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Territorial planning and Sustainable Development Goals: implementation of metrics for analyzing the Land-use planning of the municipalities of Rio do Sul, Lontras and Presidente Nereu, Santa Catarina, Brazil

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Authors' notes'

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Abstract

Objective: to measure the propensity and quality of Land-use Planning (LUP) of three municipalities in Alto Vale do Itajaí (Santa Catarina), regarding the sustainability dimensions and Sustainable Development Goals (SDGs 2015-2030).

Methodology: quanti-qualitatively exploratory and documentary procedure. Three municipalities were selected for analysis, considering the regional characteristics in terms of the amount of population contingent (small, medium and large). Therefore, the propensity of the plans to meet the requirements of the dimensions of sustainability and the SDGs 2015-2030 was assessed quanti-qualitatively.

Relevance: the developed methodology of quanti-qualitative analysis correlating LUPs and their propensities in meeting the dimensions of sustainability and the SDGs 2015-2030 requirements.

Results: the three LUPs showed good results regarding the expectation for meeting the sustainability dimensions. However, the LUP of Rio do Sul presented a lower propensity to meet the SDGs compared to the other two municipalities analyzed.

Contributions: it contributes to discussions on territorial planning and sustainable development, as well as presents a methodology for quanti-qualitative LUP analysis.

Conclusion: the LUPs analysis, regards the SDGs 2015-2030, helps in the process of qualification of these, regarding sustainable development, as well as the analysis of the five dimensions of sustainability. Analyses and discussions like this are relevant as it aims to increase the relation of city development through territorial planning (LUP) and sustainability in different dimensions.

Keywords: territorial planning, sustainable development, land-use planning, climate changes, environmental governance

PLANEJAMENTO TERRITORIAL E OBJETIVOS DE DESENVOLVIMENTO SUSTENTÁVEL: IMPLEMENTAÇÃO DE MÉTRICAS PARA ANÁLISE DOS PLANOS DIRETORES DOS MUNICÍPIOS DE RIO DO SUL, LONTRAS E PRESIDENTE NEREU, SANTA CATARINA, BRASIL

Resumo

Objetivo: mensurar a propensão e qualidade dos Planos Diretores Municipais (PDM), de três municípios do Alto Vale do Itajaí (Santa Catarina), referente ao atendimento às expectativas das dimensões da sustentabilidade e dos Objetivos de Desenvolvimento Sustentável (ODS 2015-2030).

Metodologia: procedimento qualitativo, exploratório e documental. Foram selecionados três municípios para análise, considerando as características regionais em termos da quantidade do contingente populacional (pequeno, médio e grande). Assim, foi analisado quanti-qualitativamente a propensão dos PDM quanto ao atendimento às expectativas das dimensões da sustentabilidade e dos ODSs 2015-2030.

Relevância: a metodologia desenvolvida de análise quanti-qualitativa correlacionando PDM e suas propensões no atendimento às dimensões de sustentabilidade e aos ODSs 2015-2030.

Resultados: os três PDM mostraram bons resultados quanto a expectativa para o atendimento das dimensões de sustentabilidade. No entanto, o PDM de Rio do Sul apresentou menor propensão no atendimento dos ODS em comparação aos outros dois municípios analisados.

Contribuições: contribui nas discussões sobre planejamento territorial e desenvolvimento sustentável, bem como, apresenta uma metodologia de análise quanti-qualitativa para PDM.

Conclusão: a análise dos PDMs, frente aos ODS 2015-2030, auxilia no processo de qualificação destes, no que condiz ao desenvolvimento sustentável, assim como, a análise das cinco dimensões de sustentabilidade. É relevante que análises e discussões como esta, ocorram, visando cada vez mais relacionar o desenvolvimento das cidades por meio do planejamento territorial (PDM) e sustentabilidade, em diferentes dimensões.

Palavras-chave: planejamento territorial, desenvolvimento sustentável, planos diretores municipais, mudanças climáticas, governança ambiental

PLANIFICACIÓN TERRITORIAL Y DESARROLLO SOSTENIBLE: IMPLEMENTACIÓN DE MÉTRICAS PARA EL ANÁLISIS DE LOS PLANES DIRECTORES DE LOS MUNICIPIOS DE RIO DO SUL, LONTRAS Y PRESIDENTE NEREU, SANTA CATARINA, BRASIL

Resumen

Objetivo: medir la propensión y la calidad de los Planes Directores Municipales (PDM) de tres municipios del Alto Vale do Itajaí (Santa Catarina), referentes a cumplir con las expectativas de las dimensiones de la sostenibilidad y los Objetivos de Desarrollo Sostenible (ODS 2015-2030).

Metodología: procedimiento cualitativo, exploratorio y documental. Se seleccionaron tres municipios para el análisis, teniendo en cuenta las características regionales en cuanto a la cantidad del contingente de población (pequeño, mediano y grande). Así, se analizó cuantitativamente la propensión de los PDMs en cuanto al cumplimiento de las expectativas de las dimensiones de sostenibilidad y de los ODS 2015-2030.

Relevancia: la metodología desarrollada de análisis cuanti-cualitativo correlacionando los PDM y sus propensiones en el cumplimiento de las dimensiones de sostenibilidad y los ODS 2015-2030.

Resultados: los tres PDM mostraron buenos resultados en cuanto a las expectativas de cumplimiento de las dimensiones de sostenibilidad. Sin embargo, el PDM de Rio do Sul mostró una menor propensión al cumplimiento de los ODS en comparación con los otros dos municipios analizados.

Aportaciones: contribuye a los debates sobre la ordenación del territorio y el desarrollo sostenible, y presenta una metodología de análisis cuanti-cualitativo para el PDM.

Conclusión: el análisis de los PDMs, frente a los ODS 2015-2030, ayuda en el proceso de cualificación de los mismos, en lo que se refiere al desarrollo sostenible, así como al análisis de las cinco dimensiones de la sostenibilidad. Es importante que se produzcan análisis y debates como éste, que relacionan cada vez más el desarrollo de las ciudades mediante el planeamiento territorial (PDM) y la sostenibilidad, en diferentes dimensiones.

Keywords: planificación territorial, desarrollo sustentable, planes directores municipales, cambios climáticos, gobernanza ambiental

Introduction

Thinking about the development process of societies requires understanding the socio-spatial formation process, as described by Santos (1977, 1978). Along this journey, various themes emerged, including the issue of sustainable development. Discussions on this topic have been ongoing for almost half a century, addressing different dimensions (Veiga & Zatz, 2008). Although the concept gained emphasis in the 1980s, its dissemination began in 1972 with the United Nations Conference in Stockholm. Two main issues dominated this conference: environmental protection and the reversal of demographic growth. Three important aspects emerged from these discussions: i) the need for a simultaneous commitment to nature preservation and the rational use of resources; ii) Diversity of perspectives on the relationship between development and the environment; and iii) the responsibility attributed to demographic dynamics as a factor responsible for inequalities in economic growth distribution and pressure on natural resources (Costa, 2008).

These debates originated from the challenges posed by climate change and its transboundary impacts, disregarding territorial and political boundaries. This necessitates joint action among governments and society to mitigate consequences and adopt practices aiming for a balance between human activities and the environment (Espíndola & Ribeiro, 2020). Due to the need for a paradigm shift in the concept of development, the United Nations (UN) formulated and adopted a new agenda for sustainable development in 2015, known as Agenda 2030 (2015-2030). This document established 17 Sustainable Development Goals (SDGs), which are somewhat generic, providing objectives and targets adaptable to the reality of each country, state, and city. These goals can guide policies, projects, programs, and plans related to territorial planning.

