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Original Research

Indigenous land of Brazilian Cerrado and their changes in land cover

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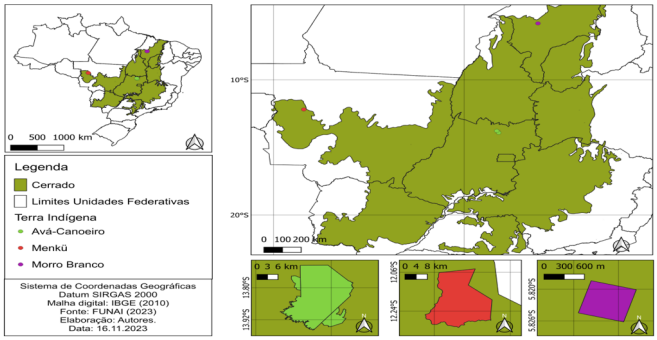

Abstract: This research compares the evolution of land cover change inside the Indigenous Lands (ILs) of the Brazilian Cerrado with changes occurring in their respective buffer zones delimited by 10km. For this, data from the MapBiomas platform are used, which provides the annual series of land cover data, and FUNAI's (National Foundation of Indigenous Peoples) mapping of indigenous lands. For land cover analysis, the annual period of 1985 and 2020 were considered and compared, using the map with the 2022 IL layout. In this research, three Indigenous Lands were discussed, which are Avá Canoeiro, Menka and Morro Branco, located in the Brazilian Cerrado biome. The results point to changes in land cover from 1985 to 2020 within the Indigenous Lands as well as in their buffer, therefore, it is considered that the delimitation of ILs contributes to the conservation of biodiversity in addition to serving as a space to protect the forms of relations of the original peoples. Finally, possible future paths for research in this area are highlighted.

Keywords: Cerrado, environmental fragility, indigenous lands, land cover, original people.

Introduction

The ILs are linked by traditional forms of land use. On the whole, these represent territories of resistance to the advance of agribusiness, since anthropogenic activities threaten the survival of these communities. Mining [1], intensive farming, advancement of urban structures, illegal mining, illegal wood exploration and contamination of water resources are some of the activities responsible for the ILs weakening [2].

The indigenous people have a great role in the biodiversity management of fauna [2] and vegetation. This is why their relationship with space is different from that of the rest of colonial and capitalist society, which are guided by the reification of nature in the name of extensive production of commodities and products [3]. The capitalist system of production and appropriation transforms nature's resources into merchandise, changes the landscape in quantitative and qualitative aspects, and violently interferes with the metastability conditions of ecosystems [3, 5].

The environmental discussion, which had its initial mark between 1940 and 1960, emerged in a political and social context where there is confidence in the advancement of scientific knowledge and technology, as being the tools responsible for solving socio-environmental impacts. Based on the discussions centered on developed countries and the discourse of accountability for human actions over natural resources and their management, the environmental debate distances itself from its necessary political character and becomes replaced by the behaviorist logic of a sustainable development, empty at its core of criticism [4].

Nature's resources are used to feed the productive logic, or even to maintain the current economic system that outsources the environmental impacts. In other words, with the advancement of globalization, the spoils of production serve to one point on the globe, or a specific class, while the destruction and barbarism are delivered to the other locations and another social class [5].

Study the land cover dynamics in a comparative way between ILs and their buffer zones to demonstrate the difference between these spaces, but in addition serve as an indicator to propose public policies for environmental

preservation and protection, an alert for a necessary modification in ways of reproducing and producing life, and a way to draw attention to preserve and protect the indigenous peoples and their culture.

The Yanomami people, for example, have suffered invasions into their territory from illegal mining since the 1980s. This has resulted in epidemics, child malnutrition and death of at least 15% of their population [6]. Only in 1991, after a lot of conflicts in a war scenario, through the Ação pela Cidadania (Action for Citizenship), and because of the emergency faced by Yanomami people, the Yanomami Sanitary District officially became recognized by the State and their responsibility to protect them [7].

However, it is seen in 2023 that in the last two years, in 2021, the Indigenous Health Special Secretary warned the former president that the Yanomami people were in a serious nutritional situation [6]. In March 2022, this scenario was changed again. With the inauguration of the current president, Lula, the Transition Commitment, and the end of presidential secrecy, these letters were only brought to light in 2023 [6, 7].

