CRITICAL EVALUATION OF SMART AND SUSTAINABLE CITIES: COMPARING TRÊS LAGOAS (MS) AND CURITIBA

https://doi.org/10.56238/sevened2024.032-018

Kassiane Macedo Maganha Campos, Lenice Fernandes do Nascimento Silva, Maria Elise Barbosada Silva and Nuemis Francisco

ABSTRACT

This article critically analyzes the characteristics of smart and sustainable cities, focusing on the comparison between Três Lagoas, in Mato Grosso do Sul, and Curitiba, in Paraná. Curitiba is internationally recognized for its innovative practices in urban mobility, waste management and environmental planning, standing out as a model of sustainability. On the other hand, Três Lagoas, which is experiencing rapid economic growth due to its pulp and paper industry, faces significant challenges, such as pressure on natural resources and the lack of an efficient public transportation system. The study emphasizes the importance of integrated public policies that consider sustainability, economic development and social inclusion. For Três Lagoas to become a smart and sustainable city, it is essential that there is greater collaboration between the government, the private sector, and civil society. The work concludes that the transformation of Três Lagoas into a model of sustainable city is possible, as long as policies are implemented that prioritize environmental preservation and the quality of life of the inhabitants, inspired by successful experiences such as that of Curitiba.

Keywords: Smart Cities. Urban Sustainability. Urban Mobility. Public Policies.

INTRODUCTION

The concept of "smart city" has been gaining prominence worldwide due to the growing demands for urban solutions that integrate advanced technologies, sustainable planning, and quality of life. Cities such as Curitiba, known for its pioneering spirit in urban mobility and environmental management, and other global metropolises cited as "smart cities", have been a reference in this field. The use of innovative technologies, the promotion of sustainable practices, and the prioritization of quality of life are common characteristics of these cities, which seek to balance economic growth with the preservation of natural resources and social inclusion. This article seeks to compare the characteristics of these smart cities, highlighted in the analyzed videos, with the reality of Três Lagoas, in Mato Grosso do Sul. Known for its rapid economic growth and importance in the industrial sector, Três Lagoas presents a challenging context in terms of sustainable development.

By analyzing aspects such as mobility, environmental management, technology and governance, this study aims to understand how much the city is aligned with the best practices of sustainability and urban intelligence, using Curitiba as a comparative parameter. In this way, a critical analysis of the qualities and challenges of Três Lagoas in areas such as infrastructure, technological innovation and public services will be made, highlighting its potentialities and weaknesses in the face of examples of sustainable cities. Finally, we will discuss the necessary conditions for Três Lagoas to be recognized as a sustainable city, pointing to more integrated and responsible development paths.

For a city to be considered smart and sustainable, it must meet a series of criteria that involve the efficient use of natural resources, the integration of cutting-edge technologies, and the promotion of economic development that takes into account the social and environmental needs of the population. According to Harrison and Donnelly (2011), smart cities are those that use information and communication technologies (ICTs) to optimize urban processes, promote innovation, and improve the quality of life of citizens, while reducing environmental impact.

Curitiba, one of the most notable examples of a smart city in Brazil, is internationally recognized for its innovative solutions in public transportation, waste management, and urban planning. The creation of the bus rapid transit (BRT) system and the integration of urban green areas are examples of successful policies that combine urban development and sustainability (Rabinovitch, 1992**).** The city also stands out for its high recycling rate and policies that encourage environmental education among its inhabitants. On the other hand, Três Lagoas, despite its recent economic growth, especially in the pulp and paper sector, faces considerable challenges in adapting to these sustainability standards. Although it has

consolidated itself as an industrial hub, the city still lacks efficient solutions in terms of urban mobility and environmental management. Rapid industrial growth has brought economic benefits, but also pressures on urban infrastructure and local natural resources, such as the excessive use of water for industrial production and the need for proper management of waste generated by these activities.

