react adequately to the challenges it faces.

This author reveals that the intention is for the organization to conduct the development process so as not to be driven by external and uncontrollable factors. However, he emphasizes that this does not mean assuming that the future is controllable, but only that the analysis of changes and the possibilities of adaptation increase an organization's room for maneuver to better deal with eventual conflicts or crises that may arise. Rezende [2010] in turn, emphasizes that the construction of a strategic vision cannot ignore the limitations that the financial and institutional reality imposes on its implementation, under penalty of loss of credibility of the planning effort. Much less, it comes down to the need to integrate planning and budget, as provided for in the constitutional provisions.

For this author, it is in the territory, whose occupation is impacted by changes in the economy and demography that accentuate disparities and conflicts and threaten the sustainability of the country's economic union. Thus, in the absence of a spatial strategy, conflicts and antagonisms create an unfavorable environment for federative cooperation and, therefore, increase the difficulties for the reconstruction of planning. As for the identification of risks, he emphasizes that they need to be properly evaluated so that the government can anticipate their outbreak and include the necessary measures among the priorities to be met.

In general, Matias-Pereira [2009] emphasizes that planning is an essential practice, both in public and private administration, due to the benefits that the instrument brings to organizations. In public administration, Santos [2008] states that given the current complexity,

characterized by the scarcity of resources and growing demand from the population, it is essential to act in a strategically planned way in public institutions. In this sense, Rezende [2011] highlights that the definition of strategies and their translation into a plan have little effect if the effective conditions for their implementation are not adequate. These conditions, according to the author, depend on the capacities that public bodies have to exercise their responsibilities, even taking into account the limitations imposed by the regulations in force.

For De Toni [2009] strategic planning in relation to government management, is the art of governing – when we ask if the government is moving towards where it wants to go, if it is doing what is necessary to achieve its objectives, if it is beginning to debate the problem of planning. Thus, for this author, the big question is whether the organization is dragged by the rhythm of day-to-day events, like the force of the current of a river or if it knows where to get and concentrates its forces in a defined direction. In this way, it points out that planning, seen strategically, is nothing but the science and art of adding greater governance to our destinies both as people and as organizations or countries. Therefore, government planning can be defined as a collective political process, coordinated by the State, which, through the increase of government capacity, carries out a strategic project for society (De Toni, 2014).

For Lopes [1990] governmental planning, according to its sphere of action, can be classified as: a) national (defining goals and guidelines for the nation), b) regional (limited to the economic and social peculiarities of a region), c) urban (circumscribed to the growth of a city environment) or sectoral (linked to a specific sector, such as education or the environment). Therefore, it is in the public administration, according to Cunha [2011], that the responsibility for defining the Government's strategy in all its public policies is found. For this author, this process of defining actions involves negotiations and conciliation of interests of different groups and social movements, which is essential for the effectiveness of planning. It also reveals that this strategic definition constitutes an intelligent mapping of actions aimed at achieving a shared future, as well as a description of the path used to achieve the government's objectives. Thus, a government's strategy is largely expressed in its governmental planning.

On the topic of planning, Souza [2004] considers it to be the fundamental administrative function, serving as the basis for all other functions employed. In addition to this vision, it reveals that in the case of Governments, planning aims to define society's future goals and establish the means to achieve them, so that social transformations are not determined by external or fortuitous circumstances, but rather be a result of conscious

decisions generated by managers and inhabitants. In this sense, Cardoso Jr; Melo [2011] emphasize the need for institutions that encourage long-term actions. For Rezende [2010] and Rezende [2011] in a Federation such as the Brazilian one, a national project cannot be confused with a federal government plan. It must have broader purposes, aimed at building a strategic vision of long-term national interests, which includes the actions required to promote these interests and the measures necessary for their defense in the context of international relations. For Melo [2011] continuity in public policies and in the performance of government bodies, over successive administrations, can be achieved through guidance from a long-term development policy or a development plan. This author emphasizes that the expression “long term” should be redundant, were it not for the fact that, with some frequency, the term “development” is used in reference to short-term events and changes.

2.2. STRATEGIC PLANNING IN BRAZIL AND RONDÔNIA

In Brazil, as in the rest of Latin America and the Caribbean and in other relatively less developed countries, more systematic planning experiences began in the 1930s in the wake of public policies designed to face the consequences of the 1929 Crisis. In general, they were limited to a few sectors considered priorities in each country – especially energy, transport, basic sanitation [Costa-Filho, 2011]. Starting in the 1940s, Brazil launched numerous development plans. As historical examples, we can mention the SALTE Plan – Health, Food, Transport and Energy (l947), the Goals Plan (l956) and the National Development Plans (I and II – PNDs, from l972 to l974 and from l975 to l979), respectively [Paulo, 2011]. According to the author, with the crisis of l979 and the decrease in the availability of external resources, the deficit in public accounts caused a cycle of uncontrolled inflation in the country that contributed to the weakening of planning. With the redemocratization, government planning once again stood out as an inescapable attribution of the State, being foreseen in the Federal Constitution of l988 through the obligation to prepare pluriannual plans.

De Toni [2014] highlights that in the recent history of the country, post-redemocratization, government planning was slowly resumed in a different perspective from the seventies and eighties: more indicative and regulatory, but integrated into the public management dimension and more participatory and decentralized.

According to Santos [2011], the current formal model of governmental planning is anchored, in particular, on two bases: the Federal Constitution (CF), which determined and

gave outlines to three planning instruments (Pluriannual Plan - PPA, Law of Directives Budgets – LDO and Annual Budget Law – LOA); and the 2000 budget reform, which sought to integrate plan, budget and management. For the author, despite the constitutional declarations, the three instruments still lack a lot of evolution to fulfill the objectives for which they were created. For Vaz [2006], redemocratization stimulated pressure from society for citizen participation, transparency and social control of governments. Para Santos [2011], apesar da tentativa de organizar a ação estatal, o modelo atual não foi capaz de conduzir o planejamento formal a uma posição suficiente para subsidiar adequadamente a coordenação governamental.

In this context, Rezende [2010] and Rezende [2011] considers that the planning and budget model established by the 1988 Constitution did not represent a major innovation. For the author, the change caused a loss for planning, because instead of dealing with a national plan, the PPA, it was reduced to a federal government plan, with each State and also the Municipalities taking care of the elaboration and execution of the own PPAs, without any mechanism having been instituted to seek greater articulation of the plans of each entity of the Federation. In the conception of Rezende [2010], the root of the problems that affect the quality of planning is the absence of a national project, supported by a strategic vision of the challenges that the country faces to promote a balanced economic development, in the triple perspective under which this balance must be observed – social, regional and sectoral – in addition to being environmentally sustainable. In this sense, he states that the horizon of the PPA is too short.

In the case of Rondônia, Cunha; Neves [2008] reveals that the planning experience begins when the first planning attempt is made, in 1977, with the elaboration of the first Rondônia Goals Plan, whose objective was to obtain a document that contemplated claims, not only in the scope of segments the public sector, but also involving representatives of other segments of society. The visit of government technicians to each municipality and locality represented the first experience of “participatory planning”, as investments began to be made as a result of opinions and meetings with the various communities. In the current Strategic Plan for Rondônia 2019-2023, it is reported that Rondônia is among the newest States in Brazil, having been a Federal Territory and, finally, a Federative Unit only in the second half of the 20th century. Therefore, his youth characterized insertions of state planning in an already constituted reality, with the economic cycles of the past and existing local characteristics, shaping his current urban and economic conception. Given this, it is exposed

that five foundations were established for the elaboration of the plan, namely: "[...] The first foundation is the commitment to consider the regional peculiarities with social and environmental responsibility, with sustainability as a guideline for the protagonism of Rondônia as a model for the development of the Legal Amazon. The identification of the current forces of change is key in the construction of planning, which must be aligned with current trends and uncertainties and strategies of the main actors for the realization of a vision of the future as reliable as possible - this is the second foundation. The third foundation consists of structuring the Plan based on the great legacies that it intends to leave for the years to come. The definition of priorities must reflect pragmatism and feasibility, so that few good legacies are delivered, causing a relevant positive impact for the current and future generations.

The study and analysis of other existing plans and those under construction, the alignment of strategic actions with the 2020-2023 Multiannual Planning (PPA) and the Rondônia State Sustainable Development Plan (PDES), were considered for the preparation of this document, and the compilation of what is most concrete and tangible in these inputs for the formulation of this – this being the fourth and penultimate foundation. The last foundation refers to thinking about the well-being of the citizen, which defines that all the battles that need to be won by Rondônia were built from indicators and goals that directly impact the result for the Rondônia, as it is the mainstay of the strategy and the raison d'être of the state administration [Governo de Rondônia, 2019]. The Strategic Plan for the state of Rondônia 2019-2023 has seven thematic axes: management and strategy, health, safety, education, citizenship, economic development and environment and territorial development. For each of them, great challenges, the main results and initiatives were defined.

2.3. STRATEGIC PUBLIC SECURITY PLANNING IN BRAZIL AND RONDÔNIA

According to the Federal Constitution of 1988 in Chapter II, Art. 6, security is a social right: “These are social rights to education, health, food, work, housing, leisure, security, social security, maternity and childhood protection, assistance to the destitute, in the form of this Constitution” [Brazil, 1988]. According to Kahn; Zanetic [2005] until recently, in Brazil, the problem of public security was understood as something that concerns only the state government and, within it, specifically the organs of the criminal justice system: police, prosecutors, judiciary and prison administration. Also according to the authors, the main

argument for not getting involved in the issue of public security was the fact that article 144 of the Constitution assigns to the state government the responsibility for the civil and military police. Thus, from a limited conception of security, provoked by the Federal Constitution itself, federal and municipal actions were compromised.

Since the enactment of the Constitution in 1988, several plans and public security programs have been developed and presented by the federal government with a view to implementing public policies to prevent violence and reduce crime. Highlights include the National Public Security Plan (1991); I National Human Rights Program (1995-1996); National Public Security Plan (2000); II National Human Rights Program (2002); Public Security Project for Brazil (2003-2006); National Program for Public Security with Citizenship - Pronasci (2007-2010); Safer Brazil Plan (2012); National Homicide Reduction Plan (2015); National Public Security Plan 2016/2017; National Policy on Public Security and Social Defense (PNSPDS), 2018.

The 2000 National Public Security Plan is considered the first national and democratic security policy focused on stimulating technological innovation; it alludes to the improvement of the public security system through the integration of security, social policies and community actions, with which it is intended to define a new public security and, above all, a novelty in democracy [Silva Júnior, 2005]. However, in the view of Ballesteros [2014] public security policies in Brazil have, as a rule, been designed and implemented in a fragmented and poorly planned way. Also according to the same author, unlike what happened with other rights supported and reformulated by the Constitution, the right to security and order, as well as the organizational structure that should guarantee them, was restricted to the list of some police organizations, passing away from the citizen characteristic attributed to the other spheres of Brazilian social life, which was beginning to be reconfigured.

According to Brazil [2018], the national territory has been experiencing difficulties in the implementation of public policies, whose roots lie much more in the form and mechanisms of federative articulation and coordination (between levels of government) and of the republic itself (between State bodies and Powers) than in the absence of initiatives. The country needs to look at the governance mechanisms of the public security and criminal justice system, in order to give maximum effectiveness, and efficiency to the efforts that are being made and interrupt the cycle of fear and violence that challenges the public power and threatens the society. It is known that population insecurity and crime reduction are not issues of immediate solution and, however, given the current stage, this issue does not involve only specialists in

the area, but an initiative between federal, state, municipal governments, civil society and other organizations [Cruz, 2013].

With regard to the state of Rondônia, the State Plan for Public Security of Rondônia was created in 2003, with the objective of "reducing by at least 40% (forty percent) the number of crimes per hundred thousand inhabitants, in the period from 2004 to 2007" [Lessa, 2018]. During the period between 2008 and 2017, Rondônia's public security policy was not the result of sectoral strategic planning, given that there was no state plan. In 2019, Decree No. 23,698, of February 27, approves the Strategic Plan for Public Security, Defense and Citizenship of the State of Rondônia (SESDEC), for the period from 2018 to 2030. It is worth noting that the strategic plan of SESDEC and subordinate institutions, with a time horizon of 2018-2030, aims to “make Rondônia a developed, competitive, modern State with excellence in public management, socially fair and environmentally sustainable”, concentrating efforts, in order to seek a “Rondônia for peace”, committed to overcoming challenges to guarantee people a safe environment with less violence and crime.

However, for the achievement and excellence in the vision of the future, starting from the premises focused on the areas of results regarding public security, the aforementioned strategic plan for public security in Rondônia directs strategic actions from the perspectives of cooperation, social justice, science and innovation: Carry out dynamic and innovative management with a focus on improving public security services; Provide public security policies, aiming at the culture of cooperation between public bodies and society; Improve public security services and modernize strategic management through partnerships; Transform public safety with an emphasis on people, seeking to improve employee productivity and motivation; Increase budget participation and strengthen extra-budgetary fundraising; Base actions on research and development to generate innovation and technology; Make decisions based on social, political, economic and cultural contexts, with distributed information; Base decisions on knowledge of the external and internal environment, in order to impact the results, through monitoring and evaluation; Provide quality infrastructure for public security agencies; Promote an integrated work process, focused on efficiency; Promote the well-being of employees; Strengthen public security agencies and community police actions; Promote collaborative relationship between public security bodies, external bodies and society; Prioritize preventive, repressive and inspection actions for internal security at borders, ports and airports; Promote planned actions for the institutional growth of the secretariat and its bodies; Ensuring integrated training actions for bodies linked

to public security; Rational use of financial, human and institutional resources; Strengthen and create a fundraising mechanism for sustainability for institutional development.

Regarding the Rondônia Strategic Plan, 2019-2023, the issue of public security is also presented as one of the axes in this document. The axis encompasses state actions that prevent and repress violent actions against property; and those of a character more focused at the level of individuals, comprising the entire state public security system. In the plan, the major strategies intended to meet the security needs of the population were concentrated in the four main stages of the flow of the state public security system (intelligence, prevention, coercion and social reintegration), with the challenges presented as being: Technological modernization in the prevention and investigative process of the police, in order to establish a high rate of elucidation of violent crimes in the State; The reduction in the rate of violent crimes against property and traffic, in order to make Rondônia the safest state in the northern region; The implementation of alternatives to the current model of the prison system, both for the reduction of overcrowding and for the resocialization of the prisoner.

For Ballesteros [2014] the effectiveness of the public security system results from the ability to articulate multisectoral and interorganizational interventions aimed at preventing crime or overcoming its consequences after it has already occurred. This articulation is fundamentally based on an efficient management of resources, information and strategies, which favors participatory formulation and implementation and is supported by constant and reliable monitoring and evaluation instruments, to correct the course of interventions, to consolidate well-established and socially legitimate practices. Ferreira [2019] states that, in the current scenario of society, where violence and crime persecute the State as one of its most serious problems, the strategic planning tool is basic to preventive and repressive preparation and control. According to this author, a new vision of prevention and social response to the problems and damage caused by urban violence and crime is needed, which can provide a very useful tool for government management.

2.4. CONTEXTUALIZATION ON THE THEME OF CRIMINALITY

Criminality has worsened daily in Brazil, drastically affecting the lives of its citizens [Santos; Kassouf, 2008]. The accelerated growth of violence and the State's inability to promote crime control policies raised the discussion on public security to the main concerns of Brazilian society [Fórum Brasileiro de Segurança Pública, 2019]. According to Waiselfisz

[2013], Brazil is currently among the countries with the highest homicide rates in the world, whether based on an absolute or relative criterion. Brazil is currently ranked 14th in the world in terms of intentional violent deaths and 2nd in absolute numbers [Câmara dos Deputados Federal, 2018]. Brazil currently has a rate of 30.5 homicides per 100,000 people, the second highest in South America, after Venezuela, with 56.8. In total, around 1.2 million people lost their lives to intentional homicides in Brazil between 1991 and 2017 [UNODC, 2019].

In the diagnosis of homicides in Brazil, produced by the Ministry of Justice [CGPES/DEPAID/SENASP/MJ, 2015], the following macro causes of homicides in the country were identified:

(i) gangs and drugs;
(ii) property violence;
(iii) interpersonal violence;
(iv) domestic violence;
(v) conflicts between civil society and police;
(vi) lack of State presence.

In addition to factors that are transversal to all homicides, such as: availability of firearms and accumulation of social vulnerabilities.

Santos; Kassouf [2008] emphasize that the costs of crime to society are relatively high. Material damage, public and private spending on its prevention and combat are just some of the elements that make up the costs of crime for society. In addition, they cause other costs, no less important, such as the reduction of the stock of human capital, the reduction of the quality of life, the reduction of tourist activity and the loss of attractiveness of new productive investments and/or the expulsion of existing ones.

In Brazil, the distribution of deaths from violent causes is not restricted to a Region, State or Municipality, but impacts Brazilian society in general, causing loss of life, threats and fear. Also, it does not occur homogeneously, but varies between these territories and in each space over time [Januário; Nascimento; Fioravante, 2017]. According to the Atlas of Violence 2019 [IPEA/FBSP, 2019], the evolution of homicide rates between 2007 and 2017 was quite different across Brazilian regions. In recent years, while there was a residual decrease in the Southeast and Central-West regions, there was a certain stability of the index in the South region and accentuated growth in the North and Northeast. According to Riccio et al. [2018], a recent but serious phenomenon is the internalization of violence that has grown in medium and small cities in the last two decades in the wake of drug trafficking. According to the

authors, new demands arise for an overburdened criminal justice system in its various spheres. According to these authors, the characteristics of each region and the social relations they produce interfere with existing crime patterns. Thus, border regions, intensive agriculture or large urban centers have specificities in relation to the incidence of violence.

The federal government and Brazilian sub-national units and civil society organizations have sought to integrate actions to combat crime in large and medium-sized cities in the country. The experiments to contain the alarming crime rates, however, proved to be unsuccessful in most of them [Nascimento et al., 2018]. With regard to the Amazon, in Northern Brazil, Fraga [2007] points out that the region is experiencing a significant increase in indicators of violence, and its large territorial extension and the absence of an adequate public security policy make the problem difficult to face, contributing to its expansion. The author emphasizes that violence in this region is traditionally related to conflicts over land tenure, the illegal exploitation of its natural resources and the appropriation of the spaces of the traditional communities inserted there. Added to this is the geographic location, on the border with cocaine-producing regions, which places it on the route of international trafficking.

Deluchey [2017] reports that in the more rural regions of the Amazon, homicides seem to accompany the pioneering fronts of deforestation and the intensification of human activities (mining and soy). he concentration of “firearm homicides” follows the arrival of pioneering human activities in areas of deforestation and the transformation of the Amazonian rural territory into areas of intense cultivation, mainly soybeans. However, the discussion on the public agenda about crime in the Amazon has privileged the debate on the preservation/conservation of its biodiversity, the survival of the Amazon forest, deforestation and fires, national defense and protection of borders, among others no less relevant. In a way, the defenders of the criminality agenda in the academic and political agenda have not been successful in the relevance of the theme [Nascimento et al., 2018]. According to Machado [2018], the history of the colonization of Rondônia can explain the violence and the large number of conflicts that permeate its society, since its colonization repeated, to a large extent, the very history of the colonization of Brazil with the decimation of indigenous peoples and deterritorialization of traditional peoples. The number of homicides recorded in Rondônia, compared to other States of the Federation, is very high and represents social conflicts that have not yet been dealt with, since most of them are related to people who work in the field, in mining and in large enterprises, which they leave to behind a trail of unemployed, displaced, deterritorialized, in short, people without work and without perspectives, marginalized.

According to Lessa; Silva [2015] due to the geographic position of Rondônia, with 1,343 km of territorial area bordering Bolivia, the State has a significant portion of crimes that occur in its territory related to transnationality. According to the authors, the crimes of robbery and theft of vehicles (taken to Bolivia to serve as currency for drugs), homicides (the result of settling accounts between traffickers), smuggling, embezzlement, among other crimes, are common. However, the authors consider that the main illicit activity in the State's border area is related to the trafficking of drugs, diamonds and weapons. The dispute over the domain of territories for the distribution and sale of drugs also reflects their numbers on crime. Pereira-Filho; Tannuri-Pianto; Sousa [2010] emphasize that crime has become, in recent periods, one of the biggest Brazilian social problems, and has increasingly demanded, in addition to financial resources, more planning, operational intelligence and coordination in the various attempts to overcome it. Therefore, in Deluchey [2017] view, building proposals for public security means taking into account the context in which criminal violence is exercised, and the interests it serves. Once this examination has been carried out, the author also suggests proposals for changes in the exercise environment of this public sector, before expressing proposals related to public security itself.

2.5. CONTEXTUALIZATION ON THE THEME OF SOCIAL VULNERABILITY

The word vulnerable comes from the Latin verb “vulnerare”, which means to hurt, to penetrate. Due to these etymological roots, vulnerability is a term generally used to refer to predisposition to disorders or susceptibility to stress [Janczura, 2012]. The approach to vulnerability is characteristically interdisciplinary and strongly anchored in the social and human sciences, seeking to understand, in addition to epidemiological determinants, the dimension of the senses and meanings of subjects' exposure to certain risk situations, as well as the implications and differentiated effects of these exhibitions in individual and interactive trajectories [Ruotti; Massa; Peres, 2011].

The issue of social vulnerability is not new, as this terminology has been commonly applied by social scientists from different disciplines for quite some time. The theme is characterized by a complex conceptual field, consisting of different conceptions and dimensions that can focus on economic, environmental, health, rights, among many others. Although this theme has been worked on over the years, it should be noted that it is a concept

under construction, given its magnitude and complexity [Monteiro, 2011]. Social vulnerability is the negative result of the relationship between the availability of material or symbolic resources of actors, whether individuals or groups, and access to the structure of social, economic, cultural opportunities that come from the State, the market and society [Abramovay et al., 2002].

The vulnerability framework allows us to understand the ways in which individuals face adverse events and adopt certain behaviors, not according to the view of a rational subject who guides his action only by the availability of information, but from the perspective of a subject imbricated in a dynamic system of relationships and constraints of different orders (social, political and economic), which influences their choices and conditions of existence.

The situation of vulnerability combined with turbulent socioeconomic conditions causes great tension among young people, which directly aggravates the processes of social cohesion and, in some situations, encourages an increase in violence and criminality [Abramovay; Fefferman; Régnier, 2012]. In Brazil, violence is present in most cities, where high crime rates are accompanied by social inequality, misery, government failure, inefficiency of policies in the area of security and frustrations generated by the consumer Society. In this context, considering the latest available data on criminality and social vulnerability, it remains to analyze the context of Rondônia from the perspective of strategic planning for public security and discuss new approaches that may arise from this logical approach.

3. METHODOLOGY

For the development of the present study, the hypothetical-deductive method was adopted as a line of reasoning. The methodology consisted of collecting data in secondary databases from official sources of the Brazilian government. Data were collected following the municipal logic aggregated by microregions of Rondônia. The research analyzed the microregions of the State, considering the IBGE methodology, which classifies Rondônia with two mesoregions and 8 microregions, namely: i) Madeira-Guaporé mesoregion, involving the microregions of Porto Velho and Guajará-Mirim; ii) East Rondoniense mesoregion, covering the micro-regions of Ariquemes, Ji-Paraná, Alvorada do Oeste, Cacoal, Colorado do Oeste and Vilhena.

Table 1. Counties surveyed according to micro and mesoregions.

Mesoregions	microregions	Municipalities
Madeira-Guaporé	microregion Guajará-Mirim	Costa Marques, Guajará-Mirim, São Francisco do Guaporé
	microregion Porto Velho	Buritis, Campo Novo de Rondônia, Candeias do Jamari Cujubim, Itapuã do Oeste, Nova Mamoré, Porto Velho
East Rondoniense	microregion Alvorada D'Oeste	Alvorada D'Oeste, Nova Brasilândia D'Oeste, São Miguel do Guaporé, Seringueiras
	microregion Ariquemes	Alto Paraíso, Ariquemes, Cacaulândia, Machadinho D'Oeste Monte Negro, Rio Crespo, Vale do Anari
	microregion Cacoal	Alta Floresta D'Oeste, Alto Alegre dos Parecis, Cacoal, Castanheiras, Espigão D'Oeste, Ministro Andreazza, Novo Horizonte do Oeste, Rolim de Moura, Santa Luzia D'Oeste
	microregion Colorado do Oeste	Cabixi, Cerejeiras, Colorado do Oeste, Corumbiara, Pimenteiras do Oeste
	microregion Ji-Paraná	Governador Jorge Teixeira, Jaru, Ji-Paraná, Mirante da Serra, Nova União Ouro Preto do Oeste, Presidente Médici, Teixeirópolis, Theobroma, Urupá, Vale do Paraíso
	microregion Vilhena	Chupinguaia, Parecis, Pimenta Bueno, Primavera de Rondônia, São Felipe D'Oeste, Vilhena

Source: IBGE [2017].

For data processing, the SPSS statistical tool, version 23, was used as an instrument to calculate the criminality and social vulnerability rates, idealized by the research, based on the technique of multifactorial analysis. The model in question follows the calculation reasoning proposed or applied by Reis [2001]; Hair et al. [2005]; Santana [2005a]; Gama et al. [2007]; Santana [2007]; Cavalcante [2011]; Favero; Belfiore [2017].

3.1. INDICATORS RAISED BY THE RESEARCH

The indicators surveyed and which were part of the analysis of this work are listed in Table 2. For the criminality indicator constructed in this study, it followed those presented in the atlas of violence in Brazil, prepared by IPEA. The indicator of social vulnerability, named because it represents social factors, are somehow related to factors that, in principle, have the potential to interfere in criminality, was chosen based on the data available, at the municipal level, by the official agencies.

