

Analysis of The Current Situation of Irregular Dwellings in The Black Land Neighborhood of Manacapuru-Am: Causes and Consequences

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ABSTRACT

The present work aimed to perform an analysis of the current situation of irregular dwellings in the black earth neighborhood of Manacapuru-AM using geotechnologies. The methodology consists in identifying the irregular occupations of the neighborhood, and demonstrating the problems encountered as well as the possible solutions. The information obtained was used to generate the diagnostic maps to analyze the characteristics of irregular dwellings and if they have water and sewage network, waste collection, junk dump and drainage network, because it is a simple technique, it is possible to be used in other neighborhoods of Manacapuru, being extremely important in helping public policy planning and environmental monitoring.

Keywords: geoprocessing, master plan, sanitation, irregular use, black earth.

1. INTRODUCTION

With the population growth of cities, social and environmental problems such as irregular occupations and risk areas arise (MENDONÇA, 2004; ALMEIDA and TRINDADE, 2017; PEREIRA, 2019). Thus, with less physical space and / or financial conditions, the less privileged part of the population often choose to occupy areas of risk and / or preservation, and in some cases are responsible for soil degradation, riparian forests, water bodies, springs. and slopes (SAMPAIO et al., 2003). The identification of environmental degradation by anthropic action in the Pernambuco forest zone was studied by Lorena et

al. (2018). The authors used geoprocessing techniques from 2006 to 2011 to show that anthropic action and deforestation are the main responsible for the degraded areas along the banks of the Tapacurá River.

In addition, the socioenvironmental impact of these irregular occupations and constructions may increase the cost of water treatment and threaten the quality of distributed water due to urban pollution (GUERRA, 2017). The proposal of a methodology to evaluate the impact of land use and occupation on water quality in small and micro watersheds in rural areas was the main objective of Silva (2018). While Pereira (2010), Perin (2013) and Martins (2014) showed that water resources can be impacted by land use and occupation.

At the same time, population growth has become one of the main factors that has been constantly affecting the environment and the reality of urban areas. Nowadays this growth has become a challenge, as we must specify what is regular and irregular within the urban context, so that the areas where they particularly want to occupy are in accordance with current legislation. However, to say that it is appropriate or not about the extent to which it is intended to occupy is in such a way as to meet the expectations of accommodating the city's population with at least the basic sanitation provided for by law (MARTINS, 2006; FREITAS *et al.*, 2017).

However, associated with irregular occupations are landslides, favored by the removal of the vegetation cover (FREIRE *et al.*, 2018; DE ALENCAR SILVA, 2018) and impermeable soils. Residents of these areas poorly use basic sanitation, such as reservoir water supplies and drinking vessels, causing damage to public health and the population's own development, as basic sanitation has become essential for society and for the protection of the environment. Thus, it is essential to study these areas to obtain the planning and to know which areas are irregularly occupied (TASCA *et al.*, 2017).

Brazil is one of the countries with one of the highest rates of social inequality in the world, where part of the population lives in places considered inappropriate by illegality or due to the risk of disasters. The Terra Preta neighborhood, located in Manacapuru Municipality, has permanent preservation areas such as: steep slopes, hilltops, waterfronts and water bodies, wetlands, etc., however, the residents occupy these unsuitable areas for housing, endangering your safety (COSTA, 2018).

However, households do not have enough income to acquire the land, as land has become a source of monetary wealth. Unfortunately, construction in irregular areas has brought serious environmental and urban problems (SILVA and MORAES, 2018). Technically, the soil is a legal institute that is responsible for allocating the areas where the buildings can be built according to the master plan. Thus, without the planning established through master plan the houses are unable to be considered worthy of occupation, ie, occupations without any control of the public power (REIS, 2019).

Thus, through geoprocessing, the situation of irregular dwellings in the Terra Preta neighborhood in the municipality of Manacapuru was analyzed, thus showing possible solutions to the problems encountered, with the objective of guiding the public managers of the municipality. Finally, residents were made aware of irregular occupations and the risks they expose.

2. MATERIAL AND METHODS

The study was limited to the Terra Preta neighborhood in the municipality of Manacapuru which is located on the left bank of the Solimões River in the state of Amazonas (as shown in figure 1). First, an analysis of the legislation was carried out to specify the laws that regulate land use and occupation in the city. Given the diversity of irregular occupations in the Terra Preta neighborhood, it was necessary to elaborate a typology of such areas, to facilitate the identification and subsequent characterization in loco. The master plan of Manacapuru / AM was used as a basis for the identification of land use and occupation based on current laws. For these are a basic instrument for planning and guiding the development policy and planning of urban expansion and social functions of the municipality.

