
**CHALLENGES FOR THE SUSTAINABLE DEVELOPMENT OF THE
SOUTHWESTERN MARANHÃO REGION IN THE EASTERN AMAZON**

DESAFIOS PARA O DESENVOLVIMENTO SUSTENTÁVEL DA REGIÃO SUDOESTE
MARANHENSE DA AMAZÔNIA ORIENTAL

DESAFÍOS PARA EL DESARROLLO SOSTENIBLE DE LA REGIÓN SUROESTE
MARANHENSE DE LA AMAZONIA ORIENTAL

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ABSTRACT

The definition of Metropolitan Regions (MR) as territorial units has been a strategy for integrating public policies of common interest in various municipal arrangements. This work seeks to understand the territorial dynamics, as well as the management activities adopted in the Metropolitan Region of Southwestern Maranhão (MRSM), in order to identify the potential and opportunities for strengthening the metropolization process and adopting contemporary and sustainable policies for the preservation of the studied ecotone. The cross-referencing of data indicated that there is still a gap between the administrative definitions and the actual dynamics and flow between the municipalities of the MRSM, which requires greater internal coordination to strengthen the influence of the central hub and sub-centralities in the other municipalities of the MR.

Keywords: Metropolitan Region of Southwest Maranhão; Eastern Amazon; Amazon and Cerrado Biome; Urbanization.

RESUMO

A definição de Regiões Metropolitanas (RM) como unidades territoriais tem sido uma estratégia para integração de políticas públicas de interesse comum em diversos arranjos de municípios. Este trabalho busca compreender as dinâmicas territoriais, assim como as atividades de gestão adotadas na Região Metropolitana do Sudoeste Maranhense (RMSM), a fim de identificar as potencialidades e oportunidades para o fortalecimento do processo de metropolização, e adoção de políticas contemporâneas e sustentáveis para preservação do ecótono estudado. O cruzamento de dados indicou que ainda existe uma distância entre as definições administrativas e as dinâmicas e fluxo reais entre os municípios da RMSM, que necessita de maior articulação interna para o fortalecimento da influência do polo e subcentralidades nos demais municípios da RM.

Palavras-chave: Região Metropolitana do Sudoeste Maranhense; Amazônia Oriental; Bioma Amazônico e do Cerrado; Urbanização.

RESUMEN

La definición de Regiones Metropolitanas (RM) como unidades territoriales ha sido una estrategia para la integración de políticas públicas de interés común en diversos arreglos de municipios. Este trabajo busca comprender las dinámicas territoriales, así como las actividades de gestión adoptadas en la Región Metropolitana del Sudoeste Maranhense (RMSM), con el fin de identificar las potencialidades y oportunidades para el fortalecimiento del proceso de metropolización, y la adopción de políticas contemporáneas y sostenibles para la preservación del ecotono estudiado. El cruce de datos indicó que aún existe una distancia entre las definiciones administrativas y las dinámicas y flujos reales entre los municipios de la RMSM, lo que requiere una mayor articulación interna para fortalecer la influencia del polo y subcentralidades en los demás municipios de la RM.

Palabras clave: Región Metropolitana del Sudoeste Maranhense; Amazonía Oriental; Bioma Amazónico y del Cerrado; Urbanización.

1 - Introduction

Metropolitan Regions (MRs) are spaces of innovation and entrepreneurship, where a large number of assets and job opportunities are concentrated (Silva Costa, 2020), becoming important commercial, industrial, and service centers in the region (Silva; Clementino, 2019). They consist of a grouping of neighboring municipalities that, in turn, assume significant national importance due to their high population density, significant conurbation, high degree

of diversity, service specialization, and vast opportunities for socioeconomic interaction (Guimarães, 2004; Sousa et al., 2023).

According to Gouvêa (2005), the metropolitanization process in Brazil occurs simultaneously with the concentration of industrial activities, due to market opportunities and the migratory flow toward major urban centers. This usually results in the expansion of the central core and the incorporation of peripheral areas. Thus, the Metropolitan Region becomes an area polarized by a central city that economically and functionally organizes the nearby peripheral localities (Carmo, 2019).

The main objective for the creation of Metropolitan Regions as territorial units is the integration of public policies of common interest through coordinated action in the political-administrative sphere (Brasil, 2015). In Brazil, the 1988 Constitution and the Metropolis Statute (Law 13.089/2015) transferred the authority to establish Metropolitan Regions from the federal government to the states, with the aim of integrating the organization, planning, and execution of public functions of common interest. After this constitutional change, the states acquired the legal prerogative to create MRs, resulting in a significant increase in the number of these territorial divisions in the country.

With the constitutional change, a kind of "metropolitan paradox" was forged, as the significant increase in the number of MRs does not necessarily correspond to actual metropolitan spaces (Santos; Amaral, 2021). The recognition of a Metropolitan Region through legal instruments allows development and more efficient urban challenge management due to the integration of municipal arrangements (Santos et al., 2023). However, although these territorial units are programmatically defined to primarily meet political-administrative objectives (Moura; Firkowski, 2001) they often become merely a process of institutional metropolitanization (Costa et al., 2018). Moreover, the expectation of access to additional resources for regional public policies that these territorial units should receive does not always materialize in practice (Souza, 2003).

Although many Metropolitan Regions in Brazil comply with the existing legal-political provisions, there is often a significant gap between the "the theory" and the actual institutional practice, given that in some of these regions there is neither spontaneous metropolitanization nor political articulation or integrated planning among the municipalities. In the Western Amazon region, the term "Paper Metropolis" had already been created by researchers, who

identified urban centers of institutionalized Metropolitan Regions that do not exhibit the functionalities of a metropolis, such as political-economic and social influences, as well as the flow of information, capital, and people (Santos et al., 2023).

According to IBGE (2023), the agency responsible for institutionalizing municipal arrangements, there are three Metropolitan Regions in the state of Maranhão, which is part of the Eastern Amazon: the Southwestern Maranhão Metropolitan Region, composed of 22 municipalities; the Greater São Luís Region with 13 municipalities; and the Eastern Maranhão Zone Region with 8 municipalities.

The Southwestern Maranhão Metropolitan Region (SMMR), which is the focus of this work, was created by State Complementary Law No. 89 in 2005 (Brasil, 2005) and restructured by State Complementary Law No. 204 in 2017 (Brasil, 2017). It has an Integrated Development Plan for the Southwestern Maranhão Metropolitan Region (PDDI/RMSM) created through Provisional Measure No. 255 of October 27, 2017, implemented through the Southwestern Maranhão Metropolitan Executive Agency (AGEMSUL).

Located in an area of high environmental relevance, in the transition zone between the Cerrado and Amazon biomes, the municipality of Imperatriz serves as its central hub, coordinating the surrounding municipalities. The SMMR plays an important role in southern Maranhão, with strong influence from the regional metropolises of Belém (PA) and São Luís (MA), but it also has strong connections with other regional centers in the Eastern Amazon, in adjacent states like Marabá in Pará and Araguaína in Tocantins (Santos; Amaral, 2021).

