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FOREST FIRES IN THE BRAZILIAN PANTANAL: A GEOGRAPHICAL READING

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ABSTRACT

The occurrence of forest fires in the Brazilian Pantanal results from changes in productive dynamics as a reflection of the advance of capitalist relations of production. This is the scope of this investigation whose objective is to identify the main causes of forest fires in the Pantanal and analyze the physical, political, social and economic aspects involved. As a technique for investigating empirical data, direct observation was used in two groups of inhabitants of the Pantanal of Mato Grosso do Norte, living in the municipalities of Cáceres and Poconé. The research script was composed of two central questions: a) why do forest fires occur in the Pantanal? b) What are the climatological, political, social and economic aspects involved? The primary information was grouped from the perspective of qualitative research. Secondary data were obtained from the Center for Weather Research and Climate Studies of the National Institute for Space Research (1998 – 2020). It is concluded that forest fires are not only due to events related to changes in climate dynamics, but occur due to the advance of the capitalist model of production, which appropriates agrarian space, determining transformations in the traditional models of nature management, contributing to the concentration of land structure, wealth and accentuating the destruction of biodiversity and sociodiversity.

Keywords: Forest fires, Agrarian space, Brazilian Pantanal, Cáceres and Poconé.

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INTRODUCTION

The present text has in its scope the premise that the occurrence of forest fires in the Brazilian Pantanal results from changes in productive dynamics as a reflection of the advance of capitalist relations of production, therefore it is not only a consequence of events pertinent to changes in climate dynamics, although this aspect is of paramount importance and greatly influences its explanation. Thus, when analyzing the occurrence of forest fires in the Pantanal, it is taken into account that capital appropriates the agrarian space, determining the uses of nature and social and production relations.

In this sense, geographic space is understood as social space, defined by Lefebvre (1991, p. 26) as a "(social) product" that is based on nature that is transformed by social groups through work. Thus, to interpret space it is essential to consider social relations as constituents and it is from them that nature is changed, so the social relations of production, consumption and (social) reproduction are determinants in the production of space, in addition, new relations can give different functions to preexisting forms, because space has elements from different times.

In Brazil, capitalism in its historical expansion redefines geographical space, the use of nature and the social relations of production, subordinating them to the global process of reproduction and accumulation of capital (DELGADO, 1985). Economic groups supported by government policies operationalize the onslaught of capital in the agrarian space with the objective of boosting international relations via the market, making use of modernization and expanding agribusiness based on the export of monocultures, which has a decisive impact on issues related to deforestation, as can be seen in figure 1.

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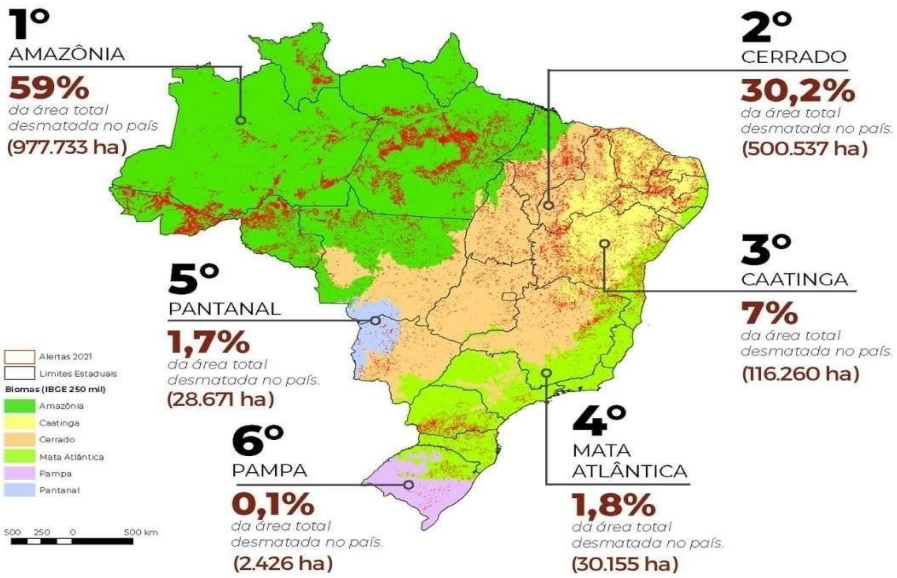
Figure 1 - Most deforested biomes according to MapBiomas



Source: MapBiomas Project, 2022.

Located in the states of Mato Grosso and Mato Grosso do Sul (Figure 2), whose economic bases are centered on agribusiness, the Pantanal has been the target of concerns due to the model based on monoculture, mainly grains and livestock, which is no longer practiced extensively and takes on intensive and semi-extensive characteristics, with the replacement of native pastures by cultivated pastures (ROSSETTO, 2015; SCHULZ, et al., 2019).

