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# URBAN SUSTAINABILITY AND GREEN AREAS INDICATORS IN THE CITY OF SÃO PAULO

# SUSTENTABILIDADE URBANA E INDICADORES DE ÁREA VERDE NO MUNICÍPIO DE SÃO PAULO

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## Abstract

The present study evaluates the role of green area index and their contribution to urban sustainability and reduction of environmental inequality, taking as a case study the municipality of São Paulo, which has heterogeneous, and complex land use and occupation. The research carried out has an exploratory character with a qualitative approach, and as a result, it was found that there is no consensus in the literature on an ideal value of vegetation index in cities, due to the different scales of analysis of the studies. The value of IAVT (Total Green Area Index) calculated was 16.70 m² of green area / inhabitant, above the ideal value of green area attributed to the World Health Organization (WHO) of 12 m². However, only 30% of the 32 administrative regions (subprefectures) of the municipality actually have a higher index than recommended, with part of these areas being forested. Therefore, the IAVT should be used with caution in the development of policies and actions aimed at reducing environmental inequality since it has limitations, since it does not include urban afforestation, but mainly because it does not consider the share of occupation that may be more, or less, urban. The index attributed to WHO can be applied because they make cities comparable to each other, however, it is not suitable for local public policies because it does not accurately represent the population's exposure to green areas. Still, IAVT can be adopted as a decision-making parameter for the expansion of green areas in the city, such as the implementation of parks, seeking greater environmental equity.

**Keywords:** green area, vegetation cover, indicators, climate change, urban sustainability.

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## Resumo

O presente estudo avalia o papel dos índices de áreas verdes e sua contribuição para a sustentabilidade urbana e redução da desigualdade ambiental, tendo como estudo de caso o município de São Paulo que possui uso e ocupação do solo heterogêneo e complexo. A pesquisa realizada tem caráter exploratório com abordagem qualitativa, e como resultado, verificou-se que não há um consenso na literatura sobre um valor ideal de índice de vegetação nas cidades, devido às diferentes escalas de análise dos estudos. O valor de IAVT (Índice de Áreas Verdes Totais) calculado foi de 16,70 m² de área verde/habitante, acima do valor ideal de área verde atribuído à Organização Mundial da Saúde (OMS) de 12 m². Porém, apenas 30% das 32 subprefeituras do munícipio possuem realmente um índice superior ao recomendado, sendo que parte dessas áreas são florestadas. Portanto, o IAVT deve ser utilizado com cautela no desenvolvimento de políticas e ações que visam a redução da desigualdade ambiental visto que ele apresenta limitações, por não contemplar a arborização urbana, mas principalmente por não ponderar pela parcela da ocupação que pode ser mais, ou menos, urbana. O índice atribuído à OMS pode ser aplicado pois tornam as cidades comparáveis entre si, entretanto, não é adequado para políticas públicas locais por não representar precisamente a exposição da população às áreas verdes. Ainda, o IAVT pode ser adotado como parâmetro de tomada de decisão para a ampliação das áreas verdes na cidade, tais como a implantação de parques, buscando maior equidade ambiental.

**Palavras-chaves:** área verde, cobertura vegetal, indicadores, mudanças climáticas, sustentabilidade urbana.

## Introduction

Waterproofing and compacting of soil and the intense suppression of vegetation are factors resulting from the inadequate occupation of the urban territory. These changes in land use and occupation accompany the transformations that culminated in the contemporary lifestyle. Such transformations result from the demand for basic services and the minimum infrastructure for the population, including adequate housing, supply of drinking water, sewage collection and treatment, electricity, transportation system, etc. (CORTESE and NATALINI, 2014). The magnitude of these changes depends on the direct relationship between the need for basic services and the number of inhabitants. The urban population reflects this provision, which currently represents about 54% of the world population, which is estimated to reach around 66% by the year 2050 (United Nations Regional Information Center [UNIRIC], 2018). Thus, the growing demand for changes in land use and occupation imposes increasing pressure on the quality of life in the urban environment.

