

GIS application in the analysis of transformations in the old core of Tiradentes/MG related to tourism exploitation in the area

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ABSTRACT

This article discusses some of the possible contributions of GIS technology (Geographic Information System) to the analysis, planning and management of heritage sites, focusing mainly on the study of the effects produced in such sites by processes related to the tourism exploitation. To this end, it adopts as its object of inquiry the old core of the city of Tiradentes, in Minas Gerais, Brazil – protected by the *Instituto do Patrimônio Histórico e Artístico Nacional* since 1938 and characterized as one of the main tourist destinations in the country today –, for which it is proposed, firstly, the construction of a digital base in the QGIS software and then, based on bibliographic and documentary sources, an analysis of its historical evolution, current conformation and main ongoing processes. A comparative analyzes between the characteristics of land-use verified on the site in the years 1980, 2001 and 2017 is also carried out. As a result, besides creating such a database for the municipality, a further study of the relationships between the transformations observed in the mentioned characteristics and the increase in tourism activity in the area is provided. Considerations are also presented regarding the effects generated on the preservation of local heritage as a result of these same transformations, along with possible recommendations for the effective and sustainable management of Tiradentes' cultural heritage.

KEYWORDS: Cultural heritage preservation. Geographic Information System. Tiradentes.

1 INTRODUCTION

The ancient sites, recognized as cultural assets of heritage value, only became eligible for such distinction in a relatively recent period, compared to that in which the recognition of architectural works as historical monuments occurred, corresponding to the 15th century. In the case of the former, the acquisition of this new status are related to the influences exerted by the significant transformations experienced by some European urban centers after the advent of the Industrial Revolution and through reforms such as those in Paris, Barcelona and Vienna undertaken in the mid-19th century. As Françoise Choay (2006, p. 179, *our translation*) would say, these reforms, "by the effect of difference", contributed to the conversion of ancient cities into objects of research and ultimately led to the creation of the concept of urban heritage in the early 20th century.

Given this relative novelty, and the fact that even in dealing with architectural heritage – which predates the urban heritage by about five centuries – certain theoretical and methodological discussions and challenges continue to persist to this day, it was to be expected that dealing with ancient cores would also face its own discussions and challenges far from being fully resolved. This is especially true considering the complexity associated with these ancient cores, not only due to their scale but, more importantly, due to the various processes that often affect them. These processes involve not only the combination of a considerable number of variables but also the creation of a series of serious threats to their proper preservation.

Among these processes, for example, are the densification and expansion of urban areas driven by real estate speculation, which puts pressure on the structure of old city centers. Additionally, there is the introduction of new elements that do not conform to the identity of these historic centers or elements that end up being pastiches of original features, leading to the creation of pseudo-historical sceneries. Furthermore, there is the mass insertion and exploitation of tourism activities, resulting, among other effects, in impacts on the traditional dynamics of these sites, especially through transformations in the use and character

of buildings and spaces to better accommodate such activities. These changes ultimately interfere with the character of the relationships established between the local community, these spaces and buildings, and also with the configuration of elements of local intangible heritage. These are processes that are generally and primarily associated with shortcomings and gaps in the analysis, planning and management of such sites, conducted by the municipal administration and preservation agencies, which often give rise to several of these lags and gaps because they also do not act in a properly articulated and coordinated manner.

Some relatively recent technologies, developed especially since the second half of the 20th century, have shown significant potential to transform this reality by contributing, if not to its complete resolution, at least to the mitigation of the problems arising from it. They do so by optimizing the way data related to ongoing processes at these sites can be stored, managed and visualized, and subsequently, by improving how the development of these sites can be planned and managed, all while keeping in mind the preservation of their cultural heritage. Particular reference is made here to Geographic Information System, also known by its acronym GIS.

In order to demonstrate some of the contributions of this technology to the analysis, planning and management of ancient sites, this work – derived from ongoing research by one of its authors – focuses on its application in the historic core of the 18th-century city of Tiradentes, located in the state of Minas Gerais, Brazil. It is worth noting that this particular core was selected as the object of study due to its status as a representative cultural heritage site of the country, as evidenced by its listing in 1938 by the current *Instituto do Patrimônio Histórico e Artístico Nacional* (IPHAN), and due to the fact that, over the past four decades, it has been the target of a series of processes with significant impacts on its traditional character. Among these processes, the exponential growth in tourism activity in the area, mentioned earlier, stands out and this article does not only seeks to analyze how these processes relate to the mentioned impacts but also aims to discuss how they occur.