In this context, the present article aims to characterize the metropolitanization process in the SMMR to advance the discussion on strategies for the region's development. The unique environmental and social issues present in the SMMR, particularly due to its location in significant biomes like the Cerrado and Amazon, underscore the importance of considering contemporary and sustainable strategies for the growth of the Metropolitan Region. Additionally, since this region is still in the process of consolidating metropolitanization—considering that today the municipality of Imperatriz is regarded as a medium-level hub rather than a metropolis—it is still possible to design effective strategies to address the characteristic imbalances of traditional metropolitanization.

Imperatriz, the region's hub city, is characterized according to the IBGE's study on Regions of Influence of as a "Regional Capital," in the subcategory "Regional Capital B" (Cordeiro, 2019). The regional capital has management capacity at a level immediately below that of metropolises, with an area of influence at the regional level, being referred to as a destination for a range of activities by many municipalities. In the SMMR, the articulation between municipalities in terms of conurbation is almost nonexistent. What exists is a process of polarization of Imperatriz over smaller cities and the surrounding regional sub-centers, which, therefore, function as medium-sized cities (Santos; Amaral, 2021). According to the Metropolis Statute, "a metropolis is an urban space with territorial continuity that, due to its population and political and socioeconomic relevance, has national influence or influence over a region that constitutes at least the area of influence of a regional capital, according to the criteria adopted by the Brazilian Institute of Geography and Statistics Foundation" (Brasil, 2015).

The traditional metropolitanization scenario, without the strengthening of multiple sub-polarities, further drives the spread of the urban fabric, leading to environmental degradation and a reduction in the provision of ecosystem services; intensifying urban mobility problems, and consequently increasing emissions, as well as climate-related issues. Therefore, it is important to promote macrospatial decentralization strategies for economic activities by strengthening sub-regional hubs (Magalhães, 2010). Contemporary alternatives must be considered to address the various challenges these urban arrangements present, particularly regarding low quality of life, social exclusion, informality, insecurity, urban mobility problems, irregular land occupation, lack of basic sanitation and water management, low air quality, urban heat islands, among others.

To this end, this work aimed to characterize the flows and territorial dynamics of the SMMR, seeking to understand the interactions between the municipalities in the region, thereby describing the socioeconomic, environmental, and urban realities. Furthermore, this work seeks to evaluate the management actions, including those implemented by AGEMSUL - Southwestern Maranhão Metropolitan Executive Agency.

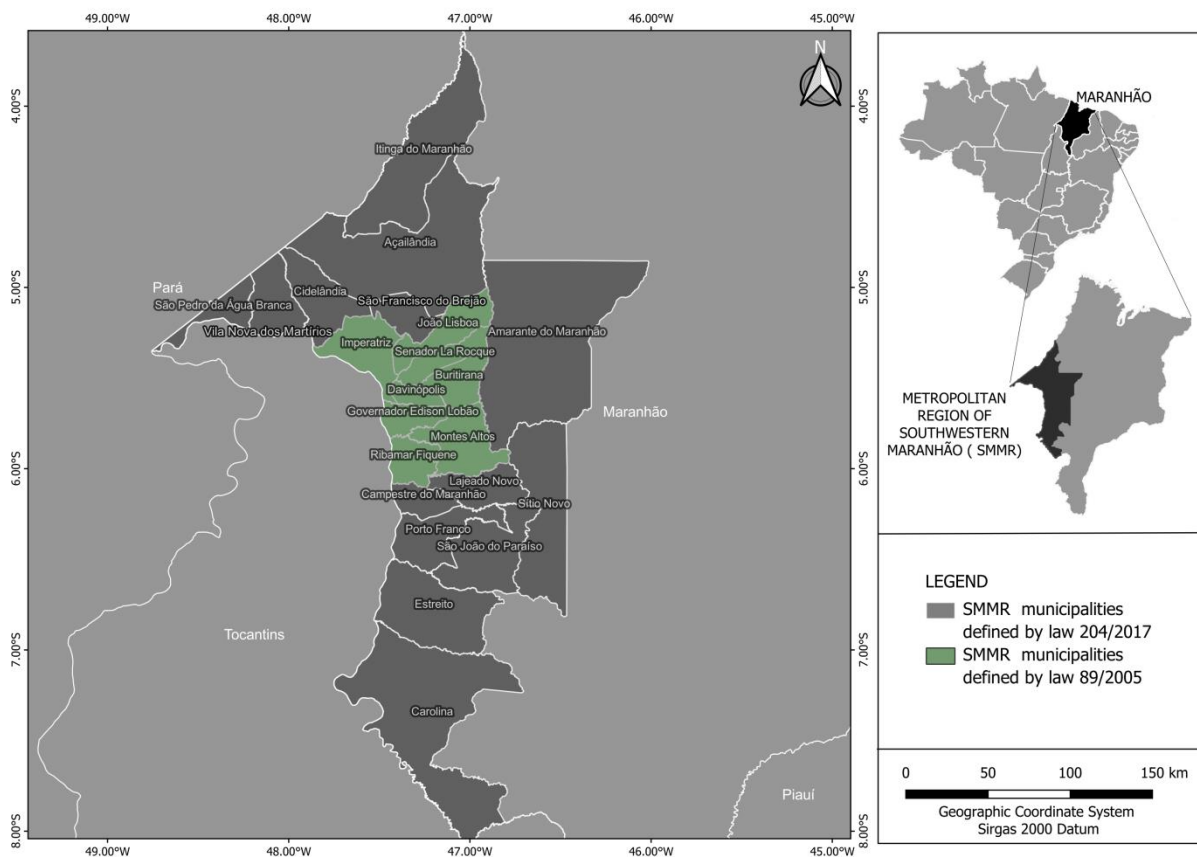
2 - Study Area: Southwestern Maranhão Metropolitan Region – SMMR

Initially created with eight municipalities by State Complementary Law No. 89 of 2005, the SMMR had a population of 325,299 (IBGE, 2008). In 2017, the region was restructured by State Complementary Law No. 204, expanding it to 22 (twenty-two) municipalities with a

population of 714,266, which corresponds to 9.7% of the population of the State of Maranhão (IBGE, 2023).

Currently, the SMMR is composed of the following municipalities: Açailândia, Amarante do Maranhão, Buritirana, Campestre do Maranhão, Carolina, Cidelândia, Davinópolis, Estreito, Governador Edison Lobão, Imperatriz, Itinga do Maranhão, João Lisboa, Lajeado Novo, Montes Altos, Porto Franco, Ribamar Fiquene, São Francisco do Brejão, São João do Paraíso, São Pedro da Água Branca, Senador La Rocque, Sítio Novo, and Vila Nova dos Martírios. The SMMR now covers an area of 45,434 km², which is equivalent to 33.1% of Maranhão's territory (Figure 1).

Figure 1. Location map of the study area of the Southwest Maranhão Metropolitan Region.



Source: Authors (2024).

The urbanized area of the SMMR corresponds to 184.88 km², or 0.40% of the total area of the municipalities. The municipalities in this region have an average low gross population density of 22 inhabitants/km². It is important to note that according to the 2010 Census, the 22 municipalities of the region had a population of 689,375, meaning that between 2010 and 2023,

there was a population growth of 3.64%, a low population dynamic for the period, considering that between 2000 and 2010, the region's growth was 12.8% (IBGE, 2020).