However, one should not adopt a mystifying view that indigenous peoples live in complete harmony with nature or cannot desire the social and economic development of their means of production and reproduction of life. The discussion presented in this paper is that the creation of ILs by the State requires the recognition of an area to be preserved and a people and their culture to be protected. It is noticeable that public policies for the creation of areas do not always satisfy the subjects they should (indigenous peoples), however, this is an issue that should be addressed in future research.

In this paper, the hypothesis is established that the ILs presents a lower rate of change in land cover compared to the buffer zones subject to exploration by agribusiness, between the years 1985 and 2020.

The main purpose of this article is to quantitatively analyze the contribution of Indigenous Lands (ILs) resistance to agricultural frontier advancement and biodiversity contribution.

Experimental Section

The data presented in this study were a cutout of the project FragTI – Indigenous Lands and Change in Land Cover, being a proposition of this project's work with all Indigenous Lands of Cerrado Biome and Rio Grande do Sul State, totaling 129 ILs, analyzing the years of 1985 to 2020 with a five-year interval. In this article, some of the ILs have been chosen that present resistance at the agricultural frontier in the Cerrado. This work presents only one part of the data that is currently being analyzed by the involved researchers.

Presentation of the study area

The Brazilian Cerrado has nearly 200 million hectares area, being the second largest biome in the national territory in terms of territorial extension, second only to the Amazon biome. It occupies approximately 22% of the country and this affects twelve states, including Goiás, Mato Grosso, Tocantins, Mato Grosso do Sul, Minas Gerais, Bahia, Piauí, Maranhão, Rondônia, Pará, São Paulo and Distrito Federal, in addition to within Amapá, Roraima and the Amazon itself [8].

It is a biome that began, and continues, to be discriminated against as a poor desert where can be freely explored [8,9], being the target of agrarian policies that favor monoculture, exploitation of logging and mining companies, as well as the exploitation of water resources, and it is noteworthy that, especially in this biome, the largest hydrographic basins in the country are concentrated [8–10].

Preliminarily, 25 ILs in the Cerrado biome and 5 in Rio Grande do Sul state were processed, for eight years pre-defined in the research project. These ILs were presented here as a previous part of the project FragTI. Their present a methodology and analysis test for the project. FragTI aims to investigate temporal trends in LULC and the impacts in ILs. Because of the location and field study of the researchers of the project, in this article we investigate ILs located in Cerrado and in Rio Grande do Sul state. Furthermore, we aim to analyze all ILs in Brazil to better understand the patterns of LULC and socioenvironmental crisis.

Although, in this article, only the years 1985 and 2020 were used to demonstrate a comparison between the starting year and the final year in the project analysis.

As well, in this article, only three ILs were addressed, all localized in the Cerrado biome: IL Avá Canoeiro, IL Morro Branco, and IL Menka, which were selected because they presented significant changes in land cover for the selected years (Figure 1).

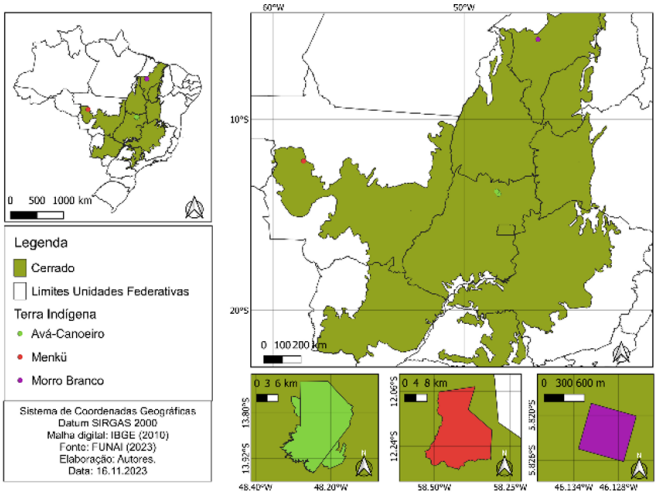

Figure 1. map of the location of IL Avá Canoeiro, IL Morro Branco and IL Menka.

