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Temporal Dynamics of Land Cover and Phytosociological Parameters in Cerrado at CEBUDV, Cuiabá, Mato Grosso

Frederico Fernandes Neto[1]
Secretaria de Estado de Educação de Mato Grosso

Maria Corette Pasa[2]
Universidade Federal de Mato Grosso

Gabriel Henrique Pires de Mello Ribeiro[3]
Universidade Federal de Mato Grosso

ABSTRACT

This study examines the temporal dynamics of land cover and phytosociological parameters in a 1.6 ha area managed by the Centro Espírita Beneficente União do Vegetal (CEBUDV) community in Cuiabá-MT, Brazil. Over a 35-year period, satellite imagery assessed land use changes, while a full inventory recorded 2,100 individuals from 35 species, 33 genera, and 18 families. The Fabaceae family was the most abundant. The five species with the highest Expanded Value of Importance (EVI)—*Machaerium hirtum, Astronium fraxinifolium, Astronium urundeuva, Cordia trichotoma*, and *Magonia pubescens*—accounted for 58.45% of the total EVI. The basal area was 11.38 m².ha⁻¹, and density was 1,313 ind.ha⁻¹. Predominantly anemochoric dispersal (87.42%) indicates adaptation to open areas, while zoocoric (11.9%) dispersal emphasizes the role of fauna in ecological dynamics. The low proportion of trees in the inferior stratum (9.3%) suggests barriers to natural regeneration, with findings indicating that abandoned pastures may evolve into encroached savanna states.

Keywords: Abandoned pastures; Natural Regeneration; Expanded Value of Importance; Dispersal modes; Vegetation types.

[1] Mestre em Ciências Florestais e Ambientais pela Universidade Federal de Mato Grosso(UFMT), Secretaria de Estado de Educação, Cuiabá –MT. Palácio Paiaguás - Rua Des. Carlos Avalone, s/n - Centro Político Administrativo CEP: 78049-903. **ORCID**: https://orcid.org/0009-0003-6822-3577.
Lattes: http://lattes.cnpq.br/0571497613681079. **E-mail:** fredericoico@yahoo.com.br.
[2]Doutora em Ecologia e Recursos Naturais pela Universidade Federal de São Carlos (UFSCar). Professora do Instituto de Biociências da Universidade Federal de Mato Grosso, Cuiabá, Mato Grosso, Brasil. Av. Fernando Corrêa da Costa, nº 2367 Bairro Boa Esperança – CEP: 78060-900. **ORCID:** https://orcid.org/0000-0001-5304-5294.
Lattes: http://lattes.cnpq.br/6935789833701375. **E-mail:** pasaufmt@gmail.com.
[3]Doutor em Ciências de Florestas Tropicais pelo Instituto Nacional de Pesquisas da Amazônia (INPA). Professor da Faculdade de Engenharia Florestal da Universidade Federal de Mato Grosso, Cuiabá, Mato Grosso, Brasil. Av. Fernando Corrêa da Costa, 2365. Bairro Boa Esperança. CEP: 78060-900. **ORCID:** https://orcid.org/0000-0002-3343-3043.
Lattes: http://lattes.cnpq.br/5790046030990301. E-mail: gabrielribeiro@ufmt.br.

Dinâmicas Temporais da Cobertura do Solo e Parâmetros Fitossociológicos no Cerrado no CEBUDV, Cuiabá, Mato Grosso.

RESUMO

Este estudo examina as dinâmicas temporais da cobertura do solo e dos parâmetros fitossociológicos em 1,6 ha do Centro Espírita Beneficente União do Vegetal (CEBUDV) em Cuiabá. Imagens de satélite foram analisadas (período de 35 anos), para avaliar as mudanças no uso da terra, enquanto um inventário florestal registrou 2.100 indivíduos de 35 espécies, 33 gêneros e 18 famílias. A família Fabaceae foi a mais abundante. As cinco espécies —*Machaerium hirtum*, *Astronium fraxinifolium*, *Astronium urundeuva*, *Cordia trichotoma* e *Magonia pubescens*—representaram 58,45% do Valor Expandido de Importância. A área basal foi de 11,38 m².ha⁻¹, e a densidade foi de 1.313 ind.ha⁻¹. A dispersão predominantemente anemocórica (87,42%) indica adaptação a áreas abertas, enquanto a dispersão zoocórica (11,9%) enfatiza o papel da fauna nas dinâmicas ecológicas. A baixa proporção de árvores no estrato inferior (9,3%) sugere barreiras à regeneração natural, indicando que pastagens abandonadas sem intervenção humana não retornam a fitofisionomia original.

Palavras-chave: Pastagens abandonadas; Regeneração natural; Valor Expandido de Importância; Modos de dispersão; Tipos de vegetação.

Dinámicas Temporales de la Cobertura del Suelo y Parámetros Fitosociológicos en el Cerrado en CEBUDV, Cuiabá, Mato Grosso.

RESUMEN

Este estudio analiza la dinámica temporal de la cobertura del suelo y los parámetros fitosociológicos en 1.6 ha gestionadas por la comunidad del Centro Espírita Beneficente União do Vegetal (CEBUDV) en Cuiabá, Brasil. Durante 35 años, imágenes satelitales evidenciaron cambios en el uso del suelo, y un inventario registró 2.100 individuos de 35 especies, 33 géneros y 18 familias. Fabaceae fue la familia dominante. Cinco especies—*Machaerium hirtum*, *Astronium fraxinifolium*, *Astronium urundeuva*, *Cordia trichotoma* y *Magonia pubescens*—acumularon el 58,45% del Enhanced Vegetation Index (EVI). El área basal fue de 11,38 m².ha⁻¹ y la densidad de 1.313 ind.ha⁻¹. La dispersión anemocórica (87,42%) sugiere adaptación a áreas abiertas, mientras que la zoocórica (11,9%) resalta el rol de la fauna. La baja proporción de árboles en el estrato inferior (9,3%) indica obstáculos para la regeneración natural, sugiriendo que los pastizales abandonados no recuperan su fitofisionomía original sin intervención.