SDG 11 specifically addresses the sustainability of cities. Achieving a more sustainable future requires making cities resilient to disasters associated with climate issues and risk management, aiming to protect people and promote prosperity for them (Rosenzweig et al., 2015). Sustainable urban development plays a crucial role in combating climate change and achieving a more sustainable development. Therefore, territorial planning should be aligned with this goal. In Brazil, territorial planning is regulated by the City Statute (Law No. 10,257, 2001), which establishes Municipal Master Plans (PDM) as the main instrument for territorial planning policy. Municipal Master Plans are essential tools for achieving SDGs, provided they include provisions to this purpose.

To truly implement the "management of planetary resources in a way that ensures quality and abundance for the future generations in the long term" (Thomas & Callan, 2012, p. 24), territorial planning must be oriented toward the long term, considering different dimensions for present and future generations. This requires an approach to territorial governance. From the perspective of Beck and Ferasso (2023), Stakeholder Capitalism proves relevant for achieving some SDGs, especially when global alliances are present. This implies considering the role of Municipal Master Plans, whose main objective is to define the city's function and urban property, ensuring access to urbanized and regularized land for all social segments, guaranteeing the right to housing and urban services for all citizens, as well as implementing democratic and participatory management (Britto, 2011).

Thus, Municipal Master Plans play a fundamental role in realizing sustainable development in different dimensions, alongside the essential role of cities in the climate change debate (Carvalho, Silva, Bom & Fernandes, 2020). The public sector plays a crucial role in promoting the transition to a sustainable urban model by defining public policies that favor sustainable practices and the rational and careful use of natural resources in all urban activities. Additionally, incentive measures should lead to a change in societal behavior (Carvalho et al., 2020). With this in mind, this study aims to assess the inclination and quality of Municipal

Master Plans in three Brazilian municipalities located in the Alto Vale do Itajaí in the state of Santa Catarina, regarding their compliance with the sustainability dimensions and the Sustainable Development Goals of Agenda 2030. Integrating sustainability dimensions and SDGs into the main tool for city planning is crucial for establishing a mandatory public policy directing sustainable urban development. The article's novelty lies in proposing a methodology to qualitatively evaluate Municipal Master Plans regarding their inclination to meet the SDGs, ensuring a better quality of life for the population. To initiate this discussion, supported by exploratory and documentary research, this article is divided into 7 sections in addition to this introduction: i) brief considerations on sustainable development; ii) brief notes on Brazilian territorial planning; iii) some considerations on urban sustainable development; iv) the methodology; v) the results; vi) discussion of the results; and vii) final considerations.

Sustainable development

The 20th century in the Western world was marked, in economic terms, by strategies aimed at improving people's living conditions through the intensive use of capital, especially post the technical-scientific period (Santos, 1994). The overall development of humanity in recent decades has led to increasingly unfavorable climate changes (Klarin, 2018; Rodrigues & Rippel, 2015). The 19th-century idea of progress was replaced by that of development (Rodrigues & Rippel, 2015). Countries began to be classified based on indicators dependent on their level of industrialization, i.e., indicators of an economic nature (Heidemann, 2009). Despite significant economic growth, this did not result in improvements in social indicators, especially in "peripheral" countries, and it also caused profound environmental impacts affecting the entire globe indirectly and directly (Daly, 1999). The problem persisted [and persists]. It is a development solely material, i.e., unsatisfactory; there is a need for a development that is sensitive to the possibilities and primary interests of humanity (Heidemann, 2009).

In this context, sustainable development emerged as an alternative, as it is a process that seeks constant qualitative improvement in the way of life, including eradicating poverty

while simultaneously respecting the physical and biological limits of ecosystems. The concept of sustainable development is based on the concepts of development, needs, and future generations (Klarin, 2018). While compatible with economic thinking, it involves selecting policies that maximize objectives subject to constraints (Alexiadis, 2017). Sustainable economics, in turn, is the product of sustainable development. This economic model aims to balance development with the conservation of its primary source of natural resources, maintaining the regenerative capacity and assimilation of each ecosystem (Daly, 1999). It requires a rethink of the circular flow of income, incorporating a sustainable perspective.

One of the central issues contributing to planetary unsustainability addressed during "ECO-92" or "Rio-92" was population density. According to neo-Malthusian thoughts, major environmental and social problems stem from population growth (Martine, 1993). However, it is not the sole culprit (Martine, 1993). Achieving sustainability requires continuous monitoring and evaluation for sustainable development, as highlighted by Agenda 21 (UN, 1992). This gives people the right to development but also the obligation to preserve the environment (Klarin, 2018).

For a long time, especially until the 1990s, sustainable development was closely associated with ecology. Natural systems allow people to live and support the outcomes of human activities, so sustainability can hardly be considered without an ecological aspect (Jenkins, 2009). Sachs (1993) introduced a rich reflection when describing sustainable development from different dimensions. According to the author, the sustainability analysis dimensions are: i) social (equity in the distribution of goods and income); ii) economic (efficient allocation and management of resources); iii) ecological (set of measures); iv) spatial (better territorial distribution of human settlements and economic activities); and v) cultural (cultural changes with an endogenous character). Sustainable development is either a mission or a survival strategy (Bojarska, Złoty & Wolf, 2021). In light of the above, sustainable development can only occur when different dimensions are met [and understood].

Sachs (2000) also emphasizes the need for globally-oriented actions, highlighting the responsibility of the United Nations system. In this regard, it is essential to observe the Sustainable Development Goals (SDGs) set by the UN in Agenda 2030, which defined 17 objectives to be achieved by 2030, particularly those linked to social, environmental, and economic dimensions. The SDGs constitute a universal set of goals, targets, and indicators that UN member states will use to frame their agendas and policies over the next 15 years (Hák, Janoušková & Moldan, 2016; Bojarska et al., 2021). They represent an action plan for people, the planet, and prosperity. Adopting the SDGs would unite the global population to respond urgently to ending poverty, safeguarding the planet, and ensuring peace and prosperity (Leal Filho et al., 2022). The SDGs provide guidance for the integrated planning of infrastructure to ensure long-term sustainable development (Thacker et al., 2019).

To achieve sustainability in all dimensions, governance-supported strategies that must occur, especially in the field of territorial planning. Sustainable development does not seek to sustain cities or urbanization but rather to ensure that human needs are met in all settlements without depleting environmental resources (Satterthwaite, 1997). The implementation of urban infrastructure can assist in achieving 68% of the SDG targets (Thacker et al., 2019), benefiting cities in reaching Agenda 2030. However, implementing this infrastructure without considering sustainable development can negatively impact the achievement of SDGs (Thacker et al., 2019).

Governance allows public and private actors from the State, the market, and civil society to govern public issues at multiple levels, autonomously or in mutual interaction (Sampford, 2002; Oliveira, 2020). In this perspective, Solly, Berisha, and Cotella (2021, p. 11) describe that "governance interventions that attempt to improve the mechanisms by which government actors manage urban and rural areas seem to influence how sustainable development is realized at regional and local levels."

Therefore, governance prompts us to think about integration, and territorial governance [considering that the concept of territory implies thinking about power relations] is characterized as the process of managing territory, integrating associations not only from the State and civil society but also from market agents (Dallabrida, 2015). From the perspective of Beck and Ferasso (2023), in the spectrum of discussion on ecological economics, the Stakeholder Capitalism perspective proves favorable to "foster a friendly environment to achieve most SDGs and can contribute to global governance, especially in achieving SDGs 8, 9, and 17."

