Resumos expandidos

Priority areas for identifying traditional agricultural systems in the agrotechnological districts of Jacupiranga-SP and Lagoinha-SP.

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Abstract

In this study, the landscape mosaic approach is presented as a strategy for identifying hotspots of Traditional Agricultural Systems (TAS). It analyzes land use and cover through spatial composition, resulting in a mapping strategy that links local socio-environmental interactions to territorial planning. However, identifying and characterizing TAS involves methodological challenges related to spatial heterogeneity. The approach is part of the contributions of the Remote Sensing axis of the Semear Digital project in connection with the Agro-Technological Districts (DATs). In this phase, we conducted an exploratory analysis to identify Priority Areas (PAs) based on the diversity of land use and land cover classes in the DATs of Lagoinha and Jacupiranga in São Paulo State. Six PAs were identified, one of which in Lagoinha. The composition and proportion of classes within the PAs reflect the historical patterns of land use and cover and the drivers of socioeconomic adaptations related to TAS. Technical, social, and economic factors necessary for methodological improvement were identified. The PAs can support the implementation of the mosaic-based approach and point to strategic areas for Semear Digital's engagement with the DATs.

Keywords: Remote Sensing; Rural Development; Traditional Peoples and Communities.

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1. Introduction

Hotspots of Traditional Agricultural Systems (TAS) are highly vulnerable to the loss of cultural and agro-environmental values in the face of sociocultural adaptations by the communities that maintain them (Solymosi, 2011; Tieskens et al., 2017). These are enclaves of unique agricultural systems, shaped by the interaction and interdependence of farming and extractivist activities with both tangible and intangible cultural elements (Eidt; Udry, 2019). Today, traditional territories preserve practices and knowledge crucial to achieving the global sustainable development goals of the 2030 Agenda (Nações Unidas Brasil, 2016). These territories hold rich agrobiodiversity and provide strategic ecosystem services (Santiago et al., 2024).

The Lagoinha and Jacupiranga DATs are located in the Alto Paraíba and the Ribeira Valley regions, areas with a significant presence of traditional communities. Their socio-cultural heritage stems from the interaction and adaptation of indigenous, Portuguese, and African elements, forming the basis of traditional culture in São Paulo State. (Santiago et al., 2024). When associated with intensive agricultural systems, the detection of TAS requires meticulous work to distinguish small plots within mosaics that may also include land uses linked to large-scale properties (Bermeo et al., 2014). Moreover, complexities arise from the spatial heterogeneity of the systems themselves (Jiang et al., 2022).

The landscape mosaic approach offers an alternative for overcoming these challenges. It involves analyzing land use and land cover through spatial composition, extracted using a moving window technique and weighted by local social, historical, and economic factors (Messerli et al., 2009; Schmid et al., 2021). Diversification is a crucial element in studies that historically characterized the landscapes of traditional populations in São Paulo. Although these systems may partially reproduce features of their surrounding landscapes, the diversification component stands out, particularly due to the prevalence of polyculture (Müller, 1951). In this context, this article presents the results of an exploratory analysis based on the mosaic approach. The objective is to identify Priority Areas (PAs) within the DATs of Jacupiranga and Lagoinha with diversified land use and land cover profile.

2. Methods

This analysis uses 2023 land use and land cover data from the MapBiomas project for the selected DATs, generated by automated classifiers based on the Landsat image series (Souza Júnior et al., 2020). Before the analysis, data were reclassified into eight categories: NVC – Natural Vegetation Cover; PA – Pasture; TC – Temporary Crop; PC – Perennial Crop; FP – Forest Plantation; MOU – Mosaic of Uses; NVA – Non-Vegetated Area; and WA – Water. To assess land use diversity, a focal operation using a 5 × 5 km moving window performed a neighborhood analysis by assigning each central pixel the number of distinct land cover classes in its surroundings (Longley et al., 2015). This procedure was carried out using the Focal Statistics tool in Variety mode, available in the Spatial Analyst extension of ArcGIS.