When comparing Três Lagoas with Curitiba, some gaps become evident. Curitiba knew how to reconcile population growth with sustainable urban planning, prioritizing quality public transport and the preservation of green spaces. By contrast, Três Lagoas has not yet been able to implement an effective public transportation system that meets the needs of its expanding population, and environmental preservation has been compromised by rapid industrial advancement, raising concerns about long-term sustainability.

Castells (1996) points out that a truly smart city must be able to integrate the economic, social and environmental dimensions in a balanced way. For Três Lagoas to move in this direction, it is essential that there is public management that promotes not only industrial growth, but also sustainability policies that involve the local community, such as improving public transport, efficient solid waste management and the conscious use of natural resources, especially water.

Cities have become the focus of discussions on sustainable development and innovation, particularly as they face complex urban challenges such as population growth, resource scarcity, and climate change. The smart city concept emerges as a response to these challenges, integrating digital technologies with urban infrastructure to optimize the quality of life of citizens. Cities such as Curitiba are often cited as examples of success in this context, having implemented innovative solutions that promote sustainable urban mobility and efficient waste management. The public transport system, which prioritizes the use of buses over cars, in addition to the preservation of green areas, demonstrates how smart urban planning can bring social and environmental benefits. Curitiba's experience not only highlights the importance of using technologies, but also the need for a political and social commitment to sustainability, creating a model that other cities can follow. On the other hand, cities such as Três Lagoas, which stand out for their economic growth, often face difficulties in keeping up with the demands of sustainable development. With an accelerated growth driven by the pulp and paper industry, Três Lagoas presents a reality that contrasts with the principles of smart cities. Pressure on natural resources, especially water, and inadequate waste management are issues that need to be urgently addressed. This situation demands a critical look at how Três Lagoas can adapt to sustainability and urban intelligence practices, using the experience of Curitiba as a guide. The challenge lies

in finding a balance between economic development and environmental responsibility, promoting social inclusion and quality of life. Therefore, the comparative analysis between these two cities is essential to understand the different approaches and the results that can be achieved, highlighting the importance of integrated public policies and community participation in the urban transformation process.

In short, the city of Três Lagoas has the potential to become a reference in sustainability, as long as it manages to implement public policies that promote sustainable development, in line with the best practices observed in cities like Curitiba. To this end, it is necessary not only the use of innovative technologies, but also the involvement of civil society, the environmental responsibility of local industries, and the strengthening of urban infrastructures aimed at social inclusion and environmental preservation.

METHODOLOGY

This article uses a bibliographic research approach for the critical analysis of the characteristics of smart and sustainable cities, comparing the reality of Três Lagoas (MS) with that of Curitiba (PR). The bibliographic research allows an in-depth understanding of the theoretical and practical concepts related to the theme of "smart cities" and urban sustainability practices, through the review and analysis of works and studies already published.

The methodology adopted in this work follows the following steps:

1. Survey of Theoretical References: Academic works, scientific articles, institutional reports and documentaries relevant to the understanding of the concept of smart and sustainable cities were selected. Among the most cited authors are Harrison and Donnelly (2011), who discuss the role of ICTs in smart cities, and Castells (1996), who addresses the integration of economic, social and environmental development. In addition, case studies on Curitiba, internationally recognized for its innovative practices, and data on Três Lagoas, a city in industrial expansion, were consulted.
2. Comparative Analysis of Cities: To make the comparison between Três Lagoas and Curitiba, an analysis of articles and reports that detail the public policies and sustainable development strategies adopted in Curitiba was carried out, such as the studies by Rabinovitch (1992) on urban mobility and environmental planning. In parallel, reports and data on Três Lagoas were used, focusing on its industrial growth, environmental impact and urban infrastructure.
3. Identification of Sustainable City Criteria: From the reviewed literature, the main

criteria that characterize a smart and sustainable city were defined, including: efficient urban mobility, solid waste management, preservation of natural resources, use of innovative technologies, social inclusion and citizen participation. These criteria are used to evaluate and compare the practices adopted by Curitiba and Três Lagoas.