Palabras clave: Pastizales abandonados; Regeneración natural; Valor Expandido de Importancia; Modos de dispersión; Tipos de vegetación.

INTRODUCTION

The rapid urbanization of Cuiabá, where approximately 98% of the population now resides in urban areas, began accelerating in the 1970s (VILANOVA; MAITELLI, 2009). During the 1980s, the city experienced its highest population growth rate, leading to a 136% expansion of its urban site into peripheral areas (BARROS, 2018). This urbanization has led to three significant phases of landform modification: 1) the foundation of the urban site in the 18th century; 2) the agricultural frontier expansion in the 1970s and 1980s; and 3) intensified real estate speculation in the 1990s, 2000s, and 2010s (VILARINHO NETO, 2009; VOLOCHKO, 2013). In 2003, the urban perimeter was expanded to include the Núcleo Habitacional Sucuri

Condominium for relocating residents from flood-risk areas and due to a mistake, the expansion occurred along the access road to the Distrito da Guia (SANTOS et al., 2022).

Known as the "green city," Cuiabá's urban green spaces are diminishing (FRANCO; NOGUEIRA; NOGUEIRA, 2013). Industrial development, the replacement of native vegetation with buildings, and changes in land use have significantly altered the local landscape (SILVA; TARIFA, 2017). The city's original vegetation, predominantly cerrado, now only persists in peripheral areas earmarked for urban expansion and permanent preservation (MAITELLI; DUBREUIL; DE MUSIS, 2014).

In 2019, about 54% of the Cerrado was still covered by vegetation, though studies on its fragmentation are scarce (POMPEU; ASSIS; OMETTO, 2024). Forest fragmentation reduces habitat, species diversity, and connectivity between environments, leading to smaller, isolated forest fragments within a landscape heavily altered by human activity (COSTA, MATRICARDI, et al., 2015; HADDAD et al., 2015).

Floristic and phytosociological surveys are vital for assessing richness and diversity and supporting studies on the restoration of degraded areas (ALMEIDA, 2016; GOMES CHAVES et al., 2013). In the last 60 years, 485 articles on floristics and phytosociology in Cerrado areas have been published, with 70 conducted in Mato Grosso (LIMA et al., 2020). Research on forest fragmentation in Brazil is concentrated in the Atlantic Forest, accounting for 63% of scientific publications in this field (TEIXIDO et al., 2020).

This study aimed to analyze the temporal dynamics of vegetation cover and evaluate phytosociological parameters in terms of composition, structure, and diversity in an area managed by the Centro Espírita Beneficente União do Vegetal (CEBUDV) community group, in the 13th Region of Núcleo Arvoredo, Cuiabá, Mato Grosso, Brazil. We hypothesized that the CEBUDV area would exhibit a recovery of natural areas, whereas the Buffer area would experience a loss of native vegetation (in line with the patterns of land use change observed in Mato Grosso State by SOUZA *et al.* 2020).

MATERIALS AND METHODS

Study Area

The study was carried out in the Midwest region of Brazil, in the state of Mato Grosso, at the Administrative Unit of the União do Vegetal (UDV), Arvoredo Center, belonging to the 13th Region of the Institution, located on the Santa Rosa Sucuri Tarumã road – 9 km (about 7.3

km away from the Núcleo Habitacional Sucuri Condominium), which is part of the CEBUDV group community, from the 13th Region, Núcleo Arvoredo, in the city of Cuiabá, at the geographical coordinates 15°31´22.27´´S e 56°10´33.10´´W (Figure 1).

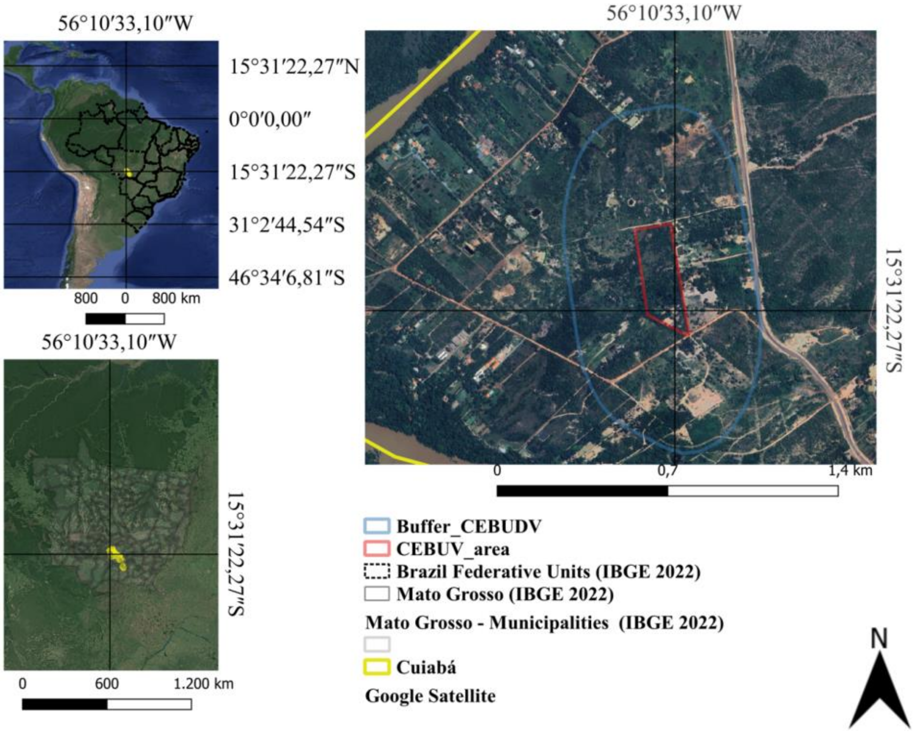


Figure 1. Location of the study area, near Cuiabá municipality, in the state of Mato Grosso, Brazil.

