


VARGEM ALTA AND THE PATH TO SUSTAINABILITY: A COMPARATIVE ANALYSIS WITH CURITIBA <https://doi.org/10.56238/sevened2024.032-024>**Érica Escobar, Gisele Santiago Dondoni, Maricélia de Oliveira Silva Souza and Valdemir Salomé de Matos****ABSTRACT**

This article critically analyzes the sustainable characteristics of Vargem Alta (ES) in comparison with Curitiba (PR) and smart cities around the world. The research reveals that, although Curitiba is already a model of sustainable development with an efficient transport system and well-structured waste management, Vargem Alta has great potential to be explored. With its rich biodiversity and sustainable agricultural practices, the city of Espírito Santo can become an example of innovation and resilience. However, the challenges faced, such as waste management and the lack of an efficient public transport system, need to be addressed. The analysis highlights the importance of community engagement, environmental education and collaboration between different sectors to promote sustainable development. Smart cities, such as Copenhagen and Barcelona, demonstrate that the integration of technology and citizen participation are key to achieving sustainability. Therefore, Vargem Alta can learn from these experiences and adopt solutions adapted to its reality, building a more balanced and healthy future.

Keywords: Sustainability. Vargem Alta. Curitiba. Smart Cities.



INTRODUCTION

The search for sustainable cities has been one of the great contemporary challenges, driven by growing urbanization and the need to preserve natural resources for future generations. Curitiba, capital of Paraná, is often cited as a world reference in this regard, being highlighted in the videos analyzed, for its examples of urban planning, green infrastructure and sustainable mobility. However, when we compare these characteristics with smaller cities, such as Vargem Alta, in Espírito Santo, it is possible to identify specific challenges and opportunities for sustainable development.

Vargem Alta, a predominantly rural and small city, faces different challenges in relation to large metropolises, but also has intrinsic advantages that can be leveraged towards sustainability. By analyzing the successful practices of Curitiba and comparing them with the reality of Vargem Alta, we can critically explore how each city deals with issues such as waste management, public transport, green areas and community participation. In this article, a critical analysis of the sustainable characteristics of Curitiba will be made as opposed to the reality of Vargem Alta, evaluating to what extent the city of Espírito Santo meets the principles of sustainability and how it can improve its practices to consolidate itself as an example of sustainable development.

With this, we will seek to answer a central question: to what extent can Vargem Alta, with its peculiarities, follow the path of Curitiba and become a sustainable city?

By contrasting Vargem Alta with Curitiba in terms of sustainability and smart cities, striking differences emerge, both in structure and planning, but also some similarities and opportunities. Curitiba, recognized globally for its pioneering spirit in urban solutions and sustainability, is often cited as an example of a "smart city". Through its policies aimed at public transport, waste management and preservation of green areas, the city has stood out as a reference in the use of technologies and planning to promote quality of life and reduce environmental impacts.

URBAN MOBILITY AND TRANSPORT

Curitiba is famous for its efficient public transport system, the BRT (Bus Rapid Transit), which has reduced the number of cars on the streets and significantly decreased CO₂ emissions. This transport model is a classic example of a smart city, using technology and urban planning to optimize mobility and make the city more sustainable. In Vargem Alta, however, the scenario is quite different. As it is a smaller city with a strong agricultural vocation, public transport is limited, and most of the population depends on private vehicles or informal transport. Although vehicle traffic is much lower compared to large cities, this



dependence on cars results in a high carbon footprint for a city of its size. However, Vargem Alta's compact size and mountainous geography can be seen as an opportunity for the development of sustainable transport alternatives, such as bike lanes and public transport with less environmental impact, which could be adapted to local characteristics. This type of initiative, in line with smart city trends, could reduce dependence on private vehicles, contribute to the reduction of emissions, and improve the quality of life of the population.

WASTE MANAGEMENT AND ENVIRONMENTAL PRESERVATION

In terms of waste management, Curitiba has implemented an innovative selective collection program, known as "Garbage that is not garbage", which efficiently separates recyclable and organic waste. In addition, the city encourages the population to actively participate in these practices, reinforcing the concept of sustainability. Vargem Alta, in turn, faces greater challenges in this area. Being a smaller city with limited infrastructure, there are still difficulties in the efficient management of solid waste, especially with regard to selective collection and recycling.

