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Impact of REDD+ certification on the deforestation rates of RESEX Rio Preto-Jacundá in the Amazon

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Abstract: In Brazil, the Amazon's role in regulating the Earth's climate, resulting from the conversion of carbon dioxide (CO_2) from the atmosphere into biomass, it is threatened by high rates of deforestation. The impact of a REDD+ Project for forest conservation in the Rio Preto-Jacundá RESEX in Rondônia – RO was evaluated from the comparative analysis between deforestation that occurred before (2004-2012) and after the Project (2012-2020), on a local and regional scale (RO) based on data provided by the Amazon Deforestation Calculation Program (PRODES). The results showed that, from 2015 onwards there is a greater deforestation trend in the RESEX than in the state of RO and that, between 2016 and 2019, all deforestation occurred inside the Project limits. It was concluded that this REDD+ Project without proper regulation and government support has not been able to help to stop deforestation and, consequently, combat the urgent climate crisis that we face.

Keywords: Carbon market; forest conservation; PRODES; protected areas; Rondônia.

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Introduction

The Amazon is the largest tropical forest in the world, in a biome with 4.2 million km² in Brazil alone, corresponding to 49% of the national territory. This forest covers half of the terrestrial species and 12% of all biodiversity on the planet and is home to the largest hydrographic basin in the world with 20% of available fresh water (COSTA; ALVES, 2018). The maintenance of the Amazon brings important environmental contributions, being considered essential for the regulation of the Earth's climate, preservation of biodiversity, human health, food and water security, and energy production, in addition to its immense aesthetic and cultural value (COSTA; ALVES, 2018; ELLWANGER et al., 2020).

It is estimated that 700,000 km² of the original forest cover of the Amazon has already been deforested, which is equivalent to the area of 23 Belgium(s), or 17 Netherlands(s) (INPE, 2021b). The advance of this deforestation generates disastrous consequences not only for the environment, but also for the economy of the region, since forest destruction deprives Brazil and the world of ecosystem services essential to life, in addition to affecting Brazilian democracy by reducing the territories of riverside and Indigenous people, and relying on illegal practices (ABRAMOVAY, 2020).

The Greenhouse Gas Emissions Estimation System (SEEG BRASIL, 2021) indicates that, between the years 2000 and 2018, seven of the ten Brazilian municipalities that emitted the most carbon (C) into the atmosphere are in the Amazon and have deforestation as the main source of emission. According to this system, São Félix do Xingu in the state of Pará is the municipality that emitted the most C in Brazil, with 29.7 million gross tons of carbon dioxide (CO_2) in 2018. Land use changes account for 25.44 million tons, followed by agriculture with 4.22 million tons (CO_2). If it were a country, São Félix do Xingu would be the 111th in the world in emissions, ahead of Uruguay, Norway and Chile (SEEG BRASIL, 2021).

Despite the challenges, large municipalities in the Amazon and with many protected areas, such as Altamira in the state of Pará, have high rates of capture of greenhouse gases from the atmosphere (SEEG BRASIL, 2021). Through photosynthesis, forests capture (CO_2) of the atmosphere and convert it into living biomass: tree trunks, roots, branches and leaves, in addition to storing C in the soils, absorbed by litter, woody debris and roots (BRACK, 2019). According to the UN, forests absorb and store about 30% of the current levels of C issued by fossil fuels and industries in the world, but they have the potential to store much more (BRACK, 2019).

Recognizing the fundamental role of forests in combating climate change, in 2007 the 13th United Nations Conference on Climate Change (COP) in Bali formalized a mechanism, called REDD+ (Reduction of emissions from deforestation and forest degradation + conservation of forest carbon stocks, sustainable management of forests and increase of forest carbon stocks), which financially compensates forest-owning countries that reduce carbon emissions from deforestation and forest degradation (LA VIÑA; LEON; BARRER, 2016). REDD+ projects aim at forest conservation through activities of monitoring, control, promotion of sustainable use of resources, and engagement of local

communities; allowing, from a carbon market, the receipt of payment for C not emitted into the atmosphere (WEST, 2015; UN, 2007).

In the same year as COP 13, the University of North Carolina listed 338 REDD+ and other carbon projects occurring in the world, with Brazil responsible for 56 of them (CIFOR, 2017). Between 2006 and 2014, public and private funding pledges for these projects were more than $ 8.7 billion (NORMAN; NAKHOODA, 2015). Microsoft alone invested more than $ 4 million in offsets in Brazil, Kenya and Cambodia in 2012 as part of its goal to become a carbon-neutral company (NORMAN; NAKHOODA, 2015).

Due to the relevant financial contribution and the expectation of socio-environmental benefits that they see being deposited in these projects, especially for the urgent fight against the climate crisis, studies that analyze the impact of the REDD+ instrument for forest conservation are necessary. This work proposes to carry out this analysis in a Protected Area (PA) of the Extractive Reserve (RESEX) type in the state of Rondônia (RO) that, in the period prior to the implementation of the REDD+ project, was the one that suffered the most from deforestation among the 17 RESEX of its reference region, in addition to being located in a state that has faced high rates of deforestation since the 1970s due to large developmental projects, such as the opening of the BR-364, and that has already lost about a third of its original forest cover (MARINHO, 2017).