The climate of the region is classified as Aw, according to the Köppen system, characterized by two distinct seasons: a rainy season and a dry season. The dry season extends from May to September, during which the largest temperature variations are observed (ALVARES et al., 2014). During this period, relative humidity decreases notably, and temperatures fluctuate between 30°C and 36°C (SANTOS, 2013), occasionally exceeding 40°C.

The Cuiabá Depression is predominantly composed of lithologies from the Cuiabá Group. Pedologically, Concretionary Soils are the primary representatives, with significant occurrences of concretionary and non-concretionary Cambisols, plinthic and non-plinthic, rocky and non-rocky, with medium and clayey textures. Red-Yellow and Red-Dark Latosols, associated with the material covering the lithologies of the Cuiabá Group, are consistently present in this region, all under Tropical Subcaducifolious Cerrado vegetation (CPRM, 2006). In addition, Orthic Quartzarenic Neosols predominate over sandstone formations in the area (SANTOS et al., 2022).

Spatiotemporal analysis

The characterization of land use and occupation changes was based on data generated by the Annual Mapping Project of Land Use and Coverage in Brazil (MapBiomas, Collection 9: 1985 to 2023, launched in August 2024). The MapBiomas initiative, established in 2015, is a collaboration between universities, non-governmental organizations, and technology companies aimed at developing a fast, reliable, and low-cost method for producing annual time-series maps of Brazil's land cover and land use (LCLU) at a 30-meter resolution. This initiative seeks to enhance the understanding of land use dynamics in Brazil.

The dataset used for MapBiomas Collections 1 through 9 was obtained from imagery captured by the Landsat sensors Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and the Operational Land Imager and Thermal Infrared Sensor (OLI-TIRS), onboard Landsat 5, Landsat 7, Landsat 8, and Landsat 9, respectively. These Landsat imagery collections, with 30-meter resolution, were made accessible via the Google Earth Engine platform, and produced by NASA and the USGS (https://brasil.mapbiomas.org/wp-content/uploads/sites/4/2024/08/ATBD-Collection-9-v2.docx.pdf).

Using Google Earth Engine (GEE), land cover rasters from MapBiomas were extracted for the study area, along with an analysis of the surroundings using a 0.5 km² buffer at five-year intervals between 1985 and 2020. Subsequently, the data were reclassified using QGIS 3.8 software to generate relevant metrics and cartography for the study area.

Phytosociological survey

The data were obtained from a forest census, or 100% inventory, due to the small size of the study area (1.6 ha). All living tree and shrub individuals with a diameter of ≥5 cm at ground level (D_{30cm}, 0.3 m above the ground) had their D_{30cm} and total height (H) measured and were identified. For species nomenclature, The International Plant Names Index system was used along with accepted names according to the Flora of Brazil project (available at http://floradobrasil.jbrj.gov.br/), while taxonomy followed the APG IV classification system (APG IV, 2016). For individuals bifurcated below DAP, each trunk was measured separately, and their quadratic diameters (Dq) were later calculated following the methodology of Scolforo (1994).

The floristic composition was analyzed by tabulating the species according to their botanical families. Species were categorized based on their likelihood to indicate the phytophysiognomies of the Cerrado Biome and according to their dispersal syndromes

(PERES, 2016; BUENO et al., 2018). In the evaluation of horizontal structure (Table 1), the phytosociological parameters considered were density, dominance, frequency, and rankings, calculated according to Mueller-Dombois and Ellenberg (1974). The sum of the relative parameters expresses the Importance Value Index (IVI%).

Table 1. Phytosociological parameters of forest horizontal structure

Absolute variables	Formula	Relative variables	Formula
Absolute Frequency of species *i* (%)	$FAi = \frac{Pi}{\sum_{i=1}^{n} Pi} * 100$	Relative Frequency of species *i* (%)	$FRi = \frac{FAi}{\sum_{i=1}^{n} FAi} * 100$
Absolute Density of species *i* (ind.ha^{-1})	$DAi = \frac{Ni}{A}$	Relative Density of species *i* (%)	$DRi = \frac{DAi}{\sum_{i=1}^{n} DAi} * 100$
Absolute Dominance of species *i* (m^2.ha^{-1})	$DoAi = \frac{Gi}{A}$	Relative Dominance of species *i* (%)	$DoRi = \frac{DoAi}{\sum_{i=1}^{n} DoAi} * 100$

In phytosociological studies, each stratum requires the calculation of its phytosociological value, enabling the assessment of the sociological position of each species. This information provides a more comprehensive understanding of the status of each species, as it complements the perspective offered by its horizontal structure (NETO et al., 2018). The IUFRO Method (LAMPRECHT, 1990) was selected due to its superior performance compared to other methods (Sociological Position, Vega, Longhi, Calegário, Souza, and Leite, and Hasenauer) as demonstrated in a previous study (NETO et al., 2018).

The dominant height is obtained by calculating the average height of the 80 trees with the largest circumference at breast height (CBH). This study uses the diameter at ground basis (30 cm above ground) for vertical stratification:

- Inferior stratum ($Hj < \frac{Hdom}{3}$)
- Middle stratum ($\frac{Hdom}{3} \leq Hj < \frac{(2*Hdom)}{3}$)
- Superior stratum ($Hj \geq \frac{(2*Hdom)}{3}$)

Where: Hj = height of j-th tree to be classified in the stratum.