Methodology analysis

With data from the annual land cover series available in Collection 6 of the MapBiomas Project platform [12], with a 30 m pixels, for the period of 1985 and 2020, and with the map of ILs existing in 2022 [13], it was possible to compare the evolu-

tion of land cover change within ILs with its 10 km buffer zone.

Initially, the data was processed in a geographic information system (GIS) using QGis software [11]. Therefore, the data was tabulated in electronic spreadsheets and land cover graphics were generated from the raster data analysis for zonal layers in QGis for the 10 km buffer zone and the ILs area for the studied period. The bar graphs were elaborated to demonstrate the evolution of land cover over the years for each class.

Results and Discussion

The Forest Formation to the IL Avá Canoeiro, within its limits, did not present significant modifications passing through the years 1985 to 2020 (30.4% and 30.0%, respectively), in the buffer zone, there was a reduction of this class (passing through 29.1% to 19.1%) [12].

In the IL Morro Branco, the Forest Formation in the buffer zone in 1985 was 30.0%, reducing to 12.0% in 2020 [12]. The same occurred in IL Menka, observing the years 1985–2020 with a forest reduction in the IL area (86.1% to 79.3%) and in their buffer zone (87.8% to 73.7%) [12].

The forest formation composes the Cerrado landscape and is a significant element of species richness [14, 15]. Its decline in the ILs with signs of the emergence of Soybeans and Other Agricultural Uses, shows a possible inadequate exploitation of forest resources. The Savanna Formation, a feature of the Cerrado region [16], presented a reduction within all three ILs and in their buffer zones (Figure 2). Pasture is understood here as an area that was previously predominantly planted and related to agribusiness activities, as shown in the MapBiomas classification. It showed an increase in this class in 2020 in all three ILs and their buffer zones. For example, the percentage in Morro Branco of the area with Pasture in the ILs was 1.3% in 1985, going to 2.9% in 2020 [12]. In the buffer zone, it was 2.6% in 1985, rising to 15.3% in 2020 [12]. The replacement of Savanna Formation by Pasture in the Cerrado, as shown by the reduction of one while the other increases, highlights the advancement of agriculture under the Cerrado or even on the agricultural frontier (Figure 2).

Mosaic Agriculture and Pasture were reduced from 1985 to 2020 in the ILs Avá Canoeiro and Morro Branco (Figures 2a and 2b), within the IL, and in their buffer zones. The Soybean shows up in the buffer zone of Morro Branco in 2020, with 2.2% of the cultivated area. At Menka, it occurred the same as in the 2020 year, wherein the soybean cultivation inside the IL limits was 6.2% and in the buffer zone was 13.9% [12]. Urban area in Morro Branco, in the buffer zone, was 1.2% (1985 year), presenting 4.3% in 2020, and inside ILs went to 72.2% [12]. This increase in urban zones can be related to the population growth that occurred in these two ILs between the years of 1989 and 2010.

This way, patterns of land cover change are observed in the ILs, using these three ILs as an example and their buffer zone limits, respectively. In general, when comparing the years 1985 with 2020, the Forest and Savanna Formation decreased in 2020 (Figure 2). In exchange, the Pasture, Mosaic Agriculture and Pasture, Soybean and Urbanization increase are some examples of anthropogenic actions that gain intensity through occupied areas, a fact already observed in other studies [17–19].

