MULTITEMPORAL STUDY OF THE USE AND LAND COVER IN THE MUNICIPALITY OF URBANO SANTOS, MA

Juliane Borralho de André ¹, Carlos Augusto Rocha de Moraes Rego ¹, Alysson Oliveira de Carvalho ¹, Francielle Cabral Amorim ¹, Juan López de Herrera ²

¹ Agronomist. Professor at the State University of Maranhão, São Luís, Department of Agriculture Engineering, Brazil.
² Students in agronomy from the State University of Maranhão, São Luís, Brazil.
³ Technical University of Madrid (UPM), Department of Agroforestry Engineering, University City, 28040 Madrid, Spain.

Article Information

Keywords:
K1. Land Cover
K2. Environmental Degradation
K4. Image Processing
K5. Urbanization
K8. Mapping

Corresponding author: Carlos Augusto Rocha de Moraes Rego
Tel.: +34697930311
E-mail: cassielscarlos@hotmail.com
Address: Calle Beatriz de Bobadilla Nº 11 Piso 2A

Abstract

The demographic expansion and industrialization that occurred in Brazil, recently, has induced the increase of urban areas and, therefore, the increase of the use of new areas. The multitemporal analysis of a region is a process from which is possible to evaluate how certain information about this region varies with time. Monitoring of land-use and land-cover is important for the study of certain regions, as it contributes for the knowledge of the environmental reality, such as the research regarding solutions for problems that may occur. Therefore, the objective of this paper is to approach the multitemporal study of the land-use and land-cover at the county of Urbano Santos, localized at the territory of the lower Parnaiba, Maranhão State Citizenship to the East of the State of Maranhão in the Northeast region. To fulfill said objective, data obtained by remote sensing technique have been used, such as images from the TM/Landsat 5 satellite from the year of 1984, provided with free charge by INPE - National Institute for Space Research and images from the TM/Landsat 8 from the year of 2014, provided by the website of NASA - National Aeronautics and Space Administration.

1 Introduction

With the rise of technology, the global dynamism in geographic space and uniform alteration that the man maintains is elementary for the planning and control of space. Whereas some concerns that appear related to the sustainable use of natural resources in recent decades mainly. Depending on how these resources are used and exploited, the effect can cause ecological imbalance, causing degradation and alteration of the environment.

After the Atlantic Forest, the Cerrado is the Brazilian ecosystem with bigger process of change for human occupation. With increasing pressure to open new areas, aiming at increasing the production of meat and grains for export, there has been a progressive depletion of natural resources in the region. In the last three decades, the Cerrado has been degraded by the expansion of the Brazilian agricultural frontier [1].

A data comparison from different eras, for the same region, is known as multi-temporal analysis. Geographic Information System (GIS) point of view consists of an overlay operation, for example, overlapping of different letters in the same location. This type of work allows characterizing the changes in land cover type a specific place [2].

Systems and remote sensing techniques may allow the study of the environmental evolution of a region through multi-temporal analysis, making comparisons of the same landscape between two or more times and could thus assist in environmental monitoring in the region [3].
1.1 Objective

General objective
To analyze the evolution of change in the vegetation cover and its relation to land use in the municipality of Urban Santos, with the recognition of the local agricultural landscape and its evolution over 30 years (1984 and 2014), creating a database for help define guiding policies of regional development.

Specific objectives:
- Develop land use and vegetation cover maps using the satellite images Landsat TM 5 and Landsat TM 8 for Urbano Santos-MA;
- Quantify areas of use and defined coverage in images;
- Evaluate and compare the changes through a time series of 30 years (1984 and 2014).

2 Method

The studied area is the municipality of Urban Santos, located in the territory of Citizenship Lom Parnaiba Maranhão, to the east of the State of Maranhão, between the coordinates 02° 44’ 23”S and 42° 57’ 46” W, distant 280 km of São Luís capital. The municipality has an area of 1,207.834 km². The estimated population in 2013 is 26,833 habitants, according to IBGE [4].

The vegetation that predominates in the region is formed by open savannah with diverse floristic composition; among the most common species are Attalea speciosa Mart. (Babaçu), Capparis coriacea (Canaúba) and Mauritia wintera (Buriti). The Cerrado Courts generally have grasslands with scattered trees or saplings. The climate that predominates in the municipality is Tropical with winter rains, according to Koppen climate classification, with moderate water deficiency in the months from June to September.

For the continuation of this work were employed the following data and applications: a) satellite digital scenes Landsat TM-5 with a spatial resolution of 30 m, the year 1984 acquired the free site <www.impe.br>; b) satellite digital scenes Landsat TM-8 with a spatial resolution of 15 m, the year 2014, acquired the site, http://earthobservatory.nasa.gov. c) Letters planiattimetricos Letras-SUD-ESE in the range of ES 1: 100,000 and d) software SPRAING.