Therefore, to evaluate the vertical structure, after defining each stratum, the methodology proposed by Finol (1971) was employed. The Absolute Sociological Position (s.P.abs.i) and Relative Sociological Position (s.Pi %) were calculated. The sum of s.Pi % and the Importance Value Index (IVI) expresses the Expanded Value of Importance (EVI %). The parameters were applied in accordance with Finol (1971) as follows:

$$s.P.|.|i = \sum_{j=1}^{j} (\frac{Nj}{N}) * Nij$$

$$s.Pi = \frac{s.P.|.|i}{\sum_i^S s.P.|.|i} * 100$$

were:

Nj = number of individuals of the ith stratum;

N = total number of individuals of all species in all strata;

Nij = number of individuals of the ith specie in the jth height strata;

S = number of all species in all plots.

RESULTS

Spatiotemporal analysis of Land use changes

At the spatial distribution level within the 0.5 km² buffer zone (Figure 2), six land use and occupation classes were identified through a 35-year temporal analysis. These classes include: Savanna Formation, Pasture, Mosaic of Uses, Urban Area, Other Non-Vegetated Areas, and River, Lake, and Ocean. In contrast, within the study area of the Centro Espírita Beneficente União do Vegetal - Núcleo Arvoredo, three classes were identified: Savanna Formation, Pasture, and Mosaic of Uses.

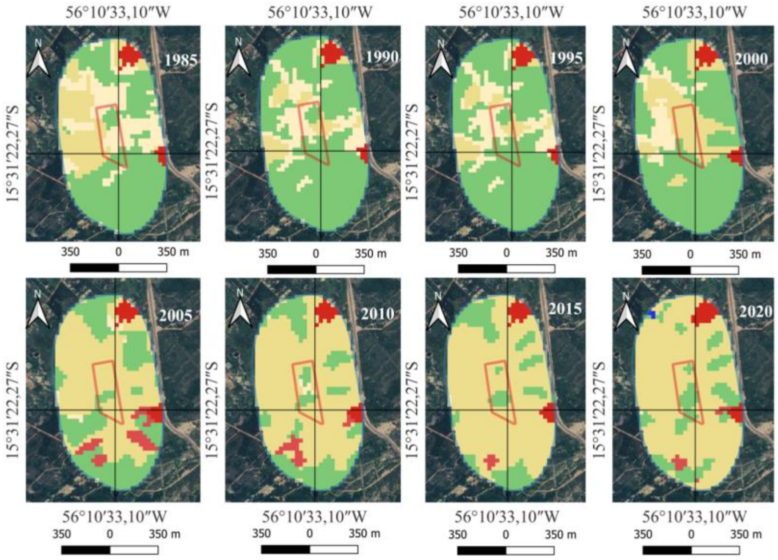


Figure 2. Spatiotemporal land use changes in CEBUV area and in a 0.5 km² buffer.

In percentage terms, it is evident that within our study area (Figure 3), there has been a significant shift toward natural conservation and preservation. These data highlight one of the key pillars of the Centro Espírita Beneficente União do Vegetal in its commitment to protecting nature. However, in the surrounding area (Figure 4), the landscape matrix reveals the opposite trend, with a reduction in the area covered by savanna formation.

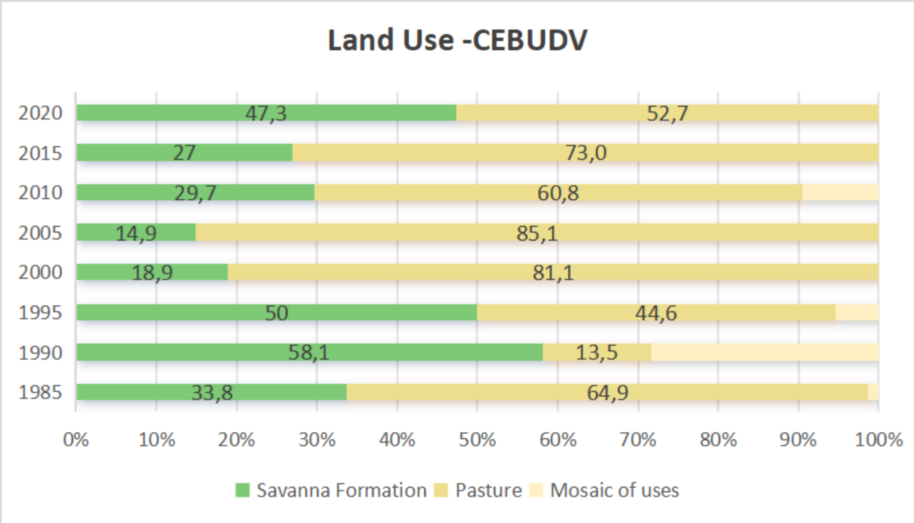


Figure 3. Land use changes in CEBUV area with 5 year interval from 1985-2020.

Among the identified significant variables explaining the loss of vegetation in the Cerrado, the distance to rivers was noted, where greater distances correlate with greater loss. In contrast, the distances from cities and roads exhibit an opposite trend compared to rivers. Additionally, factors such as agricultural potential, both permanent and annual crop agriculture, as well as cattle ranching, have historically contributed to vegetation loss (COLMAN et al., 2024).