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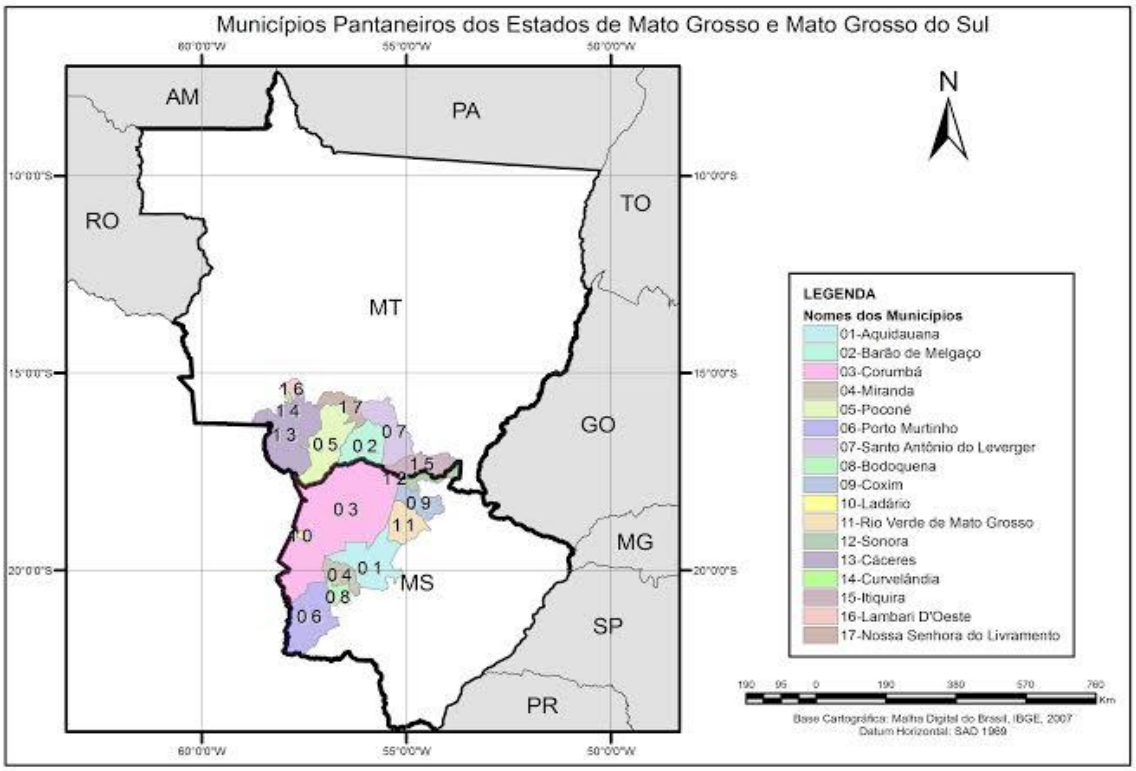
Figure 2 - Pantanal municipalities



Source: Rossetto (2015).

The techniques used to transform the biome include the removal of native vegetation and its management through burning. This practice has been used by traditional Pantanal people for about three hundred years (ROSSETTO, 2004; 2021). Burning can be conceptualized as a technique in which fire is used as a cleaning element, in a controlled manner (BRASIL, 1998) and differs from forest fires whose causes come from natural or anthropic sources and the fire remains uncontrolled.

It turns out that, gradually, forest fires resulting from human action have been getting worse, especially in 2019 when 10,025 hot spots were recorded and until September 2020, 15,425 hot spots (INPE, 2020), unprecedented rates in the history of the Brazilian Pantanal. Forest fires destroy large areas, killing and leaving few refuges for wild animals, impacting the infrastructure of the areas of family farmers, indigenous ethnic groups, traditional populations and Pantanal farms, as well as economic chains, including tourism, fishing and agriculture.

The largest wetland on the planet is drier. According to the MapBiomas Project (2020), the difference between the total area covered by water and flooded fields recorded in the 1988/1989 flood and in 2018 is 29%. In the first flood recorded in the historical series of satellite images analyzed by the project, this total was 5.9 million hectares. In the last

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one, (2018), the area reached only 4.1 million hectares. In 2020, this value was 1.5 million hectares, the lowest in the last 36 years. The drier it is, the greater the possibility of forest fires in the Pantanal, because in wet periods there is the growth of herbaceous, shrubby, aquatic and semi-aquatic plants, accumulating biomass; In the dry season, this vegetation becomes fuel for fire.

This problem is the main context of investigation of this article, which aims to identify and analyze the main causes of forest fires in the Brazilian Pantanal, starting from the central questions, namely: a) why do forest fires occur in the Pantanal? b) What are the climatological, political, social and economic aspects involved? It is then admitted as an initial hypothesis that the occurrence of forest fires is not only related to climatic variations, but to the totality of characteristics that, articulated with each other, explain the phenomenon.

In addition to this introduction, the text is divided into sections. In the first, the methodological procedures are presented, while in the second, the climatological data that evidence the cycles of drought and floods of the Pantanal Biome are discussed, followed by the registration, discussion and analysis of the multiple factors that influence the occurrence of forest fires, combining the testimonies collected in the field with the considerations of the team of researchers, thus performing the proposed geographical reading.

