https://dx.doi.org/10.22161/ijaers.612.10 ISSN: 2349-6495(P) | 2456-1908(O)

Evolutionary Analysis of Tarumã Açu Degradation by Urban Growth

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Abstract*— *Tarumã açu is a neighborhood located in the west of the city of Manaus, in which in recent decades we have accompanied the progressive increase in pollution and degradation from anthropic actions that occurred in the city, making it difficult to preserve resources water and its green areas, which maintains its ecological chain of the region through the maintenance of fauna and flora, in addition to preserving the natural characteristics of the site. For the research, a set of LANDAT-8 satellite images, operational terra imager (TERRA) sensor, in geotiff format, colored composition of RBG bands, with spatial resolution of 30 x 30 m, was selected. The scene of the study area were the orbits from 231 to 262. The ArcGis version 10.3 tool, used as an aid to obtain images to detect the types of degradation occurred and in which areas were most affected by anthropomization in 2010,2013, 2015 and 2017.

Keywords*— *Degradation, classification, anthropoization, arcmap.

I. INTRODUCTION

During the last decades the city of Manaus has experienced rapid population growth, denominated by many as the metropolis of the Northern region. This denomination is partly due to its economic and historical importance, in addition to providing services and products, through the free zone. In addition, the capital of Amazonas opens opportunities for residents of the interior of the state, where the chances are lower.

However, urban and industrial development has caused the expansion of the urban perimeter of the city over the years, which has caused negative impacts on the environment. For Araújo (2004), cities are mischaracterized by the exaggerated increase in the population which lose their original essence. On the other hand, this mischaracterization and lack of infrastructure are exposed to environmental and socio-environmental problems, such as difficulty accessing basic health, violence, discrimination and leisure (MARICATO, 2002). In addition, this growth is capable of triggering a series of changes in the quality of the environment, deteriorating the physical, biological and chemical qualities of the sites, by increasing materials such as waste thus negatively impacting the city (GAUVEA, 2012).

Also, Fernandez (2004) verifies that ambient modifications are caused by various causes, resulting from the action of anthropic, natural and community cultures activities, which has contributed to the changes in physical characteristics and biological diseases of the ecosystem in which we live. Environmental degradation can be understood as occurrences of cases that end up deteriorating and depleting the environment (DEL GROSSI, 1991; LEMOS, 2011). A recurrent factor in the growth of urban areas and environmental degradation is the reduction of native vegetation cover that, in addition to affecting thermal comfort in tropical, arid and semi-arid regions, reduces surface flow, water infiltration, and also surface and groundwater quality (TUCCI, 2008; FELIPE et. al., 2012).

Deforestation is considered one of the factors that cause environmental impact. The forest has as its role to care for and maintain biodiversity thus safeguarding all living species present on site, water cycling, and carbon storage (FEARNSIDE, 2006). For Freire (2004) when natural biodiversity is lost by the process of human occupation, evidence of destruction of riparian forests, water resources, loss of fauna, contamination of resources occurs, are visible factors that disorderly occupation can cause the municipality.

On the other hand, the quality/quantity of water resources in the areas modified entropically is not only an environmental problem, but it is also a public and economic health problem for municipalities (SILVA et. al., 2007; TUCCI, 2008). Therefore, changes in the natural environment lead to the stocking of these areas, increasing water turbidity,

https://dx.doi.org/10.22161/ijaers.612.10 *ISSN: 2349-6495(P) | 2456-1908(O)*

in addition to groundwater contamination by construction and solid/liquid waste dumps, which increases the costs of treating these waters.

However, the studies of Felipe, et. al., (2012) showed that at various times, the absence of an Environmental awareness is a determining factor in water contamination, because without the knowledge of environmental education residents often throw debris into river beds, without passing due treatment. The release of sewage into water bodies modifies physicochemical characteristics, such as a large part of suspended materials, such as the presence of organic matter, phosphorus, oils and greases and biological stemming from the decomposition of organic matter.

One way to monitor irregular occupations and impacts caused by them to the environment is through the use of high-resolution remote sensors such as LANDSAT images. These sensors study at the logo of time the change of surface characteristics, also the phenomena that occur in space, besides monitoring the cities, agricultural areas and Permanent Preservation Areas (APP) (DELATORRE et. al., 2011). The relationship between deforestation and population density was addressed by Wood and Skole (1998), through the use of satellite images. The authors showed that deforestation in the Amazon region is more closely linked to the settlement of rural areas with low population density.

