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Factor Analysis and the Social Capital Index: A Study at the Brazil / Bolivia Border

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Abstract*— Objective:** *The study aimed to build the level of social capital by neighborhoods Guajará-Mirim border region between the State of Rondônia, Brazil and the Republic of Bolivia, which in recent years has been showing signs of social fragility due advance not virtuous practices.* ***Method: *This work made use of research in secondary bases as well as in primary bases. The tabulation of qualitative and quantitative data was performed in Excel (2010) and for their processing performance index construction purposes were calculated following the factorial analysis techniques presented by Hair et al. [19] Santana [20, 21]; and Choi [22]. For this, we made use of the statistical tool SPSS (Statistical Package for Social Sciences) for the construction of the indices of social capital. The correlation analysis process was done in Excel.* ***results:*** *It was observed that the capital reached regular levels in Guajará-Mirim neighborhoods not observable, so correlations between the studied parameters, however, it needs to be further studied as factors such as the flooding of the Mamore river may have interfered in any way in the implementation process of the field survey to the residents of the city. It became clear that the municipality of Guajará-Mirim suffers from serious social problems and that most problems are correlated with the increase in alcoholic beverage market in the city and use drugs. However, was not observed as the institutional arrangements are dealing with this problem, that is, as*

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public bodies are relating to discuss actions for concrete solutions to this evil that plagues large portion of the population of Guajará-Mirim, mainly young teenagers residents of Guajá-Mamim. However, we hope to continue this work in order to better understand this mechanism of social network between the actors of this process in the region.

Keywords— Social Capital Index. Factor Analysis. Guajará-Mirim.

I. INTRODUCTION

This study aimed to discuss the capital in Guajará-Mirim border region between Rondônia and Bolivia, which in recent years has been showing signs of weakness due to the social advancement of non-virtuous practices.

Within an international perspective, the first great work in this direction was developed by Putnam [1] on the modern Italy.

Thus, using the regional Italian experience, Putnam [1] tried to analyze the new context of the country's political reform and its consequences, ascertaining how new institutions were created and how they evolved in their early 20s.

The fact of the Italian reform has made it possible to implement a single institutional model, ie a model replicated in different parts of that country, an extraordinary moment provided an opportunity to follow the evolution of these changes over time. So, as the institutional model theoretically remained constant simultaneously create regional governments with similar organizational structure, other external factors could be tested, such as the economic context and the political tradition. In addition, in order to illustrate the problem of this research, we prepared the following questions: What level of capital of the neighborhoods of Guajará-Mirim? Neighborhoods that have higher capital ratios have the lowest crime rates in the city? What future expected on a level of capital achieved by the municipality? It is enough to promote institutional change long awaited at the local level?

This is because, curiously note a rapid expansion process of this economic segment inversely proportional to local development. This research therefore seeks to analyze this aspect based on the theoretical perception of the capital, from the work of Putnam [1].

The spatial area corresponded to the urban area of Guajará-Mirim, more specifically 15 neighborhoods. Thus, this study aimed to build the level of social capital by neighborhoods Guajará-Mirim.

1.1. Problem Context

The social capital has a multidimensional nature. The narrower view defines it as a set of norms and social networks that affect the community's well-being in which are inscribed by facilitating cooperation among its members by reducing the cost of obtaining and processing information. [2]

According to Portes [3], the first contemporary analysis of social capital was produced by Pierre Bourdieu, which defined the concept as "the current resource unit or potentials that are connected by possession of a durable network of more or less institutionalized relations acquiescence or recognition "And Putnam [4]: "Social capital refers to features of social organization such as networks, norms and ties of trust to facilitate coordination and cooperation for mutual benefits. Capital Social increases the benefits of investment in physical and human capital. "

The social capital is therefore related to the ability of people to work together in groups and organizations that make up civil society. [5]

Therefore, the social capital has been identified as an integral component of economic and social development, which shapes the quantity and quality of social interactions of a society. Recognizing the potential of this concept, the World Bank has been using it to investigate and analyze how and in what form the social capital enables the poor to actively participate and benefit from the development process. [6]

For Evans [7] the most advanced societies show higher *social capital*, however, the potential of its construction in developing countries would be great and would be a challenge to be faced.

As Marteleto; Silva [2] There is evidence that social capital can be used to promote poverty reduction, development and social welfare, which would approach the interests of sociology and economics in this field.

It is understood that social capital is the process and empowerment tool of the citizen and that can change personal relationships and social exchanges to generate more networks of cooperation and solidarity. Thus, the rise of social capital ratios can have positive effects for their impact on democracy and socio-economic development [8].

To Arizpe [9] and according to D'Araújo [10] the social capital it is innovative concept in the analysis and development proposals, expresses the ability of a society to establish interpersonal bonds of trust and cooperation networks with the intention of produce collective goods. When trying to unravel the causes of the dynamic expansion of the capitalist production system in recent decades, favors the contribution of social and human capital for technological development, increased productivity and the very growth of the economy. According to Hutchinson and Vidal [11], all forms of capital can be understood independently, but are best understood when analyzed through their reciprocity and interdependence.

