BIBLIOGRAPHIC REVIEW THAT REPORTS ON THE SUSTAINABLE URBAN MOBILITY INDEX, BETWEEN THE YEARS 2018 AND 2022

Revisão bibliográfica que se reporta ao índice de mobilidade urbana sustentável, entre os anos de 2018 e 2022

Revisión bibliográfica que informa sobre el índice de movilidad urbana sostenible, entre los años 2018 y 2022

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ABSTRACT
The referring work presents a narrative bibliographic review, on the subject “Sustainable Urban Mobility Index”, based on research carried out at Capes, Scielo, Google Scholar and Digital Bank of Theses and Dissertations within the time frame from 2018 to 2022, where we will point out the main authors used as references and their contributions. During the research, we noticed that there is little academic production in the area to contribute, with the majority being prepared based on the analysis methodology proposed by Costa. Next, we will talk about the importance of urban mobility indices and their relationship with Brazilian municipalities. Later we will describe the main contributions of the sustainable urban mobility indices in the cities of Sinop, Lençóis Paulista, Aracaju, São Mateus and Campinas, in parallel we will demonstrate the sustainable urban mobility indices in the cities of São Mateus, Lençóis Paulista and Sinop.

Keywords: Sustainable urban mobility index; Sinop; Aracaju; Lençóis Paulista; Campinas; São Mateus.

RESUMO
O referente trabalho apresentar uma revisão bibliográfica narrativa, acerca do assunto “Índice de Mobilidade Urbana Sustentável”, a partir da pesquisa realizada na Capes, Scielo, Google Acadêmico e Banco Digital de Teses e Dissertações dentro do recorte

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temporal de 2018 a 2022, onde apontaremos os principais autores utilizados como referência e suas contribuições. Durante a pesquisa, notamos que há escassa produção acadêmica na área para contribuir, sendo a maioria foi elaborada com base na metodologia de análise proposta por Costa. Em seguida, iremos falar da importância dos índices de mobilidade urbana e sua relação com os municípios brasileiros. Posteriormente iremos descrever as principais contribuições dos índices de mobilidade urbana sustentáveis das cidades de Sinop, Lençóis Paulista, Aracaju, São Mateus e Campinas, paralelamente demonstraremos os índices de mobilidade urbana sustentável das cidades de São Mateus, Lençóis Paulista e Sinop.

Palavras-chave: Índice de mobilidade urbana sustentável; Sinop; Aracaju; Lençóis Paulista; Campinas; São Mateus.

RESUMEN
El trabajo referente presenta una revisión bibliográfica narrativa, sobre el tema “Índice de Movilidad Urbana Sostenible”, con base en investigaciones realizadas en la Capes, Scielo, Google Scholar y el Banco Digital de Tesis y Disertaciones en el período de 2018 a 2022, donde analizaremos señalar los principales autores utilizados como referencia y sus aportes. Durante la investigación notamos que existe poca producción académica en el área para aportar, siendo la mayoría elaborada con base en la metodología de análisis propuesta por Costa. A continuación, hablaremos de la importancia de los índices de movilidad urbana y su relación con los municipios brasileños. Posteriormente describiremos las principales contribuciones de los índices de movilidad urbana sostenible en las ciudades de Sinop, Lençóis Paulista, Aracaju, São Mateus y Campinas, en paralelo demostraremos los índices de movilidad urbana sostenible en las ciudades de São Mateus, Lençóis Paulista y Sinop.

Palabras clave: Índice de movilidad urbana sostenible; Sinop; Aracaju; Lençóis Paulista; Campinas; São Mateus.

1. Introduction

Sustainable urban mobility indices are crucial in evaluating and improving transport conditions in cities, providing valuable information for planning public policies, pointing out areas for improvement and promoting solutions that are friendlier to the environment and citizens. They involve intelligent and inclusive solutions, with the use of clean technologies and encouragement of public transport and bicycles, encouraging awareness of the need to adopt sustainable mobility practices, contributing to a more equitable and healthy future.

The bibliographic review allows the selection of important indicators that allow the identification of trends and scenarios in cities, enabling the development of public policies that aim to combine the growth of cities with sustainable development.
The objective of this study is to present a narrative bibliographic review regarding the topic of “sustainable urban mobility index”, within a five-year time frame (2018-2022). Its relevance is that most Brazilian cities, despite having the Master Plan and Urban Mobility Plan in most cases, are experiencing disorderly growth and difficulties in evaluation and monitoring, harming the cities in a negative way.

