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Environmental diagnosis of forest fragments belonging to the Santa Genebrinha ecological corridor, Campinas, São Paulo

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Abstract

Green areas, whether located in urban or rural environments, play an important role in maintaining ecological systems that provide vital environmental services for the quality of life of populations. In this sense, the present study assessed the environmental damage in the forest remnants that make up the Santa Genebrinha ecological corridor in Campinas city, São Paulo State, to identify limitations in the implementation and maintenance of this corridor. Initially, we surveyed geoindicators and the distribution of forest remnants in the Ribeirão Anhumas watershed, where the corridor is inserted. Subsequently, we developed an impact assessment matrix to quantify the main environmental damages affecting the forest remnants that make up this corridor. The results allowed us to identify the most impacting actions on the corridor: agriculture/monoculture, deforestation, burning, urbanization, and land use and occupation, with quantification (Q) averages of -7.6; -8.3; -7.3; -8.1; and -7.3, respectively, resulting in a high damage percentage (66.7%) for each action. The diagnosis pointed to local scope, direct incidence, and current temporality, reinforcing the need to consider these factors for implementation and management of the quoted corridor.

Keywords: Anthropic actions, geoprocessing, geoecological indicators, remaining natural vegetation.

Diagnóstico ambiental dos fragmentos florestais pertencentes ao corredor ecológico Santa Genebrinha, Campinas, São Paulo

Resumo

As áreas verdes, localizadas em ambientes urbanos ou rurais, desempenham papel fundamental para a manutenção dos sistemas ecológicos que fornecem serviços ambientais vitais à manutenção da qualidade de vida das populações. Nesse sentido, o presente estudo teve por objetivo levantar os danos ambientais ocorrentes nos remanescentes florestais que compõem o corredor ecológico Santa Genebrinha no município de Campinas/SP a fim de identificar as limitações na implantação e manutenção deste corredor. Inicialmente realizou-se um diagnóstico dos geoindicadores e da distribuição dos remanescentes florestais na Bacia do Ribeirão Anhumas, onde o corredor está inserido. Posteriormente aplicou-se uma matriz de avalição de impactos adaptada de forma a quantificar os principais danos ambientais que acometem os remanescentes florestais que compõem esse corredor. As ações mais impactantes observadas sobre o corredor foram: a agricultura/monocultura, o desmatamento, as queimadas, a urbanização e o uso e ocupação do solo, com médias para quantificação (Q) de -7,6; -8,3; -7,3; -8,1 e -7,3, respectivamente, acarretando em percentual para danos elevados de 66,7% para cada ação e diagnóstico de abrangência pontual, incidência direta e temporalidade atual, reforçando a necessidade de consideração destes fatores na implantação e gestão do corredor ecológico em estudo.

Palavras-chave: Ações antrópicas, geoprocessamento, indicadores geoecológicos, vegetação natural remanescente.

Introduction

Lack of urban planning coupled with poor urban management and social imbalances affect landscape quality, environmental components, and quality of life standards (Patra, Sahoo, Mishra, & Mahapatra, 2018). According to Maynard, Cruz and Gomes (2017), detecting human impacts on ecosystems is essential to make decisions consistent with the reality of each location.

In addition, understanding the interaction between natural and social elements is fundamental for establishing a systemic and integrated approach to territories. This process, called as geosystemic approach, aims to diagnose geosystems from their physical and social attributes, and lead to an appropriate territorial ordering (Pereira; Chávez, & Silva, 2012).

In this context, an effective tool for the spatial organization of these territories is watershed delimitation. Watershed planning enables the integration between anthropic and natural systems, thus approaching a condition closer to sustainability (Peres & Chiquito, 2012). To assess watershed status, in turn, it is necessary to apply qualitative and quantitative indicators for actions that aim, especially in urban watersheds, to raise the degree of human interference with the natural landscape (Carvalho, Curi, Carvalho, & Curi , 2011).