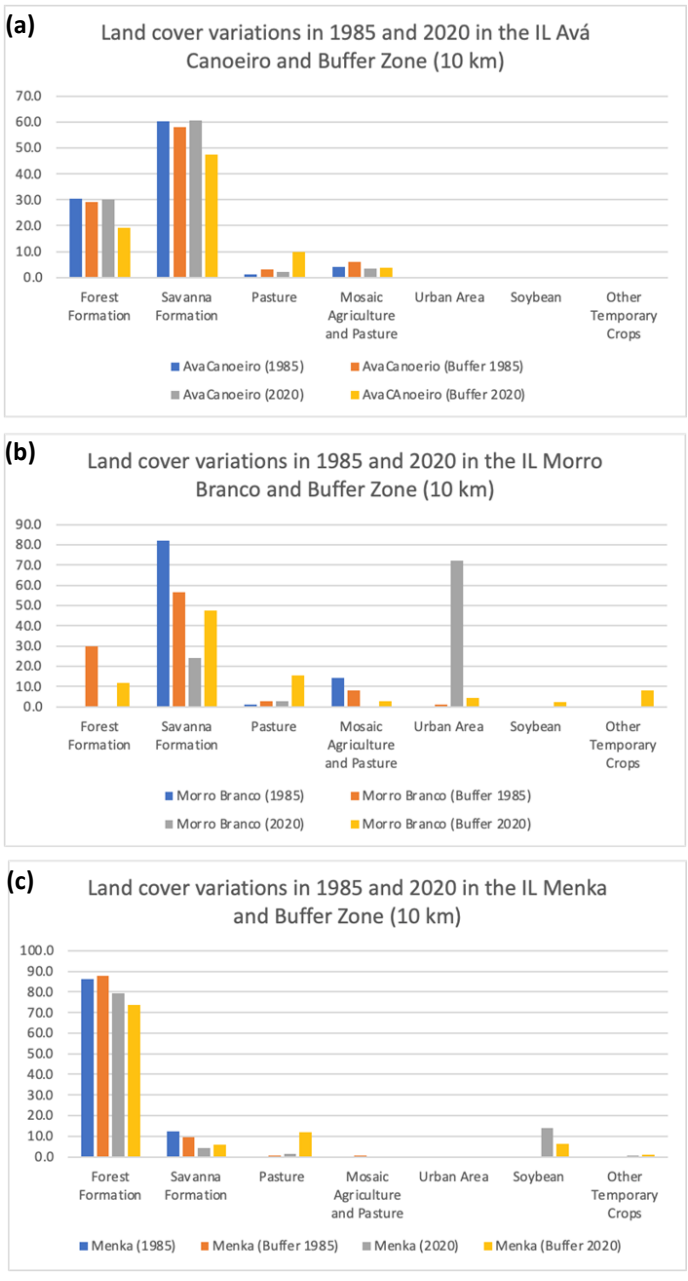

Figure 2. Land cover variations in 1985 and 2020 in (a) IL Avá Canoeiro and Buffer Zone (10 km), (b) IL Morro Branco and Buffer Zone (10 km), and (c) in IL Menka and Buffer Zone (10 km).

Conclusions

Finally, it can be seen that in the initial hypothesis of this article, the Cerrado ILs suffer pressure on their land cover with the incentive to agribusiness and the advancement of agricultural frontier. Since the Cerrado as a biome has always been seen as an exploitation zone for intensive agriculture, public policies, research and actions to the advancement of the agricultural frontier. Therefore, this situation reinforces the initial hypothesis that the institution of ILs, as a commitment to environmental management by the State, acts as a barrier against this advance.

The absence of planning for land use and occupation motivates exploration of native vegetated areas, which are extremely economically and environmentally important to indigenous communities and the rest of society. However, even if they serve as a barrier against the agricultural frontier, it can't be seen romantically that they prevent the use of these resources by the original communities. It is extremely important to break with this existing imaginary of development and construct new ways of land use that don't have the only possible horizon of barbarism.

The initial results of this research confirm the existence of different patterns of land use in the buffer zone and inside the ILs area, directly linked to changes in individual-nature relationships. The emergence of soybean and cultivated areas, or the conversion of savanna formation into agriculture, pasture, or forest plantation, shows a conversion of the phytophysiognomies of Cerrado to cater to the interests principally of the market.

Future research should be focused on the diverse landscape formations of Cerrado and their inter-correlations with the metastability state of the local and total ecosystem. Furthermore, the studies of the FragTI project will analyze the changes in land cover and use to comprehend the different dynamics of transformation in environmental relationships (nature-society-culture). Also, the dynamics of the culture-nature relationship within their communities will be investigated with indigenous members, so that it is possible to better understand the way in which public policies should act for the conservation and protection of original populations and nature.

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Authors Contribution

L. P. Marques: Writing-Original Draft, Formal Analysis, Methodology, Writing-Review & Editing; C. E. L. Dorneles Souza: Writing-Review & Editing; Analysis Review & Editing; M. de D. Cassenote: Formal Analysis, Writing-Original Draft, Writing-Review & Editing, Graphic Constructions & Editing; R. C. Cruz: Writing-Review & Editing, Supervision, Project Administration. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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