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CONTRIBUTION OF PROTECTED AREAS TO AVOIDED DEFORESTATION IN MATO GROSSO, BRAZIL

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Resumo

Contribuição das Unidades de Conservação no desmatamento evitado em Mato Grosso, Brasil. As Unidades de Conservação (UCs) são importantes espaços para a proteção da biodiversidade, capazes de limitar o avanço do desmatamento e colaborar nas intenções de reduzir as mudanças climáticas. O objetivo deste estudo foi demonstrar a importância das Unidades de Conservação do estado de Mato Grosso no desmatamento evitado e estimar sua contribuição para a redução das emissões de Gases de Efeito Estufa e da erosão do solo. A metodologia se baseou em dados secundários e processamentos em ambiente GIS. Como resultado verificou-se que em Mato Grosso existem 120 UCs entre federais, estaduais e municipais, ocupando em torno de 6% da área territorial do estado e a maioria no contexto do bioma amazônico. A cobertura florestal do Mato Grosso em 2019 era de 49,8 milhões de hectares, com um estoque de carbono florestal estimado em mais de 16,4 $GtCO_2$. As UCs foram criadas ao longo dos anos no estado, mas o maior período de novas áreas protegidas ocorreu entre 2000 e 2005 e juntas, em 2019 elas eram responsáveis por evitar o desmatamento de mais de 726 mil hectares de floresta, 10 milhões de toneladas de erosão e estocando 281 milhões de toneladas de carbono, que se transacionado no mercado de crédito teria o valor estimado de mais de US$1.25 milhões. Caso as UCs não existissem e fosse efetivado o desmatamento, o custo de reposição dessa área seria de mais de US$2.73 bilhões. Portanto, é notória a importância das UCs na conservação ambiental e na economia relacionada à cobertura florestal.
Palavras-chave: Áreas protegidas; cobertura florestal; estoque de carbono; erosão do solo.

Abstract

Contribution of Protected Areas to avoid deforestation in Mato Grosso, Brazil. Protected Areas (PAs) are important spaces for the protection of biodiversity, capable of halting deforestation and collaborating in the intentions to reduce climate change. The objective of this work is to demonstrate the importance of Protected Areas in the state of Mato Grosso in the avoided deforestation and to estimate their contribution to the reduction of greenhouse gas emissions and soil erosion. The methodology was based on secondary data and the use of a GIS environment. As a result, it was found that in Mato Grosso there are 120 PAs between federal, state and municipal, they protect 6% of the territorial area of the state and most are located in the Amazon biome. Mato Grosso's Forest cover in 2019 was 49.8 million hectares, with an estimated forest carbon stock of over 16.4 GtCO2. The PAs were created over the years in the state, but the greatest number occurred between 2000 and 2005 and together, in 2019 they were responsible for preventing the deforestation of more than 726,000 hectares of forest, 10 million tons of erosion and storing 281 million tons of carbon, which if traded on the credit market would have an estimated value of more than US$1.25 million. If the PAs did not exist and if deforestation were to be carried out, the cost of replacing this area would be more than US$2.73 billion. Therefore, the importance of PAs in environmental conservation and in the economy related to forest cover is notorious.
Keywords: Protected areas; forest cover; carbon stock; soil erosion.

INTRODUÇÃO

The Protected Areas (PAs) are territorial spaces and their environmental resources, including jurisdictional waters, legally instituted by the Government. They have relevant natural characteristics, which aim at the conservation of biodiversity, with defined limits, under a special management regime, to which adequate protection guarantees are applied, considered strategic for the conservation of biodiversity, as they can guarantee the provision of ecosystem services fundamental to society (BRASIL, 2000; YOUNG; MEDEIROS, 2018).

In light of increasing human pressure on the planet's resources, an effective global system of protected areas holds out hope for the conservation of representative and viable areas of natural ecosystems and their habitats and species. Therefore, PAs are a valid and measurable indicator of progress in conserving the remaining biodiversity in the world or, at least, reducing the rate of loss (CHAPE *et al.*, 2005). However, even with the advances in protected areas around the world, global biodiversity is still in decline, making it necessary to increase the effectiveness of existing PAs for biodiversity conservation (COAD *et al.*, 2015).

Protected areas are a fundamental tool in the conservation of global biodiversity and carbon stocks, but despite being able to reduce deforestation rates in their area, they have not eliminated it (AMIN *et al.*, 2019; WOLF *et al.*, 2021).

Observing the reality of the state of Mato Grosso – Brazil, it appears that it is one of the states with the highest deforestation rates in the legal Amazon, appearing among the top three in the ranking in recent years, alternating positions with Pará, Rondônia and Amazonas (INPE, 2022). It has 6% of its area protected by some type of PA, with 22 federal PAs, 52 state PAs and 46 municipal ones (SEMA, 2018). But the state still suffers from deforestation within its PAs. In 2022, protected areas in the Amazon that is at Mato Grosso state had 1.6% of deforestation detected, even with a low concentration of deforestation, forest destruction in PAs almost doubled in relation to the same period of the previous year (ICV, 2022).