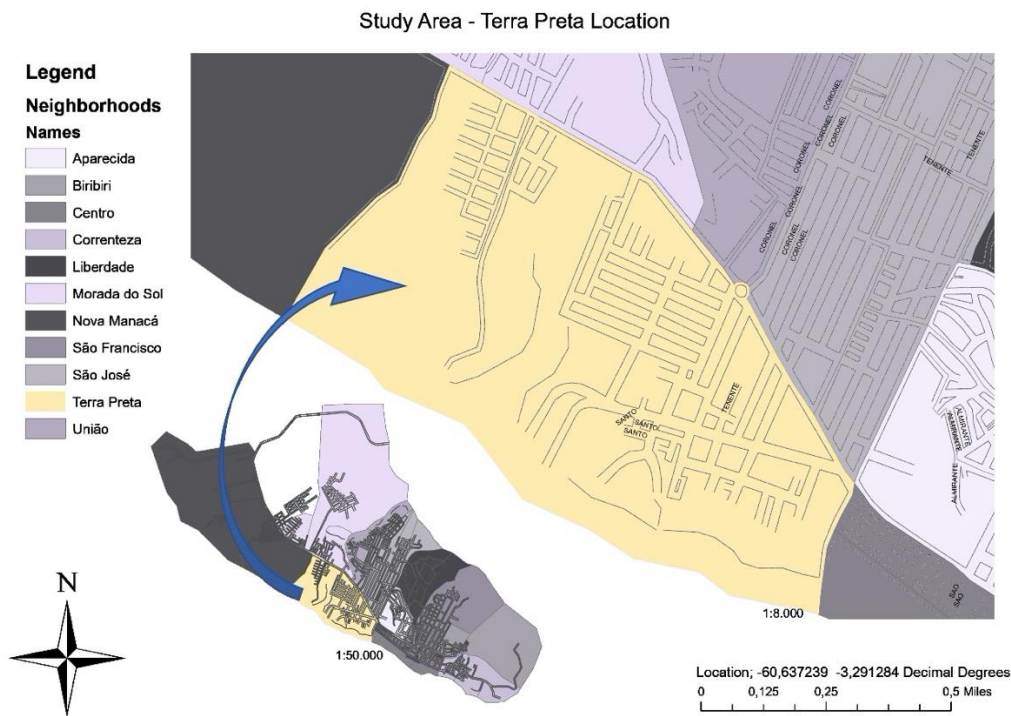


Figure 1: location of the area of the black earth neighborhood of the municipality of Manacapuru.

Subsequently, field measurements were performed over a three-month period (from June to August 2019). The field information obtained by the GPS receiver (GPSMAP 78S GARMIN), were prepared diagnostic maps that served as a tool for the identification and analysis of irregular occupations present in the neighborhood. After checking the diagnostic maps, the characteristics of each irregular dwelling were analyzed, such as presence of water and sewage network, waste collection, junk dumps and drainage network.

The data obtained in loco were tabulated so that the columns represented latitude in x and longitude in y, converted to decimal degrees. Subsequently, the information was saved in xls format (Excel) making it easy to export to the Arcgis version-10.3 environment. Finally, a visual comparison analysis was performed between the updated maps of irregular occupations generated on the spot, and the data obtained through the survey of the municipal (Civil Defense Secretariat) and federal (Brazil Geological Service-CPRM) public institution.

Thus, from the analyzes it was possible to understand the process of expansion or paralysis of irregular occupations, and the possible estimates generated by the maps of the municipal master plan. Following the previous step, the streets that have basic housing infrastructure were identified, such as: water and sewage network, drainage network, waste collection and junk dumps. Finally, based on the information generated, improvement proposals were generated for the neighborhood.

3. RESULTS AND DISCUSSIONS

MASTER PLAN

Manacapuru is one of the member municipalities of the Manaus Metropolitan Region - RMM, a Brazilian metropolitan region created on May 30, 2007 by Complementary Law No. 52/2007 and amended on January 27, 2008 by Complementary Law No. 59 encompassing Manacapuru Municipality. , according to the IBGE population estimate (2018), the population at the moment of the census is 96,236 inhabitants, distributed over a territorial extension of 7,336,579 km².

According to the federal constitution, article 182 and 183, the master plan is an indispensable municipal law for municipalities with cities with population of more than 20,000 inhabitants and which should be a basic instrument of the municipal policy of urban development and expansion, which has as its objective aim to order the full development of the social functions of the city and to ensure the well-being of its inhabitants. Article 182 of the federal constitution states that the policy of urban development and expansion, of which the master plan is the basic instrument, must express the fundamental requirements of city ordination, since the constitutional text includes housing, sanitation urban transport, and the planning and control of urban land use, of land parceling and occupation.

Thus, the master plan of the municipality of Manacapuru was prepared by law No. 52 and approved on October 10, 2006, so that the municipality from this law meet the determinations imposed by the statute of the city law No. 10,257 of 10 July 2001 and the Brazilian Constitution (1988). The master plan of Manacapuru is based on the laws of land use and occupation, it is observed in table 1 that it states that the land parceling is not allowed according to art.54.