Currently, satellites have been a major ally in monitoring deforestation and fires. Applying the methodology of supervised classification of modis satellite images, Machado et. al, (2004) located deforestation areas in the Brazilian Cerrado, showing an annual average of 1.5%, equivalent to three million hectares. The authors estimate the Cerrado may disappear by 2030 if the development model is maintained. At the same time, Shimabukuro and Almeida-Filho (2008) applied the supervised classification of landsat-5 images from 1987 to 1996, to map the degraded areas in the Amazon region, identifying a growth of 341 hectares to 1,986 hectares of agropastoral activities in forest areas.

In recent years, water resources have been found to be scarce worldwide. And one of the causes has basically been the way man's water reserves are used, which make them unusable for healthy consumption due to pollution of water resources and the growing demand for use that is associated with population growth (PEREIRA, 2009).

Thus, this work will show through the classification of images of the LANDAT-8 satellite, Operational Terra Imager sensor (TERRA), during the period from 2010 to 2017 an analysis of soil cover, increase of deforested areas and the effect of anthropomization in the Tarumã and Puraquequara basin region are located in the urban network of the city of Manaus/AM (MELO et. al., 2006).

II. MATERIAL AND METHODS

The methodology developed in this work is similar to that used in Preste (2018), applied at the Giant Creek in the municipality of Manaus/AM. On the other hand, at this time it will be developed in the Tarumã Açu Neighborhood, in the west of Manaus, near the microbasin of the giant stream, located in the southwestern part of Manaus, on the left bank of the Tarumã River, delimited by the coordinates -2,954º latitude and -60.160º Longitude, covering 133,756.40 hectares. Figure 1 shows the delimitation of the Tarumã basin, which is located the neighborhood to be studied. According to the Brazilian Institute of Geography and Statistics (IBGE, 2015) the population was around 13,763 inhabitants, considered one of the three largest neighborhoods in Manaus. First, an on-site visit was made in order to know the situation surrounding the creek, through photographic records of the place and thus, if it obtains characterization of the study area.

Fig.1: Location of the Tarumã Açu basin.

https://dx.doi.org/10.22161/ijaers.612.10 ISSN: 2349-6495(P) | 2456-1908(O)

After the site's reconnaissance visit, the selection of the set of satellite images was selected. The images used in this work are the images of landat-8, operational terra imager sensor (TERRA), in geotiff format, colorful composition of RBG bands, with spatial resolution of 30 x 30 m. The scene of the study area were the orbits from 231 to 262. The images are part of the collection of the PRODES project of the National Research Institute (INPE). Due to the rapid growth of the city of Manaus in the last decade, we opted for the use of images in the years of 2010, 2013, 2015 e 2017.

After the selection of images in the years mentioned above, these were processed with the assistance of the Tool ArcGis version 10.3. Thus, it was possible to perform an supervised classification of the images and finally obtain the information of the surface type, change and determine the degradation levels that occurred in each area. By classifying the images, we tried to identify the possible causes of environmental degradation of surfaces during the years analyzed.

III. RESULTS AND DISCUSSION

The increase in irregular occupations in large metropolises is combined with the progressive increase in environmental pollution and contamination of seas, rivers and streams. The preservation of natural resources maintains the ecological chain of the region through the maintenance of fauna and flora, in addition to the preservation of physicochemical and biological characteristics.

In order to obtain a detailed analysis of the situation, a technical visit was made as shown in Figure 2. The figure portrays the current situation of the neighborhood, where visibly many areas of irregular occupations were visibly detected, it was also possible to find areas where vegetation is preserved, and deforestation, erosion, streams with the presence of materials in suspension among others that are not positive qualities and that cause visual, physical, biological and chemical pollution.

Fig.2: Vision of the main changes suffered in Tarumã

https://dx.doi.org/10.22161/ijaers.612.10 ISSN: 2349-6495(P) | 2456-1908(O)

Through supervised classification. Through the supervised classification it was possible to visualize the evolution of the processes analyzed in the years 2010, 2013, 2015 and 2017, besides defining the polygons that configure the classes of land use and occupation, where pixels represent each of the types of and their occupation at different points (JENSEN, 2009). Through the satellite image it was observed that the year 2010, represented by Figure 3a, the Tarumã Açu area still predominated large-scale vegetation at the site, but with the expansion of interventions that occurred on site, ended up annihilating part of what was Saved. It is verified that urban expansion did not predominate in the region. On the other hand, Figure 3b shows through a histogram the sum of pixels related to each type of soil use classified.

