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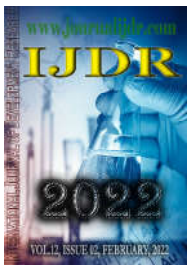

RESEARCH ARTICLE OPEN ACCESS

USE OF GEOTECHNOLOGIES IN THE SPATIALIZATION OF VEGETATION COVER IN THE CITY OF URUBURETAMA, NORTHEASTERN BRAZIL

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ABSTRACT

The presence of green area in large urban centres is a strong indication of the welfare of the city and causing, above all, debates to draw attention of both the population and the government. The present research sought to identify the vegetation cover in the city of Uruburetama-CE through geoprocessing techniques to analyze the results of the urbanization effects. The mapping consisted in acquisitions of images from Google Eath and the IBGE database for the delimitation of the urban area of Uruburetama and were processed through the software SPRING 5.2 and Quantum GIS 2.0 for confection of the map. The result had 67% of the area with vegetation cover, i.e., of the 5,665.730 m² of the urban area, 3,790.502 m² are covered by vegetation. Therefore, the products obtained by the Remote Sensing technique and the GIS allowed the aid of such studies with a certain degree of accuracy, obtaining cartographic data in the studies of vegetation cover.

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INTRODUCTION

In the historical-geographical process of occupation and transformation of the Brazilian territory, natural conditions and forms of use have always been interrelated. In this way, environmental problems have also been the result of these interactions. Environmental degradation in Brazil began right after its discovery, with the brazilwood cycle, whose species suffered a totally predatory extraction. The lack of greenery in large urban areas has been bringing damages, impairing the city's well-being and causing, above all, debates to draw attention of both the population and public agencies. The problems related to the environment have been observed with more intensity in cities, therefore, studies related to the quality of the urban environment can contribute to improve the planning from the generation of policies capable of making a planning less impactful to the environment, and improve the quality of life of the population, which needs an ecologically balanced environment.The quality of the vegetative element in the urban network is related to its functions, which may be: ecological, aesthetic and leisure. According to Loboda and De Angelis (2005), the ecological contributions occur to the extent that the natural elements that compose the urban spaces minimize the impacts resulting from urbanization. The aesthetic function is guided mainly by the integration between the built spaces and those intended for circulation. The leisure function is directly related to the provision of spaces for the well-being of the population.

Because of these important functions that relate directly and indirectly to socio-environmental issues, the environmental quality of cities has become an increasingly present concern in urban planning and management. According to Nucci (2001), it is worth highlighting the importance of vegetation cover for a city, because in addition to all the needs to care for and preserve for future generations that human beings have in relation to vegetation it is important to remember that cities are increasingly degraded, especially natural resources such as air and water, which can be reduced by preserving local vegetation. The occupation of the Uruburetama mountain range is related to the occupation of its first municipalities, composed by Itapajé, Uruburetama and Itapipoca, being the cotton cultivation in Itapipoca the most important for its development. The settlement of the Uruburetama nucleus goes back to the colonial period with the sesmarias, passing from village to municipality in 1931. The economic activity of this municipality has always been subordinated to Fortaleza, as it met the agricultural needs of this region. However, the occupation of the mountain developed even from Itapajé, which occupied not only your area, but also Uruburetama, Itapipoca and Irauçuba (Silva, 2007) The consequence of the occupation model requires a prior study to identify the areas of greatest environmental sensitivity so that preventive proposals can be established to minimise the effects of predatory actions, mainly on the renewable and non-renewable natural resources of these environments. The absence of vegetation in public spaces and throughout the city as a whole is considered a problem that interferes in the environmental quality in urban spaces, as well as in the quality of life of the population.

