Identification of Urban Centralities Based on Multipurpose Cadastre

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Key words: Multipurpose Cadastre; Urban centralities; Subcenters; Territorial planning; GIS.

SUMMARY

This article aims to demonstrate the importance of the Multipurpose Cadastre (Cadastro Territorial Multifinalitário – CTM) as a strategic tool for urban planning by identifying subcenters in the municipality of São José dos Pinhais, which is part of the Metropolitan Region of Curitiba (RMC), in the state of Paraná, Brazil. The analysis is based on the concept of subcenters proposed by Villaça (2001), defined as diversified clusters of commerce and services, smaller than the main center, which meet the same accessibility optimization requirements but are limited to part of the city. The methodology involves integrating data from the Geometric Registry (or Physical Cadastre) and the Economic Registry (also referred to as Fiscal Cadastre), using geoprocessing and Geographic Information System (GIS) tools, such as kernel density analysis, to identify areas with a high density of commercial and service establishments. According to Erba & Piumetto (2016), the correlation of economic, physical, legal, environmental, and social data of urban parcels is only possible through the transition from the traditional cadastre to the multipurpose model, which consolidates various layers of information—previously dispersed across isolated sectors of public administration—into a single georeferenced territorial base. As a result, subcenters will be identified and ranked within the municipality, providing a better understanding of urban dynamics and city transformation to support public policies related to mobility, housing, and infrastructure.

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1. INTRODUCTION

According to Del Rio (1990), Urban Planning can be understood as a permanent activity through which a decision-making process takes place with the aim of achieving economic and social objectives. In Brazil, urban planning is directly linked to the development of master plans, defined by the Federal Constitution as the "basic instrument" of urban policy (Art. 182, § 1). However, other instruments stand out as fundamental for planning and decision-making, among them the Multipurpose Cadastre (Cadastro Territorial Multifinalitário – CTM). Formed by the territorial cadastre associated with thematic cadastres, the CTM plays a strategic role in consolidating a territorial reference base for cross-sectoral public policies, as it integrates the economic, physical, legal, environmental, and social aspects of properties and the people who inhabit them (Loch & Erba, 2007). It seeks to overcome the historical fragmentation of the Brazilian cadastral system, which is marked by divisions among different institutions and purposes.

The country's legal/land cadastre, for example, is associated with the registration of properties in notary offices and has a centralized and declaratory nature. Focused on ensuring the legal security of property rights, its milestones include the Land Law of 1850, the Land Statute of 1964, and Law No. 10,267/2001, which established the mandatory georeferencing of rural properties. The fiscal cadastre, in turn, is decentralized and under federal responsibility in rural areas, and municipal responsibility in urban areas. It is generally structured in an unsystematic way, with heterogeneous updates, and focused on property taxation — a limitation that the CTM seeks to overcome.

The Land Administration Domain Model (LADM) stands out in this context as an international standard capable of structuring the way land information is recorded, promoting interoperability among registries, fiscal cadastres, and the CTM, and enabling the consolidation of a true multipurpose cadastre.

The use of multipurpose cadastral data makes it possible, among other things, to spatialize the various land uses in the city and, consequently, to identify urban centralities.

The study of subcenters proves to be essential, as it reveals the important role these areas play in structuring cities, functioning as travel-generating hubs and influencing mobility and urban expansion policies.

Over the years, several authors have sought to define the concept of subcenter. This article adopts the definition proposed by Villaça (2001), who describes subcenters as diversified clusters of commerce and services, smaller than the main center, which meet the "same accessibility optimization requirements presented earlier for the main center," with the distinction that "the subcenter fulfills these requirements only for part of the city, whereas the main center does so for the entire city." Similarly, Corrêa (1989) highlights the expressive diversity of goods and services, though in a smaller number of establishments compared to the main center, as the defining characteristic of subcenters. According to him, these central areas can have different levels of scope: regional, neighborhood clusters, and local neighborhood centers, depending on intra-urban transport connections, population density,

and income levels within their area of influence. The first corresponds to a “replica” of the city’s main center, while the latter two — neighborhood clusters and local neighborhood centers — are miniature versions of the regional subcenter (Corrêa, 1989).
Given this context, the general objective of this study is to demonstrate the application of the CTM in identifying and ranking the subcenters of São José dos Pinhais, a municipality in Paraná that is part of the Metropolitan Region of Curitiba (RMC), the state capital. This contributes to understanding the spatial distribution of commercial and service uses in the municipality and supports public administration in promoting more integrated urban planning.