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Rattner [12] reports further that while the human capital is the result of the actions of individuals in search of learning and improvement, social capital is based on the relationships between social actors that set each other mutual expectations and obligations, for in this way stimulate reliability in social relationships and streamline the flow of information, both internal and external. Contrary to human capital formation that encourages individualism, building social capital affects positively the cohesion of the family, community and society. Prevailing values that are contrary to the solidarity and cooperation help to expand the networks of corruption and crime in whatever level of society. [12] As for Fukuyama [5] the creation of social capital,

The basis for the construction of social capital is found in all societies, with their own particularities of each culture, and people end up using it, trying to achieve their goals as to satisfy their needs for economic, social and affective [13]. Corroborate this concept, authors such as Krishna; Uphoff [14]; Harpman; Grant; Thomas [15]; Ferrarezi [16].

II. METHODOLOGY

This research was structured based on the aspects of interdisciplinary research given the complexity surrounding the issue. The methodology for the development of work involved field research techniques where the researcher assumes the role of observer and explorer, directly collecting the data in place that have emerged or the phenomena [17]. According Prestes [18] field research developed mainly in the social sciences is characterized by the collection of data using techniques such as questionnaires, interviews, observations etc.

Therefore, this work made use of research in secondary bases as well as in primary bases. The tabulation of qualitative and quantitative data was performed in Excel (2010) and for their processing performance index construction purposes were calculated following the factorial analysis techniques presented by Hair et al. [19] Santana [20,21] and Cavalcante [22]. For this, we made use of the SPSS statistical tool (Statistical Package for Social sciences) v. 17 for the construction of the indices of social capital. The correlation analysis process was done in Excel.

III. ANALYTICAL MODEL

A factor analysis model can be presented in matrix form as in Dillon; Goldstein [23]:

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

Being,

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

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

ε = is the transpose vector p-dimensional random variables or unique factors, denoted by $\varepsilon = (e_1, \text{and}_2, ..., \text{and}_p)$;

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

As Gama et al. [24]; Santana [20, 21], the factor analysis model assumes that specific factors are orthogonal to each other with all common factors. Usually, E (ε) = E (F) = 0 and Cov (ε, F) = 0.

According to the same authors, the initial structure used to determine the matrix of factor loadings generally can not provide a meaningful standard loads variable, so it is not definitive. The verification or not, this initial structure can be made by various methods of rotation of factors, as Dillon; Godstein [23]; Johnson; Wichern [25]. For the purpose of this research was used VARIMAX method of orthogonal rotation of factors.

The VARIMAX method is a method in which the factors of the reference axes are rotated about the origin until some other position is achieved. The goal is to redistribute the variance of the first factors to others and achieve a simpler factor standard and theoretically more significant [26]; [19]; [21]; [24]; [20].

As mentioned earlier, the choice of the factors was performed by the latent root technique. Thus, the matrix factor weights, which measures the correlation between the common variables observable factors and is determined by the correlation matrix as Dillon; Goldstein [23].

For the determination of Thesis Performance Indices was adopted factor scores matrix estimated by orthogonal rotation factor based process as indicated by Santana [20]. The factor score, by definition, each observation is located in the space of the common factors. For each factor f_j, ith the extracted factor score is defined by F_{ij}, expressed as follows [23]:

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

Being that:

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

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

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

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

To get the equation that represents the Performance Index, Gamma *et al*. [24]; Santana [20] show evolutionary sequence of the formula from the above equation. Thus it appears that although the variable F_{ij} is not observable, it can be estimated by means of factor analysis techniques, using the matrix of observations

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vector *x* of observed 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 regression estimate from *n* factorial scores and can be affected both the magnitude and the measurement units of the variables *x*. To circumvent such problems, it replaces the variable *x* by the standardized variable *w*, given by the ratio between the deviation around the mean and standard deviation of *x* , as follows:

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

With these values, Equation 3 is modified making it possible to equation 4 below:

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

Based on equation 4, the matrix of weights beta (β) with *q* standardized regression coefficients replaces *b*, since the variables are standardized on both sides of the equation. Pre-multiplying both sides of equation 4 for the value $\frac{1}{n}w'$, where *n* is the number of observations and *w* ' is the transposed matrix *W*, allows to get 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 constitutes the matrix of interrelated variables correlated or the correlation matrix of the observations of the matrix *x*, designated R. The matrix $\frac{1}{k}w'F$ it is the correlation between the factor scores and the factors themselves, denoted by Λ. Thus, rewriting the equation 5, it follows that:

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

If the matrix **R** is nonsingular, you can pre-multiplying both sides of the equation by the inverse of R 6, obtaining:

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

Replacing the β vector in equation 4, you obtain the factor score associated with each observation, as follows:

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

Thus, one arrives at the main performance index of formula (ID), where ID is defined as a linear combination of the factor scores, and the proportion of the variance explained by each factor in relation to the common variance. The mathematical expression shall be represented by the following formula:

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

At where,

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

λ = the variance explained by each factor;

∑ λ = It is the sum total of the variance explained by the number of common factors. The factor score was standardized (FP) to obtain positive values of the original scores and allow prioritization of municipalities as the performance index values are situated between zero and one. The ranking formula that allows this can be seen by the following equation:

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

It is clear, therefore, that $\mathbf{F_{min}}$ **and** $\mathbf{F_{max}}$ are the minimum and maximum values observed for the factor scores associated with institutional performance of Rondônia municipalities for the years 1980, 1990, 2000 and 2009. Therefore, with this formula is that It was structured performance indices adopted by this research.