In addition, other problems should be mentioned such as insufficient public services; the unequal distribution of urban and community equipment; the lack of green areas; the inadequate patterns of land use; and the low technical quality of constructions (Fernandes, 2004). According to Oliveira (2001), one of the indicators that express the environmental quality of a city are the vegetation cover indices, corresponding to the whole area occupied by vegetation including private areas and areas of permanent preservation, in the orthogonal projection of the urban space. The urban headquarters have been, in this sense, suffering a series of environmental impacts regarding the significant loss of their green areas, starting with the public domain areas such as squares, APPs areas among others. The studies on vegetation cover have as main focus the green areas, in order to promote a plan of use, recovery and preservation in accordance with the chronological advance of the plans of organization of the space of the highland cities, from the initial plans to the proposal of a master plan under construction. The quantification of vegetation cover in urban areas makes it possible to assess, monitor, compare and discuss the rates of vegetation cover presented in different places around the world. It is also possible to follow the evolution or reduction of urban vegetation cover in relation to real estate speculation. The measurement of vegetation cover in urban areas allows the evaluation, monitoring, and discussion of vegetation cover indices for a given city and is based on recently published work. It is also possible to follow the evolution or reduction of urban vegetation cover in relation to real estate speculation and urban development. The use of geoprocessing techniques as a tool for spatialisation of data is used in order to obtain a more detailed and precise analysis of the vegetation cover in this region, as well as the elaboration of a geoenvironmentalcharacterisation of the city. This research seeks to identify the vegetation cover and characterise the environmental systems through geoprocessing techniques so that a study can be carried out to adopt proposals that will reduce the effects of the growth of urbanisation while preserving the renewable and non-renewable natural resources of these environments.

MATERIALS AND METHOD

The Uruburetama massif, located in the northern portion of Ceará State, extends over an area of 860 km² (Figure 1). It covers the municipalities of Uruburetama, Itapajé, parts of the municipalities of Tururu, Itapipoca, Miraíma, Irauçuba, Tejuçuoca, Umirim, Trairí, Amontada, Apuiarés and Pentecoste (Silva, 2007).

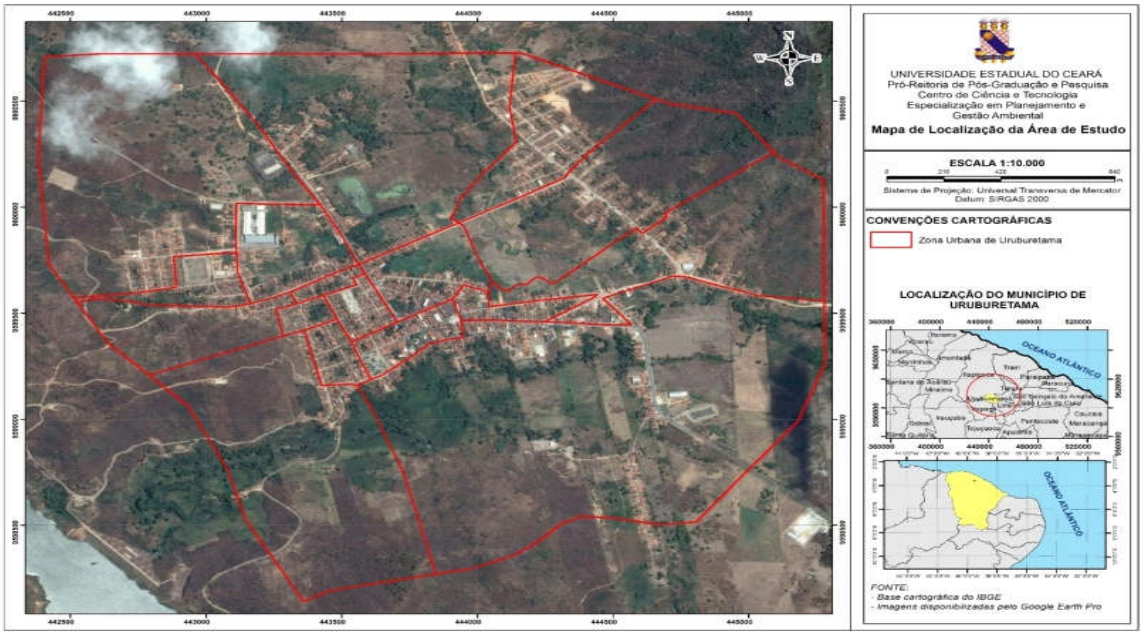
The research clipping area in the Uruburetama mass if corresponds to the urban headquarters of the municipality of Uruburetama. The mapping consisted in acquisitions of Google Eath images from the date of eighteen August two thousand and thirteen and the aid of the database of the Brazilian Institute of Geography and Statistics (IBGE) for the delimitation of the urban area of Uruburetama. These acquired images will be mosaicked and processed through SPRING and Quantum GIS software. Based on this, these images were georeferenced with datum SIRGAS 2000 with Universal Transverse Mercator projection (UTM) through the Quantum GIS and processed from the segmentation of images and then with supervised classification in SPRING. Furthermore, the map of environmental systems will be delimited with theoretical-methodological basis in SOUZA (2000) through the Quantum GIS software. The works related to the mapping of vegetation cover have several procedures such as field visits or works, with plotting of the information obtained on maps and topographic plans; and through classification of images obtained from remote sensing, whether by aerophotography or satellite orbital images (Luchiari, 2001). This classification is done by regions according to the segmented image. When the image is processed by region classification, the SPRING software uses the spectral information of each "pixel", tries to simulate and recognise homogeneous areas, based on the spectral and spatial properties of the images. Then, after the classification shape is generated, the shape will be cut by the shape of the urban area and then quantified how much vegetation cover the city of Uruburetama and the urban core have. To arrive at the vegetation cover index (VCI) according to Cavalheiro et al (1999) the total area with vegetation cover is divided by the number of inhabitants and the percentage of area with vegetation cover according to formula 01. According to the same author, a city is considered to have 70% vegetation cover.

