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Study of the environmental degradation in Permanent Protection Areas in the county of Formosa do Rio Preto - BA

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Abstract

The Western Bahia, characterized by Cerrado biome, has been transformed over the past 20 years into one of the major agricultural centers of Brazil. In this case the region is highlighted in the production of grain held by mechanization and use of water resources. For that to happen took years of research on the physical characteristics of the region, use and occupation of land as well as the change in the agrarian structure, which became potentially capitalist. Due to these processes, the objective was to see how this research new forms of agricultural production have affected the environment implying mainly in suppression of native vegetation, riparian forests and river banks, spaces surrounded by the New Forest Code in force, as Permanent Protection Areas. However in this work were identified through satellite imagery, land use, from agricultural production and urbanization, close to or within protected areas, there by resulting in several law suits that can cause environmental degradation irreparably because of the rearrangement Cerrado does not like other natural systems. The identification of the occupation of the Cerrado was based on the theoretical framework and the identification of areas of degradation, from data prepared by modern techniques of GIS and Remote Sensing using that allowed the analysis of the situation more defined through the interaction between energy and matter.

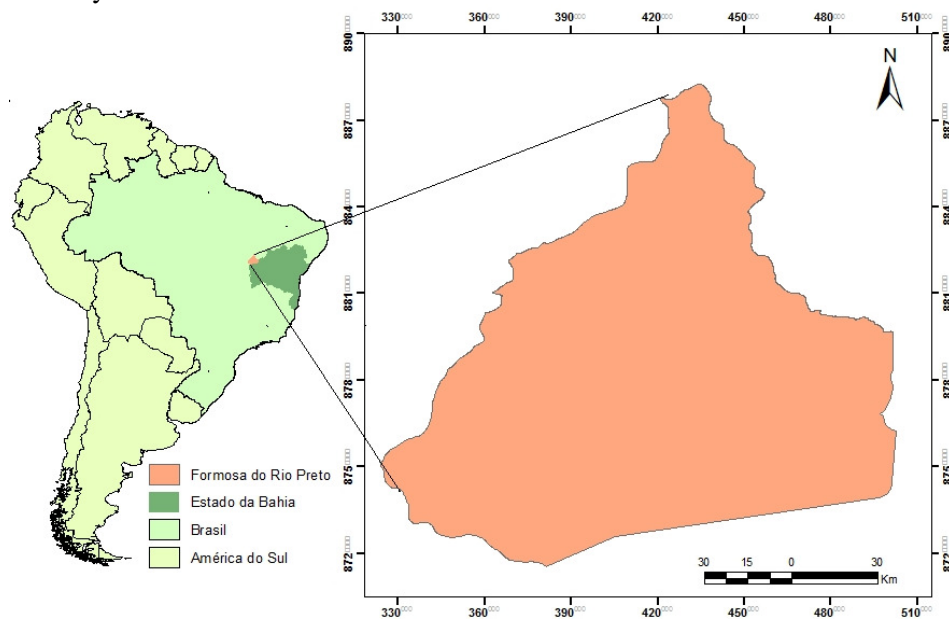
Key words: *western Bahia, degradation, environmental legislation, remote sensing, oeste baiano, degradação, legislação ambiental, sensoriamento remoto.*

1. Introduction

The use and occupation of Western Bahia happened due to several factors, among them, it is important to mention the low values by which the big extensions of land, considered non productive, were sold in the Cerrado area. In the last 20 years, with the introduction of modern agricultural techniques, there was a exponential increase in the prices of the land in this area (Cardoso, 2010; Lavoratti, 2011).

Formosa do Rio Preto has an area of about 16.514,3 km² and is at 11° 02' 54'' S and at 45° 11' 35'' W, in western Bahia, as shown in Picture 1. It is one of the areas where the agribusiness intensified relatively late if compared to the other counties in the region, being, therefore, the county

that deforests the most in the Cerrado biome (Brasil, 2011). That is why an increasing process of environmental degradation, mainly concerning hydrous resources and suppression of native vegetation is noticed in the last years.



Picture 1. Study area localization map.

According to the Novo Código Florestal (New Forest Code) of May 12, 2012, it is enacted and delimited the preservation of the river banks, of which widths between 10 to 500m should have Permanent Protection Areas (PPA) which vary from 30 to 1000m of extension, aiming to preserve the hydrographic systems. It is important to stress that the definition of native vegetation area leads to the association of several factors that interrelate and is dependent, this affirmation is linked to the systemic and dynamic analysis in which the operation, balance and organization are connected to the totality and summarize its operation, according to Chistofoletti, 1999.

