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CARTOGRAFIA MORFOLÓGICA DE QUADRAS E LOTES DE BAIRROS NO MUNICÍPIO DE JUÍNA, ESTADO DE MATO GROSSO, BRASIL

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RESUMO

Este estudo teve como finalidade identificar e analisar a cartografia morfológica e a densidade populacional das quadras e lotes da cidade de Juína- MT. Os dados foram coletados nos bairros: Módulo 1 e Módulo 6, com auxílio de técnicas e ferramentas topográficas de precisão. Posteriormente, os elementos foram processados em softwares de engenharia, os quais geraram plantas topográficas para os diagnósticos da topologia dos respectivos lotes e quadras. Os resultados mostraram que as quadras e lotes do bairro módulo 1 apresentaram formas ortogonais com densidade populacional de 28/habitantes por hectare e o Bairro Módulo 6 apresentou quadras e lotes com configurações mistas, ortogonais e não ortogonais e com densidade populacional com mais de 30/habitantes por hectare.

Palavras-chave: Plantas topográficas, diagnósticos de topologia, cartografia, paisagem urbana, densidade populacional.

MORPHOLOGICAL CARTOGRAPHY OF BLOCKS AND LOTS IN NEIGHBORHOODS OF THE JUÍNA MUNICIPALITY, MATO GROSSO STATE, BRAZIL

ABSTRACT

This study aimed to identify and analyze the morphological cartography and population density of blocks and lots of the city of Juína-MT. Data were collected in the neighborhoods “Module 1” and “Module 6” with the aid of topographic precision techniques and tools. Subsequently, the elements found were processed by an engineering software, which generated topographic plans to diagnose the topology of the respective lots and blocks. Results showed that blocks and lots of the Module 1 neighborhood presented orthogonal shapes with population density of 28 inhabitants per hectare, and the Module 6 neighborhood presented blocks and lots with orthogonal and non-orthogonal mixed configurations with population density of more than 30 inhabitants per hectare.

Keywords: Topographic plans, topology diagnosis, cartography, urban landscape, population density.

1 INTRODUCTION

Intense urban development in the 20th Century promoted transformations to territories in social and economic environments. For that matter, it is important to understand urban planning technical procedures for a better structuring of the city, and therefore a perfect organization of the morphology and demographic density of the spaces of a municipality.

To think of urban morphology and topology is to regard the need of understanding what urban space and landscape are. Lamas (1993) refers to the term "morphology" as the one used to designate the study of an object configuration. In parallel, Guimarães (2007) mentions that the term "urban form" means multiplicity and that the urban form structure translates exteriorities in common within distinct configurations. However, if "urban form" is a universe close to an infinity of individualities, the range of formal structures, on the other hand, is explained by some elements discovered in conglomerate city spaces and these elements can be assessed. Thus, in general terms, space is a set of networks linked to land use, for example, the implementation of a lot, the construction of buildings, the circulation of people and vehicles, and leisure areas. These sets of land use are the spatial organization of the city or of a place simply named "fragmented urban space". According to Cruz (2003), contingencies of production and circulation or reproduction of capital and society, as well as reproduction conditions themselves, determine an architected and built space occupied by objects and the basic rigid constructions implemented. For Carlos (2001) there are different ways for the appropriation of space and soil use. He lists individual's interests and needs, which are contradictory. Space occupation will not happen without contradiction, and hence without struggle.

As for landscape, Santos (1977) describes that everything we see is a transitory reality that is continuously forming itself. It is ever changing, that is, it will never be fully complemented and it changes in time: it is an ephemeral reality. In this way, it is possible to analyze structural landscapes in distinct Brazilian cities, for according to Teixeira (2010), the traditional urban structural landscape admits a concrete aspect that can be analyzed in the elements of architecture, in textures and materials, in sidewalks, streets and vegetation. For Carlos (2004), from the geographic point of view, the idea of landscape connects to a sphere contiguous to that of space production, pondered as a consequence of the alterations that human society concretizes as from nature in moments of productive forces increment and under their multiple forms of use, whether through the construction of housing and leisure or work activities.

Landscapes of cities, as per Pinheiro (2010), show the respective technique and community aspects that allow perceiving the dynamics of a municipality from different perspectives as well as the diagnosis of reality. They allow seeing its subversions and potentialities, the structural causes of key problems, land composition and how distinct forces operate in production, reproduction and consumption of the urban space and its respective layouts. It is important to guide the growth of cities through factors associated with a sustainable housing, road and infrastructure development in a cohesive and the most flexible possible way (Andreatta, 2008).