Therefore, reflecting the adopted working methodology, the following sections will first provide some pertinent considerations on GIS technology, addressing its origins, characteristics, potential applications and methods of integration into the development of this research. Subsequently, moving on to the case study, there will be a characterization of the historical process of Tiradentes formation, accompanied by an analysis of the development of tourism in the area since the 1970s – when its expansion began –, an examination of the observed transformations and their relationship with the tourism activity. Following this, a brief discussion will be conducted on the prospects for the site's future, considering the current planning efforts and the presence of tourism. The article will conclude with the formulation of final considerations.

2 GEOPGRAPHIC INFORMATION SYSTEM: TIMELY CONSIDERATIONS

With origins dating back to the 1960s, when geographers began employing computational tools for the analysis and visualization of data related to geographical spaces, GIS (Geographic Information System) is a system that enables the storage, management and the aforementioned visualization of georeferenced spatial data in a digital environment. Therefore, it can provide, for instance, information regarding population, topography,

vegetation, climate and other factors that may impact the use and management of territories in some way.

Today, its application extends beyond the domains of Geography, reaching fields such as urban planning and heritage management in its architectural, urban and landscape spheres. Particularly concerning this latter field, which is still relatively underexplored, GIS can be used in the generation of cartographies and digital models of the considered asset – building, site, landscape. By aggregating a set of informations related to these assets, GIS enables technicians and researchers to access and subsequently work with these informations in a more efficient and effective manner.

Regarding the current investigation, the methodology used to create the GIS for the historic core of Tiradentes included, in the first place, the selection of the open-source software QGIS, developed by the Open Source Geospatial Foundation (OSGeo), as the foundational tool. With the assistance of this software – and also utilizing other tools like Autodesk® AutoCAD and complementary computational techniques – the data considered most relevant to the research, obtained from materials primarily produced by the *Fundação João Pinheiro* (FJP) and IPHAN over recent years, as well as data collected by the authors during fieldwork, were organized. This process ultimately resulted in the creation of a digital database and cartography for the core in question. Supported by robust references and thus providing highly accurate information, these assets contributed to the execution of the analyses intended by this work, which will be presented in the following sections.

3 THE CASE OF TIRADENTES, IN MINAS GERAIS, BRAZIL

3.1 From the formation of the early settlement in the 1700s to its configuration in the 1970s

The origins of the current municipality of Tiradentes date back to the time when the named "bandeirantes" embarked on their campaigns in the interior of the country in search of resources, notably gold. As stated in a historical report prepared by FJP, the region was "pioneeringly penetrated by the bandeirantes as early as the late 17th century" (FJP, 1980, p. 5, *our translation*), serving as a passage for them "while they traveled from Taubaté in São Paulo or from the port of Parati on the Fluminense coast to the gold mines of Ouro Preto or Rio das Velhas, a route known as Caminho Velho." (1980, p. 5, *our translation*). The discovery of veins of the precious metal in the region between Tiradentes and the neighboring city of São João del-Rei, however, would bring changes to this dynamic, encouraging the establishment of the first settlements there, which would later become the urban cores of the two localities.

The growth of the settlement of the Vila de São José del-Rei, as Tiradentes was originally named, was rapid, as reported by FJP, "due to the immediate and numerous influx of miners" (FJP, 1980, p. 5, *our translation*), and not devoid of a series of conflicts. The most well-known, named "Guerra dos Emboabas", occurred between 1707 and 1709 and resulted from disputes between Paulistas and Portuguese over control of the existing mines, involving a series of armed conflicts. Stability was only achieved with the adoption of a set of measures imposed by the authorities responsible for the administration of the colony, thus making possible "the organization of social life and its incipient urban implementation." (FJP, 1980, p. 6, *our translation*).