3.1. Suitability Tests the Factor Method to Data Mass

As Gama *et al*. [24]; Santana [20], the two main tests aiming to assess the suitability of the method for mass concern, firstly, the sphericity test Bartlett, which has the property to assess the overall significance of the correlation matrix, i.e., forehead the null hypothesis that the correlation matrix is an identity matrix. The other is the Kaiser-Meyer-Olkin test (KMO), which is also widely used and is based on the assumption that the inverse correlation matrix approaches the diagonal matrix, in which case it looks for comparing the correlations between observed variables. Thus, the two methods were used for this research as adequacy measurement techniques of the method to the collected database.

According to Dillon; Goldstein [23]; Reis [26]; Mingoti [27]; Gama *et al*. [24]; Santana [20,21] mathematical formulas of these tests can be seen by the following equations:

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

Like this,

r_{ij} = Is the sample correlation coefficient between the variables x_i and x_j;

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

According to Hair *et al* . [19] the a_{ij} shall take values close to zero, since it is assumed that the factors are orthogonal to each other. Thus, according to this author, this test values below 0.50 is unacceptable.

Bartlett's sphericity test tests the null hypothesis that the variables are independent, against the alternative

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hypothesis that the variables are correlated. In other words, H_0: = R 1 or H_0: $\lambda_1 = \lambda_2 = \cdots = \lambda_p$, which allows reaching the following mathematical formula:

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

$$X^2 = -\left[n-1-\frac{1}{6}(2p+5)\right].\sum_{j=1}^{p} In\lambda \quad (11)$$

At where,

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

λ = Is the variance explained by each factor;

n = Is the number of observations;

p = number of variables;

The statistical distribution is an asymptomatic x^2 with $[0,5\ p(p-1)]$ degrees of freedom. The Bartlett test is the most common method used to test the homogeneity of variance [28].

IV. RESULTS AND DISCUSSIONS

The level of representation by gender of respondents in the research questionnaire corresponds to 58% female and 42% male.

Most respondents (43.04%) reported having incomplete higher education level, followed by 21.52% with high school education and 18.99% with a college level (Chart 1).

As regards the age group of respondents it was observed that approximately 61% of the respondents said that they have between 18 and 30 years old, 24% between 31 and 45 years old, 10% between 46 and 60 years and above that corresponded to approximately 5 % (Chart 2). The corresponding data saved by Portes [3]; by Harpham, Grant and Thomas [15].

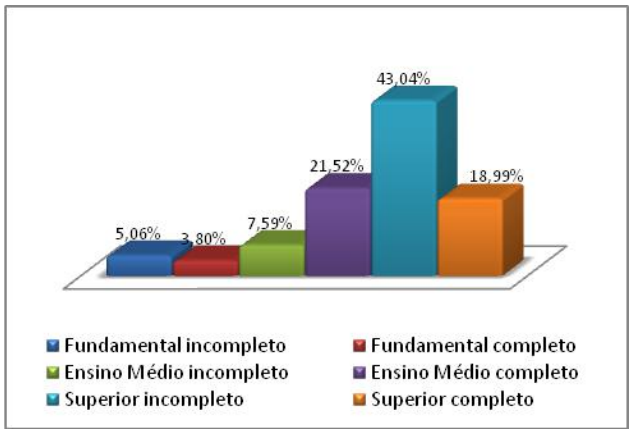

Chart 1: the respondents level of education
Source: Field Data.

Aripze [9] Cavalcante [22] Evans [7], Ocampo [13] Fortes [29] Purnam [4] corroborate the representation used in the search.

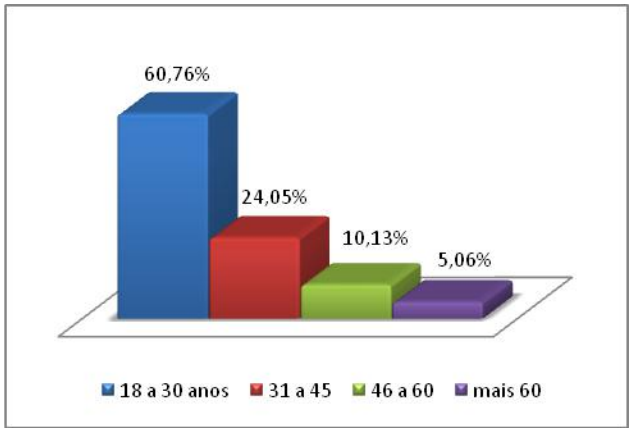

Chart 2: Age range of respondents
Source: Field Data.