Table 2. Description of the criminality and social vulnerability criteria used by the research.

Index	Indicator	Year	Source
Criminality	Rate of victims of traffic accidents (100,000 Inhabitants)	2017	IPEA (www.ipeadata.gov.br)
	Murder rate (100,000 Inhabitants)		
	Suicide rate (100,000 Inhabitants)		
	Proportion of traffic accidents as a cause of mortality		
	Proportion of traffic accidents as a cause of mortality among young people aged 15 to 29 years		
	Proportion of homicides as a cause of mortality		
	Proportion of homicides as a cause of mortality among young people aged 15 to 29 years		
	Proportion of suicides as a cause of mortality (2017)		
	Proportion of suicides as a cause of mortality among young people aged 15 to 29 years		
Social vulnerability	Proportion of people living in extreme poverty (%)	2018	National Confederation of Municipalities (https://www.cnm.org.br/municipios/registros/100111/todos)
	Mortality rate	2017	State Observatory for Regional Development (http://www.odr.ro.gov.br/home/municipioperfil#)
	Infant mortality (deaths per thousand live births)	2017	IBGE (https://cidades.ibge.gov.br/)
	Hospitalizations for diarrhea (hospitalizations per thousand inhabitants)	2016	
	Total population served with water supply	2017	National Sanitation Information System (http://app4.cidades.gov.br/serieHistorica/#)
	Total population served with sanitary sewage	2017	
	Total population served in the municipality with waste collection	2017	
	Illiteracy rate	2010	IBGE (Censo demográfico)
	School dropout - early years (1st to 5th year) (%)	2017	National Confederation of Municipalities (https://www.cnm.org.br/municipios/registros/100111/todos)
	School dropout - final years (6th to 9th grade) - base year 2017 (%)	2017	
	Percentage of employed population	2017	IBGE (https://cidades.ibge.gov.br/)
	Unemployment rate 16 years and+	2010	IBGE (demographic census)
	child labor rate	2010	IBGE (demographic census)

Source: Research data.

The scale adopted for analysis followed the following classification:

Level 1: 0.000 to 0.100 (extremely low);
Level 2: 0.101 to 0.200 (very low);
Level 3: 0.201 to 0.300 (low);
Level 4: 0.301 to 0.400 (medium to low);
Level 5: 0.401 to 0.500 (average);
Level 6: 0.501 to 0.600 (medium to high);
Level 7: 0.601 to 0.700 (high);
Level 8: above 0.701 (very high).

Based on the two indices constructed in this study, they were related using the regression graphics of SPSS, version 23. For the calculations of correlations, they were made using the statistical package of Excel, version of Windows 10 Pro, version updated in 2020.

4. DATA RESULTS AND DISCUSSION

When analyzing Table 3, we highlight only the performances considered “high” and “very high”, that is, indexes above 0.600. In this sense, in relation to the crime rate, it was found that 9.62% of the municipalities in Rondônia were at this level, presenting performance either “high” or “very high”. In relation to the social vulnerability index, 13.46% of the municipalities in the State presented performances at this level, in relation to the period of data collection used in this study. When analyzing based on the mesoregional scenario, it appears that 20% of the municipalities were concentrated in this same performance range, both for the crime rate and for the social vulnerability index. In the East Rondoniense mesoregion, this performance level was 7% and 14% of the municipalities, respectively.

But, when analyzing the performances above 0.500 (“medium to high” or higher) where it can represent an alert in terms of strategic vision on the subject, it appears that 19% of the municipalities in the State have crime rates in this range. In terms of social vulnerability, this percentage rises to half of the municipalities in Rondônia, which is still a concern.

From the mesoregional point of view, the situation is even more worrying, because in relation to the crime rate, where 30% of the municipalities in the Madeira-Mamoré mesoregion are in this range. In relation to the social vulnerability index, this percentage rises to 70% of the municipalities. In the East Rondoniense mesoregion, the result is milder, where 17% of the municipalities had a crime rate in this performance range and, in relation to the social vulnerability index, 45% of them are also in this range.

Table 3. Criminality rate and social vulnerability in the municipalities of the state of Rondônia, by microregion.

MICROREGIONS	MUNICIPALITIES BY MICROREGION	Crime Index	Index Vulnerability
Guajará-Mirim	Costa Marques	0,239	0,731
	Guajará-Mirim	0,268	0,584
	São Francisco do Guaporé	0,605	0,512
Porto Velho	Buritis	0,346	0,486
	Campo Novo de Rondônia	0,631	0,597
	Candeias do Jamari	0,528	0,600
	Cujubim	0,363	0,594

	Itapuã do Oeste	0,397	0,438
	Nova Mamoré	0,475	0,632
	Porto Velho	0,369	0,276
Alvorada do Oeste	Alvorada D'Oeste	0,199	0,498
	Nova Brasilândia D'Oeste	0,329	0,508
	São Miguel do Guaporé	0,462	0,421
	Seringueiras	0,374	0,382
Ariquemes	Alto Paraíso	0,517	0,606
	Ariquemes	0,475	0,258
	Cacaulândia	0,668	0,470
	Machadinho D'Oeste	0,442	0,480
	Monte Negro	0,446	0,424
	Rio Crespo	0,044	0,503
	Vale do Anari	0,330	0,629
Cacoal	Alta Floresta D'Oeste	0,432	0,504
	Alto Alegre dos Parecis	0,385	0,754
	Cacoal	0,287	0,212
	Castanheiras	0,161	0,462
	Espigão D'Oeste	0,360	0,390
	Ministro Andreazza	0,537	0,469
	Novo Horizonte do Oeste	0,664	0,523
	Rolim de Moura	0,423	0,313
	Santa Luzia D'Oeste	0,293	0,632
Colorado do Oeste	Cabixi	0,588	0,485
	Cerejeiras	0,387	0,415
	Colorado do Oeste	0,368	0,393
	Corumbiara	0,143	0,536
	Pimenteiras do Oeste	0,306	0,458
Ji-Paraná	Governador Jorge Teixeira	0,386	0,709
	Jaru	0,460	0,287
	Ji-Paraná	0,337	0,232
	Mirante da Serra	0,545	0,556
	Nova União	0,239	0,582
	Ouro Preto do Oeste	0,334	0,305
	Presidente Médici	0,310	0,495

	Teixeirópolis	0,491	0,546
	Theobroma	0,466	0,586
	Urupá	0,358	0,546
	Vale do Paraíso	0,156	0,581
Vilhena	Chupinguaia	0,677	0,395
	Parecis	0,347	0,673
	Pimenta Bueno	0,462	0,275
	Primavera de Rondônia	0,180	0,545
	São Felipe D'Oeste	0,342	0,539
	Vilhena	0,397	0,205

Source: Research data.

Therefore, a worrying state scenario is evidenced in relation to the two indices shown in this study, to a lesser and/or greater degree, considering the microregions of the two mesoregions of the State. The question now is how these two indices relate to each other within a municipal context. It can be seen that the five municipalities with the highest crime rates, in descending order, were: Chupinguaia (0.677), Cacaulândia (0.668), Novo Horizonte do Oeste (0.664), Campo Novo de Rondônia (0.631) and São Francisco do Guaporé (0.605. And the five municipalities that had the lowest crime rates were: Rio Crespo (0.044), Corumbiara (0.143), Vale do Paraíso (0.156), Castanheiras (0.161) and Primavera de Rondônia (0.180).

Regarding the social vulnerability index, it appears that the five municipalities in Rondônia with the highest indexes were, in descending order: Alto Alegre dos Parecis (0.754), Costa Marques (0.731), Governador Jorge Teixeira (0.709), Nova Mamoré (0.632) and Santa Luzia do Oeste (0.632). When analyzing the five municipalities with the lowest rates of social vulnerability, the following sequence is obtained: Vilhena (0.205), Cacoal (0.212), Ji-Paraná (0.232), Pimenta Bueno (0.275) and Porto Velho (0.276). In general, it is possible to verify, based on the results presented so far, that a tendency of internalization of the problems of criminality and social vulnerability in the state of Rondônia, based on the indicators worked in this study and the time cut carried out, which concerns current data available from official sources.

This process of internalization has been pointed out by some researchers in different studies carried out in the country. In this sense, according to the Map of Violence [Waiselfisz, 2014], between 2000 and 2011, violence in Brazil underwent a process of dissemination and

internalization due to having moved from large municipalities - above 100 thousand inhabitants - for small towns. For Waiselfisz [2012] the growth of homicides in the 'inland' of the country did not occur homogeneously, but some States contributed more decisively to this increase. In 2008, this same author already pointed out that the increase in homicides in smaller municipalities was due to the fact that a process of relevant decentralization and deconcentration of economic development is underway in the country, with the emergence of new growth poles in the interior. And this new territorial dynamics of development would, therefore, also impact the geographic distribution of violence in the country [Waiselfisz, 2008].

Society, in general, seeks to curb criminal activities. For these activities to undergo a process of decline in a social structure, elements such as, for example, the structuring of police apparatus, educational training, job offer, planned urbanization and income distribution must emerge [Shaefer; Shikida, 2001]. Battela; Diniz [2010], in turn, state that the crime pattern in a region is linked to regional characteristics, such as location and concentration of wealth. It is noted that there are regions in Rondônia where the problem of violence is more striking, but in other municipalities, however, the issue of social vulnerability, although violence is noticeable, shows an equally important concern. Thus, the challenge for public security lies in devising interrelated strategies between “end” activities, which are actions aimed at reducing crime through institutional control, and “means” activities, which are actions aimed at to soften and create opportunities for social inclusion aiming at improving the quality of life.

In this sense, one should, for example, question the role of the public manager in stimulating the development of municipalities located in border strips from the logic of economic, social, political-institutional and environmental integration, aiming at a more effective process in terms of regional development policies, considering that such border regions are also the focus of illicit activities, drug trafficking, concentration of income, poverty, etc. terms of strategic vision.

What is sought here is to expose exactly this aspect, where the basis of decision-making regarding the role of the State in conducting public policies, in the case portrayed here of public security, can find concomitant mechanisms of action, both in the scenario of "cause-effect", where police control of security to society is more active, as well as in interdisciplinary actions of a more transversal nature, where public security can connect to other areas of public action aiming to minimize social vulnerability, through a strategic vision

that permeates the generation of employment and income, leisure, education, health, in short, ways to satisfy the basic needs of the population, as already pointed out by the Maslow scale.

According to Batella; Diniz [2010], variables such as wealth, income inequality, infrastructure, education and population structure have impacts on the occurrence of criminal acts. Shikida; Oliveira [2012] states that despite there being a bilateral relationship between crime and development, there is evidence that socioeconomic factors are the cause of crime. According to these same authors, it is believed that as development indicators increase, the incidence of crimes tends to decrease. Therefore, given the context motivated by this research, which deals with the meso and micro-regional approach in Rondônia, and at this point inserting a fact considered relevant where the environmental issue, within an institutional context, has been impacting more strongly the mesoregion Madeira -Guaporé in relation to the East Rondoniense.

In the micro-regions of Porto Velho and Guajará-Mirim, the highest rates of criminality and social vulnerability, respectively, were concentrated in the average of the observed municipal performances. The two highlighted microregions, as already demonstrated, are part of the Madeira-Guaporé mesoregion. This mesoregion in Rondônia has the highest environmental indices in the State, a fact that is intended to be a logical element of analysis in the work of building a vision for the establishment of a more effective public security strategic planning management for the state of Rondônia. Based on the indices constructed by the present study, correlations were made between them based on the groupings by microregions of Rondônia, which can be seen in Table 4, below.

Table 4. Correlations between criminality rates and social vulnerability by microregions in Rondônia.

Mesoregions	microregions	Correlation
Madeira-Guaporé	Guajará-Mirim	**-0,7966**
	Porto Velho	**0,54363**
East Rondoniense	Alvorada do Oeste	**-0,66753**
	Ariquemes	**-0,18299**
	Cacoal	**0,126231**
	Ji-Paraná	**-0,02574**
	Vilhena	**-0,43071**

Source: Research data.

The result indicates a strong and negative correlation in the microregions of Guajará-Mirim (-0.80) and Alvorada do Oeste (-0.67). The Porto Velho micro-region presented a positive correlation of 0.54 and the other micro-regions surveyed showed a very insignificant correlation, indicating that there are other factors that can explain this behavior. In the case of the Guajará-Mirim micro-region, such values indicate that 80% of the violence can be explained by the behavior of social vulnerability and vice versa, in a negative way, that is, the higher one of the indices, the lower the other. This result indicates that more studies are needed on the subject, in order to bring new readings about this scenario that shows to be quite varied among the microregions surveyed in Rondônia. However, it is evident that the Madeira-Guaporé mesoregion presented, in microregional terms, performances that indicate a different scenario in relation to the other microregions of the State. Thus, this research suggests that Rondônia's public security policy should not be based only on a single indicator, as it can lead to a somewhat mistaken regional reading. Therefore, it is worth mentioning that this is done based on a set of indicators, through readings of constructed indices, from scientific techniques and instruments, in order to allow the micro-regional peculiarities to be perceived and that such a policy is appropriate for each of observed realities. With this, expanding the vision of abstraction of the problem of public security in Rondonia and, consequently, adjusting the strategic planning, in order to understand its regional inequalities.

5. FINAL CONSIDERATIONS

The first hypothesis built in this study is confirmed and valid, which says: “If the criminality and social vulnerability rates identified by the research point to a scenario of greater impact in the micro-regions of Porto Velho and Guajará-Mirim, so the context of the approach motivated by research finds foundation and makes logical and coherent the inequalities brought within the scope of Rondônia, which must be taken into account for the strategic planning of public security";

It is essential that the strategic planning of public security in Rondônia adopts technical, meso and micro-regional criteria, using quantitative and/or qualitative data, subject to comparative analysis, such as the one brought by the research, in order to facilitate the decision-making process decision-making to establish different strategies to be taken in relation to regions and their specificities that make them unique and specific, requiring different visions for different scenarios;

The results found for Rondônia in relation to crime and social vulnerability rates showed consistency with the theoretical and methodological foundations of the research, thus revealing its validation from a scientific point of view;

With this study, the internalization of violence in Rondônia is evidenced, which confirms the tendency of this scenario at the national level in relation to the studies shown here;

It becomes worrying and urgent the need to build a systematized and standardized database on the reality of Rondônia focused on the area of interest of public security in the State, where it is suggested the creation of a statistical department within the framework of the structure of the public security of the State, as has been observed in other regions of Brazil.

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Stricto Sensu Editora

APPLICATION OF THE VARIMAX ANALYTICAL MODEL IN THE CONSTRUCTION OF THE QUALITY PERFORMANCE INDEX OF THE HOTEL SECTOR

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1. INTRODUCTION

Tourism is one of the fastest growing tertiary sector activities in the world, according to data from the report prepared by the World Economic Forum. In Brazil, these estimates are no different. The development of tourist activity in Brazil, which is linked to the natural beauties and cultural diversities spread over its 8, 514, 876 km², leaves nothing to be desired for the great and important world destinations, such as the beaches in Central America , for

example. The Brazilian Tourism Company - EMBRATUR has revealed that this activity contributes with more than 3% of national income from the export of goods and services, as well as being responsible for the creation of more than 7% of direct and indirect jobs in the Brazilian economy [EMBRATUR, 2020]. Given this, it is clear that the countless possibilities of tourist practices in Brazil, ranging from business tourism practiced in large cities, to ecotourism, a tourist modality popularized by Lascurain in “Ecotourism: the potential and the pitffals, as the activity used observation and practices with nature [Boo, 2011]. This tourism modality committed to the environment tends to develop mainly in regions that have an ecological diversity that is still preserved, such as the States of the North region that integrate the immense Amazon forest in Brazilian lands. With this, the development of ecotourism in lands such as the state of Rondônia, more specifically the city of Guajará-Mirim, which has a rich natural, historical and cultural potential, and has an average flow of 360 visitors / tourists per day and , approximately 131,400 per year, which means more than triple the population of the municipality, must necessarily be based on a tourist infrastructure and quality services as an attraction factor. A service without quality and performance below expectations can mean the death of a business in tourism, as the authors warn Cobra [1991]; Cobra [1997] and Cobra [1992].

Tourism is an important vector of endogenous development in Guajará-Mirim. According to Barreto [1995], the distribution of tourist resources produces direct and indirect impacts on about 53 items of the economy of a location, as well as impacts on the dynamics of significant productive sectors in different places. Thus, in addition to presenting significant data in the economic field, tourism influences important socio-cultural aspects of a location, as it constitutes a complex combination of interrelationships between service production, whose composition is integrated into a social practice with cultural base with historical heritage, a diverse environment, natural cartography, hospitality social relations, exchange of intercultural information. The sum of this sociocultural dynamic generates the phenomenon, filled with objectivity, consumed by millions of people, as a synthesis of the tourist product [Moesch, 2000; 2002]. Therefore, the factors of tourist attractiveness in a given territory are constituted by natural or artificial (human) elements, which materialize as tourist destinations. Thus, Yázigi [2001]; [2002]; [1996] clarifies that for a place to be considered touristic, it must have three basic characteristics: Have a relative tourist frequency; Provide support services and equipment as a tourist infrastructure (hotels, restaurants, tourism agency, among others) and have a tourist image projection for visitation.

However, it is necessary that local actors feel part of the structuring process of tourism in a given location, as, if this aspect is not met, the chances of success are drastically reduced. According to Melián-González; García-Falcón [2003], competitiveness reveals that to increase this factor, tourist attractions, whether natural or artificial, and the action of local actors are necessary. For Loiola [2004], the development of a location would result from the capacity of its actors to structure and mobilize, based on their potential and cultural matrix. In this sense, Cunha; Cunha [2005] states that the integration of society, the environment and the economy of a locality would enable sociocultural diversities and productive differences, which would be used as potential for transformations and regional development. Thus, according to Nicolas [1996], the tourist activity would have the capacity to create, transform and even value different spaces that might not have value in the context of the production logic. This context is reflected in the local reality of the state of Rondônia, which experiences the polarization of development in the Eastern Mesoregion of Rondoniense, leaving the Madeira-Mamoré Mesoregion, more specifically the city of Guajará-Mirim, the role of “faithful depository” of immense reserves , which compromises its development in other areas of traditional economic activity [Cavalcante, 2006; 2011].

Thus, Cavalcante [2011] cites ecotourism as an alternative capable of boosting the local economy, since the city of Guajará-Mirim presents a combination of favorable elements, such as natural, historical, cultural and social factors, in addition to a strategic position in the region, in addition to the relationship with some South American countries. The development of ecotourism in the city of Guajará-Mirim is a vector of integrated and sustainable development in the region of Guajará-Mirim, in Rondônia, aiming at a healthy and balanced development process capable of boosting the local / regional economy, as well as capable of valuing local identity through respect for the environment, folklore manifestations and regional culture [Cavalcante, 2006].

Knowing the IDQSH of the hotel sector in Guajará-Mirim/RO, allows the public power and the private sector, specifically the sectors directly linked to the hotel activity, a better understanding of the importance of quality as an essential factor of competitiveness in the tourist market, which, in the specific case of this study, it forms the foundation for a desirable process of local development. Therefore, this work aims to supply the scarcity of information about the subject in the referred region, which, in general, is known as one of the most important in the state of Rondônia in the tourism segment. In light of this scenario, the general objective of this study is to build the quality performance index of the hotel sector in the city

of Guajará-Mirim, on the border with Bolivia, based on the theory of endogenous development, using the Varimax method as a model of analytical research.

2. METHOD

2.1. TYPE OF STUDY

The research was structured based on aspects of interdisciplinary research given the complexity involved in the topic. This is a hypothetical-deductive study. For the study from a qualitative point of view, interviews were carried out with guests in the different types of accommodation surveyed, following a standard model of a pre-elaborated questionnaire.

2.2 ANALYTICAL RESEARCH MODEL

The Varimax method is a process where the reference axes of the factors are rotated around the source until some other position is reached. The objective is to redistribute the variance of the first factors to others and to achieve a simpler and more theoretically significant factorial [Hair et al., 2005], [Santana, 2005a], [Santana, 2005b], [Dillon; Goldstein, 1984], [Gama et al., 2007], [Santana, 2007], [Johnson; Wichern, 1988] and [Reis, 2001]. The choice of factors was carried out through the technique of latent root. So, the array of factorials loads, which measures the correlation between the common factors and observable variables, is determined by means of the correlation matrix, as Dillon and Goldstein [1984].

In order to determine the Hotel Services Quality Performance Index - (IDQSH) the factorial score matrix estimated by the orthogonal-based factorial rotation process was used, as pointed out by Santana [2007]. The factor score places each observation in the common factors gap. For each factor F_j, the i-th factor score extracted factorial score is defined by F_{Ij}, expressed as follows [Dillon; Goldstein, 1984]:

$$F_{IJ}=b_1 x_{i1}+b_2 x_{i2}+b_p x_{ip} \quad (2)$$

Then:
b_l = are the estimated regression coefficients for the n Common factorials scores;
x_{lj} = Are the n Observations of p Observable variables.
i = 1.2,...N.
j = 1,2,...,p.

To reach the equation that is the perception index [Dillon; Goldstein, 1984], [Gama et al., 2007], show the sequence evolution of the formulas from the previous equation. It turns out that even if the variable F_{ij} is not observable it can be estimated through the factorial analysis techniques, using the matrix of observations of the vector *x* of observable variables. In factorial notation, equation 2 becomes:

$$F_{(n,q)}=X_{(n,q)}b_{(p,q)} \quad (3)$$

In Equation 3, *F* is the matrix of the estimated regression from the *n* Factorials scores and it can be affected by both the magnitude and the measurement units of the variables *x*. To work around this kind of problem, replace the variable *x* by the standard variable *w*, given the ratio of the deviation around the average and the standard deviation of *x*, as follows:

$$\frac{x_i - \bar{x})}{S_x}$$

With these values, Equation 3 is modified making equation 4 possible, then:

$$F_{(n,q)}=w_{(n,q)}\beta_{(p,q)} \quad (4)$$

Based on equation 4, the beta weights matrix (β) with *q* standardized regression coefficients, replaces *b*, given that the variables are standardized on both sides of the equation. Pre-multiplying both sides of equation 4 by the value ***w'***, in which *n* Is the number of observations and *W* is the transposed matrix of *w'*, it makes it possible to reach the following equation:

$$\frac{1}{n} w'_{(p,n)} F_{(n,q)} = \frac{1}{n} w'_{(p,n)} w_{(n,p)} \beta_{(p,q)} = R_{(p,p)} \beta_{(p,q)} \quad (5)$$

The Matrix ***w'w,*** therefore is the matrix of intercorrelated variables or correlation matrix among the observations of the matrix *x*, designated by R. The Matrix It represents the correlation between the factorials scores and the factors themselves, denoted by Λ. With this, rewriting the equation 5, one must:

$$\Lambda_{(p\backslash q)}\backslash=R_{(p\backslash p)}\beta_{(p\backslash q)} \quad (6)$$

If the matrix R is non-singular, one can pre-multiply both sides of equation 6 by the inverse of R, obtaining:

$$\beta = \mathbf{R}^{-1}\Lambda \quad (7)$$

Substituting the β vector into equation 4, we obtain the factorial score associated with each observation, as follows:

$$F_{(n,q)} = w_{(n,p)} R^{-1}_{(p,p)} \Lambda_{(p,q)} \quad (8)$$

The main formula of the perception index is reached where the IP is defined as a linear combination of these factorials scores and the proportion of the variance explained by each factor in relation to the common variance. The mathematical expression is represented by the following formula:

$$IP_i = \sum_{j=1}^{q} \left(\frac{\lambda_j}{\sum_j \lambda_j} FP_{ij} \right) \quad (9)$$ Then:

i = 1.2,...n.
λ = is the variance explained by each factor;
∑ λ = is the total sum of the variance explained by the set of common factors.

The factorial score was standardized (FP) to obtain positive values from the original scores and allow the hierarchies of the cities as the values of the performance index are located between zero and one. The formula that allows this tiering can be seen by the following equation:

$$FP_i = \left(\frac{F_i - F_{min}}{F_{max} - F_{min}} \right)$$

It can be seen that And are the maximum and minimum values observed for the factorial scores associated with the parameters observed. It is based on this understanding that it was possible to calculate the Hotel Services Quality Performance Index - (IDQSH) adopted in this study.

2.3. SCALE LEVELS

The classification used by the research to express the results achieved by the IDQSH is described in Table 1.

Table 1. Analysis scale adopted by the research.

IDQSH	Classification
> 0,900	Great
0,701 - 0,900	Very good
0,501 - 0,700	Good
0,301 - 0,500	Bad
0,000 - 0,300	Terrible

Source: adapted from Hair et al. [2005].

2.4. PARAMETERS AND VARIABLES

The IDQSH questionnaire used is structured with 4 parameters: Physical structure, service, services and daily value of the lodging and 15 variables: Accommodation of the means of lodging; physical space of housing units; decoration of housing units; comfort of bed and furniture; ventilation and absence of noise from housing units; location and layout of the garage; ease of making reservations; hospitality and service; precision and agility; willingness to listen to the guest; problem-solving ability; quality and speed in cleaning services; mastery of other languages; variety in the menu of meals and benefits compatible with the price charged.

2.5. CHARACTERIZATION OF THE RESEARCH SITE

The city of Guajará-mirim, according to the Municipal Tourism Secretariat, had 23 lodging facilities, including 9 inns, 13 hotels and one Resort, to meet the accommodation needs of its visitors. The choice of the ten researched means of accommodation was made due to the scarcity of time and resources available to carry out the process. Thus, the choice of means of accommodation was made based on random criteria. Ten hotels were randomly selected, identified as follows: Hotel “A” Pakkas Palafitas; Hotel “B” Maylla Park hotel; Hotel “C” Jamaica Hotel; Hotel “D” Las Gardenias; Hotel “E” Lima Palace Hotel; Hotel “F” Fortaleza Palace Hotel; Hotel “G” Hotel Campos; Hotel “H” Guajará Pousada; Hotel “I” Hotel Gaúcha and Hotel “J” Hotel Mini Estrela.