Studies indicate that more intensive land use can lead to a significant increase in landscape fragmentation, reducing vegetation cover areas and promoting their discontinuous arrangement (Chaves & Santos, 2009). Although the recovery of fragmented landscapes is still a challenge, there are alternatives for containing environmental degradation. Since the 1970s, one of the strategies for the conservation of fragmented ecosystems is the creation of ecological corridors. This alternative aims, above all, to increase the connectivity of the landscape, enabling the increase of fauna and flora and species displacement (Seoane, Diaz, Santos & Froufe, 2010; Greccio; Pissarra., & Rodrigues, 2009).

Ecological corridors are already part of the Brazilian environmental legislation since Federal Law No. 9,985/2000, which established the National System of Conservation Units (SNUC). In the second article of this Law, ecological corridors are defined as portions of natural or seminatural ecosystems that promote interconnection between natural areas and, thus, guarantee genetic flow, species dispersion, and habitats for species that need large extensions for survival (Lei nº 9.985, 2000).

This study assessed environmental damage in the forest remnants that make up the Santa Genebrinha ecological corridor, in Campinas city, São Paulo State, to identify limitations in the implementation and maintenance of this corridor.

Materials and Methods

Study area characterization

The Ribeirão Anhumas watershed is the largest watershed among Atibaia River contributors in Campinas city, Brazil. Its area extends from latitude 7,462,827 to 7,482,500 N and from longitude 282,500 to 296,870 E in the UTM Zone 23 S, with an approximate spatial extent of 150 km² distributed over the cities of Campinas (97%) and Paulínia (3%) (Torres, Adami, & Coelho, 2014).

Located over a transitional region between the Atlantic Forest and Cerrado biomes, the Ribeirão Anhumas watershed area can be called ecotone, in which there is a transition between two different ecosystems. Moreover, there may be tension and/or active interaction between them, resulting in distinct features in both adjacent ecosystems (Moro & Milan, 2016).

The Cerrado is a highly complex biome whose phytophysiognomy is distributed in a mosaic pattern, and can be presented under three distinct characteristics: grassland (clean field), savannah (dirty field), and forest (cerradão) (Coutinho, 2006). The Cerrado area in the Anhumas watershed is very small, corresponding to about 8.8% of the total area (Table 1), being one of the isolated patches of this biome occurring in the interior of São Paulo State (Empresa Brasileira de Pesquisa Agropecuária [Embrapa], 2013). The Atlantic Forest biome is predominant in the watershed. It is noteworthy that Brazil accounts for 33% to 36% of all plant species existing in this biome. However, forest fragmentation reducing this biome to small remnants is the main threat to its biodiversity (MMA, 2010).

Furthermore, the watershed is located in a transitional geomorphological region, with the occurrence of two Basic Compartmentation Units (UBCs): (1) Paraná Volcano-Sedimentary Basin - Peripheral Depression; and (2) Atlantic Orogenic Belt. These morphostructural units differ from each other in their structural, lithological, and geotectonic characteristics, which is linked to their genesis (Secretaria do Meio Ambiente de São Paulo, 2015). Regarding pedology, Red-Yellow Argisols (RYA = 40.3%) predominate, followed by Red Latosols (RL = 30.4%) and Red-Yellow Latosols (RYL = 19.6%) (Table 1) (EMBRAPA, 2008).

According to EMBRAPA (2019), Red-Yellow Argisols are deep and very deep, well drained soils, with predominance of the superficial horizon A and medium to clayey texture; however, their natural fertility is low. Red Latosols are distinguished by their reddish color due to high levels of iron oxides. These soils are deep and porous and generally have low amount of water available to plants and greater susceptibility to compaction. Red-Yellow Latosols, in turn, are also characterized by being well drained and deep. They are uniform in color, texture, and structure, and generally have low phosphorus contents under natural conditions.

Table 1. Geoindicators in the Ribeirão Anhumas watershed in Campinas city, São Paulo State, 2009.