4. Critical Analysis: Based on the reviewed material, a critical analysis was carried out, identifying the strengths and weaknesses of Três Lagoas in relation to sustainability and urban intelligence practices. From this analysis, the challenges faced by the city on its path to becoming sustainable were discussed, based on the example of Curitiba.

Discussion of Paths to Sustainability: Finally, the study presents suggestions for public policies and strategies that can be adopted by Três Lagoas, with the objective of aligning its economic growth with sustainable practices, inspired by the example of Curitiba and the characteristics identified in smart cities.

By opting for the bibliographic methodology, this work seeks to integrate theoretical and practical knowledge already consolidated in the literature, providing a comparative view that helps in understanding the challenges and opportunities of Três Lagoas towards sustainability.

STATE OF THE ART

The concept of smart and sustainable cities has evolved over the past few decades, driven by the growing demand for urban solutions that integrate technology, innovation, and sustainability. The term "smart city" involves the use of Information and Communication Technologies (ICTs) to optimize urban services, improve resource efficiency, and increase the quality of life of citizens. Authors such as Harrison and Donnelly (2011) argue that these cities should be able to use data and integrated systems to promote real-time solutions to issues such as mobility, safety, and the environment. At the same time, the concept of urban sustainability involves the implementation of practices aimed at economic and social development in harmony with environmental preservation. Castells (1996) argues that true sustainability is only achieved when there is a balance between economic growth, social inclusion and environmental responsibility. Several studies have analyzed examples of cities that apply these practices, such as Curitiba, known for its innovative transportation system and the efficient management of its natural resources and solid waste (Rabinovitch, 1992). Cities such as Barcelona and Amsterdam are also often cited as models of "smart cities" for integrating cutting-edge technologies with sustainability and citizen participation policies. In

contrast, many cities in developing countries, such as Três Lagoas, face the challenge of balancing rapid economic growth, often driven by industrialization, with the urgent need to adopt sustainable practices. The state of the art of research on smart and sustainable cities reveals an expanding field, with growing interest in solutions that combine urban planning, technological innovation and environmental responsibility, and it is essential to understand the adaptations needed for specific urban contexts, such as that of Três Lagoas, in Mato Grosso do Sul.

RESULTS AND DISCUSSION

The results of the comparative analysis between Três Lagoas and Curitiba reveal important differences and similarities in relation to sustainable development and the adoption of characteristics of a smart city. Curitiba, widely recognized for its efficiency in public transport and environmental management, stands out for initiatives such as the bus rapid transit (BRT) system, considered a world reference for its low cost and high impact on the reduction of polluting gas emissions (Rabinovitch, 1992). In addition, Curitiba's urban planning has always taken into account the preservation of green areas, with more than 52 m² of green areas per inhabitant, a factor that directly contributes to the quality of life and sustainability of the city. These aspects demonstrate how much the integration between governance, strategic planning, and effective environmental policies can transform a city into an example of urban sustainability. On the other hand, Três Lagoas, although showing robust economic growth, especially in the industrial sector, faces significant challenges in terms of urban infrastructure and sustainability policies. The rapid advancement of the city as an industrial hub in Brazil, especially in the pulp and paper sector, has brought economic benefits, but also environmental pressures, such as excessive water consumption and increased production of solid waste, which is still not treated optimally. The report by the SOS Mata Atlântica Foundation (2018) highlights that the preservation of natural resources in the region is a critical point, since industrial growth has generated significant impacts on rivers and local biodiversity.