3. Results and Discussion

The analysis identified six Priority Areas (PAs) with a diversified composition of land cover classes, only one of which lies in Lagoinha (Figure 1). These areas do not correspond directly to the moving window used in the analysis; instead, they represent clusters of pixels that showed similar results regarding class variety within their surroundings. In this case, the maximum observed variety reached eight classes. The composition and proportion of classes within each PA (Table 1) reflect the historical land use and cover patterns in the DATs. In Jacupiranga, the PAs are predominantly covered by natural vegetation, particularly J3 (97.52%) and J4 (98.79%). In contrast, the PA in Lagoinha (L1) is mainly characterized by pasture (65.55%). Temporary crops appear more frequently than perennial crops (which remain below 0.5%) and are most notable in J5 (14.90%) and J1 (9.33%). Forest plantations (FP) play a minor role, with a slight increase only in J1 (2.76%).

Since the 1950s, extractivist and agropastoral practices within Traditional Agricultural Systems (TAS) have undergone intense socioeconomic transformation (Santiago, 2019). These shifts disrupted a subsistence-based economy centered on family farming and surplus exchange, historically linked to major urban markets. The emergence of a new urban-industrial rationality, supported by politics and science promoted the “overcoming” of traditional systems, triggered a dual process: exclusion—via devaluation of traditional products and loss of surplus markets—and subordinate inclusion into the dominant economic regime (Santiago, 2019). In Alto Paraíba, one major consequence was the intensification of cattle ranching, which converted former TAS and crop areas into

pasture. While present since the 19th century, ranching became dominant after the 1940s, driven by urban demand and new leaseholders (Shirley, 1977). In Lagoinha, the impact is clear: by 2023, pastures occupied an estimated 69% of the municipality—around 13,450 ha (Souza Júnior et al., 2020). In the Ribeira Valley, the process involved changes in land structure, infrastructure, and environmental regulation (Martines et al., 2023). This enabled banana monoculture, led by non-traditional producers, to expand and cause significant environmental and sociocultural impacts on TAS (Eidt; Udry, 2019). By 2017, roughly 44% of Jacupirangas' farms cultivated bananas, covering about 3,300 hectares (IBGE, 2017).