Biome[1]	Atlantic Forest	91.2%
	Cerrado	8.8%
Geomorphology[2]	Paraná Volcano-Sedimentary Basin	84.9%
	Atlantic Orogenic Belt	15.1%
Pedology[3]	RYA	40.3%
	RA	1.6%
	RYL	19.6%
	RL	30.4%
	YL	0.9%
	Other classes	7.20%

(1) Map of São Paulo State biomes, on a 1:500,000 scale, produced by the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Environment (MMA) (IBGE, 2018); (2) Geomorphological Map of São Paulo State, on a 1:50,000 scale, produced by the Department of Geography of the Faculty of Philosophy, Letters and Human Sciences of the University of São Paulo (FFLCH) in partnership with the Institute for Technological Research (IPT) (ROSS & Moroz, 1997); (3) Mapping of soils, on a 1:50,000 scale (EMBRAPA, 2008).

Data collection and analysis

The watershed diagnosis was a priori based on the analysis of land use and occupation, performed from the "Map of Land Use and Coverage of UGRHI 05 (PCJ) - 2013" (Secretaria do Estado de São Paulo, 2013) from visual interpretation of

SPOT image with 10 m resolution for the period 2007 to 2009.

Then, forest remnants were mapped considering the subclasses of land use and occupation called "forest" and "reforestation". The fragments in the Anhumas watershed were mapped from the orthophotos for the year 2010, provided by Empresa Paulista de Planejamento Metropolitano (2010), and in comparison to the forest fragments identified by Futada (2007).

All analyses were performed using GIS software. From this survey it was possible to diagnose the watershed of interest, correlating geoecological factors (biome, geomorphology, pedology, and remnant vegetation) to socioeconomic factors (land use and occupation).

Considering the existence and distribution of forest fragments in this watershed, we took as object of study those fragments of the "Mata Santa Genebrinha - APP Ribeirão Anhumas" ecological corridor (Figure 1), a project that is part of the Municipal Plan of Green Areas of Campinas City and aims to protect and connect preservation areas between the universities PUC-CAMPINAS and UNICAMP.

The "Mata Santa Genebrinha - APP Ribeirão Anhumas" corridor is established by municipal legislation (Resolução n. 13 de julho de 2016) and has fifteen fragments, which together total approximately 82 ha and eleven watercourses (among them Ribeirão Anhumas and Ribeirão das Pedras) (https://informacao-didc.campinas.sp.gov.br). Table 2 summarizes the main information about the fragments.

Environmental Impact Assessment (EIA)

The environmental impact on the "Mata Santa Genebrinha - APP Ribeirão Anhumas" ecological corridor was assessed from the application of the Environmental Impact Assessment Matrix adapted to natural vegetation fragments (Gomes, 2017). To facilitate the matrix application, the forest fragments that make up the ecological corridor were grouped according to geographical location into six groups, so that in each group the fragments are no more than 250 m apart. Thus, 6 matrices were elaborated, which included the respective sets of fragments: M(1): F1, F10, F12, F14; M(2): F7, F15; M(3): F2; M(4): F13; M(5): F3, F4; and M(6): F5, F6, F8, F9, F11.

Environmental aspects of landscape relevance (agriculture/monoculture, movement of people, circulation of vehicles, deforestation, atmospheric emissions, burning, noise, urbanization, land use and occupation, rural and urban roads) were evaluated based on data collected through geoprocessing software.

Qualitative and quantitative parameters were then defined: benefit, absence of damage, low damage, moderate damage, and high damage, as suggested by Leopold et al. (1971) and applied by Gomes (2017). Moreover, three indicators that characterize damage and degradation (scope, incidence, and temporality) were applied, as described in Table 3.

Impacts were quantified (Q) according to the Equation $Q = C \times (P + R + Se + Si)$, whose attributes are shown in Table 3.

To discuss the results, we considered the average obtained for each impact action and for each damaged environment, that is, the average was calculated for each row and each column, being presented at the end of the matrix. For averaging, Equation $(\sum Q) \div 12$ was applied for impact actions, and Equation $(\sum Q) \div 19$ for damaged environment. Table 4 presents the final configuration of the Environmental Impact Assessment Matrix adapted for the present study.