2.6. DATA ANALYSIS

The statistical tool SPSS (Statistical Package for Social sciences) was used, which enabled the application of mathematical knowledge and allowed the construction of the IDQSH based on the results of the questionnaire.

2.7. ETHICAL ASPECTS

The questionnaire was applied after signing the Informed Consent Form – TCLE.

3. ANALYSIS AND DISCUSSION OF RESULTS

3.1 GUEST PROFILE CHARACTERIZATION

The research made it possible to trace the profile of guests in the means of accommodation in the city of Guajará-Mirim, a Brazilian city that borders Bolivia. The following variables were considered: gender, age, education, income level, place of birth, current residence, frequency of visits to the city and Length of stay in the city.

Male guests prevail. In some hotels the prevalence of male guests reaches 90%. The hotels that predominate female guests can be explained by the location close to the municipal bus station and the ease of transport between the hotel and the crossing point for Bolivia. This fact can be explained by the location of the aforementioned hotel in relation to the municipal bus station and, also, the price charged by the establishment. Thus, it can be inferred that they are mostly street vendors coming, in general, from Porto Velho, through the formal bus line, which aims to shop in Bolivia, and then resell in the informal market in Porto Velho, capital of the State of Rondônia.

In relation to age, which most lodging establishments presented, in general, an almost uniform distribution. However, when adopting the same analysis performed previously for responses with 50% or more, it was found that in 20% of the accommodations guests are in the range of up to 30 years (Hotel A and G), 30% in the range of 31 to 45 years (E, H and J) and another 20% in the age group from 46 to 60 years (D and I). There was no significant record for respondents over 60 years of age.

Regarding the level of education, it is observed that in 40% of the facilities and accommodations, the interviewed guests declared to have only elementary school, in 41% of them reported having high school and only in 19% of these establishments the guests

declared to be of higher education. Only in hotel "A" 80% of guests have a university degree. Fifty percent or more of guests with elementary education were identified in accommodation facilities B, C, D, H. I and J. Hotels E, F and G had the highest percentages for secondary education.

As for the income level of the interviewees, it can be observed that 20% of the guests declared having an income of 1 to 3 minimum wages, 40% reported receiving 3 to 8 minimum wages and 30% declared receiving more than 8 minimum wages. The highest percentages with income from 1 to 3 salaries were found in hotels H and J, while hotels A, D, G and J had the highest percentages of 3 to 8 minimum wages and hotels B, C and F had more than 8 minimum wages.

The origin of the guests presented relatively uniform percentages in the North, South, Midwest and Northeast regions. Considering only the answers above 50% among the respondents of the lodging facilities surveyed, the hotels that presented the highest percentages with people from the state of Rondônia were B, D, G, H and I.

The results show that in 90% of the means of accommodation, respondents said they reside in Rondônia and only 10% declared that they currently reside in other States in other regions of Brazil. Only the Pakaas Novos hotel is the only one to attract a number of guests from other States more significantly, with 70% of guests from other regions of Brazil. This aspect is explained by the characteristics of the lodging facilities included in the Hotel Resort category, such as the Pakaas hotel, where nature is the main product of attractiveness. When considering only responses above 50% among respondents, it was observed that the means of accommodation with the highest percentages residing in the state of Rondônia were, in descending order: B, C, I, D, F, G, H, J and E. The results show that 80% of guests are visiting the city more than once. Guests visiting the city more than once constantly stay at hotels J, C, D, E, G, H, F and I. Sixty percent of guests visit the city 1-2 times a year and 30% 3-5 times a year. Hotels D, E, F, C, H and J were the most that received guests 1 to 2 times a year.

The length of stay of guests in the city helps to better understand the dynamics of the tourism sector in Guajará-Mirim. This information can be useful in the hotel planning process, as it indicates, together with feedback to hotels about the quality of their services in the city, and be translated as an indicator of attractiveness that can influence the decisions of guests. Eighty percent of guests stay in town for 2-3 days. The hotels that stayed the most between 2 and 3 days were hotels D, H, C, E, B, F, G and J.

3.2. FACTORS DETERMINING THE CHOICE OF ACCOMMODATION

3.2.1. Physical appearance of facilities

The physical appearance of the facilities are generally responsible for the first impressions that a guest may have about the establishment in which they will be staying, hence the importance of knowing how much it can influence the choice of a client/user. Fifty percent of surveyed guests say that the physical appearance of a hotel's facilities is not important when choosing. The hotels in which guests answered that their physical appearance was not very important in their choice were in descending order: I, G, J, A and E.

3.2.2. Hospitality

It is known that the act of "welcoming", as an attitude of hospitality, influences the choice of customers/users of the lodging environment. Forty percent of guests surveyed said a hotel's hospitality is relatively important when choosing and only 10 percent said it is important or very important when choosing a lodging medium. This criterion was one of the most discredited by guests. It was verified that guests who registered responses in the “relatively important” (RI) category were in hotels A, B, F and G. Guests at hotels J and H stated that this criterion is “important” (I) and “very important” (MI), respectively.

3.2.3. Quality of hosting services

Ninety percent of guests are concerned about the quality of hotel services. Sixty percent answered that it is important (I) the services offered by the hotels. However, this service is not offered to guests. Most hotels have deficiencies in the services offered to guests.

3.2.4. Daily value of hosting

This parameter refers to the amount paid by guests for the daily rate, which also influences the choice of a means of lodging. 30% of the guests (A, D and H), declared that the daily rate is "important" and 20% of them (B and G) declared that this parameter is "very important" (MI).

3.3. SUMMARY OF THE QUALITY PERFORMANCE INDEX OF THE HOTEL SECTOR

Based on the calculation of the IDQSH of the ten averages of the surveyed accommodations, it was verified that, in the general average, the result pointed to an index of 0.445. Given the scale adopted by the research, it is noted, therefore, that, in general, the performance of the quality of hotel services in the city of Guajará-Mirim presented a level of quality considered "Bad". Hotel A had the best performance with an index of 0.542. Hotels F and D had rates of 0.529 and 0.514, respectively. Therefore, due to the scale adopted, these hotels are at a level of "Good" performance. The vast majority of hotels have indexes between 0.301 to 0.500 considered as a "Bad" index. These indexes were found in hotels H, B, E, C, G and J. Hotel I was the one with the worst result, reaching an index of 0.276, considered a "Terrible" index by the adopted scale.

The result found allows us to point out the ranking among the searched means of hosting. For hotels where the quality performance was considered "Good", they are, in descending order of the IDQSH: A (0.542), F (0.529), and D (0.514). In the quality classification scale considered "Bad" are the hotels, in descending order of the IDQSH: H (0.483), B (0.467), E (0.452), C (0.433), G (0.393) and J (0.369). Hotel I, with an index of 0.276, reached the classification that indicated a "Terrible" quality performance.

Table 2. IDQSH of hotels in Guajará-Mirim.

Hotel	IDQSH	Classification
A	0,542	Good
F	0,529	Good
D	0,514	Good
H	0,483	Bad
B	0,467	Bad
E	0,452	Bad
C	0,433	Bad
G	0,393	Bad
J	0,369	Bad
I	0,276	Terrible
Average	**0,446**	**BAD**

Source: Search result

Based on the result presented, it can be seen that the quality of services offered by hotels in Guajará-Mirim may be influencing the decision of tourists, which leads to underutilization of the city's hotel capacity. With this, it helps to explain why some tourists prefer to stay in the city of Guayará-Mirin in Bolivia and other tourists do not stay in hotels in Guajará-Mirim, returning immediately after their tours or business in the city.

3.4. SUMMARY OF GUESTS' OPINION ON THE POSSIBILITY OF THEIR RETURN AND LOCAL TOURISM

3.4.1. The return of the guest to the accommodation

Although the IDQSH has presented a result considered Bad for most hotels, the respondent guests affirmed, almost hegemonically, that they would return to stay in those means of accommodation. Despite the poor conditions of some hotels, this result would at first indicate a positive feedback. What may seem like satisfaction may also indicate the lack of alternative hotels with better quality in the city. The hotels that respondents said they would stay again, even with their deficiencies, were hotels A, B, C, D, E, F and G (100%), and hotels H, I and J (90%). There is a prevalence regarding the return to the hosted hotel. This context seems to be paradoxical. Despite the poor conditions, guests would return to stay at the same hotel.

3.4.2. Tourism as a vector of development in the opinion of guests

The hotels A, B, C, D, F, G, H and J were unanimous in recognizing that tourism is a vector of development for the city of Guajará-Mirim. For hotels E and I, this rate was 90%. Beni [1998] raises the importance of quality of service, comparing hotel developments with other industrial and commercial establishments as follows: While in the industry it is possible to plan the right amount of equipment, facilities and personnel for a certain type of production, the same does not occur with the hospitality industry, which expects the customer to put their operational plan into action. The product of the hotel is static. The consumer has to go to it. Industrial or commercial companies, on the other hand, make the product reach the customer. The costs of the hotel operating regime are fixed. The hotel company, when compared to other types of companies, is less prone to automation, as personal treatment, human warmth, is an essential part of the provision of hotel services.

There are several internal and external factors that influence the process of purchasing

a hotel good or service [Engel; Blackwell; Miniard, 2000]; [Churchill; Peter, 2000]; [Schiffman; Kanuk, 2000]; [Solomon, 2011]; [Kotler; Keller, 2006]. The basic factors that influence guests when choosing a hotel for business tourism, for example, are: location, comfort, maintenance of the apartment, daily rates, belonging to a network of business center services, food and beverage services, fitness center facilities and loyalty programs [Petrocchi, 2001].

In this sense, the housing units (UHs) with the smell of mold, the lack of courtesy and professionalism of the employees, the shower with low water pressure, a breakfast with little variety, an uncomfortable work area in the apartment, the delays in excessive check-out and poor maintenance in the apartment are some of the factors that tend to go against the quality of hotel services. In general, the means of accommodation are Housing Units – UHs that are, in fact, the space, accessible from the main areas of common circulation of the establishment intended for the use of the guest, for their well-being, hygiene and rest. And they are classified into: I – room – HU composed of, at least, one room for the exclusive use of the guest, with an appropriate place to store clothes and personal objects. II - apartment - HU consists of the previous item, a bedroom plus private bathroom and: III - suite - HU consists of apartment II, plus living room.

Organizations permanently seek to "manage images" with some appeal for their audience to position themselves positively in the market [Alvesson, 1990]; [Alvesson; Berg, 1992]. With this, it is understood that the physical structure and the decorative environment of the accommodations of a hotel are responsible for forming the first impressions and expectations, which pay attention to the cumulative satisfaction of the esteem and the needs of self-realization of the user. Scenarios or environments are influential elements in the public's perception of service encounters, as tangible attributes often pointed out by consumers as having a greater influence on service satisfaction and quality [Hutton; Richardson, 1995].

On how people create and manage impressions in front of an audience, comparing them to the performance of service providers, it was realized that they are always looking to create and even maintain good impressions with their target audience [Grove; Fisk, 1989]. The layout of the facilities, furniture and other tangible elements are responsible for conveying value-added messages to customers about the service they are acquiring, as it is through them that the customer can also evaluate the positioning of the company, as well as the notion of value of the service offered [Zeithaml; Bitner, 2003].

According to the Forum of Hotel Operators of Brazil (FOHB), the costs of renovations

in the means of lodging vary according to the scope and state of the reform, and the ideal would be to allocate a fund around 5% to replenish its assets. This concern with design, according to Schewe and Smith [1982], would make it possible to establish a specific style of establishment in the market, in the sense of providing psychological satisfaction (status) in the enjoyment of its services by customers. However, physical appearance alone is not a single decision factor available to a guest. Thus, other factors may also be influencing this decision. Satisfaction, in this case, is a preponderant factor that goes beyond the physical aspect of the enterprise, because other elements are embedded in this vision. However, as satisfaction is practically inseparable from marketing, the concept presented is based on this perspective: The incessant search for ways to please consumers, offering products and services to conquer and keep them, and profit from this activity, is what characterizes the market-oriented company that practices marketing concepts efficiently [Samara; Barros, 1997].

Quality is a term originating from the Latin qualitate that, according to Albrecht [2000], is correlated with the way in which a good or a service experience satisfies a need, solves a problem or adds value to the customer. From the point of view of hotel products and services, quality enables the customer to meet their needs and, for the company that adopts TQM (total quality management), greater possibilities to stand out in the market, such as the term quality: It is a real finding for companies, that is, it is the solution found so that a hotel or hotel chain can have a competitive advantage over competitors [Castelli, 2001; 2000 and 2005]. Total Quality Management or "Tital Quality Management" consists of a quality-oriented management strategy in all organizational processes, using the PDCA (Plan Do Check Act Correct) cycle [Ruthes, 2019]. In this sense, quality gains the status of a very important competitive factor in the provision of tourist services, since in a market full of tourism service providers, a company needs to offer more and better services, as customers can choose to obtain the same product from another supplier. To succeed, a tourism organization needs to understand the meaning of quality for the future customer and strive to improve the quality of the service offered. Only then will customers come back again.

These and other literary definitions attributed to the term quality are synthesized by Garvin [1984] in five main approaches, supported by Paladini [1997]. The user-based approach is the most comprehensive of all, because when it cares about the consumer, it is understood that the company is automatically serving others. In these terms, quality is a competitive weapon based on capturing the desires, needs and expectations of customers,

which must be put into practice in the face of competition [Castelli, 2001; 2000 and 2005]. Quality can also often be related to the level of customer satisfaction, as presented by Kotler [2000] and Slack et. [1997] in three possible situations: When customers' expectations are higher than their perceptions: quality is good; When customer expectations live up to their perceptions: quality is acceptable. Quality would be in the identification of service meetings that constitute true decisive moments of interaction with the client in order to always improve the services provided to customers/users, acting, for example, in the greater qualification of employees, in a process of improvement that continuously surprises customers [Castelli, 2001; 2005].

Also according to the same author, hotel companies that only provide basic and essential attributes valued by customers would be doomed to leave the market, because, to establish a strategy with a competitive differential, they must offer their customers unexpected values, such as surprise attributes, for example, providing a basket of fruits or even a flower in the guest's apartment on the occasion of their arrival or special dates. Such surprising attributes, over time, cease to be unexpected and are expected by guests, recognized as part of the hotel's own products/services, hence the need to always be innovating to offer unexpected services. Therefore, the quality of hotel services that deal directly and permanently with various tourists, requires from employees a lot of initiative, creativity and receptivity to customer wishes, as well as agility and promptness in the execution of services, with time being a variable that is highly charged by its visitors.

In this case, the improvement of service and full customer satisfaction would depend on the daily flow of occupancy of the establishment related to its ability to recognize the degree of accuracy of the guest, as well as its willingness to devise a sales plan that allows it to effectively manage its service capacity. It also emphasizes the use of automated (computerized) systems. These systems, integrated internally, would enable the planning and control of hotel activities, from the guest's check-in, the collection of the extra services consumed by the customer and their check-out, thus streamlining the receptive services provided by the hotel establishment. The level of professional qualification and the mastery of other languages are decisive factors for the tourist to choose to return, because, according to Castelli [2001] and [2000], in hotel services, the first contact is very important and definitive so that the customer can measure the quality of the services provided, because one of the characteristics of the services is that there is, Perhaps, no second chance for corrections. The mastery of other languages is an important differential [Savedra, 2003]; [Holden; Rogers,

2002]; [Rajagopalan, 2009].

By experiencing, even if eventually the hospitality of relatives, friends or even a hotel, one has the idea of how a good impression of a good reception is born. The art of hospitality is the first and main rule of hotel management and service providers concerned with delighting their customers. The art of hospitality is the first and main rule of hotel management and service providers concerned with delighting their customers. A unique feature in the provision of hotel services would be the promise of selling "pleasant moments", something intangible, related to the perfect synchrony that must exist between the service and its physical structure. Hospitality would be a wide range of structures, services and attitudes that would be intrinsically related to the well-being of the guest, from a welcoming environment, constituting an important input for the hotel sector and an attraction often decisive in the choices made by guests [Castelli, 2001; 2000]. This aspect is confirmed by Mullins [2004], when he states that a good hospitality begins with the knowledge of what guests like, from their arrival, lodging, from the constant attention to their desires during their stay, until their departure. Relevant points in hotel management can be to maintain the cleanliness of the establishment, as well as a good posture of the front employees and others involved in the service; have the habit of welcoming guests, using welcoming expressions such as: a discreet smile and an appropriate greeting, knowing how to listen to them before anything else; call visiting guests "Mr. or Lady", and in the case of regular guests, call by name, demonstrating recognition and personalized service; treat guests with a spirit of service, with kindness, enthusiasm, objectivity and promptness in the provision of service, and with the necessary information; recognize and even anticipate the needs, desires and expectations of customers, always ending the service with a "golden key" competition [Castelli, 2001; 2000 and 2005]. Therefore, the act of being hospitable when considered as the ability to provide a personalized and disciplined service, capable of transmitting seriousness and confidence to the client, should be performed according to Dantas [2007] by service providers who, in addition to knowing what they do, should like to deal with people, be friendly and cordial in their activities, in addition to knowing how to negotiate with others.

Unlike the sale of a product that has specifications predetermined by the manufacturer (in terms of size, weight, volume, use, etc.) that give the consumer, through its handling, a clear idea of the benefit acquired, while services, due to their intangibility and specific specifications, can only, according to Crosby [1992], be partially measured in subjective terms. This intangibility makes it impossible to adjust inventories and even the possibility of

replacing a defective service. The importance of quality in process management is related to the fact that services are not protected by law against copying, which in turn makes them more competitive and dynamic than tangible goods. In this sense, the quantification of parameters that characterize and allow the judgment of the performance of a service is supported by ISO 9004-2 (Quality Management and Quality System Elements. Part 2: Service Guidelines), which warns of the importance of service requirements being clearly defined, with the characteristics observed and evaluated by customers. Thus, indicating the following essential characteristics: The waiting time for delivery or processing of the service; the ease and capacity of the personnel and material involved; Reliability, safety and hygiene; The competence, courtesy, comfort, aesthetics of the environment, among others [Soares; Correa, 1994].

The best way to measure the quality of the performance of the services provided by hotel organizations is through the perception of their guests/users, obtained through market research [Parasuraman; Zeithaml; Berry, 1985]. In this case, customer satisfaction can be objectively and subjectively measurable, and objective models use indicators such as market share, number of complaints, annual billing, among others, and subjective ones are based, in turn, on the perception of customer satisfaction in relation to their individual needs [Lingoes; Pfaff, 1972].

4. FINAL CONSIDERATIONS

In the research, it was observed that the male population with a low level of education and age ranging from 20 to 45 years old prevails. It was found that guests who declared having an income of 1 to 3 minimum wages stay in hotels with lower daily cost and that come from all regions of Brazil with a predominance of guests from the state of Rondônia itself.

It was also found that 80% of the guests of hotels J, C, D, E, G, H, F and, I had already visited the city of Guajará-Mirim at least once, despite the deficiencies in infrastructure and services offered to tourists and / or visitors around the city. The guest's stay in the city varies between 2-3 days.

Regarding the 4 factors that would be influencing the choice of hotels, it was found that, significantly, in 50% of the means of accommodation (hotels I, G, J, A and E) the opinion of guests about physical appearance was considered as "little important ”(PI). For the

hospitality parameter, the result showed that in 40% of the establishments surveyed (hotels A, B, F and G) this parameter was considered as "relatively important" (RI) and for only 10% of this (H and J), hospitality when choosing a means of accommodation, it was considered “important” and “very important”.

The Hotel Services Quality Performance Index (IDQSH) in the city of Guajará-Mirim obtained an index of 0.445, considered as “Bad”, according to the adopted classification. This result allows us to accept the first research hypothesis where the quality of services would be interfering in the choice of guests, which helps to understand the low level of hotel occupancy in the city throughout the year. Regarding the parameter that analyzes the amount paid for the daily rate for hosting services, it was found that in 30% of the means of accommodation surveyed (hotels A, D and H), it was considered "important" (I) and 20% of the establishments (hotels B and G) “very important” (MI).

The Hotel Services Quality Performance Index (IDQSH) in the city of Guajará-Mirim obtained an index of 0.445, considered as "Bad", according to the adopted classification. This result allows us to accept the hypothesis that the quality of services would interfere with the choice of guests, which helps to understand the low level of hotel occupancy in the city throughout the year.

The result found allows us to point out the ranking among the searched means of hosting. Thus, for those hotels where the quality performance was considered as “Good”, they are, in descending order of the IDQSH: A (0.542), F (0.529), and D (0.514). In the quality standard considered “Bad” are the hotels, also in descending order of the IDQSH: H(0.483), B (0.467), E (0.452), C (0.433), G (0.393) and J (0.369). Hotel I, with an index of 0.276, reached the classification that indicated a “Terrible” quality performance.

Therefore, this result validates the hypothesis that the quality of services offered by the means of accommodation in Guajará-Mirim may be influencing the decision of tourists to no longer enjoy the city's hotel capacity.Despite this precarious situation, guests are attracted to the city because it is located on the border with Bolivia, where there is a shopping attraction in the city of Guayará-Mirin.

From the point of view of endogenous development, it is undeniable that there is recognition that tourism is the main development vector for the region. It was found that for accommodation facilities A, B, C, D, F, G, H and J, guests were unanimous in agreeing with this, and for accommodation facilities E and I, acceptance was 90%. Thus, the survey confirmed that the sector lacks quality, planning and management improvements. There is

no way to think about endogenous development without mobilizing and strengthening the entire tourist trade, in the case of this study, the hotel sector. Cooperation between the parties is essential for everyone's survival. This is the closest way to success. Despite recognizing that there are serious deficiencies in the city's infrastructure, which hinders the region's good tourist performance, even so, there are other elements that equally deserve attention.

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Stricto Sensu Editora

SOCIOECONOMIC DEVELOPMENT INDEX OF MUNICIPALITIES IN FREE TRADE AREAS LINKED TO SUFRAMA: A MULTIFACTORIAL ANALYSIS

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1. INTRODUCTION

The theoretical foundation of this work is based on the theory of endogenous development and the theory of poles of regional development in association with the institutionalist theory of Douglass North. The idea of Endogenous Development is to endogenize a series of previously exogenous variables (such as human capital, the environment, etc.) in order to generate increasing returns. Economic growth would then be

an endogenous result of an economic system, and not the result of forces that affect it from the outside. It is noteworthy, therefore, that the importance of this theory has been driven by the process of globalization, where reflections on the role of locality and territory in development strategies have been gaining density in the contemporary agenda [Sachs, 2008].

On endogenous development Vázquez-Barquero [2001] states that “economic development occurs as a result of the use of locally generated potential and surplus” and complements by stating that “to neutralize the steady state tendencies, it is necessary to activate the factors determinants of the processes of capital accumulation, namely, the creation and diffusion of innovations in the productive system, the flexible organization of production, the generation of agglomeration economies and economies of diversity in cities and the strengthening of institutions”. In this sense, Dowbor [1996] presents a vision of development that, without underestimating the economic importance, places the human being and the collective and majority interests as a central point, converging on the possibility of enhancing the capacities of all individuals. An important contribution made by Campanhola and Graziano da Silva [2000] points out that “the global cannot exist without the local, and the local is characterized by social relations that are structured by global social relations”. Thus, Amaral Filho [2002] understands endogenous development as a process in which economic growth leads to a continuous expansion of the capacity to generate and add value to production and also of the region's absorption capacity in retaining the economic surplus generated in the local economy and in the attraction of surpluses from other regions.

For Buarque [2002], local development is defined as an endogenous process of change that leads to economic dynamism and improved quality of life for the population in small territorial units and human groups. To be consistent and sustainable, local development must mobilize and exploit local potential and contribute to raising social opportunities and the viability of the local economy; at the same time, it must ensure the conservation of local natural resources, which are the basis of its potential and condition for the quality of life of the local population. Zapata et al. [2004], in turn, highlights that local development consists of a process in which the social character is integrated with the economic one. The strategy of endogenous development or local development proposes to, in addition to developing the productive aspects, enhance the social, cultural, environmental and political-institutional dimensions that build the well-being of society. In this sense, endogenous development seeks to meet the needs and demands of the local population through the active participation of the

community involved. More than obtaining gains in terms of the position occupied by the local productive system in the international or national division of labour, the objective is to seek the economic, social and cultural well-being of the local community as a whole. In addition to influencing productive aspects (agricultural, industrial and services), the development strategy also seeks to act on the social and cultural dimensions that affect the well-being of society [Barquero, 2001].

For Buarque [1999] local development within globalization is a direct result of the ability of local actors and society in which they are structured and mobilized, based on their potential and their cultural matrix, to define and explore their priorities and specificities, seeking competitiveness in a context of rapid and profound transformations. Thus, considering the theoretical context of endogenous development, it is necessary for the Amazon region to adopt mechanisms to strengthen its local specificities, outlining collective actions in favor of a development model compatible with the multiple cultural characteristics existing in the territorial context in order to overcome obstacles and the “knots” that impede the perfect flow of development fluidity, based on a critical and organizational reading of four strategic factors: knowing your strengths, weaknesses, threats and opportunities, referring to the ZOPP method. It is understood, therefore, that the theory of endogenous development helps to substantiate the historical process of the Manaus Free Zone policy, by making it possible to understand that the process of construction of that policy is rooted in local needs and claims. However, one should be aware of the risk of this policy generating historical dependence, from the perspective of the self-reinforcing characteristics of North [1990], Nobel Prize in Economics, in 1993, based on his institutionalist theory.