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In this way, the present research aimed to identify and analyze the morphological cartography and population density of blocks and lots of the city of Juína-MT, seeking to understand the best way of utilizing urban spaces.

2 BIBLIOGRAPHIC REVIEW

2.1 The layout of a city

The layout of a city is represented by its topologies, typologies and topographies, being an important instrument for the city. To illustrate these forms, Figure 1 presents layouts of neighborhoods of the city of Juína-MT. Ferro and Magli (2010) mention that the idea of tracing the orthogonality of a city initiated with Alexander the Great, founder of Alexandria in 331 BC. The city was delineated in harmony with the foundations of “orthogonal grid”. To reaffirm this theory, Kirkpatrick (2015) mentions in his research that the orthogonal grid plan, or rectangular plan, arose from the need to organize large cities of antiquity, whose precursor was a former city planner known as Hippodamus of Miletus (480-408 BC).

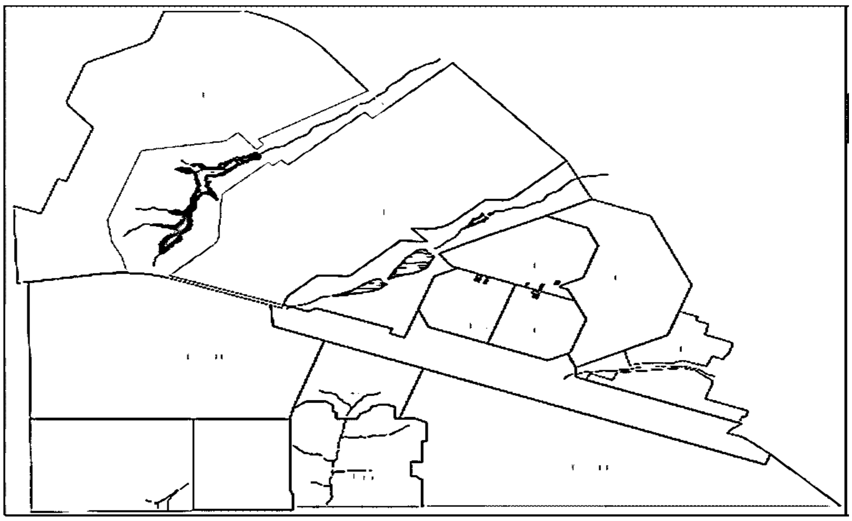

Figure 1: Layout of an urban area in Juína, Mato Grosso state. Source: Adapted from City Hall of Juína-MT

For Mascaró (2003) urban layout comprises the definition of avenues, streets and pedestrians precincts that are essential to make accessible different parts of the space to be adjusted. Rodrigues (2011) reports that the layout of cities is entirely connected to it growth, contributing to people’s mobility and accessibility. There are some types of urban layouts: they can be orthogonal, non-orthogonal and triangular. Figure 2 represents an orthogonal urban layout and it is possible to observe that the arrangement of spaces and streets is organized in a perpendicular way, forming angles of 90º in the meeting of sides, fronts and backs of lots and blocks.

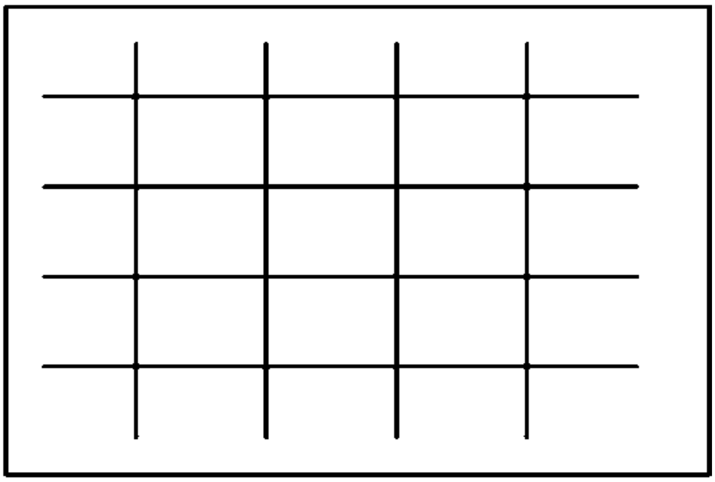

Figure 2: Orthogonal layouts model. Source: Adapted from Mascaró (2003).