When the urban expansion that legitimately seeks to supply the population's needs is incompetent, this generates a series of negative environmental consequences. This includes an increased vulnerability of the urban environment to climate change, due to intrinsic characteristics of cities such as the formation of heat islands. In addition to locally affecting thermal comfort, heat islands promote convective activities in the city, increasing the frequency and intensity of extreme precipitation events, already expected by changes in the global climate regime (MARENGO et al., 2020). The combination of these changes in rainfall patterns with the high demand for water resources and with waterproofing of the soil, lead to severe consequences in the city, from water scarcity to floods. These are considered the two worst natural disasters in cities, affecting infrastructure, economic activities, and the health of the population (MUIS et al., 2015; GU et al., 2015; LARSEN et al., 2016). These variations in temperature and precipitation regimes add to the impact of urban expansion on local biodiversity, which, together, can cause an increased probability of the proliferation of zoonoses, such as dengue or malaria (FRANKE and HACKBART, 2008).

Facing urban challenges, such as urban mobility, air quality, health and safety, climate change, among others, are barriers to be overcome in the search for regional development, and demand collective actions (SILVA et al., 2019). The actions need to promote the integration between the environment, the economy, culture, and society, such as Agenda 21 (CARVALHO, 2014).

Therefore, green areas play a key role in the search for sustainable and regional development, since they act in the promotion of a balanced environment, while promoting cultural and social interactions (ACSELRAD, 1999).

Literature and public policies identify green areas as important instruments in the search for urban sustainability and the mitigation of climate change (THE NATURE CONSERVANCY, 2019), with the aim of promoting the improvement of quality of life. These benefits are in line with that proposed by Article 225 of the 1988 Federal Constitution, which advocates the right to a balanced environment that promotes maintaining people's positive quality of life. In addition to benefits to the city, such as aesthetic and social, it is linked to improving quality of life, and mental and physical health (BENAYAS, NEWTON, DIAZ and BULLOCK, 2009; ASGARZADEH et al., 2012).

In the municipality of São Paulo, whose territorial extension is 1,521,110 km², the reality is much more complex (CARVALHO and DAMACENA, 2012), since its population is estimated at 12,106,920 people and 98% lives in an urban environment (Brazilian Institute of Geography and Statistics – Instituto Brasileiro de Geografia e Estatística [IBGE], 2018). This population is exposed to a variety of environmental conditions that only highlight the inequality observed in the region (LOCOSSELLI et al., 2020) and, in large part, the inequality is associated with the heterogeneous distribution of green areas within the municipality (SILVA et al., 2019). An example of this heterogeneity are the sub-municipalities located predominantly in the South Region of São Paulo, which concentrate a large part of the green areas in relative extension and benefit from pollution levels up to 50% lower (MOREIRA et al., 2018) and surface temperatures up to 25% lower (FERREIRA and DUARTE, 2019). The directly associated population is impacted by the concentration of green areas in the reduction of some health problems, such as the significant reduction in cases of hypertension (MOREIRA et al., 2020).

These works presented by MOREIRA et al. (2018,2020) and FERREIRA and DUARTE (2019), conducted in the municipality of São Paulo, demonstrate the magnitude of the benefits promoted by green areas to the associated population and that these benefits are directly proportional to their relative extent within the urban network. Focusing on the use of green areas as instruments of eco-systemic importance for cities, the role of green areas and their contribution to urban sustainability and regional development is demonstrated, through the analysis of the distribution indicators of the green area of the city of São Paulo (SP). The analyzed indicator is the TGAI (Total Green Areas Index) of the municipality of São Paulo, in its total values, by region, and sub-prefecture.

## Theoretical Reference

This topic aims to support the theoretical basis that will assist future discussions, data analysis, and diagnostics to be developed during the research. We divided it into three theoretical pillars: regional development, urban sustainability, and management instruments.