Increased deforestation endangers not only environmental services, but also institutional spaces created with the aim of safeguarding heritage, such as PAs (BASTOS *et al.*, 2015). However, even with some shortcomings, the PAs have the capacity to limit the advance of deforestation. Faced with the problem presented, this study sought to answer the following question: If the PAs did not exist in the municipalities in which they are located, how much additional forest remnant would be lost?

Mato Grosso is one of the states that deforests the most in Brazil (PRODES, 2020), therefore, the hypothesis of the work is that the existence of PAs in the state can limit the advance of this deforestation, causing the average rates of remaining forest within the PAs is greater than the average rates of forest remnants outside the PAs.

During this work, the term used to identify this difference between the forest remnants within the PAs with the forest remnants in the municipality in which the PA is inserted, except for the PA, is the term avoided deforestation. This term, whenever used, will refer to the potential capacity of the PAs to reduce the rate of deforestation in an area, so that the average of additional forest remnants maintained by the PAs is greater than in the municipalities that house the PA.

In addition to the concern of this study in highlighting the importance of PAs to prevent deforestation, it was also demonstrated that the existence of these PAs has the potential to generate monetary benefits through their potential to generate carbon credits and reduce the erosion, avoiding expenses to de-silt water resources that can be used for some type of use. One of the great challenges faced by Brazilian society in recent decades is to reconcile development and conservation (BASTOS *et al.*, 2016).

The existence of PAs is important to limit deforestation, collaborating in the absorption of carbon from the atmosphere and helping to mitigate global warming. They also prevent soil erosion where they are located (Alvarenga Junior *et al.*, 2018; Mendes *et al.*, 2018). This study aims to demonstrate the importance of Protected Areas in the state of Mato Grosso in terms of avoiding deforestation and estimating their contribution to reducing greenhouse gas emissions and soil erosion.

MATERIAL AND METHODS

The methodology used in this work was of the descriptive research type, in order to detail the evolution of the creation of the PAs in Mato Grosso, Brazil, with secondary data obtained from the website of the Secretary of the Environment (SEMA) of the state of Mato Grosso and in the National Register of Conservation Units (CNUC) of the Chico Mendes Institute for Biodiversity Conservation (ICMBio) and the Ministry of the Environment (MMA). Data on vegetation cover in Mato Grosso are based on historical records made available by the Project for Annual Mapping of Coverage and Land Use in Brazil, called MapBiomas. In this work, data from the Forest class were used, subdivided by subclasses: Natural Forest, Forest Formation, Savanna Formation, Mangrove and Planted Forest. All analyzes and procedures in a GIS environment were performed using the free software QGIS 3.16.5-Hannover.

To estimate the contribution of a Conservation Unit in terms of its ability to reduce greenhouse gas (GHG) emissions, avoided deforestation was used, based on the methodology of Alvarenga Júnior *et al.* (2018). To carry out the calculation, it is considered that if a certain CU ceased to exist, not all forest remnants within it would be deforested, as it would follow the same preservation history as the municipality in which it operates. This is exemplified in Figure 1, which shows a municipality with a forest remnant of 30% and a PA within its territory with a forest remnant of 70%, therefore, it is considered that the PA effectively contributes to the additional conservation of 40% of the forest remnant. That is, for the results of the calculations in this work, it was considered that the effective contribution of this area to the conservation of the forest carbon stock is not equivalent to the total carbon stock in its interior (ALVRENGA JR. *et al.*, 2018).

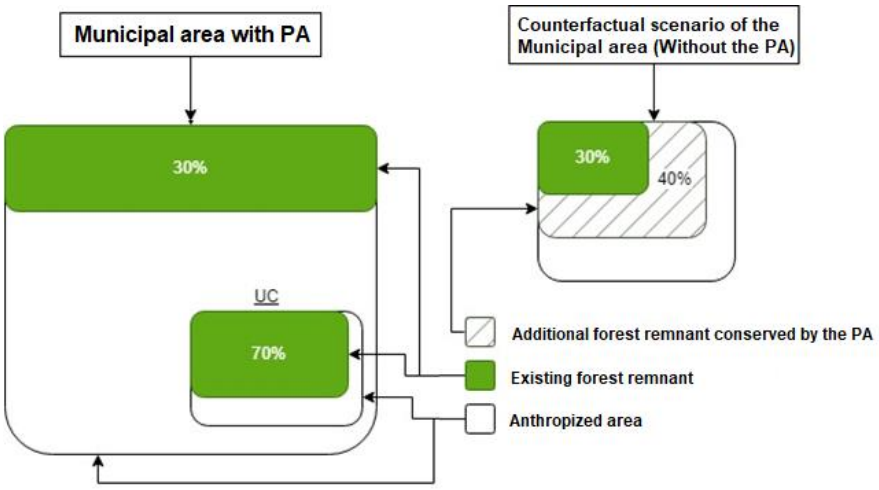

Figure 1. Carbon calculation methodology.
Figura 1. Metodologia de cálculo de carbono.
Source: Adapted from Alvarenga Jr. *et al.* (2018).