The occupation dates back to the 16th and 17th centuries, with Imperatriz being the hub city of the SMMR, created in 1856 and becoming a city only in 1924. Due to its isolation, it was known for decades as the Siberia of Maranhão, but in the mid-1950s, with the beginning of the construction of the Belém-Brasília highway, Imperatriz experienced accelerated growth.

The main economic cycles of Imperatriz were: the Rice Cycle (from 1950 until the early 1980s); the Wood Cycle (1970 to 1980), the Gold Cycle (in the 1980s - 1990s), when Imperatriz became the supply hub for the Serra Pelada gold mine, and in the 2000s, with industrialization. From the 2000s onward, new economic dynamics have been explored, focused on boosting agriculture, with strong connections in the area of confluence between Pará and Tocantins. These dynamics resulted in territorial articulation, migratory dynamics, demographic and economic expansion, urbanization growth, culminating in the establishment of Imperatriz as the central hub of Southwestern Maranhão (Santos; Amaral, 2021).

Characterization of Landscape Changes in the SMMR

Analyzing landscape dynamics allows for understanding the modifications in land use and land cover by humans, as well as identifying urban sprawl processes to detect potential conurbation, which is a key requirement for characterizing metropolitanization processes. The MAPBIOMAS project consists of a collaborative network that provides annual land use and land cover data for the entire territory of Brazil, generated through satellite image classification. These maps are generated in raster format (30x30 m) using images from the Landsat sensor, with an accuracy of 80% for scales of 1:100,000, making it ideal for regional studies (Mapbiomas, 2022).

This study analyzed the land use and land cover maps provided by version 8.0 of the MAPBIOMAS project. A time series analysis of land use and land cover maps was conducted for the years 2010, 2017, and 2022. These files were compiled into a Geographic Information System, and the areas of each landscape class were calculated using QGIS 3.22 software.

Characterization of Flow Dynamics and Integration Among SMMR Municipalities

The second stage involved characterizing the municipalities in the SMMR based on their degree of urbanization, level of specialization, and socioeconomic integration. For this purpose,

various secondary data provided by free Brazilian databases were integrated into a Geographic Information System (GIS) using QGIS 3.22 software. These databases included alphanumeric data from IBGE, IPEA, ANATEL, and the INDE - National Spatial Data Infrastructure database. To characterize the central city and sub-centralities within the SMMR, the following data were spatialized: Degree of urbanization, Average Household Income, Internet Coverage, Number of Trade and Service Establishments registered with Simples Nacional, and Number of Commercial Establishments.

Characterization of Metropolitan Management of the SMMR

This analysis aims to assess the level of consolidation of the SMMR through a set of descriptors by analyzing territorial issues and management guidelines to understand the stage of the metropolitanization process (Board 1). This set of descriptors is expected to provide insight into the development level of the RMSM, as well as highlight the main challenges for strengthening sustainable development within the RMSM.

Board 1. Structure for characterizing metropolis, metropolitan region and metropolitan area.

Metropolis (M)	Metropolitan Region (MR)	Metropolitan Area (MA)
Analysis of territorial continuity	Regional unit within the state	Representation of the continuous expansion of the metropolis's urban fabric
Demographics (Population)	Relevant legislation	Conurbation through the integration of road systems
Political Relevance	Analysis of the grouping of neighboring municipalities	Conurbation through residential integration
Social Relevance	Planning actions	Conurbation through service and industrial sectors
Economic Relevance	Adoption and execution of relevant public functions	Conurbation through the presence of commuting within the territory
Degree of national or regional influence	Analysis of common interest	
Degree of Influence on the Regional Capital	Integrated Urban Development Plan	

Source: Authors (2024).

The article seeks, in a way, to continue the work carried out by Santos & Amaral (2021), considering the analysis in the Metropolitan Regions of Eastern Amazonia. The proposal is

complemented by a strategic analysis focusing on the planned objectives of the Executive Metropolitan Agency of Southwest Maranhão – AGEMSUL.

Analysis of the landscape dynamics of the SMMR

To gain a better understanding of the results, a characterization of the eight (8) municipalities of the SMMR based on the 2000 census and the 22 (twenty-two) based on the 2010 census was conducted. Land use and land cover were also characterized through the analysis of maps from the Mapbiomas collection for the years 2010, 2017, and 2022, using QGIS software, version 3.22. The landscape dynamics were assessed based on the image classifications of the Mapbiomas 8.0 collection maps. In total, 15 landscape classes were identified during the evaluated years (Table 1).

Table 1 – Area of Mapbiomas landscape classes in the years 2010, 2017 and 2022.

Class	2010 Area (ha)	2017 Area (ha)	2022 Area (ha)	Balance
Forest Formation	1,353,014.50	1,330,165.92	1,310,695.28	1,46%
Savanna Formation	981,943.98	815,953.43	768,444.51	21,74%
Flooded Forest	154.12	157.90	159.01	0,70%
Silviculture	56,310.36	68,921.79	75,607.87	34,26%
Flooded Field	11,647.22	13,085.19	12,005.33	8,25%
Grassland Formation	113,060.07	111,988.00	1,102,266.93	874,93%
Pasture	1,880,026.16	1,976,254.10	1,960,108.53	4,25%.
Land Use Mosaic	83,297.57	45,181.61	94,090.10	12,95%
Urbanized Area	15,335.09	14,263.24	15,335.09	32,17%.
Other Non-Vegeted Areas	6,394.14	7,953.65	9,370.28	17,81%
Rock Outcrop	1,354.61	1,354.11	1,353.36	0,055%
Water Bodies	20,979.03	33,359.26	34,449.26	3,26%
Sugar Cane	---	---	1.88	---
Soybeans	19,495.81	77,546.47	124,638.63	539,39%
Other Temporary Crops	7,046.27	50,134.83	29,788.81	322,75%

Source: Authors (2024).

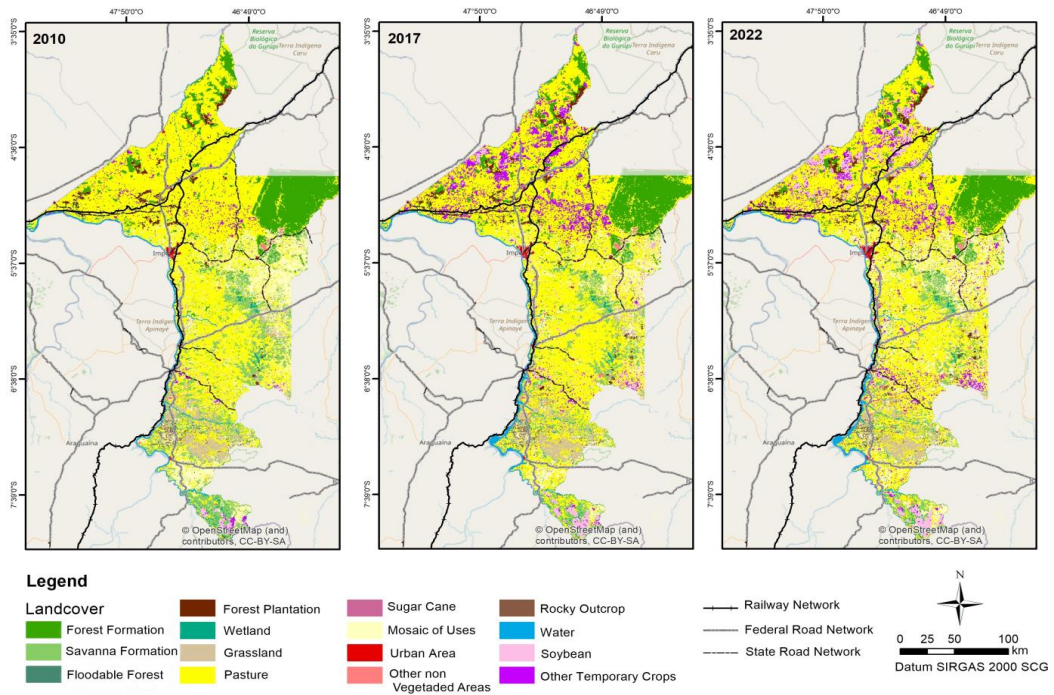
Throughout the historical series analyzed, a reduction in forest remnants was observed, but primarily in the Savanna Formation, with a reduction of 21.74% between 2010 and 2022. The