Items	Category
I	On land located in preservation areas, as provided by this law and its regulations;
II	In flooded or flood-prone land, before steps are taken to ensure runoff;
III	On land that has been grounded with material harmful to public health without being previously;
IV	On land in protected areas, in accordance with this law and its regulations, without complying with the guidelines set forth therein;
V	Prevent free access to rivers;
VI	On land with a slope equal to or greater than 30% (thirty percent), unless the specific requirements of the competent authorities are met;
VII	On land where geological conditions do not advise building;
VIII	In ecological preservation areas or those where pollution impedes bearable sanitary conditions until their correction;

Table 1: Areas not permitted for land use.

Source: Master Plan (2006).

Therefore, from the information described in the master plan of Manacapuru / AM it was possible to detect in loco the basic characteristics for the identification of land use and occupation from the current laws and the typology used based on art. 54 described in Table 1, which facilitated the identification of a variety of irregular occupations in the Terra Preta neighborhood, such as: occupation in flooded or flooded land, land in protected areas, in land with slopes equal to or greater than 30%, on land where geological conditions do not advise the building, shown in Figures 2,3,4 and 5.



Figure 2: Flooded houses during floods.



Figure 3: The houses after the flood.



Figure 4: Terrain with slope greater than 30%.



Figure 5: House destroyed by ground mass movement.

DIAGNOSTIC MAPS

The diagnostic maps were elaborated as a tool for the identification and analysis of the irregular occupations present in the Terra Preta neighborhood. In which the verification of these maps was possible analyzes the characteristics of each irregular dwelling in the neighborhood, such as presence of water and sewage network, waste collection, junk dumps and drainage network within this urban space. The data collected on site were necessary to perform a visual comparison analysis between the maps prepared in the 2006 municipal master plan along with the existing land use and occupation guidelines for land subdivision, and the data obtained through the institution survey. (Civil Defense Secretariat) and federal (Brazil Geological Survey-CPRM) public area delimiting areas considered inappropriate for housing.

Figures 6 and 7 show the areas of the Terra Preta neighborhood considered by the master plan, the geological service of Brazil-CRPM, and the municipal civil defense secretariat as irregular occupations. The villas are made up of all kinds of materials in which they are set on steep hillsides that lead to streams and rivers, with risk of slipping, since there are ravines and cracks in the hillside and many walls and walls have cracks. At the base of this slope are houses that are at risk of material.

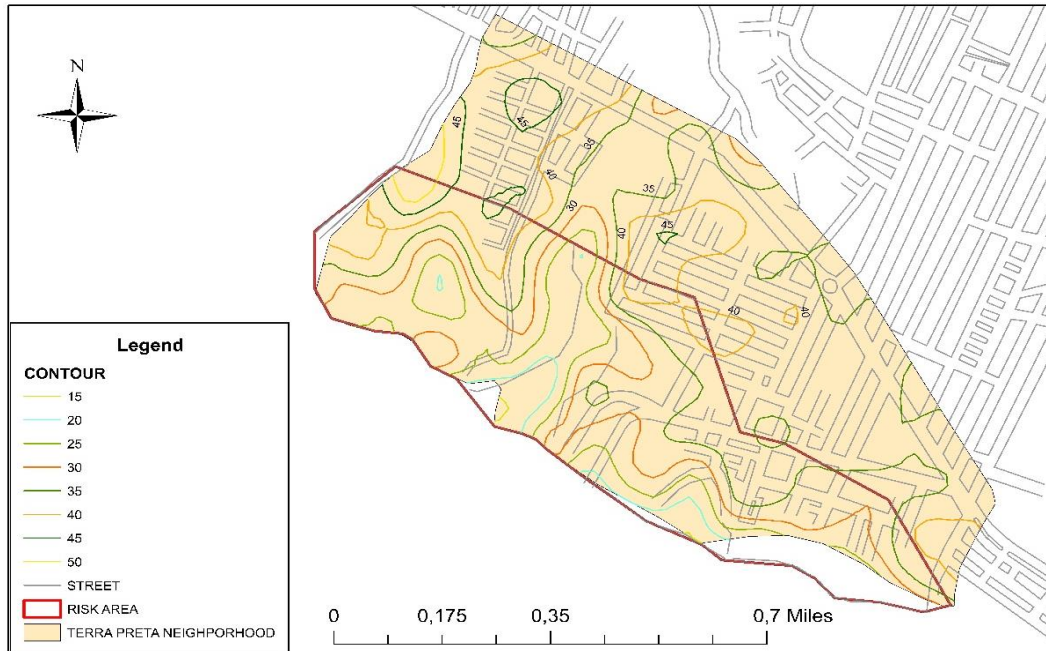


Figure 6: Map of the old and current risk areas of the Terra Preta neighborhood in Manacapuru-AM.

In the lower zone, houses are built on stilts, as they constantly suffer from flooding events as shown in Figure 7.