## Urban Sustainability

The idea of urban sustainability arises from the combination of urban space and the concept of sustainability, originated by political re-articulations, such as Agenda 21, which seeks a more socially just world, environmental conservation, and economic growth. Another is the United Nations Agenda 2030 [UN], presented as a global development plan with long-term actions and established 17 Sustainable Development Goals. Since these documents cover cultural, social, economic, political, and environmental aspects, they depend on interdisciplinary, interdependent, and systemic public policies to produce concrete effects (SOTTO et al., 2019).

This intense urbanization, combined with the consequences of climate change, is a challenge for cities. Documents presented by federal governments entitled Nationally Determined Contribution and state and municipal action plans, establishing mitigation and adaptation measures, have become necessary management tools. Within this context, green areas play a key role in the pursuit of urban development, as they act to promote a balanced environment, while promoting cultural and social interactions (ACSELRAD, 1999).

Green areas' benefits extend to aesthetic, spiritual, and recreational factors, as well as public health issues, whether physical or mental, in addition to positive aspects related to the environment (THE NATURE CONSERVANCY, 2019). However, to achieve these benefits, it is essential to adequately plan the use and occupation of the soil, population growth, environmental conditions, and

the territorial distribution of leisure areas. Each municipality has its own characteristics, and the green areas have ecological, educational, aesthetic, psychological, and social functions that should be inserted into urban planning, following the type of use they are intended for.

## Regional development

Urban environmental planning, with the promotion of sustainability, integrates global themes from the global environmental agenda such as climate change and solutions based on nature, to environmental themes from regional development agendas. According to the Ministry of Regional Development [MRD], regional development must be understood in a multidimensional way, that is, with its multiple scales of intervention, aiming to develop the territory with plans, programs, and projects that recognize inequalities in multiple scales of intervention. It is comprised of measures or policies that aim to "correct regional imbalances to ensure a more even distribution of the population and economic activities across the territory" (MAILLAT, 1998).

Regional development is a multidisciplinary theme (CARNIELLO and SANTOS, 2013) that must be understood and observed together with cultural and social aspects, such as education, health, quality of life, and employability (SILVA, KOVALESKI and PAGANI, 2019). Currently, the National Policy for Regional Development (Política Nacional de Desenvolvimento Regional PNDR) is advocated by Decree No. 9,810, of 2019. However, according to Cavalcante (2020) "the legal basis for these initiatives is the 1988 Federal Constitution, which enshrines the reduction of inequalities as one of the fundamental objectives of the Federative Republic of Brazil". Therefore, to reduce regional inequalities, it is necessary that the management instruments are aligned with this objective.

## Management instruments for regional development

Public policies are important instruments for seeking to change current paradigms, such as mitigating the effects of climate change and achieving the desired urban sustainability and regional development, as they alter or maintain the behavior of citizens or organizations to obtain a desirable result. Additionally, they are applicable to several issues involving citizens, companies, communities, and institutions" (JUSTI and RAUEN, 2020). The conservation of urban green areas (MEIJER and BOLÍVAR, 2016) and the control of environmental resources associated with efficient social management (DA SILVA, 2003) are key instruments within this search.

Social management depends on advanced institutional capacities, democratic governance, and effective management to address challenges (LEITE and AWAD, 2012). To make public policies efficient instruments, critical analysis on urban legislation and regulation is essential along with environmental policy in participatory strength and efficient management to address challenges (MEIJER and BOLÍVAR, 2016). In this context, governance and public policies are regulatory instruments that play a fundamental role in the development of a smart and sustainable city (MEIJER and BOLÍVAR, 2016), as presented by MACHADO; VILANI; CHAME (2012, p. 12) "the loss of environmental quality and the reduction of the stock of natural resources require a new direction in the agenda of themes and problems to be discussed and institutionalized through the formulation and / or improvement of public policies".

