Revista ARACÊ
ISSN: 2358-2472

BETWEEN ALLEYS AND HOPES: EXPERIENCING THE RESILIENCE OF SANTA LUZIA

https://doi.org/10.56238/arev6n4-174

Submitted on: 12/11/2024 **Publication date:** 12/12/2024

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ABSTRACT

This study explores the community of Santa Luzia, located in Brasilia, Brazil, as an emblematic example of the intersection between socio-environmental challenges and agroecological resilience. The community faces inadequate urban infrastructure, with unpaved roads and lack of basic sanitation, resulting in precarious housing that is vulnerable to environmental adversity. Despite these adverse conditions, the community is notable for its ability to adapt and innovate in the face of resource scarcity and institutional neglect. The practice of agroecology emerges as a sustainable solution to combat food insecurity and promote biodiversity, potentially strengthening community autonomy and contributing to ecological balance. The environmental analysis revealed a complex interplay between urban challenges and sustainability, emphasizing the need for more effective urban planning. The study proposes specific interventions, including the development of an agroecological corridor to sustainably integrate residential areas with the surrounding environment. This planning aims not only to improve the quality of life for residents but also to strengthen the community's environmental resilience, highlighting the fundamental importance of community participation and innovation for a sustainable future.

Keywords: Agroecological resilience, Urban sustainability.

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ISSN: 2358-2472

INTRODUCTION

Vila Santa Luzia, also referred to as Chácara Santa Luzia or simply Santa Luzia, emerged in 2002 and faces serious challenges related to social, environmental and health vulnerability. The area is marked by geographical marginalization, disorderly land occupation and practices of subdivision of unregulated properties. Currently, the population of approximately 16 thousand people lives in inadequate housing and without access to basic sanitation infrastructure. The situation is even more critical due to the proximity of the community to the deactivated landfill in Brasília, which intensifies the already existing problems. The complexity of the scenario is amplified by the issue of land regularization, a delicate issue given the tension that arises due to the location of the village in the vicinity of one of the most important conservation areas in the Federal District, the Brasília National Park.

According to Andrade [1], Santa Luzia lives the "peripheralization of the periphery", which makes the residents live in extremely precarious conditions, aggravated by the constant threats of eviction due to its location, with the justification by the government of soil contamination because of the Structural Dump and for aggravating the risk of degradation of the Brasília National Park.

The theoretical analysis and objectives of this study are based on the health promotion paradigm, encompassing concepts of healthy cities and housing and theories of social representations, as discussed in several academic studies [2]. The research also considers public policies and essential practices related to public health, the built environment, the conservation of natural resources, and residential sanitation, among other critical factors for sustainable development [3].

Vila Santa Luzia emerged as an extension of Estrutural, a neighborhood that recently underwent a regularization process. However, Vila Santa Luzia, due to its location adjacent to the Brasília National Park, remains in an irregular situation and is the subject of legal litigation due to the possible risks to the park, configuring itself as a favorable scenario for complex socio-environmental and sanitary conflict.

The socio-environmental and sanitary conflict under analysis is manifested in the tension between the residents' search for the recognition and enforcement of fundamental human rights by the residents of Santa Luzia (Figure 1) and the need to reconcile these rights with the preservation of the environment. This dilemma is deeply rooted in the Brazilian legal framework, notably in the Federal Constitution, in the Organic Law of the

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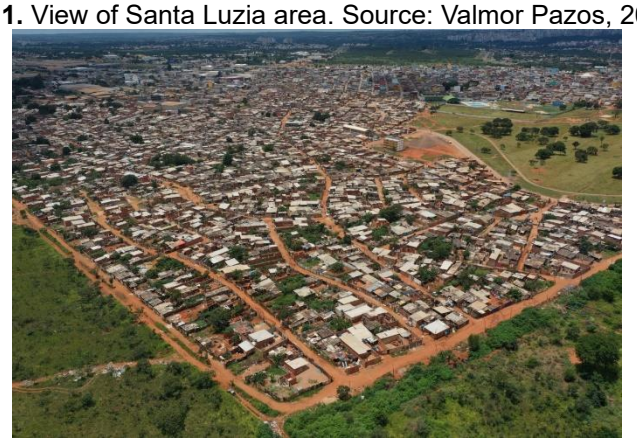
Federal District and in other pertinent legislation, outlining a complex scenario of disputes and negotiations.