METHODOLOGICAL PROCEDURES

The present research was developed within the scope of the Research Group in Agrarian Geography and Biodiversity Conservation (GECA) of the Federal University of Mato Grosso (UFMT), which since 1998 has been developing studies in the Brazilian Pantanal. This group enabled data collection in the field, a space for dialogue and the construction of knowledge about the Pantanal Biome, mainly through direct recording and observation (HAGUETTE, 1995; MINAYO, 1994), as a technique for investigating empirical data, however, between the years 2018 and 2020, we were given the opportunity to follow and record the experiences of two groups of inhabitants of the Pantanal of Mato Grosso do Norte, residing in the municipalities of Cáceres and Poconé, at the times when they formed volunteer brigades and put out forest fires. Therefore, in this period, the research of primary data was developed in a more systematized way with guiding questions whose information was grouped from the perspective of qualitative research that enabled the interpretation and understanding of the phenomena (PESSÔA, 2012).

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Secondary data were obtained from the Center for Weather Research and Climate Studies (CPTEC) of the National Institute for Space Research (INPE), whose period analyzed was from 1998 – 2020. This information was detected using the two-period Simple Moving Average (SMA) statistical technique. This technique is a resource used to identify the trend of a set of data arranged in a time series. The moving average indicator is obtained from a certain data in a time sample to calculate an average in a given period that will point out up, down or stationary trends for the analyzed results. Thus, this indicator is composed of past data, which predict the direction of the analyzed numbers and help identify possible trends, as well as signal a possible reversal of this trend. (NORONHA, 1987).

The monthly variability of heat source records in the Pantanal of Mato Grosso was made available with the use of the Box Plot technique, a graph to visualize the center, dispersion and asymmetry of a data set, as well as the detection of *outliers*, which These are those values that are very far from most of your data and can be generated by measurement errors or the occurrence of extreme values. The statistical technique of the Box Plot is interesting in several aspects, since it allows the identification of patterns of dry and rainy years and those close to the average (including the extremes) based on criteria related to the establishment of the medians (avoiding contamination by extreme values) and not by the definition of purely arbitrary levels. The data generated from the Box Plot technique can help in the planning of human activities that depend directly or indirectly on rainfall, such as agriculture and energy production, and can be an important tool in the study of rainfall variability.

EXPLANATORY ARGUMENTS: PATH UNDER CONSTRUCTION

The Brazilian Pantanal is undergoing transformations that have been reshaping socioeconomic relations and the Pantanal nature; thus, it is essential to understand the biome as a place for centennial social groups, with significant biodiversity, where the seasonality of the waters has influenced the way of life and the use of natural elements for generations. However, the globalization of the economy has been interfering and transforming the management of economic activities and consequently of nature, so it is observed that burning as a traditional practice has been transformed into forest fires and between 1998-2020, there was a high incidence of hot spots in the Pantanal biome (Figure 3).

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Figure 3 – Monthly and annual data on hot spots in the Pantanal of Mato Grosso

Ano	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novembro	Dezembro	Total Anual
1998	-	-	-	-	-	12	206	172	542	507	162	58	1659
1999	161	10	17	29	106	65	845	2988	1922	2049	743	52	8987
2000	93	30	19	1	8	29	25	263	503	950	295	74	2290
2001	66	62	11	36	67	219	444	2540	2264	879	175	19	6782
2002	137	28	10	24	29	320	805	2934	2662	2761	2328	448	12486
2003	180	48	36	40	107	170	260	517	1188	715	378	83	3722
2004	185	126	141	68	15	240	384	1164	3963	1912	335	155	8688
2005	20	107	100	163	331	435	1259	5993	2997	933	125	73	12536
2006	28	51	36	19	104	101	375	892	1024	266	254	23	3173
2007	6	13	30	68	101	239	341	1858	5498	1481	189	45	9869
2008	14	13	20	28	48	44	216	588	1660	1046	274	594	4545
2009	380	117	71	525	815	308	311	695	1127	919	414	55	5737
2010	31	47	88	87	67	247	511	1548	3072	1142	385	795	8020
2011	145	22	2	2	20	42	105	309	807	562	873	643	3532
2012	188	83	97	38	115	109	490	2698	2518	832	157	122	7447
2013	108	55	115	51	47	17	129	440	1201	544	513	176	3396
2014	103	64	23	55	16	27	90	134	375	459	184	37	1567
2015	95	51	28	29	36	218	225	1025	1181	794	282	494	4458
2016	37	29	18	34	59	93	542	966	2000	1066	215	125	5184
2017	261	73	68	38	48	93	610	1092	2588	669	214	19	5773
2018	23	8	14	19	28	46	190	275	785	120	20	163	1691
2019	337	211	93	33	68	239	494	1690	2887	2430	1296	247	10025
2020	265	164	602	784	313	406	1684	5935	8106	2856	778	223	22116
Total Anual	2863	1412	1639	2171	2548	3719	10541	36716	50870	25892	10589	4723	153683
% mensal	1,86	0,91	1,06	1,41	1,65	2,42	6,85	23,89	33,1	16,84	6,89	3,07	14,39
máximo	380	211	602	784	815	435	1684	5993	8106	2856	2328	795	22116
mínimo	6	8	2	8	8	12	25	172	375	120	20	19	1567

Source: Organized by the authors, based on data from INPE/CEPETEC (1998-2020).