We observed during the research that there are few works in the area to collaborate with, most of which were developed using an analysis methodology defined by Costa. The Costa Sustainable Urban Mobility Index is made up of nine domains, in addition to focusing on sustainability, accessibility and mobility, the proposal aims to achieve economic, social and environmental objectives.

This work is divided into six sections. The first section presents an introduction to the topic and its relevance. The second section, called methods and materials, demonstrates how the narrative bibliographic review was carried out. In the third section, the main considerations regarding the Urban Mobility Index are presented, and in the fourth, the relationship between Brazilian municipalities and urban mobility indices is demonstrated. In the fifth section, the main contributions and results of the studies evaluated in this work. The last section presents final considerations about the research.

2. Methods and Materials

In this work, through a search carried out in electronic media, on the platforms Capes, Scielo, Google Scholar, and Digital Library of Theses and Dissertations, between 15.07 and 21.07.2023, a search was carried out on publications relating to the last ten years, using as the search term “Sustainable Urban Mobility Index”. The analysis of the works included the following aspects: year, title, objectives, methodology, indices applied or proposed, results and conclusions. From this analysis, it was possible to identify the main characteristics, advantages and limitations of sustainable urban mobility indices, as well as the gaps and challenges for the development and application of these indices in the Brazilian context. 23 publications were found, including articles,
theses and dissertations, as shown in Table 1.

<table>
<thead>
<tr>
<th>Data base</th>
<th>Number of Publications</th>
</tr>
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<tbody>
<tr>
<td>Capes</td>
<td>06</td>
</tr>
<tr>
<td>Scielo</td>
<td>02</td>
</tr>
<tr>
<td>Google acadêmico</td>
<td>06</td>
</tr>
<tr>
<td>BDTD</td>
<td>09</td>
</tr>
<tr>
<td>TOTAL</td>
<td>23</td>
</tr>
</tbody>
</table>

Source: Prepared by the author.

As exclusion criteria, a time frame and reading of publications were first adopted. After this analysis, three articles remained, found on the Capes and Google Scholar platforms, and two dissertations found in the Digital Library of Theses and Dissertations. Relevant information from publications was extracted through reading and the author's perception, identifying trends, gaps in the literature, among other relevant aspects. We highlight any limitations of the methodology adopted in the bibliographic review, such as the possibility of missing some relevant studies, selection bias or lack of access to articles outside the platforms used.

3. Sustainable Urban Mobility Index (IMUS)

Urban mobility is a concept that relates to people's ability to move, by any means of transportation, with the aim of establishing social and economic relationships, satisfying needs and ensuring rights (Localiza Gestão de Frotas, 2023).

Sustainable urban mobility indices are instruments that make it possible to measure and compare the performance of cities in relation to urban mobility, considering aspects such as pollutant emissions, energy consumption, road safety, accessibility, equity and social participation.

Costa (2008) created a methodology for analyzing urban mobility indicators, which has helped to achieve economic, social and environmental objectives proposed by alternative scenarios and public policy packages. Other urban indicators have focused on specific aspects of sustainability, such as accessibility, mobility and environmental capacity.
In the time frame, it was found that the authors were based on Costa with bibliographical references, with contributions from other authors, as we can see in Table 2.

Table 2. Main referenced authors

<table>
<thead>
<tr>
<th>Author</th>
<th>Reference</th>
<th>Local</th>
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Source: Prepared by the author.

Among the contributions of Mancini, Ribeiro and Bettine, Miranda and Berh, Corso, Nascimento and Freitas, we can highlight that the sustainable urban mobility index is an important instrument for evaluating a city, as it allows measuring and characterizing the existing context in cities that is applied, with the aim of investigating whether the data obtained would confirm the presence of favorable qualities regarding the sustainable mobility of the city. Observing similarities in experiences and challenges in implementing the indices, as well as specific particularities in the planning of transport systems in each city analyzed. We take data limitations into account, often noticing incomplete and outdated data.

Machado et al. (2012) developed a mobility index for the Metropolitan Region of Porto Alegre, based on the three dimensions of sustainable development, to assess how transport and mobility affect each of them.