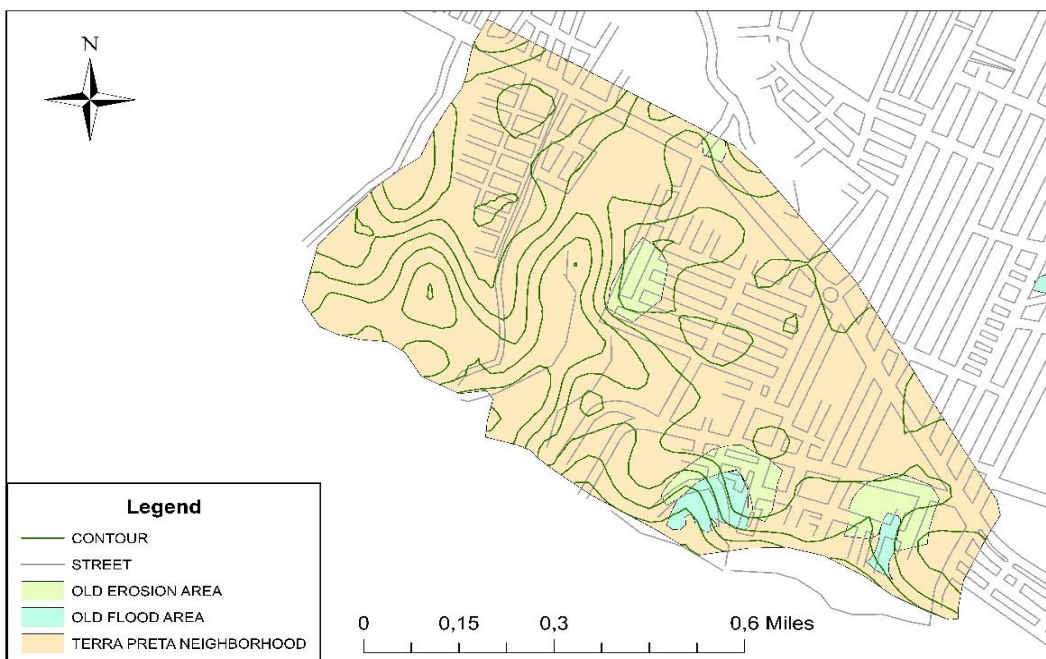


Figure 7: Map of old and current flooding and erosion areas of the Terra Preta neighborhood in Manacapuru-AM.

For housing installation vertical slopes are common for slope, there are sloping trees, banana trees on the slope, solid waste, wastewater thrown by PVC pipes and septic tanks at the top of the slope saturating and eroding the soil, absence of sewage or rainwater drainage system, as well as a slip scar show instability of the area. The Terra Preta neighborhood is located on the edge of Manacapuru, where the Solimões river turns and undermines the ravines, causing the phenomenon of fallen lands, especially during the ebb. Thus, the river is an extra risk factor for these riparian residents as there is a record of landslide with fatalities.

In October 2010, according to CPRM, three children died due to a large rotational landslide that hit some houseboats, several regional boats and canoes. In March 2017, civil defense relocated the population affected by a landslide in the black earth district on the riverside street leading to the deaths of some residents (Figure 6). Due to this disaster, the municipality declared an emergency situation in March. This natural event was recognized by the Federal Government, and families who had their homes destroyed received relief until their needs returned to normal, totaling 41 families who had their homes invaded by land and currently the affected are on paid social rent. by the City Hall of Manacapuru.

Area near the steep slope, are over 30 m high, and high slope in several stretches, where houses are a few meters high on the slope.

According to CPRM currently in the area known as Beco do Boto, there are houses on the edge of a steep terrain slope, with a height of approximately 20 m, with a slope ranging from 60-80 °, with houses at the top of the slope. In the lower part, it is constantly flooded (Figure 7) and presents greater landslide potential because it consists of consolidated silt-silt sediments, sawdust and solid waste discharged into these sediments.

From 2013 to 2018 there was an increase in the size of risk areas accounted for by CPRM. An allotment was newly built on the other bank, which in this case is less steep of the stream, and even with low slope may have poorly competent soils (Figure 6). In 2013 about 161 properties and approximately 644 people were at risk, and in 2018 around 261 properties and approximately 1,305 people are at risk. In 2019 civil defense accounted for 95 families that suffered flooding about 380 people in the black earth neighborhood and 2 families on the riverside street by soil mass movement (Figura7).

In this way, Terra Nova district, like any other district in Brazil, suffers from various problems related to irregular occupations, and one of them is the lack of basic sanitation, in which the disorder with the disposal of garbage in public places and private wastelands are easy targets. for the irregular disposal of waste of all categories, as well as disturbing by its stench and attracting insects and rats, as well as causing difficulties in the rainy season, when the waste is carried by water into manholes, causing flooding. . Figure 8 shows the map of the current and old junk dumps in the Terra Preto neighborhood, which was compiled with data from the 2006 municipal master plan and current data collected on the spot to check for an increase in junk dumps over the years. Given this it was found that 2006 had 11 points of junk dumps and currently 26 points, so there was a significant increase in junk dumps in the neighborhood and a third of this increase is due to irregular occupations, since in some streets the garbage truck does not pass to collect this waste as shown in Figure 9.