Regarding the latter,

It can be considered that in the first half of the 18th century the nucleus was urbanistically defined within the functions it has maintained to the present day. Its houses were concentrated along the main road that, starting from the high point of the Matriz church, whose construction seems to have begun around 1710 to replace the original chapel, reaches the adjacent bank of the Santo Antônio creek at Praça do Chafariz. The Matriz church is one of the oldest local religious monuments, indicating its prominent location, as well as its proximity to buildings of greater antiquity or architectural nobility. This suggests that the definitive urban nucleation may have begun at that high point in the city, later expanding along the road leading to Barbacena and Rio de Janeiro, between the ridge line and the floodable area of the Santo Antônio creek. (FJP, 1980, p. 7-8, *our translation*).

With the decline of mining activities, which began in the second half of the 18th century in Minas Gerais, Tiradentes, at that time, did not immediately show any significant impacts and continued its process of urban development. This can be evidenced by the fact that many significant works in the municipality, such as the Capela da Santíssima Trindade and the currently designated Casa do Padre Toledo, were precisely executed during this period.

By the beginning of the next century, its urban structure was already quite consolidated. However, from then on, the locality entered into an economic stagnation driven by the increasing scarcity of resources derived from mining exploitation. (FJP, 1980, p. 8-9). It can be observed, then,

With gold extraction limited to a small number of miners, the activities of the residents of the Vila de São José del-Rei were reduced to cattle raising and incipient agriculture, including the cultivation of corn, rice, beans and various fruits. Despite communication difficulties due to poor roads, the predominant trade consisted of pork, cattle and sheep, which were sent to various locations in Minas Gerais and even to Rio de Janeiro.

It is also worth noting that in 1831, there was significant activity in spinning and weaving in the Vila [...].

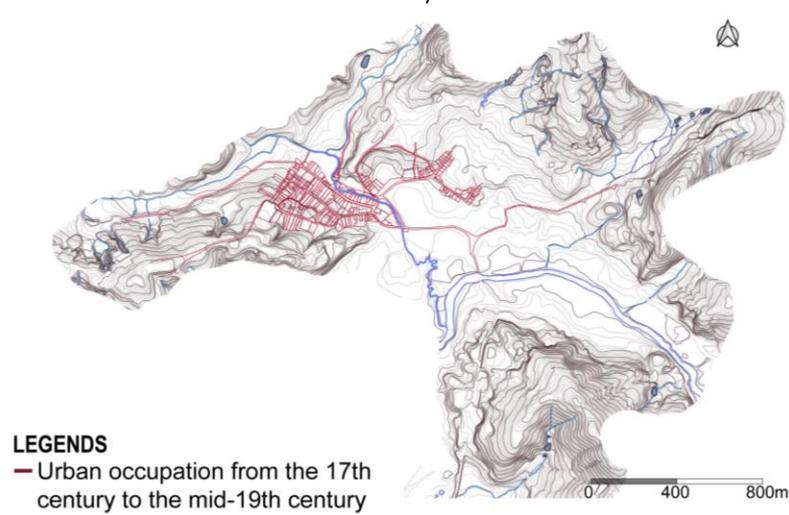
However, the textile industry did not develop into an industrial organization there, as it did in São João del-Rei, where several factories were established. In fact, the proximity of São João as the political center of the Rio das Mortes District and a hub for regional wholesale trade posed serious challenges to the economic development of the present city of Tiradentes. (FJP, 1980, p. 9-10, *our translation*).

Elevated to the status of a city in 1860, Tiradentes had, until then, maintained its urban configuration virtually unchanged. This condition only began to be transformed at the end of the century, as can be observed in Maps 1 and 2, with the modernization of its road system, including railways and roads. This allowed both the transportation of local production and the arrival of new elements that at the time symbolized a certain material and social progress. (FJP, 1980, p. 10).

In 1938, due to its extensive and rich architectural and landscape heritage, the site underwent a listing process by the SPHAN (*Serviço do Patrimônio Histórico e Artístico Nacional*, currently IPHAN). This, to some extent, also contributed to a "greater appreciation and dissemination of the local collection, both as an object of interest to scholars and as tourism potential" (FJP, 1977a, p. 5, *our translation*). However, this potential would only begin to be

