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Supervised Classification Of Land Use And Occupation In The Region Of Influence Of The Belo Monte Hydroelectric Complex

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Abstract
Background: *The energy sector is highlighted in the development context and provides subsidies to the national economy. In this context, there are several projects aimed at the implantation of hydroelectric plants in Amazonian territories, due to the measurable potential of the hydrographic basins. The Belo Monte Hydroelectric Plant, located in the southeast of the state of Pará, was installed from the diversion of the Xingu River course, which enabled the operation of these plants. The works started in 2011 and are still being finalized. Therefore, we present information on the environmental impacts generated. To this end, the method used consisted of a bibliographic survey in order to obtain a theoretical basis, and the use of the Geographic Information System (GIS) as a geoprocessing tool.*
Materials and methods: *In order to analyze mainly the environmental change, data from satellite images from the Earth Explore database was used. The software used was Qgis. The digital processing of the images used the SCP complement in all stages, where it started with atmospheric correction. , for the removal of noise, the RGB composition of the images was immediately performed. In the operational sequence, the vectorization procedure of the land use classes was carried out through manual digitalization training for the classes identified by the process of visual interpretation in the satellite images.*
Result:*As a result, collect the following findings: a large increase in areas composed of Water, Secondary Vegetation and Exposed Soil and a significant reduction in areas of Dense Vegetation. However, this capacity for intensive use and more intense occupation of the soil, occurred mainly from 2010, with the beginning of the works of the Belo Monte Hydroelectric Plant and expansion of timber and agricultural activities. During the period under study or land use and occupation in the municipality, it suffered changes, mainly in the decrease of vegetation, such as increase of exposed soil, water and secondary vegetation*
Conclusion: *Through the analysis of the results it was possible to obtain considerations regarding the current situation of the use and occupation of the land in the region of Altamira, detecting the transformations that occurred during ten years.*

Keywords: *remote sensing, Belo Monte, SCP*

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I. Introduction

Man is responsible for several changes in the terrestrial environment, and so what has as an answer for this action are the various types of environmental disasters, most often affecting natural resources, requiring immediate responses. The Brazilian Forest Code examines ways that can minimize future damage that can affect future generations, one of which is the conservation of forests. The purpose of this code is to protect the fauna and flora of areas important to the ecosystem (DE CASTRO OLIVEIRA at.al 2014).

Remote sensing establishes the application in a simultaneous way, instruments such as data processors, tools that are placed on board an aircraft in which it transmits information, software platforms and so, this equipment is intended to help in the analysis of phenomenon information, eventuality, and changes that have occurred or occur on the surface of planet Earth, everything is done from the observation and correlation of electromagnetic bands (NOVO, 2010), with a certain type of treatment of this information obtained through remote sensors at long distances trapped in satellites .

Based on data derived from geotechnologies, different methodologies appeared, one of which is the production of maps, where the main product is the classification of satellite images. This elaboration of images intends to provide tools that facilitate the recognition and removal of information included in these representations, where in the future it will be studied in more detail. The main principle of this satellite image

treatment is obtained in response to the physical principles of optics (reflection, refraction and light absorption) in relation to the bands of electromagnetic spectrum bands. In this way, numerical values are used, where each pixel is represented by a numerical value of the spectrum, helping to represent a specific characteristic of the earth surface (CRÓSTA, 2002; JENSEN, 2009; LILLESAND; KIEFER; CHIPMAN, 2008).

The objective of this work was to use remote sensing techniques in the region of influence of the De Belo Monte Hydroelectric Complex, to understand the use and occupation of the soil, satellite images from the Earth Explore database collected from the TM-Landsat satellite were used. 5 in 2007 and OLI-Landsat 8 satellite in 2017, which were processed in a GIS environment using the free software Qgis 3.8.3 and the Semi-Automatic Classification Plugin (SPC). There are two types of classification techniques where one is supervised and the other is not superficial. The superficial classification is based on the recognition of different types of spectral procedures. To that end, the area to be analyzed for each pixel is first chosen, identifying the classes as urban areas, drainage, exposed soil, different types of vegetation cover (undergrowth and dense vegetation) (DE CASTRO OLIVEIRA at.al 2014).