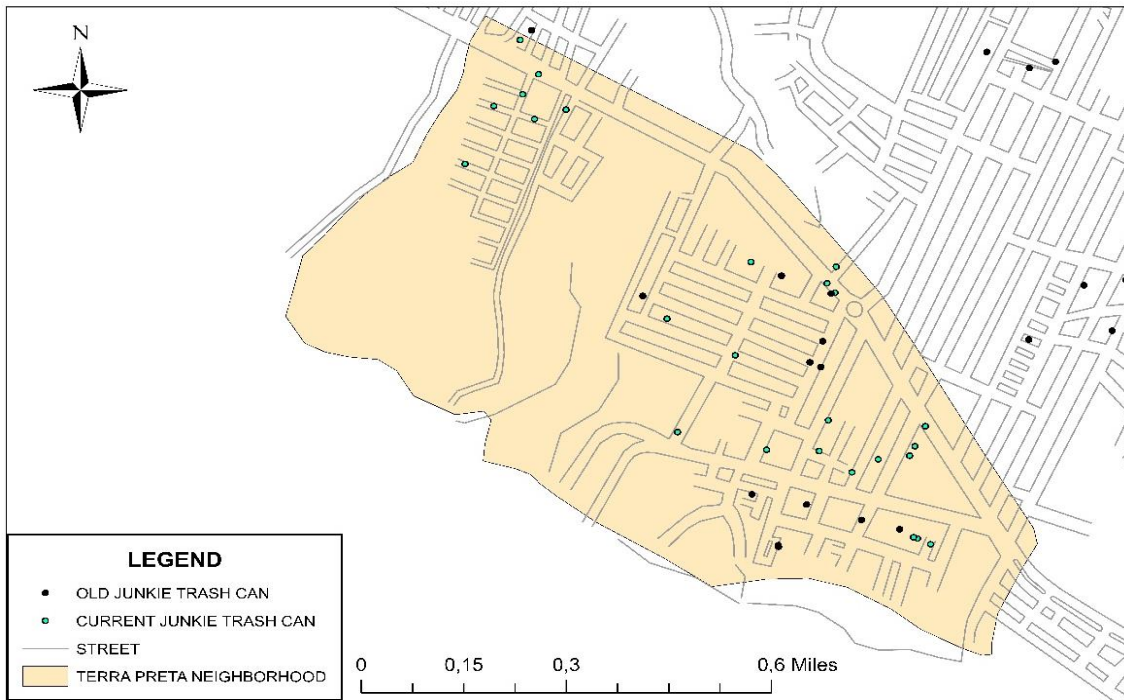


Figure 8: Map of old and current junk dumps of the Terra Preta neighborhood in Manacapuru-AM.

The neighborhood home garbage truck routes (Figure 9) currently still suffer from street infrastructure, often companies are unable to meet all demand as a result of not being able to reach the streets of irregular occupations and have as their One of the main consequences is the increased generation of municipal solid waste and many of this waste is dumped in areas protected by law. That, however, these effects cause harm to human health and the environment, and the most frequent are divided into physical, chemical and biological agents that are present in solid waste. It is observed that in 2006 garbage trucks did not cover most of the routes, but there is currently an increase in the areas covered by the services. Therefore, as it is an area that is difficult to reach, the companies responsible for garbage collection generated in these places do not act effectively.