In 2010, the dense ombrophilic forest had the greatest success with 16,000 pixels, along with the predonymous vegetation with just over 14,000 pixels, while the soil exposed on the site totaled about 14,000 pixels. It is verified that some areas that were previously covered by forest and vegetation have undergone changes through deforestation. It is observed in the following years that these deforested areas gave rise to irregular occupations, thus collaborating negatively for the environment. In addition, it is verified through the histogram that the amount of suspended materials is high, around 14,000 pixels. This high amount of materials in suspenation are a consequence of the increase in anthropoized areas, as shown by Shimabukuro and Almeida-Filho (2008).

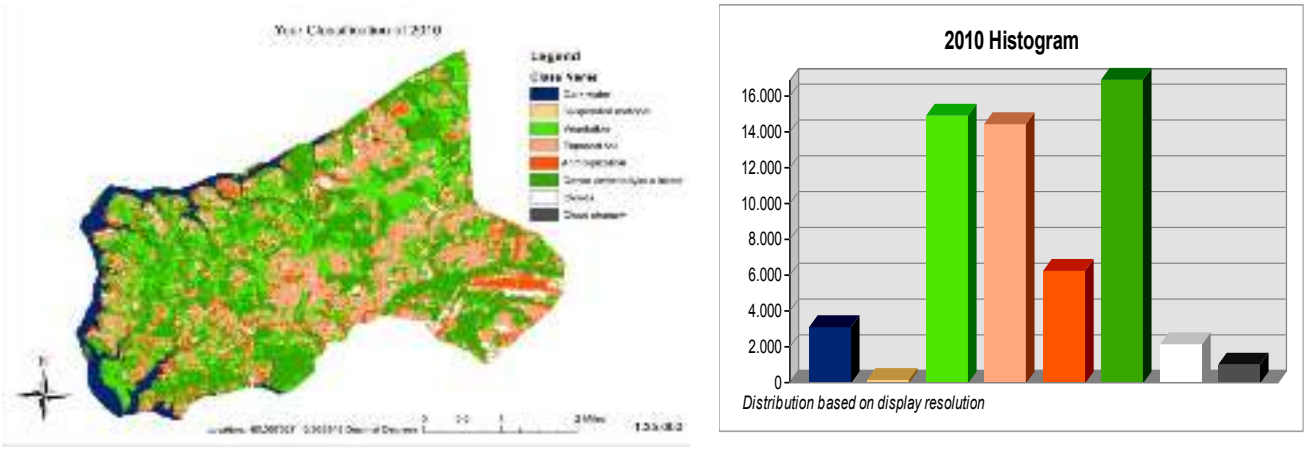

Fig.3 : Year 2010; a) Site map; b) Histogram of classes

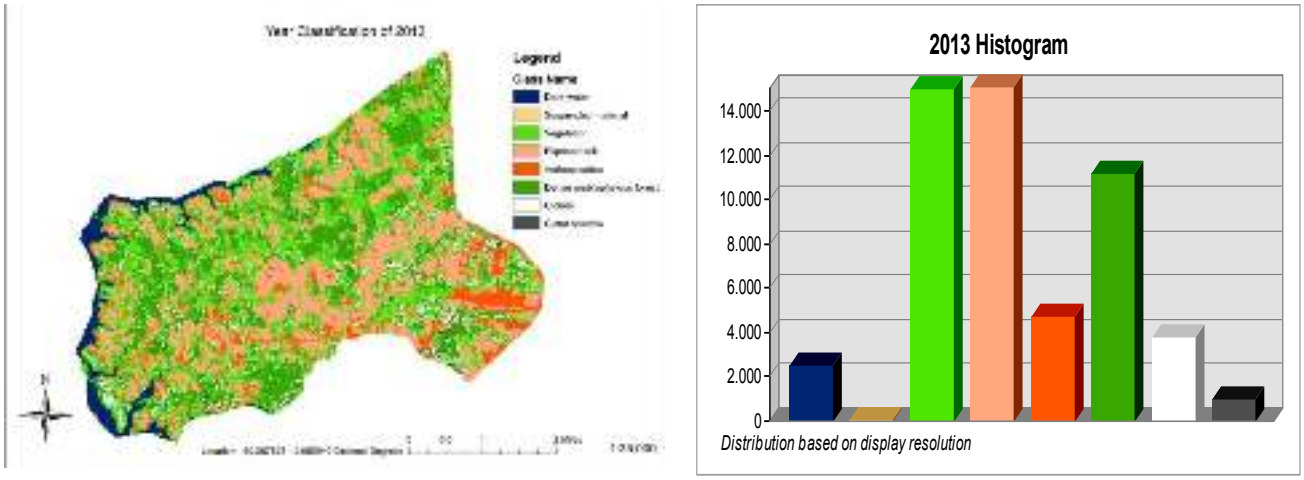

Fig.3 : Year 2013; a) Map of the tarumã Açú neighborhood; b) Histogram of the year 2013