In the unsupervised classification, it is the algorithm that defines the classes grouping these pixels (Moraes, 1999), because sometimes the area is not known beforehand, so identification is a little difficult (Meneses & Sano, 2012).

II. Methodology

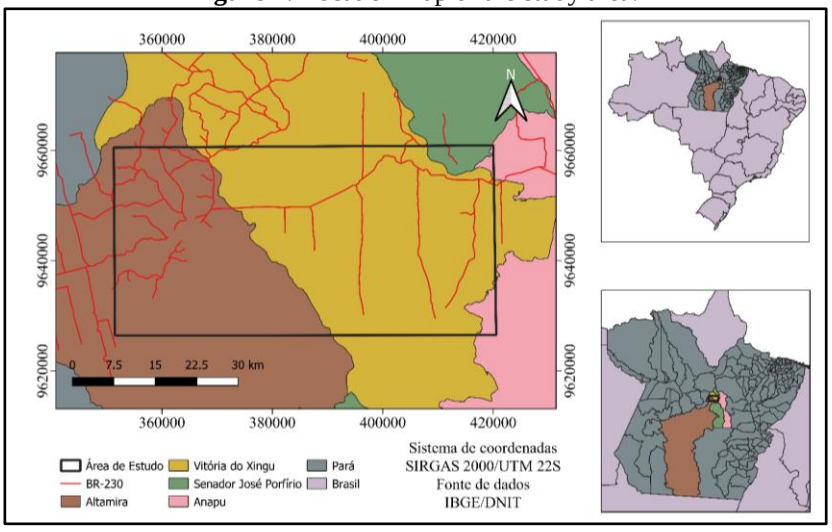
2.1 Characterization of the study area

A região da area de estudo refere-se aUsina Hidrelétrica Belo Monte (Figura 1),que esta instalada aproximadamente a 40 km do municipio de Altamira, abrange uma area de aproximadamnete 516 km² e suas obras foram iniciadas em 2011 na Bacia do Rio Xingu, mas precisamente ao norte do estado do Pará, em 2017 as obras já estavam com mais de 96% de concluidas. Porém, obras desse porte afetam areaaonde esses empreendimentos estão inseridos, como a população ribeirinha e os indígenas e também a floresta.

Essa construção gerou um dois procesos principais onde um foi o alagamento da area que ocassionou um transtorno para as familias que tiveram que ser reposicionadas para outros lugares e um migratório de muitos trabalhadores, provocando uma ocupaçao territorial The region of the study area refers to the Belo Monte Hydroelectric Power Plant (Figure 1), which is installed approximately 40 km from the municipality of Altamira, covers an area of approximately 516 km² and its work began in 2011 in the Xingu River Basin , but precisely in the north of the state of Pará, in 2017 the works were already over 96% completed. However, works of this size affect the area where these projects are located, such as the riverside population and the indigenous people and also the forest.

This construction generated two main processes where one was the flooding of the area, which caused a disturbance for the families that had to be relocated to other places and a migration of many workers, causing a disorganized territorial occupation. This brought several negative points, such as: deforestation, increased violence, drug trafficking, increased informal employment. This work, from the beginning of its project in 1975 until 2011, has undergone several changes, due to several social and environmental factors.. O que trouxe vários pontos negativos,como: desmatamento, aumento de violencia, trafico de drogas,aumento de emprego informal. Essa obra desde o inicio do seu projeto em 1975 até 2011, este sofreu várias mudanças, devido a vários fatores tanto socias e ambientais.

Figure 1: Location map of the study area.



Source: Author, 2019.

2.2 Methodological procedures

In order to analyze mainly the environmental change, data from satellite images from the Earth Explore database was used. The software used was Qgis. The images used in the work were from the Landsat-TM 5 project, in which bands 3, 4 and 5 were used where it is possible for the bands to observe the vegetation, biomass content and moisture content of the soil and vegetation. Another project used was the Oli-Landsat 8 project, working with bands 4, 5 and 6 where it allows quantifying data in up to 12 bits, that is, it allows a high precision characterization.