The reading of the data in figure 3 shows that there is a great variation between one year and another and there is no pattern, since there is a variation in 1998 close to 1,000 and in 1999 close to 10,000, revealing discontinuous rhythms in their totals. The highest value of hot spots (8,106) occurred in September 2020.

In the analyzed period, 2018-2020 (Figure 4), there was an increase in the trend line (Figure 5) that presents the fluctuations and shows that the year 2020 presented the highest total value of hot spots in the period (50,870), which represents 33% of the total. It should also be noted that this phenomenon can pose a serious threat.

Figure 4 – Monthly and annual data on hot spots in the Pantanal of Mato Grosso in the period 2018-2020.

Ano	Jan	fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Total Anual
2018	23	8	14	19	28	46	190	275	785	120	20	163	1691
2019	337	211	93	33	68	239	494	1690	2887	2430	1296	247	10025
2020	265	164	602	784	313	406	1684	5935	8160	2856	778	223	22170
Total Mensal	625	383	709	836	409	691	2368	7900	11832	5406	2094	633	

Source: Organized by the authors, based on data from INPE/CEPETEC (2018-2020).

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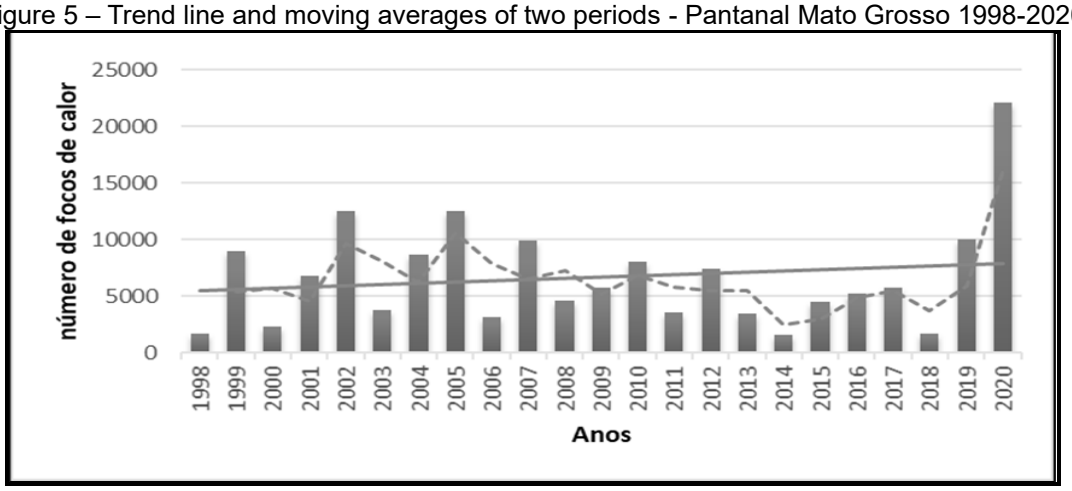
Figure 5 – Trend line and moving averages of two periods - Pantanal Mato Grosso 1998-2020



Source: Organized by the authors, based on data from INPE/CEPETEC (1998-2020).

According to Köppen's classification, the climate of the Pantanal is tropical semi-humid to humid with a dry period in winter and an average annual temperature between 22° and 26 C°. Regarding precipitation, the annual average is about 1,400 mm, varying between 800 and 1,600 mm. The highest rainfall indices are observed on the plateau (BRASIL, 2021). Table 1 shows, in a simplified way, the periods of rainy season, average rainfall (transition season) and dry season distributed monthly. The months of August, September and October belong to the dry season, when there is no rain or little rain.

Table 1 – Monthly periods of floods and drought in the Pantanal of Mato Grosso

JAN FEV MAR	APR MAY	JUN JUL AGO	SET OUT	NOV DEC
Rainier	Rains Medium	Less rainfall/no rainfall	Rains Medium	Rainier
Flood/Humidity (usually peak in February)	End of the Full	Drought		Beginning of the floods
Rainy season	**Dry season Season Rainy**			

Source: Organized by the authors, 2022.

A linear reading of chart 1 does not show the climate changes that have been occurring in the Pantanal. Marcuzzo et al. (2010) studied the intensity of rainfall anomalies in the Pantanal biome of Mato Grosso do Sul, from 1980 to 2010, using 12 rainfall stations, with 30 years of monitoring, distributed in the Pantanal biome, five located in Mato Grosso and seven in Mato Grosso do Sul. The data were obtained from the National Hydrometeorological Network of the National Water Agency (ANA), rainfall stations with 30 years of stored data. The highest rainfall observed in the Pantanal biome for the month of November was 228.3mm in 1984 and the lowest was 60.3mm in 1993. The months that

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suffered decreases in their rainfall were: January, February, March, April, May, June, August, September, November and December, with the months of July and October with an increase in rainfall. There was a trend from June to July of decrease in precipitation in the variations of the forecasts, indicating a lower rainfall index.