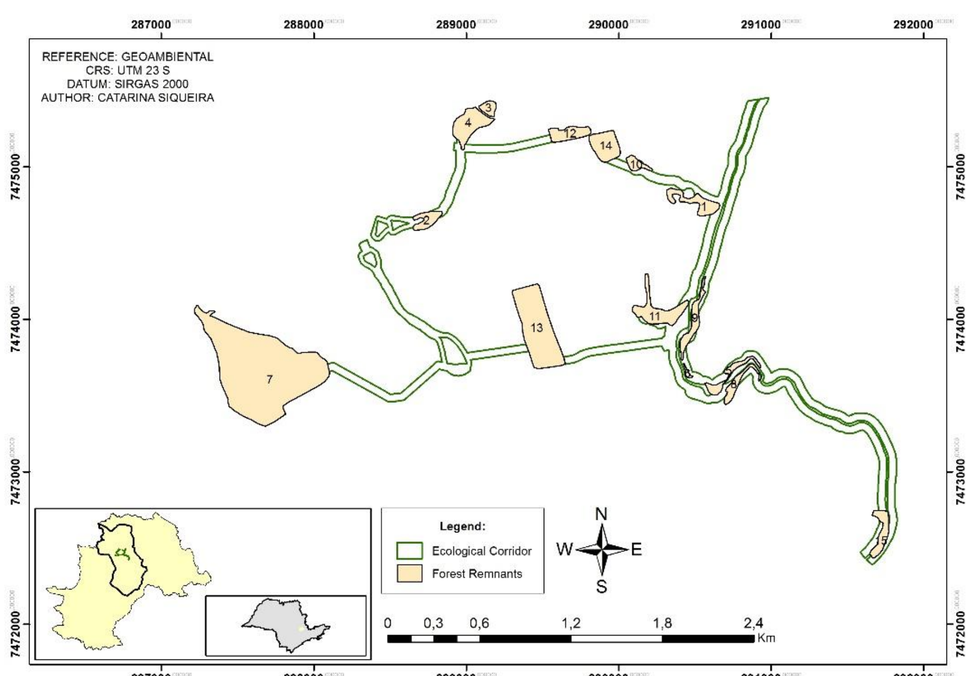

Figure 1. Map of "Mata Santa Genebrinha – Ribeirão Anhumas Permanent Preservation Area" ecological corridor, Campinas city, São Paulo State, 2016.

Table 2. Forest fragments of the “Santa Genebrinha - APP Ribeirão Anhumas” ecological corridor, Campinas city, São Paulo State, 2016.

	Fragment	Latitude (UTM)	Longitude (UTM)	Perimeter (m)	Area (m²)	Phytophysiognomy
F1	Mixed Forest - Argentina Farm	7474765.36	290503.25	1,089.31	22,972.18	Mixed Forest
F2	Swamp Forest - Argentina Farm	7474650.76	288741.07	648.56	14,182.85	Swamp Forest
F3	Swamp Forest - Argentina Farm	7475384.50	289147.84	342.69	7,832.72	Swamp Forest
F4	Swamp Forest - Argentina Farm	7475274.34	289020.66	858.74	34,895.7	Swamp Forest
F5	Mixed Forest - Anhumas Farm	7473624.33	290714.96	1,114.38	14,205.16	Mixed Forest
F6	Mixed Forest - Anhumas Farm	7473648.52	290450.34	254.33	1,762.31	Mixed Forest
F7	Semideciduous Seasonal Forest (SSF) - Santa Genebrinha	7473664.11	287654.09	2,716.93	330,514.19	SSF
F8	Mixed Forest - Sta. Cândida Farm	7473571.75	290776.75	931.94	12,722.42	Mixed Forest
F9	Mixed Forest - Anhumas Farm	7473977.91	290484.38	1,230.88	19,236.84	Mixed Forest
F10	Mixed Forest - Argentina Farm	7475016.04	290115.36	449.2	8,599.43	Mixed Forest
F11	SSF - Argentina Farm	7474054.46	290259.65	1,341.89	35,955.93	SSF
F12	Mixed Forest - Argentina Farm	7475216.34	289671.09	680.13	20,007.07	Mixed Forest
F13	SSF - Anhumas Farm	7473940.70	289468.25	1,463.92	105,102.42	SSF
F14	SSF - Anhumas Farm	7475136.59	289912.39	654.62	29,885,28	SSF
F15	Mixed Forest - Santana da Boa Vista Farm	7472602.19	291721.17	819.27	18,349.82	Mixed Forest

Source: adapted from Geoambiental (2016).