Forest Formation class, corresponding to the Amazon Forest, remained practically unchanged, with a reduction of only 42,319.22 hectares. It is also noted that there was a significant increase in Grassland Formations, which may indicate the transformation of the shrub portion of the Cerrado into fields. Grassland Formations increased by 874.93% during the evaluation period. Pasture areas remained stable, with a small increase of 80,083.37 hectares between 2010 and 2022, representing a 4.25% increase. However, it is possible that these open fields mentioned above are also being used for pastures. Still considering agricultural activities during this period, there was a 539.39% increase in Soybean activities, a 34.26% increase in Silviculture crops, and a 12.95% increase in Mosaic of Use, which refers to various crops. Temporary Crops increased by 43,088.56 hectares between 2010 and 2017, followed by a reduction of 20,346.02 hectares by 2022. Overall, the period evaluated saw an increase of 322.75% between 2010 and 2022. Another crop that appeared in the area in 2022 was Sugarcane planting.

Regarding urbanized areas, a small increase of 3,732.89 hectares was recorded, corresponding to a 32.17% growth. This scenario shows that the SMMR experienced a significant boost in agricultural activities, but urban growth did not keep pace with this expansion, particularly in terms of urban sprawl. The low representation of urban areas in the SMMR and the great relevance of agriculture are evident. Alarming issues such as the reduction of Savanna Formations and the increase in Grassland Formations indicate that there is indeed a pronounced level of vegetation removal, turning wooded areas into fields and promoting livestock farming.

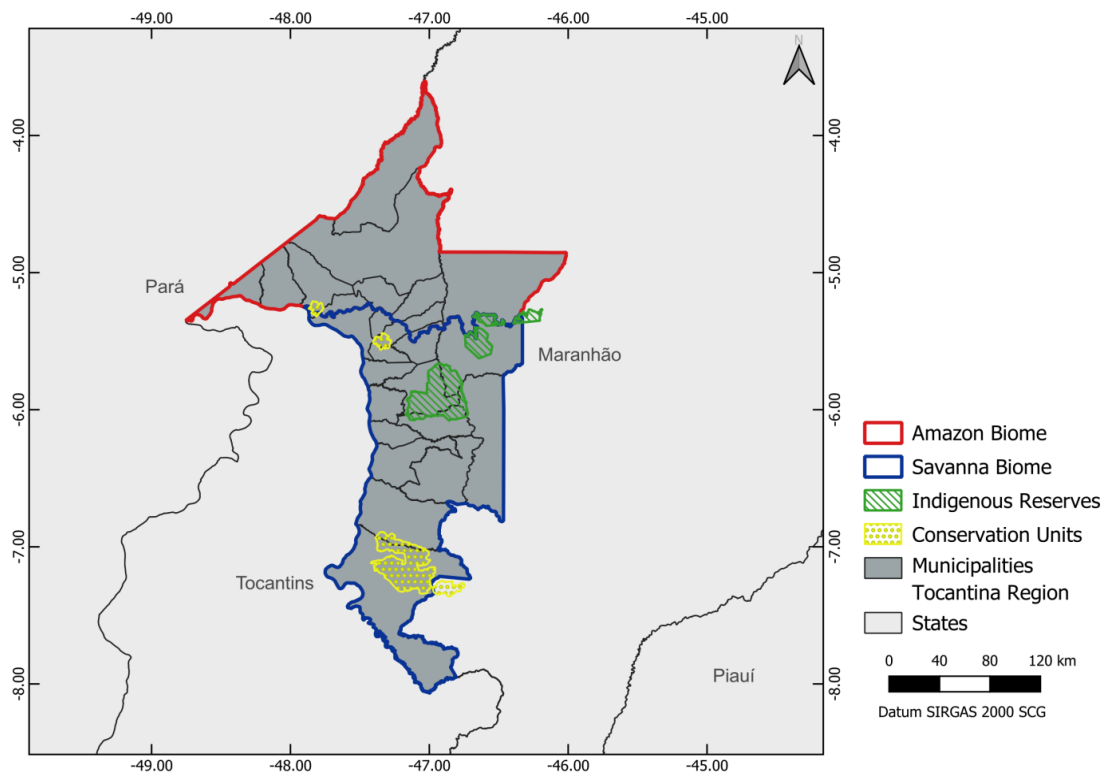
Land use and land cover mapping show the high prevalence of Pastures throughout the SMMR, as well as the limited urban patches (Figure 2). There are no significant processes of urban conurbation in any location. It is also observed that, particularly in the northern part of the SMMR, agricultural activities strengthened after 2017, while in the south, Pasture activities increased, and there was a significant reduction in Savanna Formations, which consist of the shrub species of the Cerrado. The Forest Formations in the SMMR remained practically stable because they are mostly located within Indigenous Areas in Amarante do Maranhão, in the northeast of the SMMR. Similarly, in the central portion, where preserved Savanna Formation still appears, it is largely located in the Indigenous Reserve in the municipalities of Montes Altos and Ribamar Fiquene. Vegetation also remained more intact in the Conservation Units (UCs) of the Metropolitan Region (Figure 3).

Figure 2. Map of land use and coverage of the SMMR in the years 2010, 2017 and 2022.



Source: Authors (2024).

Figure 3. Thematic map representing Conservation Units and Indigenous Areas in the SMMR.