The volume of rainfall indices is important for the flooding dynamics of the Upper Paraguay basin - Pantanal biome, as it influences the variability of flooded areas. According to Ramos, Pereira and Cardozo (2020), there were greater floods in the Pantanal in 2011, followed by the years 2006 and 2008; The years that had a smaller flooded area were 2012, 2013 and 2005. The authors also conclude that in the years with the lowest percentages of flooded areas, it was observed that in general the rainfall indexes, in addition to being lower, there is a lower concentration of them in the months of March and April, that is, the opposite situation observed in the years of greater flooding (RAMOS; PEAR TREE; CARDOSO, 2020).

Brazil shows important vulnerabilities in the environmental and climate areas. The observed increase in the frequency and intensity of extreme weather events has greatly impacted the population, the economy and the functioning of ecosystems. Extreme weather events impact agricultural production, coastal infrastructure, the availability of water resources, and the environmental quality of cities, among many other effects. The deforestation of 11,000 km² per year of forests in the Amazon has a strong impact on global warming and affects the regional climate of South America, with changes in water vapor transport and surface albedo (ARTAXO, 2019).

A point of concern is the effect of increased temperature and reduced precipitation of great magnitude in the Amazon rainforest. The forest stores 120-150 billion tons of carbon, which corresponds to about twelve years of global fossil fuel burning. If a significant fraction of this carbon goes into the atmosphere, the impact will be very significant both in the Brazilian regional climate and in the global climate (NOBRE et al., 2016).

Recent work shows that the Amazon may not be far from this situation, as the forest, which was absorbing large amounts of carbon ten years ago, is now neutral in terms of emissions, and could become a global source of CO2 in a few years. This is due to the increase in tree mortality, associated with the increase in droughts in recent years, such as the droughts of 2005, 2010 and 2015. The climate is becoming more extreme in much of the Amazon (ARTAXO et al., 2016).

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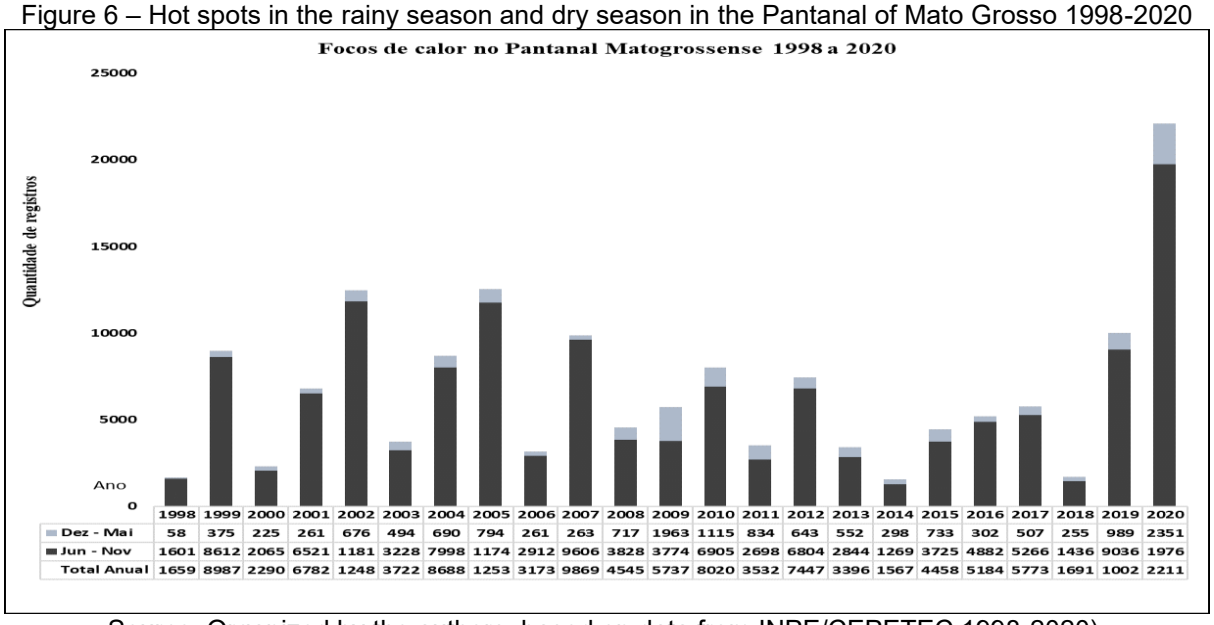
According to Artaxo (2020), the agricultural sector is strongly impacted by the change in the rainfall regime, and climate models with higher quality forecasting and scenarios based on socioeconomic narratives based on sustainability can subsidize the adaptation of this and other important sectors to a changed climate. Thus, it is necessary to contribute to the development of strategies based on the integration of different areas of science, aiming to achieve water, food, health and energy security and social justice, seeking climate adaptation strategies, minimizing socioeconomic impacts on society.