The calculation formula is described below:

$$CF(PA) = \sum_{1}^{n} \left(\left[RFPA_{j,i} - RFM_i \right] . A_{x,i} \right) . \delta_i$$

Where:

CF(PA) = tons of forest carbon conserved by the PA;

RFPAx,i = % of remaining forest in PA x, located in municipality i;

RFMi = % remaining forest in municipality i;

Ax,i = area of PA x in municipality i;

δi = Carbon density in municipality i.

The carbon density per hectare database is from the SISGEMA of the Environment Economy Group (GEMA - IE/UFRJ) (YOUNG, 2016), the data are separated by municipalities, making each value respective to forest characteristics of that municipality in question.

After carrying out the above calculation, which estimates the amount of carbon stored in a given area, the monetary gains must be calculated, which were calculated using the following value for a ton of carbon: US$ 4.3/tCO2e (DONOFRIO *et al.*, 2020).

Regarding the estimate of benefits generated by avoided erosion, the methodology was based on Mendes *et al.* (2018), which uses the Universal Soil Loss Equation (USLE), described below:

$$USLE: A = R * K * LS * C$$

The average rainfall erosivity (R), soil erodibility (K) and topographic (LS) factors were calculated for each PA area considered through the SISGEMA base. The soil use and management factor (C) was calculated from reference values for land, pasture and forest uses (MENDES *et al.*, 2018). The cost of removing one ton of sediment was US$ 3.98 per ton of sediment removed (YOUNG *et al.*, 2015).

To annualize the values found in the calculations, a rate was applied referring to the "rent factor" of this stock, this rate corresponds to an annual return on capital (opportunity cost of capital) that reflects a kind of compensation for economic activities that could not be carried out to develop around the PAs because of the conservation rules. For the present study, the values of 3% and 6% were adopted (ALVARENGA JR. *et al.*, 2018; YOUNG *et al.*, 2015).

It should also be noted that the costs of replacing native vegetation are quite high, that is, if you want to replace the lost forest, the replacement cost is high. A monetary metric of the value of the impact of forest loss can be given by the cost of recovering the native vegetation at the site, that is, the monetary value of the natural resources lost would be equal to the cost of forest recovery. The recovery cost structure estimated in this case considers the expenses of fencing the area, purchasing native seedlings, basic inputs for treating the seedlings,

labor, and costs of transporting the inputs and administering the recovery project (YOUNG *et al.*, 2015; YOUNG, 2016).

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For the descriptive analysis of the evolution of the forest area in the PAs of Mato Grosso, only the federal and state categories were considered, due to the difficulty in finding geographic data for the municipal PAs. This occurs because many city halls do not inform the National Registry of Conservation Units of the PAs created and maintained under their management.

RESULTS

The first PA created in the state of Mato Grosso was the Águas Quentes State Park in 1978, a full protection PA with an area of approximately 1,500 hectares. Mato Grosso has 22 federal Protected Areas, under the responsibility of ICMBio, 52 state Protected Areas, which are managed by the State Department for the Environment (SEMA) and 46 municipal ones, which are managed by the city halls.

In Mato Grosso state, home to three Brazilian biomes, approximately 6% of its territory is protected by federal, state, and municipal PAs. In addition, the Protected Areas in the state of Mato Grosso are 65% in full protection group and 35% in the sustainable group. Considering only the state and federal PAs, in terms of quantity, the Cerrado has the largest number of PAs, followed by the Amazon and Pantanal, but in terms of area (hectares), the Amazon biome has the greatest number (Figure 2).