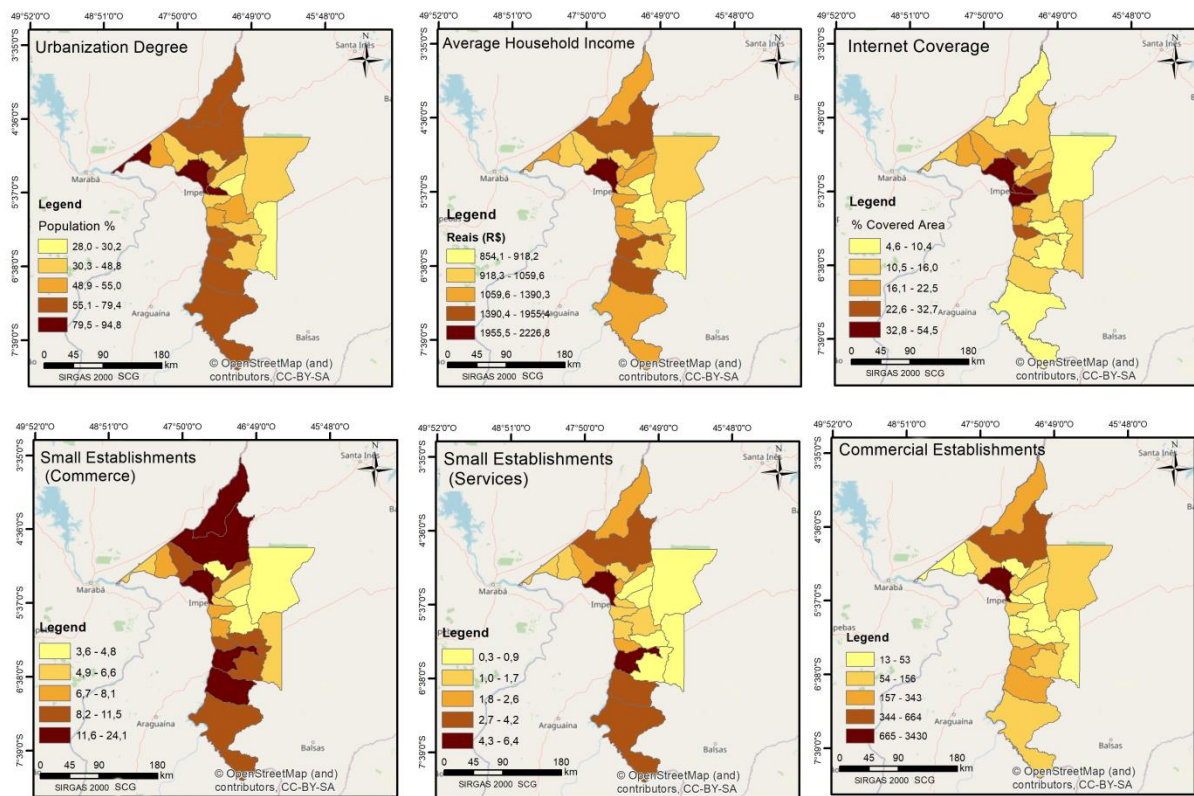


Source: Authors (2024).

Characterization of hubs and flow dynamics

Overall, Imperatriz stands out as the main hub city, with a higher level of specialization, urbanization, and income. However, other sub-centralities can be observed, mainly in the extreme north and south of the SMMR. Additionally, the municipalities in the east show lower levels of urban development and interaction, suggesting that the main drivers of development may not come from the state of Maranhão but possibly from Pará and Tocantins. Since the sub-centralities are located far from Imperatriz, this may indicate that Imperatriz's polarization power is not fully consolidated (Figure 4).

Figure 4. Descriptors of the level of specialization and urbanization of the SMMR.



Source: IPEA, ANATEL, IBGE.

Analyzing the Degree of Urbanization of the RMSM, it can be seen that, in the surroundings of the hub city of Imperatriz, the municipalities have less than 50% of the population living in rural areas, except for Divinópolis, which is located nearby. This strengthens the indication of Imperatriz's low degree of polarization in its immediate surroundings in terms of urbanization. The most urbanized municipalities are Imperatriz, Davinópolis, and São Pedro de Água Branca,

followed by the municipalities northwest of Açailândia and Itinga do Maranhão, and to the south Porto Franco, Estreito, and Carolina.

The map of Average Household Income indicates Imperatriz as the best-ranked hub city, followed by Açailândia to the north, and the municipalities of Estreito and Porto Franco to the south. The Internet Coverage map, which describes immaterial flows, defined as virtual information exchanges stemming from globalization processes that articulate and organize the territory, as well as part of material flows, shows that Imperatriz is able to polarize mainly two surrounding municipalities: Governador Edson Lobão and Davinópolis. It also shows low internet coverage in the RMSM, indicating a low degree of globalization, which tends to suggest low levels of territorial specialization and a high level of rurality in the region.

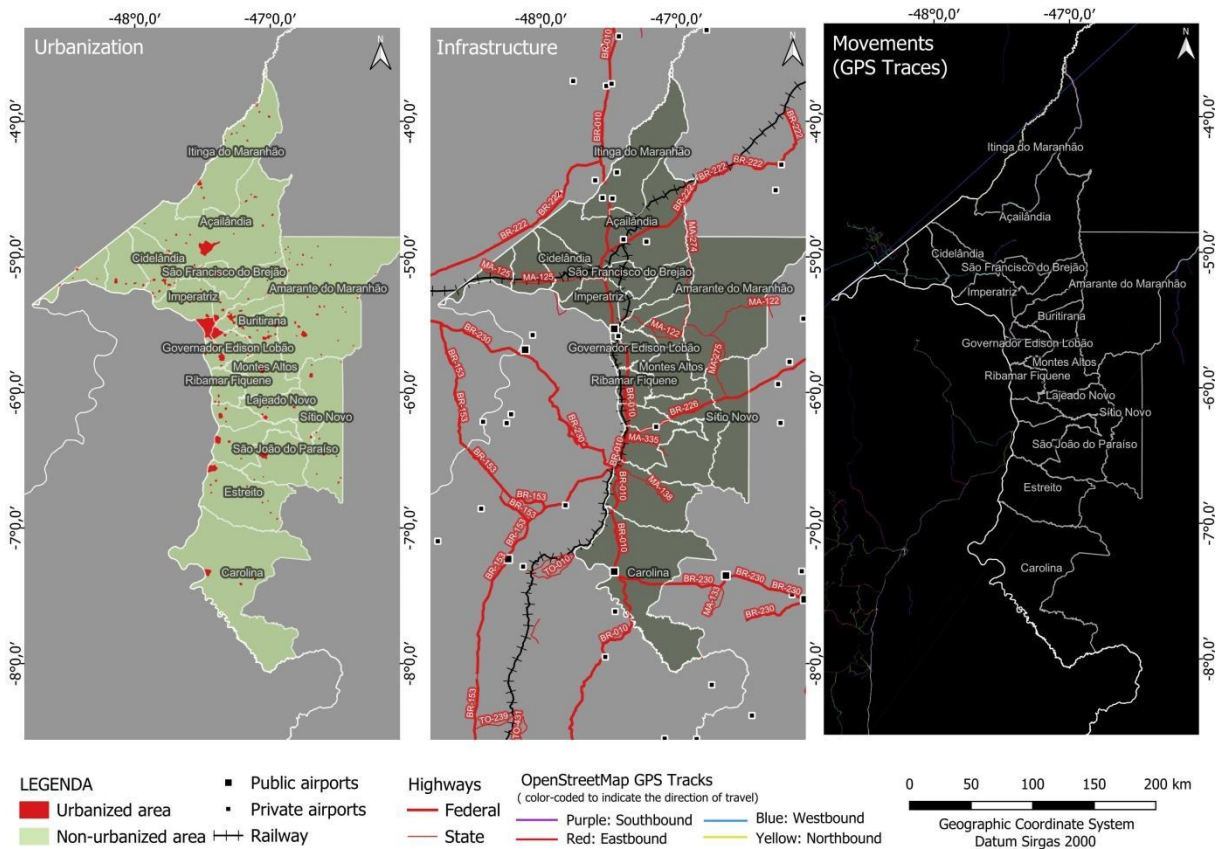
The number of commercial establishments indicates that the largest ones are mainly located in Imperatriz, and secondly in Açailândia. Meanwhile, smaller commercial establishments registered in the Simples Nacional system, such as individual micro-entrepreneurs (MEI) and microenterprises, are more widely distributed across the territory. Even so, the municipalities with the highest prominence are Imperatriz, Açailândia, Estreito, and Porto Franco. Finally, service establishments linked to the Simples Nacional system are more concentrated in Imperatriz and Porto Franco, followed by Açailândia, Estreito, and Carolina.