In the county of Fromosa do Rio Preto the agriculture has been intensified close to the banks of the rivers, the streams and the path areas, infringing environmental laws suppressing and compromising the natural resources and landscapes. The changes in the landscape, caused mainly by the advance of the agriculture, may lead to environmental impacts that also reverberate social and economically. That way, data made available by IBAMA (Brasil, 2011) indicate that the situation in the Cerrado, with a highlight to western Bahia, is critical facing the advance of the mechanized agriculture.

The use of data from remote sensing and from geoprocessing was increased in the last 40 years for the monitoring of the earth's surface, making possible to have more detailed and updated information about natural resources. Researchers of this area confirm that these tools are important in the acquisition and analysis of information from afar, which give support to understanding of the concepts and use of the techniques, of which we highlight the processes of interaction between electromagnetic radiation, this being considered fundamental in the identification of different objects in the surface, such as vegetation, soil and hydrographic potential (Meneses, 2012; Monteiro, 2010; Silva, 1999).

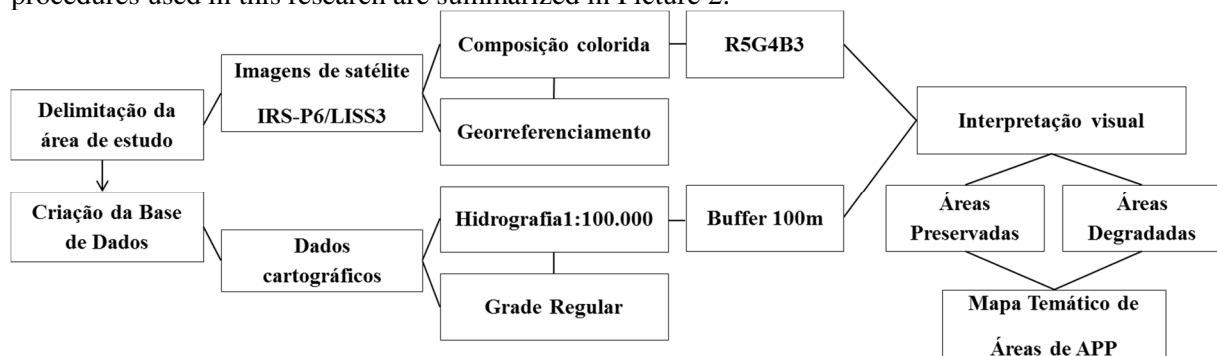
The image processing aimed to explore the technique's potentiality and the extension of remote sensing, a necessary contribution to the expansion and dissemination of the effort of scientific knowledge. The process of the electromagnetic radiation interaction enables the observation of the spectral region, which made possible the analysis, for example, in the vegetation index study, in which the reflectance interacts with the plant when this object reflects back a quantity of electromagnetic radiation, being three the phenomena: reflection, transmission and absorption. These depend on the

physicochemical characteristics of each object and its disposition in the space (Novo, 2012; Jensen, 2010)

2. Methodology of the research

Facing the changes that happened in the landscape in western Bahia, this study aimed to analyze the current process of environmental degradation in the natural system in protected areas. At first, a comprehensive bibliographic research about the western region and the characteristics of the Cerrado biome was made, thus defining the area to be studied. After that, the necessary data base to the development of the research was structured, as well as the cartographic data of the County of Formosa do Rio Preto and the satellite images. These were used aiming spatially identify the areas of riparian forest suppression and other signs of environmental degradation. Then these images were processed, making possible a better analysis of the spatial and temporal information of the degradation of PPA close to the rivers, giving support to the research and also to the grounded legal criteria to the effectuation of the current legislation.