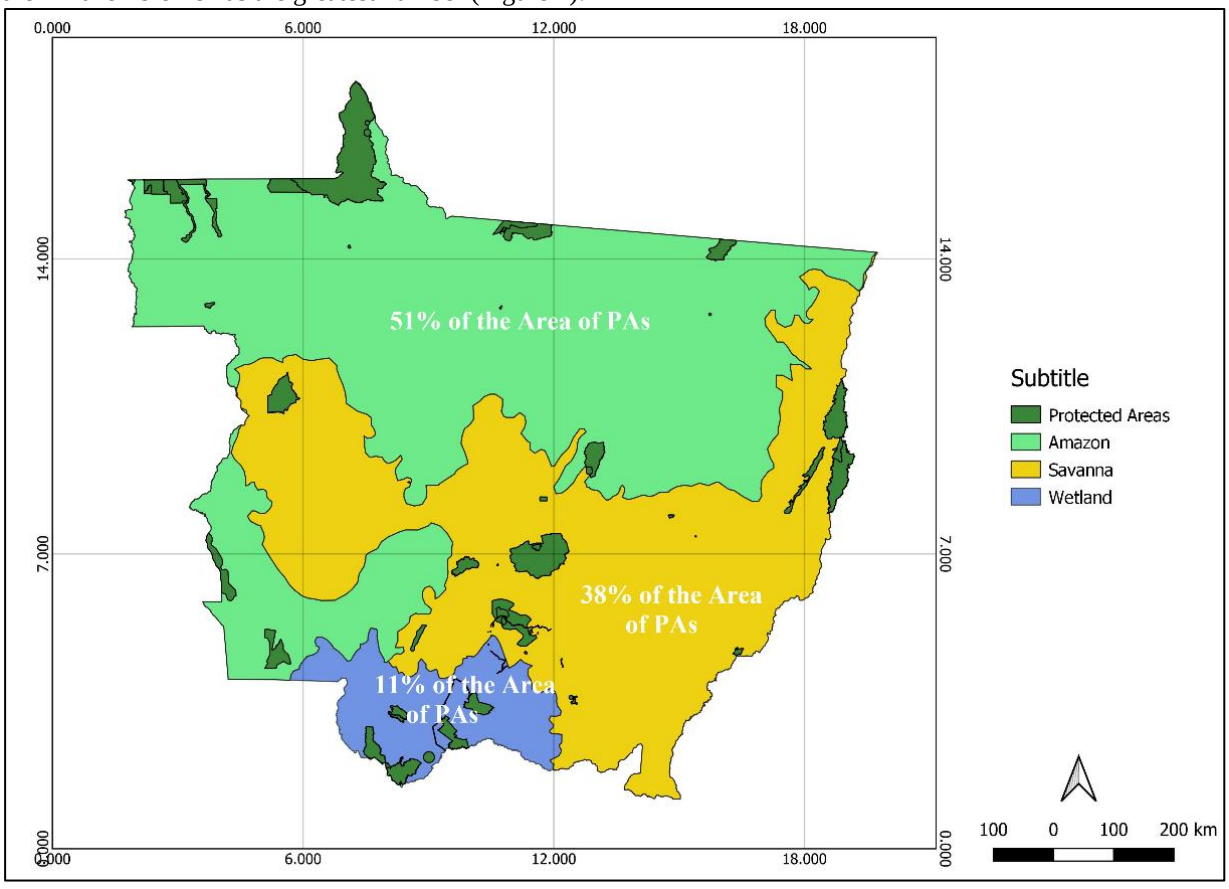

Figure 2. Proportion of state and federal PAs area (ha) by biome in Mato Grosso.
Figura 2. Proporção da área de UCs (ha) estaduais e federais por bioma em Mato Grosso.
Source: Own elaboration

As shown in Figure 2, the Amazon and Cerrado biomes are the ones with the largest area in the state of Mato Grosso and, consequently, the ones with the largest number and area of PAs. The Pantanal, on the other hand, for having a smaller proportion, has less representativeness in the number and area of the PAs. The evolution of the creation of PAs in Mato Grosso can be seen in Figure 3.

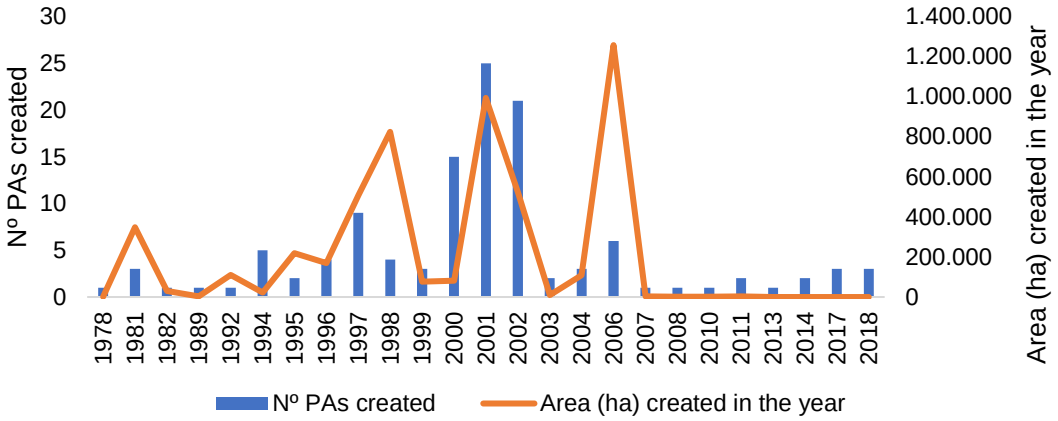

Figure 3. Number of PAs and area (ha) created per year.
Figura 3. Número de UCs e área (ha) criadas por ano.
Source: Own elaboration based on SEMA (2018) e MMA (2020).

As noted, despite the years 2001 and 2002 being the ones in which the most Conservation Units were created, it was in 2006 that the proportion of protected areas was the highest. That is, this year only six UCs were created, but these protected an area of more than 1.2 million hectares. The total protected area in the state is approximately 6% of its territory (Figure 4).