$$LCI = \sum \text{Vegetation cover (m}^2\text{)} / \text{Total surface area (m}^2\text{)} \quad (01)$$

Furthermore, another vegetation cover index was carried out, this index relates the amount of vegetation cover per person (inhabitant) represented by the Index of Vegetation Cover per Inhabitant (ICVH). Based on the following formula (02):

$$HVCI = \sum \text{Vegetation cover (m}^2\text{)} / \text{Number of inhabitants} \quad (02)$$

It is worth pointing out that the vegetation cover is considered to be every green stain on the satellite image resulting from the radiation emitted by the vegetation on the satellite sensor.



Source: prepared by the authors.

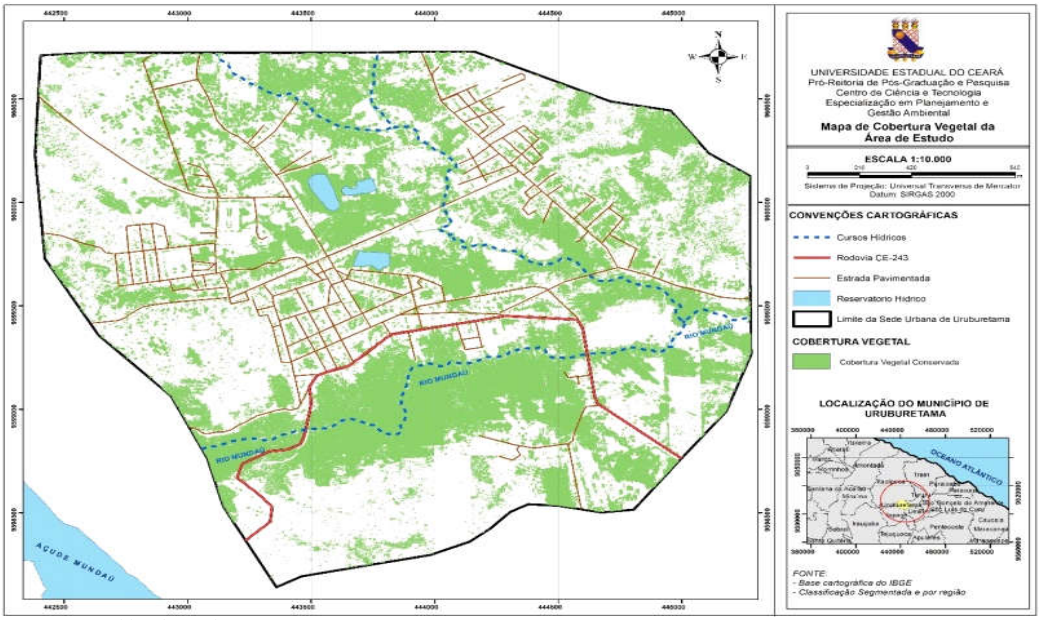
Figure 1. Location map of the city of Uruburetama

According to Cavalheiro and Del Piccha (1992), the UN (United Nations Organization), FAO (Food and Agriculture Organization) and WHO (World Health Organization) recommend that cities should have at least 12 m² of vegetation cover/inhabitant, considering an ideal value for improving the quality of life of the population. Thus, it will be taken into account these authors since the work is based on the concept of vegetation cover of that author.