Therefore, it is inevitable that the development of new efficient policies and decision-making is supported by scientific evidence, requiring the adoption of parameters and / or indicators. Indicators are quantitative and qualitative parameters, obtained through the association of two different variables and / or factors for the study and search for the identification and measurement of a problem, as well as the identification and choice of the strategy of action and solution of the problems (FREITAS, 2013). The Total Green Area Index [TGAI] is an example that aims to "evaluate the distribution of public green areas in the city, regardless of their function, that is, for leisure and contemplation use (urban parks and squares) or for ecosystem conservation (restricted use, for research)" (SVMA, 2013). It should be noted that green areas are understood to be all green areas in the public domain, that is, squares, parks, flower beds, etc. It should be noted that road afforestation and other isolated trees are considered as vegetation cover.

This study aimed to evaluate the use of vegetation indices as an instrument of regional development, mainly for the reduction of urban environmental inequality. Thus, the following questions were answered: I) Is there a consensus in the literature about an ideal vegetation index value in cities? II) Does the application of this index in different geographical scales result in similar

patterns of exposure of the population to the extent of green areas? III) Can these indexes be used consistently to develop public policies for regional development with a focus on environmental inequalities? The municipality of São Paulo was used as a case study as it has a range of geospatial data necessary to answer these questions.

## Method

The research in this article has an exploratory character with a qualitative approach. The primary objective of exploration is to develop concepts more clearly and to formulate a better delineated research problem. The exploratory research establishes criteria, methods, and techniques for the elaboration of a research and aims to offer information on its objective and guide the formulation of hypotheses (Cooper & Schindler, 2011; Martins & Theóphilo, 2009). It is used to perform a study in which the main objective of the research is to become familiar with the phenomenon that is being investigated, so that the subsequent research can be created with a greater level of depth.

Conversely, studies with a qualitative approach aim to know "how and why things happen", that is, to enable the understanding of the different meanings attributed by people to their experiences, using appropriate research techniques to record understandings, motivations, and interpretations (Cooper & Schindler, 2011; Collins & Hussey, 2005). Qualitative assessment is characterized by understanding, describing, and interpreting facts and phenomena (Martins & Theóphilo, 2009).

The research problem in this article is related to the daily lives of large cities, with the search for an answer on how green area indicators interfere with urban sustainability and regional development. In this case, exploratory research aims to analyze a particular variable, the TGAI, to understand its insertion and relationship with urban sustainability.

The development of the research was outlined in two stages: (a) survey of secondary data: real and ideal green area indicators in the municipality of São Paulo and (b) analysis of the data collected through comparison and calculation of indicators with secondary data and preparation and visual analysis of maps, as described below.

In the first stage, the authors collected data needed to calculate the indicators, namely: the value in square meters of green areas in the municipality of São Paulo, as well as the number of inhabitants. The data on green areas by sub-prefecture were obtained through documentary research with the Secretariat of Green and Environment – Secretaria do Verde e do Meio Ambiente (SVMA) and can be requested directly through the Transparency Portal at (https://www.prefeitura.sp.gov.br/ cidade / secretarias / controladoria_geral / Coordenadoria_de_promocao_da_integridade / index.php? p = 225079, accessed on XX of XX of 2019). Data on the number of inhabitants were obtained directly through the internet portals of the Municipality of São Paulo –MSP and IBGE, and calculated with the aid of Microsoft Excel software. In this first stage, we searched for ideal parameters for comparison with the calculated indicators, not only through documentary research with public policies and instruments of inductive regulation, but also in bibliographic research conducted in high impact national and international publications.

Using data for 2017, published in 2018 by SVMA, and the number of inhabitants of MSP and IBGE for each of the 32 Municipalities of the city, TGAI was calculated by dividing the total green areas in $m^2$ by the number of inhabitants, for the municipality of São Paulo. These will be evaluated on three spatial scales: the first considers the limits of the municipality in its entirety, the second calculates the indices by region (five sectors), and the third calculates the indices by sub-prefecture (32 sectors).