However, the agricultural vocation of Vargem Alta, if well planned, can be an important differential in the management of organic waste, for example, through composting and encouraging the use of technologies for the sustainable management of agricultural waste. The adoption of circular economy practices — where waste from one sector can be reused as input in another — is a strategy that could transform the city into an example of smart management, even in a rural context.

GREEN AREAS AND CONSERVATION

The preservation of green areas is another aspect in which Curitiba stands out. The city has a vast amount of parks and leisure areas, such as the Botanical Garden, Barigui Park and many other spaces that are used both for recreation and for ecological functions, such as rainwater retention and temperature control. The integration of green areas into urban planning is one of the pillars of its sustainability and a determining factor for the title of smart city.

Vargem Alta, although it has a very rich territory in terms of biodiversity and preserved natural areas, especially in the mountains and forests that surround the city, lacks an effective integration of these areas with the urban population. The appreciation and promotion of these areas as sustainable environmental and tourist attractions are still limited, and this is one of the areas that could be better explored. The city could invest more in ecotourism and preservation policies, using technologies and management strategies that



integrate the environment with local economic and social activities, promoting a more sustainable relationship with nature.

ENVIRONMENTAL EDUCATION AND COMMUNITY PARTICIPATION

Another highlight in Curitiba is the emphasis on environmental education and the active participation of the community in sustainable initiatives. The population is widely involved in awareness projects and sustainable practices, which contributes to the creation of a culture of respect for the environment. Vargem Alta, despite having a local community that is very engaged in sustainable agricultural practices, still has a way to go in terms of urban environmental education. The promotion of community initiatives that encourage the active participation of residents in urban planning, care for the environment, and the creation of sustainable policies can strengthen the city's ecological identity.

WAYS FOR VARGEM ALTA TO BECOME A SMART AND SUSTAINABLE CITY

In short, while Curitiba has already gone well along the way to consolidate itself as a sustainable and smart city, Vargem Alta has particularities that, if well used, can boost sustainable development in the municipality. The city has great potential in its proximity to nature and its small size, which allows for faster and more efficient local solutions, such as low-emission transport, renewable energy and sustainable management of natural resources.

To get closer to the concept of a sustainable city, Vargem Alta would, however, need to face structural challenges such as the expansion of the public transport system, solid waste management and environmental preservation in an integrated manner with urban planning. The application of technologies, the encouragement of the circular economy, and the strengthening of community participation can be effective strategies to transform the city into an example of sustainability, even in a rural context. Thus, Vargem Alta, by adopting sustainable urban planning practices, aligned with its rural and environmental characteristics, can follow a path that leads it to be seen as a sustainable city, valuing its specificities while adopting intelligent practices inspired by successful examples such as Curitiba.

METHODOLOGY

The methodology of this article is based on bibliographic research, using a critical and comparative approach between the characteristics of Vargem Alta (ES) and Curitiba (PR), with regard to the aspects of sustainability and smart cities. The choice for



bibliographic research allows an in-depth analysis of the different sources of information already existing on the subject, enabling the theoretical basis necessary to discuss sustainable practices and urban solutions in both cities. This method also favors the identification of the potentialities and limitations of Vargem Alta in comparison with Curitiba, through the review of books, scientific articles, official documents and reference materials on urban sustainability.

The first stage of the methodology involves the collection of information and data about sustainable development and the strategies used by Curitiba to be recognized as a global example of a smart and ecological city. This collection includes the study of public policies implemented in the city of Paraná, such as the BRT public transport system, the selective waste collection program and the planning of green areas, in addition to their impact on the quality of life of citizens and environmental preservation. To this end, technical documents, institutional reports and articles that analyze the success of these initiatives over time were used.

Then, these strategies are compared with the reality of Vargem Alta, using sources that deal with the socioeconomic and environmental context of the municipality of Espírito Santo. Here, the critical analysis is based on the interpretation of data on infrastructure, agricultural practices, waste management and local challenges, always contrasting with the examples of Curitiba. The methodology is also based on studies that discuss the concept of smart cities, exploring the feasibility of its application in small cities such as Vargem Alta, focusing on sustainable practices adapted to their rural and less urbanized reality. In addition, theories related to sustainability and smart cities were used as bibliographic references, based on renowned authors in the area of urban planning and sustainable development. These works offer theoretical support to interpret how the innovations implemented in Curitiba can be adapted, partially or entirely, to a city like Vargem Alta, taking into account its local context. The choice of this theoretical framework allows for a discussion based on widely accepted concepts about sustainable planning, circular economy, and community participation, which are fundamental to analyze the two cities.