Orthogonal grid is the most used project method for territorial structuring, which makes it meaningful for urban architecture (Fonyódi, 2008). The orthogonal structure is not only a shape, it is a method of establishing an urban system. Smith (2007) mentions that orthogonality, or the "grid" pattern, describes the use of straight angles in relation to edifices and cities. There is no doubt that in most cases the orthogonal layouts found in cities are a picture of central urban planning.

2.2 Non-orthogonal layouts

With respect to economy, non-orthogonal layouts present higher costs than orthogonal ones and provide "minimum" success rates, for they constitute irregular properties, consequently giving rise to a double financial loss. It is possible to observe this layout in figure 3.

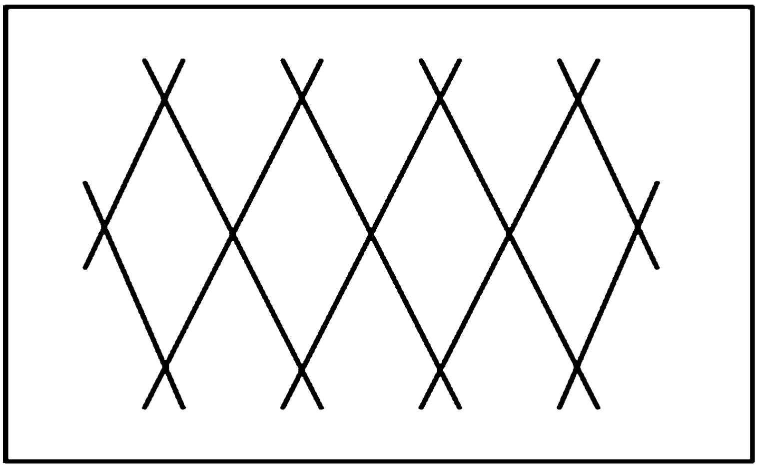

Figure 3: Non-orthogonal layout model. Source: Adapted from Mascaró (2003).

In the non-orthogonal layout, lots and blocks have angles smaller or bigger than 90º called "acute" and "obtuse", providing irregular geometric forms to certain localities of a city. Among those layouts, the orthogonal one is the most used and it is inexpensive. The other layouts generate higher costs for municipalities and are of less use in the implementation of land subdivision, because of the many irregular lots that would make spaces less exploitable. Non-orthogonal shapes are applied in terrains with higher slope, aiming to improve land use and occupation (Miranda et al., 2017).

2.3 Land use and occupation: lots and city blocks

In the decades of 1930 and 1940, urban planning was initiated in Brazil as a broad process of participative, innovative and globalizing planning in the sense of changes and improvements in urban development sceneries, seeking to delineate guidelines to make the desirable reality existent in the city one longs for (Duarte, 2007).

According to Mascaró (2003), city blocks are urban spaces surrounded by streets. They are part of the urban planning of a city and give rise to significant problems in corners (triangular and trapezoidal forms in lots), when considering the minimum requirements for the planning of city spaces. For Heryé (2012) lots and blocks easy to delineate on paper could be hard to delimit in the field due to the different topologies and topographies of the terrain.

From the economic point of view, lots shall have the greatest depth possible so that their urbanization cost decreases. As for their use, they should be as close as possible to the most square or rectangular forms, as shown in Figure 4. In these lots, houses can be designed more freely and offer better solar orientation.

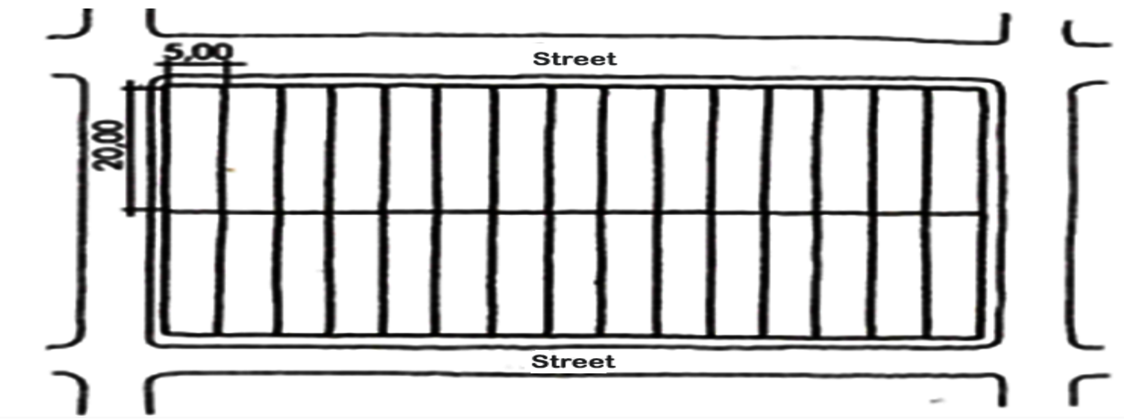

Figure 4: Conventional Block. Source: Source: Adapted from Mascaró (2003).