To develop this research, images from the Indian satellite Resourcesat-1 (IRS-P6), sensor LISS3, with spatial resolution of 24m were used. The selected date was the most updated available of the scene 329-84/85 and date of July 10, 2012, with better absence of cloud coverage, aiming to have a precise analysis. A colour composite was made, using the associated color channel in: R in band 5, G in band 4 and B in band 3, respectively, in which the red channel was expressed in the swuir or far infra-red area, the green channel was expressed with more definition in band 4, setting close infra-red and blue channel showed a little or no expression in band 3, in which, instead of blue, visible red was got. After that a Geocover mosaic based georeferencing of the images was made, time zone UTM 23 South, and datum WGS 1984. The images were cropped according to the limits of the county. A 100m buffer was created from the hydrographic layer, in a scale of 1:100.000. The width of the buffer was set according to the legislation that enacts that rivers from 50 to 200m should have a PPA of 100m. Following that the identification of the degradation processes in the buffer area was made by visual interpretation of the images with the support of a regular grid that enabled following an order in the linear identification of the spaces occupied by the advance of the agribusiness with emphasis in the areas of native vegetation, riparian forests and rivers proximities. Then a PPA identification map was elaborated, in which were identified areas with expressive signs of anthropization caused by agribusiness, which relate to the geometrical shapes, where the main processes of environmental degradation occur, but the PPAs that are preserved were also identified. The methodological procedures used in this research are summarized in Picture 2.



Picture 2. Fluxogram of the methodological procedures

3. Results and discussion

First we should take into consideration the presence of the new agricultural border, developed with federal programs of expansion, which consequently caused a new identity in the transformations in the organization of the territory and the landscape.

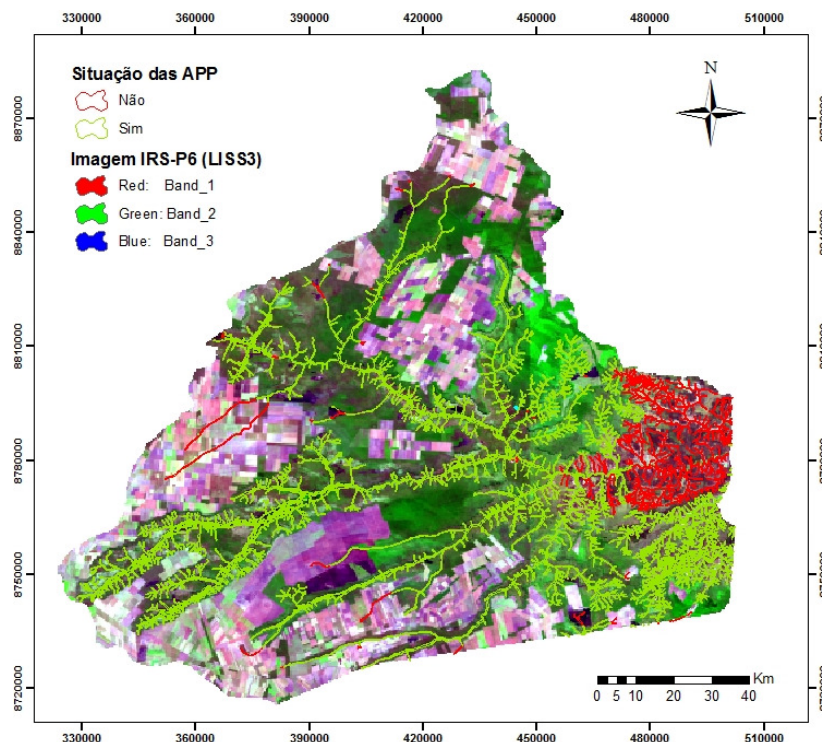
During the work the aim was to identify and to visualize the advance of the agriculture in the study area from the modernization and mechanization of the country, causing the loss of the natural vegetation biomass caused also by the deforestation and forest fires aiming to open space to mainly

soy, cotton, corn and pasture fields. Starting from the bibliographic review and the satellite images interpretation, it could be observed that the advance of the agribusiness has been the main agent of the acceleration in the landscape changing. The biggest problems found in the areas which should be preserved was the landscape and native vegetation mischaracterization, along with the influence of the agriculture on the river banks, stream banks and path areas, spaces that should be preserved according to the Novo Código Florestal (New Forest Code).

One of the steps of the work was the observation and analysis of the satellite image, with good cloud coverage and most recent date, from which could be understood that the main degradation processes happen because of the acceleration of the use of the soil that goes over the natural space and specially close to the rivers, through the agricultural production. The obtainment of the scenes that are part of the image is available on the INPE website. The analysis of the PPA was done, from which it was possible to identify the anthropization degree marked by characteristic features and later the analysis of the process of environmental degradation for the whole study area was done, from which we could get an area of 203.932,000 hectares in high danger of degradation caused by agriculture, mechanized production and forest fires in path and natural vegetation areas.