2. MATERIALS AND METHODS

The method was based on the integration of different cadastral databases from the municipality of São José dos Pinhais, carried out through the use of geoprocessing tools and a Geographic Information System (GIS), more specifically the QGIS 3.28.10 software.
Initially, the data from the Geometric Cadastre (or Physical Cadastre) and the Economic Cadastre (also referred to as Fiscal Cadastre) were unified within the GIS environment, using a common identifier in the “Join” function of QGIS. The objective was to obtain information on the location and land use of the city’s parcels, as illustrated in Figure 1 below.

Figure 1. Schematic illustration of the integration of the economic registry (first image in the upper left corner) and the geometric registry (lower left corner) through the QGIS software

The Municipal Tax Registry data, available through a spreadsheet in .xlsx format provided by the Municipal Finance Department (PMSJP, 2025), include information such as property registration number and tax identification, address, lot area, built area, topography, pedology, building construction system, construction type (1 – House, 2 – Apartment, 3 – Duplex, 4 –

Warehouse, 5 – Hall, 6 – Garage, 7 – Others, 8 – Annex), and land use (1 – Residential, 2 – Commercial, 3 – Industrial/Warehouse, 4 – Workshops/Storage, 5 – Special, 7 – Others).
The Physical Registry, provided by the Geoprocessing Division of the Municipal Department of Urbanism, Transport, and Traffic (PMSJP, 2025), contains parcel polygons in shapefile (.shp) format, including information such as tax identification, neighborhood, watershed, zoning, lot type (1 – Implemented, 2 – Not Implemented, 3 – No Information, 4 – Rural, 5 – Vertical Condominium, 6 – Horizontal Condominium, 7 – Assigned to the Road System), and area.
The integration of the two registries, enabled by the tax identification number (a common identifier), allowed the classification of lots according to their land use and their representation in different colors, as shown in Figure 2.

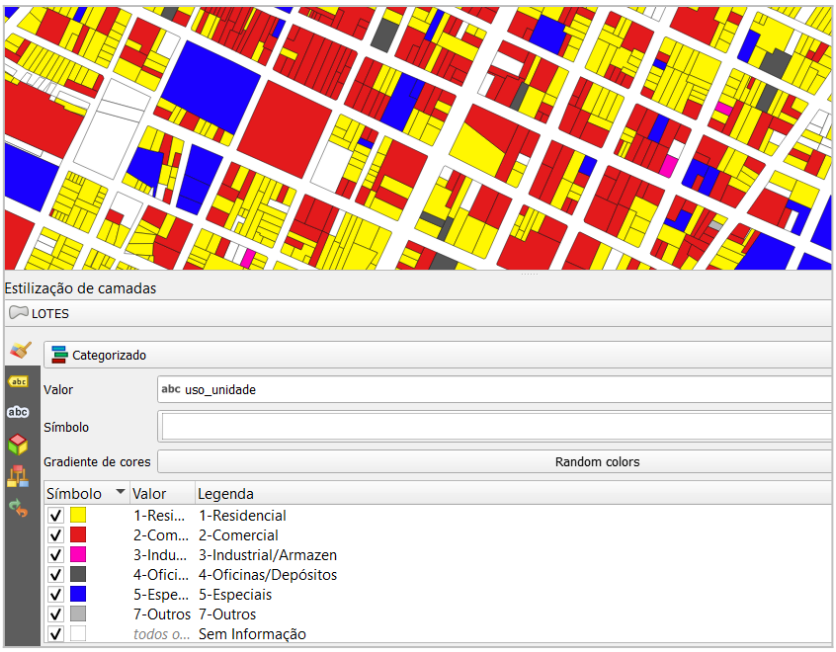

Figure 2. Excerpt of the parcels of São José dos Pinhais, classified according to land use (1 – Residential, 2 – Commercial, 3 – Industrial/Warehouse, 4 – Workshops/Storage, 5 – Special, 7 – Others), obtained through the integration of the economic and geometric registries