Climate change goes far beyond the increase in temperature. Changes in precipitation, atmospheric circulation, extreme weather events, sea level rise, and others are also key issues that strongly impact the socioeconomic system.

Irigaray et al. (2011) reiterate the importance of maintaining the extent of flooding in Pantanal areas for the regulation of regional climate, although the magnitude of its effect on the climate still needs more in-depth research. Climatic characteristics can act in conjunction with human actions, practiced mainly through agriculture, where fire is used as a management tool. In the period analyzed, the highest values of hot spots are concentrated in the months of June to November (Figure 6), however greater monthly variability is observed in the month of September (Figure 7), highlighting the period of low rainfall as conducive to management through burning.

Figure 6 – Hot spots in the rainy season and dry season in the Pantanal of Mato Grosso 1998-2020



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Dez - Mai	58	375	225	261	676	494	690	794	261	263	717	1963	1115	834	643	552	298	733	302	507	255	989	2351
Jun - Nov	1601	8612	2065	6521	1181	3228	7998	1174	2912	9606	3828	3774	6905	2698	6804	2844	1269	3725	4882	5266	1436	9036	1976
Total Anual	1659	8987	2290	6782	1248	3722	8688	1253	3173	9869	4545	5737	8020	3532	7447	3396	1567	4458	5184	5773	1691	1002	2211

Source: Organized by the authors, based on data from INPE/CEPETEC 1998-2020).

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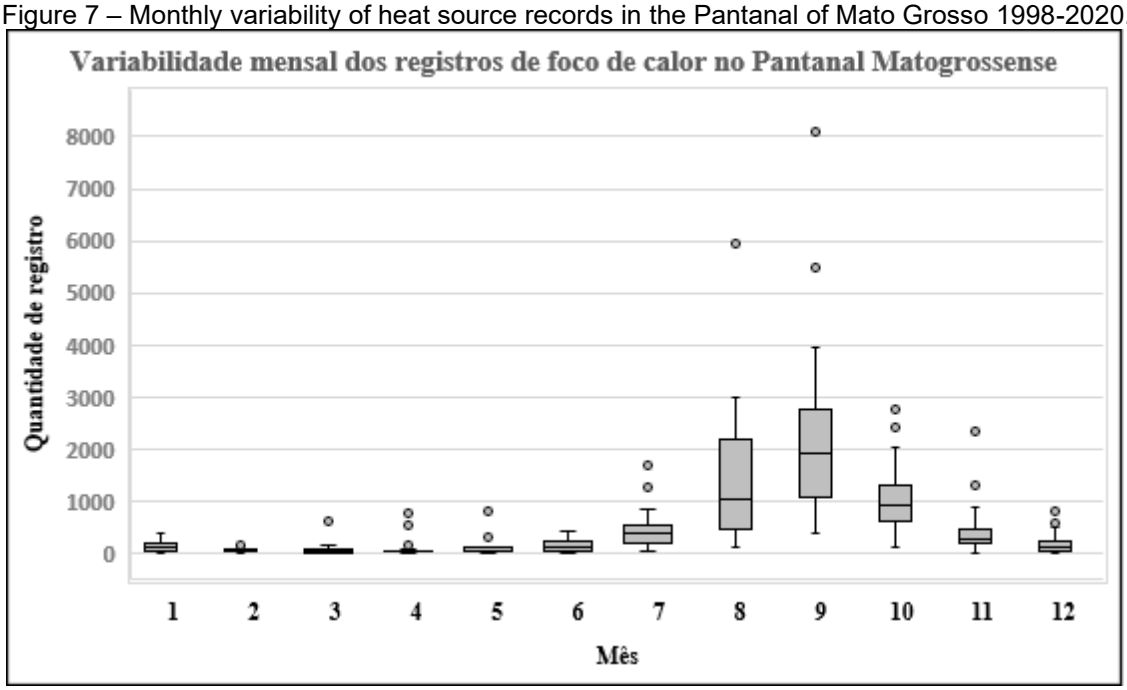
Of all the Brazilian biomes, the Pantanal was the one that burned the most in the last 36 years: 57% of its territory was burned at least once in the period, or 86,403 km². Areas of grassland vegetation and savannas were the most affected, accounting for more than 75% of the burned areas. In all, 93% of the fires in the period occurred in native vegetation; only 7% occurred in an anthropic area. In 2020, more than 2.3 million hectares were burned, since 1985 this figure is only lower than the burned area of 1999, with 2.5 million hectares. While 83.8% of the plain was covered by native vegetation in 2020, on the plateau this occurred in only 43.4% of the territory. Degraded pastures, the lack of forests that protect springs and rivers, the construction of hydroelectric dams affect the flow of rivers, which also suffer from the deposition of sediments that reduce the flow of water on the plateau and in the plain.