According to Santos & Amaral (2021), in their study on the Metropolitan Regions in Eastern Amazonia, the main drivers of SMMR development are local wholesale and retail groups, as well as agribusiness, aligning with the scenario found in this study. Wholesale groups are mainly located in Imperatriz, while small and medium-sized trade and service companies are more diffusely distributed throughout the SMMR, with strong representation not only in the hub city but also in sub-centralities. The strength of agribusiness in the region can be observed in the land use and land cover maps, where pastures, and mainly crops to the north, exert significant influence on the territory.

Flow dynamics were analyzed through the intersection of data from major highways, GPS traffic volume, and the urban and rural perimeters of SMMR municipalities (Figure 5). The disconnection between urban perimeters is evident, supporting the land use maps that indicate the lack of conurbation between the municipalities of the SMMR. Small, scattered urban centers with little or no degree of conurbation can be observed, as already indicated in the study by

Santos; Amaral (2021). There is a trend towards conurbation between Imperatriz and Davinópolis, but it is still in the process of consolidation.

Figure 5. Map with urban and rural perimeters (a), main highways (b) and main traffic volumes via GPS (c) of the municipalities of the SMMR.



Source: IBGE, DNIT and Openstreetmap tracks.

The BR-010 is the main north-south axis connecting most urban centers. However, the BR-010 does not appear as one of the roads with the highest vehicle traffic, indicating low integration between the municipalities of the SMMR. The main vehicle flows in the SMMR are in an arc connecting Imperatriz to the municipalities of Davinópolis and Governador Edson Lobão, indicating the polarizing power that the hub city exerts over the surrounding municipalities. However, it is clear that the other sub-centers in the RMSM show little influence from Imperatriz.

Açailândia, an important sub-center to the north, is supplied by a flow from the state highway MA-125, indicating that the integration axis with Pará is stronger than with Imperatriz. To the south, a similar process occurs, with the main sub-center being Porto Franco, which has a high

level of integration with Tocantins rather than Imperatriz. Santos; Amaral (2021) noted in their study the weak pendular movements in the SMMR, highlighting once again the need for greater internal integration and articulation to consolidate the metropolitanization process.

Analysis of the Management of the Metropolitan Region of Southwest Maranhão

The Statute of the Metropolis, Federal Law No. (13.089/15), mandates that all Brazilian metropolitan regions and urban agglomerations develop their Integrated Urban Development Plans (PDUIs). This is a legal instrument that establishes a series of guidelines regarding public functions of common interest and priority actions for strategic territorial development and the creation of structuring projects. It is, therefore, an important tool to consolidate the metropolitanization process and strengthen internal flow dynamics and growth guidelines.

AGEMSUL is an autonomous entity created in 2017 with the purpose of integrating and organizing the planning and execution of public functions of common interest in the SMMR. This body is responsible for creating the Integrated Urban Development Plan (PDUIs), but six (6) years after its creation, it still does not have the full PDUIs, highlighting the fragility of SMMR management.

The Integrated Urban Development Plan addresses metropolitan issues that go beyond municipal boundaries, requiring an articulated approach and interfederal management. It addresses issues such as urban sprawl, land use changes, the management of informal settlements, risk areas, mobility, and the development of normative instruments that promote territorial regulation. It also provides for the creation of a macrozoning plan for the territorial organization of RM municipalities, integrating their Master Plans.

The Metropolitan Region of Southwest Maranhão

The metropolis headquarters, Imperatriz, was founded in 1852 and has three key macro periods of importance: the period of centrality of dynamics along the Tocantins River; the period of expansion of primary activities, including rice, livestock, gold, and timber; and the period of construction of the Belém-Brasília highway, which brought regional integration (Santos; Amaral, 2021). In 2005, the Metropolitan Region of Southwest Maranhão was created by State Complementary Law No. 89 of 2005, initially with eight municipalities and a population of 325,299 (IBGE, 2000). In 2017, the region was restructured by State Complementary Law No. 204, expanding to 22 municipalities with an area of 45,434 km², equivalent to 33.1% of

Maranhão's territory. According to IBGE (2020), the urbanized area corresponds to 184.88 km², or 0.40% of the total area of the municipalities. The municipalities that make up this region have a population density of 22 inhabitants/km², considering rural, urban, and natural areas.

Based on the population dynamics of the region, the 2023 IBGE Census shows that the RMSM represents 9.7% of the population of Maranhão, or 714,266 people (IBGE, 2023). It is important to note that, according to the 2010 Census, the 22 municipalities of the region had 689,375 inhabitants, meaning that between 2010 and 2023, the population grew by 3.64%. This represents low population growth for the period, especially considering that between 2000 and 2010, the region's growth was 12.8%.

The RMSM can be considered a regional unit within the state of Maranhão. The state government is technically and financially responsible for its management through AGEMSUL, based on the legal framework that provides general guidelines for its planning, management, and execution (Board 2).

Board 2. Characteristics of the Metropolitan Region of Southwest Maranhão.

M e t r o p o l i t a n R e g i o n	Fundamental Concepts	Characteristics of the Southwest Maranhão Metropolitan Region
	Regional unit within the state	Southwest Maranhão Metropolitan Region
	Relevant Legislation	State Complementary Law No. 89 of 2005 with eight municipalities and a population of 325,299 according to IBGE, based on the 2000 Census and reformulated by State Complementary Law No. 204 of 2017, 2010 census and population of 689,375 (MARANHÃO, 2005, 2017).
	Analysis of the grouping of bordering municipalities	Geographically, the headquarters of the Metropolis is located in Imperatriz (Regional Capital C). Another 21 municipalities are also part of the RMSM. The intermediate and immediate region according to IBGE is Imperatriz. The mesoregion is the Western Maranhão and the microregion is considered to be Imperatriz.
Planning Actions	The Region has AGEMSUL – Metropolitan Executive Agency of the Southwest of Maranhão, headquartered in Imperatriz. It was created by Provisional Measure No. 255, of October 27, 2017.	