Finally, the methodology adopts a comparative approach as a central axis, being the most appropriate method to identify the particularities of each city and evaluate how Vargem Alta can, with its limitations and advantages, move towards a more sustainable urban structure. The critical analysis of the collected sources will be essential to understand the divergences and convergences between Vargem Alta and Curitiba, aiming to propose possible solutions adapted to the local context of Vargem Alta, with the objective of promoting its sustainable development.



RESULTS AND DISCUSSION

The comparative analysis between Curitiba and Vargem Alta (ES) reveals striking contrasts in terms of sustainable development and application of smart city concepts. However, it also highlights opportunities that Vargem Alta can explore to follow a path more aligned with sustainable practices. The results show that, although Curitiba is widely recognized for its pioneering spirit in urban planning and in the integration of sustainable solutions, Vargem Alta has characteristics that, if well used, can boost sustainability in the municipality, even with its particular challenges.

In terms of urban mobility, Curitiba is a consolidated example of efficiency, with its BRT (Bus Rapid Transit) system being a world reference. This system promoted a reduction in the number of private vehicles on the streets, which, in turn, resulted in lower emissions of polluting gases and more agile and accessible mobility for the population. In contrast, Vargem Alta, being a small city with rural characteristics, does not have a robust public transport structure, which leads to a greater dependence on private vehicles. However, this scenario should not be seen as an impediment to progress in terms of sustainability. On the contrary, the small scale of the city can facilitate the implementation of alternative solutions, such as bike lanes, smaller public transport, and even programs to encourage the use of electric vehicles. Solutions like these, aligned with the principles of smart cities, can reduce the city's carbon footprint and improve the quality of life of residents.

As for waste management, Curitiba also stands out for its innovative public policies, such as the "Garbage that is not garbage" program, which facilitates the separation and recycling of materials. This type of initiative is essential for the sustainable management of urban waste, preventing pollution and encouraging a circular economy. In Vargem Alta, solid waste management is still a challenge, especially with regard to the selective collection and treatment of agricultural waste, which represents a significant part of the local economy. However, the municipality's agricultural vocation can be transformed into an advantage, with the promotion of composting practices and the use of organic waste for fertilizer production, for example. The creation of public policies that encourage the sustainable management of agricultural and urban waste could make Vargem Alta become a reference in rural sustainability.

With regard to green areas, Curitiba once again serves as a model with its urban parks, which perform not only ecological functions, such as flood mitigation and microclimate regulation, but also offer spaces for leisure and social interaction for the population. Vargem Alta, in turn, has an abundance of natural green areas, located in its mountains and forests, but these areas are not yet fully integrated into the daily life of the



urban population. The city can explore ecotourism and adventure tourism, promoting the sustainable use of its natural resources while stimulating the local economy. Environmental preservation and the conscious use of these areas can be key to the sustainable development of Vargem Alta, if accompanied by environmental education and efficient management policies.

Environmental education and community participation are central points in Curitiba, where environmental awareness is integrated into urban planning and sustainability policies. The active participation of the community has been a differential in the successful implementation of sustainable programs, something that still needs to be developed in Vargem Alta. The city of Espírito Santo could invest in environmental education programs to involve its residents in recycling practices, saving resources and preserving biodiversity. This type of initiative would be essential to create a culture of sustainability in the municipality, preparing the population for future challenges and strengthening local identity around sustainability.

From a smart city perspective, Curitiba already implements advanced technologies and strategies for urban monitoring and management, using real-time data to optimize resources and improve public services. Although Vargem Alta has not yet entered the context of technology-intensive smart cities, the development of more accessible technological solutions, such as the use of sensors for monitoring water resources or solar energy, may represent a significant advance. In addition, the adoption of low-cost technologies and the digitalization of public services can make urban management more efficient, even in a small city. The results of the analysis indicate that, while Curitiba has already reached a high level of sustainable development, Vargem Alta presents a scenario of great potential, although it needs to overcome structural challenges. The reality of Vargem Alta as a smaller city with rural characteristics should not be seen as an obstacle, but rather as an opportunity to adapt smart and sustainable solutions to its local context. The combination of initiatives in mobility, waste management, environmental preservation and community education can gradually evolve the city towards a sustainable development model.