In a study by Solly, Berisha, and Cotella (2021), it is emphasized that there is no ideal tool to be used in land use management, but sustainable urbanization and land use can be achieved through the implementation of a variety of instruments. Furthermore, this approach encourages us to think that global partnerships are essential to promote decent work, economic growth, innovation, infrastructure development, and sustainable industrial dynamism. In this approach, Solly, Berisha, and Cotella (2021) highlight some factors that must be considered to promote sustainable development: i) visions and strategies; ii) norms and legal devices; iii) land use regulations; iv) programs; and v) projects. Has Brazilian territorial planning been concerned with sustainable development in its different dimensions? To answer this, we should observe how the process has occurred [and is occurring] in Brazil, which will be discussed in the next section in brief reflections.

Contextualization of Brazilian Territorial Planning

The planning process in Brazil is rooted in the Land Law (Law No. 601 of September 18, 1850), which also laid the foundation for transforming land into a commodity (Maricato, 2008). Later, with the increasing urbanization, particularly arising from the 1930 Revolution, the Brazilian state institutionalized planning, led by the alliance of dominant classes represented by the agrarian sector [linked to the domestic market] and the emerging industrial bourgeoisie (Rangel, 1981). The country established itself as a sovereign nation but faced significant

structural problems, such as the growing expansion of low-income urban peripheries without state presence or any planning (Rolnik, 2011).

In 1930, a more structured territorial planning process began in Brazil. Until 1970, planning practices were highly focused on urbanism, geared towards supporting the country's economic growth process. An example is J.K.'s Goals Plan (1956-61), envisioning to "grow 50 years in 5." Environmental sustainability dimensions were virtually nonexistent, given the need to strengthen the economic dimension at that moment in the country's productive history. Later, during the military dictatorship, the 1970s were characterized by technocratic and bureaucratic urban planning and strong encouragement for the industrialization of national branches in department 1 [capital goods industry], basic inputs, and the implementation of energy and transportation infrastructure (roads, ports). The I and II National Development Plans (I and II PND) focused on increasing the Gross Domestic Product (GDP) and per capita income through the encouragement of technological progress and industrial consolidation, placing the country on the international trade stage.

In the 1980s, the country experienced the period of democratization and the approval of the 1988 Federal Constitution, emphasizing that Articles 165, 182, and 183 include provisions on territorial planning policy (regional and urban development), emphasizing the social function of the city. However, it was only in 2001 that Articles 182 and 183 of the 1988 Federal Constitution were regulated through the approval of the City Statute (Law No. 10.257, 2001), aiming to establish parameters and guidelines for urban policy in Brazil, providing instruments for municipalities to intervene in urban and territorial planning and management processes, ensuring the right to the city. The innovations brought by the Statute are basically threefold: i) new urbanistic instruments to induce, not just regulate, land use and occupation forms; ii) a new management strategy incorporating direct citizen participation in decision-making processes about the city's fate; and iii) the expansion of possibilities for regularization of urban possessions located in the ambiguous border between legal and illegal (Rolnik, 2001).

Moreover, it can be observed that, with the City Statute, the demand for social participation gained even more prominence and encouragement. In recent research perspectives, such as Staloch (2019), new forms of social relationships have emerged – through cyberspace – and are therefore possible to be appropriated for municipal territorial planning, especially in the elaboration and/or revision of Municipal Master Plans. However, some obstacles persist in the Brazilian context: political, institutional, administrative, technical, cultural, economic, and social.

Urban sustainable development

Due to increasing debates in the 1980s and 1990s regarding the conservation and preservation of natural resources and the role of humans integrated into the environment, discussions about the quality of life in cities began to emerge, especially concerning the role they play. Thus, the discussion about sustainable development in relation to cities gained greater social recognition (Satterthwaite, 1997). During this period, the environmental dimension was not integrated as a structuring element in guidelines and proposals for urban management in Brazil (Peres & Silva, 2013). However, the speed at which space was occupied to generate wealth must gradually be replaced by attention to the environment, which needs to be seen and understood as a promoter of human life. Mitigating the causes, not just adapting to the effects, reduces vulnerability and seeks to perpetuate life with quality, making cities resilient, especially in the face of climate change (Carvalho et al., 2020). A way to minimize the problems caused by human activities to the environment and their climatic consequences lies in urban sustainable development (Yigitcanlar & Teriman, 2014).

Urban sustainable development is the implementation of sustainable development at the local level (Opschoor, 2011; Alexiadis, 2017; Bento, Conti, Baptista & Ghobril, 2018), including considerations and methods for urban sustainable development, such as providing sustainable natural resources, sustainable protection of urban systems against environmental disaster risks, and improving urban quality of life (Yang & Yin, 2010), also ensuring the economic development of cities. This new way of planning and developing, based on sustainable development and

ensuring quality of life, helps urban managers take the necessary measures for the local implementation of the sustainable agenda (Yigitcanlar & Teriman, 2014). It is important to highlight that SDG 11 aims to ensure that cities are inclusive, green, safe, and sustainably managed (Allam & Jones, 2021), meaning it aims to promote urban sustainable development. In general, the SDGs can be a guide for urban managers regarding the topics to be addressed in territorial planning, as they can be adapted to local or even regional realities and are the minimum standard necessary to achieve sustainable development, ensuring quality of life and social and environmental justice.

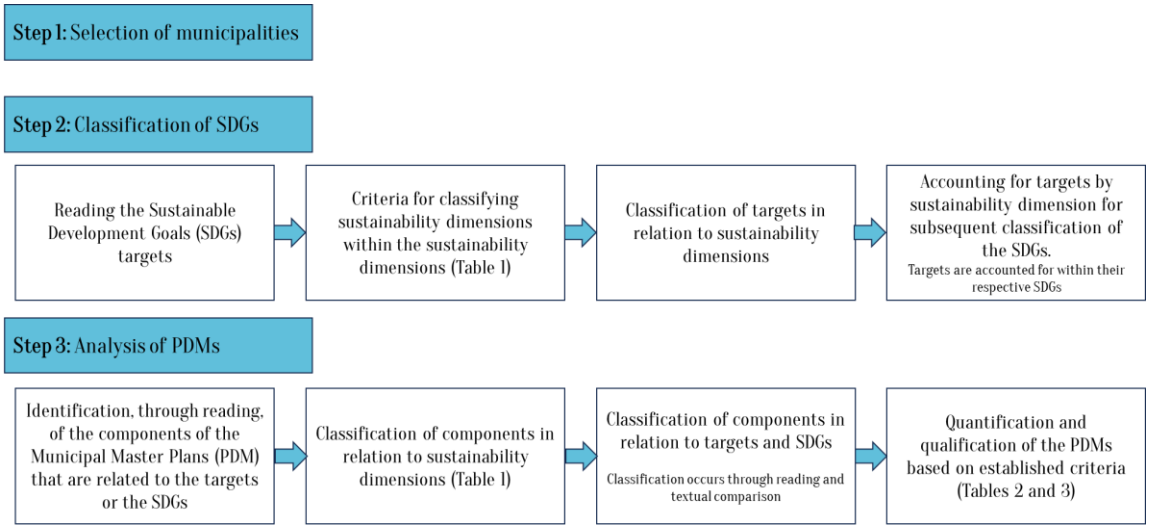
Sustainable cities are not only about SDG 11 but also have effects on other SDGs and call for placing society at the center of the issue, understood as a sharing of values and ideas between the current generation and future generations (D'adamo, Gastaldi, Ioppolo & Morone, 2022). To ensure that the right infrastructure is built, policymakers need to establish long-term visions for sustainable national infrastructure systems, informed by the SDGs, and develop adaptable plans that can substantiate this vision (Thacker et al., 2019). Therefore, there is a need to strategically plan land use and urban sustainability (Mallick et al., 2021; Iannillo & Fasolino, 2021). Cities play a fundamental role in people's lives and the journey toward sustainable development, and it is necessary to analyze all their dimensions and facets, priorities, and criticalities to define and promote strategies to make them more sustainable (Flores et al., 2021; Yigitcanlar & Kamruzzaman, 2018), including the crucial area of territorial (urban and regional) planning.