The degraded PPAs were super estimated, since most of the rivers do not have width above 50m, what would in fact generate a PPA of 100m. Nevertheless, the available images resolution would not allow analysis using a buffer smaller than 100m. The technique application in the satellite images resulted in the elaboration of products like thematic maps, in which areas modified after the advance of the agribusiness could be identified.

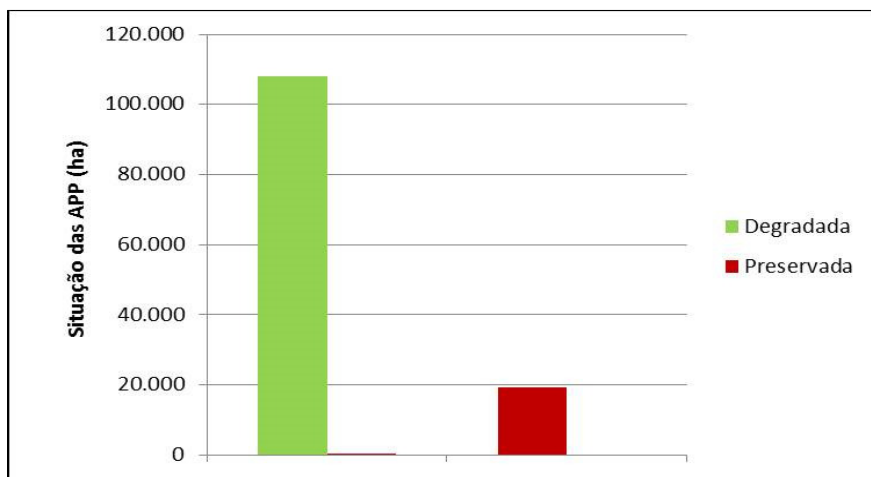
The obtainment and spacializing of the data were enabled by geoprocessing techniques, which helped identifying the advance of the agriculture in inadequate areas where the analysis of degrading factors, in logical arguments, may help governmental decisions, resolutions for laws and/or private parts to preserve the natural resources remaining, as shown in picture 3, that shows a larger number of preserved areas, but that go on a process of suppression due to the advance of production and growth on the demand for food. It is indefinably important to stress that not only Brazil goes through an increase in consume, but that also refers to the availability of tillable lands and that a large part of what is produced in westerns Bahia goes to international markets.



Picture 3. Situation of the PPAs in the county of Formosa do Rio Preto

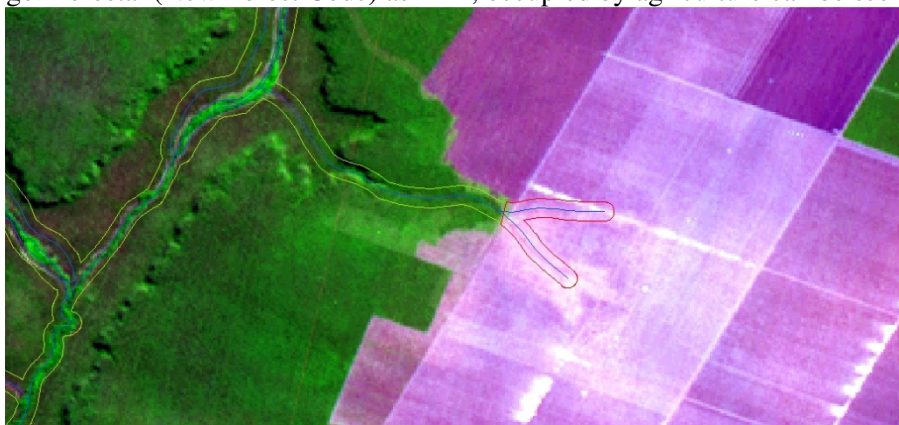
The technique's application in the satellite images resulted in the elaboration of products like thematic maps, in which areas modified after the advance of the agribusiness could be identified. The PPAs are liable of identification under the GIS (Geographical Information System) environment through remote sensing data, but these techniques do not replace the legal demarcation criteria, even though this study may allow a synoptical vision in relation to the hydrographical system vulnerability and the environmental degradation due to the agribusiness in the study area.