Thus, the discussion reinforces that the way to make Vargem Alta a sustainable city lies in valuing its local particularities, accompanied by committed public management and investments in appropriate technologies and incentive policies. In this way, the city can consolidate itself as an example of sustainability adapted to the rural reality, inspiring other locations with similar characteristics.



As discussed, the comparative analysis between Vargem Alta and Curitiba shows that the city of Espírito Santo has the potential to become a reference in sustainable development, as long as it uses its unique characteristics to its advantage. Authors such as Leandro de Almeida and Patrícia H. de Oliveira emphasize that urban sustainability is a process that must consider the local specificities and the socioeconomic reality of each municipality, as there are no universal solutions that apply to all cities. Thus, the ability of public policies to adapt to the particularities of Vargem Alta may be the necessary differential for its sustainable evolution.

In addition, the implementation of smart cities is a concept that has been gaining prominence in discussions about contemporary urbanism. According to urban planning expert Carlos A. A. Ferreira, smart cities are not only those that use advanced technologies, but also those that promote social inclusion and citizen participation in decision-making processes. In Vargem Alta, the participation of the community in the formulation of public policies and sustainable initiatives is fundamental. The creation of community forums and environmental education programs can foster citizen awareness and engagement, allowing the population to become protagonists in building a more sustainable future. Another crucial point in the discussion about the sustainability of Vargem Alta is waste management. The literature points out that the adoption of public policies aimed at recycling and reusing materials is essential to reduce the environmental impact of cities (Garrone & Nascimento, 2019). In Curitiba, the implementation of an efficient selective collection system has shown significant results, with more than 70% of recyclable waste being recovered (Curitiba City Hall, 2020). This experience can serve as a basis for Vargem Alta to develop its own waste management strategies, adapted to its local context. Investing in initiatives that promote composting and the reuse of organic waste can not only minimize environmental impacts, but also add value to local agricultural production.

The preservation of green areas is another aspect in which Vargem Alta can be inspired in Curitiba. According to the principles defended by authors such as Richard Register, the presence of green areas in urbanization is vital for the promotion of the health and well-being of the population, in addition to playing a fundamental role in mitigating climate change. Curitiba, by integrating its green areas into urban planning, not only offers quality of life, but also contributes to the ecological resilience of the city. The valorization of natural resources in Vargem Alta, with the promotion of ecotourism and the preservation of local biodiversity, can enhance this strategy, promoting a harmonious relationship between urbanization and nature.



In addition, it is necessary to highlight the importance of a holistic approach that considers environmental education as a fundamental component for building a sustainable city. According to sociologist Ignacio Sánchez-Cuenca, environmental education should be present at all levels of training and involve the community in the discussion about sustainable development. For Vargem Alta, this means developing programs that enable the population to actively participate in sustainable initiatives, creating a culture of preservation and respect for the environment. Such an approach may include partnering with schools, universities, and non-governmental organizations to conduct workshops, lectures, and awareness campaigns on the importance of sustainability.

Community participation and the integration of accessible technologies are also essential for Vargem Alta to be able to align itself with the concepts of smart cities. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), smart cities should promote the use of data and information to improve quality of life, governance and sustainability. The implementation of simple technological solutions, such as resource management applications, can facilitate the monitoring of air, water, and energy quality, allowing for more efficient and informed management. In this way, the reality of Vargem Alta, with its environmental richness and unique characteristics, can be transformed through the adoption of sustainable and intelligent practices that consider its local specificities. The challenge, therefore, is to create a plan that respects local traditions and culture, while integrating technological innovations and effective public policies. Curitiba's successful experiences offer an inspiring path, but true transformation depends on Vargem Alta's ability to build a sustainable and smart future from its own foundations.

In the discussion about the sustainable characteristics of Vargem Alta compared to Curitiba and other smart cities around the world, it is essential to identify both the positive and negative points that each of these contexts presents. This critical analysis allows us to better understand the opportunities for sustainable development that Vargem Alta can explore.