While Curitiba implements solutions that align urban development and environmental preservation, Três Lagoas still lacks effective urban mobility and waste management strategies. According to Harvey (1996), cities that do not plan economic growth and sustainability in an integrated way end up creating "exclusion zones", where the benefits of progress are not distributed equitably. This is reflected in the lack of robust policies to include the population in an efficient public transport system or in recycling and environmental education programs in Três Lagoas. This lack puts at risk the possibility of

the city aligning itself with the criteria of a smart and sustainable city, as defined by Harrison and Donnelly (2011). However, Três Lagoas has great potential to implement sustainability practices, if there is political will and community engagement. The experience of Curitiba shows that effective public policies can be transformative, and the city of Mato Grosso do Sul could follow this example by prioritizing the creation of green areas, investing in quality public transport and promoting environmental awareness policies. As Castells (1996) argues, true sustainability is only achieved when the social, economic and environmental spheres are treated in a balanced way. In this sense, the industrial growth of Três Lagoas needs to be accompanied by an agenda of public policies that ensure the responsible use of natural resources and social inclusion, enabling the recognition of the city as an example of sustainability in Brazil.

The study shows that Três Lagoas, although still far from the standards of Curitiba, has the potential to follow the path of sustainability. Investment in green infrastructure, public transport, and the promotion of inclusive environmental practices are fundamental steps for the city to become a model of sustainable development, capable of harmonizing economic growth and environmental preservation. In order for Três Lagoas to follow the path of sustainability effectively, it is necessary to consider the strategic role of public policies and citizen engagement. Curitiba, for example, has managed to consolidate itself as a reference city over decades of planning, focusing on the integration of social, environmental and economic issues. According to Lindau, Hidalgo and Facchini (2010),

> Curitiba's success as a model of sustainable and smart city is directly related to the government's strong commitment to long-term public policies, which prioritized sustainable urban mobility, the creation of green areas, and the inclusion of the population in participatory decision-making processes.

This vision is crucial, as it reflects the need for coordinated and planned long-term actions, something that Três Lagoas should consider in its future policies. Also according to the authors,

> the challenge for Brazilian cities, especially those in a process of accelerated growth such as Três Lagoas, is to align economic development with the preservation of natural resources, ensuring that progress meets present needs without compromising future generations

Três Lagoas, when focusing on industrial development, needs to balance this growth with practices that minimize environmental impact and promote greater social inclusion. The experience of Curitiba, which since the 1970s has been implementing practices such as the use of efficient public transport and the expansion of green areas, is an example that shows

how sustainable planning can be transformative and accessible, even in cities with great population challenges. A key aspect of the transformation of Três Lagoas into a more sustainable city lies in the involvement of local industries in socio-environmental responsibility practices. Many of the cities considered smart and sustainable in the world, such as Amsterdam and Copenhagen, incorporate the private sector in the process of sustainable urban development, requiring practices to mitigate environmental impacts and greater investment in green infrastructure. As Satterthwaite (1997) points out in his study on sustainable cities,

> Collaboration between the public and private sector, along with raising awareness among the population, is one of the key factors in transforming cities into smarter and more sustainable environments. The responsibility cannot fall on the government alone; It is essential that industries and civil society are an active part of this process.

The urban transformation of Três Lagoas therefore needs an integrated strategy, which involves both effective public policies and the commitment of the private sector and the local population. Just as Curitiba has implemented a series of coordinated actions over time, Três Lagoas can adopt practices such as the creation of an efficient public transport system, which would reduce the use of private vehicles and CO2 emissions, in addition to improving urban mobility. As mentioned by Gehl (2010), cities that prioritize sustainable urban mobility, creating people-oriented spaces and reducing the dominance of automobiles, tend to be more lively, attractive, and environmentally balanced. This perspective is directly applicable to Três Lagoas, where the absence of a robust public transport system limits the mobility of the population and increases the environmental impacts of excessive car use. In addition, the creation of green areas and the responsible management of water resources are essential for Três Lagoas to align with the standards of a sustainable city. Curitiba, for example, implemented a system of linear parks along its rivers to combat flooding and create recreational areas for the population, a practice that could be adapted to the context of Três Lagoas, especially considering the local challenges with wastewater management and river preservation.