Figure 7 – Monthly variability of heat source records in the Pantanal of Mato Grosso 1998-2020.



Source: Organized by the authors, based on data from INPE/CEPETEC (1998-2020).

For Silva (2021), who studied fires in the Pantanal region through a comparison between the years 2019 and 2020, the latter was an atypical year in terms of the number of fires, with 23% of its area burned. Since the beginning of monitoring by INPE, in 1998, the year with the most hot spots was 2020. The decrease in water mirrors and the regions that suffered the most fires were detected.

It can be inferred, therefore, that in the agrarian space of the Brazilian Pantanal, climatological aspects are not the only ones responsible for the increase in hot spots and

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forest fires, as it is observed that anthropic use in the Pantanal grew 261% between 1985 and 2020, gaining 1.8 million hectares. During this period, the area of pastures in the Upper Paraguay Basin doubled, from 15.9% in 1985 to 30.9% in 2020. Agriculture, in turn, quadrupled, from 1.2% in 1985 to 4.9% in 2020. The savanna formation, on the other hand, fell from 24.4% in 1985 to 18% in 2020. In 2020, 40% of the Upper Paraguay Basin has agricultural use. (MAPBIOMAS PROJECT, 2020).

Thus, according to Santos (1991), to the extent that the capitalist logic and the scientific-informational technical environment advance, the rhythms of production and, consequently, of the transformation of nature occur in an accelerated way and the geographical space is reconfigured, establishing a dynamic of alteration in the forms of production and in the pre-existing relations. The collection of primary data in the municipalities of Cáceres and Poconé, between the years 2018 and 2020, made it possible to organize Chart 2, where we sought to separate the arguments found in the discourses of the actors involved that would explain the occurrence of forest fires.

Chart 2 - Arguments that explain forest fires in the Brazilian Pantanal

Originated from the physical environment	Originating from social, political and economic aspects	Originated from anthropogenic actions
- Large volume of dry vegetable mass without proper management; - Significant changes in rainfall indexes; - Climate change; - Decreased flood pulse.	- Changes in the management of production techniques; transformation from traditional to modern management (monoculture, cultivated pasture); - Transformations in traditional Pantanal identities (peons and farmers), where capitalist logic has supremacy over the values of tradition; - Labor relations based on cronyism are replaced by capitalist relations with the exploitation of surplus value; - Fragility of public policies and decision-making institutions; - Absence of public policies aimed exclusively at the biome and the Pantanal people.	- Deforestation of the plateau surrounding the plain and installation of monoculture crops (soybeans, sugarcane, corn, among others); - Deforestation of the Pantanal plain with native pastures for the planting of cultivated pastures; - Drainage of flooded areas, changing the course of the flood pulse and the dynamics of fauna and flora; - Installation of Small Hydroelectric Power Plants, ports and waterways in the rivers that form the Paraguay River Basin.

Source: Primary Data Collection in the Field - Research Group on Agrarian Geography and Biodiversity Conservation - GECA/UFMT (1998-2020). Organization of the authors, 2022.

The analysis of chart 2 makes it possible to understand that the increase in forest fires in the Pantanal Biome originates from several interrelated factors, therefore, the division presented in the chart is merely didactic. With this premise, it is argued in this research that the factors originating from the physical environment and anthropic actions reflect changes in the way of life, the economy and environmental policies related to the

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biome and vice versa. The analysis of the records made during forest fires exemplifies this statement because, on a local scale, the use of fire as a form of management is related to the traditional way of life of the Pantanal people and is still defended, as reported in the statement:

> Burning has always been done in the Pantanal, since my grandfather's time and it almost never happened that the fire spreads, we warned the neighbors and everyone got ready, burned the wicks and the field was clean, when the rain came, everything sprouted again! (Testimony of a Pantanal man from Cáceres – 2018).

It is observed in the records that the tradition of using fire to clear pasture without the occurrence of forest fires has been changing concomitantly with the legislations that sought to order such a process requiring the request for licensing to carry out the action. According to testimonies, "the request for a license for pasture clearance, in addition to being expensive, takes a long time to be approved, and the cattle do not wait". (Testimony of a Pantanal man from Poconé – 2020). The rereading of the discourses shows that the transformations of tradition were influenced by the remodeling of environmental policies in Brazil, which, despite a legal text, aimed at the preservation and conservation of the biome, does not have the infrastructure and human capital to materialize the legal apparatus, evidencing the fragility of public institutions.