Fig. 1. View of Santa Luzia area. Source: Valmor Pazos, 2023.



In this context, this microproject emerges as a strategic intervention aimed at the pressing needs of the community of Santa Luzia. It aims, specifically, to address the structural challenges that negatively impact the quality of life of residents, proposing to identify and implement viable and sustainable solutions that can significantly improve local infrastructure. With a scope ranging from the rehabilitation of deteriorated public roads to the optimization of water supply and basic sanitation systems, this microproject aims to develop an integrated plan that contemplates the multiple dimensions of local infrastructure, thus fostering the holistic and sustainable development of the region.

Furthermore, by laying the foundations for a more promising future in Santa Luzia, this microproject recognizes infrastructure not only as a response to the basic needs of the population, but also as a critical vector for sustainable economic growth, the continuous improvement of the quality of life, and the strengthening of the social fabric of the community. Thus, through the implementation of comprehensive and integrated infrastructure solutions, it seeks not only to meet the immediate demands of the population, but also to promote community development that is inclusive, resilient, and aligned with the principles of sustainability and social justice.

METHODOLOGY

To achieve the proposed objectives, the research was structured in three distinct phases. Initially, the first phase consisted of aerial survey and photogrammetry, using drones, in order to acquire accurate and up-to-date geospatial data. In the second stage, a

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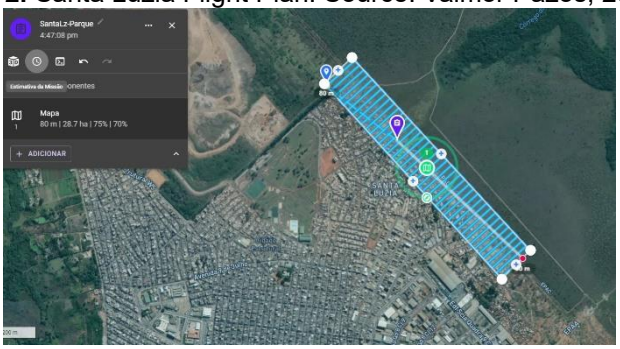
comprehensive bibliographic research was conducted, which included the review of the relevant literature on the topics that most impact the condition of Santa Luzia, such as the situation of urban infrastructure, environmental analysis and the theme of agroecology for the region. Finally, the third phase focused on the cartographic production of possible solutions for Santa Luzia, based on the information obtained in the previous stages. This step-by-step approach enabled a systematic and complete analysis, contributing to a deeper and more grounded understanding of the problem under study.

The Aerial Survey and Photogrammetry were carried out by drone, Unmanned Aerial Vehicle (UAV) – or UAV (Unnamed Aerial Vehicle) in English – in Brazil, as stipulated by the relevant legislation (Air Information Circular AIC N 21/10). According to ANAC [4], a UAV is any aircraft designed to operate without a pilot on board. For the execution of the Aerial Survey and Photogrammetry, it was necessary to prepare a specific flight plan for the region (Figure 2), using the Drone Link software.

Fig. 2. Santa Luzia Flight Plan. Source: Valmor Pazos, 2023.



The primary data, usually composed of photographs, altitude angles and support points in the field, were processed until obtaining results such as Digital Surface Model (SDM), Digital Terrain Model (DTM) and Point Cloud and Orthomosaic (NPO), generating three-dimensional spatial data to be used in GIS applications, documentation of cultural heritage and production of visual effects, as well as indirect measurements of objects at various scales [5]. The primary data collected in the first phase were processed using the Agisoft Metashape software, which generated the orthomosaic (Figure 3), used for analysis of the area.

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Fig. 3. Orthomosaic of Santa Luzia, Federal District, Brazil. Source: Valmor Pazos, 2023.

This orthomosaic was generated, capturing the precise division between Santa Luzia and the National Park. Its purpose is to illustrate in a clear and visual way the territorial restrictions imposed on the Santa Luzia area in relation to the National Park. This cartographic work highlights not only the physical border, but also emphasizes the importance and delimitation of environmental conservation zones, evidencing the commitment to the preservation of biodiversity and the unique ecosystems present in this region.

The second stage of the study consisted of the survey and analysis of articles, journals, dissertations, theses, books, legislation and existing official documents. This stage had the character of a theoretical and historical review on the theme addressed in this study.

In the third phase, the visual plan for infrastructure improvement is proposed, which is composed of guidelines for architectural and urban improvements, which may favor the protection of the National Park, through the implementation of the agroecological corridor, among other solutions specified in item 4 of this study.