Table 3. Quantitative parameters and analytical indicators of the adapted (Gomes, 2017) EIA matrix.

Indicator		Description	Weighting
Analytical indicators	Scope	Identifies whether effects occurring in degraded areas are only felt in nearby areas or can cause environmental changes in distant areas.	Local (L) Regional (R)
	Incidence	Measures whether the impacts are linked to any environmental changes in the area or are consequences of unrelated changes.	Direct (D) Indirect (I)
	Temporality	Assesses whether the impact seen in the segment was due to a current activity or a past action.	Past actions (P) Current actions (C)
Quantitative parameter	Quantification (Q)	Grid quantification.	Benefit (0.1 to 12) Absence of damage (0) Low damage (-0.1 to -4) Moderate damage (-4.1 to -8) High damage (-8.1 to -12)
Quantification attributes	Character (C)	Multiplication parameter that indicates whether the impact is positive or negative.	Damage (-1) Benefit (1)
	Probability (P)	Indicates the favorable outlook for something to happen.	Low probability (1) Average probability (2) High probability (3)
	Reversibility (R)	Parameter that varies according to the flexibility of the environment for the recovery of its natural conditions.	Reversible damage (1) Reversible damage; however, with difficulty in reaching natural conditions (2) Irreversible damage (3)
	Severity (Se)	Indicates the degree of damage severity.	Little severe damage (1) Intermediate damage (2) Very severe damage (3)
	Significance (Si)	Parameter that measures impact significance considering the impact for all the analyzed environment.	Little significant damage (1) Intermediate damage (2) Very significant damage (3)

Table 4. Environmental Impact Assessment (EIA) Matrix adapted adapted (Gomes, 2017) for the present study.

$Q \geq 12$ Benefit	$Q = 0$ Absence of damage				$-0.1 \geq Q \geq -4$ Low damage						$-4.1 \geq Q \geq 8.0$ Moderate damage					$-8.1 \geq Q \geq -12.0$ High damage				Scope	Incidence	Temporality	Average
Scope L (local) R (regional) Incidence D (direct) I (indirect) Temporality P (past actions) C (current actions)	Physical characteristics				Biological characteristics						Landscape characteristics					Sociocultural characteristics							
	Erosion	Soil sealing	Soil pollution	Exposed soil	Fauna escape	Exotic fauna	Native fauna	Exotic flora	Native flora	Vegetation suppression	Nuclear area	Connectivity	Fragment shape	Circularity index	Fragment size	Irregular occupation	Diffuse pollution	Noise pollution	Visual pollution				
Agriculture/ Monoculture																							
Movement of people																							
Circulation of vehicles																							
Deforestation																							
Atmospheric emissions																							
Burning																							
Noise																							
Urbanization (buildings)																							
Land use and occupation																							
Rural road																							
Urban road																							
Scope																							
Incidence																							
Temporality																							
Average																							

Results and Discussion

From the land use and occupation data collected for this study, the use of the Ribeirão Anhumas watershed was reclassified into five classes (exposed soil, water resources, green areas, rural areas, and built-up areas), as shown in Figure 2A. There is a predominance of land use and occupation classes corresponding to impermeable surfaces. In general, it is a highly urbanized watershed, and this feature is reflected in the high percentage of built-up areas (49.80%). This configuration occurs especially in the upper course region, one of the first urbanization regions in Campinas city and which houses the highest demographic concentrations along with the verticalization process in the city (Carpi Júnior et al., 2006).