	Adoption and execution of relevant public functions	The objective of AGEMSUL is to coordinate with the twenty-two municipalities in compliance with the PDDI, Integrated Development Master Plan.
	Analysis of common interest	Interinstitutional integration is carried out through a Council composed of twenty-two mayors of the Region.
	Integrated Urban Development Plan	The Integrated Urban Development Plan of the RMSM is an instrument that establishes, based on a permanent process of planning, economic-financial viability and management, the guidelines for strategic territorial development and structuring projects for the metropolitan region and urban agglomeration. This has not yet been fully implemented for the metropolitan region.

Source: Authors (2024).

Among the challenges for the RMSM is the establishment of the Integrated Urban Development Plan (PDUI), which, according to Article 12, § 1 of the Statute of the Metropolis (EM), must set out a series of guidelines regarding public functions of common interest, strategic projects, and priority actions for investments in the 22 municipalities of the region. It is also essential to implement macrozoning of the urban territorial unit, which should promote the implementation and revision of Master Plans in the region's municipalities.

It is important to highlight the need to establish guidelines for the coordination of municipalities in the subdivision, use, and occupation of urban land, as well as the intersectoral coordination of public policies in the urban territorial unit (Master Plans). Given that this is one of the regions that has experienced significant changes in land use and occupation, the delimitation of areas with restrictions on urbanization to protect environmental or cultural heritage, as well as areas subject to special control due to the risk of natural disasters, is necessary. This is especially relevant with the creation of Protected Areas, both for Full Protection and for Sustainable Use.

The Metropolis of Southwest Maranhão

In 2015, the Southwest Maranhão Metropolis became part of the set of 32 metropolitan areas and Integrated Region for Sustainable Development (IRSD) in the Northeast through the enactment of Law No. 13.089, known as the Statute of the Metropolis. The law, through its

institutional framework, brought the necessary capacity for the governance and management of metropolises, particularly due to the ineffectiveness of existing urban legislation at that time.

The Statute of the Metropolis defines a metropolis as:

"[...] an urban area with territorial continuity that, due to its population and political and socioeconomic relevance, has national influence or over a region that constitutes at least the area of influence of a regional capital, according to the criteria adopted by the Brazilian Institute of Geography and Statistics (IBGE)" (Ibid., section V).

Peres et al. (2018) evaluate this classification based on the area of influence of a single municipality over the region in which it is located. However, the Statute seeks to apply this definition to an "urban space with territorial continuity," without clearly defining what territorial continuity is. In this sense, the present analysis aims to assess whether these criteria can be applied to the Southwest Maranhão metropolis, using the criteria adjusted in the proposed method (Board 3).

Board 3. Conceptual analysis of the Southwest Maranhão Metropolis.

	Conceptual Analysis of the Southwest Maranhão Metropolis	Characteristics of the Southwest Maranhão Metropolis
ME TR OP OLI S	Analysis of Territorial Continuity	Overall, the 22 municipalities that make up the Southwest Maranhão metropolis do not have territorial continuity within their urban network. There is no evident process of conurbation between the municipalities in the region. Imperatriz serves as the gravitational center of the area.
	Demographics (Population)	The population of the metropolis in 2023 (IBGE, 2023) is 714,256 inhabitants. Imperatriz accounts for 38.2% of the population. Fourteen municipalities in the metropolis have fewer than 20,000 inhabitants, with five having a population of less than 10,000. The highest population density is in Imperatriz, with 199.5 inhabitants/km ² , and the lowest is in the municipality of Carolina, with 3.84 inhabitants/km ² .

	Political Relevance	As the second-largest municipality in Maranhão, Imperatriz has gained direct influence in political decisions, as it has the second-largest electoral base in the state.
	Social Relevance	Being the second-largest city in the state, the metropolis holds strategic importance due to its location. It is 467 km from Belém (PA), 479 km from São Luís (MA), 535 km from Palmas (TO), and 522 km from Teresina (PI). Imperatriz is a university hub, with four public higher education institutions. Seven municipalities in the metropolis have a low Human Development Index (HDI), fifteen have a medium HDI, and only one has a high HDI. In 2010, 47% of the working population across the 22 municipalities had a per capita monthly income of ½ minimum wage (1 minimum wage = R\$ 1,302.00 as of 12/08/2023). The average salary of workers in the region is 1.9 minimum wages (IBGE, 2021).
	Economic Relevance	Imperatriz, the headquarters of the metropolis, is the second-largest municipality in Maranhão and has the second-largest GDP in the state. The municipality has an industrial hub, particularly in the furniture, metal-mechanical, food, and construction sectors, with the Suzano paper and pulp industry contributing around R\$17 million annually. The average per capita GDP in the region is around R\$14,252.00 (IBGE, 2020).
	Degree of National or Regional Influence	It can be considered a Regional Capital B, characterized as an urban center with concentrated management activities on a regional scale. Its influence and attractiveness are particularly noted in the trade of goods and services compared to other metropolises.
	Degree of Influence in the Regional Capital	The Southwest Maranhão metropolis "commands" a small group of regional centers and their areas of influence.

Source: Authors (2024).

The Metropolitan Area of Southwest Maranhão

A metropolitan area is characterized as an urban center where socioeconomic development activities are concentrated, leading to high housing demand. These areas have socioeconomic flows based on interactions related to work, healthcare, education, and the acquisition of goods

and services. The metropolitan area of Southwest Maranhão has a strategic location, serving as a hub between the states of Pará, Maranhão, and Tocantins. Being an area of settlement dating back to the 16th and 17th centuries, Vila Nova de Imperatriz was established in 1856, becoming a city only in 1924. Due to its isolation, it was known for decades as the "Siberia of Maranhão." Only in 1958, with the beginning of construction on the Belém-Brasília highway, did Imperatriz experience accelerated growth, especially during its most important economic cycles: rice (from 1950 to the early 1980s); the timber cycle (1970 to 1980), the gold cycle (in the 1980s-1990s), when Imperatriz became a supply hub for the Serra Pelada gold mine, and in the 2000s with industrialization. Currently, the region is also an area of agricultural frontier expansion and drives development in Western Maranhão, along with the expansion of the real estate sector. It is evident that despite the entire historical process of building the metropolitan area of Southwest Maranhão, there are still enormous challenges for its effective construction (Board 4), as it remains an isolated region not only within Maranhão but also within Brazil.

Board 4. Characteristics of the Metropolitan Area of Southwest Maranhão.

	Conceptual Analysis of the Southwest Maranhão Metropolitan Area	Characteristics of the Southwest Maranhão Metropolitan Area
M E T R O P O L I T A N A R E A	Representation of the Continuous Expansion of the Urban Network of the Metropolis	The Southwest Maranhão metropolitan area is not characterized by a continuous urban network among all 22 municipalities. The primary conurbation occurs only between the municipalities of Imperatriz and João Lisboa. The urban cores have a limited area of occupation, as 14 municipalities have up to 5.18 km ² . The largest urbanized area is the municipality of Imperatriz, with 65.8 km ² .
	Conurbation between Municipalities via Road Systems	The degree of conurbation via the road system occurs between the municipalities of Imperatriz and João Lisboa through the metropolitan bus system. The main connecting road in the region is the BR-010, along with MA-122, MA-222, and MA-280.
	Main Residential Areas	The municipalities of Imperatriz and Açailândia stand out with the largest resident populations. However, there are no

		conurbated corridors of roads and avenues between the municipalities.
	Conurbation by Service and Industrial Sectors	No visible conurbation occurs through service and industrial sectors. Imperatriz and Açailândia are the main municipalities in the metropolitan area, responsible for meeting the demand in areas such as healthcare and higher education, for instance.
	Main Commuter Movements in the Territory	Commuter migration mainly involves workers and higher education students who live in smaller municipalities. These movements occur between smaller neighboring municipalities and larger ones, such as Imperatriz and Açailândia.