With regard to income, about 20% said gain up to 1 minimum salary, 25% 1 to 2 minimum wages, 22% between 2 and 4 minimum wages, 24% between 4 and 8 times the minimum wages, 5% 8 to 16 minimum wages, and around 4% reported earning above that amount (Chart 3).

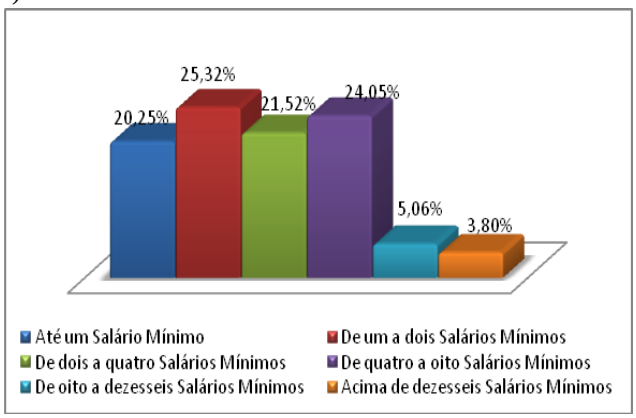

Chart 3: Average income of the respondents
Source: Field Data.

In Chart 4, it is observed that, on average, respondents stated not to participate in a group (10.13%), only one group (32.91%), two groups (18.99%), three groups (17 , 72%), four group (11.39%), five groups (6.33%) and six groups (2.53%).

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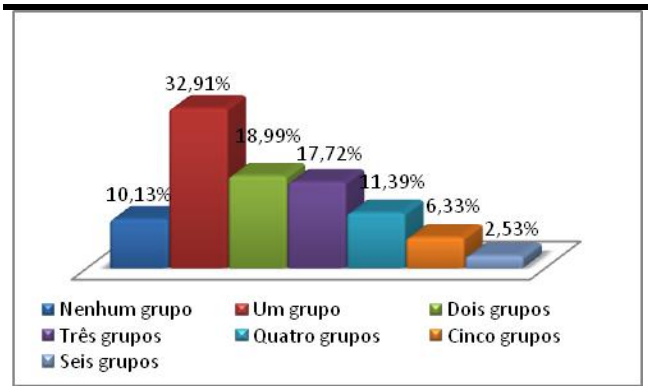

Chart 4: Quantity of group membership by respondents. Source: Field Data.

It appears in Chart 5 that the religious group was the most frequent (34.18%), followed by family group (20.25%), school group and working group (both 8.86%) and cultural group (7.59%). The others had values below 4%.

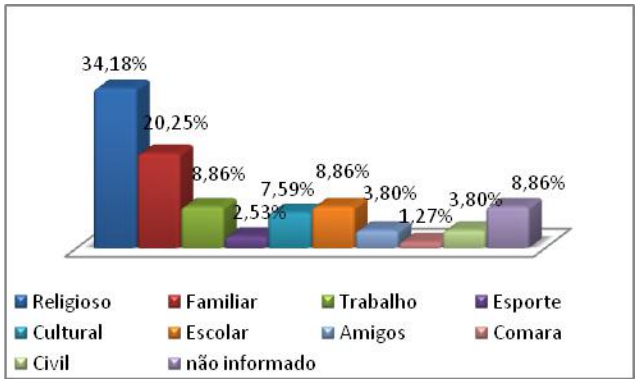

Chart 5: Types of groups considered most important. Source: Field Data.

Charts 6-12 are part of the process of analyzing the levels of social capital by neighborhoods Guajará-Mirim. Thus, six parameters were observed to calculate the capital index that is shown in Chart 12. To calculate the statistical tool used was SPSS, v. 17 to the factorial processing of data. Thus, adopting a criterion range: 0.000 to 0.200 (very low); 0.201 to 0.400 (low); 0.401 to 0.600 (regular); 0.601 to 0.800 (good); 0.801 to 1.00 (excellent) analyzes were made for each of the above parameters. Works such as Hair *et al*. [19]; Gama *et al*. [24]; Santana [20]; Dillon; Goldstein [23]; Reis [26]; Mingoti [27]; They employ the same treatment, the same criteria of scale and the same parameters used in this research.

By Chart 6, it is observed that 80% of districts were considered good performance by the scale, 13% achieved regular results (Center and Triangle) and only 7% had results considered low, as was the case of the Planalto neighborhood.