Subsequently, the lots classified as “2 – Commercial” were converted into points using the “Centroids” algorithm. Based on this dataset, the spatial density analysis technique (kernel density) was applied, revealing the regions with the highest concentration of commercial and service activities (Figure 3).

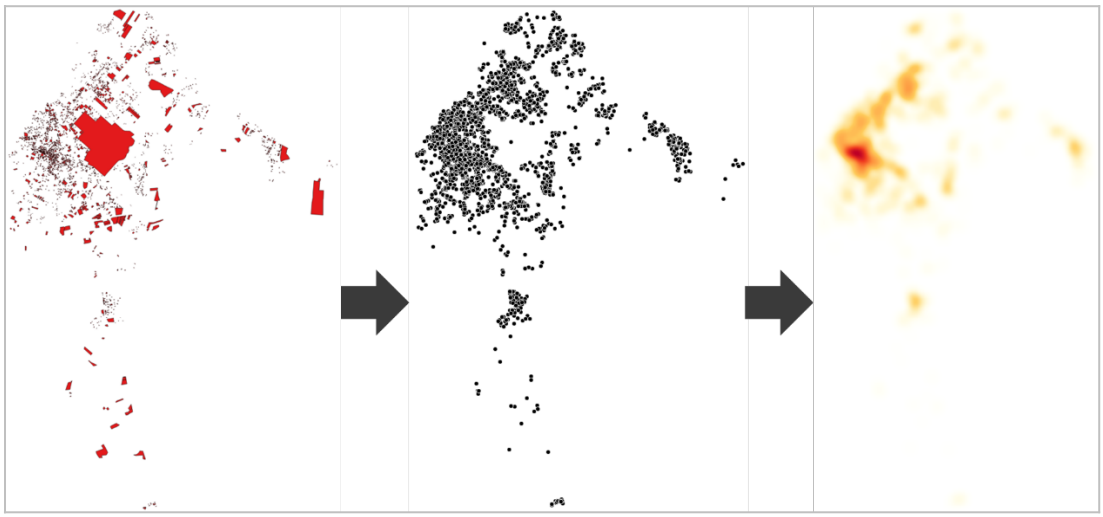

Figure 3. Illustration of the application of the spatial density analysis technique (kernel density) on commercial-use lots (in red) in São José dos Pinhais

This approach made it possible to map the locations that can be identified as potential subcenters.
The method used is in line with the ideas of Erba & Piumetto (2016), who advocate for the transition from the traditional cadaster to the multifinalitary model as a way to overcome the fragmentation of cadastral information. This transition enables the integration of different layers of information—previously dispersed across isolated sectors of public administration—into a single, territorially referenced database (Erba & Piumetto, 2016).

3. RESULTS AND DISCUSSION

The use of the spatial density analysis technique (kernel density) made it possible to generate a heat map revealing the location of areas with a high concentration of commercial and service uses. These areas are characterized as potential subcenters and were hierarchized according to the concentration of activities, into first-, second-, and third-order centralities (Figure 4).