Rey [2019] when analyzing the 50-year period of operation of the Superintendence of the Manaus Free Zone (SUFRAMA) revealed that the lack of complementation of the incentive policy generated a certain dependence in the region and that there would be a need for new public actions to correcting this process, which reinforces the theoretical foundation adopted in this study, that is, producing new trajectories from the endogenous or local force in a bottom-up logic. Thus, in view of the challenges to be faced in conducting this research, outlining the theory of endogenous development is an important step in the construction of the epistemological guidelines of the research, in order to become vigilant in the conduct of work in the field of economic sciences. At the same time, the theory of “growth poles” developed by French economist François Perroux brings the idea of creating economic incentive zones to increase the region’s productive capacity, in order to modify the geographic

space and boost local social and economic development [Campos; Ermínio, 2018]. According to these authors, Perroux's work "In his Theory of Poles of Growth, or "Théorie des Pôles de Croissance" demystifies the notion of geographic space, elevating the discussion to a level of complexity that takes into account the potential of a region to concentrate industries and human capital making it a zone of economic influence that can reach a high level of importance across borders.

According to Silva Filho; Carvalho [2001] in the models of the new theory of economic growth, growth is seen as a product of economic forces endogenous to decentralized market systems. It is these forces that drive the process more than any exogenous technological innovations over which the market has no control. Therefore, the economy can reach an equilibrium of perpetual growth through its internal forces. In order for there to be such a growth, it is only necessary that the downward trend in returns to capital be eliminated. In this sense, factors such as endogenous technological innovation (which arise as a result of the efforts of productive agents to maximize their profits), human capital (that is, the stock of knowledge of economic agents) and institutional arrangements (including government policy and civil society organization) come to assume a crucial role in the continued growth of per capita income in any economic system. Therefore, according to these same authors, it is at this point that the fundamental role played by the social actors that command the development policies of underdeveloped economies, whether economic blocks of countries, national economies or regions within a country, in the specific case of the present work, the policy of regional development of SUFRAMA, in the regional portion of the Amazon, northern region of Brazil. According to Schumpeter [1982], economic development is not a phenomenon to be explained economically, but that the economy, in itself without development, is dragged by changes in the world around it and that the causes and, therefore, the explanations development must be sought outside the group of facts that are described by economic theory.

Therefore, in general, it can be said that for Perroux, Schumpeter, Vázquez-Barquero, among others, the economy should focus on a more social context. In this direction, the institutionalist theory of Douglass North, Nobel laureate in Economics in 1993, reveals that North [1990] points out that institutional models tend to reinforce themselves, even when they are socially inefficient. It is easier for individuals to adapt to existing rules than to try to change them. When development takes a certain direction, organizational culture, customs and mental models of the social world reinforce this trajectory, that is, they drive it to move in the

same direction [Cavalcante, 2011]. Thus, North brought an approach that portrays the concern of the performance achieved by countries and regions in relation to the institutional arrangement, the result of the form and power of social interaction. In this view, the economic aspect is not a cause, but a consequence of a process of social and institutional formation of the place. In this way, the social now has the power to stimulate or stifle development.

Therefore, the present research is structured based on these theoretical principles that will guide the progress of the research and will allow conducting the study within a systematic epistemological surveillance. In this sense, the theory of endogenous development and regional development poles associated with Douglass North's institutionalist theory applied to the reality of Free Trade Areas will allow new opportunities for contribution to economic science, from the theoretical and methodological approach of research applied to the scenario Brazilian western Amazon. Free Zone, in Benton's view; Napier; Ülkü [2016], is understood as being a region inserted in the context of a national territory, where free import and export trade is allowed, through specific legislation and within an account system and special customs regime through from which the development of a given geographic region is promoted.

SUFRAMA's public policy, instituted in the 1960s in the country's Western Amazon, was an action by the federal government with the objective of giving a new impetus to development in the Brazilian Amazon region after the decline of the rubber economy, which generated socioeconomic effects. perverse in the regional and national scenario, becoming a major challenge for the country. Thus, this policy, since its origin, has as its main objective to encourage the development of the interior of the Amazon, as can be seen by Art. 1 of Decree no. 288, of February 28, 1967, which regulated it and as part of the Government's Economic Action Plan - PAEG (1964-1966): The Manaus Free Trade Zone is an import and export free trade area with special tax incentives, established with the aim of creating an industrial, commercial and agricultural center in the interior of the Amazon, endowed with economic conditions that allow its development, given the local factors and the great distance from the consumer centers of its products.

The Amazon reality was chosen as the scenario of the present study because it is the main region of biodiversity in the world and that there is international attention in relation to economic activities in the perspective of sustainable development, which requires the Brazilian government to carry out technical studies that can serve as an aid for the strategies and actions of the federal executive in designing effective public policies, which, among

others, are the result of research that can shed light on the understanding and interpretation of the regional Amazonian reality as an element of national economic integration. Thus, faced with such a scenario, Brazil created the policy of the Superintendence of the Manaus Free Zone (SUFRAMA) as a strategy to boost economic growth and regional development, without giving up environmental preservation and social justice.

Therefore, the objective was to analyze the economic and social development indices of the nine municipalities covered by the SUFRAMA policy and linked to the Free Trade Areas with the economic and social development indices of the nine municipalities that are not covered by the aforementioned fiscal incentive policy. However, they are municipalities inserted in the border strip of the Western Amazon.

Thus, given the context of economic globalization and the need to establish national policies to stimulate the development of regions with a significant presence of legally protected areas, such as the Brazilian Amazon and the Manaus Free Trade Zone policy, this work demonstrates its importance to the to analyze a regional context based on a vision of a pole of development inserted in a reality of economic freedom, which indicates the existence of an important paradox to be analyzed and discussed within science. The aim is, therefore, to fill a fertile space in terms of analysis of regional economic development policies in the country, based on solid theoretical and methodological foundations capable of bringing light and constructions to the debates around this theme.

2. RESEARCH METHODOLOGY

2.1. TYPE OF SEARCH

This is a quantitative research of the experimental type, which will seek to raise indicators for later calculation of the index for purposes of comparison between the municipalities selected for this study.

2.2. UNIVERSE AND SAMPLE

Within the universe of 92 municipalities located on the border strip in the Brazilian Western Amazon [IBGE, 2021], 9 municipalities covered by the Free Trade Areas policy were

surveyed, namely: Tabatinga (Amazonas), Guajará-Mirim (Rondônia), Boa Vista and Bonfim (Roraima), Macapá and Santana (Amapá) and Brasiléia, with extension to the municipality of Epitaciolândia, and Cruzeiro do Sul (Acre) and 9 more municipalities, for comparison purposes, not covered by the aforementioned policy, namely: Feijó, Sena Madureira and Tarauacá (Acre), Barcelos, Benjamin Constant and Boca do Acre (Amazonas) and Buritis, Nova Mamoré and Pimenta Bueno (Rondônia), totaling a sample of 18 municipalities along the border of the Western Amazon that participated in this study, with the years 2010 and 2018 being the two periods chosen for data collection. For this, the following acronyms of the municipalities selected in this work were adopted in order to facilitate the process of calculation and presentation of data, as follows: Tabatinga (TAB), Guajará-Mirim (GUA), Boa Vista (BOA), Bonfim (BOM), Macapá (MAC), Santana (SAN), Brasiléia (BRA), Epitaciolândia, (EPI), Cruzeiro do Sul (CRU), Feijó (FEI), Sena Madureira (SEN), Taraucá (TAR), Barcelos (BAR), Benjamin Constant (BEN), Boca do Acre (BOC) and Buritis (BUR), Nova Mamoré (NOV) and Pimenta Bueno (PIM).

2.3. DATA COLLECTION

The economic and social indicators collected from institutional sources are shown in Table 1 below.

Table 1. Survey of quantitative data effectively worked on for the preparation of the regional development index of the present study.

THEME	INDICATORS	SOURCE
economic índex	Gross Domestic Product per capita, at current prices (R$ 1.00)	IBGE (Statistics)
	Share of gross value added at current prices of agriculture in the gross value added at current prices of agriculture in the federation unit (%)	IBGE (Statistics)
	Share of gross value added at current industry prices in gross value added at current prices of industry in the federation unit (%)	IBGE (Statistics)
	Share of gross value added at current prices of services, administration, defence, education and public health and social security, in added value	IBGE (Statistics)
	Participação do valor adicionado bruto a preços correntes total no valor adicionado bruto a preços correntes total da unidade da federação (%)	IBGE (Statistics)
	Gross Domestic Product, at current prices (R$ 1,000)	IBGE (Statistics)
	number of cattle	IBGE (Municipal livestock research)
	Coffee production (% in relation to the state)	IBGE (municipal agricultural production)
	Value of the production of round wood (Thousand BRL)	IBGE (Production of plant extraction and forestry)
social index	Population served with water supply (%)	IBGE (demographic census)

	Unit No. Health (per thousand inhabitants)	DATASUS
	Number of beds (per thousand inhabitants)	DATASUS
	Number of doctors (per thousand inhabitants)	DATASUS
	IFDM Consolidated	Firjan
	IFDM Employment & Income	Firjan
	IFDM Education	Firjan
	IFDM Health	Firjan
	IDEB - Elementary school (early years)	INEP

Source: Own elaboration

2.4. DATA PROCESSING

This is a factor analysis study. The model in question follows the calculation reasoning proposed or applied by Reis [2001]; Hair et al. [2005]; Santana [2005a] and Santana [2005b]; Gama et al. [2007]; Santana [2007]; Fávaro and Belfiore [2017]. This model has already been tested and applied in other studies, such as Cavalcante [2011], Paraguassu-Chaves et at. [2018a]; Paraguassu-Chaves et at. [2018b]; Paraguassu-Chaves et at. [2019]; Paraguassu-Chaves et at. [2020a]; Paraguassu-Chaves et at. [2020b]; Paraguassu-Chaves et at. [2020c], where it was possible to build indexes within this methodological perspective. According to Hair et al. [2005] factor analysis is a generic name given to a class of multivariate statistical methods whose main purpose is to define the underlying structure in a data matrix. Complementing this reasoning, the aforementioned authors also reveal that when summarizing the data, the factor analysis obtains latent dimensions that, when interpreted and understood, describe the data in a much smaller number of concepts than the original individual variables. The logic of construction of the social and economic indices, proposed here, therefore follows this reasoning.

These authors reveal that although there is still much debate about which factor model is the most appropriate, empirical research has shown similar results in many cases. Continuing with this reasoning, the authors state that in most applications, both principal component analysis and common factor analysis arrive at essentially identical results if the number of variables exceeds 30, or if the commonalities exceed 0.60 for most of the variables.

Therefore, factor analysis can identify the structure of a set of variables, as well as provide a process for data reduction Hair et al. [2005]. In this study, we adopted the same methodological procedures already experienced by the authors in other research experiences. Thus, the factor analysis model adopted here is very similar to the principal components model, according to Santana [2005a] and Santana [2005b]. Also according to this author, the principal components model with m components and *p* variables (q < p), can

be written based on the description presented by Dillon; Goldstein [1984], in which the model is presented in matrix form (Equation 1):

$$CP_1 = Y_{11}X_1 + Y_{12}X_2 + \cdots + Y_{IP}X_P$$
$$CP_2 = Y_{21}X_1 + Y_{22}X_2 + \cdots + Y_{2P}X_P$$

Equation (1)

$$CP_q = Y_{m1}X_1 + Y_{m2}X_2 + \cdots + Y_{qp}X_p$$

On what:

CPi = are the i-th principal components (i = 1, 2, ..., q);

- *ij* = are the coefficients related to each variable;

Xj = are the jth variables (j = 1, 2, ..., p).

On the other hand, the basic model of factor analysis, according to Santana [2005a] and Santana [2005b], expresses each variable in terms of common latent factors and a single factor or specific factor. The algebraic representation of the model is given by equation 2:

$$X_1 = \lambda_{11}FC_1 + \lambda_{12}FC_2 + \cdots + \lambda_{Iq}FC_q + \varepsilon_1$$
$$X_2 = \lambda_{21}FC_1 + \lambda_{22}FC_2 + \cdots + \lambda_{2q}FC_q + \varepsilon_2$$

Equation (2)

$$X_p = \lambda_{p1}FC_1 + \lambda_{p2}FC_2 + \cdots + \lambda_{p.q}FC_q + \varepsilon_{mp}$$

On what:

Xi = are the i-th variables (i = 1, 2, ..., p);

- *ij* = are the coefficients related to each common factor;

FCj = are the jth common factors (j = 1, 2, ..., q);

- *i* = are the i-th specific factors.

Thus, according to the author in question, the basic model of common factors is usually expressed in matrix form as in equation 3, according to Dillon; Goldstein [1984]:

$$.X = \alpha F + \varepsilon \quad \text{Equation (3)}$$

Being,

X = the **p-dimensional**, vector transposed of the observable variables, denoted by $X = (x_1, x_2,..., x_p)$;

F = the **q-dimensional**, vector transposed of unobservable variables or latent variables called common factors, denoted by $F = (f_1, f_2,..., f_q)$, being that $q < p$;

ε = the **p-dimensional** vector transposed of random variables or single factors, denoted by $\varepsilon = (e_1, e_2,..., e_p)$;

α = the matrix (p,q) of unknown constants, called factor loadings.

In the factor analysis process, an important aspect to be submitted to the data is the rotation of factors, through a factorial rotation tool, according to Hair et al. [2005]. In practice, according to the same authors, the objective of all rotation methods is to simplify the rows and columns of the factor matrix to facilitate interpretation. Thus, it is assumed that in the factor analysis model the specific factors are orthogonal to each other, with all the common factors, where it is normally adopted that: E (ε) = E (F) = 0 and Cov (ε, F) = 0, according to Gama et al. [2007] and Santana [2007a]. According to these authors, the initial structure used to determine the factor loading matrix, in general, may not provide a significant pattern of variable loadings, thus indicating that there is not something that signals a definitive way for this to occur. Thus, the confirmation or not of this initial structure can be done through various methods of factor rotation, according to Dillon; Godstein [1984]; Johnson and Wichern [1988]. For the purpose of the present construction of the regional development performance index, the Varimax method was adopted, considered one of the most popular methods of orthogonal rotation of factors [Hair et al., 2005]. The Varimax method is a process in which the reference axes of the factors are rotated around the origin until some other position is reached. The objective is to redistribute the variance from the first factors to the others and reach a simpler

and theoretically more significant factor pattern Hair et al. [2005]; Santana [2005a] and Santana [2005b]; Gama et al. [2007]; Santana [2007a]; Santana [2007b].

The choice of factors, in turn, is performed using the latent root technique. According to Hair et al. [2005] latent root is the column sum of factor loadings squared for a factor. Also called eigenvalue, it corresponds to the amount of variance explained by a factor. According to these authors, a factor is understood to be the linear combination (statistical variable) of the original variables. The factors also represent the latent dimensions (constructs) that summarize or explain the original set of observed variables. Thus, the factor loading matrix that measures the correlation between common factors and observable variables is determined through the correlation matrix, according to Dillon; Goldstein [1984]. Therefore, to determine the performance indices of economic and social development, we used the matrix of factor scores estimated by the factorial orthogonal rotation process, as pointed out by Santana [2006]. The factor score, by definition, places each observation in the space of common factors. For each factor f_j, extracted factor score is defined by F_{ij}, expressed as follows (equation 4) [Dillon; Goldstein,1984]:

$$F_{IJ} = b_1 x_{i1} + b_2 x_{i2} + b_p x_{ip} \quad \text{Equation (4)}$$

Being that:

b_i = are the estimated regression coefficients for the n common factor scores;

x_{ij} = are the n observations of the p observable variables.

i = 1,2,...,n.

j = 1,2,...,p.

Gama et al. [2007] and Santana [2007b] show the evolutionary sequence of the formulas from the previous equation, which allows arriving at the equation that represents the regional development performance index of the municipalities object of the present study. Thus, according to the authors, it appears that although the variable F_{ij} is not observable, it can be estimated using factor analysis techniques, using the matrix of observations of the vector x of observable variables. In factorial notation, equation 5 becomes:

$$F_{(n,q)} = X_{(n,q)} b_{(p,q)} \quad \text{Equation (5)}$$

According to Santana [2007b], in equation 5, *F* is the regression matrix estimated from the *n* factor scores, which can be affected both by the magnitude and by the measurement units of the *x* variables. To get around this type of problem, the variable *x* is replaced by the standardized variable *w*, (equation 6), given by the ratio between the deviation from the mean and the standard deviation of *x*, as follows:

$$w_{ij} = \qquad \text{Equation (6)}$$

With these values, equation 6 is modified making equation 7 possible, as follows:

$$F_{(n,q)} = w_{(n,q)}\beta_{(p,q)} \qquad \text{Equation (7)}$$

Based on equation 7, the beta weight matrix (β) with *q* standardized regression coefficients, replaces *b*, given that the variables are standardized on both sides of the equation. Pre-multiplying both sides of equation 6 by the value $\frac{1}{n}\boldsymbol{w'}$, where *n* is the number of observations and *w'* is the transposed matrix of *w*, makes it possible to arrive at equation 8 [Santana, 2007b]:

$$\frac{1}{n}w'_{(p,n)}F_{(n,q)} = \frac{1}{n}w'_{(p,n)}w_{(n,p)}\beta_{(p,q)} = R_{(p,p)}\beta_{(p,q)} \quad \text{Equation (8)}$$

According to Santana [2007b] the matrix $\frac{1}{n}\boldsymbol{w'w}$ it is constituted in the matrix of inter-correlated variables or matrix of correlation between the observations of the matrix x, designated by R. The matrix $\frac{1}{k}w'F$ represents the correlation between factor scores and the factors themselves, denoted by Λ. Thus, rewriting Equation 9, we have that:

$$\Lambda_{(p,q)} = R_{(p,p)}\beta_{(p,q)} \qquad \text{Equation (9)}$$

The same author continues revealing that if the matrix R is non-singular, one can pre-multiply both sides of equation 10 by the inverse of R, obtaining:

$$\beta = R^{-1}\Lambda \qquad \text{Equation (10)}$$

Thus, substituting the *β* vector in equation 4, we obtain the factor score associated with each observation (equation 11), as follows:

$$F_{(n,q)} = w_{(n,p)}R^{-1}_{(p,p)}\Lambda_{(p,q)} \qquad \text{Equation (11)}$$

Thus, the main formula for the socioeconomic performance index (IDSE) of the municipalities studied is arrived at, from the perspective of the perception of regional

development, which is defined as a linear combination of these factor scores and the proportion of variance explained by each factor in relation to to the common variance. The mathematical expression is now represented by the following formula (equation 12), which was based on Santana [2007b]:

$$IDL_i = \sum_{j=1}^{q} \left(\frac{\lambda_j}{\sum_j \lambda_j} FP_{ij} \right) \qquad \text{Equation (12)}$$

Where,

i = 1,2,..., n.

λ = the variance explained by each factor;

∑ λ = the sum total of the variance explained by the set of common factors.

The factor score was standardized (FP) to obtain positive values from the original scores and allow the ranking of performances to be determined by the index in question, which ranges from 0 to 1. The formula that allows this hierarchy can be seen by equation 13:

$$FP_i = \qquad \text{Equation (13)}$$

It is thus seen that F_{min} e F_{max} are the maximum and minimum values observed for the factor scores associated with the performance of the socioeconomic development index (IDSE) from the perspective of the perception of regional development adopted for the present study.

With this, with multiple potential for use, due to the wide capillarity of studies linked to the interest in better understanding and analyzing, in practice, the theme of socioeconomic development and the scenarios of the local and regional reality around the Brazilian western Amazon region, which the analysis of economic and social indicators based on the multivariate method of data, using the technique of factor analysis and statistical tools from SPSS, allows the construction of a critical view of SUFRAMA's policy and its reflection in the perspective of regional development.

It is hoped, therefore, that this work can help in debates in terms of public policies for regional development, considering the economic and social focus as the axis of analysis. Thus, in the current scenario, where the issue of the Amazon has been more effectively demanded at the negotiation tables for the conclusion of bilateral or multilateral agreements

in the spheres of economic and social integration, such as economic blocs, common markets, cooperation between countries, channel efforts to the field of academic debate, from the critical view applied to the process of understanding and interpreting the regional reality, its internal dynamics and the trend of its historical trajectory, thus allowing to build a clear and objective perception of the reality object of the present study, in order to bring new elements and new bases for discussion in the context of SUFRAMA's policy focused on aspects of economic and social development.

2.5. DATA ADEQUACY CRITERIA FOR FACTOR ANALYSIS

According to Santana [2007b], the two main tests that assess data adequacy for factor analysis are the Bartlett sphericity tests, which assess the general significance of the correlation matrix, that is, it tests the null hypothesis that the correlation matrix correlation is an identity matrix; and the Kaiser-Meyer-Olkin (KMO) test, which is based on the principle that the inverse of the correlation matrix approximates the diagonal matrix, in order to compare the correlations between the observable variables. Such models can be expressed in mathematical formulas. Said mathematical formulas of these tests are based on Dillon; Goldstein [1984]; Reis [2001], Santana [2007b].

a) Bartlett's test

According to Santana [2007b], in particular, the Bartlett test of sphericity tests the null hypothesis that the variables are independent, against the alternative hypothesis that the variables are correlated with each other, as can be represented as follows, according to the said author:

$H_0: R = I ou H_0: \lambda, = \lambda_2 = \cdots = \lambda_P$, (Equation 14) and is given by:

$$X^2 = -\left[n - 1 - \frac{1}{6}(2p + 5)\right] . \in \left| R \right|$$ (Equation 15) ou

$$X^2 = -\left[n - 1 - \frac{1}{6}(2p + 5)\right] . \sum_{i=1}^{p} . \in . \lambda_i$$ (Equation 16).

On what:

|**R**| is the determinant of the sample correlation matrix;

λ is the variance explained by each factor;

n is the number of observations; and

p is the number of variables.

The statistic has an asymptotic distribution of x^2 com [0,5.p.(p-1)] degrees of freedom.

b) Kaiser-Meyer-Olkin (KMO) test

The mathematical formulas for these tests were based on Dillon; Goldstein [1984], Reis [2001], according to Santana [2007b]:

$$KMO = \frac{\sum_i \sum_j r_{ij}^2}{\sum_i \sum_j r_{ij}^2 + \sum_i \sum_j a_{ij}^2} \quad \text{(Equation 17)}$$

On what:

rij is the sample correlation coefficient between variables xi and xj;

aij is the partial correlation coefficient between the same variables that is, simultaneously, an estimate of the correlations between the factors, eliminating the effect of the other variables.

The **a**ij should assume values close to zero, since the factors are assumed to be orthogonal to each other. Values of this test below 0.5 are unacceptable.

c) Commonality

In addition to the two previous tests, there is also commonality as an important criterion for testing the suitability of data for factor analysis. In this sense, commonality is the proportion of common variance present in a given variable. Thus, on a scale of zero to one, a variable that does not present specific variance or error would have a commonality of 1, while a variable that does not share variance with any other variable would have a commonality of value 0. In general, the literature indicates a minimum value of 0.5 for commonality to be

considered satisfactory. Therefore, for a variable to work well in a factor analysis, it needs to have a large proportion of common variance Hair et al. [2005]; Matos and Rodrigues [2019]. In the specific case of this study, the cumulativeness met the requirements for factor analysis.

2.6. SCALE ADOPTED FOR ANALYSIS OF SOCIAL AND ECONOMIC INDICES

Below is table 2, which illustrates the description of the scale adopted for this study.

Table 2. Index scale and description

Scale	Description
0.801 to 1.000	Very high
0,601 to 0,800	High
0,401 to 0,600	Regular
0,201 to 0,400	Bad
< 0,200	Very Bad

Source: Authors

3. DATA ANALYSIS AND DISCUSSION

3.1. DETERMINATION OF THE ECONOMIC INDEX OF MUNICIPALITIES WITH SUFRAMA: 2010 AND 2018

The highest indices of economic development of the municipalities served by the SUFRAMA policy in 2010 were the municipalities of Macapá (0.717) and Boa Vista (0.652), capitals of the States of Amapá and Roraima, respectively, followed by the municipality of Brasiléia (Acre) 0.307 and the municipality of Santana (Amapá) 0.239. The municipalities of Tabatinga (Amazonas), Guajará-Mirim (Rondônia), Cruzeiro do Sul and Epitaciolância (Acre) and Bonfim (Amapá) had indexes below 0.200, which here was classified as having “very lowbad” performance.

In 2018, the economic development index was higher in Boa Vista (Roraima) with an index of 0.713 and in Macapá (Amapá) with an index of 0.626, followed by Brasiléia (Acre) with 0.319, Bonfim (Roraima) with 0.243 and Epitaciolândia (Acre) with 0.224, with the other municipalities (Cruzeiro do Sul and Epitaciolância in Acre, Santana and Bonfim in Amapá, Guajará Mirim in Rondônia and Tabatinga in Amazonas) with performances below 0.200. Based on this, it is noted that the municipality with the highest growth rate in the IDEC in the period in question were the municipalities of Bonfim (Roraima) with 57.3% growth,

Epitaciolândia (Acre) with 35.4% and Guajará- Mirim (Rondônia) with 13.1%. On the other hand, the municipalities that presented the highest negative growth rates were: Santana (Amapá) with -21.3% and Macapá (Amapá) with -12.8%.