In the case of irregular lots, they are harder to follow a pattern for they accompany the terrain slope, that is, the rougher the land the more irregular the geometric form of the lot, as shown in figure 5.

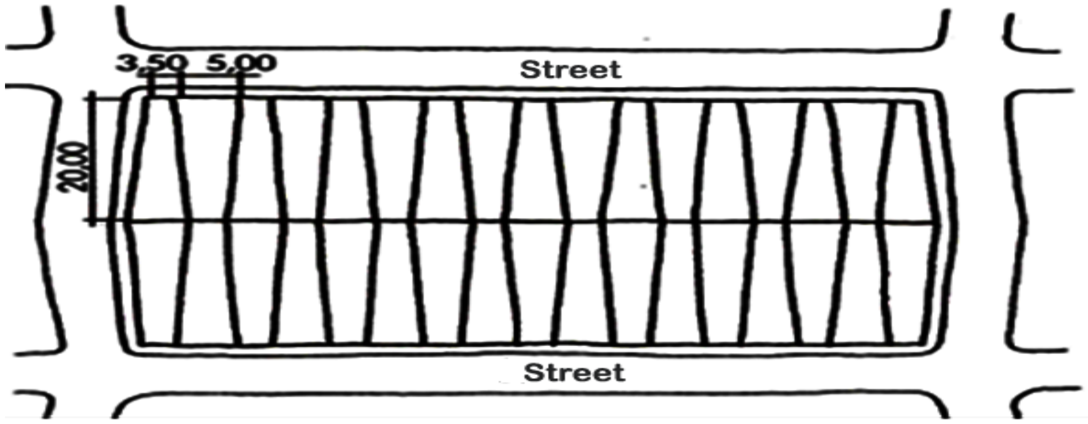

Figure 5: Blocks with trapezium-shaped lots. Source: Adapted from Mascaró (2003).

The main questions compiled in this research relate to population density and the morphology of blocks and lots in the neighborhoods “Module 1” and “Module 6” of the municipality of Juína-MT, keeping as guiding principles the orthogonal and non-orthogonal configurations of these spaces. In this sense, it is important to highlight the concept of lot and city block. Lamas (1993) clarifies that a block is a set of constructions interconnected with one another in circle or in a closed system separate from the others. It is furthermore the space delimited by the crossing of three or more streets and it can be subdivided in parcels of lands (lots) registered for the construction of buildings. Besides, he states that the block establishes an organization of urban structure between lots, constructions, streets layout and their interactions with public, semi-public and private spaces.

For Castilho (2012) lot is the parcel of terrain susceptible to population occupation, constituted by a rural property urbanization process, where private and public activities are intercepted. According to ground division federal law n° 6766/79 (included by Law 9785, 1999), lot is a land with basic infrastructure and dimensions in accordance with urban indicators defined by the director plan or the municipal law of the zone at which it is located.

2.4 Population density

It is also important to highlight population density, which is the measure obtained by the number of inhabitants per hectare. However, a very high density can generate a concentration that harms the quality of urban services rendered (Mascaró, 1987), as illustrated in Table 1.

Table 1: Relations between densities and problems originated by urbanization. Source: Adapted from Mascaró (1987).

NET DENSITY	EMENGENCE OF THE PROBLEM
30 families per hectare or more	Problems with noise and loss of privacy appear
100 families per hectare or more	The sense of privacy in green spaces is lost

200 families per hectare or more	Difficulties to find space for parking and recreation appear
450 families per hectare or more	Public space becomes totally congested

As per Silva et al. (2016), discussions on urban density in the national and international conjuncture shall not be generalized, for geographic, demographic, socioeconomic and cultural peculiarities may be different. The authors mention that the concepts of high and low density and what is admissible or not are very peculiar for distinct continents, countries, cities or neighborhoods. Table 2 presents a study performed by them, which comprehended the relations between densities and the emergence of problems in urbanization. Results differed from those of Mascaró (1987).

Table 2 – Relations between densities and the appearing of problems in urbanization. Source: Silva et al. (2016).