4. The Sustainable Urban Mobility Index (IMUS) and Its Relationship with Brazilian Municipalities

The Sustainable Urban Mobility Index is a tool that reveals current mobility conditions in cities and allows for strategies aimed at promoting sustainable mobility. This index plays a crucial role in the development of more effective
public policies to make Brazilian cities more friendly to the environment and citizens.

Urban mobility in Brazilian municipalities is mainly related to infrastructure, urban planning, public transport, land use and population awareness. It is observed that a large part of Brazilian municipalities suffer from congestion, poor public transport, lack of integration between modes, the environment, lack of accessibility directly affect the quality of life of citizens.

The urbanization process in Brazil has generated challenges, the main one being moving around cities (Ferreira et al., 2023). Urban planning and participatory management are tools that municipalities should use (Tobias et al., 2023) to seek sustainable solutions, promoting more equitable urban mobility.

5. Contributions

The Sinop – MT Sustainable Urban Mobility Index was found to be an important tool for evaluating and monitoring the urban mobility system. However, we observed criticism regarding the non-application of the Municipal Master Plan of Sinop - MT (Ferreira, et. al., 2018).

In Lençóis Paulista – SP, it was found that the creation of the simplified index provided studies in other small cities (Cardoso, 2021).

In Aracaju – SE, we verified that the work provided a set of indicators that can make up the tool (Passos, 2019).

For São Mateus – ES, it highlights the importance and contribution of the study as a possible source of assistance for social agents to design plans aimed at improving mobility covering the three dimensions (Oliveira, et. al., 2022).

We observed that in Campinas – SP, the increase in the number of cars was negatively evaluated, damaging the index in the environmental dimension (Pereira, et al., 2021).

All studies provide expansion and application to other municipalities, comparing the results with other related cities.

It was observed that it was difficult to obtain updated data in Sinop-MT, São Mateus – ES and Campinas - SP, making it impossible to formulate the sustainable urban mobility index. In Aracaju – SE, it was suggested the
implementation of legislation requiring annual calculation and disclosure of results.

Analyzing Graph 01, we can see that with the index achieved by Sinop-MT, it reached a reasonable score, however, the lack of intermunicipal consortia, the low urban population density, the lack of implementation and continuation of actions, the lack of parks and green areas and urban facilities such as schools and health centers are elements that must be worked on.

For São Mateus – ES, we observed that it also achieved a reasonable score, however it shows assistance to social agents to design sustainable urban mobility plans involving social, environmental and economic dimensions (Oliveira, et. al., 2022).

Graph 1. Sustainable Urban Mobility Index (IMUS)

Source: Prepared by the author.

In Lençóis Paulista - SP, the application of 57 indicators was proposed, however due to the lack of some data, the proposed index was applied taking into account 42 indicators. The index found also reached a reasonable score, identifying the need for investments in active transport and workforce training to provide data, improving urban mobility (Cardoso, 2021).
In Aracaju – SE, it was not the objective of the research to obtain the sustainable urban mobility index with a result of comparison with other cities, for this reason they were not represented in Graph 01. However, we can see as a positive point the indicators of actions for universal accessibility, consumption of fuel, urban mobility policy, transparency and responsibility. However, the regulation and supervision of public transport stood out negatively – contract and tenders, availability and quality of public transport, passenger index per kilometer, user satisfaction with the public transport service, individual transport – motorization index and popular participation – participation in decision-making (Passos, 2019).

For Campinas – SP, we used the mobility index developed for the Metropolitan Region of Porto Alegre and, as it presented a discrepancy with the others, it did not cooperate with the graph (Pereira, et al., 2021).

The indices presented in Graph 01 range from 0 to 1, with 1 being the best performance in terms of sustainable urban mobility. Therefore, we can conclude that cities present problems or challenges that need to be faced.

6. Final Remarks

With this study, it is concluded that Costa is the basis for the study of sustainable urban mobility index, however, as it is a study carried out in 2008, I believe it is valid to reevaluate this material, with possible subdivision in such a way to create a “standard” model that meets the country’s particularities, as a complement to the Urban Mobility Law.

This standardization would help in the involvement of the people involved, resulting in gains, as in addition to disseminating, they could standardize basic information allowing for the organization and planning of cities, providing accurate and current data that enabled studies that made it possible to measure and improve Brazilian cities.

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