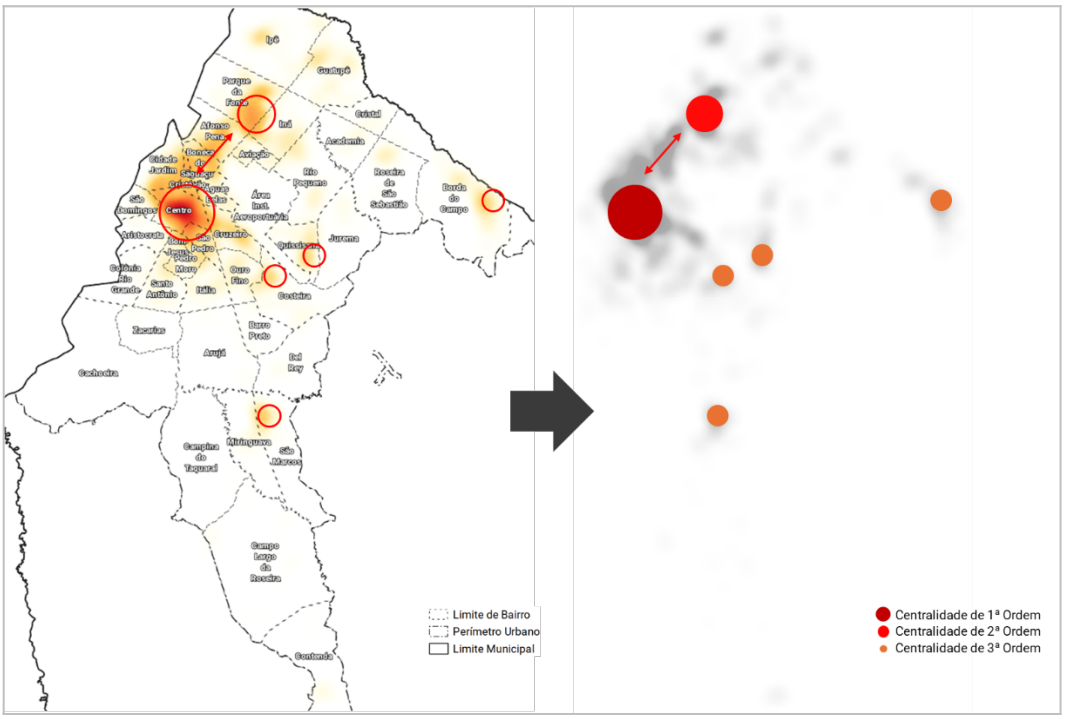

Figure 4. First-, second-, and third-order centralities of São José dos Pinhais

As shown in the figure, in addition to the main center, the municipality has centralities in the neighborhoods of Parque da Fonte, Borda do Campo, Quissisana, Costeira, and São Marcos. This is confirmed not only by the presence of commercial activities but also by the flow of people in these regions, as evidenced by the Origin-Destination (OD) survey results presented in the Municipal Urban Mobility Plan of São José dos Pinhais (Figure 5).