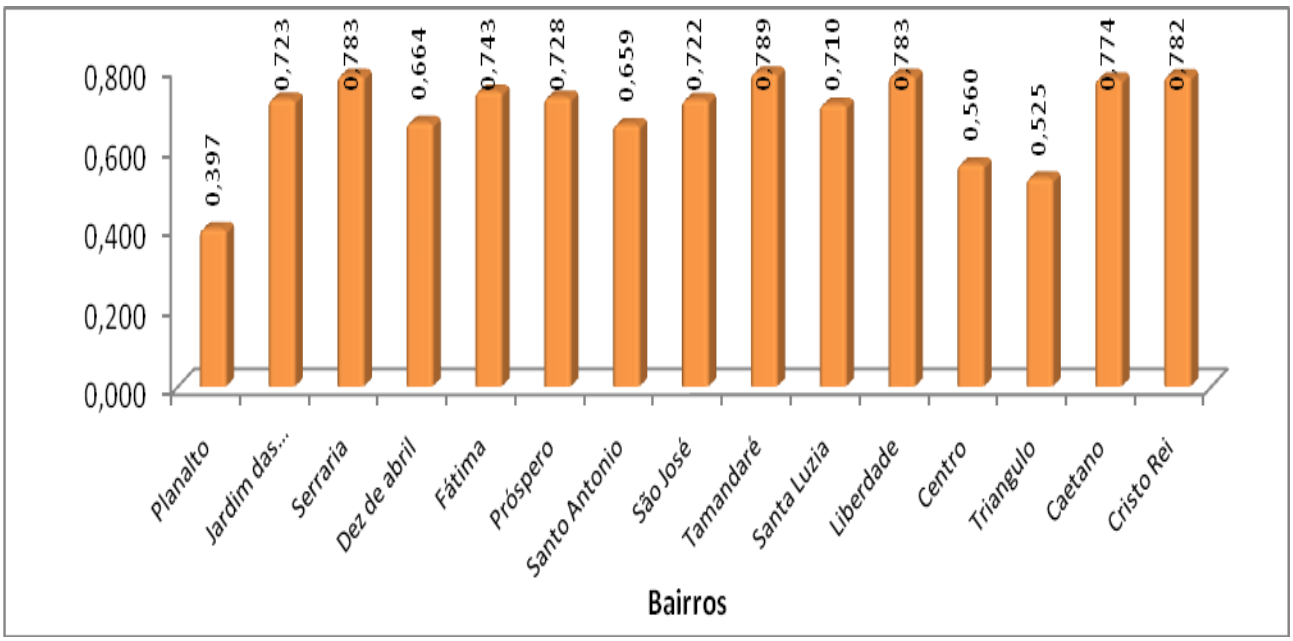

Chart 6: Groups Index and Networks neighborhoods Guajará-Mirim Source: Field Data.

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In Chart 7 it demonstrated that 100% of districts had regular results for the index of "trust and solidarity." In Chart 8, referring to the Collective and Cooperation Action Index, it was observed that 53% of districts showed very low and low results, 33% had regular performance and only 13% of them had considered performance "good" (Tamandaré and Liberty). The performances of the districts for the content of "information and communication" was "low" to 60% and "regular" 40% of them, as Graph 9.

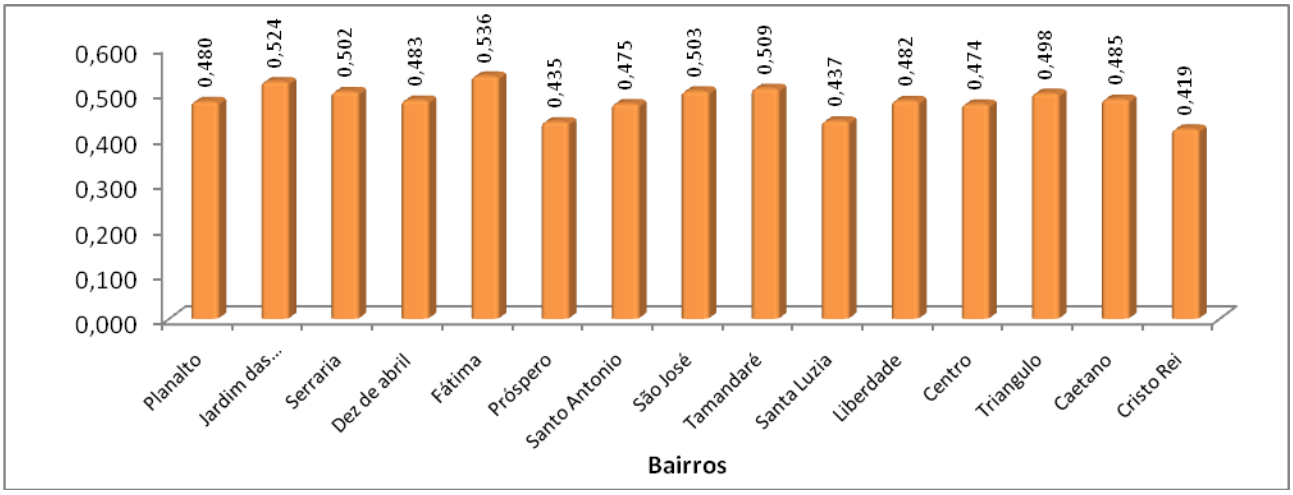

Chart 7: Confidence Index and solidarity by neighborhoods of Guajará-Mirim
Source: Field Data.