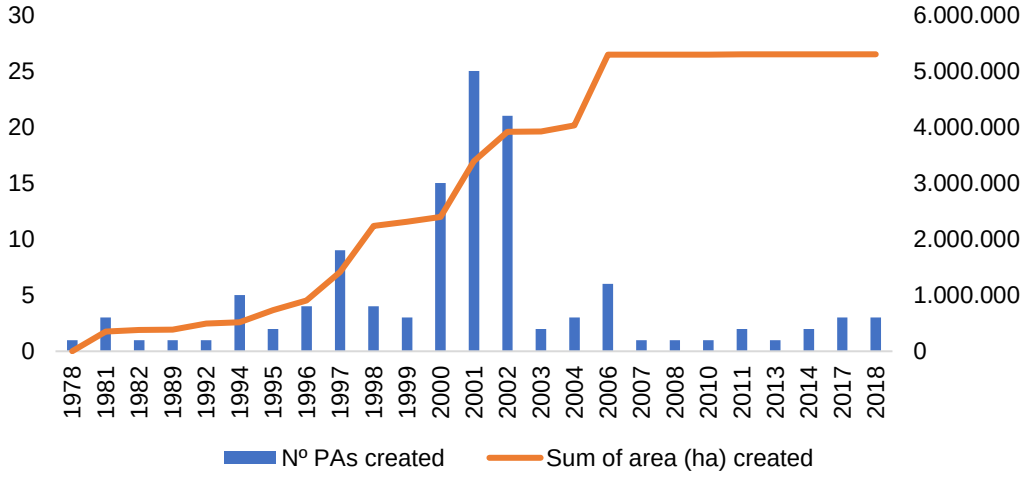

Figure 4. Number of PAs created and accumulated total protected area in Mato Grosso.
Figura 4. Quantidade de UCs criadas e total acumulado de área protegida em Mato Grosso.
Source: Own elaboration based on SEMA (2018) e MMA (2020).

As noted, from 2007 there was a stagnation in the number of PAs created. Only four state PAs and eight municipal PAs, and the protected area in the state, in terms of territory size in this period, did not increase significantly, just over 8.6 thousand hectares.

To verify the transformations in the forest landscape and land use in the state, Figure 5 presents a comparative space-time analysis between the years 1985 and 2019.

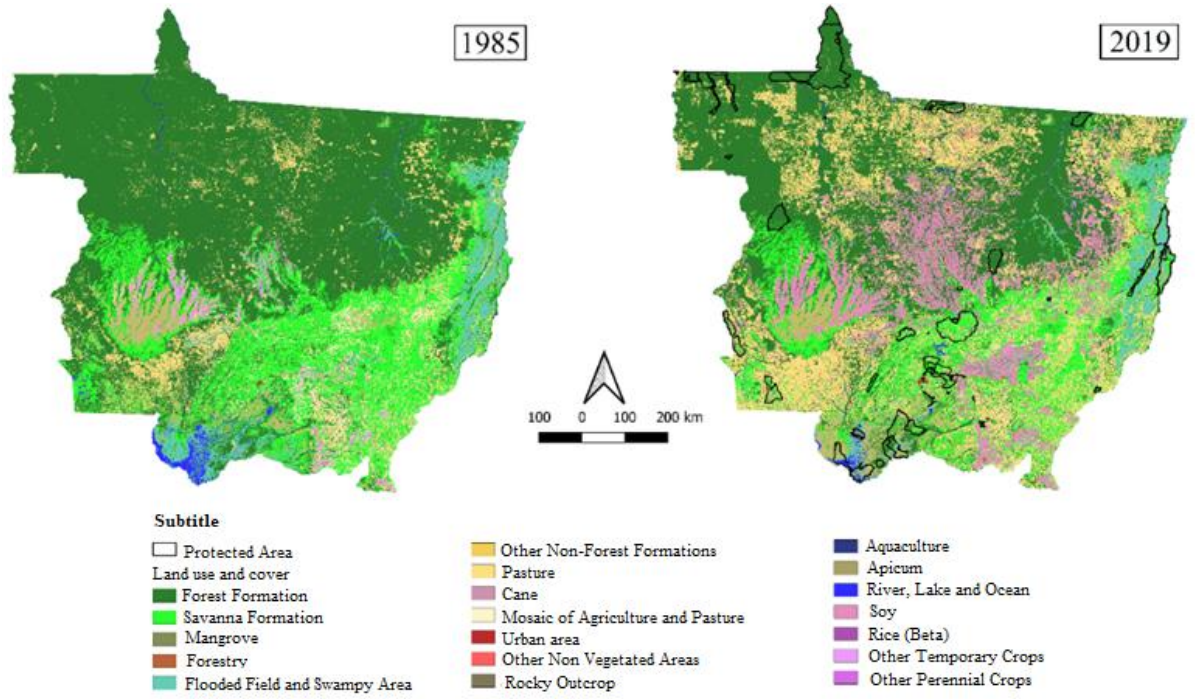

Figure 5. Uses and land cover of Mato Grosso in 1985 and 2019 and Protected Areas.
Figura 1. Usos e cobertura do solo de Mato Grosso em 1985 e 2019 e Unidades de Conservação.
Source: Own elaboration.from Projeto MapBiomas.