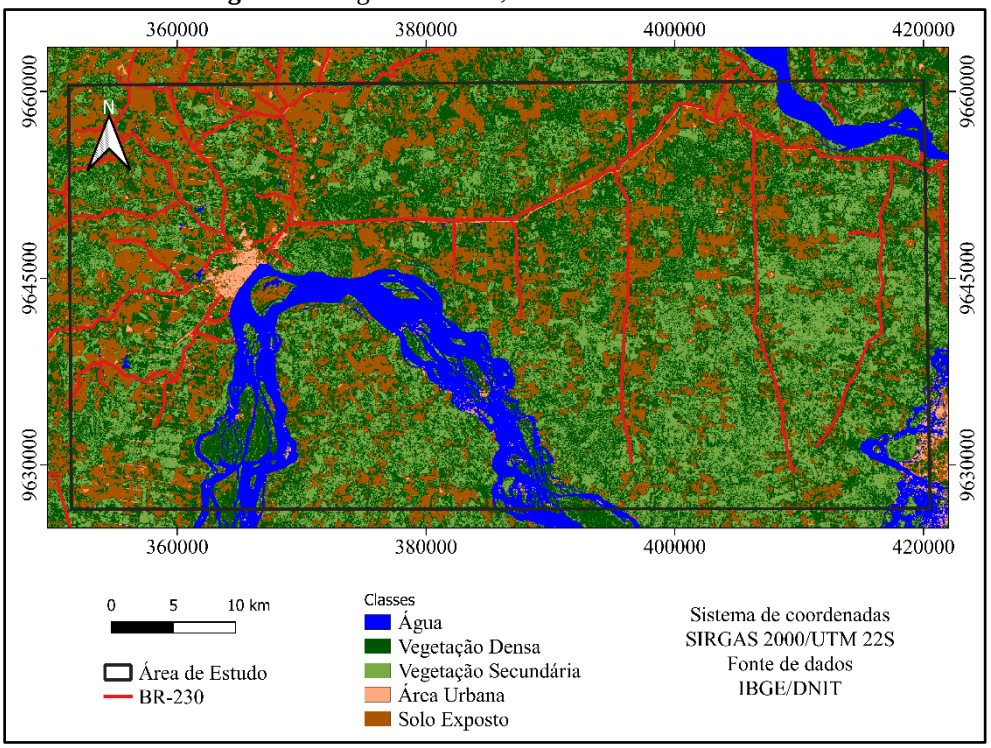
The digital processing of the images used the SCP complement in all stages, where it started with atmospheric correction, for the removal of noise, shortly afterwards the RGB composition of the images was performed. In the operational sequence, the vectorization procedure of the land use classes was carried out through manual digitalization training for the classes identified by the process of visual interpretation in the satellite images.

For supervised classification, the Semi-Automatic Classification Plugin (SPC) and the Maximum Likelihood Classification method were used. The procedure of training the algorithm was used to decrease the level of errors between the classes of land use and occupation, consequently, guaranteeing the obtaining of better results in the supervised classification. For the supervised classification, 5 classes of soil cover were determined: Dense vegetation; Secondary Vegetation; Water, exposed soil and urban area.