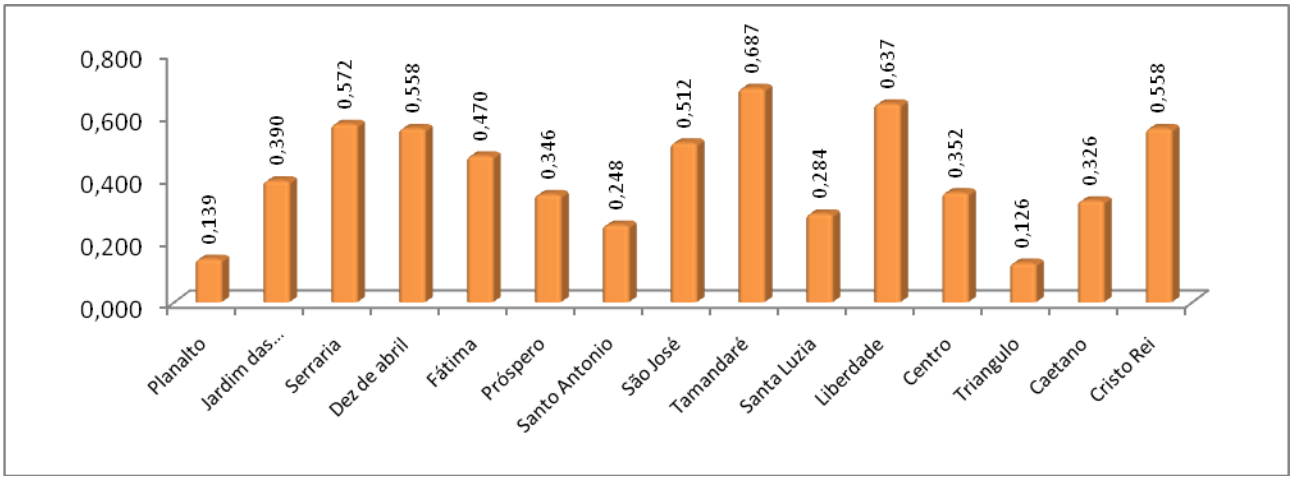

Chart 8: Collective Action and Cooperation index by districts Guajará-Mirim
Source: Field Data.

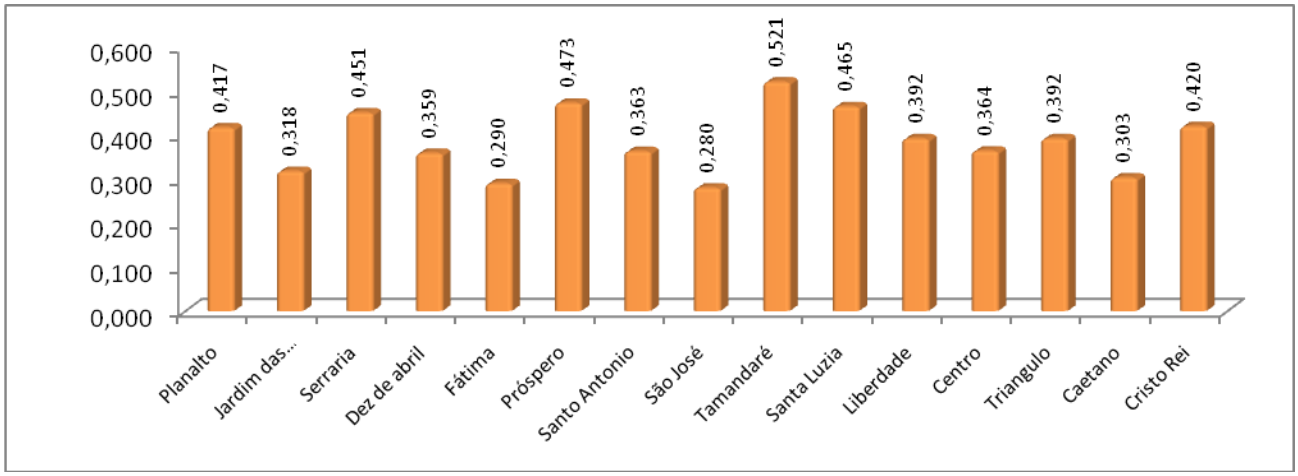

Chart 9: Information and Communication Index for neighborhoods Guajará-Mirim
Source: Field Data.

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NO "cohesion index and social inclusion" presented performance "down to 7% of the Planalto neighborhoods, 80% of them from" regular performance "and only 13% of" good "performance (Central districts and Ten April), as Chart 10.