In Mato Grosso state, the forest cover (natural forest, forest formation, savannah formation, mangrove and planted forest) was totaled in 2019, 49.8 million hectares, with an estimated forest carbon stock of more than 16.4 GtCO2. These values were 70.8 hectares of forest and 23.3 GtCO2 in 1985, that is, between 1985 and 2019 Mato Grosso lost 21 million hectares of forests that were transformed, mainly, for agricultural uses (Figure 6) and, probably failing to store nearly 7 GtCO2 of forest carbon.

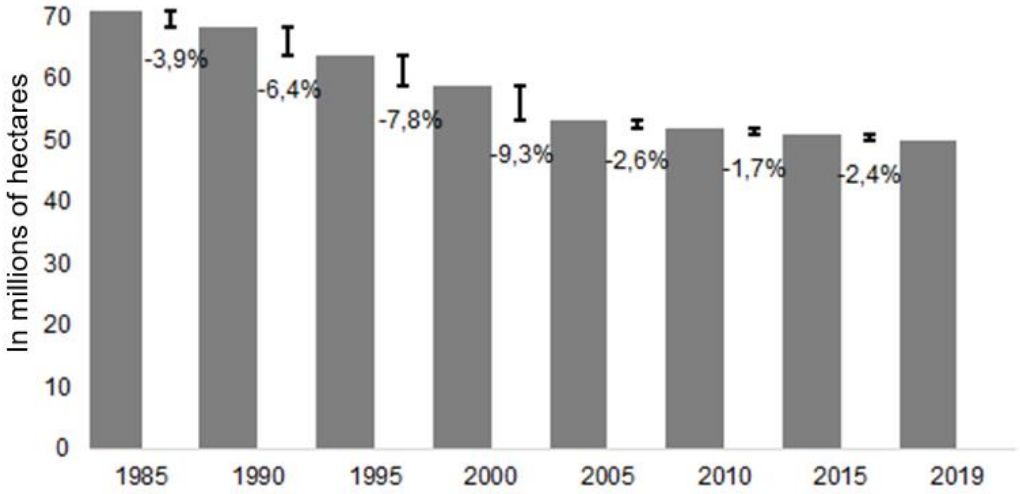

Figure 6. Variation of forest cover (in hectares) from 1985 to 2019 in Mato Grosso.
Figura 2. Variação da cobertura florestal (em hectares) de 1985 a 2019 em Mato Grosso.
Source: Own elaboration.from Projeto MapBiomas.

Until 1995 there were only 11 PAs in the state, between 1995 and 1999 15 PAs were created, but between 2000 and 2005 the number of PAs grew most significantly, representing 48% of the PAs (federal and state) that exist in Mato Grosso so far.

In Mato Grosso, forest remnants preserved by federal and state PAs totaled 3.6 million hectares in 2019, with a total forest carbon stock estimated at 1.2 GtCO2e (Table 1).

Table 1. Contribution of the PAs of Mato Grosso in the avoided deforestation and erosion and in the carbon stock.
Tabela 1. Contribuição das UCs de Mato Grosso no desmatamento e erosão evitados e no estoque de carbono.

PAs	Média Remanescente PA (ha)	Remaining average municipality without PA (ha)	Total deforestation avoided by the PA (ha)	Total erosion avoided (t/year)	Total carbon stock (tCO2)	US$ avoided by avoided erosion	US$ avoided by avoided carbon
2019	66%	49%	726.832	10.145.648	281.694.812	US$ 40.350.318	US$ 1.254.043.433

Source: Own elaboration.

Considering what is described in the methodology, to calculate the values in the table above, the total values of remainder within the PAs were not used, but only the difference between what the PA has as a remainder and what the municipality in which it is inserted has to remaining forest. Regarding forest cover in 2019, for all federal and state PAs created, it was estimated that the average forest remnant within the PA areas is 66% and the average remaining forest in the municipalities is 49% (not considering the PAs) in the same period, therefore, the calculations considered the difference from 66% to 49%, that is, 17%, a value called avoided deforestation.

Therefore, it was also calculated how much this avoided deforestation by the PAs helps in preventing erosion and how much it stores carbon, and when the values for 2019 are observed, it is verified that the estimate of avoided erosion is more than US$40.24 million and the carbon stock of more than US$1.25 billion.

Thus, when these total values are transformed into annual values using an annual rate of return on capital (opportunity cost), the value of the contribution of the PAs in the state of Mato Grosso to the conservation of forest carbon was estimated between US$ 37.6 million and US$75.2 million a year.

Also, if the PAs did not exist and it was necessary to replace the deforestation they prevent (726,832 hectares), the total cost would be approximately US$2.87 billion, around US$3.9 thousand per hectare, and this process would take many years to reach the current stage of the PAs.