III. Results And Discussion

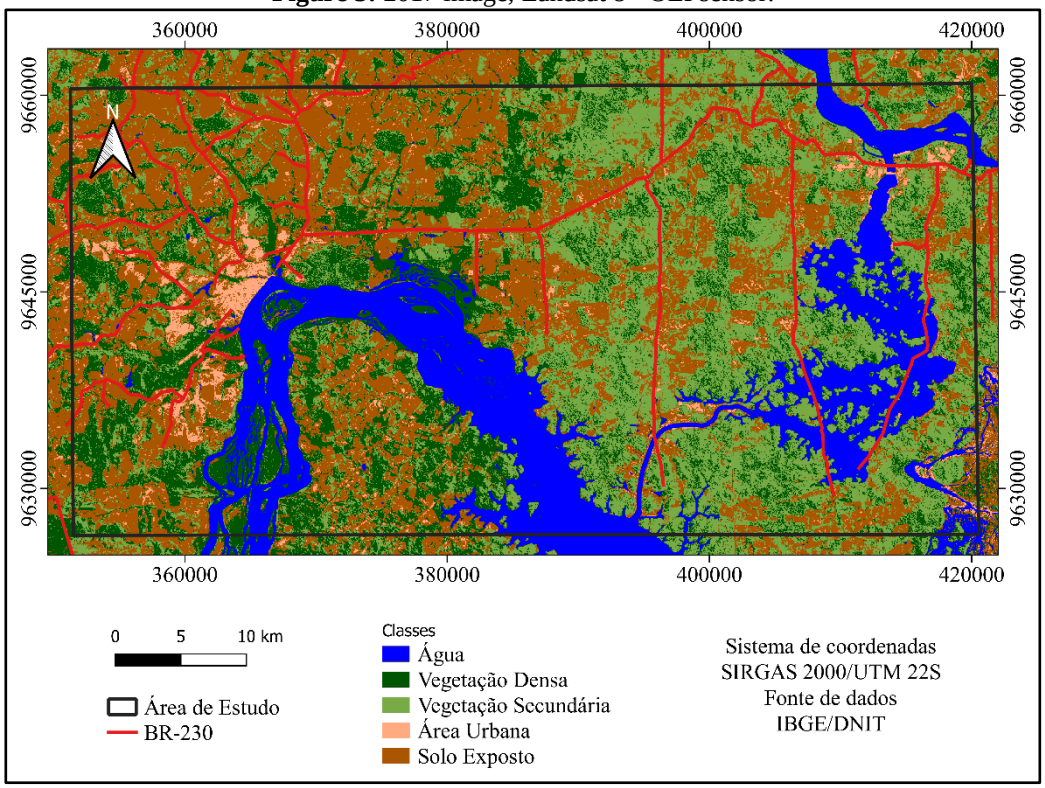
The maps of the dynamics of occupation and use of land cover in the region of the municipality of Altamirano Pará over the years 2007 to 2017 (Figures 2 and 3) show changes in the landscape originally covered by forests, although the region is also characterized by high number of exposed rocks present in the middle of forests.

Figure 2: Image from 2007, Landsat 5 - TM sensor.



Fonte: Earth Explore.

Figure 3: 2017 image, Landsat 8 - OLI sensor.



Source: Earth Explore.

From the survey of the acquired images, it is evident the change that occurred in thisregion, in relationtothe use andoccupationofthesoil. The results found demonstrate mainly, a greatincrease in the areas composed of Water, Secondary Vegetation and Exposed Soil and a significant reduction in the areas of DenseVegetation, whenwe compare Figure 2 with Figure 3. It

is worth mentioning that in this period, there was already an opening of secondary roads to BR-230 and signs of the implantation of farms and agriculture, in addition to the beginning of the construction activities of the Belo Monte hydroelectric plant.

This undertaking is responsible for one of the most significant changes in the landscape of the study area, which is the appearance of a kilometer-sized lake, with the purpose of receiving all the water passing through the generating turbines. In the Amazon, several factors can explain the processes of occupation of its territory, but the main factors that prevailed were the search for mineral wealth, vegetables and energy resources (NASCIMENTO & SILVA (2012).

When evaluating the dynamics of land use and occupation in the study area, it is possible to understand the phases of economic activities in the Amazon region and the way in which these activities contributed to the landscape fragmentation process. Until 2007, the activity of small and medium-sized farms and agriculture and some lumber companies, predominated in the region, restricting the margins of the highway, which led to a low percentage of deforestation. In 2010, with the beginning of the construction of the Belo Monte Hydroelectric Power Plant (UHBM), the intensive activity of legalized lumber companies (most of them mostly in a clandestine manner) and the implementation of agricultural properties in the area developed and prevailed. the opening of roads that facilitate the removal of wood. From the following years, there was an intense deforestation in the region for the development of agricultural activities, with the transformation of the forest cover into areas of pastures and crops, which surround the forest remnants.

IV. Conclusion

Through the analysis of the results it was possible to obtain considerations regarding the current situation of the use and occupation of the land in the region of Altamira, detecting the transformations that occurred during ten years. During this period the use and occupation of land in the municipality underwent changes, mainly in the reduction of Dense Vegetation, as well as in the increase in the area of Water, Secondary Vegetation and Exposed Soil, probably due to the large enterprise installed in the region, which has motivated more and more agricultural practices by producers and the flow of people to the municipality.

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