Associated with the high urbanization index, the watershed also presented low index of soil cover by green areas, corresponding to only 16.73% of the territory. Suppression of vegetation cover and the consequent reduction of green areas in urban centers emerge as a negative externality of urbanization (Amato-Lourenço, Moreira, Arantes, Silva Filho, & Mauad, 2016).

Both in terms of quantity and quality, soil sealing is still a major factor related to the observed hydrological changes in urban watersheds, such as increased flooding and erosion (Loboda & Angelis, 2005; Damame, Oliveira, & Longo, 2019).

Chaves and Santos (2009) highlighted that among the watersheds most impacted in terms of water quality are those that suffer or have suffered an accelerated occupation process. According to Carpi Júnior et al. (2006), the Ribeirão Anhumas watershed is an example of this. It is possible to find numerous flooding points, especially in the central region of Campinas city (upper course), which threatens the urban infrastructure due to the lack of rainwater infiltration.

However, not all green areas surveyed have the same relevance for environmental management purposes. An analysis of the typologies of green areas showed that this category is composed of the following subclasses: wetland, natural grassland, urban green space, forest, and reforestation, according to results presented in Table 5. These subclasses have very diverse characteristics regarding phytophysiognomy and therefore different importance for the environmental quality of the watershed.

The data presented in Table 3 show that the green areas in the Ribeirão Anhumas watershed consist mostly of natural grassland areas (42.90%). According to the Sistema

Ambiental Paulista DataGEO (2013), grassland areas correspond to rural areas with nonarboreal vegetation. There are also the classes “urban green space”, including squares and parks, and “wetlands”, represented by areas marginal to water bodies, but without the presence of tree cover (Silva & Longo, 2017). These areas are less representative and are not relevant for the purposes of this study, whose objective is to analyze the forest fragments of the watershed.

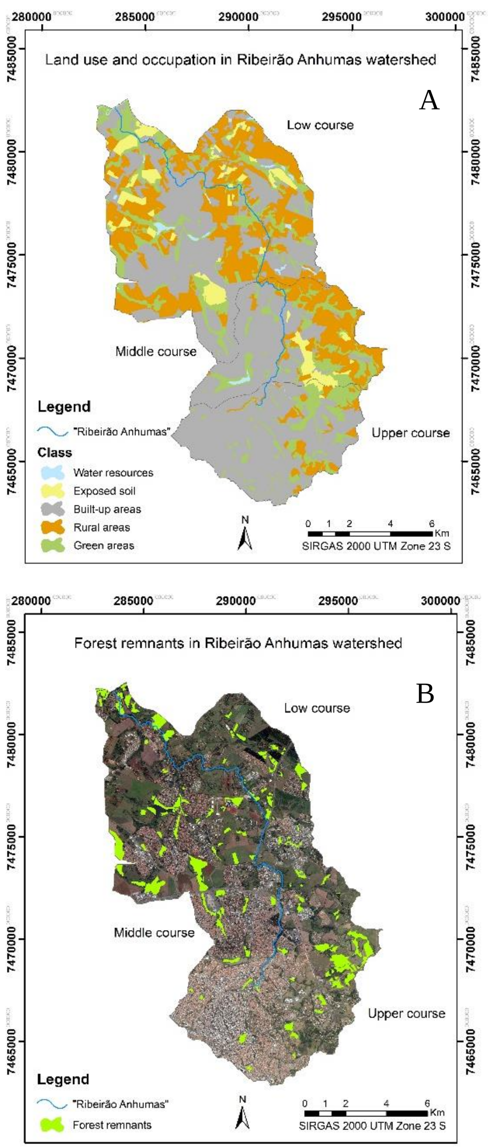

Figure 2. Land use and occupation (A) and distribution of forest remnants (B) in the Ribeirão Anhumas watershed, Campinas city, São Paulo State, 2009.