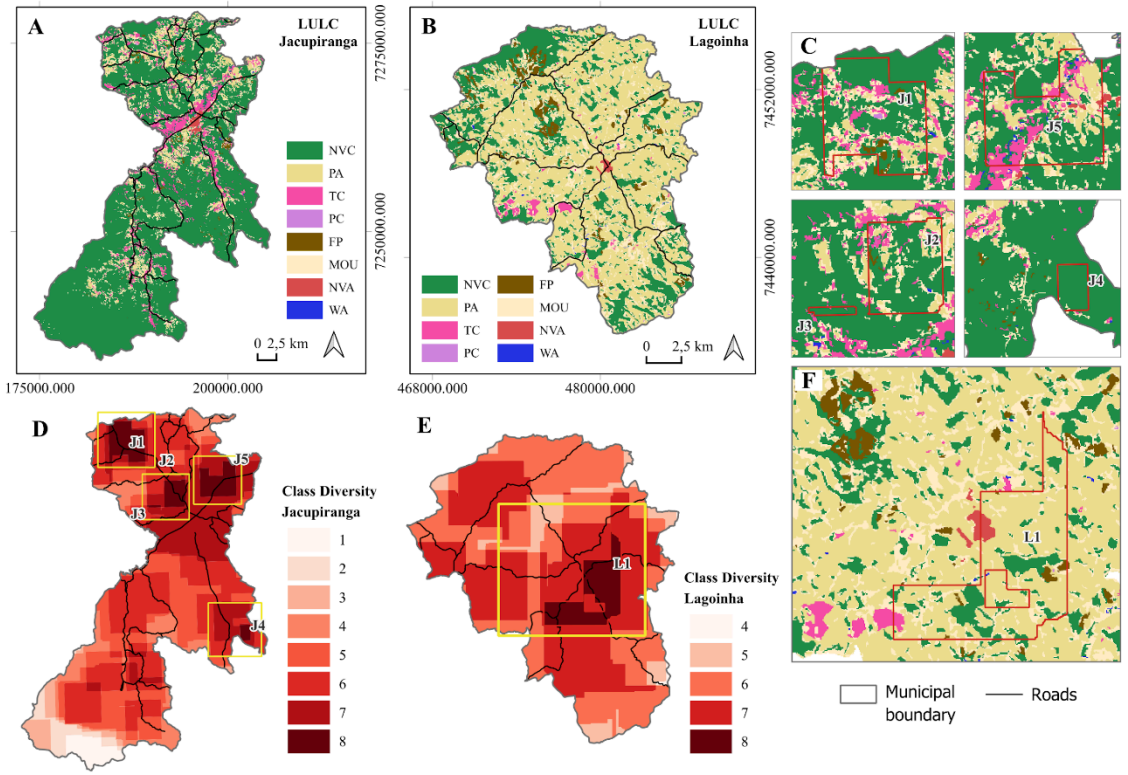

Figure 1. (A, B) Jacupiranga and Lagoinha in São Paulo State with respective Land Use and Land Cover (LULC); (D, E) Identified Priority Areas (PAs); and (C, F) Detailed view of LULC mosaics within selected PAs.

Source: Developed using MapBiomas (Souza Júnior et al., 2020) and IBGE (2023).

Table 1. LULC class distribution (%) in Priority Areas identified.

Priority Areas	Total Area (ha)	NVC	PA	C	C	FP	MOU	NVA	WA
J1	2014.50	58.27	8.44	9.33	0.40	2.76	20.70	0.07	0.03
J2	919.19	65.80	9.67	6.32	0.37	0.88	16.78	0.07	0.11
J3	45.74	97.52	0.00	2.48	0.00	0.00	0.00	0.00	0.00
J4	255.31	98.79	0.00	0.00	0.00	0.00	1.21	0.00	0.00
J5	1619.61	46.71	18.56	14.90	0.02	0.02	17.20	1.48	1.13
L1	1731.59	17.16	65.55	0.98	0.03	1.79	12.90	1.59	0.00

The dominance of banana cultivation in Jacupiranga appears underestimated in the MapBiomas data. Other classes, such as Mosaic of Uses (MOU), notably present in areas J1, J2, and J5 (Table 1), also suffer from imprecise classification (Souza Júnior et al., 2020), highlighting inherent limitations of orbital data. Despite this, the spatial resolution of the Landsat series aligns with the 5 × 5 km moving window used in the analysis and is widely applied in studies of TAS dynamics due to its temporal frequency (Schmid et al., 2021; Jiang et al., 2022). Still, physical, environmental, and agricultural factors often affect the spectral response of crops, limiting the accurate identification of crop types (Bègué et al., 2018). The moving window derives from models of shifting cultivation in tropical regions (Schmid et al., 2021), a practice still pertinent in TAS areas of São Paulo. National literature also proposes alternative methodological approaches using buffer zones, such as 100 m and 1 km to capture direct and indirect influence (Martines et al., 2023), or 20 km to represent kinship-based traditional networks (Santiago et al., 2024). However, these efforts are based on previously mapped traditional territories. The identified Priority Areas (PAs) may be refined through complementary parameters proposed by Solymosi (2011), enabling the identification of additional areas characterized by high class diversity (greater than five classes). These findings underscore the challenges of territorial planning in contexts shaped by ongoing socioeconomic adaptation. Any economic or technical strategies aimed at rural development in these regions must align with the principles that define TAS, ensuring that planning frameworks foster the inclusion and continuity of traditional communities (Santiago, 2019; Santiago et al., 2024).

4. Conclusion

- Priority areas J1, J2, J5, and L1 exhibit a spatial composition of land use and land cover (LULC) that is particularly relevant for implementing the TAS identification approach.
- Socioeconomic adaptation drivers play a key role in analyzing LULC patterns within TAS and help explain the distribution of identified Priority Areas across the DATs.
- Incorporating original LULC data produced by the Semear Digital project and applying additional analytical parameters may improve future results.

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