Methodology

The present research is characterized as qualitative due to its corpus, utilizing the method of documentary analysis in the Municipal Master Plans (PDM) of the selected municipalities. In Figure 1 below, the stages of the adopted methodology are represented, and subsequently, these are detailed.

Figure 1

Flowchart of the employed methodology



Source: developed by the authors (2023).

Step 1: Selection of municipalities

Considering that all 28 municipalities in the Alto Vale do Itajaí region (Santa Catarina/Brazil) have Municipal Master Plans (PDM), three municipalities were selected based on their population size. Therefore, one municipality with a small, one with a medium, and one with a large population were chosen, considering the regional population distribution. The average number of inhabitants in the municipalities of Alto Vale do Itajaí, according to the IBGE Census (2010), is 9,622 inhabitants. Based on these characteristics, the following municipalities were selected to compose the sample of this study: Rio do Sul (61,198 inhabitants), Lontras (10,244 inhabitants - the municipality closest to the average), and Presidente Nereu (2,284 inhabitants).

Following the approval of Federal Law No. 10,257/2001 – the City Statute, the respective municipalities conducted and approved their Municipal Master Plans. Rio do Sul had its Municipal Master Plan approved on December 12, 2006, through Complementary Law No. 163. Lontras had its Participatory Master Plan approved in 2012, through Complementary Law No. 41, and the municipality of Presidente Nereu had its Participatory Master Plan approved on

June 1, 2009, through Complementary Law No. 002. According to studies on the process of developing Municipal Master Plans in the municipalities of the Alto Vale do Itajaí region, it is noted that the coordination and management of the Master Plan development were carried out by the Association of Municipalities of Alto Vale do Itajaí (AMAVI) (Staloch, 2019), with the exception of Rio do Sul.

Step 2: Classification of SDGs in the context of the five sustainability dimensions

The 17 Sustainable Development Goals (SDGs) were initially classified according to the five sustainability dimensions. To carry out the classification of the SDGs, the 169 targets comprising them were initially categorized. The criteria used for the classification of the targets are presented in Table 1. The classification process involved posing questions, where for a target to be classified within a dimension, the answer to one of the questions should be 'yes.' In the event that more than one dimension meets a criterion with a 'yes' response, the tiebreaker is determined by considering the focus of the SDG to which the target belongs. The classification of the SDGs proceeded with the final tally of the quantity of targets per sustainability dimension. For example, SDG No. 1 has seven targets, of which six were classified in the social dimension and one in the economic dimension. Therefore, SDG No. 1 was classified in the social dimension. The final classification of the 17 SDGs can be observed in Figure 5.

Table 1

Criteria Used for the Classification of SDG Targets Across Sustainability Dimensions

	To ensure quality of life and dignity of the human person.
Social	Seeks measures to reduce poverty?
	Seeks to ensure equality and social inclusion?
	Seeks to ensure quality education at all ages (basic and vocational)?
	Seeks to end hunger?
	Seeks to promote public health?
	Seeks to relocate impoverished individuals from high-risk areas?
	Seeks to ensure broad access to social resources (education, health, security...)
	Seeks to ensure gender equality?
	Seeks to reduce discrimination based on sexual orientation?
	Seeks to assist immigrants and refugees?
	Seeks to decrease crime incidence rates, combat crime?
	Seeks to ensure equal access to justice?
	Seeks to ensure access to clean water?
	Seeks to ensure access to essential services (water, energy, sewage collection/treatment, waste collection) at affordable prices?
	Seeks to ensure access to quality employment?
	Seeks to guarantee efficient and population-serving public transportation?

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	Seeks to provide social housing and the right to housing?
Economic	**Ensure sustainable economic development and growth.**
	Seeks to ensure food security?
	Seeks to promote sustainable economic growth and development?
	Seeks to promote innovation and industrialization sustainably?
	Seeks to increase productivity?
	Seeks to promote free trade?
	Seeks to improve/establish regulations overseeing economic activities?
	Seeks to increase the participation of developing countries in economic activities?
	Seeks to encourage rural activities for sustainable growth and development of rural areas?
	Seeks to incentivize micro and small businesses?
Environmental/Ecological	**Ensure the preservation and recovery of the environment for current and future generations.**
	Seeks to preserve and enhance the quality of the environment and its natural resources?
	Seeks to manage natural resources?
	Seeks to protect biodiversity and wildlife?
	Seeks to ensure access for all to natural resources and a quality environment?
	Seeks the development of new sustainable technologies that ensure improvement and safety for the environment?
	Seeks to implement mitigating measures for damage already caused to the environment?
	Seeks the formulation of norms/legislations for environmental protection?

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	Seeks to preserve the resilience potential and self-purification of nature?
	Seeks to promote basic sanitation for all people and ensure water supply sources?
	Seeks to encourage the use of more sustainable technologies?
	Seeks to promote sustainable development?
	Seeks to reduce/prevent the incidence of natural disasters through project implementation? (e.g., dams for flood control)
	Seeks to promote environmental education?
Spatial/Territorial	**Ensure sustainable urban and rural territorial planning for everyone, guaranteeing a suitable environment for human settlements.**
	Seeks to ensure a balance in the demographic distribution of the population (urban and rural)?
	Seeks to ensure a quality environment in urban and rural areas?
	Seeks to ensure access to safe housing for everyone?
	Seeks to ensure access to recreational areas?
	Seeks sustainable territorial planning for urban and rural areas?
	Seeks to promote territorial planning and organization to prevent occupation in risk-prone or environmentally fragile areas?
Cultural	**Ensure the preservation of local culture.**
	Seeks to ensure the preservation of culture and/or cultural heritage?

Source: developed by the authors (2018).

Step 3: Analysis of Municipal Master Plans

Initially, the components (articles, sections, or paragraphs) directly or indirectly related to the Sustainable Development Goals (SDGs) or targets were identified. The identification process involved a comprehensive reading of the Municipal Master Plans (PDM). A review of the process was conducted after the initial reading of all three PDMs.

Following the identification of components, they were classified according to sustainability dimensions using the criteria presented in Table 1. Thus, the classification was based on questions, where for a component to be classified within a dimension, the answer to one of the questions must be 'yes.' In the event that more than one dimension meets a criterion with a 'yes' response, the tiebreaker is determined by examining the chapter of the legislation where the component is located.

Subsequently, the components were classified against the SDG targets to quantify how many SDGs each PDM is inclined to address. For the classification of the target or SDG that the component is inclined to address, the objective of that component was observed. Thus, the text of each component was compared with the text of the 169 targets and 17 SDGs to identify which target or SDG the analyzed component is inclined to address. This comparison occurred in two ways: through manual reading and using the text comparison tool available in Microsoft Word (2010 version). If it is observed that a component is inclined to address a target, it is directed to the corresponding SDG identified.

The criteria for quantifying and qualifying the PDMs in relation to the SDGs were established based on the number of SDGs each PDM is inclined to address, as shown in Table 2.

Table 2

Qualification of Municipal Master Plans in Relation to the Number of SDGs They Tend to Address

Qualification of the Master Plan	Quantity of SDGs
Poor	0 - 2
Fair	3 - 5
Good	6 - 8
Satisfactory	9 - 11
Excellent	12 - 14
Outstanding	15 - 17

Source: developed by the authors (2018).