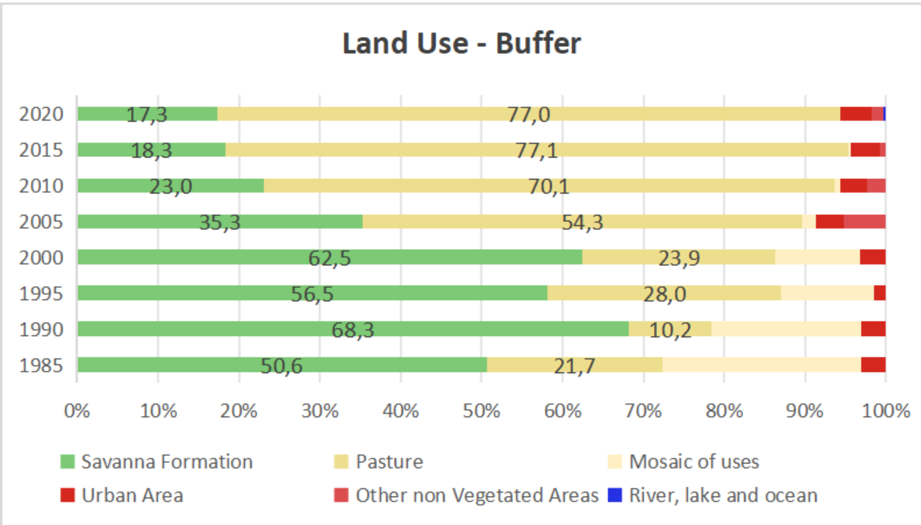


Figure 4. Land use changes in Buffer area with 5 year interval from 1985-2020.

Floristic composition and structure

Table 2 presents the overall floristic composition of the study area, along with the associated ecological characteristics linked to the dispersal syndrome the most frequently associated phytophysiognomy, and the relative phytosociological parameters of horizontal and vertical structure.

Table 2. CEBUDV Floristic composition, Vegetation type of higher occurrence probability, Dispersal syndromes, Relative Density (DR%), Relative Dominance (DoR%), Relative Frequency (FR%) and Relative sociological Position (s.P%) in 1.6 hectare

Family/Species	Vegetation type of higher occurrence probability	Dispersal syndromes	DR%	DoR%	FR%	s.P %
Anacardiaceae						
Astronium fraxinifolium Schott	Evergreen forests	Anemochory	12,43	13,85	7,24	11,45
Astronium urundeuva (Allemão) Engl.	Seasonally dry tropical forest	Anemochory	9,19	11,93	5,88	8,76
Annonaceae						
Xylopia aromatica (Lam.) Mart.	Dystrophic cerradão	Ornithochory (Birds)	0,76	0,24	2,26	0,66
Apocynaceae						
Hancornia speciosa Gomes	Dystrophic cerradão	Mastochory (Non- flying mammals)	0,10	0,04	0,45	0,12
Bignoniaceae						
Jacaranda cuspidifolia Mart.	Mesotrophic cerradão	Anemochory	7,95	7,42	6,33	7,83
Tabebuia aurea (Silva Manso) Benth. & Hook. f. ex S. Moore	Mesotrophic cerradão	Anemochory	3,48	3,14	7,24	3,49
Handroanthus impetiginosus (M art. ex DC.) Mattos	Seasonally dry tropical forest	Anemochory	0,05	0,07	0,45	0,02
Chrysobalanaceae						
Couepia grandiflora (Mart. & Zucc.) Benth. ex Hook. f.	Cerrado *sensu stricto*	Chiropterochory (Bats)	0,38	0,37	1,81	0,27
Combretaceae						
Terminalia argentea Mart. & Zucc.	Mesotrophic cerradão	Anemochory	0,86	0,76	3,17	0,70
Terminalia corrugata (Ducke) Gere & Boatwr.	Mesotrophic cerradão	Anemochory	0,24	0,42	1,36	0,20
Cordiaceae						
Cordia trichotoma (Vell.) Arráb. Ex Steud.	Seasonally dry tropical forest	Anemochory	8,43	13,24	6,79	6,76
Dilleniaceae						
Curatella americana L.	Mesotrophic cerradão	Ornithochory (Birds)	4,76	8,69	4,07	3,82
Fabaceae						

Machaerium hirtum (Vell.) Stellfeld	Seasonally dry tropical forest	Anemochory	26,38	19,47	7,24	31,13
Dipteryx alata Vogel	Mesotrophic cerradão	Mastochory (Non- flying mammals)	1,57	2,37	4,98	1,39
Hymenaea courbaril L.	Evergreen forests	Mastochory (Non- flying mammals)	1,62	1,58	4,07	1,36
Plathymenia reticulata Benth.	Dystrophic cerradão	Anemochory	0,29	0,15	1,36	0,27
Leptolobium dasycarpum Vogel	Dystrophic cerradão	Anemochory	0,10	0,08	0,90	0,12
Diptychandra aurantiaca Tul.	Mesotrophic cerradão	Anemochory	0,24	0,33	0,45	0,31
Vatairea macrocarpa (Benth.) Ducke	Dystrophic cerradão	Anemochory	0,05	0,04	0,45	0,06
Libidibia ferrea (Mart. Ex Tul.) L.P.Queiroz	Seasonally dry tropical forest	Autochory	0,05	0,01	0,45	0,06
Malvaceae						
Pseudobombax grandiflorum (C av.) A. Robyns	Seasonally dry tropical forest	Anemochory	6,48	7,00	5,88	5,94
Luehea paniculata Mart.	Dystrophic cerradão	Anemochory	0,29	0,64	1,81	0,15
Guazuma ulmifolia Lam.	Seasonally dry tropical forest	Mastochory (Non- flying mammals)	0,05	0,05	0,45	0,02
Metteniusaceae						
Emmotum nitens (Benth.) Miers	Cerrado *sensu stricto*	Chiropterochory (Bats)	0,05	0,04	0,90	0,06
Myrtaceae						
Eugenia dysenterica DC.	Dystrophic cerradão	Mastochory (Non- flying mammals)	0,57	0,45	2,26	0,55
Eucalyptus L'Hér.	NA	NA	0,14	0,05	0,90	0,10
Não identificada						
NI	NA	NA	0,52	0,77	2,71	0,49
Rubiaceae						
Alibertia edulis (Rich.) A.Rich.	Dystrophic cerradão	“Mixed”	0,81	0,23	3,17	0,73
Genipa americana L.	Evergreen forests	“Mixed”	0,10	0,07	0,90	0,12
Rutaceae						
Zanthoxylum rhoifolium Lam.	Evergreen forests	Ornithochory (Birds)	0,05	0,05	0,45	0,06
Sapindaceae						
Magonia pubescens A. St.-Hil.	Mesotrophic cerradão	Anemochory	10,67	5,10	6,33	11,55
Dilodendron bipinnatum Radlk.	Mesotrophic cerradão	Ornithochory (Birds)	0,86	0,98	3,17	0,87
Simaroubaceae						
Simarouba versicolor A. St.-Hil.	Mesotrophic cerradão	Ornithochory (Birds)	0,19	0,24	1,36	0,16
Urticaceae						