According to Hall (2014), linear parks are one of the most innovative solutions to promote sustainable coexistence in urban areas, as they combine the need for environmental protection with the creation of public spaces that foster the well-being of the population. Therefore, for Três Lagoas to approach the sustainability standards observed in Curitiba, a paradigm shift in urban planning will be essential, with an emphasis on creating a greener, more efficient and inclusive infrastructure. Economic development, although essential, must be linked to clear strategies for environmental preservation and sustainable

urban mobility, promoting a long-term vision that can consolidate the city as an example of balanced development in the Brazilian context.

FINAL CONSIDERATIONS

The comparative analysis between Três Lagoas and Curitiba highlights the complexities and challenges faced by cities that seek to align with the principles of sustainability and urban intelligence. Curitiba, widely recognized as a model of a sustainable city, demonstrates how consistent public policies, long-term planning, and social engagement can transform urban development, resulting in a more inclusive, green, and efficient city. Its innovative solutions in public transport, waste management and environmental preservation offer a valuable lesson for other Brazilian cities, such as Três Lagoas, which is in a phase of rapid economic growth. Três Lagoas, as it emerges as an important industrial hub, has faced challenges in balancing economic advancement with environmental protection and the development of sustainable urban infrastructure. The lack of an efficient public transport system, the increasing pressure on natural resources, and the need for responsible management of industrial waste are critical issues that need to be addressed so that the city can evolve towards a more sustainable reality. The experience of Curitiba serves as a beacon for Três Lagoas, showing that it is possible to reconcile development and preservation through well-implemented public policies and commitment to the well-being of the population and the environment.

The final considerations of this study reinforce the importance of integrating governance, technological innovation and environmental preservation practices into any urban development strategy. Três Lagoas has great potential to become an example of a sustainable city in Brazil, but for this, it will require a greater commitment from both the public and private sectors, in addition to the active engagement of civil society. As highlighted throughout this work, initiatives such as investment in public transport, the creation of green areas and the adoption of more sustainable industrial practices are fundamental for Três Lagoas to follow the same path as Curitiba. The urgency and importance of Três Lagoas adopting a proactive approach towards sustainable development and transformation into a smart city is highlighted. The comparison with Curitiba reveals that, although Três Lagoas has stood out in economic growth, especially in the industrial sector, this should not occur at the expense of the environment and the quality of life of its citizens. Curitiba's experience demonstrates that effective urban planning, which includes the creation of green infrastructure, an efficient public transport system, and sound waste

management policies, is crucial to ensuring a sustainable future. Thus, Três Lagoas should consider implementing similar practices, adapting them to its local context.

In addition, it is essential that the development of Três Lagoas does not occur in isolation, but in collaboration with all stakeholders, including the government, the private sector, and civil society. A joint effort can facilitate the creation of an urban environment that prioritizes sustainability and inclusion. For example, promoting environmental education in schools and communities, in addition to encouraging the participation of the population in decision-making processes, can result in more transparent and effective urban management. It can also foster a sense of belonging and responsibility among citizens, which are critical to the success of any urban transformation initiative.

Another important point to be considered is the need for continuous monitoring of the policies implemented. The ability to assess the impact of actions taken in Três Lagoas will allow for adjustments and improvements over time, ensuring that the city not only achieves but maintains the standards of a smart and sustainable city. In addition, the adaptation to new technologies and the integration of innovative solutions in urban planning can provide a significant advance, positioning Três Lagoas as a model for other cities facing similar challenges. Finally, they reaffirm that the transformation of Três Lagoas into a sustainable and smart city is a viable goal. With commitment, strategic planning, and the collaboration of all sectors of society, it is possible to create a future that not only preserves the environment but also promotes social justice and equity, ensuring that all citizens have access to a dignified quality of life. This path is not only a necessity, but a collective responsibility that will determine the legacy we will leave for future generations.

Ultimately, the transformation of Três Lagoas into a smart and sustainable city will not only depend on economic growth, but also on the ability to implement policies that promote social equity, the preservation of natural resources, and the quality of life of its inhabitants. The success of Curitiba demonstrates that, with vision, planning and active participation of all the actors involved, it is possible to achieve a balanced, sustainable and intelligent urban development.

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