In this way, it was possible to quantify the Municipal Master Plans (PDM) regarding the presence of provisions encompassing sustainability dimensions and the predictability of whether they will address the Sustainable Development Goals (SDGs) or not. In other words, the qualification solely based on the SDGs of the PDM will occur through the quantity of SDGs that the respective plan is inclined to address with its identified components. Finally, to relate the SDGs to the sustainability dimensions present in the PDMs, the analysis will consider the number of SDGs belonging to each sustainability dimension that the analyzed plan is likely to address, highlighting the level of engagement of the PDM. Thus, the base equation for measuring these indicators is defined:

$$\% = \frac{Number\ of\ SDGs\ that\ the\ Master\ Plan\ tends\ to\ address}{Number\ of\ SDGs\ belonging\ to\ the\ analyzed\ dimension} \times 100$$

The result, expressed as a percentage, provided the basis for an overall qualification of the Municipal Master Plan (PDM) by comparing SDGs versus sustainability dimensions, as shown in Table 3.

Table 3

Overall Qualification of the Master Plan: SDGs versus Sustainability Dimension

Qualification	Percentage of addressed SDGs versus total SDGs in the dimension (%)
Poor	0-20
Fair	21-40
Good	41-60
Satisfactory	61-80
Excellent	81-100

Source: developed by the authors (2018).

All the analysis of the Municipal Master Plans (PDM), as well as the calculations, were conducted with the assistance of Microsoft Excel and Word (version 2010). With the methodology clarified, the comparative analysis of the results is presented next.

Results

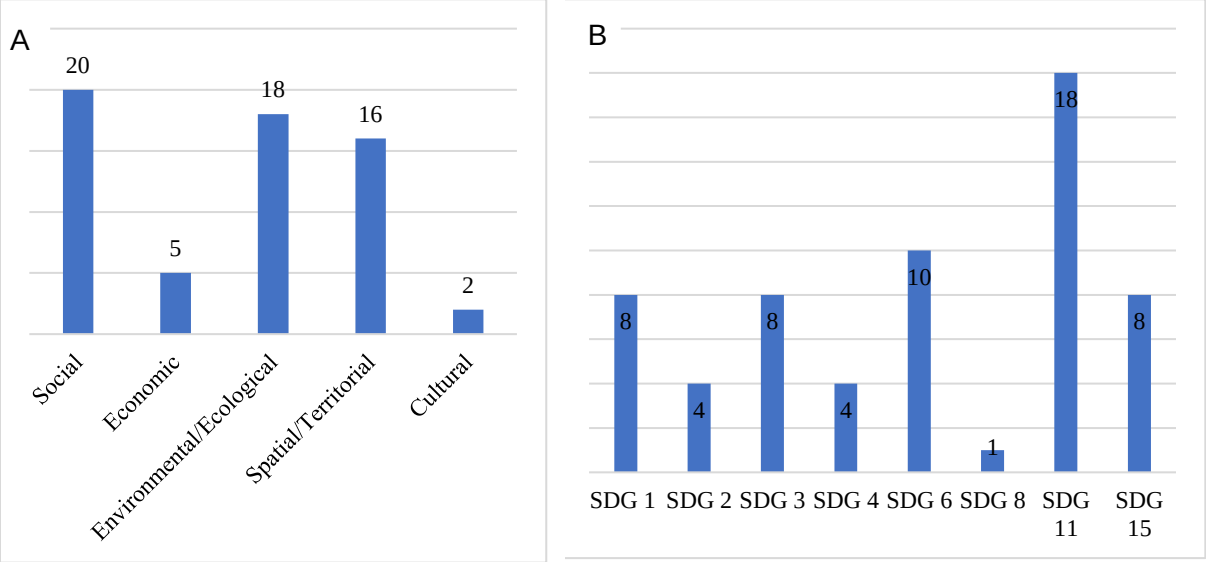
Rio do Sul – Santa Catatina/Brazil

For Rio do Sul, the analysis covered the 89 articles constituting the Municipal Master Plan (PDM), of which only 16 presented measures that tend to address some of the Sustainable Development Goals (SDGs). In other words, 17.98% of the plan includes measures aimed at meeting the five dimensions of sustainability and the SDGs. Of these 16 articles, a total of 61 components were identified in their text that tend to address the SDGs.

Through the classification performed, it can be observed that the Rio do Sul PDM has a higher tendency towards the social dimension, followed by the environmental/ecological and spatial/territorial dimensions, and finally the economic and cultural dimensions, as shown in Figure 2-A. Regarding the SDGs, the Rio do Sul PDM tends to address only eight out of the 17 SDGs, classifying it as a 'Good' Master Plan based on the quantity of SDGs it is inclined to address, as illustrated in Figure 2-B.

Figure 2 – Figure A

Classification of components of the Municipal Master Plan of Rio do Sul in sustainability dimensions. Figure B: Classification of components of the Municipal Master Plan of Rio do Sul from the perspective of the SDGs



Source: developed by the authors (2018).

In a comparative analysis between the Sustainable Development Goals (SDGs) and sustainability dimensions, the Rio do Sul Master Plan falls short. For the six SDGs classified in the social dimension, only three are addressed in the plan. In the economic dimension, out of the five classified SDGs, only two are included in the plan. In the environmental/ecological dimension, where five SDGs are classified, only two are considered in the plan. The spatial/territorial dimension has only one SDG classified in this dimension. Therefore, it is evident that the social and spatial/territorial dimensions have a higher quantity of provisions in the Rio do Sul Municipal Master Plan.

Consequently, based on the overall qualification proposed by this study, the Rio do Sul Municipal Master Plan is classified as 'Good' concerning sustainability dimensions and the SDGs.

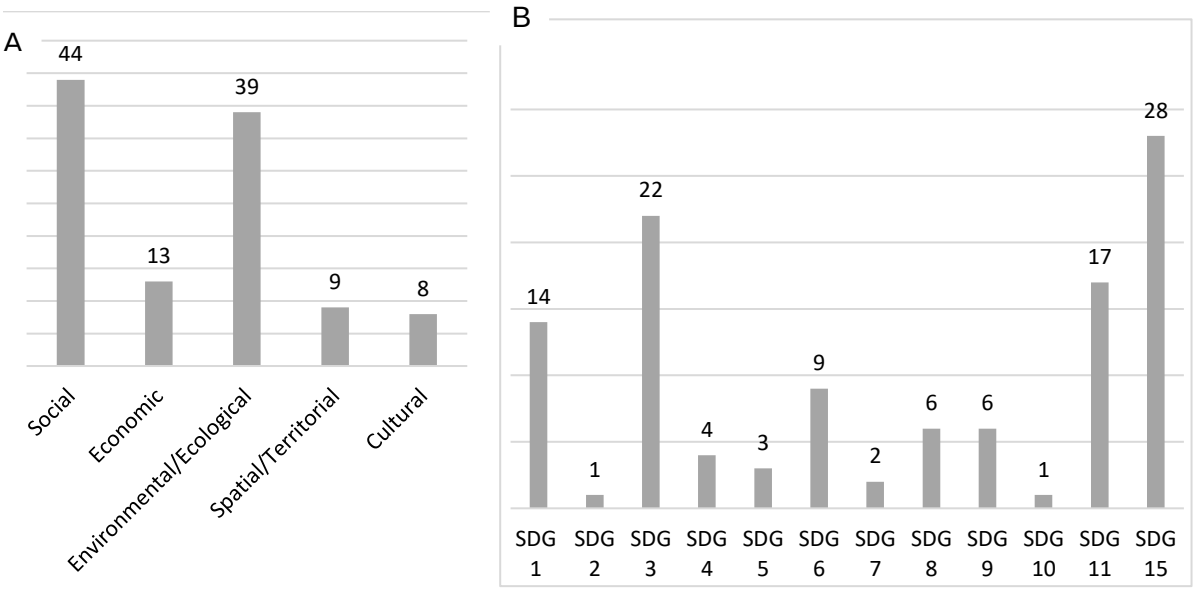
Lontras – Santa Catarina/Brazil

For the municipality of Lontras, the analysis covered the 124 articles constituting the Municipal Master Plan, of which 45 presented measures that tend to address some of the Sustainable Development Goals (SDGs). In other words, 36.29% of the plan includes measures aimed at meeting the five dimensions of sustainability and the SDGs. Of these 45 articles, a total of 113 components were identified in their text that tend to address the SDGs.