https://dx.doi.org/10.22161/ijaers.612.10 *ISSN: 2349-6495(P) | 2456-1908(O)*

In 2013, it was observed that vegetation reached 14,000 pixels on the map and the exposure of the soil at 14,000 pixels (Figure 4a). In relation to the previously analyzed year, the dense ombrophilic forest decreased the number of pixels from 14,000 to approximately 11,000. Due to the large area of forest in the region one of the forms, it is noted in relation to 2010, that 2013 showed a drop in the rate of human activity at the site had a temporary drop of 6,000 pixels, but on the other hand, there was a decrease in the areas covered by vegetation, these impacts were also analyzed in Ricklefs (1996). The author showed that such impacts caused by increased deforestation occur years before population growth. And at the same time, increases the consumption and disposal of solid waste.

In 2015, the location map showed significant differences compared to previous years. The presence of exposed soil grew above 14,000 pixels due to construction of homes, residential, school among others. At the same time, over the years the area was uncharacterized by the loss of the natural landscape by anthropic action, causing an increase in direct and indirect pollution. Anthropomization is related to human activities at the site doubled compared to the previous year, amiting to 12,000 pixels. Another interesting fact was the presence of a high number of residences compared to 2013. On the other hand, the vegetation showed a decrease in the amount of pixels classified in the image, rising to 10,000. The forest has as its role to care for and maintain biodiversity thus safeguarding all species of living beings present on site, besides assisting in water cycling, and carbon storage, indispensable for flora fauna. When analyzing Figure 5, it is verified that the decay for 10,000 pixels of dense ombrophilic forest indicates that deforestation may cause a loss of biodiversity of the site, in addition to pollution caused by construction practices, and inadequate exposure to the ground, harming the environment.

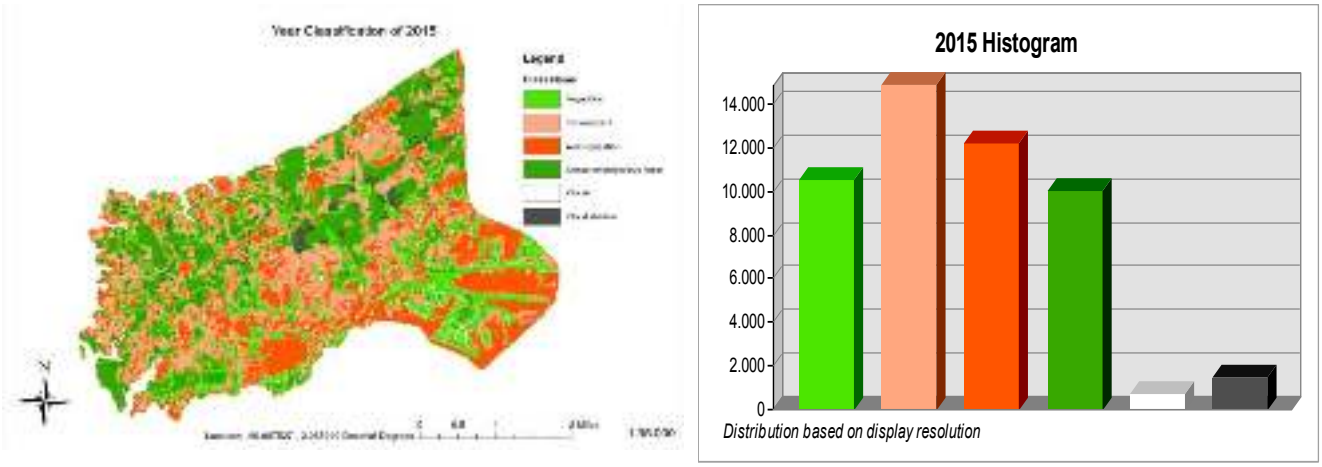

Fig.5: Year 2015; a) Map of the tarumã Açú neighborhood; b) Histogram of the year 2015