3.2. DETERMINATION OF THE SOCIAL INDEX OF MUNICIPALITIES WITH SUFRAMA: 2010 and 2018

From the point of view of social development, based on the year 2010, the municipalities assisted by the SUFRAMA policy achieved the highest rates, with Macapá (Amapá) IDSO 0.581 and Boa Vista (Roraima) IDSO 0.580. Next, in descending order, come the municipalities of Santana (Amapá) and Brasiléia (Acre) which reached, respectively, IDSO of 0.402 and 0.388, Cruzeiro do Sul (Acre) with 0.319; Guajará-Mirim (Rondônia) with 0.310; Epitaciolândia (Acre) with 0.303; Bonfim (Roraima) with 0.258 and Tabatinga (Amazonas) with an index below 0.200. The highest IDSO in 2018 was observed in the municipality of Boa Vista (Roraima) with a performance of 0.700. Next come the municipalities of Cruzeiro do Sul (Acre) with 0.508; Brasiléia (Acre) with 0.487; Macapá (Amapá) with 0.447; Guajará-Mirim (Rondônia) with 0.373; Epitaciolândia (Acre) with 0.342; Tabatinga (Amazonas) with 0.338; Bonfim (Roraima) with 0.322; Santana (Amapá) with 0.319.

From the point of view of growth in the analyzed period (IDSO-2010 and IDSO-2018), it appears that only 22.2% of the municipalities assisted by the SUFRAMA policy showed negative growth rates and this reality was observed exclusively in the municipalities of the State of Amapá that participate in this study, where the municipality of Macapá presented a rate of -23.0% and Santana with -20.7% of growth in the period. The other municipalities showed positive growth rates, especially Tabatinga (Amazonas) which achieved the highest growth rate in the period (222.6%). The others showed the following growth rates, in descending order, Cruzeiro do Sul (Acre) = 59.3%, Bonfim (Roraima) = 35.1%, Boa Vista (Roraima) = 20.7%, Guajará-Mirim (Rondônia) = 20.6% and Epitaciolândia (Acre) = 12.9%.

3.3. DETERMINATION OF THE ECONOMIC INDEX OF MUNICIPALITIES WITHOUT SUFRAMA: 2010 and 2018

In 2010, the IDEC of the municipalities that are not assisted by the SUFRAMA policy reached a performance considered “bad” for 40% of them and “very bad” for the other 60%. In descending order, the performance found follows the following sequence: Pimenta Bueno

(RO) = 0.329, Buritis (RO) = 0.263, Nova Mamoré (RO) – 0.235 and Sena Madureira (AC) = 0.229. The municipalities of Feijó and Tarauacá (AC), Barcelos, Benjamin Constant and Boca do Acre (AM) presented results below 0.200. In 2018, the distribution of performances followed practically the same trends observed for 2010. Thus, in descending order, the performance of IDEC-2018 corresponded to the following sequence: Pimenta Bueno (RO) = 0.326, Buritis (RO) = 0.283, Nova Mamoré (RO) = 0.248 and Sena Madureira (AC) = 0.202. The other municipalities presented results below 0.200.

Thus, these results allow analyzing the growth rate in the period in question, that is, between 2010 and 2018, in relation to the IDEC. A negative growth rate was found in 60% of the municipalities, namely: Barcelos (AM) = -100%, Benjamin Constant (AM) = -42.1%, Sena Madureira (AC) = -11.9%, Tarauacá (AC) = -2.8% and Pimenta Bueno (RO) = -0.9%. On the other hand, the other municipalities showed positive growth rates, namely: Boca do Acre (AC) = 179.1%, Feijó (AC) = 13.1%, Buritis (RO) = 7.7% and Nova Mamoré (RO) = 5.4%.

3.4. DETERMINATION OF THE SOCIAL DEVELOPMENT INDEX OF MUNICIPALITIES WITHOUT SUFRAMA: 2010 and 2018

The IDSO – 2010 for the municipalities without SUFRAMA, the indexes indicate “very bad” performance (70% of the municipalities) and 20% with low performance. The exception was the municipality of Pimenta Bueno (RO) which achieved the highest performance among the other municipalities, however with a scale level classified as “regular” performance, reaching an IDSO of 0.598. The municipalities with low performance were: Buritis (RO) = 0.317 and Boca do Acre (AM) = 0.215. While the municipalities with “very bad” performance, in descending order, were: Sena Madureira (AC) = 0.142, Feijó (AC) = 0.099, Nova Mamoré (RO) = 0.092, Tarauacá (AC) = 0.040 and Barcelos (AM) = 0.026.

The IDSO of municipalities without Suframa in 2018 shows a trend of behavior of similar results data from 2010. The highest performance was achieved by the municipality of Pimenta Bueno (RO) with 0.644, followed by the municipalities of Boca do Acre (AM) with 0.414, Buritis (RO) with 0.401, Sena Madureira (AC) with 0.275, Benjamin Constant (AM) with 0.255, Nova Mamoré (RO) with 0.237, Tarauacá (AC) with 0.232 and Feijó (AC) with 0.213. The municipality of Barcelos (AM) was the only one to have a performance below 0.200 in this analysis.

Table 3. Socioeconomic indices determined by the survey for the municipalities surveyed for the years 2010 and 2018 and the growth rates in the period.

Municipalities	IDSO-2010	IDSO-2018	Growth rate %	IDEC-2010	IDEC-2018	Growth rate
TAB	0,105	0,338	222,6	0,024	0,023	-4,8
GUA	0,310	0,373	20,6	0,116	0,131	13,1
BOA	0,580	0,700	20,7	0,652	0,713	9,3
BOM	0,238	0,322	35,1	0,154	0,243	57,3
MAC	0,581	0,447	-23,0	0,717	0,626	-12,8
SAN	0,402	0,319	-20,7	0,239	0,188	-21,3
BRA	0,388	0,487	25,4	0,307	0,319	3,7
CRU	0,319	0,508	59,3	0,169	0,166	-2,1
EPI	0,303	0,342	12,9	0,166	0,224	35,4
FEI	0,099	0,213	115,7	0,112	0,126	13,1
SEM	0,142	0,275	93,5	0,229	0,202	-11,9
TAR	0,040	0,232	487,2	0,125	0,121	-2,8
BAR	0,026	0,169	542,9	0,015	0,000	-100
BEM	0,055	0,255	367,1	0,023	0,013	-42,1
BOC	0,215	0,414	92,9	0,063	0,176	179,1
BUR	0,317	0,401	26,3	0,263	0,283	7,7
NOV	0,092	0,237	157,7	0,235	0,248	5,4
PIM	0,598	0,644	7,7	0,329	0,326	-0,9

Source: Search result...

Subtitle:

	Municipalities WITH SUFRAMA
	Municipalities WITHOUT SUFRAMA

According to Table 4, the municipalities of Boa Vista (RR), Macapá (AP) and Santana (AP), in 2010, reached the same level of performance, classified as “regular”. The municipalities of Guajará-Mirim (RO), Bonfim (RR), Brasiléia (AC), Cruzeiro do Sul (AC) and Epitaciolândia (AC) achieved a performance considered weak in this study. The worst performance was registered for the municipality of Tabatinga (AM) which had a “very bad” performance this year. In 2018, the situation improves for the municipality of Boa Vista (RR)

which achieves a performance considered “high”. The municipality of Macapá (AP) remains at the same performance level as it was in 2010, that is, it remains at the “regular” level of performance in 2018. The municipality of Santana (AP) also recorded a drop in the period from 2010 to 2018, going from a “regular” performance to a “bad” performance in the last year of analysis. With the exception of the municipality of Cruzeiro do Sul (AC), which rose in the performance category in 2018, upon reaching the high performance scale, all other municipalities that had a “bad” performance in 2010 remained in the same performance range in the year 2018. Added to this list of municipalities with poor performance, the municipality of Tabatinga (AM), which in the previous year had a performance considered “very bad”.

Table 4. Classification of municipalities with SUFRAMA according to the scale of this research based on the social index.

Scale	Description	IDSO-2010	IDSO-2018
0,801 - 1,000	Very high	-	-
0,601 - 0800	High	-	BOA
0,401 - 0,600	Regular	BOA, MAC, SAN	MAC, BRA, CRU
0,201 - 0,400	Bad	GUA, BOM, BRA, CRU, EPI	TAB, GUA, BOM, SAN, EPI
<0,200	Very bad	TAB	-

Source: Search result.

According to the results presented in Table 5, the municipalities of Boa Vista (RR) and Macapá (AP) remained in the same “high” performance category of IDEC in both analyzed years. No municipality was observed in the category of “very high” or “regular” performance in the period in question. In 2010, only the municipalities of Santana (AP) and Brasiléia (AC) had “regular” performance. However, in 2018, only Brasiléia (AC) remains in this category, along with the municipalities of Bonfim (RR) and Epitaciolândia (AC) that increased in performance, since in 2010 both municipalities were in the range of “very bad” performance. Thus, in 2018, the municipality of Santana (AP) is in the “very bad” performance range, in addition to the municipalities of Tabatinga (AM), Guajará-Mirim (RO) and Cruzeiro do Sul (AC) that remained with performance. “very bad” in the period from 2010 to 2018.

Table 5. Classification of municipalities with SUFRAMA according to the scale of this research based on the economic index.

Scale	Description	IDEC-2010	IDEC-2018
0,801 - 1,000	Very high	-	-
0,601 - 0800	High	BOA, MAC	BOA, MAC
0,401 - 0,600	Regular	-	-
0,201 - 0,400	Bad	SAN, BRA	BOM, BRA, EPI
<0,200	Very bad	TAB, GUA, BOM, CRU, EPI	TAB, GUA, SAN, CRU

Source: Search result.

According to Table 6, with the exception of the municipality of Barcelos (AM) which remained in the same category of “very bad” performance in the two years surveyed, the other municipalities rose in performance category in the period from 2010 to 2018. Thus, the municipality of Pimenta Bueno (RO), which was in the “regular” performance range in 2010, moves to the “high” performance category in 2018. In the same way that the municipalities of Boca do Acre (AM) and Buritis (RO) that were in the range of bad" performance in 2010 reach, in 2018, the range of "regular" performance. The municipalities of Feijó (AC), Sena Madureira (AC), Tarauacá (AC), Benjamin Constant (AM) and Nova Mamoré (RO) that were in the range of “very bad” performance in 2010, moved up to the range of bad” performance in 2018.

Table 6. Classification of municipalities without SUFRAMA according to the scale of this research based on the social index.

Scale	Description	IDSO-2010	IDSO-2018
0,801 - 1,000	Very high	-	-
0,601 - 0800	High	-	PIM
0,401 - 0,600	Regular	PIM	BOC, BUR
0,201 - 0,400	Bad	BOC, BUR	FEI, SEM, TAR, BEM, NOV
<0,200	Very bad	FEI, SEM, TAR, BAR, BEM, NOV	BAR

Source: Search result.

The Table 7 illustrates the result for the performance of the economic development index for the municipalities not covered by the SUFRAMA policy. Based on this table, it is possible to observe that the two scenarios inherent to the performance of IDEC-2010 and IDEC-2018, there was no change in the period. The municipalities of Sena Madureira (AC), Nova Mamoré (RO), Pimenta Bueno (RO) and Buritis (RO) that were in the low performance range in 2010, remained in the same range in 2018. Likewise, the municipalities of Feijó (AC), Tarauacá (AC), Barcelos (AM), Benjamin Constant (AM) and Boca do Acre (AM) remained in the range of “very bad” performance for the two analyzed periods. In this way, it can be seen that there was a concentration of municipalities in the range of " bad" or "very bad" performance for the year 2010 and 2018, unchanged.

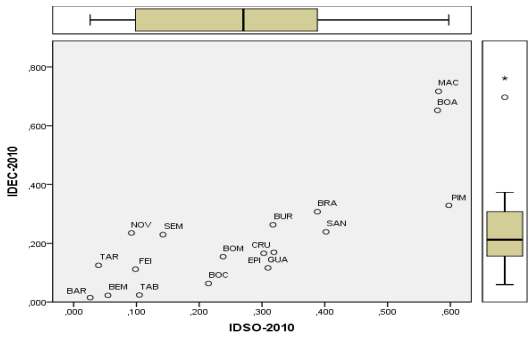
Table 7. Classification of municipalities without SUFRAMA according to the scale of this research based on the economic index.

Scale	Description	IDEC-2010	IDEC-2018
0,801 - 1,000	Very high	-	-
0,601 - 0800	High	-	-
0,401 - 0,600	Regular	-	-
0,201 - 0,400	Bad	SEM, NOV, PIM, BUR	SEM, NOV, PIM, BUR
<0,200	Very bad	FEI, TAR, BAR, BEM, BOC	FEI, TAR, BAR, BEM, BOC

Source: Search result.

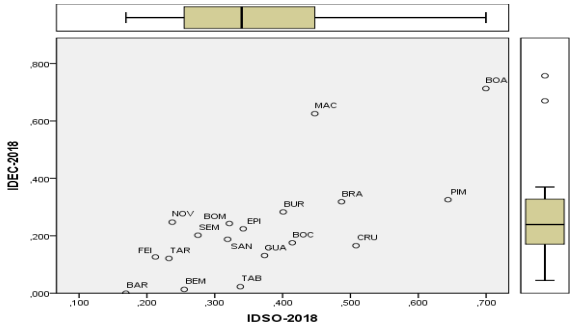
Organizing the indices found, according to the SPSS regression graph model, version 23, one arriveswe arrive at Graphs 1 and 2, below, listswe list the social and economic indices for the years 2010 and 2018, respectively, for the 18 municipalities researched.surveyed. In Figure 1, it is possible to verify that the municipalities of Macapá (AP) and Boa Vista (RR) stand out in relation to the other municipalities surveyed for presenting the highest social and economic performances for the year 2010. Pimenta Bueno (RO) also stands out for having a relatively "high" social index. The other municipalities presented average performance with a tendency to "bad or very bad" performance for the two indexes surveyed. Figure 2, in turn, shows the results of the SPSS regression, v.23 between the social and economic indices for the municipalities surveyed in relation to the year 2018.

Figure 1. Socioeconomic performance of the cities surveyed: 2010.



Source: Search result.

Figure 2. Socioeconomic performance of the municipalities surveyed: 2018.



Source: Search result.

Figure 2 shows the high performance of the municipalities of Boa Vista (RR) and Macapá (AP) for the IDEC-2018 and the “high” performance of the IDSO-2018 for the municipalities of Boa Vista (RR) and Pimenta Bueno (RO). In view of this context, the other municipalities were distributed in a range either with “regular” performance or with “bad” and

"very bad" performance, in general.

Thus, analyzing the data presented so far, the complex reality of Amazonian municipalities calls attention, which, not infrequently, tends to demonstrate a scenario still lacking in a regional development process that can in fact lead to a perspective of institutional change, according to North [1990] and that, therefore, can lead them to new trajectories, to new scenarios, to new levels. However, what is evident in this work is that although there is a certain dynamics between the municipalities surveyed, in general, such dynamics are located at a critical level, where the yellow signal is alarmed, indicating that there is a need for greater attention from the public power as an agenda. of changes through public policies, within an endogenous or local development context.

However, there is another aspect that has not been researched, but that is essential for such a change to occur. It is about social capital as a collective mechanism for the convergence of forces, in order to enhance what there is of aptitude in the region, within an internal social perspective based on the context of endogenous development.

Such results indicate that development is still something difficult to be perceived within the Amazon regional context. Thinking about the Amazon with its peculiarities and complexities is the best way to go. However, in general terms, this is not what happens in practice. And the result ends up producing scenarios with multiple variables that end up interfering in some way with the local and regional dynamics. Understanding and interpreting such a complex reality is the challenge that continues to be projected in time and space, owing, even, to the economy, the challenge of contributing to the explanation of the phenomena that tend to have increasingly complex behaviors of reality. For this, it is necessary to find orthodox and/or heterodox economic forms of development capable of pulling up this scenario observed by the surveyed municipalities, which still tend to rest their dynamics on the lowest levels of development, with reflections, including, on the quality of local and regional life.

According to the results found for the IDSO-2010 and IDSO-2018 for all the municipalities surveyed, it can be observed that 70% of the municipalities assisted by the SUFRAMA policy showed improvements in their performance from 2010 to 2018 and, in the same way, 100% of the municipalities not served by this policy had their rates improved from 2010 to 2018. It can be seen that there was almost no change in performance in the two years surveyed. However, 50% of the municipalities assisted by the SUFRAMA policy had a small and slight improvement in 2018 when compared to 2010. Regarding the municipalities without

SUFRAMA, it was observed that approximately 30% of the municipalities had a slight improvement in performance.

To obtain new perspectives of analysis, Tables 8 and 9 were constructed, which deal with the distribution and frequency of the indices for a certain level of scale for the municipalities with SUFRAMA and without SUFRAMA, respectively. Table 8 shows that 66.7% of the municipalities assisted with SUFRAMA that participated in this research presented "bad" and "very bad" performance for the social development index for the year 2010. For 2018 this start was even higher, reaching 77.8% of the municipalities with this low level of performance.

Table 8. Distribution and relative frequency of the socioeconomic indices of the municipalities WITH SUFRAMA determined by the survey.

Scale	Description	IDSO-2010		IDSO-2018		IDEC-2010		IDEC-2018	
		qde	%	qde	%	Qde	%	qde	%
0,801 - 1,000	Very high	-	-	-	-	-	-	-	-
0,601 - 0,800	High	-	-	1	11,1	2	22,2	2	22,2
0,401 - 0,600	Regular	3	33,3	3	33,3	-	-	-	-
0,201 - 0,400	Bad	5	55.6	5	55,6	2	22,2	3	33,3
➢ 0,200	Very bad	1	11,1	-	-	5	55,6	4	44,5
Total	-	9	100%	9	100%	9	100%	9	100%

Source: Search result.

Although the SUFRAMA policy is a reality for these municipalities, it is noticeable from the data and indices analyzed that such a scenario could be even worse if such a policy did not exist. This allows us to point out that it is not simply a matter of denying the importance of the aforementioned regional development policy, but of stating that there is a need to redirect the strategic focus so that SUFRAMA's policy can be felt more strongly by society in general, especially those residing in local level. In this sense, it is worth noting, in general, the fact that the taxes generated by economic activities in these municipalities served by the Manaus Free Zone influence policy are normally directed to the federal government treasury, with no possibility of part of this amount being applied. in the region covered by that policy. Thus, the return of part of these values transferred to the treasury to be applied in local public policies seems to us to be a fair measure for strategic planning in favor of local and endogenous development. Thus, strengthening the internal social capital and the natural vocation of these regions that could focus their planning in favor of actions that aim to guarantee greater

investments in infrastructure, health, education, etc. In relation to the municipalities not assisted by the SUFRAMA policy, the result was even worse (Table 9).

In this sense, 88.9% of these municipalities were at the "bad" and "very bad" level of development, both in 2010 and 2018. Regarding the economic development index for the year 2010, it was observed that 100% of the municipalities presented “bad” and “very bad” performances for both 2010 and 2018.

Table 9. Distribution and relative frequency of socioeconomic indices of municipalities WITHOUT SUFRAMA determined by the survey.

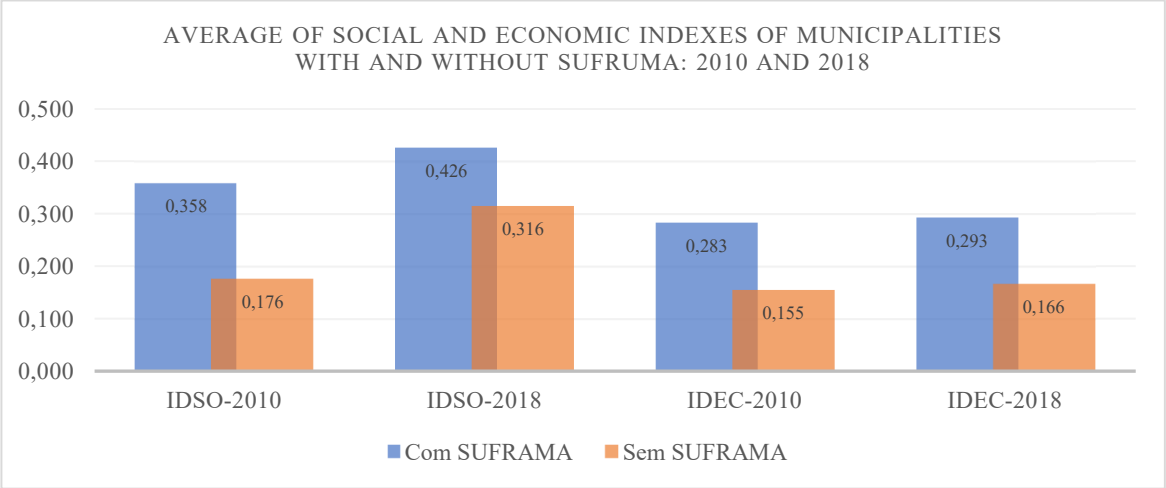
Scale	Description	IDSO-2010		IDSO-2018		IDEC-2010		IDEC-2018	
		qde	%	Qde	%	qde	%	qde	%
0,801 - 1,000	Very high	-	-	-	-	-	-	-	-
0,601 - 0,800	High	-	-	1	11,1	-	-	-	-
0,401 - 0,600	Regular	1	11,1	2	22,2	-	-	-	-
0,201 - 0,400	Bad	2	22,2	5	56,6	4	44,4	4	44,4
➢ 0,200	Very bad	6	66,7	1	11,1	5	55,6	5	55,6
Total	-	9	100%	9	100%	9	100%	9	100%

Source: Search result.

Although these results have been reached, further research and deeper analysis is necessary due to the multiple variables that may be acting and interfering in the dynamics observed in this study. Anyway, the present study signals a worrying scenario in terms of regional development, seen here based on economic and social indices, which allows new abstractions regarding the Brazilian Amazon region. By taking the average of the indexes between the municipalities with SUFRAMA and without SUFRAMA, with the objective of verifying, in a comparative way, the two samples of municipalities surveyed, we arrive at Figure 3.

From this Figure 3, it is possible to notice that in all scenarios the average of the indices presented by the municipalities with SUFRAMA exceed the average of the municipalities without SUFRAMA. The fact that the capitals of Roraima and Amapá are participating in this sample of municipalities, in some way, may have contributed to this scenario. However, this does not preclude the results found, which showed some coherence with the reality in question. This observation serves so that future studies can analyze this aspect in order to corroborate or not with the results achieved here.

Figure 3. Average social and economic indices of municipalities with and without SUFRAMA: 2010 and 2018.



Source: Search result.

Thus, the starting point for a better understanding of this dynamic is the historical-economic formation of these regions, in order to allow a better critical analysis of the culture and its respective processes of endogenous development. Corroborating with the thought of North [1990] where the social is the basis for understanding the dynamics or stagnation of an economy, that is, the economic is not the cause but a consequence of a certain institutional arrangement built by the social force of the place, it allows to trace new future perspectives of studies in the field of social capital as a means to understand, from the historical trajectory, the present scenario and, from it, the future of the region. In view of this, studies in this direction prove to be quite fertile to understand the Amazon scenario and its peculiarities materialized in its multiple variables that normally escape the context of the everyday national scenario of large urban-industrial centers. Understanding such dynamics involves expertise and requires methodological instruments capable of dealing with a complex reality such as, in general, the regions inserted in the Brazilian Amazon context.

4. FINAL CONSIDERATIONS

In general, a low level of economic and social development of the surveyed municipalities was evidenced, indicating a reality that goes through challenges that need to be overcome and focused on the local reality in an integrated way to the national context such as logistics, infrastructure, health, education and aspects economic and socio-environmental

issues as the main axis of strategic vision to overcome such a regional challenge. Such results can, in the first place, serve as a counterpoint to the main reason for maintaining the SUFRAMA policy in the region. However, the fact that this scenario of weak or very weak regional development observed in the municipalities that participated in this study, including the municipalities that are not assisted by the SUFRAMA policy, allows us to conclude, therefore, that this is a reality faced in the Amazon region as a whole. This reality should be the subject of future research, in order to determine which factors contribute to this scenario, which may require other statistical methods used in multivariate data analysis, such as multiple regression, among other available and applicable models.

On the other hand, based on the ceteris paribus concept, an analysis can be made from the endogenous point of view of SUFRAMA's regional development policy based on the indices and results found in this study. In this way, it became evident that even with performances, in general, depressing in terms of the performance of IDEC and IDSO, especially in the municipalities served by the aforementioned policy, it is still necessary for the development of the region, in the view of many of these municipalities, characterized by be significantly limited by nature conservation units and indigenous lands that end up, in some way, limiting productive areas, which strengthens the maintenance of the SUFRAMA policy as an alternative of strategic action in search of the sustainable development of these regions, in particular, the Amazon western. In addition, it was demonstrated that even with low levels of economic and social development in this study, the municipalities covered by the SUFRAMA policy showed to have a slightly better scenario compared to those that are not assisted by this federal government policy, evidencing with this, in some way, the influence of this policy in the local reality.

From the point of view of the growth pole theory and the economic development pole brought by Perroux, it is clear that it was not possible to observe the effects of this reality in the municipalities covered by the SUFRAMA policy and which participated in this study. Even so, it is clear that the scenario could be more serious if such a policy did not exist in the respective regions. Perhaps therein lies the biggest problem of this policy in not having yet managed to produce a prosperous and autonomous environment of endogenous development, which seems to impact the way of seeing the aforementioned policy not as an element of change in the local and regional reality, but as a welfare policy. generating behavior dependent on government actions that ends up contributing in some way to low social capital, human capital and, consequently, the impact of this behavior on the culture of

the place. Although it is an aspect perceived in this study in an abstract way, there is a need for further studies within this perspective. Within a view of contributing to greater effectiveness of SUFRAMA's policy, the issue of distribution of resources collected from taxes generated by the economic activities of the place can be mentioned. This is because the current model indicates that all resources from taxes paid by companies installed and collected by the government basically present a one-way path, with a one-way path to the national treasury coffers and not in a two-way context, with a sense also back to the municipal coffers. In this sense, an observation is made on this aspect that, in our view, could positively impact the development of these regions covered by the aforementioned policy.