Through the classification performed, it can be observed that the Lontras Municipal Master Plan has a higher tendency towards the social and environmental/ecological dimensions, followed by the economic, spatial/territorial, and cultural dimensions, as shown in Figure 3-A. Regarding the SDGs, the Lontras Municipal Master Plan tends to address 12 out of the 17 SDGs, classifying it as an 'Excellent' Master Plan based on the quantity of SDGs it is inclined to address, as illustrated in Figure 3-B.

Figure 3 - Figure A:

Classification of components of the Municipal Master Plan of Lontras in sustainability dimensions. Figure B: Classification of components of the Municipal Master Plan of Lontras from the perspective of the SDGs



Source: developed by the authors (2018).

The SDG that shows a greater likelihood of becoming a reality through the application of the Municipal Master Plan of Lontras is SDG 15, from the environmental/ecological dimension, particularly when considering the quantity of components.

In a comparative analysis between SDGs and sustainability dimensions, the Lontras Municipal Master Plan demonstrates an excellent outcome in the assessment conducted by this study. It meets at least half of the classified SDGs in each sustainability dimension: out of the six SDGs classified in the social dimension, five are addressed in the plan; out of the five SDGs classified in the economic dimension, three are included in the plan; out of the five SDGs classified in the environmental/ecological dimension, three are incorporated in the plan; and the spatial/territorial dimension has only one SDG classified in this dimension, which is included in the plan. Consequently, it is evident that sustainability dimensions and the SDGs are well-

addressed, providing the Municipal Master Plan from Lontras with significant engagement and making it an excellent instrument for implementing the 2030 Agenda in the municipality.

Therefore, based on the overall qualification proposed by this study, the Lontras Municipal Master Plan is classified as 'Excellent' concerning sustainability dimensions and the SDGs.

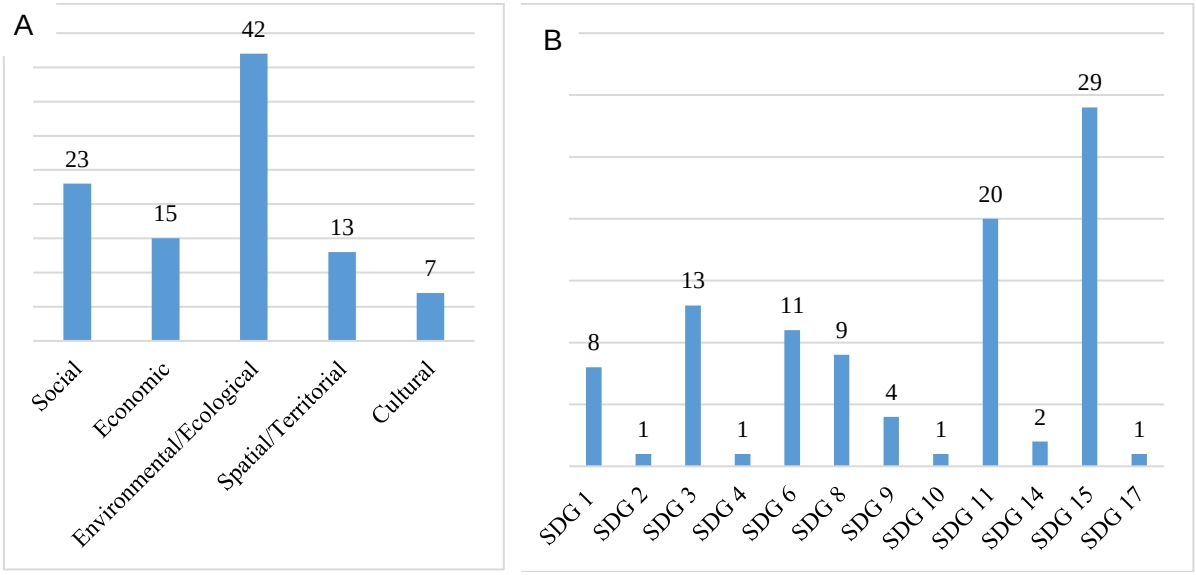
Presidente Nereu – Santa Catarina/Brazil

For the municipality of Presidente Nereu, the analysis covered the 91 articles constituting the Municipal Master Plan (PDM), of which 32 presented measures that tend to address some of the Sustainable Development Goals (SDGs). In other words, 35.16% of the plan includes measures aimed at meeting the five dimensions of sustainability and the SDGs. Of these 32 articles, a total of 100 components were identified in their text that tend to address the SDGs.

Through the classification performed, it can be observed that the Presidente Nereu Municipal Master Plan has a higher tendency towards the environmental/ecological dimension, followed by the social, economic, spatial/territorial, and finally, the cultural dimensions, as shown in Figure 4-A. Regarding the SDGs, the Presidente Nereu Municipal Master Plan tends to address 12 out of the 17 Sustainable Development Goals. The SDGs that are likely to be addressed and their respective quantity are shown in Figure 4-B.

Figure 4 – Figure A:

Classification of components of the Municipal Master Plan of Presidente Nereu in sustainability dimensions. Figure B: Classification of components of the Municipal Master Plan of Presidente Nereu from the perspective of the SDGs



Source: developed by the authors (2018).

The SDG that shows a greater likelihood of becoming a reality through the application of the Municipal Master Plan of Presidente Nereu is SDG 15, from the environmental/ecological dimension, particularly when considering only the quantity of components.

In a comparative analysis between SDGs and sustainability dimensions, the Presidente Nereu Municipal Master Plan demonstrates excellent results in the assessment conducted by this study. It meets at least half of the classified SDGs in each sustainability dimension: out of the six SDGs classified in the social dimension, four are addressed in the plan; out of the five SDGs classified in the economic dimension, three are included in the plan; out of the five SDGs classified in the environmental/ecological dimension, four are incorporated in the plan; and the spatial/territorial dimension has only one SDG classified in this dimension, which is included in the plan. Consequently, it is evident that sustainability dimensions and the SDGs are well-addressed, providing the Municipal Master Plan of Presidente Nereu with significant

engagement and making it an excellent instrument for implementing the 2030 Agenda in the municipality.