In relation to previous years, 2017 clearly shows the exponential growth process of occupation of the area, increasingly evident, this fact can also be seen in Daniel (2018). The author showed through the geoprocessing technique the reduction of green areas in the Giant's watershed in Manaus/AM due to the occupation of the soil improperly, completely altering the natural environment. The results in 2017 show that urban growth is the cause for increasing the anthropoized area to more than 12,000. At the same time, the histogram shows that the amount of areas of the exposed soil increased even more, past 14,000 pixels, caused by the removal of vegetation and deforestation for constructions of condominiums, houses, trades among others. Furthermore, the practice of occupation and urban expansion can generate urban and environmental conflicts, and these processes that end up generating a reflection on the search for economic and social development (JESUS, 2011).

The removal of vegetation and forest is one of the main problems causing environmental impact, causing the increase in soil exposure making it susceptible to erosion by the process of ravines and voçorocas and decreased infiltration (TUCCI, 2008). Furthermore, the obrophilic forest has great importance for the hydrological cycle and fauna and flora still maintains its classification with 11,000 pixels.

It is clear the occurrence of change in the place during the years, which was clear both through technical visits in the region, as through satellite analysis, showing deforested areas giving way to residences, houses, allotment, farms among

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others. Furthermore, it is possible to verify high growth n the exposure of the soil, and the removal of vegetation and the anthropoization of the site making it vulnerable and thus harming the environment in general.

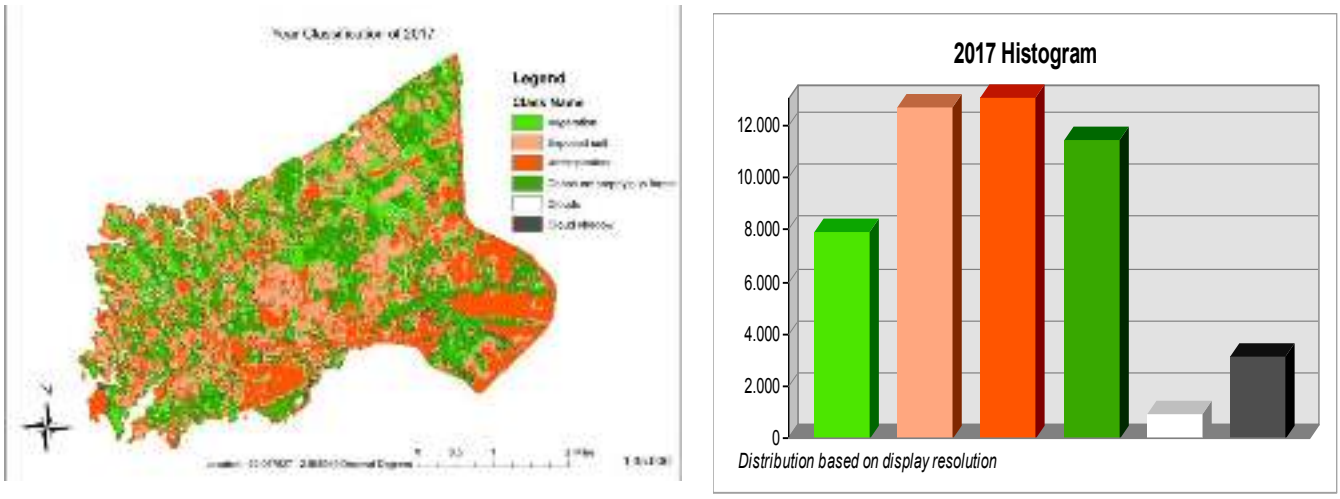

Fig.6 : Year 2017; a) Map of the tarumã Açú neighborhood; b) Histogram of the year 2017

IV. FINAL CONSIDERATIONS

Through the high resolution images of the LANDSAT satellite, a supervised classification study of the use and occupation of the soil was carried out in the Tarumã Açu neighborhood, in the city of Manaus/AM. The desordeno growth of the city of Manaus has led to an increase in areas of irregular occupations in areas of ambiemtal preservation. It was noted that during the period 2010 to 2017 there was a significant decrease in vegetation cover was predominant at the site, soil exposure and anthropoization causes serious environmental problems to the environment.

With this, today we face certain consequences that often visible and easily perceived, such as the degradation of the environment, and pollution in various ways. It is necessary to establish and plan for recovery in the points where the higher impact index is shown, as well as a way to reduce impacts that end up affecting society itself, thus causing erosion and assorements affecting resources water at the site.

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