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Stricto Sensu Editora

MULTIVARIATE ANALYSIS OF HEALTH INDICATORS IN THE STATE OF RONDÔNIA, WESTERN AMAZON, BRAZIL

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1. INTRODUCTION

The Unified Health System - SUS was consolidated as a model of primary health care from 1988 when, based on articles 194, 196, 198 and 200 of the 1988 Constitution of the

Federative Republic of Brazil, the citizen's right was guaranteed and the State's duty to promote comprehensive health. These Magna Carta articles are considered basic, as they establish principles, guidelines and competencies of the National Health System. The regulation of constitutional notes came through Law No. 8,080 of 9/19.90 (Organic Health Law/LOS) which fundamentally was born to give visibility and structuring to SUS, together with Law 8,142, of 12/28/90 that regulates the social control within the scope of SUS, enabling the creation of forums for debates, workshops, seminars and conferences, in a space for the exercise of democracy. This is characterized by a design consisting of three arrangements that make up the Unified Health System (SUS) in Brazil: the municipal, state and national systems. The consolidation of SUS involved the implementation of Basic Operational Norms (NOBs - norms that deal with the financing policy of the Unified Health System - SUS, that is, norms that define the criteria for the transfer of financial resources from the federal government of Brazil to States, Municipalities and the Federal District) and the Operational Health Assistance Norms (NOAS - norms that aim to guarantee access to all health actions and services, optimizing the available resources and further promoting the process of holding state and municipal managers accountable for completeness attention to its citizens). These legal provisions are the main regulatory instruments.

The SUS financing logic was implemented through NOBs 91, 92 and 93 and 01/96, constituting a dynamic process that regulated the production payment system, redefined resource allocation criteria and established a participation financing mechanism and decentralization of health actions and services. In 2006, the Ministry of Health of Brazil launched the Pact for Health, which proposed to strengthen the capacity to respond to current challenges in the management and organization of the system in order to give concrete answers to the health needs of the Brazilian population and to do health a state policy more than a government policy [Brazil, 2007a]. This was divided into three dimensions: Pact for Life, Pact in Defense of SUS and Management Pact.

One of the main critical points in public administration is to guarantee access with equality and equity. One of the theories that most applies to the principle of equity is Rawls's Theory of Justice [Rawls, 2000], which proposed that: a) Everyone has the right to an entirely satisfactory project of equal basic rights and freedoms for all, a project compatible with everyone else; and, in this project, political freedoms, and only these, must have their equitable value guaranteed. b) Social and economic inequalities must satisfy two requirements: first, they must be linked to positions and positions open to all, under conditions

of equal opportunities; and second, they must represent the greatest possible benefit to the least privileged members of society.

For Porto; Porto et al. [2007] based on Brazilian legislation, the equity principle must be understood as the one that governs distributive functions, which aim to compensate or overcome existing inequalities, considered socially unjust, and that equitable results presuppose unequal redistributions of resources, product of adjustments made according to the biological, social and political-organizational factors that determine existing inequalities. The Brazilian health model has as a constant search the applicability of the principle of equity, which is added to all the others. Universality and integrality only occurs in proportion to equal access to health goods and services in a care form.

The configuration of the SUS access network was consolidated through ordinances and technical standards, which passed after the conquest of the constitutional and infraconstitutional instruments to guide the implementation, organization and operationalization. The construction took place concretely in spaces constituted as: Tripartite Intergovernmental Commission (CIT), Bipartite Intergovernmental Commission (CIB), Health Council and Health Management Councils (CONASS and COSEMS) [Brazil, 2007a].

As proposed by the Pact for Health, responding to the needs of the population [Brazil, 2007a] and [Brazil, 2007b], in the view of Viana et al. [2007], overcoming the inequity patterns in which the health system is inserted is one of the challenges for the expansion of social protection in Brazil. Socioeconomic and health inequalities in the country have a strong territorial expression, indicating the importance of regional public policies in various areas, including health.

In the context of territoriality, [Santos 1999] defines and starts to emphasize the geographical space as a social instance. The author proposes the concept of used territory, a hybrid of materiality and action, of form and content, of the built environment and the movement of society, generated by men, institutions and companies. Silveira [2005], on the other hand, in the notion of geographical situation, says that it deals with a division of the geography of the world in subtotalities, which become significant structures for each set of events. A split of the totality is a new totality with a meaning, a structure in a more comprehensive set, a structure and a system because its reality is through movement. (...).

However, it reinforces once again the understanding of territoriality as an organization of the network of access to health services, clearly explained in the objective of the Management Pact [Brazil, 2007b], which points to the decentralization of the Ministry of

Health's attributions to the States, and to the Municipalities, accompanied by the reduction of bureaucracy in the normative processes; and, Reinforces the territorialization of health as a basis for the organization of systems, structuring health regions and instituting regional management collegiate bodies.

The systematic analysis of the health situation requires the monitoring of standardized indicators, capable of measuring, in a synthetic way, relevant aspects of the population's health status and its correlation with conditioning and determining factors [OPAS, 2001]. According to Rouquayrol [2010], health indicators are parameters used internationally with the aim of assessing, from a sanitary point of view, the health of human aggregates, as well as providing subsidies to health planning, allowing the monitoring of fluctuations and historical trends in health and health pattern of different collectivities considered at the same time or of the same collectivity in different periods of time.

Indicators are summary measures that contain relevant information about certain attributes and dimensions of health status, as well as the performance of the health system. Taken together, they should reflect the health status of a population and serve to monitor health conditions [Brazil, 2002]. According to Rouquayrol's view [2010], the concept of "science that studies the health-disease process in human collectivities behaves to the concept of epidemiology, analyzing the distribution and determining factors of illnesses, damage to health and events associated with collective health, (...) ".

For social epidemiology, the strong association between the distribution of health problems and social factors explains that the field of social epidemiology brings the focus of attention previously focused mainly on health risk factors, to examine in more depth the social context in which they occur [Souza; Grundy, 2005]. Thus, to be able to identify and describe the various social conditions that seem to influence the health status of populations. Jannuzzi [2006] defines that "social indicator is a generally quantitative measure endowed with substantive social meaning, used to replace, quantify or operationalize an abstract social concept, of theoretical interest (for academic research) or programmatic (for policy formulation)".

On the recommendation of the Third Interagency Workshop (OTI), in December 1997, the source institutions undertook to prepare a first version of the qualification sheets, based on a script provided by the Technical Secretariat of RIPSA containing eight topics [Brazil, 2002]:

• Conceptualization: Characteristics that define the indicator and the way it is expressed, if necessary adding information to understand its content.

• Interpretation: A brief explanation of the type of information obtained and its meaning.

• Uses: Main ways of using the data, which must be considered for analysis purposes.

• Limitations: Factors that restrict the interpretation of the indicator, referring both to the concept itself and to the sources used.

• Sources: Institutions responsible for producing the data that are adopted for the calculation of the indicator and the information systems to which they correspond.

• Calculation method: Formula used to calculate the indicator, precisely defining the elements that compose it.

• Suggested categories for analysis: Levels of data disaggregation that can contribute to the interpretation of information and that are effectively available, such as sex and age.

• Statistical data and comments: Summary and commented table, which illustrates the application of the indicator based on the actual situation observed. Whenever possible, data should be disaggregated by major regions and for selected years of the previous decade.

The adhesion of the State Secretariat of Health of Rondônia, in the Western Amazon (SESAU/RO) to the Health Pact is part of the incorporation of health policies. The agreement of the health indicators is a requirement for the signing of the term of commitment that becomes a contract between the Union and the Federated State. According to the Strategic Directorate of Integrated Health Care (DEAIS/SESAU) the document must be signed by the end of each year.

In the light of current technology, with the resources available in information technology or computer science, it is clear that the evolution has occurred in real time. The research assistance is phenomenal in view of the gains in the analysis of statistical data Knowledge, associated with statistical methods and techniques, contributes to the advancement of the knowledge and information production process, enabling institutions and researchers to make new knowledge more appropriate. The first concept of multivariate analysis deals with “analysis of multiple variables in a single relationship or set of relationships” [Hair et al., 2005].

Reis [2001] defines how a set of statistical methods that allows the simultaneous analysis of multiple measures for each individual or object under analysis, that is, any method that allows the simultaneous analysis of two or more variables can be considered as belonging to this scientific group. And, he proposed that, one of the objectives of Multivariate

Statistics is to simplify the data, describing the information through a reduced number of dimensions of analysis.

Multivariate Analysis is seen as a set of techniques for data analysis that is always expanding. This set comprises the following techniques [Hair et al., 2005]: analysis of main components and analysis of common factors; multiple regression and multiple correlation; multiple discriminant analysis; multivariate analysis of variance and covariance; joint analysis; canonical correlation; cluster analysis and multidimensional scaling.

Prior to the choice of the Multivariate Analysis technique, it is necessary to know basic concepts that aim to guide the choice of the technique. Hair et al. [2005] points out that the researcher must rely on the theoretical and conceptual basis for choosing the safe technique, and proposes guidelines to assist the researcher's decision. The guidelines for multivariate analysis and interpretations are: to establish practical significance, as well as statistical significance; the sample size affects all results: the results must be evaluated in the light of the sample used in the analysis; know the data: the researcher must "know where to look", strive for parsimonious models: irrelevant variables can mask the real effects because of multicollinearity; examine errors: the researcher must examine whether there is a prediction error and from then on validate the results, and validate the results: the researcher must guarantee sufficient observations for each estimated parameter.

Fundamentally, the previous steps led us to the decision to use in the study in question the techniques of principal component analysis and analysis of common factors, since the joint use includes a statistical approach that makes it possible to analyze interrelationships between a large number of variables in terms of dimensions, whereas the objective is to reduce the number of original variables in a set of smaller variables represented by factors.

From the perspective of data reduction, "factor analysis provides the researcher with a clear understanding of which variables can act together and how many variables can really be considered to have an impact on the analysis" [Hair et al., 2005]. When using factor analysis, the researcher must adopt percentage of variance criteria in order to obtain practical significance for the determined factors. What is desirable is that the level of explanation of variance is 95% [Hair, et al., 2005].

In the analysis of Principal Components (PCA) based on Reis [2001] it is possible to understand that, from a set of partial indicators that characterize a certain phenomenon, identify the main relationships underlying the totality of the multiple relationships between the indicators. (...) it is based on the assumption that q variables that are not statistically

correlated can be defined from linear combinations of the initial *p* indicators - main componentes.

The qualification of these components, as well as the measure of the contribution of each one to the explanation of the behavior of the initial indicators, constitute the most important results of application of methods of factor analysis of the main components.

It is understood from the teachings of Reis [2001] and Hair et al. [2005] that it is not possible to treat Principal Component Analysis (PCA) without first understanding factor analysis, and, above all, from the perspective of the exploratory perspective. The objectives of the two techniques share the same intentions and needs: treduce the sample size and to allow a better understanding of the dimension of the variables.

However, it is important to take Reis's definition [2001] on Principal Component Analysis (PCA) which "is a multivariate statistical method that allows transforming, a set of initial variables correlated with each other, into another set of non-correlated (orthogonal) variables, the so-called main components, which result from linear combinations of the initial set".

PCAs are presented in decreasing order, in which the first explains as much of the variance as possible from the original data, the second as much as possible of the unexplained variance, the third and so on. The mathematical representation of linear combinations does not imply the imposition of any causal model, but it also does not allow the detection of any cause/effect relationships between the initial variables, even if they exist.

Thus, the present study proposed to analyze the significance of the epidemiological, socioeconomic and health service coverage indicators, applying the multivariate statistical technique and to compare indicators with statistical significance compared to the indicators agreed by the State of Health of Rondônia in the period corresponding to a year.

2. MATERIALS AND METHODS

The study in question had as a methodological approach an exploratory descriptive study applied to epidemiological indicators (morbidity and mortality by municipalities), socioeconomic indicators (education, income, living conditions, etc.) and health service coverage indicators (consultations, home visits, doctor and nurse/1000/inhab, etc.) in the State of Rondônia. The purpose was to explore the statistical significance through the application of the Factor Analysis Technique (PA) and the Principal Component Analysis

(PCA) method, and later comparison of the indicators that showed statistical significance compared to the indicators agreed by the State Secretariat of Health of Rondônia in one year.

The choice of indicators for the study was based on the notes of Mingoti [2005] to ensure the quality of the sample data "most of the multivariate statistical techniques use only the complete observations, that is, if for a sample element, if the value of any variable has been lost, it is eliminated from the analysis process". Thus, we considered the indicators that presented the time of data collection continuous information in the online information systems.

The 52 municipalities in the state of Rondônia were considered as study material and the variables were grouped by factors so named: Factor 1 - epidemiological indicators, Factor 2 - socioeconomic indicators and Factor 3 - health service coverage indicators.

From the territorial delimitation and the materials in question, the next step was to identify with the existing databases the variables that were presented, continuously, in the online information systems. In order to establish fidelity, data collection was concentrated in the main databases considered to be official in the operationalization of the Health System at the national level, being: National Registry of Health Establishment (CNES), Department of Informatics of SUS (Datasus), Integrated Pacted Programming (PPI), Integrated Health Information Network (RIPSA); Public Health Budget Information System (SIOPS), Brazilian Institute of Geography and Statistics (IBGE) and United Nations Program for the Development (UNDP).

The construction of the database took place by capture in an isolated way in each information system through online access via Asymmetric Digital Subscriber Line (ADSL) with connectivity and domestic accessibility. Each variable presented was extracted from the main system and isolated, and grouped in a table in the Microsoft Excel program. The data capture period was approximately 6 (six) months due to the large number of variables. It is worth mentioning that ADSL was adopted by the Rondônia State Health Department for this type of service, as it has a connection with an intense flow of information, a high capacity for agility and ease of quick exchange of information.

The first procedure to arrive at the statistical method was to carefully observe the data collected in order to identify distortions in the data collected, thus ensuring continuity of the information contained in the variables in the 52 municipalities.

In view of the above, the data were treated statistically using the Factor Analysis (PA) technique and the Principal Component Analysis Method (PCA) and the Softwer Statistic 7 was used as a statistical tool. The procedure at the first moment was to apply the technique

and the statistical method to 121 grouped variables and after, only, to the group of variables with explanation above 95% divided, thus, in two scenarios: Scenario 1: 121 variables; epidemiological, socioeconomic and health service coverage in the State of Rondônia; and, Scenario 2: 42 variables; epidemiological, socioeconomic and health service coverage with explanation above 95% in the State of Rondônia.

3. RESULTS AND DISCUSSION SCENARIO

1 = 121 epidemiological, socioeconomic and health service coverage variables in the State of Rondônia.

Statistically in the context of factorial exploration it was found that the factor (1) epidemiological indicators showed a variance of 69.90%, the factor (2) socioeconomic indicators of 14.47% and factor (3) indicators of health service coverage 6,46%. The set of factors accumulated eigenvalues of 92.84% of explanations extracted, from the Principal Component Analysis (PCA). Considering what Mingoti points out [2005] “the eigenvalues are ordered in decreasing order, the first component is the one with the greatest variability and the bad one is the one with the lowest”, the first main component is revealed in the study as the epidemiological indicators, the second the socioeconomic indicators and the third the health service coverage indicators. Considering the author’s notes, the first main component is placed in the multivariate analysis as the most representative, and, for contextualization of greater importance in view of the object of study. Table 2 shows the statistical findings.

The correlation eigenvalues can also be explained through the total variance that has the capacity to synthesize the global variance of the multivariate distribution, since this is the sum of the variances of all the variables involved. Eigenvalues of total variances indicate greater global dispersion of the variables, Mingoti [2005]. The statistical findings of the factorial exploration and application of the ACP, indicate the first group of indicators with explanation of approximately 80% of the total variation. The correlation between the factors and the cases showed that: factor (1) obtained 13 cases with negative inferences, factor (2) obtained 27 cases and factor (3) obtained 24 cases. Of these, the Health Regions stand out with the following Municipalities: Porto Velho (Capital), Ariquemes, Ji- -Paraná, Cacoal, Rolim de Moura and Vilhena, only Porto Velho (Capital) presenting a negative situation in a decreasing situation in factors 1, 2 and 3. Thus, health regions are summarized in Table 3.

Table 1. Indicators agreed in Rondônia in the year of study.

Order	Main	Order	Main
01	Proportion of own revenue applied to health as provided for in Regulation (EC regulation) No 29/2000	21	Proportion of priority municipalities for combating dengue with a contingency plan for the care of dengue patients
02	Contracting index	22	Leprosy cure rate in the years of the cohorts
03	Proportion of constitution of regionally managed collegiate bodies	23	Cure rate of new tuberculosis baculiferous cases
04	Regular feed index of national databases	24	Annual parasitic incidence of malaria
05	Qualification index of the basic functioning of the health council	25	Proportion of clinical samples for diagnosis of the influenza virus in relation to the recommended
06	Proportion of municipalities with updated PPI	26	Proportion of long-term care facilities for the elderly, inspected
07	Proportion of live births to mothers with 4 or more prenatal consultations	27	Notification rate for cases of acute flaccid paralysis - PFA in children under 15 years old
08	Annual average of medical consultations per inhabitant in basic specialties	28	Proportion of rash diseases properly investigated
09	Infant mortality rate	29	Proportion of notified cases, closed opportunely after notification, except for classic dengue fever
10	Ratio between cervical cancer preventive exams in women aged 25 to 59 and the female population in this age group	30	Proportion of cases of cured visceral leishmaniasis (VL)
11	Proportion of deaths of women of childbearing age investigated	31	Proportion of non-fetal deaths reported to SIM with defined basic causes
12	Rate of stroke admissions (stroke)	32	Concentration of mammography in women aged 40 to 69 years
13	Proportion of hospitalizations for complications of diabetes mellitus	33	Proportion of breast puncture of necessary cases
14	Coverage of the first programmatic dental consultation	34	Neonatal mortality coefficient
15	Proportion of the population covered by the family health program (PSF)	35	Taxa de mortalidade infantil por doença não diarreica
16	Vaccination coverage by tetravalent in children under one year of age	36	Infant mortality rate due to diarrheal disease
17	Proportion of municipalities in the state with adequate vaccination coverage (95%) for hepatitis B in children under 1 year of age	37	Maternal mortality ratio
18	Proportion of municipalities in the state with adequate vaccination coverage (95%) for tetravalent patients in children under 1 year of age	38	Proportion of municipalities that do not make payment through code 7
19	Proportion of properties inspected for identification and elimination of aedes aegypti breeding sites	39	Proportion of live births to mothers with 7 or more prenatal consultati
20	Proportion of priority municipalities for combating dengue with		

Source: Health Indicator System for Monitoring the Pact for Health. Ministry of Health.

Table 2. Demonstration of eigenvalues, in the application of ACP in the 121 variables, in the year of study.

Values	Eigenvalue	% Total Variance	Cumulative Eigenvalue	Cumulative %
F (1) Epidemiological Indicators	69,90479	57,77255	69,90479	57,7725
F (2) Socioeconomic Indicators	16,47150	13,61281	86,37628	71,3853
F (3) Health Service Coverage Indicators	6,46530	13,61281	92,84158	76,72858

Source: Prepared by the researchers using secondary data.

Table 3. Demonstration of negative and positive cases (home region of health region) based on correlations, extracted from the principal component analysis (PCA), with 121 variables.

Cases	Factor (1) Indicators Epidemiological	Factor (2) Indicators Socioeconomic	Factor (3) Health Service Coverage Indicators
5 Ariquemes	-7,8181	4,2101	2,92478
9 Cacoal	-8,8542	5,4915	2,88012
24 Ji-Paraná	-11,4610	4,6260	2,01097
37 Porto Velho	-47,8678	-11,4336	-2,23120
41 Rolim de Moura	-4,9203	6,8001	0,65169
52 Vilhena	-9,0195	8,5311	1,33950

Source: Prepared by the researchers using secondary data.

Considering the contribution of cases based on correlations of variables, the largest contribution is to the Health Region of Porto Velho with 72.84% and 17.64% of the concentration of diseases in factor (1) and (2) consecutively.

This municipality, specifically, corroborates the notes of Mingoti [2005], because in this case it may be associated with the quantitative component of the diseases, justified even by the characteristic of this Health Region, which tends to concentrate the procedures as it is the only reference of the State for medium and high complexity procedures.

Scenario 2 = 42 epidemiological, socioeconomic and health service coverage variables with an explanation above 95% in the State of Rondônia From the exploration of the 121 constant variables, it was necessary to consider the notes of Hair et al. [2005], which proposes, in the use of Factor Analysis (PA), to adopt criteria of percentage of variance with the objective of obtaining practical significance for the determined factors, considering it desirable that the level of explanation of variance is 95%.

Table 4. Demonstration of contribution of cases, by factor, based on a correlation of 121 variables, Rondônia.

Regions of health	F (1) Indicators Epidemiological	F (2) Indicators Socioeconomic	F (3) Health Service Coverage Indicator
Porto Velho	72,84	17,64	1,71
Ariquemes	1,94	2,39	2,94
Ji-Paraná	4,18	2,89	1,39
Cacoal	2,49	4,07	2,85
Rolim de Moura	0,77	6,24	0,15
Vilhena	2,59	9,82	0,62
All others	15,19	56,96	90,34
Grand total	100,00	100,00	100,00

Source: Prepared by the researchers using secondary data

Scenario 1 represents the findings of the application of PA and ACP in the 121 variables. Scenario 2, in turn, represents the findings of the application of PA and ACP in variables with an explanation above 95% in the State of Rondônia. It should be made clear that Scenario 2 is extracted from Scenario 1, with the objective of obtaining greater clarity in the exploration of data and envisioning a greater possibility of contributing to the situational health diagnosis in the planning area.

In this scenario of exploratory analysis the application of PCA, it was found that of the 42 variables 34 had an explanation above 70%.

Of these, the expectations of high explanation were confirmed in factor (1) epidemiological indicators with 24 variables with an explanation above 95%. Table 5 shows the concentration of variables by fator.

Table 5. Demonstration of the concentration of variables by factor and percentage of explanation, in the period of one year.

Factors	Explanation	Variables
F (1) epidemiological	95% - 99%	27
F (2) socioeconomic	70% - 82%	08
F (3) health service coverage	70% - 80%	03

Source: Prepared by the researchers using secondary data.

As for the relationship between the first and the last variable, according to Mingoti [2005] “variance is used to measure the degree of linear relationship between two variables”. Thus, in the application of PCA in the 42 variables above 95%, the variable with the greatest explanatory power is the first with 99.66% (% children aged 10 to 14 years with more than 1 year of school delay), from the second and onwards.

The correlation between factors (1), (2) and (3), which explains 66.53% for epidemiological indicators, 18.72% for socioeconomic indicators and 7.53% for service coverage indicators. The finding corroborates with Hair et al. 2005] when he states that “the first factor can be seen as the best summary of the linear relationships shown in the data”.

According to Reis [2001] and Mingoti [2005], commonality is “the total amount of variance that an original variable shares with all other variables included in the analysis” or “the variables have a common source of variation”. In Scenario (1) the set of 121 variables (epidemiological, socioeconomic and health service coverage) showed 61 variables with communalities above 70%. In Scenario (2), the set of 42 variables (epidemiological, socioeconomic and health service coverage with explanation above 95%) presented 16 variables with communalities above 95% (Table 6).

It should be noted that the variables in Scenario (2) are included in Scenario (1).

Table 6. Demonstration of communalities in variables above 95% of explanation.

Variables	Factor (1) Indicators Epidemiological	Factor (2) Indicators Socioeconomic	Factor (3) Indicators of Health Services Coverage	Multiple R-Square
NMAC15ANOS	0,983867	0,996511	0,996612	1,000000
MULAC25ANOS	0,985501	0,996481	0,996542	1,000000
POP1ANO	0,965979	0,994573	0,995047	0,999977
POP10-14ANOS	0,978427	0,996382	0,996495	0,999994
POPAC15ANOS	0,982552	0,995959	0,996183	1,000000
POPAC25ANOS	0,984372	0,995766	0,995977	1,000000
POP<5ANOS	0,974340	0,995863	0,996087	0,999988
POPAC65ANOS	0,979914	0,980371	0,980497	0,999872

Source: Prepared by the researchers using secondary data.

Table 7. Demonstration of the distribution of cases per municipality in the health region, with variables with explanation above 95%, Rondônia.

Cases/County	Factor (1) Indicators Epidemiological	Factor (2) Indicators Socioeconomic	Factor (3) Indicators of Health Services Coverage
5 Ariquemes	2,15530	1,72601	0,85357
9 Cacoal	2,16431	5,03617	2,57045
24 Ji-Paraná	5,18270	0,96644	0,07120
37 Porto Velho	75,67787	10,85300	0,41854
41 Rolim de Moura	0,66104	6,52710	0,59666
52 Vilhena	1,63556	5,79697	0,00015

Source: Prepared by the researchers using secondary data.

Considering the Scenario (2), Table 7 shows the contribution of cases per municipality in the Health Region, pointing to the same trend as Scenario (1) with a concentration of cases in the municipality of Porto Velho (Capital), consecutively in factors (1) and (2) 75.67% and 10.85%.

4. CONCLUSION

There is an almost absolute predominance of epidemiological variables in factor (1), which accounts for more than 70% of the explanation, with a total of 54 variables, 46 of which account for 66.90% of explanation. This fact, external, as well as the affinity of the object of the work in the face of being represented by the health problems, mainly the causes of hospitalizations and deaths.