CASE STUDY EVALUATION

URBAN INFRASTRUCTURE SURVEY

The disorderly population growth in cities often results in the occupation of areas unsuitable for housing, such as places with great slope, valley bottoms, squares, viaducts, among others. Zmitrowicz [6], when analyzing the structuring of urban space, argues that economic growth, together with social development, causes an increase in migrations, leading to concentrated population growth and, consequently, to a shortage of housing. To meet the demand for housing, there is an expansion of the urban area, often accompanied

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by a lack of infrastructure due to the scarcity of resources for city management. In this scenario, favelas, tenements and precarious housing in the periphery emerge; generally composed of one or more buildings built on urban lots, with precarious access and use of unbuilt spaces, inadequate sanitary facilities, circulation problems and deficient infrastructure. This can result in water contamination due to poor sanitation conditions, leading to health problems.

The detailed analysis of the region called Vila Santa Luzia (Figure 4) unveils a reality in which urban planning adopts an informal form, characterized by the irregular arrangement of houses and a remarkable spatial heterogeneity. This heterogeneity is manifested through the variety of architectural styles, lot sizes and land uses, reflecting an urban development that occurred in an organic and autonomous way, in the absence of structured urbanization guidelines. This spontaneous growth translates into significant spatial diversity within the community, where different areas have evolved under distinct influences and needs, resulting in a rich tapestry of urban environments.

Fig. 4. Area view of the central area of Santa Luzia. Source: Valmor Pazos, 2023.

The access roads to Vila Santa Luzia, mostly made up of unpaved roads, stand out as a symbol of the community's vulnerability to adverse weather conditions. This characteristic makes the roads susceptible to becoming impassable after episodes of heavy rain, which, in turn, seriously compromises the mobility of residents, as well as access to essential and emergency services. The situation highlights the urgent need for infrastructure interventions that can improve community resilience to such environmental and social challenges.

The region significantly lacks essential infrastructure, evidencing a notorious deficiency in basic sanitation systems. It is observed that the dwellings exhibit a diversity both architecturally and in the materials used, reflecting the autonomy of the residents in

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the construction of their homes and evidencing the economic differences between them. In addition, the scarcity of green areas and the rarefaction of trees compromise not only air quality, but also the well-being of the population, which is deprived of spaces for recreation and contact with nature, essential elements for maintaining an ecologically balanced environment.

Although some households try to mitigate this lack through small vegetable gardens and the planting of trees, these initiatives are insufficient to counterbalance the widespread absence of vegetation in the locality of Santa Luzia, a situation that is aggravated even with the proximity of the National Park, where greenery is more abundant. The environmental challenges are accentuated by the inadequate drainage of the area, which increases the risk of flooding, especially due to the topographic configuration that places the residences at a lower level in relation to the roads. Such provision increases the vulnerability of dwellings to rainfall events, aggravating the already precarious living conditions. The housing density reveals a dense community where, despite the possibility of strong social ties, residents live in extremely precarious conditions, facing constant threats of eviction.

These threats are justified by the government under the allegation of soil contamination, a direct consequence of the proximity to the Structural Landfill, and the potential risk of environmental degradation that the occupation imposes on the Brasília National Park. These government justifications place residents in a position of continuous uncertainty and tension, oscillating between the struggle for recognition and the defense against forced displacement, evidencing the complexity of the socio-environmental conflicts that mark the region.

ENVIRONMENTAL CHALLENGES AND POTENTIAL SOLUTIONS IN SANTA LUZIA: AN INTEGRATED ANALYSIS

The environmental issue of space in the Santa Luzia region is complex and multifaceted, marked by significant challenges and a dynamic interaction between human development and the environment. The first and most evident environmental issue is the lack of green infrastructure. The scarcity of green areas and afforestation in the region not only compromises air quality, but also negatively impacts local biodiversity and the well-being of residents. Green spaces are crucial for the ecological health of any urban area, providing benefits such as reducing pollution, improving the microclimate, and providing recreational and relaxation spaces for the community.

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Green infrastructure plays a key role in promoting the climate resilience of cities, while contributing to the creation of healthier environments and improving the local quality of life. This is due to the various environmental services that these infrastructures offer, such as microclimate regulation, rainwater management, and the reduction of greenhouse gas emissions, among others. In addition, they also provide social benefits, such as strengthening social cohesion [7].