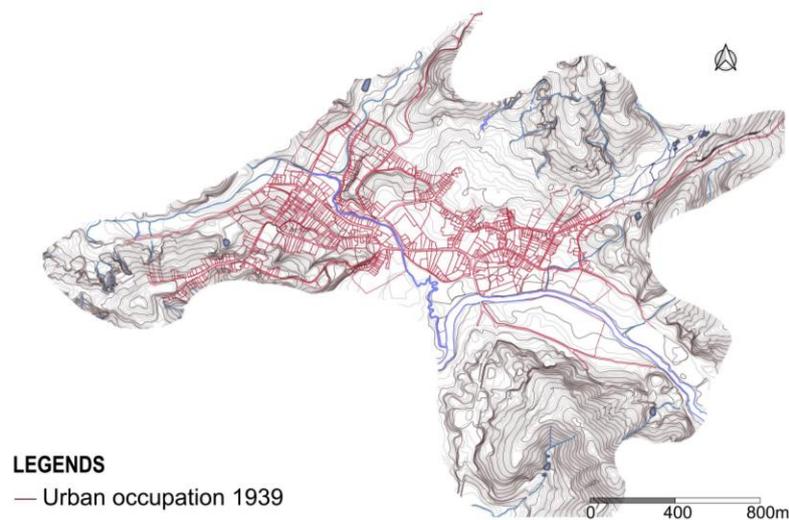
effectively explored about four decades later, considering that, as reported by Madureira (2011, p. 92), until the 1970s, the daily life of the residents was characterized by a rather peaceful pace of life, with the presence of visitors only observed in a timid and sporadic manner.

Map 1 – Representation of the urban occupation of Tiradentes in the period from the 18th century to the mid-19th century



Source: Prepared by the authors, 2023.

Map 2 – Representation of the urban occupation of Tiradentes in 1939



Source: Prepared by the authors, 2023.

3.2 From the 1970s to the present: the growth of tourism and changes in the character of the locality

From the 1970s onwards, Tiradentes began to notice a gradual increase in the arrival of "ETs" – or "*extratiradentinos*", as they are called by the native residents – who

[...] came from various places, mainly from the nearest capitals: Belo Horizonte, São Paulo and Rio de Janeiro. According to reports from Tiradentes residents, they were adults (mostly between 35 and 65 years old) with good financial means and high levels of education. Some were attracted by the tranquility and beauty of the city

(those seeking leisure and purchasing their second residence), others by the potential for tourism development (those who invested in businesses), but most were seeking both simultaneously.

Among the new residents were visual artists and craftsmen (which gave a new face and impetus to Tiradentes' crafts [...]), entrepreneurs (responsible for opening shops, restaurants and hotels), and the Globo director, Yves Alves (1929-1996) – the main person responsible for the city's media exposure. (MADUREIRA, 2011, p. 92-93, *our translation*).

It is interesting to note that up to that point, the main economic activities in the municipality, in terms of labor absorption, were agriculture (35.9%), particularly related to dairy production, and industry (32.9%), linked to the manufacture of costume jewelry and the production of non-metallic minerals (FJP, 1980, p. 12-15). "The service sector, responsible for employing 11.5% of the labor force, ranks third, followed by trade (6.3%), transportation (3.8%), public administration (3.3%) and others." (FJP, 1980, p. 12-13, *our translation*). However, when it comes to income generation, it was the industry that took the lead (FJP, 1977b, p. 92), while the tourism – component of the service sector and now located in that lead – was in the following situation:

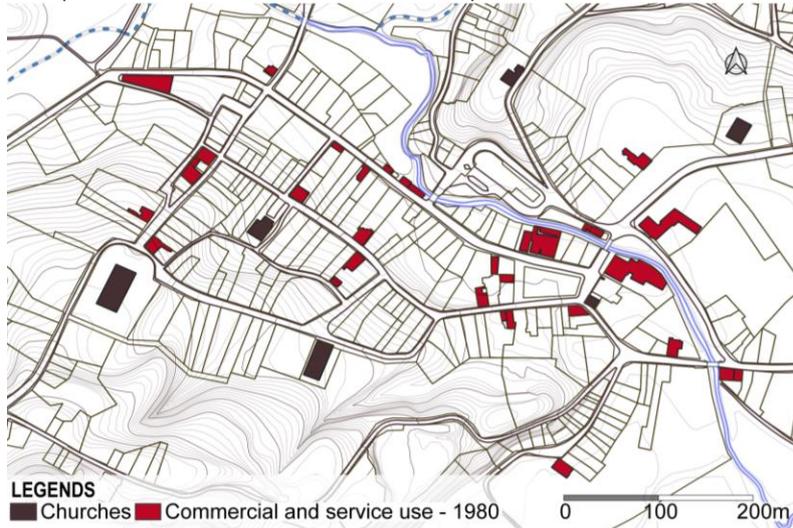
[...] local hotels [a total of four¹], with the exception of Holy Week and Carnival, are constantly underutilized, as are the various existing restaurants. Visits to the Matriz Church, a must-visit for all city visitors, averaged 23.1 people during the first 10 days of March 1980, during the low season. (FJP, 1980, p. 17, *our translation*).