Source: Authors (2024).

Since the 2000s, new economic dynamics have shaped this part of Southwest Maranhão, linked to the confluence of Pará and Tocantins. These dynamics have led to territorial articulation, migratory patterns, demographic and economic expansion, an increase in urbanization rates, and the establishment of Imperatriz as the central hub of the region (Santos; Amaral, 2021; Ferreira et al., 2024).

However, it is important to note that the metropolitan area of Southwest Maranhão remains dispersed, with small urban centers and little to no conurbation between most municipalities. The commercial and service sectors are concentrated in Imperatriz and Açailândia, with limited commuter movements outside the Imperatriz-Açailândia axis.

The Challenges of the Southwest Maranhão Metropolitan Region in the Eastern Amazon

Until the 1988 Federal Constitution (CF), the creation of Metropolitan Regions (RMs) in Brazil was an exclusive prerogative of the federal government, reflecting a centralized and authoritarian approach, as there was no dialogue with the states (Cordeiro, 2019). After the constitutional change, states gained the legal authority to create RMs, resulting in a significant increase in the number of such territorial divisions. This led to what can be seen as a "metropolitan paradox," as the number of RMs grew, even in areas without actual metropolitan spaces (Santos; Amaral, 2021).

This has created numerous challenges in terms of institutional, territorial, socioeconomic, and environmental aspects, particularly regarding diagnosis, planning, political adoption, implementation of plans, programs, and projects, and performance evaluation of these regions

across Brazil. Currently, the region is served by AGEMSUL – the Southwest Maranhão Metropolitan Executive Agency, headquartered in Imperatriz. Created in 2017 as an autonomous entity, it aims to organize, plan, and execute common public functions within the Southwest Maranhão Metropolitan Region.

Among the institutional challenges faced by AGEMSUL is the need to articulate the municipalities in the region with public and private entities, as well as state, federal, and international organizations. The agency's goal is to align efforts toward integrated planning and the fulfillment of common public functions, particularly through the creation of an Integrated Urban Development Plan (PDDI) based on an Ecological-Economic Zoning Plan that meets the needs of the Araguaia-Tocantins watershed committee.

A key territorial challenge is consolidating the information from the PDDI's programs and projects for inclusion in the State's Multi-Year Plan, Budget Guidelines Law, and Annual Budget Law, as well as in those of the municipalities in the metropolitan region. The region still lacks a well-established Ecological-Economic Zoning Plan, which is crucial to leverage the development of municipalities with low Human Development Indexes (HDI) but rich biodiversity, particularly considering the Amazon and Cerrado biomes.

It is also essential to provide technical and organizational support to municipalities in the metropolitan region, assisting in the development and revision of master plans and land-use laws to ensure alignment with metropolitan interests expressed in the PDDI. Currently, eight municipalities in the region have more than 20,000 inhabitants, making it crucial to implement and revise master plans that integrate key environmental, urban, and sectoral policies, particularly the National Climate Change Policy.

There is a need to conduct diagnostics of the socioeconomic realities of municipalities, particularly in collaboration with local research centers (UEMASUL), state and municipal bodies, and civil society, to support integrated planning. There is an urgent need to create a Research Center for the Eastern Amazon to evaluate the region's biodiversity potential, especially the importance of the Tocantins River as an economic link.

An environmental challenge is to implement a regional environmental plan based on technical studies and establish a database with updated information to support sustainable development, emphasizing agricultural practices that value traditional communities in the short, medium, and long term.

Another important challenge from an administrative standpoint is to foster cooperation between public and private institutions, both nationally and internationally, to secure investment or financing for the integrated development of the Southwest Maranhão Metropolitan Region.

3 - Conclusion

While the Southwest Maranhão Metropolitan Region is institutionalized, it still needs to strengthen its management processes, as well as the territorial dynamics and socioeconomic interactions between its municipalities. There is indeed a process of metropolitanization, but it cannot yet be considered a traditional metropolitan space, as metropolitanization in this case occurs through social, economic, political, and cultural flows (Santos; Amaral, 2021).

According to the 2008 IBGE study on the Regions of Influence of Cities (REGIC), Imperatriz rose in the hierarchy from a "Sub-regional Center" to a "Regional Capital" (Cordeiro, 2019). However, Imperatriz needs to strengthen its role as a hub municipality by improving its coordination with other municipalities in the metropolitan region, particularly the sub-centralities. The strategic location of the region establishes a strong connection with the states of Pará and Tocantins, which has bolstered the sub-centralities of Açailândia to the north and Porto Franco to the south. However, these sub-centralities, particularly Porto Franco, are not strongly connected to Imperatriz. Developing strategies to better integrate the internal dynamics and flows of the metropolitan region is essential, making the creation and implementation of the PDDI both fundamental and urgent.

Strengthening the internal dynamics of the metropolitan region can help improve the quality of life for its population, as Maranhão currently has one of the lowest human development indexes in the country (Paiva et al., 2020). The region's social fragility must be considered in the metropolitanization process to generate new opportunities and improve the quality of life for its residents. Environmental conservation is also a crucial factor, as the region is located at the ecotone between the Cerrado and Amazon biomes. The transition zone between these biomes and the Cerrado to the south faces the most pressure, especially due to agribusiness, specifically livestock farming. In addition to creating new conservation units and structuring integrated watershed plans, the PDDI must develop strategies for sustainable rural development.

The PDDI should also adopt a contemporary metropolitan approach, avoiding traditional and environmentally harmful issues. Urban sprawl, for example, which increases emissions and contributes to soil impermeabilization, can be avoided by promoting compact, high-tech cities.

Since conurbation does not occur in the region, maintaining compact urban perimeters while connecting and enhancing flows between municipalities through other means would be ideal. Improving internet capacity in all municipalities and creating railways to support the flow of goods and knowledge could be an efficient, low-emission alternative to road-based transport, which facilitates urban sprawl. The Metropolis Statute defines that in metropolitan regions established by state complementary law, interfederative consortium urban operations may be conducted, allowing for public action coordination with private sector and societal involvement. This could facilitate the implementation of necessary infrastructure to strengthen the region and connect it to Pará and Tocantins, which would also benefit from more efficient modes of transportation for production outflow.

Lastly, establishing guidelines to strengthen sub-centralities would make advanced services more accessible while reducing unnecessary travel and associated emissions. Instead of merely expanding Imperatriz's influence, the focus should be on strengthening multiple centralities, fostering complementary roles among the municipalities, and reducing gas emissions. Therefore, contemporary, sustainable, and innovative alternatives must be considered to consolidate the Southwest Maranhão Metropolitan Region, moving away from traditional Brazilian metropolitan models. This is crucial as the region develops within ecosystems of great environmental importance.

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