In addition, the proximity to the Brasília National Park (Figure 5) brings up issues of environmental conservation. While the park offers a natural counterpoint to urbanization, the pressure exerted by urban sprawl and the lack of proper regulation in Vila Santa Luzia threatens the integrity of this important ecosystem. The situation is exacerbated by the presence of the old Structural Dump, which increases concern about soil and groundwater contamination, affecting the quality of life of residents and the health of the surrounding ecosystem.

Fig. 5. View of Santa Luzia area and the Brasilia National Park. Source: Valmor Pazos, 2023.

In addition, the informal occupation of Santa Luzia is located in the micro-watershed of the headwaters of the Cabeceira do Acampamento Stream, a location that defines the urban ecosystem of the area. In response to pressure exerted by the Public Prosecutor's Office of the Federal District and Territories, which points to an increase in environmental impacts, the Government of the Federal District is committed to relocating the occupants through a 3.2 km long linear social housing project, as a mitigating measure.

However, according to Rezende [8], Santa Luzia is not the main responsible for the environmental degradation of the watershed, which contradicts the State's argument that defends the removal of the community because of the damage caused to water resources

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and local biodiversity. Thus, the importance of debating the possible permanence of the community in the area is highlighted.

In the face of these challenges, Santa Luzia presents itself as a vibrant and dynamic community, whose infrastructure challenges directly affect the quality of life of its residents. With an ever-growing population, it becomes essential to address infrastructure issues to ensure a safe, healthy, and prosperous environment for all residents.

Land irregularity and disorderly growth also contribute to environmental problems. Without proper planning, the development of the region occurs randomly and often to the detriment of the environment. This results in problems such as inadequate waste management, a lack of efficient drainage systems, and the degradation of natural areas, which can lead to environmental disasters such as flooding and soil erosion.

Additionally, the reality of precarious housing in Santa Luzia highlights the issue of the environmental vulnerability of residents. Homes built without proper consideration for safety and sustainability standards are more susceptible to environmental damage, such as flooding and landslides, especially in at-risk areas.

In summary, the environmental situation in Santa Luzia is an intricate web of urban and ecological challenges. It calls for a holistic approach that considers both the need to improve urban infrastructure and residents' living conditions and the preservation of the surrounding natural environment, balancing human development with ecological sustainability.

AGROECOLOGY IN SANTA LUZIA: CHALLENGES AND POTENTIALS FOR SUSTAINABLE DEVELOPMENT WITH NATURE-BASED SOLUTIONS

According to Wolf, Rauf, and Hamel [9], Nature-based Solutions (NBS) are "actions to protect, conserve, restore, use, and sustainably manage natural or modified terrestrial, freshwater, coastal, and marine ecosystems, which address social, economic, and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and benefits for biodiversity" [10].

The researchers found examples of six different types of NbS already implemented in informal settlements in the Southeast Asian region: constructed wetlands, open green spaces, community gardens, street trees, riparian or seaside vegetation rehabilitation, and infiltration devices. Community gardens were the most frequently used solutions, followed by seafront revegetation projects. Constructed wetlands have been applied in informal

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settlements in Indonesia, Fiji and Vietnam under the RISE (Revitalising Informal Settlements and Their Environments) programme. The researchers and practitioners collaborated with residents to co-design wastewater treatment systems. These systems use a range of components, including biofilters, septic tanks, and surface and subsurface wetlands, to collect and treat wastewater locally in informal settlements.

In Brazil, the research started from studies carried out by Andrade [11] on spatial patterns and techniques of ecological infrastructure in the urban environment, to achieve water-sensitive urban design. Studies have been carried out with fact sheets carried out by the EPA's (American Environmental Protection Agency) "Water-Sensitive Urban Design" Program [12], 2008) as well as on "Smart Growth: Good Water Resources Management Practices and Densities, the "Water for a Sustainable World" report. This research was part of the construction of the manual "Designing with water: spatial patterns and ecological infrastructure techniques" and so far includes 52 patterns, coordinated by Professor Liza Andrade.

In the Santa Luzia region, agroecology emerges as a fundamental practice, not only for food resilience and nutritional security, but also as a pillar of sustainability and environmental conservation. The cultivation of food in small gardens allows residents to partially meet their food needs, promoting a more diversified and healthy diet. This direct approach to food production also plays a crucial role in preserving local biodiversity and contributes to the maintenance of soil and water resources, especially important in areas facing severe environmental challenges.