NET DENSITY	SOME CONSEQUENCES
100 inhab./ha	Problems with noise and loss of privacy appear
300 inhab./ha	The sense of privacy in green spaces is lost
600 inhab./ha	Difficulties to find space for parking appear
1500 inhab./ha or more	Public space becomes totally congested

Gomes (2012) explains that with the widening of demographic density, urban centers become denser. Hence, a rise of the population in search for cities' peripheral spaces is inevitable. With the absence of order and control in the occupation of these areas comes densification within an environmental context.

According to Zmitrowicz (1997), density integrated to imperfect urban and habitation designs lead to lower rates of quality of life. According to Reis (2006), urban expansion is directly linked to a urban density characterized by a disperse urbanization marked by the appearing of new neighborhoods distant from the center of the city, spreading the urban mesh into different ways, encompassing private condominiums, popular housing complexes, slums, new developments, among other elements present in the urban space.

Urban dispersion can then be understood as a rise of the urban fabric that is characterized by low density or by discontinuity or low physical integration in relation to the already existent urban fabric, or by the combination of both characteristics. A balanced analogy between more and less dense areas, axes of public transport, public spaces and the offering of services can institute more efficient and successful urban areas (Pacheco, 2017).

3 METHODOLOGY

The study was carried out in the municipality of Juína-MT, a town located at approximately 730 km from Cuiabá, the capital city of the state of Mato Grosso. In geographic coordinates, its position is 11º22'42" south latitude and 58º44'28" west longitude. Altitude is 422 meters in relation to Geoid, the sea reference level. The city of Juína-MT is divided in neighborhoods considered “modules”, besides adjacent sectors where each module represents a neighborhood. Figure 04 shows its location within the Brazilian territory.

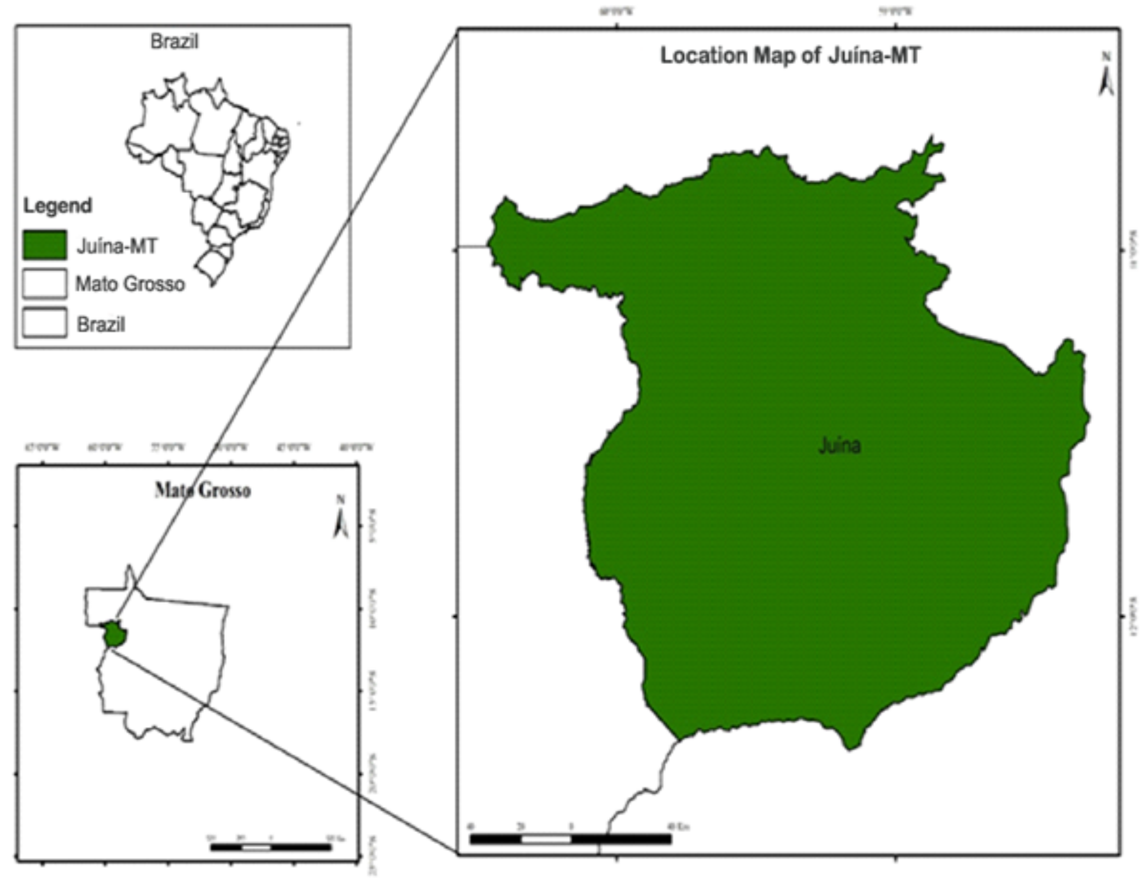

Figure 6: Location of the city of Juína-MT.