The second step is related to data analysis and involved comparisons between the numerical indicators raised with the ideals. These analyses were divided into three scenarios: a) the entire municipality, b) by region (East, West, North, South and Central Zones) and c) by Sub-prefectures (analyzing each of the 32 sub-prefectures of the municipality). These analyses used Excel software as a tool to construct the tables and graphs. In addition, maps of the municipality were built with the aid of the QGIS Team Developer software, to elucidate the numerical survey found graphically and facilitate analysis on the territory scale.

The numbers found were compared with the existing management instruments, with the objective of verifying the consistency of the indicators found with the decisions adopted by public policies for the expansion of green areas in the city. The projected green area values ($m^2$) are derived from information from the 2017-2020 Goals Program for the implanted parks, for the years 2019 and

planned for 2020, according to documentary research and participant observation, such information can be sought through the Transparency Portal, as previously mentioned.

## Results and Discussion

The disparity in the information obtained from a fixed TGAI value, such as 12 m² / inhabitant, is evident when evaluating the coverage of green areas in the city of São Paulo. Within the municipality scale, in its entirety, the values presented a TGAI of 16.70 m² / inhabitant (Green Area = 194,138,890 m² and number of inhabitants = 11,696,088, Table 2), a value that exceeds the value recommended by WHO by about 40%. This figure still exceeds 15 m² / inhabitants recommended by SBAU (1996) and the real indexes calculated for the municipality of Vinhedo (2.19 m² per inhabitant) (HARDER, RIBEIRO E TAVARES, 2006).

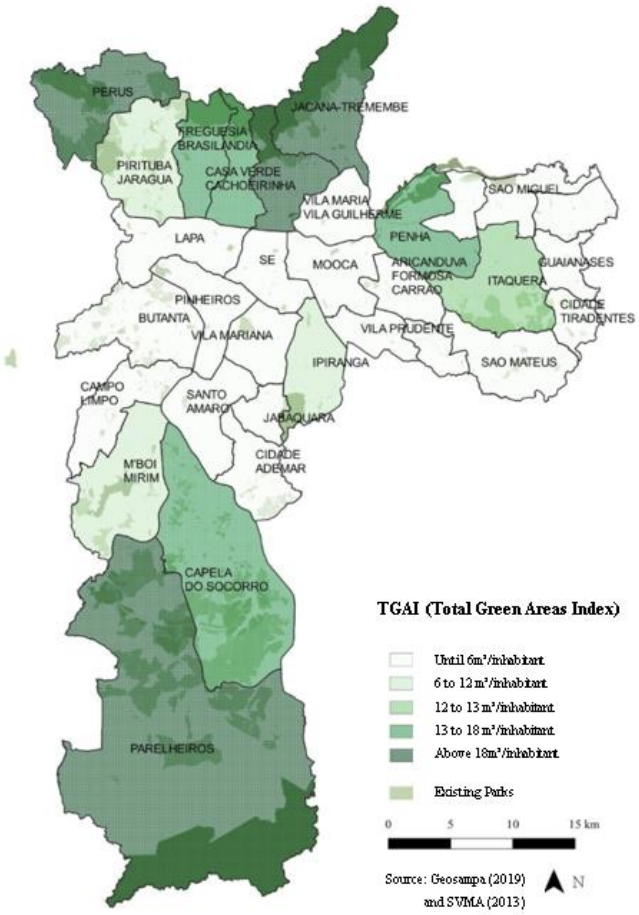
The analysis by region, according to the second spatial scale, revealed a heterogeneity of values different from the calculated index. As an example, only the North and South Regions meet the indicator considered ideal by WHO, while the other regions have TGAI of at least 50% lower than this ideal indicator (Table 2). Considering the third spatial scale evaluated, within the domains of the sub-municipalities, the results reveal an even more evident inequality in the distribution of green areas. Only 10 of the 32 sub-municipalities meet the ideal indicators (12 m²), which equates to only about 30%. Figure 1 shows the results of these indicators by Subprefecture of the municipality of São Paulo. The present study used data from 2017 and presented different results from those found in the research by Buckeridge (2015). These differences indicate that, currently, the highest concentration of green areas is in the North and South regions, and no longer in the central region of the city. This difference in results is largely due to the implementation of municipal parks in these areas.