According to Silva and Longo (2017), forest fragments in the Ribeirão Anhumas watershed cover an area of 1,002.10 ha, which is equivalent to only 6.40% of the watershed. Among these, 65.09% are in the lower course region. The high number of fragments in a relatively small area indicates an intense process of landscape fragmentation. According to the definition of the Ministry of Environment (MMA)(2003), fragmentation is the phenomenon of fractionation of a previously continuous landscape or habitat. When fragmented and isolated, these areas begin to interact more effectively with the surrounding environments, becoming even more vulnerable to the edge effect, intensifying habitat changes and increasingly modifying that environment (Sampaio, 2011; Oliveira et al., 2015).

Table 5. Subclasses of Green Areas in the Ribeirão Anhumas watershed, Campinas city, São Paulo State, 2009.

Subclass	Area (ha)	% in relation to green areas
Wetland	18.81	0.72
Reforestation	167.34	6.39
Forest	965.73	36.88
Urban Green Space	343.30	13.11
Natural Grassland	1,123.44	42.90
Total Area	2,618.62	100.00

Regarding the results of the Environmental Impact Assessment, Figure 4 presents the selected relevant aspects (agriculture/monoculture, burning, etc.) and the respective percentages obtained in relation to the quantification given by the application of the adapted Environmental Impact Assessment (EIA) matrix in the six sets of fragments.

Except for the impacts “atmospheric emissions” and “noise”, all others presented a high classification percentage (Table 6), justifying the low environmental conditions found for the fragments in the ecological corridor. The impacts “agriculture/monoculture”, “deforestation”, “burning”, “urbanization (buildings)”, and “land use and occupation” emerged as the most aggravating, with the highest valuation for the “high” quantification.

Table 6. Quantification percentage of the impact actions listed in the EIA matrix

Impact actions	Benefit (%)	Absence of damage (%)	Low damage (%)	Moderate damage (%)	High damage (%)
Agriculture/ Monoculture	0	0	0	33.3	66.7
Movement of people	0	0	16.7	50	33.3
Circulation of vehicles	0	0	0	66.7	33.3
Deforestation	0	0	0	33.3	66.7
Atmospheric emissions	0	0	100	0	0,0
Burning	0	0	0	33.3	66.7
Noise	0	0	100	0	0,0
Urbanization (buildings)	0	0	0	33.3	66.7
Land use and occupation	0	0	0	33.3	66.7
Rural road	0	50	0	0	50,0
Urban road	0	0	0	50	50,0

According to Silva, Felizmino, & Oliveira (2015), one of the most significant environmental impacts in recent years has been the removal of land cover, particularly due to deforestation and intensive land use. Allied to this activity, the level of degradation resulting from anthropic activity observed in natural environments intensifies along with the urbanization process.

Since it involves the concentration of people and productive activities in a restricted space, urbanization generates environmental impacts with synergistic and persistent effects. However, it is not only the occupied land area that accounts for environmental impacts: the pattern of consumption and waste generation may require and impact an amount of natural resources that goes beyond the occupied area. In developing countries, urbanization is mostly associated with greater environmental degradation (Jatobá, 2011).

In a study conducted in the Amazon region, Santos, Andrade Filho, Rocha, & Menezes (2017) found that changes in land use patterns have been quite intense, significantly interfering with the climate of the region. According to the authors, deforestation and burning are the main causes of these impacts, since they emit trace gases and particles leading to negative changes in the hydrological cycle of the region, such as decreased rainfall, prolongation of the dry season, and changes in rainfall recycling.

In assessing the dynamics and succession of agricultural landscape patterns in Côcos city, Bahia State, Hessel, Carvalho Junior, Gomes, Martins, & Guimarães (2012) found a relationship between deforestation in the Cerrado biome and its appropriation, especially by entrepreneurs linked to the agribusiness and foreign market. The dynamics of land use and land cover in the aforementioned city, in the years of 1996 and 2008, showed that human interventions in forest areas usually occur from burning and deforestation. Roads are then established in these initially altered regions, causing the landscape to be divided and the Cerrado to be fragmented.