As for the factor (2) of the socioeconomic variables, of the 57 variables, there was a predominance of 04 variables that tend to express the quality of the education system in Rondônia due to the presence of indicators that measure access to basic education. The factor (3) - the health service coverage variables - is not significant for the study.

For the 52 municipalities in question, the situation of the Municipality of Porto Velho (Capital) stands out, which presents a negative correlation of (-47.86%) that can be justified by the presence of common conditions, for the other municipalities, for example, dengue,

tuberculosis, leprosy, injuries due to external causes etc., here only numerical values are observed.

Another important observation to make is in relation to the contribution of cases, where again the municipality of Porto Velho (Capital) contributes with 72.84% in Factor (1) and 17.64% in Factor (2). This fact can be explained by the municipality's characteristic of concentrating medium and high complexity services in health and being a reference for all municipalities in the state.

Scenario (2) aimed to stratify the result of Scenario (1), in order to ensure better clarity to the study. In the application of FA and ACP in the 42 variables with explanation above 95%, it confirmed the ability to represent the epidemiological indicators of Factor (1), pointing out that 08 (eight) variables influenced the set of variables with explanation between 99, 66% - 99.99%.

These variables serve the group of access to basic education, income, non-health public goods and services.

It can be said that the statistical attribute communality directly influences the research result, since it was highly present in Scenario (1) with 61 variables and in Scenario (2) with 16 variables. Among the variables that showed commonality for this study, the most important can be considered: number of preventive cancer exams, pregnancy complications and number of deaths in the previous 4 years.

As for the contribution of cases in Scenario (2), the same trend of concentration of cases was observed in the municipality of Porto Velho (Capital) with 75.67% in factor (1) and 10.85% in factor (2).

In the comparison between surveyed indicators (121) and agreed indicators (39), it was noticed that of the 39 indicators, 33 (thirty-three) are included among the indicators with statistical significance in the study.

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Stricto Sensu Editora

CONSTRUCTION OF THE SUSTAINABLE DEVELOPMENT INDEX AT THE RIVER BASIN LEVEL IN RONDÔNIA FROM FACTOR ANALYSIS

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1. INTRODUCTION

The growing demand for water has exacerbated problems in many parts of the world. As a consequence, an increase in the statistics of completely dry rivers and/or streams and

other sources totally unsuitable for human consumption, whether surface or underground, is observed more frequently. Therefore, much of the water extracted for human activities, from any source, has been used very ineffectively [Setti et al., 2001]. Decree No. 24,643 of 1934 (Water Code) already regulated the use of water in Brazilian territory. Although it is recognized that the Water Code established an advanced policy for the time, its regulation was limited to aspects related to the development of the electricity sector, leaving aside multiple uses and the protection of water quality [Granziera, 2001]. The problems arising from water resources have been constantly pointed out by many researchers as an increasingly worrying scenario. For Peixoto Filho and Brondarovsky [2000], part of the available fresh water cannot be considered suitable for human consumption, because many times, industries, agricultural activities and sanitation companies do not treat the water used in their processes, before returning it to water. to the environment, and end up harming the aquatic environment. Corroborating this, Rebouças [1997] states, among other aspects, that the misuse of water, deforestation, occupation of river banks and the waterproofing of urban soils end up generating serious problems in the water environment.

The United Nations World Report on Water Resources Development 2017 points out that “two-thirds of the world's population live in areas that are affected by water scarcity for at least one month a year” [UNESCO, 2021]. Population growth, economic development, changes in consumption patterns, among others, are factors that have contributed, according to the World Water Assessment Program (WWAP), to the increase in the rate of water demand by 1% per year, and the forecast is for a significant increase in the coming decades. The use of water in industries and homes will increase faster than in agriculture, but the agricultural sector will still be the biggest consumer, especially in developing countries and emerging economies [UNESCO, 2018]. The demand becomes increasingly greater than the availability, and in this sense Barros and Amim [2007] consider that population and economic growth has aggravated the problems related to water, generating pollution and scarcity of water resources. The United Nations points out that millions of people are affected every year by floods and billions are exposed to critical situations of water scarcity. The intensity of water problems varies according to the region and is aggravated by local factors, including climatic conditions, regional, environmental, social and economic aspects [WWAP, 2015].

According to data from the National Water Agency - ANA [2016], the Brazilian territory covers 12% of the available water resources on the planet, divided into 12 hydrographic regions that guide the implementation of the national water resources policy. The three largest

hydrographic basins in the country, Paraná, São Francisco and Amazonas, together, hold the largest volume of fresh water in the world. And even so, some regions of the country do not escape experiencing water scarcity, which impelled the Federal Government to adopt measures in the search to guarantee the preservation of water resources, in the face of a management based on environmental, social and economic sustainability, adapting laws and implementing public policies [Brazil, 2010]. In the 1980s, with the establishment of the National Institute for Environmental Policy (PNMA), Brazil started to have a structure to deal with environmental issues, which contributed to boost the formulation of new rules related to water management [Conejo et al., 2007]. The Federal Constitution of Brazil, promulgated in 1988, played an important role in the management of water resources, because it defined waters as goods of use and changed the dominance of waters in the national territory, previously defined by the Water Code 1934. Article 21, item XIX of the Federal Constitution of Brazil grants the Union the competence to establish a National System for the Management of Water Resources and define criteria for granting the right of use [Porto; Porto, 2008].

According to Setti et al. [2001], water resources management, in a broad sense, is the way in which it is intended to equate and resolve issues of relative scarcity of water resources, as well as to make proper use, aiming at optimizing water resources, resources for the benefit of society. Lanna [1997] conceptualizes water resources management as an analytical and creative activity focused on formulating principles, preparing normative documents, structuring management systems and decision-making, whose ultimate objective is to promote inventory, use, control and protection of water resources. Law no. 9,433, of January 8, 1997, instituted in Brazil the National Water Resources Policy (PNRH) and the National Water Resources Management System, which, according to article 1, presents the following grounds: a) the management of water resources must always provide for the multiple use of water; b) the hydrographic basin is the territorial unit of implementation of the National Water Program Resource Policy and performance of the National Water System Resource Management System; c) the management of water resources must be decentralized and count on the participation of the Government, users and communities. One of the PNRH guidelines is to adapt the management of water resources to the physical, biotic, demographic, economic, social and cultural diversity of the different regions of the country, the integration of water resources management with environmental management and the articulation of resource planning, with that of users and with the regional, state and national planning sectors. In the context of the State of Rondônia, Complementary Law nº 255, of

January 25, 2002, “establishes the State Policy of Resources of the State of Rondônia and creates the Management System and Fund of Water Resources for the State of Rondônia and other measures”. By CNRH Resolution No. 32, of October 15, 2003, the Brazilian territory was divided into 12 Regions, as follows: Amazon, West Northeast Atlantic, East Northeast Atlantic, Parnaíba, Tocantins-Araguaia, São Francisco, East Atlantic, Southeast Atlantic, South Atlantic, Paraná, Uruguay, Paraguay. With regard to Rondônia, the State is part of the Amazon River Region, with its territory divided into 7 hydrographic basins, which are the Guaporé River, Mamoré River, Abunã River, Madeira River, Jamari River, Machado River and Roosevelt River.

Santos [2004] states that water management, based on hydrographic basins, denotes: “The close connection between water, other natural resources and human activities”. In general, integrated plans for the management and management of watersheds, focused on resources associated with water, are broader and more effective when they add soil conservation measures, vegetation and fauna remnants and the control of rural and urban activities. The watershed as a planning unit, therefore, is accepted worldwide, as it constitutes a well-defined geographically system, where phenomena and interactions can be integrated a priori by input and production, thus watersheds can be treated as geographical units, where resources natural are integrated. It also constitutes a spatial unit that is easy to recognize and characterize, considering that there is no area of land, however small, that is not part of a river basin network and, when the central problem is water, the solution must be intimately related to its handling and maintenance [Prochnow, 1990]. In this sense Guerra [2006] reports that the basins integrate a joint view of the behavior, conditions and human activities developed in them, since significant changes in any part of the basin can generate changes, effects and/or impacts downstream and in energy flows. output (discharge, solid and dissolved charges), among other consequences.

From the point of view of planning and regional development management, hydrographic basins are presented as objects of study with an integrated and unified vision of planning, enabling approaches and studies from the most diverse perspectives [Schultz; Moraes; Bach, 2002]. For Magalhães Jr [2007] the watershed as a management and planning unit results from the complex interaction between the parts and the whole. The advantage is that the drainage network of a basin consists of a preferred path in most cause-effect relationships, especially when dealing with the water environment. The disadvantages are that municipalities and state boundaries do not always respect basin dividers. According to

Guerra [2006], the management of basin plans in Brazil, for the most part, only addressed the aspect of the use of water resources (irrigation or sanitation or energy generation), causing problems of a social, environmental, economic, political and cultural. This is because these plans are not always related to sustainable development, since the environmental capacity to support development always has a limit, beyond which all other aspects will inevitably be affected. Faced with the need to understand scenarios within this approach, authors such as Rebouças [1997] suggest evaluating the environmental damages of a region, through the inclusion of factors such as water availability and demand, in addition to geo-environmental and sociocultural peculiarities, in order to guarantee the good-being of populations, economic development and conservation of environmental heritage. Currently, the management of water resources through hydrographic basins occurs throughout the Brazilian territory, through the Union and the States [Porto; Porto, 2008]. The aforementioned authors also emphasize that all human activities are carried out at the level of the hydrographic basin and are based on the forms of occupation of the territory and use of its waters.

The concept of sustainable development, at the international level, arises from a "philosophy of development that, from a tripod, combines economic efficiency with social justice and ecological prudence, as premises for the construction of a solidary and just society" [Jacobi, 1999]. It is a continuous and complex process, the result of a long history of the relationship between man and nature [Van Bellen, 2004]. For Zambam and Fernando de Aquino [2016], sustainable development is the principle of quality of life, and for this to happen, changes in behavior regarding the use and exploitation of natural resources are necessary, linking political, economic, legal, technological and cultural conditions, which make this concept viable. Lustosa [2010] contributes by saying that development is sustainable because it does not deplete natural resources and makes their use possible in the future. In Jacobi's view [1999], sustainable development refers to a multiple strategy or model for society, since economic and ecological feasibility must be analyzed. It is a two-pronged process, where, on the one hand, restrictions to the exploitation of natural resources, technological development and institutional structure are considered. On the other hand, qualitative aspects related to equity, resource use and environmental damage are considered. In this sense, the author emphasizes that development must be focused on overcoming social deficiencies, basic needs and changes in living standards considered

unsustainable, in order to conserve basic resources, especially agricultural, energy, minerals, air and water [Jacobi, 1999].

In this sense, Lustosa [2010] describes sustainable development as the combination of “economic growth, quality of life, environmental protection, equity in income distribution, democracy, citizen participation and appreciation of culture”; in short, it is development that encompasses political, social, economic and cultural aspects. In this way, there is an interrelationship between environmental protection and economic development. Therefore, the principle of sustainability is not limited to economic and ecological issues, it is about a balance between all the elements that make up the environment, whether natural, artificial or cultural [Lustosa, 2010]; [Vasconcelos, 2013]; [Custodio; Vieira, 2015]. The concept of sustainable development, despite being treated as a world reference, serving as the basis for several international conferences, is a “term much criticized and fought by researchers from different areas” [Munck; Borom-de-Souza, 2013]. This is a contradictory concept, since its defenders emphasize the need to impose limits on the use of natural resources, while at the same time emphasizing advances in economic growth. In this way, the Brundtland Report is criticized, for not giving any direction to the concept, as it does not defend the position of ecologists or defenders of the inalterability of production and consumption models, which characterizes, for the author, duality, which under the appearance of an environmental preservation policy hides questionable practices, seeking to control new business opportunities.

Corroborating, Carvalho et al. [2013] from their studies, denote that in addition to bringing a new perception of the environmental crisis, the concept of sustainable development ended up generating a series of questions regarding its understanding, which creates difficulties for the operationalization of the same. Although there is resistance to adopting sustainable development as an alternative model of development, and there is no consensual definition among researchers [Ferreira; Tostes, 2015], the fusion between environmental risk and social insecurity is evident, making it clear that environmental issues go far beyond mere questions, of the utilitarian market reason [Copetti; Lotterman, 2010]. In the view of Grubba and Hamel [2016], to establish sustainable development, it is necessary to take into account the complexity of the environment and integrate it as part of this process. Faced with an anthropocentric notion, it can be said that “ecological effects have repercussions on human life, in its conservation, reproduction and evolution”. In this way, the authors affirm that there cannot be a development that is not sustainable. Based on this logic, Lacerda and Cândido

[2013] point out that, in practice, sustainable development is a great challenge for society, as it requires a holistic, systemic and interdisciplinary vision regarding the rational use of natural and built environments, in order to integrate local communities in the elaboration of strategies and plans. In summary, Melo Neto and Ribeiro [2006] state that all development takes place at the local level, since this is the space for negotiations, conflict resolutions and initiatives. From this point on, community involvement in local projects results in transformations that possibly imply the creation of a sustainable environment.

Given this scenario, it is possible to affirm that in recent decades, the concept of sustainable development has acquired greater reach internationally [Pimenta; Nardelli, 2015]. World authorities have met at various conferences, including the Stockholm Conference in 1972, the United Nations Conference on Environment and Development (RIO 92), in 1992, the World Conference on Sustainable Development in 2002 (RIO + 10), the United Nations Conference on Sustainable Development (RIO + 20), in 2012, where participating countries sign agreements and set long-term goals (UN, 2017). In these meetings, alternatives are discussed to reduce consumerism, use natural resources rationally and minimize environmental damage, with the aim of promoting a better quality of life for populations. The principles of sustainable development are based on Agenda 21, a document approved by more than 180 countries during the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992 (RIO 92). The ideas contained in the document were assimilated by the organizations of the United Nations system and several international organizations [IBGE, 2002]. Brazil and other countries in Latin America, as well as in the Caribbean, only started the changes towards sustainable development, 20 years after Rio-92 [Guimarães; Fontoura, 2012]. For the authors, much remains to be done to confront the multiple challenges of the future for the consolidation of this process. The realization of Rio-92 turned the Amazon into a target of public policies and international collaborations, such as the creation of protected areas, demarcation of indigenous lands and expansion of reserves [Sawer, 2014]. For Sawyer, policies were a way of separating society and nature, except in the case of indigenous lands and extractive areas. The author states that although protected areas can prevent the extinction of endangered species, they are not enough to maintain ecological functions that require a wider space, since environmental sustainability is not limited to ecological corridors or isolated points, it depends on the entire territory, including human presence. Based on this understanding, Abramovay [2010] concludes that the most important element in a sustainable development strategy in the Amazon is the systematic

application of science and technology for the sustainable use and exploitation of its biodiversity, which presupposes business and political activities, very much different from those prevailing today.

Copetti and Lottermann [2010] state that environmental inequalities regarding protection and access to natural resources demonstrate that the central point is not the promotion of nature's sustainability, but the way in which society appropriates and makes use of these resources, the that highlights and relates social inequalities with environmental ones. Thus, the authors emphasize that poverty and inequalities trigger environmental crises. In this sense, sustainable development happens as long as human needs are met, increasing the productive potential and equality among all, since poverty limits individuals, making it impossible to use the environment sustainably, which ends up increasing the pressure on it [Garcia; Souza, 2007]. Currently, the values linked to sustainable development and respect for environmental policies have been institutionalized to a greater or lesser extent, worldwide, through the media, social and environmental movements, as well as through governments [Barbieri et al., 2010]. This development will be achieved through the creation and implementation of public policies that ensure an increase in national income, access to basic services (health, education and economy) and the reduction of environmental impacts arising from production and consumption systems [Romeiro, 2017]. Corroborating this understanding, Custodio and Vieira [2015] point out that, for sustainable development to take place, the population must have the right to intervene in the processes of activities that may cause some environmental damage. Given the above, even if there is no consensus on the concept of sustainable development, the difficulties related to the studies of this process and the diversity of understandings on the subject, should serve as motivation to create new visions and tools, in order to present and measure sustainability [Clemente; Ferreira; Lírio, 2011]. In view of the above, the spatial clipping at the level of the hydrographic basins of the State of Rondônia was adopted as a central element of analysis, due to its important role for strategic planning and environmental management. In this context, the objective of the study was to build a sustainable development index for watersheds in Rondônia, using factor analysis as an analytical model. With this, it is expected that the model presented by the research can contribute to future studies and, thus, serve as a basis for academic, technical-scientific discussion within this theme.

2. ANALYTICAL MODEL PROPOSAL

Factor analysis was used as a mechanism to build performance indices for each parameter studied. Factor analysis is a generic name given to a class of multivariate statistical methods whose main purpose is to define the underlying structure in a data matrix. In general terms, factor analysis addresses the problem of analyzing the structure of interrelationships (correlations) between a large number of variables, defining a set of dimensions, called factors. With factor analysis, the researcher can first identify the separate dimensions of the structure and then determine the degree to which each variable is explained by each dimension. Once these dimensions and the explanation of each variable are determined, the two main uses of factor analysis - data summarization and reduction - can be achieved. When summarizing the data, factor analysis obtains dimensions that, when interpreted and understood, describe the data in a much smaller number of concepts than the original individual variables. Data reduction can be achieved by calculating scores for each latent dimension and replacing the original variables with the same ones [Hair et al., 2005]. Santana [2005a]; Santana [2005b]; Santana [2006]; Santana [2007a]; Santana [2007b]; and Cavalcante [2011] are some of the important authors that corroborate the study by Hair et al. [2005].

For the analysis of environmental, social, economic and political-institutional parameters, the municipalities were grouped by hydrographic basins, based on the distribution adopted by the Rondônia Secretariat for Environmental Development (SEDAM), as shown in tableTable 1. It is also noteworthy that the Abunã river basin was not included in this work, as there are no cities in its coverage area.

Table 1. Index of sustainable development by river basins in Rondônia.

Watersheds	Counties
Madeira River	Nova Mamoré e Porto Velho
Mamoré Rive	Guajará-Mirim
Guaporé Rive	Costa Marques, São Francisco do Guaporé, Seringueiras, São Miguel do Guaporé, Alta Floresta do Oeste, Alto Alegre dos Parecis, Corumbiara, Cerejeiras, Cabixi, Colorado do Oeste e Pimenteiras do Oeste
Jamari Rive	Candeias do Jamari, Itapuã do Oeste, Alto Paraíso, Rio Crespo, Ariquemes, Monte Negro, Buritis, Campo Novo de Rondônia e Cacaulândia
Machado Rive	Cujubim, Machadinho do Oeste, Vale do Anari, Thebroma, Ouro Preto do Oeste, Governador Jorge Teixeira, Vale do Paraíso, Jaru,

	Teixeiropólis, Ji-Paraná, Nova União, Mirante da Serra, Urupá, Presidente Médici, Alvorada do Oeste, Cacoal, Castanheiras, Espigão do Oeste, Pimenta Bueno, Chupinguaia, São Felipe do Oeste, Vilhena, Primavera de Rondônia, Rolim de Moura, Novo Horizonte do Oeste, Parecis, Nova Brasilândia do Oeste e Santa Luzia do Oeste
Roosevelt Rive	Ministro Andreazza

Source: Prepared from SEDAM data.

Figure 1. Division of the Hydrographic Network of the State of Rondônia

Source: Prepared from SEDAM data.

2.1. ANALYTICAL MODEL

This is a factor analysis study. The model in question follows the calculation reasoning proposed or applied by Reis [2001]; Hair et al. [2005]; Santana [2005a], [2005b], Santana [2007b], Gama et al. [2007]; Fávero and Belfiore [2017]. This model has already been tested and applied in other studies, such as Cavalcante [2011], Paraguassu-Chaves et at. [2020a]; [2020b]; [2020c]; [2019]; [2018a]; [2018b], where it was possible to build indexes within this methodological perspective.

A model of factor analysis can be presented in the matrix form as in Dillon; Goldstein [1984]:

$$X=\alpha F+\varepsilon (1)$$

Then,

X = is the p-dimensional vector transposed from observable variables, denoted by $X = (x1, x2,..., xp)$;

F = is the q-dimensional vector transposed from non-observable variables or latent variables called common factors, denoted by $F = (f1, f2,..., fq)$, where q < P;

ε = is the p-dimensional vector transposed from random variables or unique factors, denoted by ε = (e1, e2,..., ep);

α = is the array (p, q) of unknown constants, called factorials loads.

According to Gama et al. [2007]; Santana [2007b], in the factorial analysis model it is assumed that specific factors are orthogonal, among themselves, with all common factors. Normally, E (ε) = E (*F*) = 0 and Cov (ε, F) = 0.

According to the authors, the initial structure used to determine the array of factorials loads, in general, may not provide a significant pattern of variable loads, so it is not definitive. This initial structure can be done by several methods of rotation of the factors, as Dillon and Goldstein [1984]; Johnson and Wichern [1988]. It was used the VARIMAXVarimax method of orthogonal rotation of the factors for this study.

The Varimax method is a process where the reference axes of the factors are rotated around the source until some other position is reached. The objective is to redistribute the variance of the first factors to others and to achieve a simpler and more theoretically significant factorial [Hair et al., 2005]; [Santana, 2005a]; [Santana, 2007b]; [Reis, 2001]; [Gama et al., 2007].

The choice of factors was carried out through the technique of latent root. So, the array of factorials loads, which measures the correlation between the common factors and observable variables, is determined by means of the correlation matrix, as Dillon and Goldstein [1984].

For the determination of sustainable development indexes, the matrix of factor scores estimated by the factorial basis orthogonal rotation process was adopted, as pointed out by Santana [2006]. The factor score, by definition, places each observation in the space of common factors. For each factor *f*j, the i-th factor score extracted factorial score is defined by *F*Ij, expressed as follows [Dillon; Goldstein, 1994]:

$$F_{\mathrm{IJ}}=\mathrm{b}_1 x_{\mathrm{i}1}+\mathrm{b}_2 x_{\mathrm{i}2}+\mathrm{b}_p x_{\mathrm{ip}} \quad (2)$$

Then:

*b*i = are the estimated regression coefficients for the *n* Common factorials scores;

*x*Ij = Are the *n* Observations of *p* Observable variables.

i = 1,2,...,n.

j = 1,2,...,p.

To arrive at the equation that represents the Performance Index, Gama et al., [2007]; Santana [2007a], show the evolutionary sequence of formulas from the previous equation. It turns out that even if the variable FIj is not observable it can be estimated through the factorial analysis techniques, using the matrix of observations of the vector x of observable variables. In factorial notation, equation 2 becomes:

$$F_{(n,q)}=X_{(n,q)}b_{(p,q)} \quad (3)$$

In Equation 3, *F* is the matrix of the estimated regression from the *n* Factorials scores and it can be affected by both the magnitude and the measurement units of the variables *x*. To work around this kind of problem, replace the variable *x* by the standard variable *w*, given the ratio of the deviation around the average and the standard deviation of *x*, as follows:

$$\frac{x_i - \bar{x})}{S_x}$$

With these values, Equation 3 is modified making equation 4 possible, then:

$$F_{(n,q)}=w_{(n,q)}\beta_{(p,q)} \quad (4)$$

Based on equation 4, the beta weights matrix (β) with *q* standardized regression coefficients, replaces *b*, given that the variables are standardized on both sides of the equation. Pre-multiplying both sides of equation 4 by the value $\frac{1}{n}$***w'***, in which *n* Is the number of observations and *W* is the transposed matrix of *w'*, it makes it possible to reach the following equation:

$$\frac{1}{n} w'_{(p,n)} F_{(n,q)} = \frac{1}{n} w'_{(p,n)} w_{(n,p)} \beta_{(p,q)} = R_{(p,p)} \beta_{(p,q)} \quad (5)$$

The Matrix $\frac{1}{n}$***w'w***, therefore is the matrix of intercorrelated variables or correlation matrix among the observations of the matrix *x*, designated by R. The Matrix $\frac{1}{k}w'F$ It represents the correlation between the factorials scores and the factors themselves, denoted by Λ. With this, rewriting the equation 5, one must:

$$\Lambda_{(p,q)}=R_{(p,p)}\beta_{(p,q)} \quad (6)$$

If the matrix R is non-singular, one can pre-multiply both sides of equation 6 by the inverse of R, obtaining:

$$\beta=\mathrm{R}^{-1}\Lambda(7)$$

Substituting the β vector into equation 4, we obtain the factorial score associated with each observation, as follows:

$$F_{(\mathrm{n,q})}=\mathrm{w}_{(\mathrm{n,p})}R^{-1}_{(\mathrm{p,p})}\Lambda_{(\mathrm{p,q})} \quad (8)$$

In this way, the main formula of the Performance Index (I.D.) is arrived at, where the ID is defined as a linear combination of these factor scores and the proportion of the variance explained by each factor in relation to the common variance. The mathematical expression is now represented by the following formula:

$$\mathrm{ID}_i = \sum_{\mathrm{j}=1}^{q}\left(\frac{\lambda_j}{\sum_j \lambda_j}\mathrm{FP}_{\mathrm{ij}}\right) \quad (9)$$

Then:

i = 1,2,..., n.

λ = is the variance explained by each factor;

∑ λ = is the total sum of the variance explained by the set of common factors.

The factorial score was standardized (FP) to obtain positive values from the original scores and allow the hierarchy of the municipalities since the values of the performance index are between zero and one. The formula that allows this hierarchy can be seen by the following equation:

$$FP_i = \left(\frac{F_i - F_{min}}{F_{\mathbf{max}} - F_{\mathrm{min}}}\right)$$

It can be seen that F_{min} e F_{max} are the maximum and minimum values observed for the factor scores associated with the parameters observed by municipalities in Rondônia, framed in the level of hydrographic basins, for a period of 10 years. Thus, it is based on this understanding that it was possible to determine the performance indices adopted by this research.