Cecropia pachystachya Trécul	Evergreen forests	“Mixed”	0,05	0,02	0,45	0,06
Vochysiaceae						
Callisthene fasciculata Mart.	Mesotrophic cerradão	Anemochory	0,29	0,12	2,26	0,33

A total of 2,100 tree and shrub individuals were evaluated, distributed across 35 species, 33 genera, and 18 botanical families. The richest families were Fabaceae (8 species), Bignoniaceae (3), Malvaceae (3), Anacardiaceae (2), Combretaceae (2), Myrtaceae (2), Rubiaceae (2), and Sapindaceae (2); the remaining botanical families each comprised one species. The most abundant forest species were *Machaerium hirtum* (Vell.) Stellfeld (555 individuals), *Astronium fraxinifolium* Schott (261), *Magonia pubescens* A. St.-Hil. (224), *Astronium urundeuva* (Allemão) Engl. (193), *Cordia trichotoma* Vell. (177), *Jacaranda cuspidifolia* Mart. (167), *Pseudobombax longiflorum* (Cav.) A. Robyns (136), and *Curatella americana* L. (100). The species were ranked in descending order based on their Expanded Value of Importance (Figure 5).

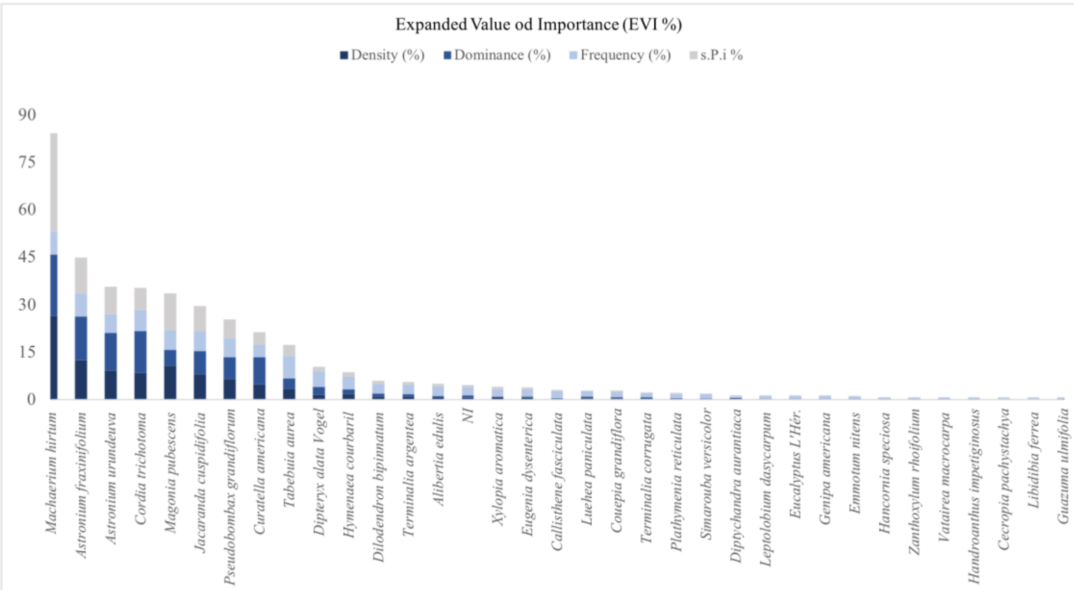
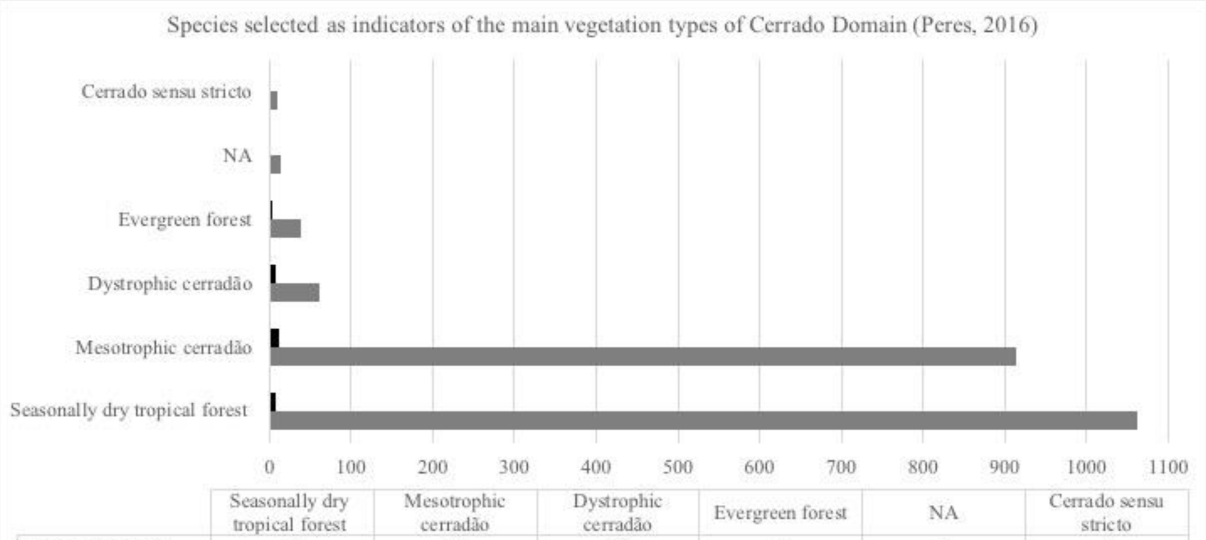