Source: Adapted from City Hall of Juína-MT, 2017.

The informative data of the present research were registered under criteria that demanded accuracy. They were mostly obtained with the aid of an equipment used in topography called “Total Station”, with angular accuracy of 20” and linear accuracy of 1/10000, as well as cartographic information from the City Hall of the town. Godoy (1988) mentions that topography defines the contour, dimensions and position of a limited portion of land surface, which objective is the generation of cadastral topographic plans and maps of the actual situations found in the place of interest.

Total surveyed area presented 453 built lots and 17 vacant plots in the neighborhood “Module 1”, and 1243 built lots and 1205 non-built lots in the neighborhood “Module 6”, making a total of 163 blocks. In this way, in order to meet the aims of this research, the exploratory descriptive systemic approach was employed as a scientific reference, which central theme were cartographic morphological studies and the population density of the samples. Afterwards, a diagnosis and a prognosis of the situations found in blocks and lots were carried out with the aid of topographic plans and maps generated through topographic data collection performed *"in loco",* with a view to characterize orthogonal and non-orthogonal spaces, as well as the demographic density of the referred blocks and lots.

4 RESULTS AND DISCUSSION

4.1 Module 1 Neighborhood

It was verified that city blocks, lots and public areas of the Module 01 neighborhood kept standard dimensions of 168m X 80m, whereas its layout followed a conventional orthogonal archetype with angles of 90º in all its vertices. Lots had the following dimensions: right and left sides of 40m each, backs of 12m and front of 12m, making up an area of 480.00 m² for each plot. Public footpaths and widths of streets in the Module 1 neighborhood accompany the values of Table 3. A basic characteristic of the road system is the orthogonal mesh structure, which articulates urban expansion by means of structural axes, with important collector and local streets.

Table 3: Streets and public footpaths measures in the Module 1 neighborhood.

Armando Ganzer Street	Local Measures
Width	14.20m
Public footpath (sidewalk)	3.0m
Carriageable road	8.20m

It was possible to verify from the available data that blocks and lots of the Module 1 neighborhood follow the same configurations as the original project from the time of creation of the municipality of Juína-MT, keeping its orthogonalities. Only a small part of lots had alterations in their dimensions due to division and reassembly processes, as per Figure 7.

Figure 7: Module 1 neighborhood orthogonal layout.

Source: elaborated by the authors, 2014.

The relation between population and the defined area of study of the Module 1 neighborhood was of approximately 28 lots/ha. In the face of the analysed data and with the intention to interpret occupational and morphological dynamics, Mascaró (1987) is quoted where he mentions that, with an average of 30 families per hectare or more, problems with noise and loss of privacy appear. In that respect, the proportion of lots per hectare is within the occupational urban parameters for densification.

4.2 Module 6 Neighborhood

Lots, blocks and public areas of the Module 6 neighborhood accompany an orthogonal and non-orthogonal mixed configuration different from the Module 1 neighborhood, which has an orthogonal shape.

From the topographic survey of the Module 6 neighborhood, one observes that some city blocks have over 30 lots on average each, as seen in figure 8, when problems with noise and loss of privacy come up, as already mentioned.

With densities increase comes challenges. Factors linked to economy end up moving people away from cities' centers and conducing them to further agglomerates, where the price of dwellings is usually cheaper. These urban spaces become highly dense, which blocks the ingress of basic urban services, being more vulnerable to criminality and natural disasters (Pacheco, 2017).

Neighborhoods with high densities might overload and motivate saturation in infrastructure and urban services networks, placing more influence of demand over urban soil and, thus, generating an overpopulated environment that is improper for urban development (CODEPLAN,2017).

