



GREEN AREA AND VEGETATION COVER INDEXES OF THE SQUARES IN THE MUNICIPALITY OF ITABERAÍ, GO

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ABSTRACT

The interest in analyzing green spaces in urban areas and correlating them with human health has expanded due to rapid urbanization, increased pollution, and growing trends of physical inactivity among the population. Considering the importance of preserving natural areas for promoting public health, the present study aimed to evaluate green spaces (green areas, vegetation cover, and vegetation cover percentage) in the Municipality of Itaberaí, Goiás. For this purpose, with the assistance of Geographic Information Systems (GIS) technology, the Green Area Index (GAI), the Vegetation Coverage Index (VCI), and the Vegetation Coverage Percentage (VCP) of the studied urban area were calculated. In the analysis of the IAV, the base map from Google Satellite in the QGIS 3.28.10 software was used; however, the ICV was measured using the Normalized Difference Vegetation Index (NDVI), calculated from images downloaded from the CBERS-4A satellite. With the application of the methodology in question, Itaberaí demonstrated that only 13.80% of its urban territory is covered by vegetation. Regarding the IAV, the study obtained a value of 1.32 m2/inhabitant, classified as very poor by the Brazilian Society of Urban Arborization (SBAU). Given the above, it is concluded that the urban area of Itaberaí requires special attention regarding the analyzed topic, as the city does not meet the internationally recommended levels of interurban vegetation.

Keywords: Vegetation Cover; NDVI; Index; Urban Area.

INTRODUCTION

The intensified urban growth in Brazil starting from the 1960s led to a significant expansion of cities and caused several problems, such as the formation of heat islands, air and water pollution, and the reduction of vegetation cover.

To better understand the adversities manifested from urban growth, many researchers have begun to evaluate interurban green areas.

The most debated concepts when talking about urban vegetation are the Green Area Index (GAI) and the Vegetation Coverage Index (VCI). According to Faustino (2019), the Green Area Index (GAI) corresponds to the product of the sum of green areas in public spaces, in m², divided by the number of inhabitants in the analyzed region. The ICV, on the other hand, corresponds to the product of the sum of all the

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vegetation covering the surface of the urban area, in m², divided by the number of inhabitants of the urban area (Santos, 2018).

Given the growing interest in studying urban green areas, the objective was to investigate the green space of the city of Itaberaí, Goiás, through the analysis of IAV, ICV, and PCV, with the aim of providing support for planning and decision-making that involves the quality of life of the population.

METHODOLOGY

The research began with the process of mapping and vectorizing the parks and squares in the study area. The area values were obtained by creating a polygon layer, using the boundaries of the squares and the park visualized on the Google satellite base map in the QGIS 3.28.10 software as a reference.

Completed the stage of determining the areas of the squares and the park, the IAV was calculated using equation 1, represented below.

$I_{AV} = \frac{\sum \text{ the green areas (m}^2)}{n. \text{ of inhabitants in the urban area}}$

(Eq. 1)

For the classification of IAV, only the sum of the areas of the analyzed spaces was considered, without taking into account the projection of the tree canopies in the area calculation, in relation to the number of inhabitants.

The analysis of the ICV was conducted using the calculation of the Normalized Difference Vegetation Index (NDVI) in the QGIS software. For the calculation of NDVI, images from the CBERS-4A satellite from the year 2023 were used. With the results in hand, a reclassification of the raster image was performed, so that each pixel of the image now had only one predefined value range, table 1.

Adopted Classes	Values resulting from NDVI	Visual Representation
(1) Built-up areas and Water resources	-1,0 a 0,0	
(2) Exposed soil and Built-up areas	0,0 a 0,4	
(3) Sparse vegetation and Grasses	0,4 a 0,6	
(4) Dense vegetation	0,6 a 1,0	

 Table 1. Classes adopted with the respective NDVI values





Source: Prepared by the Author, 2023

The study proceeded by converting the NDVI raster file into a vector file, subsequently categorizing the shapefile by separating the four spectral classes, and finally concluding the analysis by summing the areas of classes 3 and 4, sparse vegetation and dense vegetation, respectively. With the result of the sum of the areas of classes 3 and 4, it was possible to obtain the ICV, using equation 2.

$$I_{CV} = \frac{\sum \text{ vegetation cover (m2)}}{n. \text{ of inhabitants in the urban area}}$$
(Eq. 2)

For the calculation of the Green Coverage Percentage (PCV), equation 3 was used, as represented below.

$$P_{CV} = \frac{\sum \text{ vegetation cover (m^2)}}{\text{total urban area}} \times 100$$
(Eq. 3)

RESULTS

As a result, Table 2 shows the areas of the squares and the park used in the study, the values were obtained with the help of QGIS. Thus, considering the values in Table 2, a total area of 61,104.8 m2 was reached. Based on this result and considering that the urban population of Itaberaí is 44,734 inhabitants, according to the 2022 IBGE census, the value of 1.32 m2/inhabitant of IAV was reached.

Total Area (m²)	
4.542,35	
3.709,25	
10.071,99	
2.322,44	
340,04	
18.404,38	
21.714,35	

Table 2. Area of the Squares and Park of Itaberaí-GO

Source: Prepared by the Author, 2023





The area in square meters of green cover in the urban zone of Itaberaí was calculated using QGIS, applying the NDVI technique, as illustrated in the steps of figure 2.

Figure 1. Stages for obtaining the green cover area. (A) NDVI, (B) reclassified NDVI, and (C) vectorized NDVI



Source: Prepared by the Author, 2023

The final NDVI analysis showed that the urban area of Itaberaí has 1,502,660 m² of green cover. Based on this result and considering that the urban population of Itaberaí is 44,734 inhabitants, it was possible to compute the value of 33.59 m2/cap of GVI.

Finally, Equation 3 was used to obtain the Green Coverage Percentage for the urban area of Itaberaí.

CONCLUSION

Our findings revealed that Itaberaí has 13.80% of its urban territory covered by vegetation. The conclusion is a warning to public managers about the need to invest in neighborhood greening projects, as green infrastructure positively impacts the health of the population. For example, it is capable of reducing air pollution levels (Hongshan Ai et al 2023), significantly improving asthma crises in children (Yabin Hu et al 2022;





Tingting Ye 2023), reducing residents' anxiety symptoms, benefiting psychological health (Tafzila et al 2023; Hiwot et al 2022; Angel et al 2018), among others.

Another result that caught attention was the IVI of 1.32 m²/inhabitant, a value considered very poor; the index suggested by the Brazilian Society of Urban Arborization (SBAU) is 15 m²/inhabitant. Finally, it was possible to conclude that there were planning failures during the urban growth process, as the values of the Indices that evaluate Green Infrastructure are discrepant from those recommended by international bodies.

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