DISCUSSION

Mato Grosso has great biological diversity, as it comprises three major biomes: the Amazon, Cerrado and Pantanal. However, changes in land use and the expansion of agribusiness, mainly, have suppressed forests (BURKE *et al.*, 2016). For this reason, the creation and maintenance of PAs in the state is one of the main strategies for the conservation of its biological diversity.

It was shown that in Mato Grosso state, the Amazon biome is the one that concentrates the largest area of PAs, followed by Cerrado and Pantanal. Still, the largest number of PAs created occurred at the end of the 1990s and beginning of the 2000s, this happened due to the creation of the Agro-environmental Development Program (PRODEAGRO), signed in 1992, between the Brazilian government and the World Bank, with a duration of approximately 10 years.

This program emerged in the context of the commitments assumed by Brazil, in the Convention on Biological Diversity (CDB), as a result of ECO 92, and its main objective was to implement a new approach in the management of natural resources, conservation and development in the state of Mato Grosso. Among the various components provided for PRODEAGRO, one of extreme importance was support for the creation of Protected Areas (PA) (DA SILVA *et al.*, 2015).

However, even though PRODEAGRO organized and compiled the existing database in the state to propose the Socioeconomic and Ecological Zoning (ZSEE), the project received more criticism than praise from representatives of socio-environmental movements. The main criticism pointed out that the investment made over 10 years, which required more than US$ 30 million in the state's ZSEE, was not completed within the time allotted for the Program (DA SILVA *et al.*, 2015).

The creation of PAs has a great role, not only for conserving biodiversity, but also for preventing the burning of native forests, and guaranteeing the conservation of other ecosystem services (QUEIROZ; YOUNG; MEDEIROS, 2010). Mato Grosso state has a 55.49% high and extreme risk of fires, especially in central, south, and southwest regions of the state, regions characterized by their strong anthropic influence and with major changes in land use, consequently, flammable material from open forests has lower water content, which increases the probability of fire. In the northwest region, where the forest is dense, the risk of forest fire is lower (MOTA *et al.*, 2019).

In this sense, the PAs can play an important role, since, as they are protected areas, they maintain a higher average of remaining forest than non-protected areas, that is, they are important areas to avoid deforestation, if

they did not exist, they would suffer the same pressure that occurs in the rest of the municipal territory, losing part of its remaining.

However, even with the existence of PAs in the state, their forest cover has reduced over the years, the results showed that the amount of forest remnant in 1985 was 70.8 hectares of forest, in 2019 this value was 49 .8 million hectares, meaning a loss of 21 million hectares of forests that were transformed, mainly, for agricultural uses and in a large number of times, this deforestation occurred illegally.

In the Legal Amazon, of which Mato Grosso is part of, illegal deforestation prevails over legal deforestation. Deforestation was detected by INPE in 83 municipalities in the state, and only 33 of them had an area with legal deforestation, which means, they had valid authorizations issued by the environmental agency. After about 12 years of slow decline, the illegality of deforestation in Mato Grosso has grown again, reaching 88.1% in 2020. That is, less than 12% of the deforestation detected was carried out in areas with valid authorizations for deforestation issued by the state environmental agency (ICV, 2020).

Deforestation mapped by the National Institute for Space Research (INPE) throughout the Legal Amazon was 11,088 km² between August 2019 and July 2020. Mato Grosso was second in the ranking of states that most destroyed Brazilian forests, being responsible for 15 .9% of all deforestation detected, which corresponds to 1,767 km². In the state, a clear transformation of its forest area can be seen, which is linked to the deforestation and, a large part of the area that remains with the original vegetation is where the protected areas are, but the opening of new areas continues to advance, with an increase of 3.8% in the area deforested in 2019 compared to the same period of the previous year. Given this scenario, Mato Grosso state is far from reaching the goals established in its state plans and strategies and also, fulfilling the international commitment assumed during the Climate Conference in Paris in 2015, to reduce deforestation reaching 571 km² per year by 2030 (ICV, 2020).

As seen in this work, deforestation reduces the carbon absorption capacity of forest remnants, Mato Grosso had the capacity to store approximately 23.3 GtCO2 while in 2019 this value was 16.4 GtCO2. In turn, the PAs in 2019 had 3.6 million hectares of forest remnant capable of storing 1.2 GtCO2e.

Young and Medeiros (2018) highlight that in Brazil the total of forest remnants are 496.8 million hectares, with an estimated forest carbon stock of more than 232 GtCO2e. For the authors, conserving these areas is important to ensure the provision of fundamental ecosystem and services for human well-being, such as timber and non-timber forest products, fishing resources, biodiversity, public-use, soil protection, in addition to climate regulation.