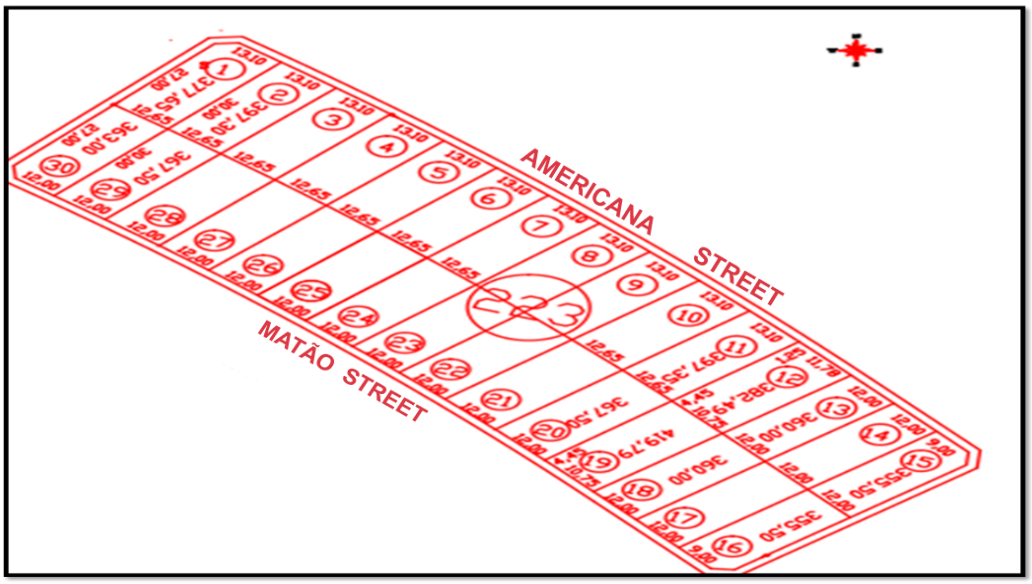

Figure 8: Topographic plan of the Module 06 non-orthogonal block "223".

Source: City Hall of Juína- adapted by the authors (2017).

In 2014, there were 783 buildings registered for Module 06 in the city hall. This number rose up to 1243 in 2017, when there were 1205 non-built lots. They contained an average of 34 lots per block with dimensions of approximately 13.10m X 12.65m, making up an average total area of 397.30m^2 within patterns of lots that did not follow a single format only and which deviated from the official map approved in the city hall.

In view of the numerous aperiodic areas that the place possesses, it was possible to perform its mapping through geo-referenced topographic data collection of areas not regularized by the municipality, according to the following space localization coordinates: 58º47’21.4”w, 11º25’37.3”s, 58º46’53.00”w, 11º26’22.50”s, 58º46’58.00”w and 11º26’25.5”s. The overlay of image with the local topographic plan showed the irregularity of lots and blocks that were not placed as per the original project (see Figure 9).