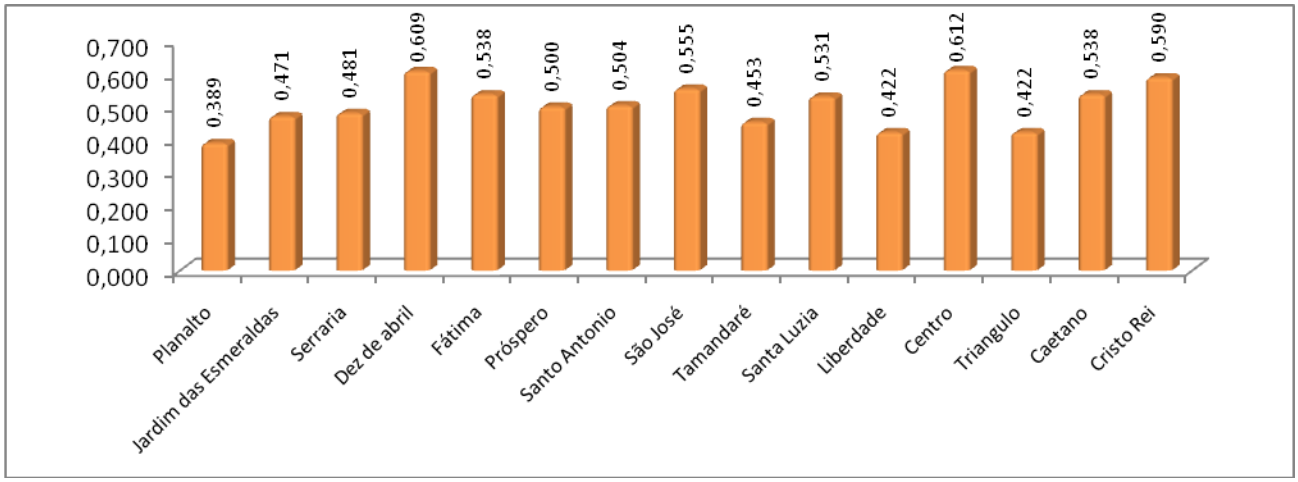

Chart 10: Cohesion and Social Inclusion Index for neighborhoods Guajará-Mirim
Source: Field Data.

With regard to the last parameter of capital (Chart 11), it was observed that 87% of districts had "regular" performance and only 13% showed results consistent with "good" performance (neighborhoods Christ the King and Center).

Already Chart 12 brings the result synthesis of capital by neighborhoods Guajará-Mirim as envisioned by this research.

Adopting the same analysis criteria based on the scale, it was observed that 100% of districts had capital of performances considered as "regular", that is below 0,600. Therefore, the level of social capital Guajará-Mirim reached the average, a value of 0.508, far, so what would be ideal, that is above 0,800.

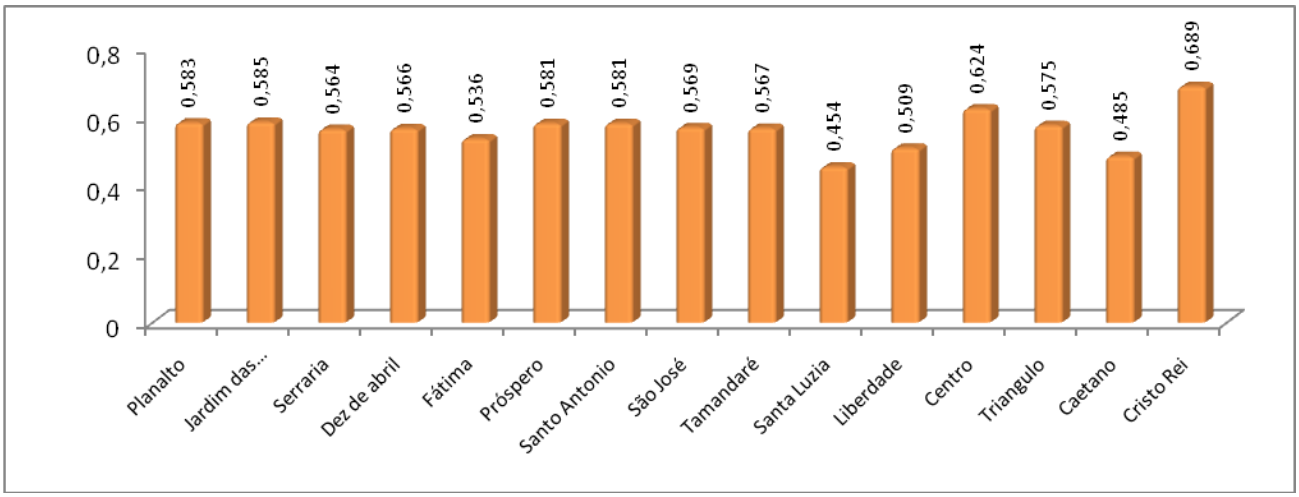

Chart 11: Empowerment Index by neighborhoods Guajará-Mirim
Source: Field Data.