Therefore, it was through the implementation of city marketing strategies fostered by an association between the private sector and the government, involving increasing investments (FJP, 1980, p. 23) and media promotion of the locality, that the situation regarding tourism gradually began to change, gaining more momentum. However, it should be noted that this was done without proper planning, that is, planning that took into account the potential negative impacts on the site. In the context of the protected core, the consequences of these actions began to be observed, especially through a gradual change in the use of properties originally intended for residential purposes, as illustrated by the following maps (Maps 3, 4 and 5), which depict the presence of properties dedicated to commercial and service use in the old core of Tiradentes in the years 1980, 2001 and 2017²:

¹ Information obtained in another part of the document prepared by FJP (1980, p. 20) from which the quote was extracted.

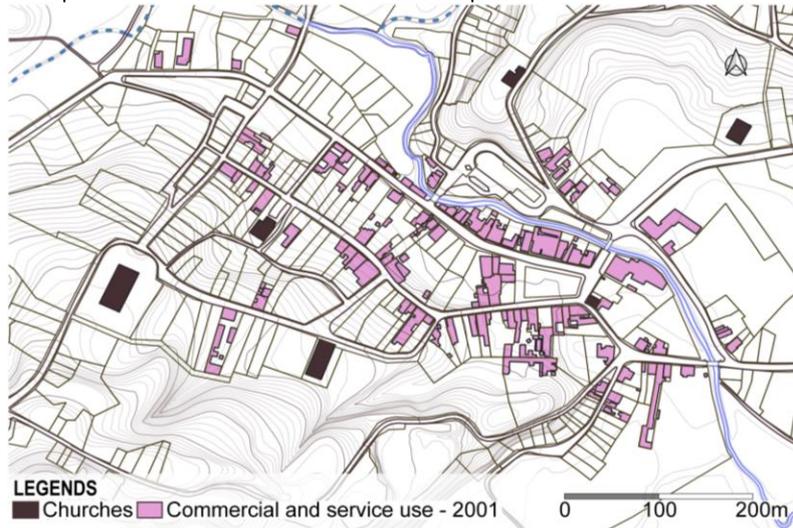
² It was not possible, due to the lack of information available in the sources consulted for the preparation of the maps, to precisely determine what types of commercial and service uses all the properties housed (for example, restaurant, souvenir shop, travel agency, inn, etc.) on the dates considered, which could contribute to a better understanding of their relationship with the growth of tourism in the locality. In any case, the mapping helps to provide a fairly close approximation of this relationship, especially considering that, with regard to the availability of establishments dedicated to "everyday" commerce and services by the local population, Tiradentes continues to have a significant dependency on the neighboring city of São João del-Rei.

Map 3 – Properties with commercial and service uses present in the core of Tiradentes in 1980



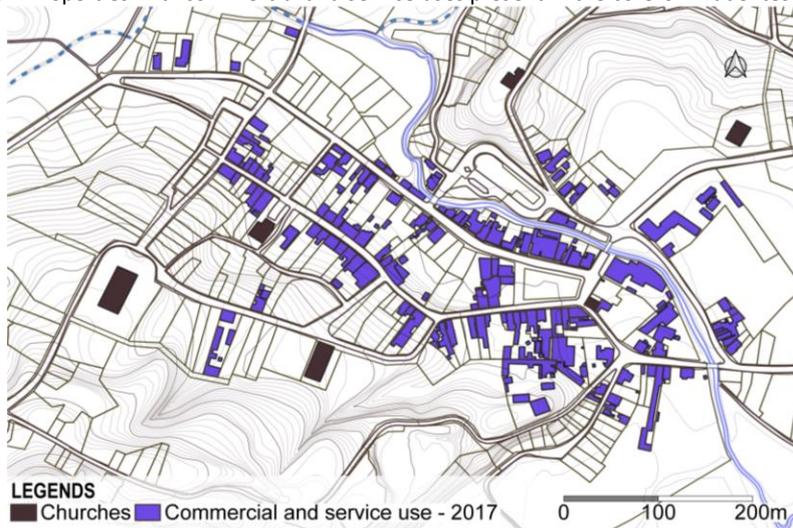
Source: Prepared by the authors, 2023.