Mireya et al. [13] point out that the First National Meeting on Agroecology emphasized the importance of a "sustainable and democratic rural development model", in which agroecology plays a fundamental role as an approach and strategic component. This alternative model of rural development, which seeks to be both sustainable and democratic, serves as a political basis for agroecological mobilization.

The research group led by researchers Mireya and Cavanesi [13] aims to disseminate knowledge about Agroecology and its relevance to society. In 2024, they founded ERA: Rural Extension and Agroecology. The research group on rural extension and agroecology at UnB (Figure 6) highlights the importance of the chain of equivalence of Agroecology (Figure 7).

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Fig. 6. ERA Group - Research Group in Rural Extension and Agroecology at UnB (2024). Source: ERA Group, 2024.

Fig. 7. Chain of equivalences and importance of Agroecology. Source: Bittencourt, 2019.

Eduardo Sevilla Guzmán [14] addresses a rural development approach when he states that Agroecology constitutes the field of knowledge that promotes the ecological management of natural resources, through forms of collective social action that present alternatives to the current crisis of modernity.

Agroecology is not just limited to agricultural practices; It encompasses a significant educational dimension, increasing environmental awareness among the inhabitants. Through it, residents learn about sustainable practices and the importance of a balanced relationship between humanity and nature. This educational aspect is vital for building a more informed and aware community about ecological issues.

In addition to its environmental and educational benefits, agroecology in Santa Luzia is an instrument of empowerment and local development. By providing skills and knowledge about growing food, it enables greater self-sufficiency and can even open up avenues for income generation. This is especially relevant in areas with limited economic opportunities.

These agroecological practices are also an effective strategy for dealing with the effects of climate change. They promote climate resilience through crop diversification and

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improvements in soil water retention, crucial aspects for adaptation in areas vulnerable to extreme weather events.

A notable aspect of agroecology in the region is its focus on the reuse and recycling of resources. In a context of limited resources, the creative use of materials and waste not only decreases implementation costs, but also reduces the environmental impact of agricultural practices.

However, despite the numerous benefits, agroecology in Santa Luzia faces significant challenges. Issues such as the lack of suitable land for cultivation, scarcity of resources, and the need for technical training in efficient and sustainable agricultural practices are barriers that need to be overcome to maximize the potential of agroecology in the region. Thus, for agroecology to fully reach its transformative potential, it is essential that there is support, capacity building, and adequate allocation of resources.

PROPOSAL FOR REFLECTIONS AND PATHS IN SEARCH OF THE EVOLUTION OF URBAN INFRASTRUCTURE

Investing in urban infrastructure improvements is a fundamental strategy to transform Santa Luzia into an example of a modern, sustainable and inclusive city. The development of structural projects that address essential needs in transportation, sanitation, energy supply, communications, and revitalization of public spaces not only elevates urban functionality and aesthetics, but also significantly promotes the well-being and quality of life of citizens.

In the Integrated Plan: Housing and Agroecological Corridor (Figure 8), it is proposed the creation of an agroecological corridor, designed to function as an effective buffer zone in the protection of the Brasília National Park. This proposal aims to harmonize the coexistence between housing areas and the environment, promoting biodiversity conservation and sustainable development. The agroecological corridor is planned to offer multiple benefits, including the preservation of habitats, the promotion of sustainable agriculture, and the creation of a natural barrier that minimizes the negative impacts of human activities on the park.

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Fig. 8. Integrated Plan: Housing and Agraecological Corridor. Source: Valmor Pazos, 2024.

This innovative approach not only strengthens environmental protection, but also fosters a more balanced and sustainable relationship between urban and natural spaces. The implementation of this agroecological corridor represents a significant step towards integrated environmental management, ensuring nature conservation while meeting the needs of the local community.

For Santa Luzia to achieve this goal, it is essential that urban infrastructure planning is carried out in an integrated manner, considering the interconnection between different areas and the long-term impact of each project. This implies a holistic approach that takes into account not only technical aspects, but also social, economic and environmental aspects, ensuring sustainable solutions that meet the present and future needs of the population.

Community participation in the process of planning and implementing these improvements is another crucial pillar. Involving the inhabitants of Santa Luzia in decision-making ensures that projects reflect the real needs of the population, in addition to fostering a sense of belonging and collective responsibility for the city. This can be achieved through public consultations, workshops, and digital civic engagement platforms, promoting participatory and transparent governance.