For the processing of digital images as well as for data analysis, it was used the software Georeferenced Information Processing System (SPRING), version 4.3.3. With the help of software, the areas bounded form, classified and quantified as the land cover changes and land use, through the interpretation of satellite images Landsat TM5 and Landsat corresponding TM8 the study area, the municipality mentioned above, with a space time 30 years. The work was basically split into five stages, namely: Acquisition of images, Georeferencing, Cut the municipalities, regions and rating Segmentation, Interpretation and Visual Ranking.

At the beginning of the process of targeting the region start from a pixel or pixels. According to National Institute for Space Research (2000), for each region of the segmented calculate the spectral attributes, such as: mean, variance, and texture. The aggregation of the regions is performed according to the criteria of similarity and area are provided by the analyst.

The preliminary results generated by Espindola et al. [5], shows values between 8 and 10 to 20 and 25 of area, can be good indicators of an ideal segmentation. In this case of work, better targeting has been generated for similarity of 15 and 30 area, in disagreement with the above values.

The results were adjusted guidance for the interpretation of visual, based on elements of photo-interpretation, how: tint, shape, shadow, texture, eliminating elements that were added to classes without following the criteria predefined for segmentation and delimitation of new areas that were ignored by the digital classification.

After correction of segmentation, polygons errors are identified in the visual interpretation all the images. Classifying and quantifying the space occupied in all are identified with colors for each defined class polygons.

3 Results and Discussion

Through visual analysis performed on the images, it was established that with agricultural growth, and especially the appearance of eucalyptus and soybean industries, there has been a disorganized occupation and indiscriminate use of land, especially the Cerrado ecosystem (Table 1).

<table>
<thead>
<tr>
<th>Classification</th>
<th>1984 (ha)</th>
<th>%</th>
<th>2014 (ha)</th>
<th>%</th>
<th>Variation (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>5,639,10</td>
<td>4,7</td>
<td>20,008,46</td>
<td>16,6</td>
<td>14,367,4</td>
</tr>
</tbody>
</table>

PROCEEDINGS OF THE XXV INTERNATIONAL CONFERENCE ON GRAPHICS ENGINEERING - 139 -
Table 1. Area of use land according to the image and their properties compared in the year 1984 and 2014.

<table>
<thead>
<tr>
<th>Urban use</th>
<th>178.34</th>
<th>0.15</th>
<th>1,268.67</th>
<th>1.04</th>
<th>1,080.33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savannah tree</td>
<td>78.860</td>
<td>66.3</td>
<td>81.542</td>
<td>67.4</td>
<td>2,682.1</td>
</tr>
<tr>
<td>Savannah park</td>
<td>36.166</td>
<td>30</td>
<td>18.023</td>
<td>15</td>
<td>18.133</td>
</tr>
</tbody>
</table>

Deforestation rampant in urban Saints, mainly to meet the great agricultural demand, not only causes the extinction of animal species and native vegetation and also leads to increase environmental problems. It was noticed that the Savannah Park suffered a very considerable reduction of approximately 18,000 ha, while the Land Use grew rampant, with a range of about 15,000 there (Figure 1 and 2).
The removal of the native vegetation in the region intensifies the process of environment degradation. The increased level of these areas and the short time in which it occurs is worryingly.

This Geographic Information System and remote sensing provides an extensive set of knowledge to characterize dynamic phenomena that occur in agricultural areas. As a result, growth and validation of multi-temporal analysis techniques are important to conduct the necessary knowledge to better use of remote sensing in this field. Through the interpretation of satellite images reached up, an updated and accurate thematic map of the different spatial structures resulting from the process of occupation and land use (Figures 3 and 4).

![Map of the use and land cover in city of Urbano Santos - MA (1984)](image)

**Fig. 3** Map of the use and land cover in city of Urbano Santos - MA (1984)
4 Conclusion

In view of this, the discussion and interpretation of the results obtained by analyzing the images, depending on the applied methodology to the following conclusions:

1. In the areas of Savannah Park in 30 years (1984-2014) there was a reduction of approximately 18,000 ha, while the areas of Land use, had an increase of approximately 15,000 ha, what can we say, according to visualization and interpretation of satellite images, which are considerable variations in what concerns the use and coverage, due to the growth of soybean farming and especially eucalyptus.

2. From the highlights shown in this study, there is just how overblown the process of occupation and land use in the municipality of Urban Santos-MA, whose environment is fragile, and already has high levels of land use as a result indiscriminate replace the original vegetation cover for large areas of eucalyptus and soybean crops.

References