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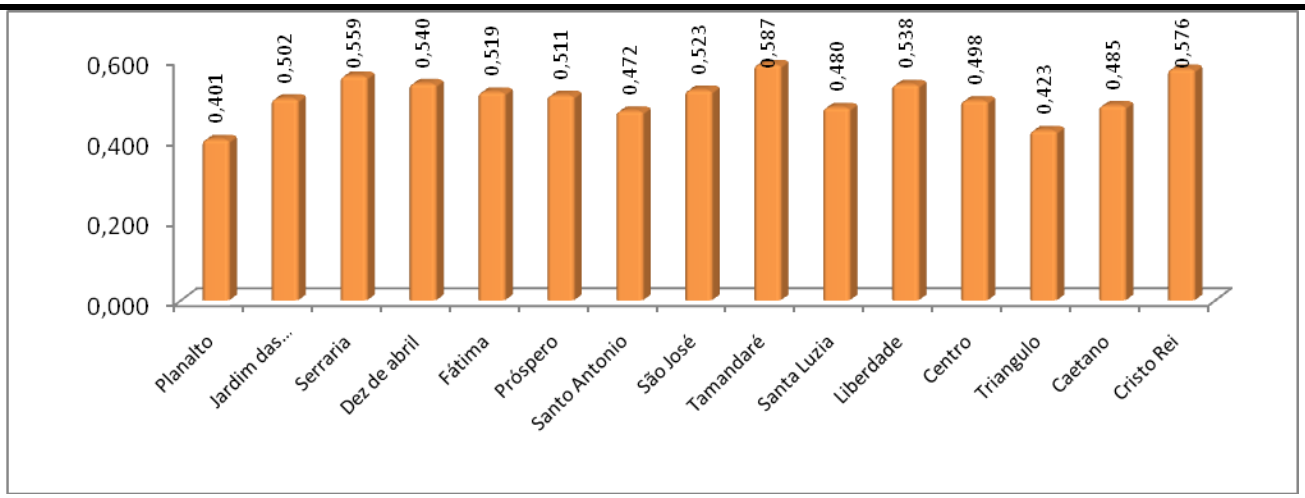

Chart 12: Social Capital Index by neighborhoods Guajará-Mirim
Source: Field Data.

The next step was to correlate the data in order to obtain information relevant to the object of this study. Therefore, the correlation was made procedure adopting the model Excel data analysis from the parameters shown in Table 1.

Adopting the same criterion of the performance scale presented above, however, according to the following descriptions (very weak, weak, regular, strong, very strong) results showed that the capital exerted no correlation with the parameters analyzed: Urban violence, beer consumption, marketing outlets, which may indicate the need for a deeper understanding on the subject of a possible renewal of this research, as the flood of the Mamoré River may have altered social behavior to the point of harming the questionnaires.

Table.1: adopted parameters for correlation: urban violence, beer consumption, marketing outlets and social capital.

NEIGHBORHOODS	URBAN VIOLENCE	BEER CONSUMPTION (LITERS)	MARKETING OUTLETS	SOCIAL CAPITAL BY NEIGHBORHOODS
Planalto	61	15,16	3	0,401
Jardim das Esmeraldas	162	15,18	12	0,502
Serraria	103	3,68	3	0,559
Dez de abril	149	48,69	10	0,540
Fátima	51	14,11	8	0,519
Próspero	43	10,41	6	0,511
Santo Antonio	15	1,33	3	0,472
São José	37	6,56	4	0,523
Tamandaré	122	21,9	8	0,587
Santa Luzia	88	31,84	13	0,480
Liberdade	77	4,72	7	0,538
Centro	125	25,62	8	0,498
Triangulo	68	5,34	5	0,423
Caetano	28	2,83	5	0,485
Cristo Rei	20	6,17	6	0,576

Source: Field Data.

Research such as Fukuyama [5] which deals with social values and creating prosperity; Fukuyama [30] which addresses the social capital development; Ferrarezi [16] assigns concepts and contributions of capital to public policies; Marteleto; Silva [2] with the approach of information for local development; Rattner [12] which is concerned with the construction of social capital as a priority, help to better understand the need to discuss and

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build social capital ratio in order to analyze the correlations of the parameters, the possibility of highlighting the institutional arrangements, problems that afflict of the least favored population and the mechanisms of social network between the actors of the process in a certain location, or region.

The scaling of the index construction is guided in the work of Ocampo [13]; Portes [3]; Fukuyama [30]; Hutchinson and Vidal [11]; Krishna and Uphoff [14]; Santana [21].

V. FINAL CONSIDERATIONS

Therefore, it was observed that the social capital reached regular levels in the districts of Guajará-Mirim not observable, the correlations between the studied parameters, however, it needs to be detailed with other research methodologies and identification of more variables, since factors such as the flood of Mamoré River may have interfered in any way in the implementation process of the field survey to the residents of the city.

Moreover, it was evident that the municipality of Guajará-Mirim suffers from serious social problems and of the problems is correlated with the increase in alcoholic beverage market in the city and in possession of narcotics. However, was not observed as the institutional arrangements are dealing with this problem, that is, as public bodies are relating to discuss actions for concrete solutions to this vicissitude plaguing a portion of the population of Guajará-Mirim, especially young. However, it is expected to further research to understand this mechanism using other scientific tools to study the social network of interaction between the actors in this process in the region and its impact on regional development.

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