Therefore, based on the overall qualification proposed by this study, the Presidente Nereu Municipal Master Plan is classified as 'Excellent' concerning sustainability dimensions and the SDGs

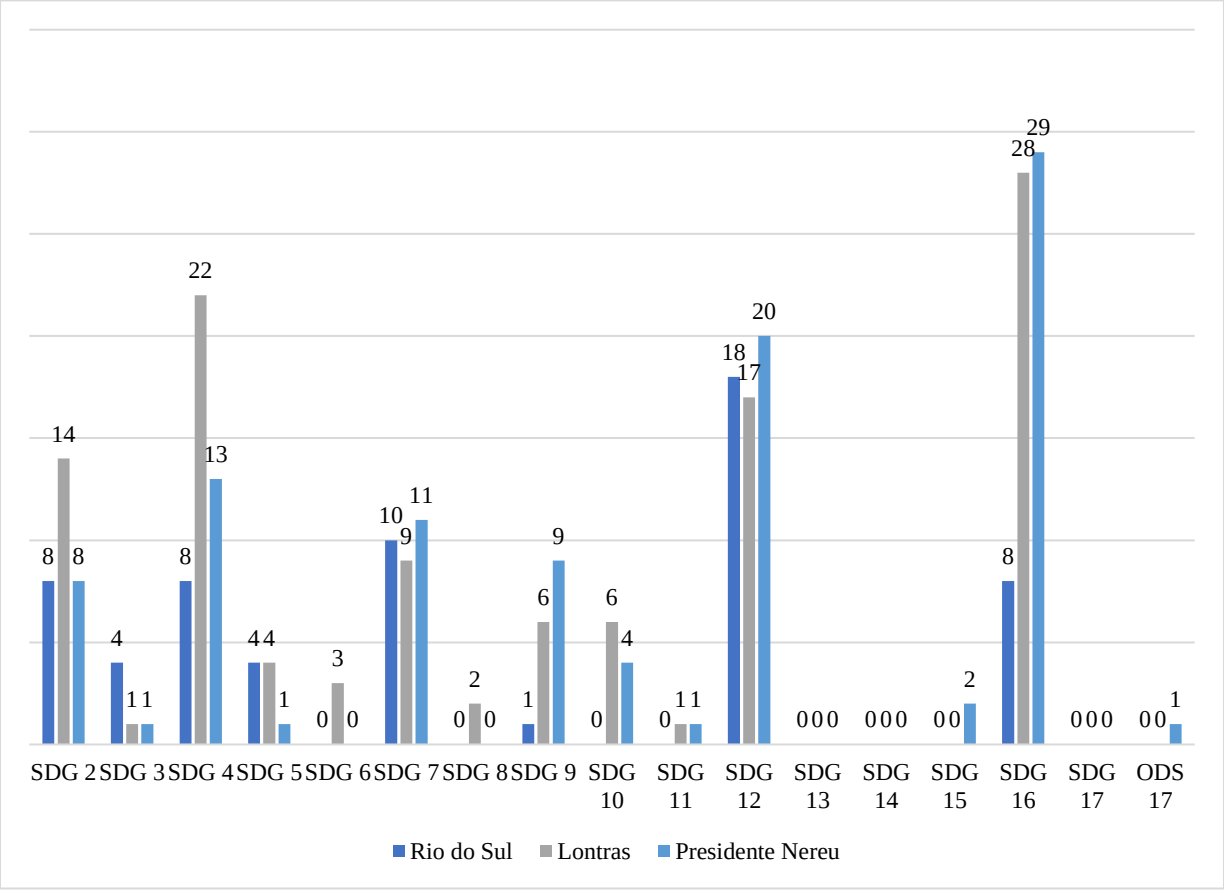
Comparative Analysis among the Analyzed Municipal Master Plans (PDMs)

As mentioned, the Master Plans of Lontras and Presidente Nereu have a substantial number of components that can contribute to achieving the Sustainable Development Goals (SDGs). Both, through their respective components, manage to address 12 out of the 17 SDGs proposed by the Agenda 2030, making them effective instruments for implementing the agenda in the municipalities.

In contrast, the Master Plan of Rio do Sul has fewer components compared to the Master Plans of Lontras and Presidente Nereu, addressing only eight out of the 17 SDGs proposed by the agenda, as demonstrated in Figure 5.

Figure 5

Classification of components of the analyzed Municipal Master Plans concerning the SDGs that are likely to be addressed



Source: developed by the authors (2018).

Discussion

Theoretical Implications

There is an urgent need to address sustainable development in the face of the current climate change scenario. The number of disasters resulting from climate change in urban areas has quadrupled in the last thirty years (Apollaro & Alvim, 2017). Uncontrolled growth and development, without proper planning, have led to the occupation of high-risk areas and degraded environments, directly impacting the environment (Ribeiro, 2008). Espíndola and Ribeiro (2020), in their analysis of master plans in Brazilian capitals, observed a lack of

mechanisms to address climate change. They pointed out that master plans are not oriented towards minimizing the effects and adapting to climate change. In the face of constant threats, it becomes essential to guide municipal planning and management for urban adaptation, impact mitigation, prevention, and resilience enhancement for the city and its citizens (Espíndola & Ribeiro, 2020), especially considering social and environmental justice, sustainable development, and the Sustainable Development Goals (SDGs), which have these objectives.

The master plans analyzed here perform well in terms of addressing sustainability dimensions and the SDGs of the 2030 Agenda. Considering that the master plans of municipalities in the Alto Vale do Itajaí region, except for Rio do Sul, were jointly developed with the Association of Municipalities of Alto Vale do Itajaí (AMAVI) (Staloch, 2019), it is expected that the master plans in the region have this characteristic. The disparity in the Rio do Sul master plan, compared to the master plans of Lontras and Presidente Nereu, regarding the difference in qualification in the proposed analysis, can be explained when analyzing the publication year of these plans in relation to historical events and especially the publication of new environmental legislation and documents. It was noticeable that the Lontras and Presidente Nereu master plans underwent notable interferences in the social and environmental/ecological dimensions due to the promulgation of laws and documents that favored these aspects. However, these are not observed in the master plan of Rio do Sul, as it was published before the occurrence of several milestones.

There is a need to strengthen the articulation between other environmental policies, such as watershed plans and municipal sanitation plans, to ensure greater and better guidance in the pursuit of sustainable development. However, integrated management is not only achieved through the articulation of technical instruments; the political participation of society is also necessary (Peres & Silva, 2013). Analyzing the content of the master plan is just the first step to ensure that the SDGs are truly achieved by 2030, and this, in turn, demonstrates the theoretical relevance of the article presented here, as it proposes to develop a methodology for

evaluating master plans in relation to the SDGs, corroborating and contributing to discussions on the territorial planning process, especially considering the context of territorial governance and the perspective presented by Beck and Ferasso (2023) on Stakeholders. Furthermore, territorial planning, especially urban planning, benefits from this study as it initiates a conceptual and methodological delineation to think about less technocratic and more participatory master plans that involve more discussions for long-term development, including the perspective of global unity as pointed out by Leal Filho et al. (2022).

As the SDGs provide guidance for integrated infrastructure planning for long-term sustainable development (Thacker et al., 2019), understanding whether master plans are adopting such guidelines in their directives and provisions becomes fundamental to incite and stimulate changes in their implementations, which, in turn, come closer to discussions on sustainable development. Finally, the importance of aligning discussions on sustainable development, SDGs, and urban sustainable development with the array of legal instruments and tools available for city planning, as well as for planning city infrastructure investments, is highlighted. This means that what matters to cities and urban sustainability permeates discussions, understandings, and practical implementations through territorial planning instruments—namely, master plans—for achieving the SDGs in their entirety. These approaches also align with the understanding of Solly, Berisha, and Cotella (2021) when they emphasize that there is no ideal tool to be used in land use management, but sustainable urbanization and land use can be achieved through the implementation of a variety of instruments connected by a common goal: the quality of life for present and future generations.

Therefore, the main theoretical implications of this article, linked to urban sustainability, are: i) it corroborates discussions on the Brazilian territorial planning process and proposes a qualitative-quantitative analysis methodology; ii) conceptual and methodological delineation for less technocratic and more participatory master plans; and iii) alignment of discussions on territorial planning, sustainable development, SDGs, and master plans.

Practical Implications

The main challenges for public managers and urban planners include the coordination and addressing of conflicts of interest among the departments and sectors that make up the municipality (health, education, economic development, environment, etc.) in order to establish a common objective for achieving the SDGs. Coordination between departments and plans (sanitation, watershed, solid waste) is crucial, and the SDGs are an excellent tool to ensure this. The water crisis is already a reality, both in Brazil and globally, so integrating the planning of all sectors essential to guaranteeing human dignity is the main challenge for urban planners, especially in terms of watershed planning.