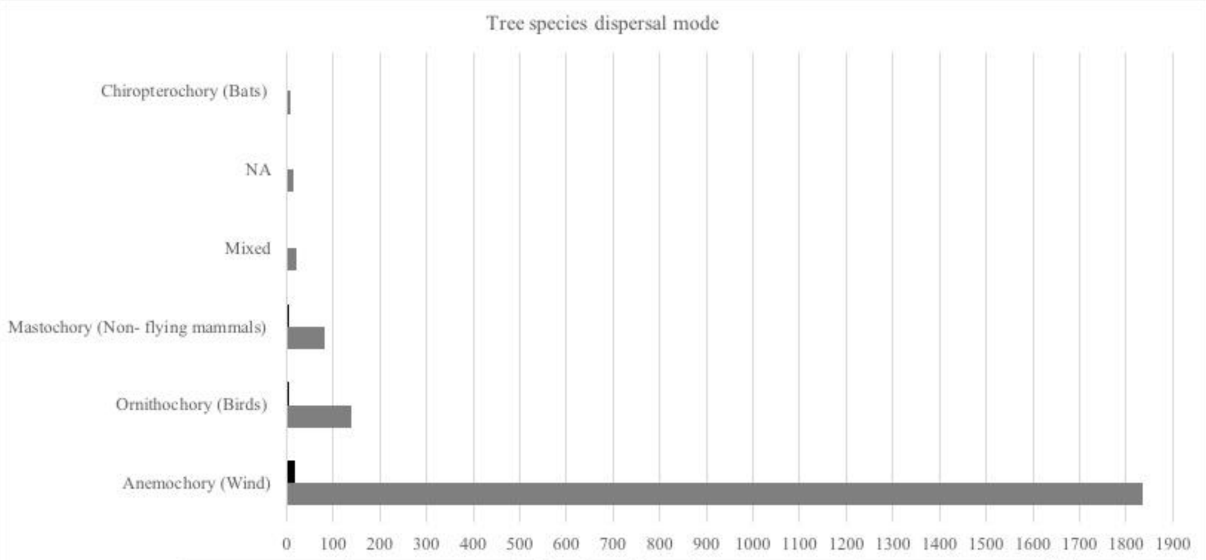
Figure 5. Representation of all species in descending order of Expanded Value of Importance.

The total number of individuals is 1,313 ind.ha⁻¹, with a basal area of 11.38 m².ha⁻¹. Among the individuals sampled from the total area of 1.6 ha, the majority are more likely to occur in seasonally dry tropical forests (50.62%) and 43.52% found in mesotrophic cerradão (Figure 6). Furthermore, 87.42% exhibit anemochoric dispersal strategies (Figure 7). Although less represented, 15 species (11.9%) have dispersal modes associated with fauna.



	Seasonally dry tropical forest	Mesotrophic cerradão	Dystrophic cerradão	Evergreen forest	NA	Cerrado sensu stricto
■ Species number	7	12	8	4	2	2
■ Tree density (1.6 ha)	1063	914	62	38	14	9

Figure 6. Species selected as indicators of the main vegetation types of Cerrado Domain (Peres, 2016).



	Anemochory (Wind)	Ornithochory (Birds)	Mastochory (Non-flying mammals)	Mixed	NA	Chiropterochory (Bats)
■ Species number	18	5	5	3	2	2
■ Tree density (1.6 ha)	1836	139	82	20	14	9

Figure 7. Tree species dispersal mode.

From the vertical structure, the inferior stratum (< 2.81 m), is composed by 196 individuals of 18 species, the middle stratum (≥ 2.81; < 5.63), had the majority of individuals (1474) and species (33), the superior stratum (≥ 5.63) had 430 individuals represented by 24 species. Considering all species, *Alibertia edulis* and *Xylopia aromatica* did not reach the superior stratum. The following species were exclusively found in the middle stratum: *Cecropia pachystachya*, *Diptychandra aurantiaca*, *Emmotum nitens*, *Genipa americana*, *Hancornia speciosa*, *Leptolobium dasycarpum*, *Libidibia ferrea*, *Vatairea macrocarpa* and

Zanthoxylum rhoifolium. Conversely, *Guazuma ulmifolia* and *Handroanthus impetiginosus* were restricted to the superior stratum, while *Callisthene fasciculata*, *Couepia grandiflora*, *Eucalyptus* L'Hér, *Luehea paniculata*, *Simarouba versicolor* and *Terminalia corrugata* were absent from the inferior stratum.