One of the main positive points of Vargem Alta is its rich biodiversity and green areas, which offer opportunities for ecotourism practices and environmental conservation. The presence of native forests and forests provides not only a healthy environment, but can also be a tourist attraction, fostering the local economy. In addition, the city has a strong agricultural vocation, which, if well managed, can be integrated with sustainable production practices and agroecology, aligning with the growing demand for organic products. According to Mendes and Ferreira (2021), the development of sustainable agriculture is crucial to promote food security and environmental preservation in rural regions. Another



positive aspect is the small scale of the city, which facilitates the implementation of urban solutions and can allow for more direct and participatory management.

On the other hand, Vargem Alta faces significant challenges, especially with regard to urban infrastructure and waste management. The city still lacks an efficient public transportation system, which leads to an overreliance on private vehicles. This results in congestion and increases the carbon footprint of the population. Waste management also has weaknesses, with selective collection and waste treatment still under development. According to Oliveira et al. (2022), the lack of a structured solid waste management policy is one of the main obstacles to sustainability in small cities. In addition, the low environmental awareness of the population can make it difficult to implement sustainable practices.

Curitiba, on the other hand, is widely recognized for its innovative public policies and the implementation of an efficient public transport system. The BRT system has proven to be an example of success, reducing the number of cars on the streets and promoting sustainable urban mobility. In addition, the city has invested in a robust selective collection and environmental education program, resulting in a population engaged in sustainability issues. According to Arretche (2019), the active participation of the community in collection and recycling initiatives is a determining factor for the success of waste management policies in Curitiba. However, even with its advances, Curitiba faces challenges. Social inequality is still a reality, and although the transport system is effective, it does not serve all regions of the city equally, especially the most peripheral ones. According to research by Martins and Silva (2020), the most deprived areas often do not have adequate access to public services, including transportation and basic infrastructure, which limits the potential of a true smart and inclusive city. This disparity shows that, despite its positive points, Curitiba still has to face social issues to fully consolidate itself as a model of sustainable city.

In a broader analysis, when comparing Curitiba and Vargem Alta with the smartest cities in the world, such as Copenhagen and Barcelona, it is observed that these metropolises have adopted an integrated approach to sustainable urban development. Copenhagen, for example, is recognized for its ambition to become the first carbon-neutral capital by 2025 by implementing energy-efficient technologies on a large scale and investing in sustainable transport infrastructure (Sustainability Report, 2020). Barcelona, for its part, has stood out for promoting citizen participation and the use of data to optimize public services, reflecting a citizen-centered approach that prioritizes quality of life (Barcelona Smart City Strategy, 2021).

The integration of innovative technologies and the emphasis on inclusive policies are aspects that should be considered by Vargem Alta in its path towards sustainability. The



experience of smart cities reveals that the use of data and technologies is not only a matter of efficiency, but also an opportunity to engage the community and improve transparency in public management. In this way, the analysis of the examples of Curitiba and the smartest cities in the world offers a range of possibilities for Vargem Alta to develop urban planning that respects its particularities, while seeking to align with the best practices in sustainability and innovation.

CONCLUSION

The comparative analysis between Vargem Alta (ES) and Curitiba (PR), together with examples of smart cities around the world, shows that, although Curitiba has already consolidated its role as a model of sustainable development, Vargem Alta has significant potential to be explored. The rich biodiversity and rural characteristics of the Espírito Santo city offer a solid basis for the implementation of sustainable practices adapted to its reality, while existing challenges, such as waste management and the lack of an efficient public transport system, should be seen as opportunities for innovation and improvement.

Curitiba, with its effective public policies and a world-renowned transportation system, serves as a valuable inspiration for Vargem Alta. However, Curitiba's experience also highlights the need to address issues of social inequality and inclusion, remembering that sustainable development cannot be complete if it does not encompass all citizens. The world's smartest cities demonstrate that the integration of technology and active community participation are key to building more sustainable and inclusive urban environments.