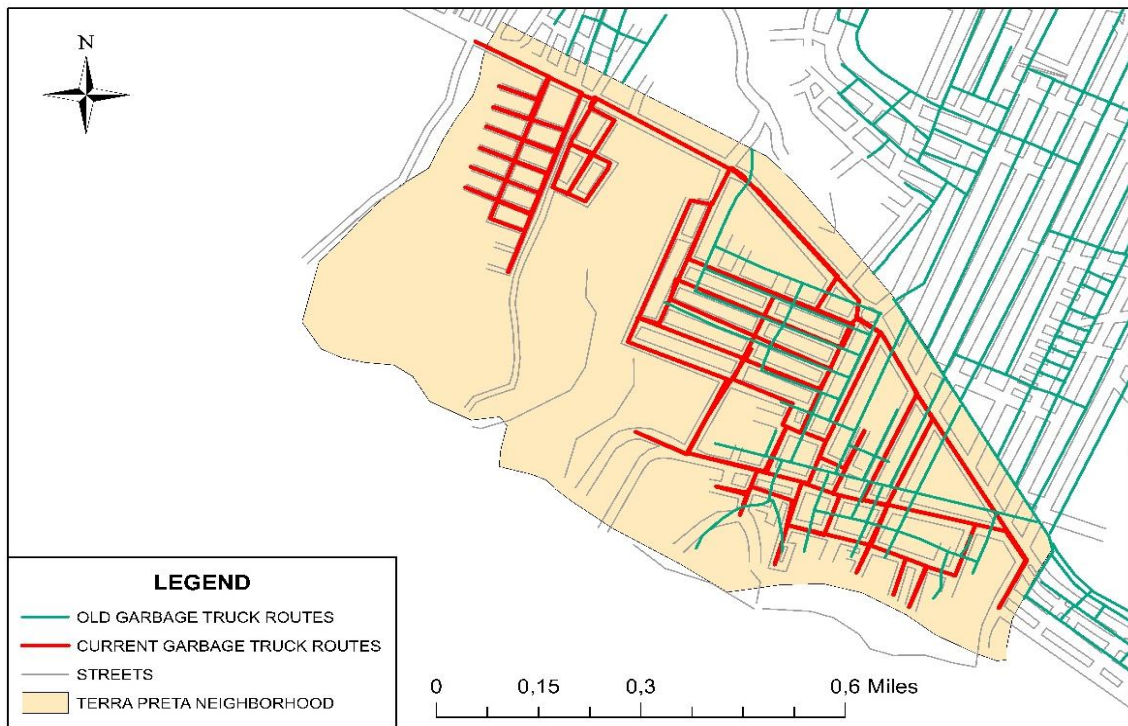


Figure 9: Map of the old and current routes of the home collection trucks of the Terra Preta neighborhood in Manacapuru-AM.

Since the routes cannot reach these places, the neighborhood is disturbed during the rainy season, when the waste left by them is carried by the waters into manholes, causing floods that often cause disease, damage and disrupt traffic, among other consequences. To avoid these catastrophic events, the master plan requires manholes to be laid out, as well, making it clear that there are areas in the cities and surrounding areas that should not be occupied: riverbanks, dune and native forest areas, the slopes above a certain range. quota and among others. They are included in the forest code and the law of permanent preservation areas. In addition to the problems of waterproofing the land and the destination of the garbage in these areas, the construction of dwellings in the canals bed stands out, reducing its cross-section and, consequently, the runoff, causing urban flooding. Much of the black earth district obtains manholes, as shown in Figure 10, totaling 39 manholes in 2006 by the master plan and 46 currently collected on-site. It can be observed that there is still a decrease, as well as the houses that are located in areas. inadequate have no drainage network.

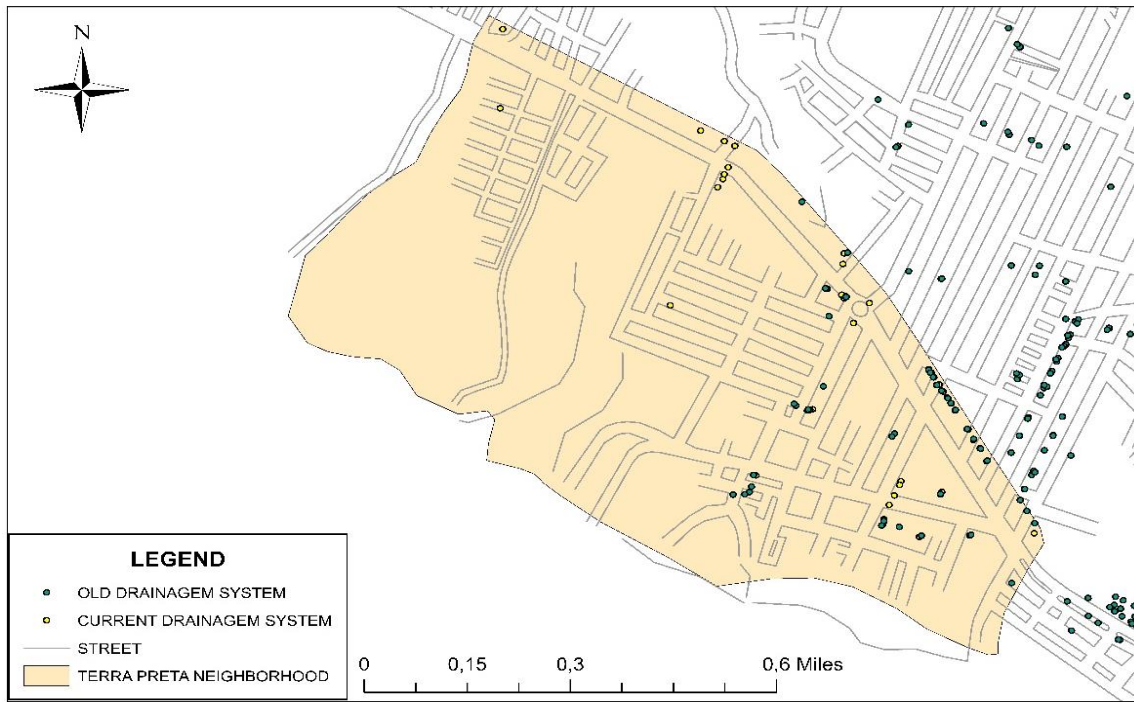


Figure 10: Map of the old and current wolf's mouths of the Terra Preta neighborhood in Manacapuru-AM.

The neighborhood's water supply system initially involves the capture of raw water from the environment, then there is adequate treatment to make it drinkable and, finally, there is distribution to consumers, in sufficient quantity to meet their domestic consumption needs, utilities and other uses. The neighborhood as a whole receives this service, that is, even in areas that are improperly occupied receive water from the water reservoir. Figure 11 shows two reservoirs in the master plan map, but which currently do not reside in these stipulated locations, but two reservoirs were built to supply the population elsewhere.