**Table 2**: Actual indicators calculated by region of the municipality of São Paulo

| Region | IAV (data: 2017) |
|---|---|
| North Zone | 28.1 * |
| Central Zone | 2.5 |
| West Zone | 5.4 |
| South Zone | 26.4* |
| East zone | 5.8 |

* above the WHO recommendation
Source: the authors

**Figure 1:** Map of the Municipality of São Paulo with the TGAI (Total Green Areas Index)




Source: the authors.

It is noted that the central region has lower values of the indicator, and that the highest values of the green area indicator are found on the edges of the city. This spatial pattern is justified by the presence of Serra da Cantareira in the north of the city, and extensive areas of Atlantic Forest in the south, which, together with other areas, make up the green belt of São Paulo. In addition, the high TGAI value of these regions can also be attributed to the low population density of the region. These distinctions in the distribution of green areas are clearer in Figure 2, which aims to demonstrate the spatialization of green areas in the municipality compared to verticalization and Demographic Density. Figure 2 shows a higher concentration of green areas in less vertical areas and with less demographic density. These results corroborate Silva et. Al (2019), which indicates highly densely populated areas in the city, where low-income populations live, often do not have green areas, and in contrast to regions such as the south of the municipality, which also have low-income populations surrounded by extensive green areas of environmental protection that do not provide greater quality of life.

The 2017-2020 Goals Program, a public policy instrument, was renegotiated by the São Paulo City Hall in 2019, to revise the commitments for the next biennium, 2019-2020, with the objective of tackling the main problems identified in the city. The initiatives were organized into three pillars: 1) taking care of the city, 2) protecting people and 3) innovating in management; and the program consists of 36 Strategic Objectives and 71 goals. Strategic objective 30 and goal 30.4 provide for the implementation of 10 new parks in the cities (Table 3).

**Table 3**: Forecast of the implantation of the new parks with the increase of Green Areas, according to the Program of Goals 2017-2020 of the Municipality of São Paulo.

| Year | Zone | Sub-prefecture | Park | Area (m²) |
|---|---|---|---|---|
| 2019 | West | Lapa | Jardim das Perdizes | 45,967 |
| 2020 | West | Butantã | Água Podre - Nascentes | 40,444 |
| 2020 | Center | Sé | Augusta | 24,613 |
| 2020 | South | Cidade Ademar | Búfalos | 537,291 |
| 2020 | South | Parelheiros | Ribeirão Colônia | 110,685 |
| 2020 | South | Capela do Socorro | Linear Aristocratas | 36,884 |
| 2020 | South | Campo Limpo | Paraisópolis | 68,150 |
| 2020 | South | Santo Amaro | Alto da Boa Vista | 47,270 |
| 2020 | East | Itaquera | Nair Belo | 246,863 |
| 2020 | East | São Miguel | Primavera | 148,976 |
| | | | Total | 1,307,143 |
| | | | Total 2019 | 45,967 |
| | | | Total 2020 | 1,261,176 |

Source: the authors

The authors observed that even the TGAI of the southern region of the city presenting the second best indicator with data from 2017, among the regions of the municipality, and already meeting the minimum indexes proposed by WHO, still concentrates about 60% of the green area to be expanded until the end of 2020, surpassing the North Zone and having the best index in the municipality. While the Central, East, and West Zones, which had the lowest indicators and did not meet the ideal parameters, despite the increase, it was not significant for changing this scenario.