2.1.1. Tests of adequacy of the factorial method to the mass of data

According to Gama et al. [2007]; Santana [2007a], the two main tests with the objective of assessing the adequacy of the method to the mass concern, first, the Bartlett sphericity test, which has the property of evaluating the general significance of the correlation matrix, that is, it tests the null hypothesis that the correlation matrix is an identity matrix. In addition to the Bartlett test, the Kaiser-Meyer-Olkin (KMO) test is also widely used and is based on the principle that the inverse of the correlation matrix approaches the diagonal matrix, in this case, it seeks to compare the correlations between the observable variables. Thus, both methods were used by this research as techniques for assessing the adequacy of the method to the surveyed database.

According to Dillon; Goldstein [1984]; Reis [2001]; Mingoti [2005]; Gama et al. [2007]; Santana [2007a] the mathematical formulas of these tests can be seen by the following equations:

$$KMO = \frac{\sum_i \sum_j r_{ij}^2}{\sum_i \sum_j r_{ij+}^2 \sum_i \sum_j a_{ij}^2} (10)$$

Like this,

r_{ij} = is the sample correlation coefficient between variables xi and xj;

a_{ij} = is the partial correlation coefficient between the same variables that is simultaneously an estimate of the correlations between the factors, eliminating the effect of the other variables.

According to Hair et al. [2005], the a_{ij} should assume values close to zero, since it is assumed that the factors are orthogonal to each other. Thus, according to this same author, values of this test below 0.50 are unacceptable.

Bartlett's sphericity test tests the null hypothesis that the variables are independent, against the alternative hypothesis that the variables are correlated with each other. That is, H_0: R = 1 or H_0: $\lambda_1=\lambda_2 = \cdots =\lambda_P$, which allows us to arrive at the following mathematical formula:

$$X^2 = -\left[n - 1 - \frac{1}{6}(2p + 5)\right]. \in |R| \text{ou } (11)$$

Where,

$|R|$ = is the determinant of the sample correlation matrix;

λ = is the variance explained by each factor;

n = is the number of observations;

p = is the number of variables.

The statistic has an asymptomatic distribution of x2 with $[0{,}5p(p-1)]$ degrees of freedom. The Bartlett test is the most common method applied to test the homogeneity of variances [Zar, 1996].

2.2. ANALYSIS TOOL

The SPSS program, version 17, was used as an analysis tool, which enabled the application of mathematical knowledge and allowed the construction of performance indices based on each parameter analyzed: environmental, economic, social and political-institutional.

2.3. LEVELS OF SCALE

The classification adopted by the research to express the results achieved by the river basins in Rondônia is described in tableTable 2. To evaluate the results presented, the analysis scale developed by the Santa Catarina Federation of Municipalities FECAM [2018] was adopted, as described in Table 2.

Table 2. Analysis scale adopted in the research.

Scale	Description
Low	0,000 - 0,499
Medium Low	0,500 - 0,624
Medium	0,625 - 0,749
Medium High	0,750 - 0,874
High	0,875 - 1,000

Source: FECAM.

The scale of analysis allowed classifying the indexes presented by the river basins of Rondônia in low, medium low, medium, medium high and high, according to the results obtained in this research.

2.4. INDICATORS RAISED BY THE SURVEY

The model was built based on the following indices: environmental, economic, social and political institutional. The combination of these four indexes resulted in the sustainable development index, as indicated in the methodology (methodological script). The indicators raised and the respective research sources, which were part of the analysis of this work, are listed in tablesTables 3, 4, 5 and 6, below.

Table 3. Environmental Index Indicators.

Indicators	Source
Deforestation	INPEhttp://www.dpi.inpe.br/prodesdigital/prodesmunicipal.php
Percentage of the area of the municipality occupied by Conservation Units	ICMBio SEDAM
Percentage of the area of the municipality occupied by Indigenous Lands	SEDAM

Source: Own elaboration.

Table 4. Economic Index Indicators.

Indicators	Source
Gross domestic product per capita	IBGE (Demographic census)
Number of cattle	IBGE (Municipal Livestock Research)
Rice production (% in relation to the State)	IBGE (Municipal agricultural production)
Coffee production (% in relation to the State)	IBGE (Municipal agricultural production)
Value of Pará nut production (R$ thousand)	IBGE (Production of plant extraction and forestry)
Value of non-processed wood production (R$ thousand)	IBGE (Production of plant extraction and forestry)
Cocoa production (% in relation to the State)	IBGE (Municipal agricultural production)

Source: Own elaboration.

Table 5. Social Index Indicators.

Indicators	Source
Households with access to water (%)	IBGE (Demographic census)
Households with access to sewage (%)	IBGE (Demographic census)
Households with access to electricity (%)	IBGE (Demographic census)
Number of Health Units (per thousand inhabitants)	DATASUS
No. of hospital beds (per thousand inhabitants)	DATASUS
No. of doctors (per thousand inhabitants)	Atlas of Human Development in Brazil DATASUS
Illiteracy rate	IBGE (Demographic census)
Average household income per capita	IBGE (Demographic census)
Gini index of household income per capita	IBGE (Demographic census)
Proportion of people with low income	IBGE (Demographic census)
• % population with income <1/2 MW	IBGE (Demographic census)
•% population with income <1/4 MW	IBGE (Demographic census)
Proportion of children in a low income household situation	IBGE (Demographic census)
•% children income gift <½ SM	IBGE (Demographic census)
•% children income gift <¼ SM	IBGE (Demographic census)
Unemployment rate 16a and +	IBGE (Demographic census)
Child labor rate	IBGE (Demographic census)

Source: Own elaboration.

Table 6. Institutional Political Index Indicators.

Indicators	Source
Collection capacity	
• Per capita budget revenue	Own preparation based on data from IPEADATA, STN / FINBRA
• % own revenue	Own preparation based on data from IPEADATA, STN / FINBRA
Investment capacity	
• investment expense per capita	Own preparation based on data from IPEADATA, STN / FINBRA
• investment expense over realized expense	Own preparation based on data from IPEADATA, STN / FINBRA
Per capita expenses by function (R$)	
• Education and culture	Own preparation based on data from IPEADATA, STN / FINBRA
• Health and sanitation	Own preparation based on data from IPEADATA, STN / FINBRA
No. of municipal councils	IBGE (Profile of Brazilian municipalities)

Source: Own elaboration.

2.5. METHODOLOGICAL ROADMAP

Next, the steps taken in this work will be described, which were considered essential for the consolidation of the process of construction of sustainable development indexes due to the object of the present study.

Table 7. Methodological Roadmap.

Phases	Description
1	Classification of municipalities in the State ofRondônia by hydrographic basins.
2	Survey of official data for each municipality framed by hydrographic basins.
3	Preparation of an Excel spreadsheet with the available data according to the structure recommended by steps 1 and 2.
4	Use the SPSS tool, through factor analysis, basedon the Varimax method.
5	Observe the data adequacy criteria for factoranalysis.
6	Determine the performance indexes by municipalities aggregated by river basins.
7	Using the average performance indexes of the municipalities, determine the indexes for each parameter for each hydrographic basin.
8	Using the average of the parameters, determine the index of sustainable development by hydrographic basins.

Source: Own elaboration.

3. ANALYSIS OF THE SUSTAINABLE DEVELOPMENT INDICES OF THE WATER BASINS IN THE STATE OF RONDÔNIA

From the 20th century, when environmental issues gained worldwide repercussion and the concept of sustainable development became a development model to be achieved, the need arose to measure the process towards sustainability, through instruments such as indicators. of development, “tools constituted by one or more variables that, associated

through different ways, reveal broader meanings about the phenomena to which they refer" [Guimarães; Feichas, 2018]. At first, traditional indicators (macroeconomic and pollution measurements) were not viable to indicate sustainability, making it necessary to develop new indicators that would be useful for public management decisions. Thus, it was foreseen in Agenda 21, the elaboration of effective methods for collecting and evaluating data, in the economic, social, institutional and environmental dimensions, from the local to the international scope [Souza et al., 2009]. The great challenge of sustainable development is to reconcile economic growth with environmental preservation and social justice. In this sense, indicators can be suitable instruments to assist this process, since they contain information on the economic, social and environmental situation of a given location. It is worth mentioning that sustainable development is a process under construction, so the formulation of indicators is an open work.

The main objective of indicators is to aggregate and quantify complex information, and facilitate their understanding [Van Bellen, 2004]. Corroborating this understanding, Guimarães and Feichas [2018] state that indicators can only be considered instruments of the sustainable development process if they add characteristics that allow the evaluation of social phenomena, enabling society's participation in the search for development, as well as offering subsidies for decision-making and project elaboration, by public managers, pointing out the possible variables, since society is built daily. The choice of indicators should "enable the temporal comparison within the same territory as well as the comparison between territories on a spatial and temporal scale" [Souza et al., 2009], which allows governments and society to project trends, analyze scenarios and direct public policies in the search for improvements. What is expected is that these indicators can facilitate the comparison of objectives with results, as well as the management process and indicate the gaps between the planning and execution processes of policies [Souza et al., 2009]. In this sense, "We seek to use a reduced number of truly binding indicators that provide systemic information relevant to different dimensions and sectors" [Souza et al., 2009]. The results obtained from the indicators present a partial view of reality, however, the studies must be carried out within a context that allows subsidizing analyzes and recommendations for local management. Therefore, it is necessary to "choose and develop methodologies, guidelines, parameters, criteria and instruments that adapt to the object of analysis" [Guimarães; Feichas, 2018]. The complexity of problems related to sustainable development demands integrated indicators or

aggregated indices that are easy to understand, as they will be the basis for the decision-making process in the search for solutions [Van Bellen, 2004].

From the combination of indicators, it is possible to generate indices, “powerful tools in the process of consolidating ideas and also offering more tangible information to public policy makers” [Toigo; Mattos, 2016]. Assisting in numerous governmental actions, the indexes are also widely used by public managers, as a way of facilitating their communication, given the importance of strategic planning at the local level for the implementation of policies. The formulation of sustainable development indices is a way of synthesizing a series of quantitative and semi-quantitative information, where each index results in a numerical value, the product of mathematical operations based on information collected, and which will serve as a basis for the evaluation of sustainability. According to these authors, among the existing indices, the ones that best fit the theme of sustainable development are the Sustainability Barometer, the Environmental Sustainability Index (ISA), the Sustainability Panel and the Ecological Footprint.

The construction of a sustainable development index must focus efforts so that a tool is acquired that addresses the complexity of the system in an accessible way. In this sense, even the simplest model of presentation of indices or aggregated indicators can contribute to achieving the goals of sustainable development [Toigo; Mattos, 2016]. Although several indicator systems address the dimensions of sustainable development, they cannot be adopted without being in the context of the analysis to be carried out, due to the differences that exist between the environments and the peculiarities of each place. However, this does not prejudice the use of indicators, which may vary according to the object of study [Toigo; Mattos, 2016]. A set of sustainable development indicators has been developed, tested and improved, however, this is justified by the fact that there is no consolidated methodology [Rabelo; Lima; Sales, 2008]. Choosing and considering the dimensions and aspects of the indicators of a given location are one of the main difficulties encountered, as the results will serve as a basis for decision-making, determining the sustainable development indices. The choice of indicators is important and deserves attention, so that they “reflect not only the knowledge of government institutions, but also the expectations of society” [Silva et al., 2018], since the results presented from these indicators determine a pattern normative, making a diagnosis viable, which will serve as a basis for formulating and evaluating public policies [Pereira; Pinto, 2012].

Next, the results achieved by the present study will be presented, aiming to demonstrate the scope of the model and the possibilities of analysis, depending on the proposed methodological instrument, as a suggestion of scientific criteria for decision making involving the theme of environmental management in hydrographic basins.

Table 8. Environmental, Economic, Social and Political-Institutional Index of the Hydrographic Basins of Rondônia (10 years ago).

Hydrographic basin	Environmental Index	Economic Index	Social Index	Institutional Political Index	Sustainable Development Index
Madeira River	0.288	0.333	0.502	0.364	**0.372**
Mamoré Rive	1.000	0.437	0.489	0.184	**0.527**
Guaporé Rive	0.206	0.246	0.338	0.361	**0.287**
Jamari Rive	0.071	0.223	0.367	0.229	**0.222**
Machado Rive	0.092	0.183	0.381	0.334	**0.247**
Roosevelt Rive	0.000	0.189	0.295	0.263	**0.187**

Source: Own elaboration.

Table 9. Environmental, Economic, Social and Political-Institutional Index of the Hydrographic Basins of Rondônia (current).

Watershed	Environmental Index	Economic Index	Social Index	Institutional Political Index	Sustainable Development Index
Madeira River	0.597	0.498	0.382	0.200	**0.419**
Mamoré River	1.000	0.173	0.465	0.139	**0.444**
Guaporé River	0.476	0.174	0.521	0.341	**0.378**
Jamari River	0.249	0.199	0.446	0.332	**0.307**
Machado River	0.248	0.169	0.456	0.284	**0.289**
Roosevelt River	0.033	0.155	0.507	0.215	**0.227**

Source: Own elaboration.

The evaluation of environmental, political-institutional, social, and economic parameters, based on the hydrographic basins of the Madeira, Mamoré, Guaporé, Jamari, Machado and Roosevelt rivers, allowed us to present the indices identified in each basin, as can be seen in tablesTables 8 and 9 and in Figures 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11. Subsequent to the results obtained, it was possible to determine the sustainable development index at the level of watersheds in the state of Rondônia.

Table 8 and Figure 2 present the environmental index of the hydrographic basins, where it is possible to observe that the Mamoré River basin (1,000), presents the high index, the best result, considering the scale of analysis adopted for the work. The low rate of deforestation and a significant number of conservation units and indigenous lands that make up this region are responsible for the environmental protection of this watershed. Table 9 and Figure 3 show that at present the environmental index of the Mamoré River basin remains at a high index (1,000), strong evidence that this region has low deforestation due to its preservation by conservation units and indigenous lands. At present, excluding the Mamoré

River basin, all hydrographic basins are classified as having a low environmental index. The Roosevelt River basin (0.000) and (0.033) respectively 10 years ago and today, the Jamari River basin (0.071) and (0.249), the Machado River basin (0.092) and (0.248), the Guaporé River basin (0.206) and (0.476) and the Rio Madeira basin (0.288) and (0.597) respectively in the two periods within a 10-year interval have sustainable development indices considered low. Only the Madeira River basin currently improves its environmental performance index to medium low (0.597). The Roosevelt River basin with the lowest rates is a region that has high rates of deforestation and aggression to the environment.

Considering the Economic Index, all hydrographic basins had a low result. The Mamoré River basin (0.437) 10 years ago and the current environmental index (0.173) which in the environmental parameter obtained a high index, exhibits a low result, indicating an imbalance between the assessment factors of sustainable development. The Madeira River basin with current economic index (0.498%) presented a significant result in relation to the others, as can be seen in Tables 8 and 9 and in Figures 4 and 5, which is due to livestock and wood production indicators, economic activities of great prominence in the state, considered in the economic parameter, having among the main producers, the municipalities that compose it. Despite the condition of the index considered low in the Madeira River basin, all other basins present economic indexes classified as low, distributed as follows: Madeira River basin (0.333) and (0.498), Mamoré River basin (0.437) and 0.173), Guaporé River basin (0.246) and (0.174), Jamari River basin (0.223) and (0.199), Machado River basin (0.183) and (0.169), Roosevelt River basin (0.189) and (0.155) respectively in the two researched periods.

Regarding the social index, the Guaporé River (0.521) and Roosevelt River (0.507) basins had a low average index, while the other basins are classified with a low social index (Tables 8 and 9) and (Figures 6 and 7). 10 years earlier, only the Madeira River basin had a low average social index (0.502). The low and low average social index, according to the scale adopted in the research, is distributed as follows: Madeira River basin (0.502) and (0.382), Mamoré River basin (0.489) and (0.465), Guaporé River basin (0.338) and (0.521), Jamari River basin (0.367) and (0.446), Machado River basin (0.381) and (0.456), Roosevelt River basin (0.295) and (0.507) respectively in the two study periods. This fact is related to the low percentage of basic sanitation, lack of health structure and the issue of unemployment, observed in the development of the research, after analyzing the social indicators presented in Rondônia. Although the social index of the river basins has shown

better results in relation to the economic index, these are still classified as low (considering the scale of analysis of the research), and they need effective government measures in order to strengthen the social indicators, since that social development issues have great relevance for sustainable development.

Regarding the institutional political parameter, the results presented are classified as low according to the scale adopted in the research. It can be seen in Tables 8 and 9 and in Figures 8 and 9, the low political-institutional indexes distributed as follows: Madeira River basin (0.364) and (0.200), Mamoré River basin (0.184) and (0.139), Guaporé watershed (0.361) and (0.341), Jamari River basin (0.229) and (0.332), Machado River basin (0.334) and (0.284), Roosevelt River basin (0.263) and (0.215) respectively for 10 years and nowadays. The low rates of political-institutional development demonstrate the need for actions and policies that can promote the improvement of the factors that influence the sustainable development of the State. From the analysis of the environmental, economic, social and political-institutional indices presented by basins, it was possible to determine the sustainable development index in the hydrographic basins of the state of Rondônia.

In Tables 8 and 9 and in Figures 10 and 11 it can be seen that the Mamoré River basin (0.444), followed by the Madeira River basin (0.419), currently present the best sustainable development indices, compared to the indices obtained by the other hydrographic basins, despite being classified as a low sustainable development index. 10 years earlier, only the Mamoré River basin had an index considered to be medium-low (0.527).

The sustainable development index presented by the Mamoré River basin indicates that the environmental parameter influenced the final result.

The results found, in general, reflect the way in which the State has been developing and the difficulties faced to maintain a balance between environmental preservation, economic growth, social equality and institutional political structure.

In the context of watersheds, the state of Rondônia has a low sustainable development index, according to the research, a scenario that needs to be urgently transformed, taking into account that sustainable development is the guarantee of better living conditions and well-being. performance and future generation, as defined in the Brudtland report.

This result indicates that the objectives and guidelines of the state policy for water resources need to be applied efficiently, with the help of management tools and all the actors involved, so that in this way a development can actually be achieved that is considered sustainable.

Figure 2. Environmental index of the Rondônia watersheds (10 years ago)

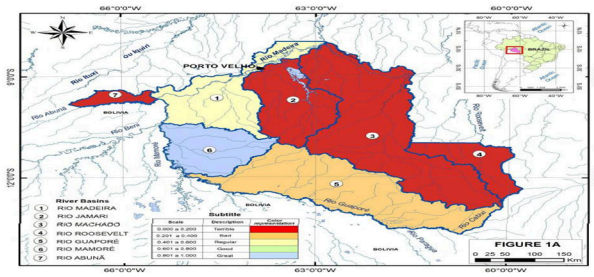


Figure 3. Environmental index of the Rondônia watersheds (current)

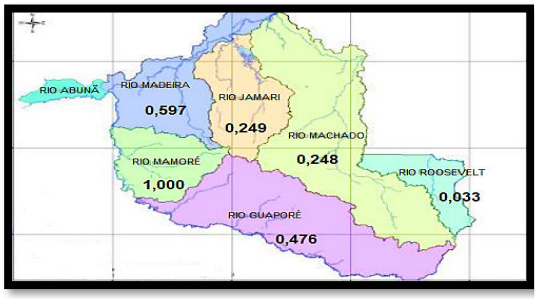


Figure 4: Economic index of the Rondônia watersheds (10 years ago)

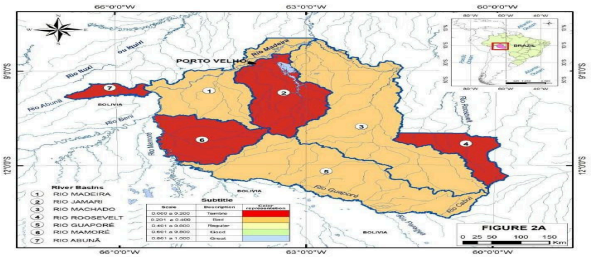


Figure 5: Economic index of the Rondônia watersheds (current)

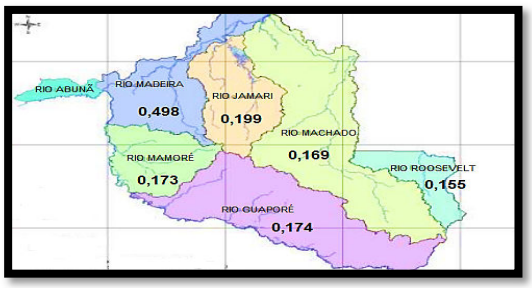


Figure 6. Social index of the Rondônia watersheds (10 years ago)

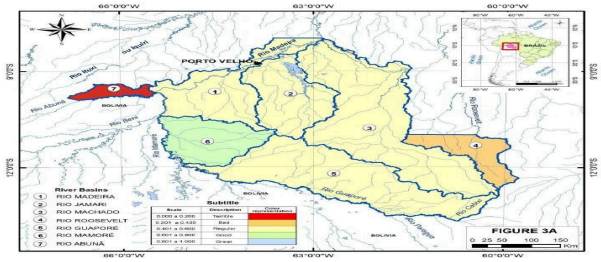


Figure 7. Social index of the watersheds of Rondônia (current)

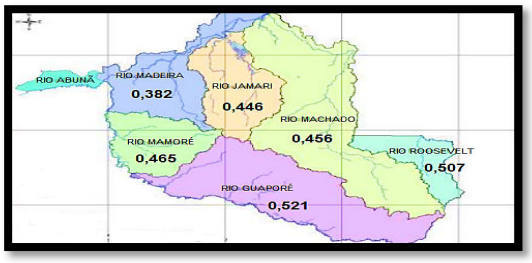


Figure 8. Institutional political index of the Rondônia watersheds (10 years ago)

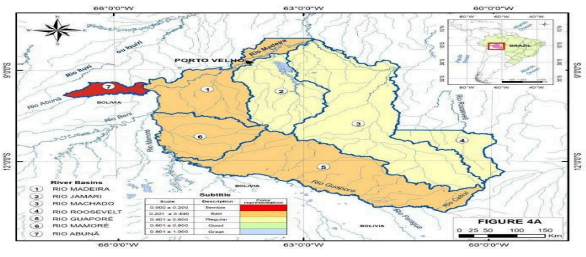


Figure 9. Institutional Political Index of the Rondônia watersheds (current)

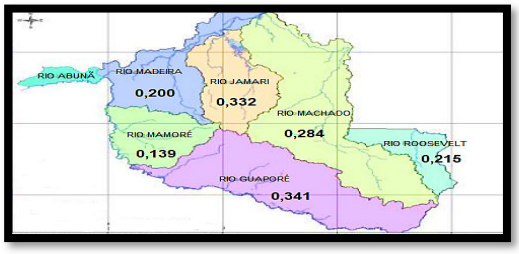


Figure 10. Sustainable Development Index of the Rondônia Watersheds (10 years ago)

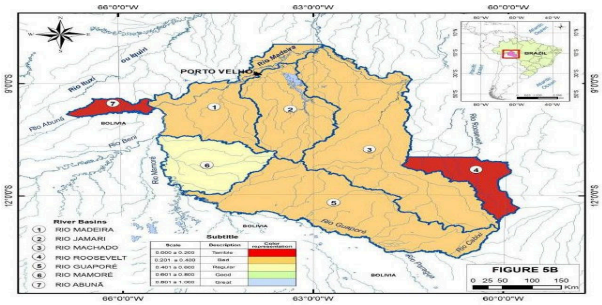
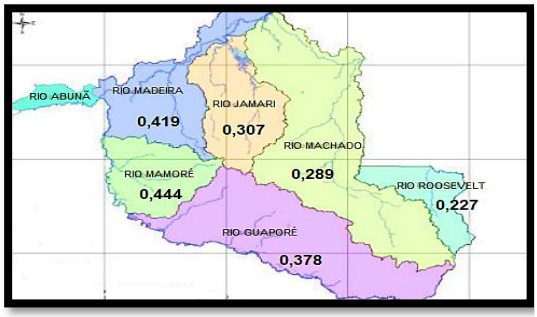


Figure 11. Sustainable Development Index of the Rondônia watersheds (current)



4. CONCLUSIONS

Factor analysis showed efficiency as a multivariate statistical method in the construction of sustainable development indices for the river basins of Rondônia. The Mamoré River basin (0.444), followed by the Madeira River basin (0.419), currently present the best sustainable development indices, compared to the indices obtained by the other hydrographic basins, despite being classified as a low sustainable development index. 10 years earlier, only the Mamoré River basin had an index considered to be medium-low (0.527).

The results found, in general, reflect the way in which the State has been developing and the difficulties faced to maintain a balance between environmental preservation, economic growth, social equality and institutional political structure. It was also found that the incipient public policy of strengthening the paradigm of sustainable development at the level of river basins in Rondônia, has contributed to the advance of deforestation in Rondônia.

In the context of watersheds, the state of Rondônia has a low sustainable development index, according to the research, a scenario that needs to be urgently transformed, taking into account that sustainable development is the guarantee of better living conditions and well-being, performance and future generation, as defined in the Brudtland report.

This result indicates that the objectives and guidelines of the state policy for water resources need to be applied efficiently, with the help of management tools and all the actors involved, so that in this way a development can actually be achieved that is considered

sustainable. Finally, it is highly recommendable to institutionalize regional public policies in the form of a Master Plan for the Rondônia Watersheds as a mechanism for planning and managing the respective areas, from the perspective of sustainable, integrated and inseparable development of their local communities.

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