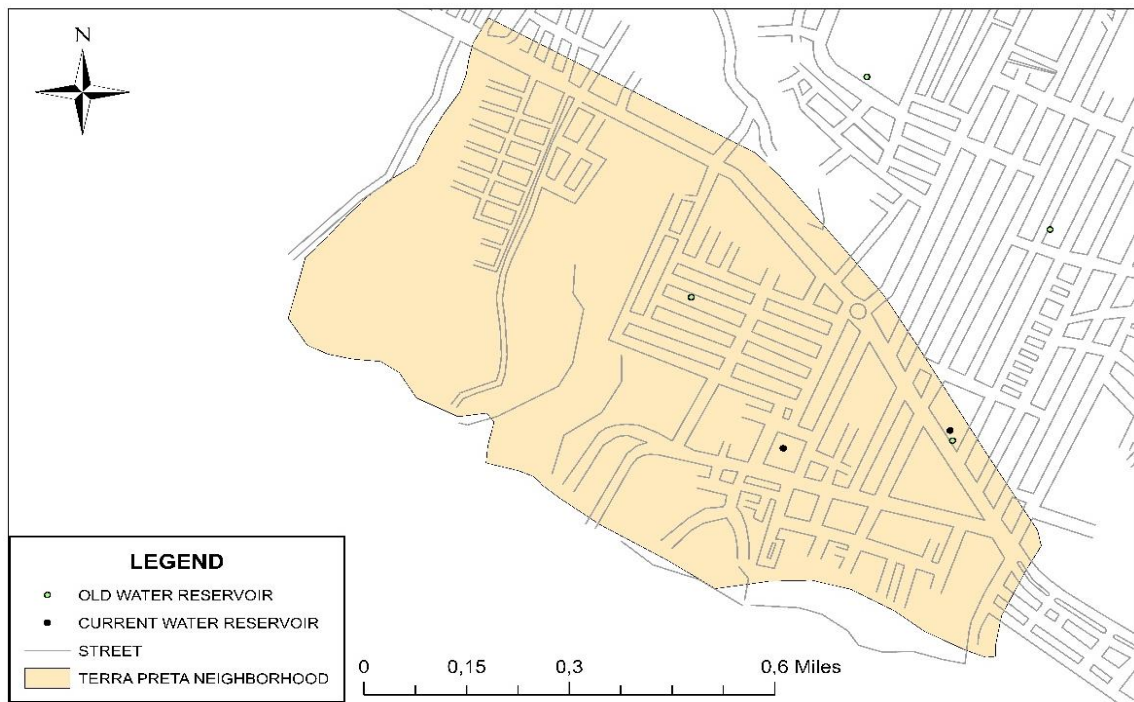


Figure 11: Map of the old and current water reservoirs of the Terra Preta neighborhood in Manacapuru-AM.

Based on the information generated, improvement proposals were prepared for the neighborhood. According to the CPRM, the black earth district will have to build an efficient drainage system to discipline rainwater and wastewater and containment works. As well as temporary removal of houses and floating near the hillside, during rainy periods and during severe ebb.

The population demands from the City Hall the supervision and prohibition of the construction of slopes, banks and interior of the watercourses according to rules established by law, as well as installing warning system for hazardous areas, through public means of communication (sirens, sirens), mobile phones), allowing effective removal of residents in the event of severe or continuous rainfall warnings, and conducting education programs for school-age children and adults in their community centers, teaching them to avoid occupying areas unsuitable for housing construction due to geological risk and also make them aware of the issue of garbage.

Another suggestion would be the implementation of the municipal risk reduction plan - PMRR, which has as its main objective the mapping of areas to further describe the direction of their urban planning, characterized by level of criticality, encompassing the slopes and / or susceptible settlements. floods located on either side of the dunes and surrounding areas or in other areas that are inappropriate for actual and complete social settlement of these settlements in the formal city.

And finally, the Civil Defense must act more preventively and, in times of drought, take advantage of the low number of occurrences to cover and survey all known risk areas and already take appropriate preventive measures. Following these tips will prevent future accidents in the neighborhood.

4. FINAL CONSIDERATIONS

The use of maps generated in Arcgis 10.3, allowed a supervised classification of land use and occupation based on the current laws of the municipality of Manacapuru properly. The Arcgis 10.3 application, through its different modules, made possible the accomplishment of the tasks, providing the data analysis and reliability in the obtained results.

Within the proposed objectives, the results from the data generation in the Terra Preta neighborhood proved to be efficient in classifying images of irregular occupations. Regarding the environmental impacts, the deforestation of the banks of rivers and streams was observed, as well as the risk of flooding to occupying families in risk areas. There is also a concern above with the narrowing of the stream, caused by the domestic sewage discharged there directly, or even due to the excess of garbage deposited on the site.

The methodology applied in the present work, because it is a simple technique, is possible to be used in other neighborhoods of Manacapuru, being extremely important in the aid of public policy planning and environmental monitoring.