**Table 4**: TGAI calculated for 2020

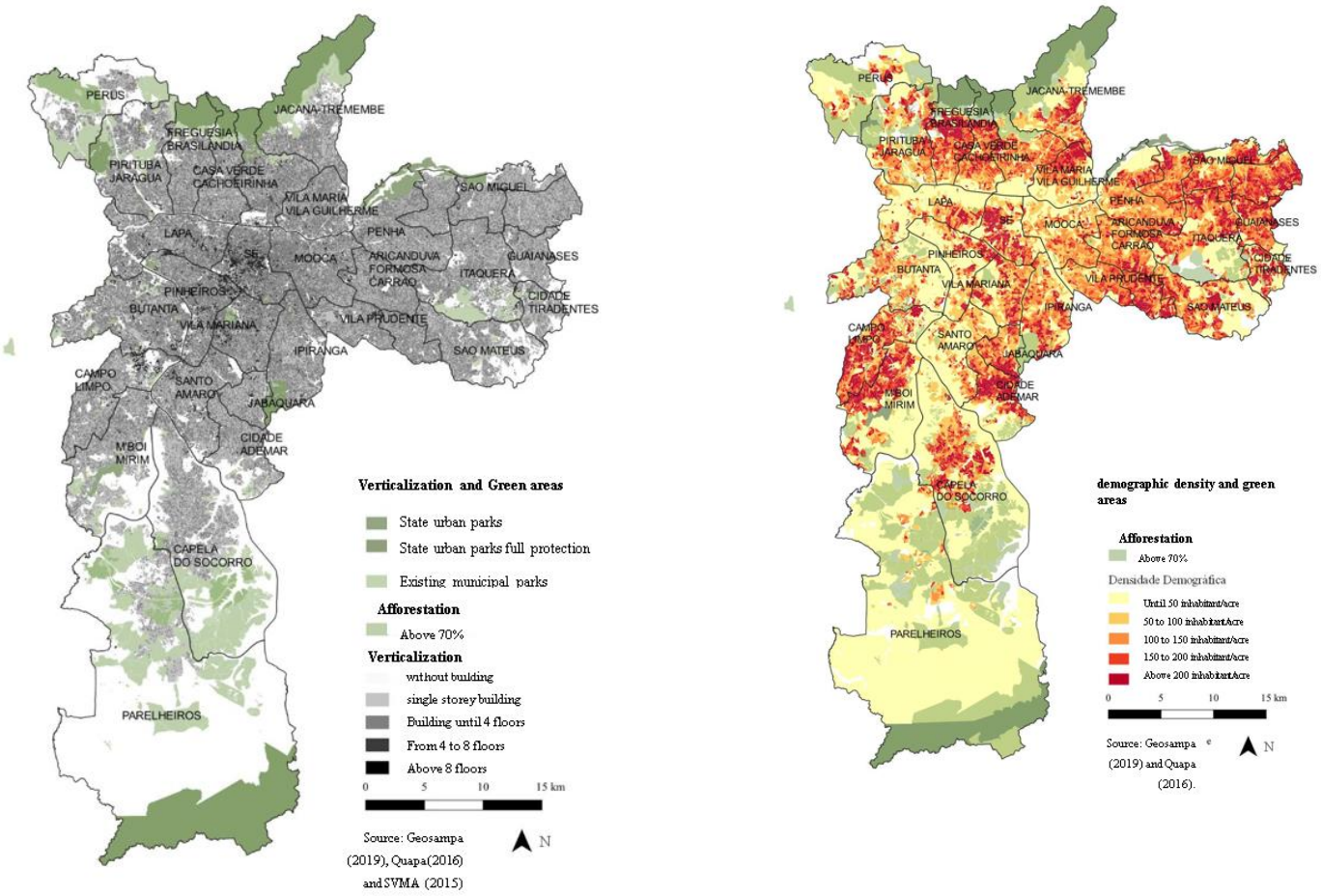
| Region | TGA (data: 2017) | TGA (data: 2020) |
|---|---|---|
| North Zone | 28.1 * | 23.1 * |
| Central Zone | 2.5 | 2.7 |
| West Zone | 5.4 | 5.8 |
| South Zone | 26.4* | 28.2* |
| East zone | 5.8 | 7.4 |

* above WHO recommendation

Source: research data

The following maps show the spatiality of the distribution of green areas in comparison with the verticalization and population density:

**Figure 2:** Map of the Municipality of São Paulo indicating verticalization and green areas and Map of the Municipality of São Paulo indicating demographic density and green areas




Source: the authors.