DISCUSSION

The data presented in the temporal analysis of land cover are consistent with studies conducted in the biome (LOPES DOS SANTOS et al., 2021). These studies highlight how anthropogenic activities, particularly large-scale intensive agriculture, have significantly increased over time, being identified as one of the main factors contributing to the degradation of natural areas in the Cerrado. In 2022, the area occupied by pastures in Mato Grosso totaled 20,768,509.299 ha, accounting for 23% of the state's total area (available at: https://atlasdaspastagens.ufg.br/map). Within the surrounding landscape matrix, there has been a decrease in the coverage of savanna formations, as also reported by Valeriano (2019), alongside an expansion of pasture areas.

Among the states containing Cerrado areas, Mato Grosso encompasses approximately 17% of the biome's total extent and has experienced the highest losses of native vegetation between 1985 and 2017, amounting to 25% of the state's Cerrado area (SOUZA et al., 2020). In contrast, within the Centro Espírita Beneficente União do Vegetal (CEBUDV), natural areas have shown signs of recovery, attributed to agroforestry systems implemented by UDV members (NETO et al., 2023). These systems have contributed significantly to the conservation and restoration of degraded areas (THEVENIN, PIROLI, 2017; THEVENIN, SAMBUICHI, 2020).

Regarding floristic composition, the botanical family Fabaceae was the richest and most abundant in the study area. This family is widely distributed in the Neotropical region, characterized by high species richness and abundance across all Cerrado phytophysiognomies (CASTRO et al., 1999; RIBEIRO et al., 2022). Other notable botanical families included Anacardiaceae, Malvaceae, Sapindaceae, and Bignoniaceae, which are also well represented at the biome level (GASTAUER et al., 2016). Fabaceae, in particular, serves as an important indicator in degraded areas, as it enhances soil nitrogen fixation through symbiosis with nitrogen-fixing bacteria (MOREIRA et al., 2014; PERIN et al., 2004), contributing to ecosystem recovery.

The species with the highest Expanded Value of Importance (EVI) were *Machaerium hirtum*, *Astronium fraxinifolium*, *Astronium urundeuva*, *Cordia trichotoma*, and *Magonia pubescens*. Together, these species accounted for 58.45% of the EVI and were associated with denser phytophysiognomies typical of forest formations. These species are indicative of secondary succession processes (CATHARINO et al., 2006; KUNZ et al., 2014), suggesting ongoing natural regeneration within the Núcleo Arvoredo.

Among the different Cerrado phytophysiognomies, three broad vegetation structures are recognized: grassland, savanna, and forest formations (RIBEIRO; WALTER, 1998). In a study conducted in Brasília-DF, seed dispersal syndromes were predominantly zoochoric, followed by anemochoric, across grasslands (69%, 27%), savannas (63%, 34%), and forest formations (72%, 23%) (PERES, 2016). However, contrary to expectations based on the literature, our study area exhibited a predominance of anemochory rather than zoochory. This pattern differs from broader findings in Minas Gerais, where a study on seed dispersal across Cerrado sensu stricto (CE), rainforests (RF), deciduous seasonally dry tropical forests (SDTF_D), and semideciduous seasonally dry tropical forests (SDTF_SD) found that 67.6% of tree species (891 out of 1,316) were zoochoric (GONÇALVES et al., 2024). In our study area, anemochorous species, typically associated with open, regenerating environments, were the most common. However, rather than being linked to savanna environments, most anemochorous species were associated with forest formations, challenging the expected trend. Despite being less frequent, zoochory was also observed, reinforcing its importance in the ecological dynamics of the Cerrado biome (CÂNDIDO; SOUSA; SOUZA, 2022). Additionally, Machaerium hirtum—an indicator of Seasonally Dry Tropical Forests—accounted for 26.4% of the total tree population in the study area (BUENO et al., 2018).

The low proportion of trees (9.3%) in the lower stratum suggests potential limitations to natural regeneration. Previous studies indicate that pastures may not necessarily transition to native vegetation even after decades of abandonment (SILVA et al., 2023). After pasture abandonment, regenerating communities are estimated to reach an ecological state resembling an encroached savanna within approximately 49 years. However, due to successional dynamics favoring forest structure, they are unlikely to revert to an old-growth savanna state (CAVA et al., 2018). This finding underscores the challenges of restoring native vegetation and the long-term ecological consequences of land-use change in the region.

CONCLUSIONS

Overall, the study highlights the intricate relationships between species composition, vegetation types, dispersal mechanisms, land use changes, and ecological recovery processes within the Cerrado biome, emphasizing the importance of conservation and sustainable land management practices. Centro Espírita Beneficente União do Vegetal in its commitment to protecting nature promoted a significant shift toward natural conservation and preservation.

The study area exhibits a rich floristic composition, with the Fabaceae family being the most abundant. This family is crucial for ecological restoration due to its nitrogen-fixing abilities, indicating a healthy potential for natural regeneration. Natural succession in the study area is likely to lead to forest structures over time, demonstrating the complexity of ecological recovery and the challenges of returning to a pre-disturbance state.

The predominant anemochory dispersal syndrome indicates adaptation to open areas and recovery processes, while the presence of zoocory emphasizes the importance of animal interactions in maintaining ecological dynamics and biodiversity in the Cerrado biome.

The species with the highest Expanded Value of Importance (EVI) suggest a trend toward secondary succession, which aligns with the area's ongoing recovery process, particularly after anthropogenic disturbances such as pasture abandonment. The low proportion of trees in the inferior stratum (9.3%) points to potential limitations in natural regeneration. Studies indicate that pastures, even after abandonment, may not revert to their original native vegetation state but may transition toward an encroached savanna over time.

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