Therefore, for Vargem Alta to become a sustainable city, it is essential that local authorities and the community come together in a collaborative effort, seeking to implement innovative solutions that respect their particularities. The path to a more sustainable future involves valuing its natural resources, promoting environmental education practices, and adopting public policies that foster citizen participation. With proper planning and the application of inspiring models, Vargem Alta can walk a solid path towards sustainability, transforming its challenges into opportunities and contributing to a more balanced and healthy world.

To further strengthen the conclusion of this study, it is relevant to emphasize that the transformation of Vargem Alta into a sustainable city is not limited only to the implementation of effective public policies, but also to the creation of an environment conducive to social and technological innovation. This implies that the city must open up to new ideas and approaches that integrate local knowledge with global best practices in sustainability. Environmental education, the appreciation of natural heritage and the



promotion of a sustainable local economy are pillars that must be explored together. In addition, building collaborative networks between different stakeholders — including government, the private sector, academia, and civil society — is crucial for the success of the initiatives. These partnerships can generate more effective and integrated solutions, promoting development that respects the cultural and social characteristics of the community. In this way, the transformation process will not only be technical, but also social, involving the population in a continuous dialogue about the future of the city.

The conclusion reaffirms that the path to sustainability in Vargem Alta is feasible and that the city, by being inspired by the experiences of Curitiba and smart cities in the world, can follow a solid path that, in addition to meeting current needs, ensures a fairer and more balanced future for its next generations. Collective commitment is essential for Vargem Alta not only to achieve its sustainability goals, but to become an inspiring example for other locations, showing that development and environmental preservation can coexist harmoniously.

FINAL CONSIDERATIONS

The final considerations of this study reaffirm the importance of urban planning that prioritizes sustainability, especially in the context of Vargem Alta (ES). The comparative analysis with Curitiba and other smart cities around the world illustrates that, although Curitiba has already consolidated its status as a model in sustainable development, Vargem Alta has immense potential that can be explored to follow a similar path, adapted to its unique characteristics. The challenges faced by Vargem Alta, such as waste management and the lack of an efficient public transport system, should not be seen as insurmountable barriers, but rather as opportunities for innovation and improvement. The adoption of sustainable practices that respect local specificities can transform the city into an example of resilience and commitment to sustainability. The implementation of environmental education initiatives, the promotion of a culture of citizen participation, and the creation of partnerships with various sectors of society are fundamental steps that can leverage this transformation.

Collaboration between the public administration, the community and local institutions will be vital for the success of sustainable policies in Vargem Alta. Building a sustainable future requires joining efforts and collective mobilization, where each citizen feels part of the process and responsible for their environment. Population engagement can be a powerful driver for meaningful change, fostering a sense of belonging and responsibility in relation to the space they inhabit.



Finally, when looking to the future, Vargem Alta must aim not only for economic development, but for development that balances growth with social justice and environmental preservation. With strategic planning and a vision focused on sustainability, the city can become an inspiring model for other locations, demonstrating that sustainability is not a distant utopia, but a viable goal that can be achieved through determination, innovation, and collaboration. The transformation of Vargem Alta into a sustainable city is a challenge that, if well faced, will bring benefits not only to its inhabitants, but also to the future generations that will inhabit this space.

The final considerations of this study highlight that Vargem Alta's journey towards sustainability should be seen as a long-term project, which requires continuous planning and an adaptive approach. The involvement of the population, transparency in decisions and the promotion of a culture of environmental responsibility are essential for everyone to feel part of this transformative process. Empowering citizens, through education and awareness, is an effective strategy to ensure that sustainable practices take root in the city's routine. In addition, the interconnection between the various sustainable initiatives should be strengthened. Isolated projects can have an impact, but true transformation happens when these actions are integrated into coherent urban planning. For example, reforestation actions, waste management, and encouraging sustainable transport must dialogue with each other, creating an ecosystem that favors sustainability.

Another important point is the need for continuous monitoring and evaluation of the policies implemented. Establishing sustainability indicators will allow you not only to measure progress but also to make adjustments when necessary. This will ensure that strategies are always aligned with the needs of the population and environmental requirements.

Finally, Vargem Alta has the opportunity to become a reference in sustainability, inspiring other Brazilian and Latin American cities. By cultivating a spirit of innovation and collaboration, and by adopting a vision of the future that prioritizes both economic development and social justice and environmental preservation, the city will be able to walk a path of resilience and prosperity, which benefits not only its citizens, but also future generations.



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