Identifying gaps in the legal frameworks that guide the territorial planning of cities allows municipal managers to guide their planning so that a broader range of SDGs can be achieved. These goals will be more easily attained with institutional instruments that guide the decision-making process more effectively (Guevara, Garostidi & Alegria, 2019). The importance of the SDGs for sustainable urban development is already recognized (Oliveira, 2020), and this is one of the goals that make up the 2030 Agenda (SDG 11). Therefore, the analysis of the quality of master plans, with the proposed methodology, can help public managers identify the major deficits and propose improvements, especially in infrastructure, which is the main field of action for the municipal master plan.

The proposed methodology in this study can be a starting point to identify what is already being observed by these instruments and tools, as well as help identify possible gaps, that is, which SDGs are not being observed. Additionally, the proposed methodology can help distance from the influences of private lobbies linked to real estate rent-seeking and the exclusion of the most vulnerable population by identifying flaws in legal instruments in providing services that guarantee minimum conditions for quality of life. Strengthening local government is essential for the implementation of public policies attentive to the diversity of housing needs

and, furthermore, to the different sizes and geographical and environmental characteristics of each city (Maricato, Colosso & Comarú, 2018).

In this presented context, the practical contribution of the study is directly linked to the processes of elaboration and/or revision of master plans and the discussions and implementation of devices that are truly connected with the perspective of sustainable development, especially taking into account the parameters discussed by Solly, Berisha, and Cotella (2021) to promote sustainable development: i) visions and strategies; ii) norms and legal devices; iii) land-use regulations; iv) programs; and v) projects.

Implications for Local Communities and Cities

The importance of the role that cities play in transitioning to more sustainable growth is increasingly recognized (Lo-Iacono-Ferreira, Garcia-Bernabeu, Hilario-Caballero & Torregrosa-López, 2022). From the perspective of territorial planning, the City Statute and Municipal Master Plans are crucial management tools that need to be utilized not only for the constitution of exchange value but, above all, for use value. Use value is directly correlated with the process of sustainable development and long-term territorial planning.

Cities need to respond to the challenges posed by climate change (Bai et al., 2018; Serpa, 2008). The rapid growth of the urban population intensifies the need to consider sustainable development, making it even more challenging to achieve Sustainable Development Goals (SDGs) in cities (Undesa, 2019). This is not only due to being the places where the consequences of climate change are most noticeable but also because cities represent an opportunity for change and evolution (Espíndola & Ribeiro, 2020).

Urban planning is the tool capable of proposing significant changes in how populations occupy and use space, lifestyles, and cultural, social, and economic aspects, aiming to mitigate, not just adapt to, environmental challenges (Carvalho et al., 2020). Thus, the Master Plans (MPs) of the evaluated municipalities exhibit positive aspects related to sustainability and ensuring a decent quality of life for people. However, there is a need for greater robustness in

MPs, especially when considering SDGs related to water and sanitation (SDG 6 and 14), affordable and clean energy (SDG 7), reduction of inequalities (SDG 10), responsible consumption and production (SDG 12), and combating climate change (SDG 13). These SDGs were underrepresented in the Master Plans analyzed in this study and are directly related to ensuring minimum urban infrastructure for the quality of life, especially for the most vulnerable populations exposed to climate change and natural disasters.

Therefore, the present methodology contributes to the context of territorial governance and stakeholders, as presented by Beck and Ferasso (2023), as mentioned earlier. Additionally, public participation in the urban planning process can help public officials and planners better understand the local needs of cities, as extensively argued in the literature and by Rolnik (2001). However, ensuring the participation of all in this process is a challenge, as the population most in need of attention from public policies often cannot be present when these instruments are open for public discussion. Therefore, this is the greatest challenge faced by local communities: ensuring participation and, above all, ensuring that the needs expressed by them are addressed, as popular needs often conflict with private interests.

The main implication of this work for professionals in the field lies in the development of a methodology that helps them identify gaps in Municipal Master Plans quickly. This, in turn, enables them to make changes to address and fill these gaps promptly. The methodology can enhance governance, which is essential to ensure that public policies are directed toward sustainable urban development. The methodology is easily replicable and requires only human effort, without the need for software acquisition, facilitating implementation in small municipalities.

Final considerations

The developed study aimed, initially, to conceive a metric for evaluating Municipal Master Plans (PDM) in correlation with the Sustainable Development Goals (SDGs). Based on the study conducted in three municipalities in the Alto Vale do Itajaí region (Santa Catarina), a

proposal was generated whose results demonstrated theoretical and practical relevance in the field of studies. The evaluated PDMs based on the envisaged parameters (Rio do Sul, Lontras, and Presidente Nereu) showed promising prospects regarding sustainability dimensions, with all five dimensions being addressed, to a greater or lesser extent. When analyzing the trend of PDMs in meeting the SDGs, a difference was observed between the Rio do Sul Master Plan and the Master Plans of Lontras and Presidente Nereu. The Rio do Sul Master Plan tends to address only 8 SDGs, with those classified in the social dimension being the most covered. In contrast, the Lontras and Presidente Nereu municipalities tend to address 12 SDGs, with Lontras fully covering SDGs in the social dimension and Presidente Nereu prioritizing SDGs in the environmental/ecological dimension. Overall, the three analyzed PDMs presented satisfactory results concerning the quantity of SDGs covered by them.

It is essential to advance discussions to bridge the gap between theory and practice since many still view sustainability merely as utopian. Analyzing the PDMs of Rio do Sul, Lontras, and Presidente Nereu in relation to the SDGs of the UN 2015-2030 Agenda contributes to their qualification in sustainable development and the analysis of the five sustainability dimensions. It is crucial that analyses and discussions like this proposal occur, aiming to increasingly link city development through territorial planning - Master Plans - and sustainability across different dimensions. Therefore, citizen participation in planning processes, as envisaged by the City Statute, is equally important.

The main contribution of the article lies in presenting a methodology for quantifying and qualifying the instruments presented in the PDMs in correlation with the SDGs. This methodology can help identify gaps, i.e., identify which SDGs are not being addressed by the PDMs, and contribute to deterring political interests associated with urban policies, assisting in ensuring the provision of services that guarantee minimum conditions for the quality of life of people in Brazilian cities.

Moreover, the article contributes to discussions on sustainable development and territorial planning, bridging the gap between these subjects. The proposed analysis methodology, based on sustainable development and the SDGs, contributing to the quantification and subsequent qualification of a territorial planning instrument, is fundamental to assist in practical advances toward urban sustainable development.

Thus, the methodology presented in this article aims to assist public officials in analyzing PDMs regarding the fulfillment of the SDGs of the 2030 Agenda. Directing the primary instrument of urban planning in Brazilian cities towards sustainable development ensures that these municipalities plan their infrastructure to have a positive impact on people's quality of life.

With the methodology presented here, these instruments can be improved, leading to significant advancements in urban sustainable development, positively impacting the lives of city dwellers. Finally, it is worth mentioning that the existence of legal provisions alone is not sufficient; practical actions that go beyond the theoretical realm are necessary. The provisions contained in the PDMs must be effectively executed, respecting the limits in the nature-society relationship during the socio-spatial formation process. Future analyses, in addition to this study, may include i) evaluating PDMs together with the Watershed Plan, Municipal Sanitation Plan, or other municipal management instruments (separately or jointly), assessing their tendency to meet the SDGs, thus forming a potential analysis of territorial governance; ii) evaluating the articulation between these instruments; iii) assessing the knowledge of public officials regarding the importance of SDGs for territorial planning; iv) cross-referencing indicators (economic, social, environmental, and cultural) of municipalities with the analysis of compliance with urban legislations concerning SDGs.

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