Map 4 – Properties with commercial and service uses present in the core of Tiradentes in 2001



Source: Prepared by the authors, 2023.

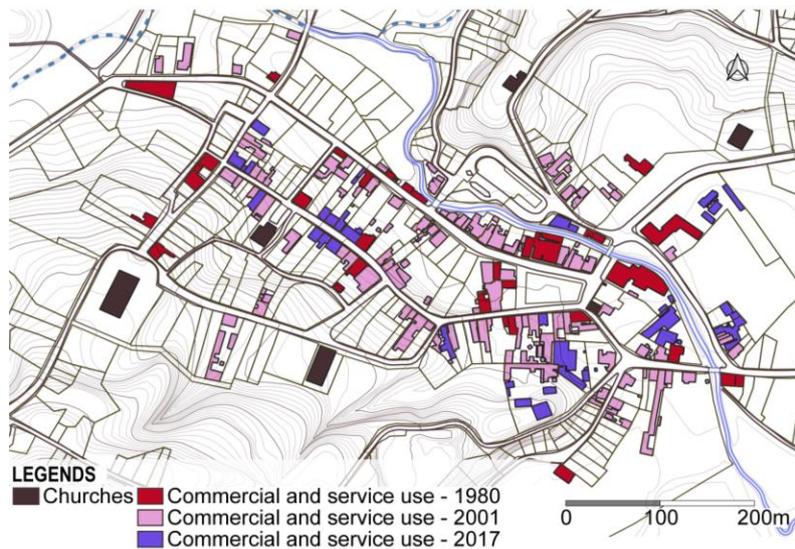
Map 5 – Properties with commercial and service uses present in the core of Tiradentes in 2017



Source: Prepared by the authors, 2023.

Combining the three maps, the following scenario can be seen:

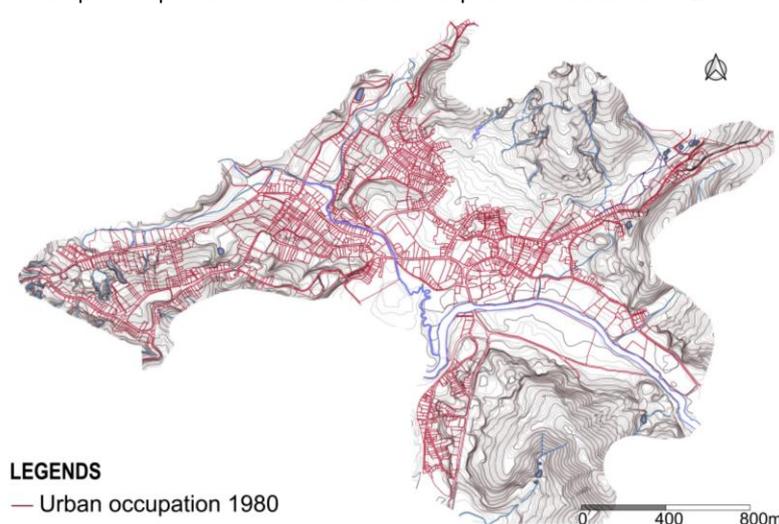
Map 6 – Evolution of the occupancy of properties with commercial and service uses in the core of Tiradentes from 1980 to 2017



Source: Prepared by the authors, 2023.

It can be observed that there was a significant increase in the number of non-residential properties in the analyzed area, especially in the two decades between 1980 and 2001, caused by the mentioned expansion of tourism in the municipality. This expansion was also evident in the nature of the occupation of the municipal territory, where in the peripheral areas new residential areas were beginning to emerge, and recently created neighborhoods were expanding. By comparing Map 2, presented earlier, with Map 7, presented below, it is possible to better visualize the evolution of this occupation.