Focusing on sustainable solutions, as we propose in the Visual Infrastructure Improvement Plan (Figure 9) is equally important. Adopting green technologies, promoting energy efficiency, and prioritizing public transport and non-motorized modes of transportation are examples of practices that contribute to urban resilience. Additionally, creating green spaces and public spaces that encourage social interaction and outdoor recreation improve air quality and contribute to residents' physical and mental health.

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Fig. 9. Visual Plan for Infrastructure Improvement. Source: Valmor Pazos, 2024.

Elevated Walkways: Elevated structures that allow the transit of people above the level of possible flooding, ensuring the mobility and safety of the community during periods of heavy rain.

Stormwater Management Areas: Spaces designated for the control and direction of rainwater, reducing the risk of flooding and improving local water management.

Community Gardens: Areas dedicated to the cultivation of plants and food by the community, which in addition to providing sustenance, also contribute to the management of rainwater and the creation of green spaces.

Natural Buffer Zones: Strips of native vegetation, which we are calling agroecological corridors, and green spaces between the housing area and the natural surroundings, functioning as barriers to protect biodiversity and prevent uncontrolled urban expansion.

Simple Housing Improvements: Upgrades and repairs to existing housing that improve residents' quality of life at no great cost, using local materials and sustainable techniques.

Therefore, it is imperative that local authorities, businesses, and the wider community of Santa Luzia continuously collaborate and invest in urban infrastructure improvements. This multidisciplinary collaboration is key to overcoming existing challenges and ensuring a vibrant, prosperous, and sustainable urban future for all its inhabitants. By adopting a strategic and inclusive vision, we can transform Santa Luzia into a model of a smart and resilient city, prepared to thrive in the decades to come.

CONCLUSIONS

Urban infrastructure improvements play a vital role in the transformation and ongoing development of cities around the world, including Santa Luzia. Such investments aim not

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only to enhance the physical functionality of the urban environment, but also to promote a more inclusive, sustainable, and resilient environment for its inhabitants. In Santa Luzia, these improvements are key to addressing contemporary urban challenges, covering critical areas such as transportation, water and sanitation, energy, communications, and public spaces.

In the field of transport, Santa Luzia benefits from investments in road infrastructure, expansion of public transport networks, bike lanes and accessible sidewalks. These initiatives not only improve urban mobility, but also reduce congestion and pollutant emissions, promoting a more active and healthy lifestyle. The modernization of public transport systems, in particular, offers a sustainable alternative to the excessive use of private vehicles, helping the city to reduce its carbon footprint.

Regarding water and sanitation, Santa Luzia is committed to universal access to drinking water and proper wastewater treatment. Investments in water supply networks and treatment systems are vital to prevent diseases and improve public health, highlighting the importance of this infrastructure for the quality of life in the city.

In the field of energy, Santa Luzia seeks to modernize and diversify energy sources, with a growing focus on renewable solutions. The transition to clean energy sources not only supports environmental sustainability but also puts the city at the forefront of the fight against climate change.

The expansion and modernization of telecommunications networks are essential for Santa Luzia, promoting digital connectivity and inclusion in all spheres of urban life. High-speed internet access and a robust communications infrastructure are critical for economic development, education, and access to digital public services.

In addition, public spaces in Santa Luzia are valued as centers of social cohesion and community interaction. Investments in parks, squares, and leisure areas not only enrich the urban fabric, but also promote the well-being and quality of life of citizens, strengthening the community bond.

In conclusion, investment in urban infrastructure is essential to build a more inclusive, sustainable, and resilient Santa Luzia. By prioritizing projects that address needs in transportation, water, energy, communications, and public spaces, Santa Luzia can overcome contemporary challenges and create an environment conducive to economic growth, social equity, and a quality life for all its inhabitants.

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THANKS

The authors would like to thank the University of Brasília (UnB) for serving as a setting of great academic inspiration, LabRAC - Laboratory for the Rehabilitation of the Built Environment, LaSUS - Laboratory for Sustainability Applied to Architecture and Urbanism, and Laboratório Periférico - Sociotechnical Advisory, for the incentive and opportunity to develop research aimed at the recovery and improvement of buildings and cities, Always focusing on the benefit of the population. We also thank the Research Support Foundation of the Federal District (FAPDF) for the financial support, encouragement and promotion of research.

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