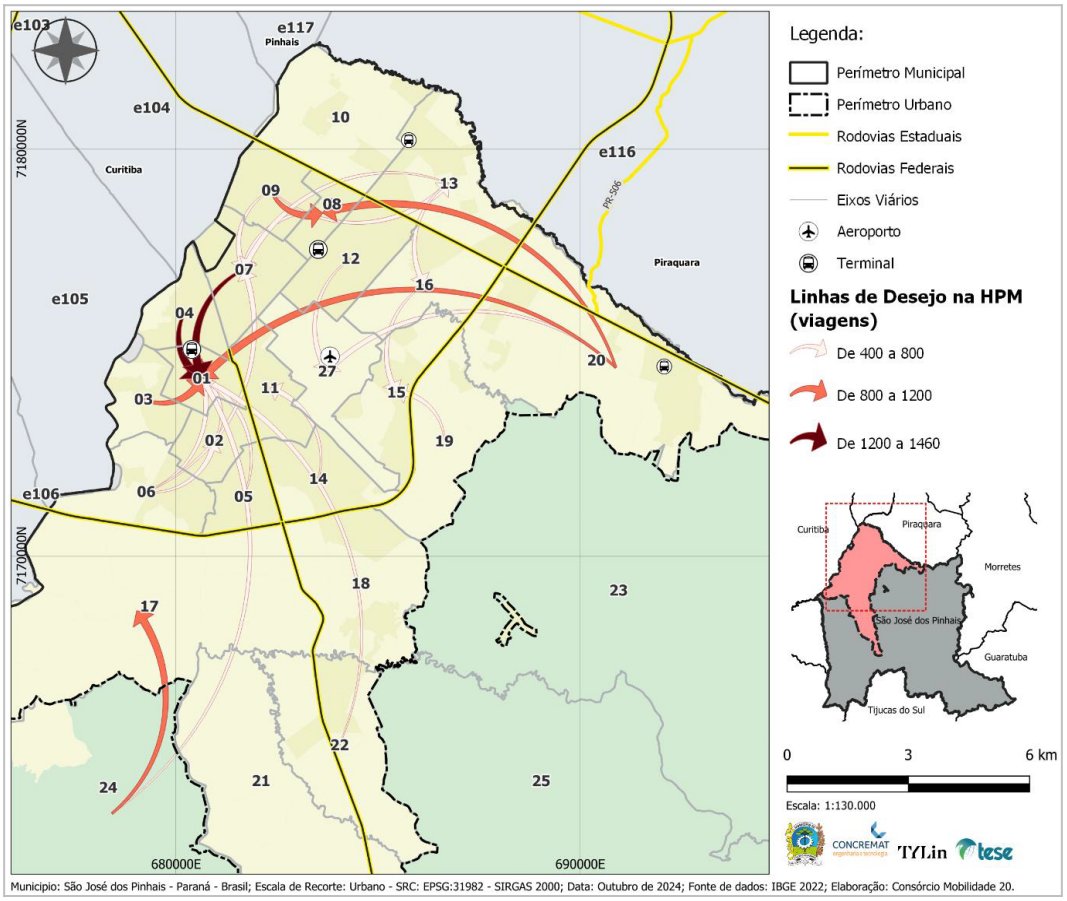

Figure 5. Result of the Origin-Destination Survey of São José dos Pinhais. Source: Municipal Urban Mobility Plan of São José dos Pinhais (2024).

Part of the literature on the subject incorporates into the definition of subcenters the ability of these areas to exert an attractive force over the urban population. For instance, Lima & Gadens (2017) define centrality as a place characterized by "the concentration of various services and urban activities, which exert an attractive power over a given area, defined as central [...]." Similarly, Milani & Silva (2009) describe a centrality as a place of continuous circulation of consumers, workers, vehicles, goods, and information to specific locations. According to these authors, the intensity of this movement or flow depends on the importance of a given place and its capacity to attract more people.

4. FINAL CONSIDERATIONS

The results of the study make it possible to affirm that the use of the Multipurpose Territorial Cadastre (CTM) is essential for structuring territorial analysis frameworks, enabling the integration of relevant information about the city in order to provide support for guiding cross-sector public policies, especially in the areas of mobility, housing, and infrastructure. It is known, however, that the reality in most Brazilian municipalities is one of fragmentation among cadastral systems, which are often used solely for fiscal purposes. According to Silva et al. (2023), “the cadastre is treated as a table, or a set of tables, within a taxation system,

often lacking spatial representation and serving only the municipality's fiscal activities." The authors also point out that one of the problems associated with this fragmentation is the lack of qualified professionals to work in the area, particularly in small municipalities, which are often distant from training centers and/or have limited resources to manage all their demands. In this context, strengthening partnerships with municipal associations and universities/institutes presents itself as a viable alternative, since these entities bring together skilled professionals who can support the management and updating of cadastral systems.

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BIOGRAPHICAL NOTES

Caroline Nayara Rech holds a degree in Architecture and Urbanism from the Federal University of Paraná and a specialization in Geoprocessing from the Pontifical Catholic University of Minas Gerais. She is currently a master's student in the Graduate Program in Architecture and Urbanism at the Federal University of Santa Catarina, where she works in the research line of City Architecture, Urban Management, and Planning. She has worked on the development of master plans and other urban planning projects in various Brazilian municipalities, carrying out municipal diagnostics, territorial management proposals, among others; including the use of geoprocessing tools for spatial analysis. Additionally, she is a researcher at the Urbanism Laboratory of the Federal University of Santa Catarina and a graduate intern at the Planning, Housing, and Urban Development Department of the Municipal Government of Florianópolis.

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