RESULTS AND DISCUSSIONS

According to Nucci (2001) conjectures, vegetation studies may mitigate urban problems by serving as a basis for urban and environmental planning, thus the vegetation cover in the urban environment must be carefully considered in the evaluation of environmental quality and planning of the urbanized landscape. Whether by quantitative or qualitative methods, the importance of the study and its distribution require greater attention from public policies for planning purposes. By mapping and quantifying the vegetation cover in the urban area of Uruburetama municipality, taking into account the IBGE delimitation and the proposed methodology, it led to a result of 67% of the area with vegetation cover, i.e., of the 5,665.730 m² of the urban area, 3,790.502 m² are covered by vegetation.

However, if only the urban core is taken into consideration (Figure 3), the result drops to 38% of the area with vegetation cover, thus, of 1,782.949 m² of the urban core of the city seat, 675.445 m² are with vegetation cover (Figure 2). In addition, in order to establish the environmental quality of the city, a vegetation cover per inhabitant ratio was calculated, called the Vegetation Cover Index (HCI), resulting in 252 m² per inhabitant. It is essential to highlight that the concept used and proposed by Cavalheiro et al. (1999), the ICV should not be confused with the index of green area per inhabitant (IAV), since the calculation of green areas does not need to quantify roundabouts, ornamental gardens, tree canopies, flowerbeds, and even permeable soil and vegetation should occupy at least 70% of the area. Related to the obtained HVCI of 252 m² per inhabitants, it shows that the vegetation cover area of 38% for the urban nucleus of the Uruburetama urban headquarters was very well classified by the minimum percentage that an urban area should contain which is 30% recommended to provide an adequate thermal balance (Oke, 1973 apud Lombardo, 1985). These results on the area occupied by vegetation cover and the VCI show some environmental qualities that occur in the city as shading for people, better air humidity, milder temperatures due also to the urban area being on the windward side of the mountains, in addition to air quality. Regarding the distribution of vegetation cover in the urban area represented on the map, it was



Source: prepared by the authors.

Figure 2. Location map of the city of Uruburetama

Source: own collection.

Figure 3. Town square with small vegetation cover

found that the distribution follows a certain balance, with the exception of the northwestern and southwestern parts of the urban core, where there is a higher number of buildings and little vegetation cover, but in the most central and eastern parts, which are close to the Mundaú River, there is a larger area of vegetation cover. The vegetation followed a clumped pattern according to Jim's classification (1989), in which there are patches of vegetation cover representing a portion of green area. This spatialisation is important, since the index should not be treated in an isolated way, since areas can be found in the urban zone with practically no vegetation cover, while in others there may be a regular distribution or a higher concentration of urban greenery. The urban nucleus was being built by natural relations and by different techniques produced by man.With this, it becomes an environment modified either by the removal of the cover or by replacement by exotic vegetation, and degraded by man's work force and by social relations with nature and the natural elements (Figure 3). However, there is a limitation of the understanding of environmental quality with the vegetation cover, since all green in the image is vegetation cover, some crops or anthropic activities may harm the mapping as it is the case sometimes of football field or fruit crops like banana trees (Figura 4).

Source: own collection

Figure 4. Banana plantation area

CONCLUSION

It can be considered that the urban centre of Uruburetama, where there is a higher concentration of buildings, presents a lower vegetation cover than the other areas.

The urban green areas provide a better quality in the excessively impacted environment of the cities and benefits to the population. With that, its loss is one of the biggest problems of the big cities. Its characteristics beyond the aesthetic aspect, with the diversification of the built landscape and the beautification of the city; the green areas also have extreme importance in the ecological, social, educational and psychological aspect of the society. In the outskirts of the urban nucleus a greater visualisation of the vegetation cover is shown, as the urbanisation processes have not yet arrived, and a large part of an area still well covered with vegetation is near the rivers and consequently the riverine plain.

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