It was observed in the images that the degraded features are characterized by geometrical shapes, polygons which mark the agricultural areas and the pasture fields. A PPA identification map for the county was elaborated, in which references to the Novo Código Florestal (New Forest Code) were used, delimitating, in chapter II, section I from paragraph 4º, the minimum width of 30, 50, 100, 200 and 500m for the waterways of 10m, 10-50m, 50-200m, 200-600m and above 600m, respectively. From the analysis in these measures a map was initially made, starting from scenes from sensor LISS3, whose images were georeferenced, using the RGB colour composite image, following the order of the bands 4, 5 and 3, respectively, the biggest reflectance being expressed in the green band, represented by SWIR, to a more expressive spatial understanding of the vegetation distribution, in which a hydrographical shape of 1:100.000 was used and a 100m buffer in the river basins, measure considered necessary to the maintenance of the native vegetation and its relations. However, the results were super estimated, since the buffer was created with 100m, measure that does not correspond to the whole hydrograph in the county, because some of the waterways are narrower than 30m and some are wider than 60m and their identification using the maximum resolution was distorted due to the spatial resolution of only 24m, one of the difficulties had because of the pixelization, which made a more precise analysis impossible. The colour composite facilitated the identification of the cultivated areas, since the image resolution defined the polygons formed by the anthropization and in grayscale the pixels definition do not differ in color, but in lighter and darker shades. From the color composite and delimitation of protected areas, a better identification and analysis of the degradation process on the river banks could be done, spaces that should be strictly preserved. Considering the severity of the deforestation and the Cerrado physical questions already mentioned by some authors, it is easy to understand the environmental degradation and the mischaracterization of the natural biome landscape, since the study area had huge participation in the deforestation of legal reserve areas, PPA and other parts of limited use. An important observation made was the presence of the mechanical agriculture advance and the fragility in the application of the environmental laws, even though the Novo Código Florestal (New Forest Code) had regulated implications, administrative and tax sanctions and even land expropriation. A data base, composed by theoretical referential and IBGE data, was created, in which was possible to identify the concepts and analysis categories, altogether with the identification of the vegetation through the Probio report, which contain several types of vegetations with their environmental fragility indexes. The steps in the data pre-processing facilitated the interpretation of the images of the protection areas occupied by agriculture within the GIS. The delimitation of the PPA was done in GIS environment, which constituted the analysis of these areas starting from the Final Probio Report, as in Sano 2007. In accordance with the native vegetation characterization and made possible through the study of the reflectance levels approached by several authors, an analysis of the landscape feature, which was compared to images of different scenes from the sensor LISS3 from different dates, focusing the periods of draught and of rain, analyzing the space occupation by polygons characterized by the new ways of production as well. To do the research, scenes from sensor LISS3 in which the resolution is defined at about 24m were selected. There is the need to discuss, also, that the declivity was not the main factor in the delimitation of the protection areas in this study and in this study area, since the region has a plain relief characteristic and mechanized agriculture does not occur in steep areas, what would facilitate with a high index the occurrence of environmental degradation in the Cerrado biome. Looking at the different ways of soil use observed in the satellite images, it was noticed that it has been increasingly more exposed, being set as the main way of alteration and acceleration of the erosive processes and natural landscape changes in the Cerrado. In spite of the existence of bigger total preservation areas, as seen in Picture 4, the degraded areas match the biggest deforestation in the smallest amount of time, since the county is characterized by a recent process of production.



Picture 4: PPAs situation graphic

In Picture 5, highlighted, the suppression of the natural resources, in areas designed by the Novo Código Florestal (New Forest Code) as PPA, occupied by agriculture can be seen clearer.



Picture 5: Clipping of the advance of agriculture in PPA

4. Conclusions

The occupation process in the Cerrado has faced different political proposals through the years, in the last instance the environmental preservation was deprived, when the degrading processes started to be identified on a larger scale, it was noticed the importance to the environmental balance against the observations of the satellite images, in which the advance of the agriculture as the main contributor to the degradation of the natural systems, it was understood that the factors involved in this occupation resulted in the fortification of the expansion and in the intensification of the agriculture and the cattle raising in the Cerrado in Bahia and this has caused processes of degradation in natural environments.

In the light of these events of agriculture development, a non-controlled occupation can be observed, from these activities, causing environmental degradation in natural areas of hydrographic systems and native vegetation, being necessary to raise awareness, especially within the bigger producers, the greatest deforesters of Cerrado, who destruct in a predatory and neglectful way. It is part of the society responsibility to delate these practices to the competent authorities and to these ones to make the laws work, independent of its representation, aiming to preserve the native vegetation areas and to plan the recovery of the degraded areas.

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