## Conclusions

The index of green areas, known as the Total Green Area Index [TGAI], whose objective is to assess the distribution of public green areas in the city, is a management tool frequently used by public policies to guide decisions to expand green areas in the city, as is the case in São Paulo, where we found these parameters being used in the 2017-2020 City Goals Plan.

However, there is no consensus in the literature as to the ideal index that should be adopted. This index varies considerably, justifying the lack of consensus on the different scales of analysis of the studies. The indicator of 12 m² of green area per inhabitant, attributed to WHO, is widely disseminated in bibliographies and public policies as being the ideal parameter for green areas. Although this indicator is not supported by data on environmental improvement, it is a parameter that makes cities comparable to each other, however, it is not the best index to support local public policies.

In São Paulo, the present study demonstrates how the spatial scale skews the TGAI calculation, analyzing green area indicators in the municipality of São Paulo at different geographic scales, resulting in different patterns of exposure of the population to the extent of green areas. The results obtained showed three distinct realities: the first in the analysis of the municipality in its entirety, the second by region (North, South, East, West and Center) and the third by sub-prefecture (32 in total). The resulting values, presented in Table 1, not only meet the ideal parameters attributed to WHO, but exceed them by at least 40%. However, in the second scenario, analyzing the regions of the municipality, only the North and South Regions meet the proposed indicators. This result shows how the vegetation index is prone to a bias related to the presence of large forested areas. However, the forested areas are not the ones with the highest population density in the city, thus showing that this benefit serves a few people. Finally, when analyzing the municipality by sub-prefecture, the third proposed scenario, it appears that only 10 of the 32 sub-municipalities meet the ideal indicators, that is, only 30% of the sub-municipalities meet the ideal parameters attributed to WHO.

The results suggest that the distribution of green areas is not adequate in relation to the demographic density and verticalization of the municipality and point to environmental inequality in the municipality of São Paulo. Considering that the purpose of the TGAI is to evaluate the distribution of public green areas in the city, it is very difficult to use this index in a region as complex as São Paulo, since it is significantly modified according to the spatial scale. Therefore, the TGAI does not represent the environmental reality of the municipality, since the indicator excludes urban afforestation and does not consider for the calculation the portion of the occupation of the areas, which may be more urban. Given the above, it appears that there is no way to compare the proportion of green areas when there are extensive areas of natural forest. In this sense, there is a suggestion for future work, which is the insertion of this factor in the calculation of the TGAI indicator.

When comparing the real indicators of the city of São Paulo with the parameters of other cities, such as a metropolitan city in Argentina, it is noted that the results are even worse than those obtained, since the ideal indicator increases from 12 $m^2$ to 25 $m^2$ of green areas per inhabitant, which, in the analysis of the municipality as a whole, results in a value around 30% below ideal. Therefore, as a second suggestion for the development of future works, it is the study of the ideal indicators for the municipality of São Paulo, which also consider urban afforestation and consider the level of population density in the region.

The comparison of the calculated indices with the values of 2017 and the forecast for 2020 also shows that, despite the public policies of the municipality, the government is not considering these indices for decision making, making sure that the imbalances are not reducing environmental conditions within the city, since the expansion of green areas in regions rich in this type of equipment is expected. However, the use of this indicator in local analyses can have a positive impact on the implementation of plans, programs, and projects and in initiatives such as the Goals Program, as it guarantees the reduction of environmental inequality in the municipality.

Finally, these indexes should be used consistently for the elaboration of public policies for regional development with a focus on reducing environmental inequalities, and the results of the TGAI by sub-prefecture in the municipality of São Paulo have a prominent role. This index can be adopted as a decision-making parameter for the expansion of green areas in the city, such as the implementation of parks, seeking to correct and balance the distribution of green areas in the city.

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