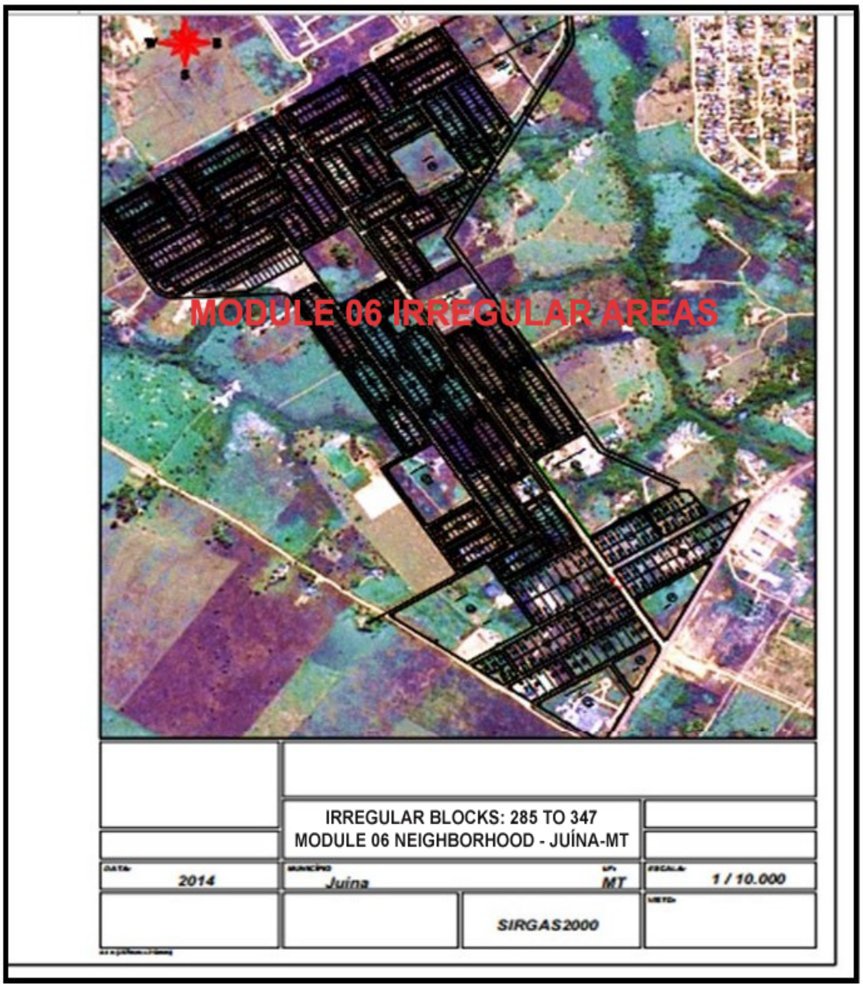

Figure 9: Module 6 neighborhood irregular areas.

Source: authors, 2014.

The provision of proper lands to low-income populations is a fundamental issue when it comes to avoid environmental and social risk. However, the search for more sustainable urban archetypes appears, on the one hand, in a context of population densification and activation of central areas as exploitable spaces and, on the other hand, by improvements in peripheries. To strengthen the use of urban space by emphasizing quality of life with decent and regular housing is a minimum factor for social and economic development (Brasil 2014).

With regard to the width of streets and sidewalks verified in the Module 06 neighborhood, we can mention that their dimensions are comparable to those of the Module 01 neighborhood, the only difference lying in its layout, which follows an orthogonal and non-orthogonal mixed mesh (see Table 6 for Collector Street and Table 7 for Local Street).

Table 4: Streets and public footpath measures of the Module 6 neighborhood – collector streets.

Nova Granada Collector Street	Local Measures
Width	12.50 m
Public footpath (Sidewalk)	2.0 m
Carriageable road	8.50 m

Table 4 shows the width of a collector street named Nova Granada of the Module 6 neighborhood, with sidewalks of both sides measuring 2.0m each, carriageable road of 8.50m, and a total width of 12.50m.

Table 5: Streets and public footpath measures of the Module 2 neighborhood – local streets.

Local Streets	Jundiaí Street Local Measures
Width	12.00 m
Public footpath (Sidewalk)	2.0 m
Carriageable road	8.0 m

Table 5 shows the width of a local street named Jundiaí in the Module 6 neighborhood, with sidewalks of both sides measuring 2.0m each, carriageable road of 8.0m, and a total width of 12.00m.

For Rodrigues (2011) public streets are diametrically placed over the natural geography of the city, influencing the accommodation and hierarchy of buildings and blocks and connecting their spaces.

5 CONCLUSIONS

Data of the present research have resulted in meaningful information for understanding the morphological cartography and population density of blocks and lots of Modules 1 and 6 in the city of Juína-MT. It was verified that blocks and lots of the Module 1 neighborhood presented orthogonal cartographic configurations, lots were practically homogeneous and followed an angle of 90º and its shape was always rectangular, except for lots that had suffered division and reassembly. It was also found that its infrastructure met the needs of the local population. Blocks and lots of the Module 6 neighborhood afforded, in turn, orthogonal and non-orthogonal mixed heterogeneous forms with irregular morphologies.

This study has been important, too, for characterizing the most efficient shape for implementation in land subdivision (orthogonal or non-orthogonal). Scholars and researchers of urban planning quoted in this article mention that by using the non-orthogonal model verified in Module 6, the length in meters of streets and general networks per lot present a cost 20% to 50% higher than that of orthogonal meshes found in the Module 1 neighborhood. In these conditions, it is evident that the most efficient model for the implementation of a lot depending on terrain topography is the orthogonal layout.

With regard to population density, the Module 1 neighborhood presented a proportion of 28 lots per hectare, whereas Module 6 had more than 60 lots per hectare. According to authors previously quoted in this research, a very high density can generate a concentration that harms the quality of urban services provided to population. This situation was verified in Module 6, and in spite of it being a recent neighborhood, the increase of population density has been bringing about problems to urban infrastructure, such as empty spaces, irregular areas, and lack of pavement and sewage network.

However, the present study has evidenced that morphological cartography and urban population density are valuable externalities in the search for balance between the quality of life of the population and the environmental and urban condition of a city. In conclusion, this type of morphological analysis proved to be relevant and may serve as guidance to municipal managers and all the community that work with urban planning.

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