5. BIBLIOGRAPHIC REFERENCES

ALENCAR, F. M. S.; BANDEIRA, A. P. N.; RIBEIRO, S. C. Mapeamento de áreas de risco geomorfológicos no distrito do Caldas-Barbalha-CE: caso do núcleo urbano do Sítio Riacho do Meio. Revista Georaguaia, v. 8, n. 2, 2018.

ALMEIDA, M. P.; TRINDADE, F. C. Crescimento urbano x área não edificantes: uma análise das ocupações irregulares da cidade de Manhuaçu. III Seminário Científico da FACIG, e II Jornada da Iniciação Científica. 09 e 10 de novembro de 2017.

ARRUDA, S. N.; LUBAMBO, C. W. Entre a cidade informal e a cidade formal: a regularização fundiária como instrumento de inclusão dos invisíveis sociais na comunidade de roda de fogo no município do Recife. 2018.

COSTA, D. C. M. “Não é bem assim!! vamos falar de moradia!”: Análise da Política Habitacional no Brasil. Trabalho de Conclusão de Curso. Universidade Federal do Rio Grande do Norte. 2018.

FREIRE, L. M.; LIMA, J. S.; SILVA, J. N. Riscos geológicos em áreas urbanas: implicações socioambientais em duas cidades paraenses. Revista GeoAmazônia, v. 6, n. 11, p. 273-292, 2018.

FREITAS, F. R.; CAPETI, K. G.; SAMPAIO, C. R. Uso e ocupação dos manguezais da área urbana de Paranaguá: uma abordagem histórica e socioambiental. Unisanta BioScience, v. 6, n. 2, p. 93-100, 2017.

GUERRA, Camila Piqui. Conflitos de uso e ocupação do solo em áreas de preservação permanente no município de Jiquiriçá-BA. 2017. Disponível

em:repositoriodigital.ufrb.edu.br/bitstream/123456789/1222/1/TCC%20_Final_CD.pdf/. Acesso em: 01 set. 2019.

LORENA, E.M.; BEZERRA, A. P. X. G.; SANTOS, I. G. S.; MEDEIROS, R. M.; ROLIN NETO, F. C.; HOLANDA, R. M. Cálculo da Evolução Temporal de área degradada às margens do rio Tapacurá na zona da mata de Pernambuco. Journal Enviromental Analsys and Progress. v. 3, n. 1, 173-180, 2018.

MARTINS, E. L. S. Diagnostico ambiental da bacia hidrográfica do córrego Grotão, Ceilândia – DF. 2014. Dissertação de Mestre em Meio Ambiente e Desenvolvimento Rural Sustentável) Universidade de Brasília, Brasília, 2014.

MARTINS, Maria Lucia Refinetti. Globalização, informalidade e regulação em

PEREIRA, J. B. M. Avaliação de ocupações irregulares nas áreas de preservação permanente no Município de Nísia Floresta. 2019. 22f. Trabalho de Conclusão de Curso (Graduação em Engenharia Ambiental) - Centro de Tecnologia, Universidade Federal do Rio Grande do Norte, Natal, 2019.

PEREIRA, J. C. D. Aplicação do modelo hidrossedimentológico AVSWAT na bacia hidrográfica do Ribeirão da Cachoeirinha–MG. 2010. Dissertação de Mestrado em Meio Ambiente e Recursos Hídricos, Universidade Federal de Itajubá, Itajubá, 2010.

PERIN, L. T. Uso do Modelo QUAL–UFMG no estudo da qualidade da água e da capacidade de Autodepuração do Rio Km119 – Campo Mourão – PR. 2013. Trabalho de Conclusão em Engenharia Ambiental – Universidade Tecnológica Federal do Paraná, 2013.

REIS, Paula Graziela. O plano diretor como instrumento jurídico de planejamento urbano para o desenvolvimento das cidades. 2019.

Serviço Geológico do Brasil-CPRM. SETORIZAÇÃO DE RISCOS GEOLÓGICOS- MANACAPURU- Disponível em: <https://www.cprm.com.br/publique/> acesso: 10/09/2019

SILVA, F. A. Proposição de Metodologia em Suporte à Avaliação do Impacto do Uso e Ocupação do Solo na Desconformidade da Qualidade da Água em Pequenas e Microbacias Hidrográficas Rurais. Dissertação de Mestrado em Engenharia Ambiental, Universidade Federal do Espírito Santo. 2018

SILVA, M.S.; LEMOS, S. S.; MORAES, A. B. Uso de geotecnologias para delimitação de Áreas de Preservação Permanente e análise das áreas de conflito de uso e ocupação do solo na zona urbana do município de Mãe do Rio-PA. v. 1, 2018.

TASCA, F. A., FINOTTI, A., POMPÊO, C. A., e GOERL, R. F. O papel da drenagem urbana na prevencao de desastres hidrologicos na bacia hidrografica do rio Itajai Acu. *Revista brasileira de cartografia*, 69(1); 2017.