But what is observed, according to data from the 2020 Greenhouse Gas Emissions and Removals Estimation System (SEEG), was that deforestation was responsible for driving the growth of greenhouse gas emissions between 2018 and 2019, representing 44% of the year's total emissions. If added to agriculture, they together account for 72% of total GHG emissions in the country. This acceleration of deforestation, mainly in the Amazon, should make the country fail to meet the goal of the National Policy on Climate Change (ALBUQUERQUE *et al.*, 2020).

The contribution of the PAs in preventing inside deforestation means contributing to the reduction of the level of greenhouse gas emissions. Brazil has 156.4 million hectares protected by different categories of protected areas, with an area that holds a forest carbon stock of more than 71.7 GtCO2. This amount is equivalent to about 31.5 times the total of Brazilian emissions for the year 2016, estimated by the SEEG (ALVARENGA JR *et al.*, 2018).

To understand what this represents, the estimated emissions for 2019 places Brazil as the 6th largest emitter of GHG in the world. The country's per capita emissions remain higher than the world average. The per capita average in Brazil is 10.4 gross tons of CO2 against 7.1 tons in the world average. For this reason, the conservation of areas of native vegetation is a major challenge to be faced by the country in a context of climate change (ALVARENGA JR. *et al.*, 2018).

And one way to protect the state from deforestation, as said, is through the creation of PAs. Despite the creation of SNUC in 2000 having influenced the expansion of PAs in Brazil, it is still necessary to make a great effort in several biomes, where both the forest cover and the representativeness of PAs are still small for the state, since only 6% of Mato Grosso's area is protected by PAs, a small percentage when looking at the level of forest conversion over the years (YOUNG; MEDEIROS, 2018).

However, it was demonstrated that the average number of remnants inside the PAs (66%) is greater than the average number of remnants in the municipalities where they are located (49%), namely, they avoid the deforestation of more than 726,000 hectares of forest. And this additional remnant is responsible for preventing the erosion of more than 10,000 tons of soil and storing more than 281 tons of carbon. And when these physical values are converted into monetary values, when talking about erosion avoided by the PAs, it means that the municipalities saved approximately US$40 million in desilting the rivers and the possible values of carbon credits are around US$1.25 billion.

The PAs manage to maintain a larger remaining forest than non-protected areas, but they still face problems that, if solved, would increase their conservation capacity, such as, for example, the elaboration of a management plan for the PAs. The management plan is the "technical document through which, based on the general objectives of a protected area, its zoning and the norms that must govern the use of the area and the management of natural resources are established" (BRASIL, 2000). The lack of a management plan prevents the effective action of environmental agencies and puts at risk all the environmental assets that the creation of the Protected Areas would protect.

It was also observed in this work that, if the PAs ceased to exist and it was necessary to replace the additional remaining forest that they maintain, the more than 726 thousand hectares, the total cost would be approximately US$ 2.87 billion, and the reforestation process would take many years to reach the current stage of the PAs.

Therefore, it is clear the importance of PAs in maintaining an additional remaining forest to what the municipalities already maintain, but even with the effort to show the potential value of a PA, there is still a misinterpretation that the policy of creating PAs represents a hindrance to development. Different actors still argue that nature conservation is incompatible with the practice of productive activities such as mining, agriculture, livestock, power generation, road construction, among others, and that investments made in this sense do not return tangible benefits for society. This false interpretation is propagated by the lack of data and systematized information about the role of Protected Areas in providing assets and services that directly and/or indirectly contribute to the economic and social development of the country (YOUNG; MEDEIROS, 2018).

CONCLUSÕES

- Mato Grosso State, which has a great biodiversity as it is home to three of the Brazilian biomes, the Amazon, Cerrado and Pantanal, has only 6% of its area protected by some form of PA (120 PAs in total).
- Mato Grosso has been losing its forest coverage over the years. Between 1985 and 2019, the state lost 21 million hectares of forests, areas that were mainly transformed for agricultural uses.
- One of the consequences of this deforestation is the loss of carbon storage capacity. In 2019, the state of Mato Grosso had 49.8 million hectares of forest cover, with an estimated forest carbon stock of more than 16.4 GtCO2. In 1985 the forest cover was 70.8 hectares and the carbon stock of 23.3 GtCO2, that is, the capacity to store carbon is being lost in the state.
- In this present study, it was estimated the remaining forest preserved by PAs in Mato Grosso had 3.6 million hectares of forest cover, with a total carbon stock estimated at 1.2 GtCO2e. Due to its capacity to avoid deforestation, it appears that the average of remaining within the PA is greater than the average of remaining within the territory of the municipality without the PA.
- It was estimated that in 2019, due to the avoided deforestation by the PAs (726,832 hectares), they maintained a carbon stock of more than 281.6 million tons of CO2 and prevented soil erosion by more than 10 million tons/year and the monetary estimate of this avoided erosion is over US$40.24 million and the carbon stock of over US$1.25 billion. Values that if annualized, using a rent factor, are estimated at US$ 37.6 million and US$ 75.2 million per year. Also, if the PAs did not exist and deforestation had occurred, the cost of restoring native vegetation would be approximately US$ 2.87 billion.

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