Schaadt & Vibrans (2015) also cited the same occupation configuration, in which deforestation and burning for the implantation of pasture; agriculture; homogeneous reforestation with exotic species; and the expansion of urban areas contributed to the reduction of the mixed ombrophilous forest area, which originally covered 45% of the territory of Santa Catarina State.

In this scenario of expansion and changes in land use, fragmentation processes are frequent. Economic development should also be considered as it makes the forest more fragmented for the benefit of other land uses. Thus, the application of techniques aimed at controlling and evaluating these fragmentation processes, such as spatial analysis, is fundamental (Costa, Matricardi, & Pires, 2015).

Complementarily, Figure 3 presents the comparison of diagnoses for analytical description of the studied remnants.

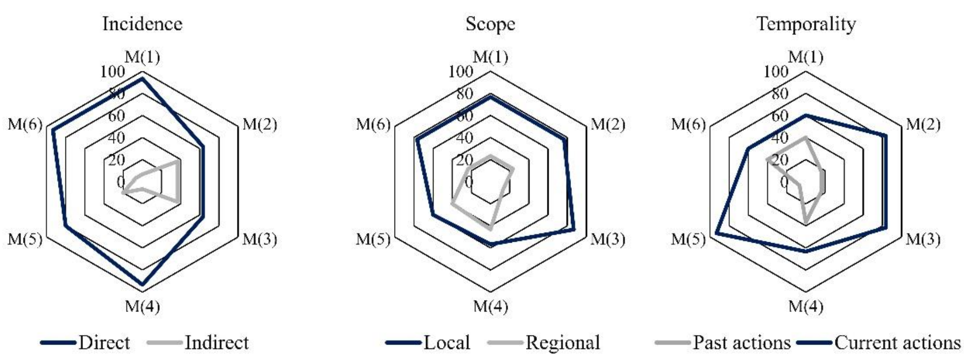

Figure 3. Comparison of EIA diagnoses for the studied fragments, Campinas city, São Paulo State, 2019. Distribution of fragments: M(1): F1, F10, F12, F14; M(2): F7, F15; M(3): F2; M(4): F13; M(5): F3, F4; and M(6): F5, F6, F8, F9, F11.

The analysis of Figure 3 allows the understanding that the impacts of direct incidence, local scope, and current temporality predominate in the analyzed sets of fragments. This is justifiable since urban occupation was directly responsible for the major changes suffered in the Ribeirão Anhumas watershed (Damame, Oliveira & Longo, 2019).

According to Rosa (2014), anthropic systems correspond to areas where there has been intense human intervention for land use, e.g., for agricultural development, animal husbandry, or mining. This would likely result in an analytical description of direct incidence, local scope, and past temporality. However, in the case under study, this system refers to an urban area with great growth potential and several active monoculture areas, so the temporality is still current.

Regarding the data obtained for incidence, the results of Sobral et al. (2007) in a study carried out in the Serra de Itabaiana National Park, Sergipe State, corroborate with the findings of this study. When evaluating the occurrence of nine impacting actions in the area of interest, such as burning, agricultural practices, wood removal, and trails, the authors found that these impacts were classified as negative and of direct origin. Notwithstanding, in assessing their scope, the authors classified burnings as regional, while the increase in erosion processes and the degradation of chemical water quality due to agricultural practices, in addition to wood removal and trails, were classified as local.

These differences are justified by the fact that the methods used in an EIA involve issues of subjectivity, since the matrices make use of weighting criteria of subjective grades and depend on the evaluator’s judgment.

Conclusions

The Ribeirão Anhumas watershed is located in a region where geomorphological structures and biomes (Atlantic Forest and Cerrado) are under transition, contributing to the rich biodiversity of the region. However, due to poor distribution of land use and occupation, there is a predominance of unnatural uses and sealed areas to the detriment of remaining natural areas.

The most impacting actions on the fragments analyzed are agriculture/monoculture, deforestation, burning, and urbanization. The average analytical diagnosis pointed to local scope, direct incidence, and current temporality, reinforcing the need for consideration of these factors during the implementation and management of the "Mata Santa Genebrinha" corridor.

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