Map 7 – Representation of the urban occupation of Tiradentes in 1980



Source: Prepared by the authors, 2023.

From the same occupation, in order to properly characterize it, it is necessary to clarify that it was not simply and exclusively associated with a need to create residences in other parts of the territory as a way to "compensate" those in the old core that started to

accommodate other uses. First and foremost, it revealed a true process of displacement of the traditionally resident population in the protected area, which often, unable to afford the high cost of living associated with the increase in land value, was forced to move to less affluent areas on the outskirts (Figure 1) or even to other cities in the region. Because of this,

[...] there are now fewer than 20 original families from Tiradentes in the city. [...] People from Minas Gerais, São Paulo and Rio de Janeiro make up the groups that have contributed the most to Tiradentes, which, with its refinement and "cultural atmosphere", has attracted intellectuals, visual artists, etc., not only changing the city's demographic profile but also its socio-cultural characteristics. (CAMPOS, 2006, p. 156, *our translation*).

Figure 1 – Partial view of Padre Gaspar Street, located in the vicinity of the protected core of



Tiradentes

Source: Authors' collection, 2019.

As for these socio-cultural characteristics, it is important to clarify that they include, for example, the fact that

[...] the local population, unable to own tourist facilities or services and with low qualifications, engages in low-paying jobs with long working hours, especially during the tourist season. Often, there are underemployment opportunities for the local population. Many are employed by "outsiders" or engage in unregistered activities that cater to tourist demand, such as carriage drivers, popsicle and popcorn vendors, unregistered tour guides, etc. (CAMPOS, 2006, p. 133, *our translation*).

This, in turn, reflects on the cultural expressions that constitute the local intangible heritage, both in terms of how they are carried out and the significance attributed to them. As reported in the mid-1990s by the then Director of the Department of Sports and Leisure to Bolson, Ferreira and Vieira Filho (2006, p. 36, *our translation*), "These expressions are becoming a theater for tourists to enjoy. People have lost their traditions because they are focused on catering to tourists, working on weekends, and no longer participate in these traditional festivals."

Another phenomenon associated with the expansion of Tiradentes' urban fabric is the increase in its population. Having gone through periods of population decline with migrations to other regions outside the state, from the 1970s onwards the city began to reverse this condition. It went from 1,830 residents in the urban area in 1980 to 2,294 in 1985

and 2,576 in 1985 (FJP, 1980, p. 29), reaching a total of 6,961 inhabitants in 2010 (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2023), the year of the last completed demographic census in the country. At that time, in addition to citizens from other states – who were distributed between the central area and the luxury condominiums that were already making their presence felt around the old nucleus – many of the new residents also came from rural areas, moving to the urban area attracted by the opportunities that came with the dynamism of the mining economy, which was, especially in the case of Tiradentes, closely related to the emergence of tourism as a potent business sector (CAMPOS, 2006, p. 113).

3.3 In the present, a look towards the future: the need to ensure genuinely sustainable tourism

As previously mentioned, Tiradentes, when it began adopting strategies aimed at expanding tourism in the city, did not have a plan that adequately considered the undesirable effects that this activity could bring with it. This is a condition attested in studies conducted by FJP on the city in the 1970s and 1980s, and which can also be seen in the account presented below, from a more recent period:

Interviewees were asked if there is a habit of planning the municipality of Tiradentes, and the negative response was unanimous: "No, there is no planning department here." "No, there is no strategic plan or master plan. It is difficult to plan because we do not have qualified technicians." "There is no municipal tourism plan. There is a lack of vision." (BOLSON; FERREIRA; VIEIRA FILHO, 2006, p. 37, *our translation*).

In 2015, through a partnership between the municipal government and the foundation mentioned, a proposal for a master plan for the city was presented. It included aspects related to tourism development, social development and land use planning, among other items, reflecting a concern for what was defined as "an integrated action of territorial planning and management with environmental and social policies, especially in their cultural and economic dimensions, combining preservation policy with the dynamic process of city development" (TIRADENTES, 2015b, p. 6, *our translation*). In this sense, it should be noted that the proposal included a series of guidelines related to the "strengthening and institutional articulation for the sustainable and inclusive management and development of tourism in Tiradentes" (TIRADENTES, 2015b, p. 10, *our translation*), the creation of an "information and monitoring system for the plan and the tourism environment" (TIRADENTES, 2015b, p. 11, *our translation*), as well as the "recovery of public space use, promoting inclusion and rebuilding a sense of belonging, respecting everyone's right to the city" (TIRADENTES, 2015b, p. 24, *our translation*). Approved in April of that year, the master plan proposal also defined the area where the old town is located as a Historic-Cultural Zone (ZHC), and in Law No. 5, enacted on December 16, 2015, some specifications related to lot division, land use and building height were established.