On the other hand, on an international geographical scale, it can be stated that the globalization of the economy, which seeks to disseminate the logic of capitalist accumulation and nature as a resource to be exploited with a view to the accumulation of wealth, greatly influences the tradition of the social groups of the Pantanal, thus, the anthropic actions described in chart 2 are observed as a direct result of the change of a traditional logic where the Pantanal was considered "the guardian of the Pantanal because, Who knows and takes care of the Pantanal is the Pantanal, we are the ones who take care of the Pantanal" (Testimony of a Pantanal man from Poconé – 2020), for a logic of accumulation recorded in the statement:

> They don't let you do anything on the farm because they say it's in the lowlands, so you can't raise cattle because you can't plant pasture, you can't plant soybeans, so what we do is abandon the farm, now I'm planting soybeans in lead and I raise the sorto cattle there in the lowlands, only food for the jaguar. (Testimony of a Pantanal man from Poconé – 2020)

The author of the statement considers "them" as the environmental agencies that penalize infractions, in addition, the abandonment of extensive farms, contributes to the

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accumulation of dry plant mass, as a correlate, the occurrence of forest fires can cause serious damage, however, the public power does not present policies/programs that suggest conservationist and preservationist alternatives for such areas, Thus, the destination is abandonment or predatory exploitation, building drains and/or dikes that divert the flood pulse and harm biodiversity.

It is also visible in the rereading of the record that, in the deponent's conception, cattle raising in the traditional way, which occurred without the planting of exotic pasture and in an extensive way, is no longer sufficient to obtain the income required by the contemporary global life model, thus, the economic activity of cattle ranching is being replaced by the planting of soybean monoculture, on the edges of the Pantanal, as is the case of the District of Chumbo, a locality belonging to the municipality of Poconé. This fact, resulting from the transformations of traditional logic, influenced by public policies and capitalist economic ideology, interferes in the conservation of the Pantanal Biome because, as the Pantanal plain and the surrounding plateau form a system in close relationship, soybean monoculture can affect and cause changes in the hydrological regime, as a result of cultural treatments with pesticides and other chemical inputs that tend to flow through the pulse of flooding, reaching aquifer sources, which can harm biodiversity and sociodiversity. In addition, the removal of native vegetation and its replacement by monoculture of grains contributes to the volume of land causing the silting up of rivers and bays.

Santos (2001) asserts that the advance of capital requires new fixed and flows, as an example of fixed, one can cite all the infrastructure required by contemporary capitalist logic, such as the 165 Small Hydroelectric Power Plants (SHPs), among those in operation (45), granted (11), available axis (56), accepted Basic Environmental Plan (47) and registered (02), in addition to suspended (02) and revoked (02) projects. Of this amount, 116 projects are in the process of being analyzed, especially in Mato Grosso, responsible for most of the water that supplies the entire system of the Upper Paraguay Basin/Pantanal in Mato Grosso. In addition, the SHPs, the ports and the Paraguay-Paraná waterway are used to transport soybeans and other grains resulting from the transformation of traditional cattle ranching into agribusiness.

On the one hand, the fixed ones convey the idea of modernization and economic development, on the other hand, they reveal the concentration of income because the municipalities of the Pantanal north of Mato Grosso have the lowest Human Development Indexes – HDI in the state, among them, the locus of the survey Poconé and Cáceres with

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0.652 and 0.708 (BRASIL, 2022), respectively. Similarly, research conducted by Braz et al. (2020) reveal that large estates concentrate 8% of the Pantanal area (847,468.28ha), while small properties have only 1% (119,836.90ha, thus, the biome is occupied by large properties that concentrate 86% of their area with about 9,450,221.35ha.

The concentration of the land structure and capital flows is accompanied by transformations in labor relations and in the exploitation of surplus value through the exploitation of the labor of the family composed of the couple, where only the male figure receives the salary, although the female figure also develops the work in domestic chores.

Finally, when carrying out a geographical reading of the forest fires that occurred in the Pantanal Biome, it is concluded that the initial hypothesis is true: forest fires are not only due to events pertinent to changes in climate dynamics, although such an aspect based on cycles of droughts and floods are relevant, but they occur due to the advance of the capitalist model of production, that appropriates the agrarian space, determining transformations in the traditional models of nature management and in the social relations of production, contributing to the concentration of the land structure, wealth and accentuating the destruction of biodiversity and sociodiversity.

FINAL CONSIDERATIONS

In the agrarian space of the Pantanal, the expansion of capitalism has been altering the means and relations of production in such a way that the traditional models of use of natural resources are replaced by an integrated, globalized economic system, based on modernization, with new forms of production and organization of work. As a result, the exploitation of natural resources becomes more intense, causing the scarcity of certain resources, threatening ecological stability and populations that do not follow the dynamics of capital, being exploited or plundered. Moreover, climate change goes far beyond the increase in temperature. Changes in precipitation, atmospheric circulation, extreme weather events, sea level rise, among others, are also key issues that strongly impact the socioeconomic system.

Such a problem generates debates and requires actions on the part of the public authorities and society. Thus, it is necessary to monitor hot spots with specific, preventive, and educational actions, added to a central issue: the choice of local residents, public managers, and global environmental protection institutions about the destinations of the Pantanal biome.

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The discourse on economic development should be understood as a complex process of changes and transformations through the creation of a set of elements capable of directing economic transformations, for the permanent and growing social, political and, mainly, human improvement, in which the quality of life and the preservation and conservation of the environment occur. In this sense, the challenge that is now imposed concerns the management of this process in the context of sustainable socio-environmental development.

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