Focusing specifically on the issue of land use, the designated area allows residential use, both single-family and multi-family, small-scale economic use, and mixed-use subject to conditions. Medium-scale economic and institutional uses are allowed under certain conditions, while large-scale economic use is not permitted (TIRADENTES, 2015a, p. 35). These specifications are based on the analysis of associated impacts on the area, which are primarily

related to vehicle and pedestrian circulation, infrastructure and environmental conditions (TIRADENTES, 2015b, p. 57-58).

Regarding the enjoyment of the old town by the local population, it can be said that it is partially neglected, as there is no clear allocation of a percentage of the area for economic use, micro-zoning with distribution of uses, or provision of mechanisms and tax incentives for the installation of more locally-oriented establishments. Therefore, the process of replacing residential use, which exacerbates the current conditions of the old town being empty, especially during low seasons, tends to continue without facing many barriers. Except, perhaps, the decision of the owners of the properties to maintain them as their residences, even if it is known that there is also, on the other hand, the problematic situation that, in many cases, no longer belonging to the city's traditional families, but to "outsiders", these properties are only occupied on weekends and holidays.

It is valid to consider that private capital can contribute to preventing or stopping degradation processes that could occur if the old town relied solely on resources from the government or the local community. However, it is essential to ensure that the public interest takes precedence over private interests. Therefore, certain guiding principles should be carefully observed, including the non-expulsion of lower-income local residents to more distant areas from the old town or, if necessary, their return to these same areas. This can be achieved through proper management of building use, investment in adapting these buildings for social housing, public school facilities, etc., as well as fiscal incentives.

In this context, given the guidelines established in Tiradentes' municipal master plan, including the need to promote sustainable and inclusive tourism development and monitor tourism activities, a GIS like the one used in this study is considered appropriate. The created base allows ongoing processes, such as changes in land use, to be more easily mapped and visualized at different scales – city, zone, neighborhood, street –, facilitating more accurate planning and management. Additionally, by being shareable over the internet, it can be used by members of the municipal government and heritage preservation organizations in real-time. It allows professionals to support their analyses and collaborate on a homogeneous, solid and reliable database, ultimately facilitating coordinated and better-informed decision-making regarding the city's future.

As for the future direction, it can be observed that Tiradentes continues to expand its tourism industry while gentrification remains as another expressive ongoing process. However, it is hoped that the municipal master plan, when properly implemented, can contribute, if not to a complete solution, at least to a partial improvement of the situation through orderly planning and other policies aimed at inclusivity. Nonetheless, it is reinforced the need to adopt a system capable of organizing, visualizing and monitoring data and information related to the territory, as challenges related to its care can be better addressed with the support of modern technologies and tools developed and incorporated into urban planning and cultural heritage preservation. Such is the case of the GIS.

4 FINAL CONSIDERATIONS

Throughout this article, it was possible to observe some of the potential applications and contributions of the Geographic Information System (GIS) to the fields of urban planning and heritage preservation, considered together, through the study of the eighteenth-century

town of Tiradentes, in Brazil. Specifically addressing the transformation in the use of properties in the old core from the 1980s to 2017 and the expansion of the urban fabric, GIS first facilitated the visualization of these processes' relationships with tourism conditions in the locality during the same period. This was achieved through digital cartography generated using the technology in question. Furthermore, considering the current issues associated with the site, GIS also allowed the recognition of points to be observed in the actions of local authorities, providing the possibility of better addressing these issues through its role as a useful technology for territorial planning and management more structured and coordinated.

Finally, it was also possible to glimpse that GIS is conformed as a technology that is not only useful, but necessary for the aforementioned fields of urban planning and heritage preservation. Therefore, it needs to be better disseminated and explored especially by municipal administrations and heritage preservation agencies in view of the multiple contributions that, as seen, it can offer.

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