The REDD+ Project in question is among the 22 carbon forest projects in Brazil that present availability of secondary data, with information such as proponent, location, project area in hectares, international standard, consulting, audit, registration and estimated GHG reduction (AGUIAR, 2018). In addition, this project is among the few REDD+ projects in Brazil that were implemented until 2012, and audited by a non-governmental organization of expertise (VERRA, 2021; AGUIAR, 2018), in addition to standing out for being an initiative of the traditional community, which resides in RESEX, as a way of generating income and valuing the forest from the commercialization of environmental services (SILVA, 2016).

In this way, to collaborate with the elucidation of society and discuss the effectiveness of the REDD+ Project, a comparative assessment will be carried out between the deforestation that occurred in RESEX, its surroundings and within the limits of the REDD+ Project.

Methods

Area of study

This manuscript has as its study area the Extractive Reserve Rio Preto – Jacundá – RO (RESEX RP-Jacundá), a sustainable use PA of the Amazon. The RESEX was created by State Decree No. 7,336, of January 17, 1996, covering two rubber plantations: Jatuarana and Vera Cruz (GOVERNO DO ESTADO DE RONDÔNIA, 1996). Currently, it has a demarcated area of 953 km^2 divided between the municipalities of Machadinho d'Oeste and Cujubim, near the interstate border of Rondônia with Amazonas (CENTRO DE ESTUDOS RIO TERRA, 2016).

The area was declared of ecological and social interest, for the benefit and use of its indigenous population, formed by families of rubber tappers, with the right to sustainable exploitation in line with the conservation of renewable natural resources (CENTRO DE ESTUDOS RIO TERRA, 2016).

The PA is managed by the Coordination of Conservation Units, of the State Secretariat for Environmental Development of Rondônia, and has a management plan approved since 2017 in order to diagnose the area, establish its zoning and standards that should preside over the use and management of resources in forestry, subsistence fishing and hunting, latex extraction, chestnut and açaí harvesting, and ecotourism (INSTITUTO SOCIOAMBIENTAL, 2021). According to the management plan (CENTRO DE ESTUDOS Rio TERRA, 2016), the geographical location of RESEX, in a macro context of the Amazon biome, generates concern, because despite being a protected area that houses rare and poorly studied environments, it is inserted in the so-called "Arc of Deforestation".

The RESEX environment is under strong pressure from anthropic activities, such as livestock and mechanized agriculture, where the replacement of forest remnants by pasture has predominated in the deforestation process (MARINHO, 2017; CENTRO de ESTUDOS RIO TERRA, 2016). The buffer zone of this PA is also in direct contact with settlements, properties and roads, which cause an edge effect on the forest (CENTRO de ESTUDOS RIO TERRA, 2016), and potentially exert greater pressure by deforestation.

In 2012 it was implemented in the area, by the *Climate, Community & Biodiversity* (CCB) and *Verified Carbon Standard* (VCS) standards, a voluntary REDD+ Project with the main objective of promoting the sustainability of the extractive community through the reduction of forest degradation and unplanned and illegal deforestation, and consequent greenhouse gas emissions, achieved through a list of activities financed by the commercialization of carbon credits (BIOFÍLICA, 2016).

The project area comprises the entire forest area of RESEX in 2012, about 942.89 km^2, and the private company Biofílica Ambipar Environment is responsible for the general coordination of socio-economic and environmental diagnosis, baseline studies and carbon stock, validation and commercialization of credits, in addition to co-management of the project and implementation of conservation activities. According to the company, there is an expectation that between October 01, 2012, and October 01, 2042 a deforestation of 352,22 km^2 will be avoided. Thus, it is expected that it will be impossible to issue 4,135,805 tons of CO_2 eq in the first 10 years of the project, and a total of 12,367,970 t of CO_2 until 2042 (BIOFÍLICA, 2016).

Among the activities financed by the project are the quarterly workshops and trainings on agroecology, waste disposal and composting; improvement of the sanitary conditions of homes; installation of an açaí and chestnut processing center; and the implementation and maintenance of an educational center for young people and adults (BIOFÍLICA, 2016).

Analysis of deforestation

To analyze the deforestation histories that they see occurring, we used the values of increment of deforestation in the region made available by the Amazon Deforestation Calculation Program (PRODES) of the National Institute for Space Research - INPE, which performs satellite monitoring of deforestation by shallow cutting in Brazil's Legal Amazon and generates these calculations (INPE, 2021b).

Spreadsheets were obtained with the values in km^2 of the annual deforestation increments available for the periods from 2004 to 2012 (the period before the REDD+ Project), and 2012 to 2020 (after the project), both on a regional scale (state of Rondônia), and on a local scale (RESEX RP-Jacundá). The data available for RESEX begin in 2008, when INPE began to disclose, in addition to the accumulated deforestation throughout Brazil's Legal Amazon, the increase in deforestation for protected areas.

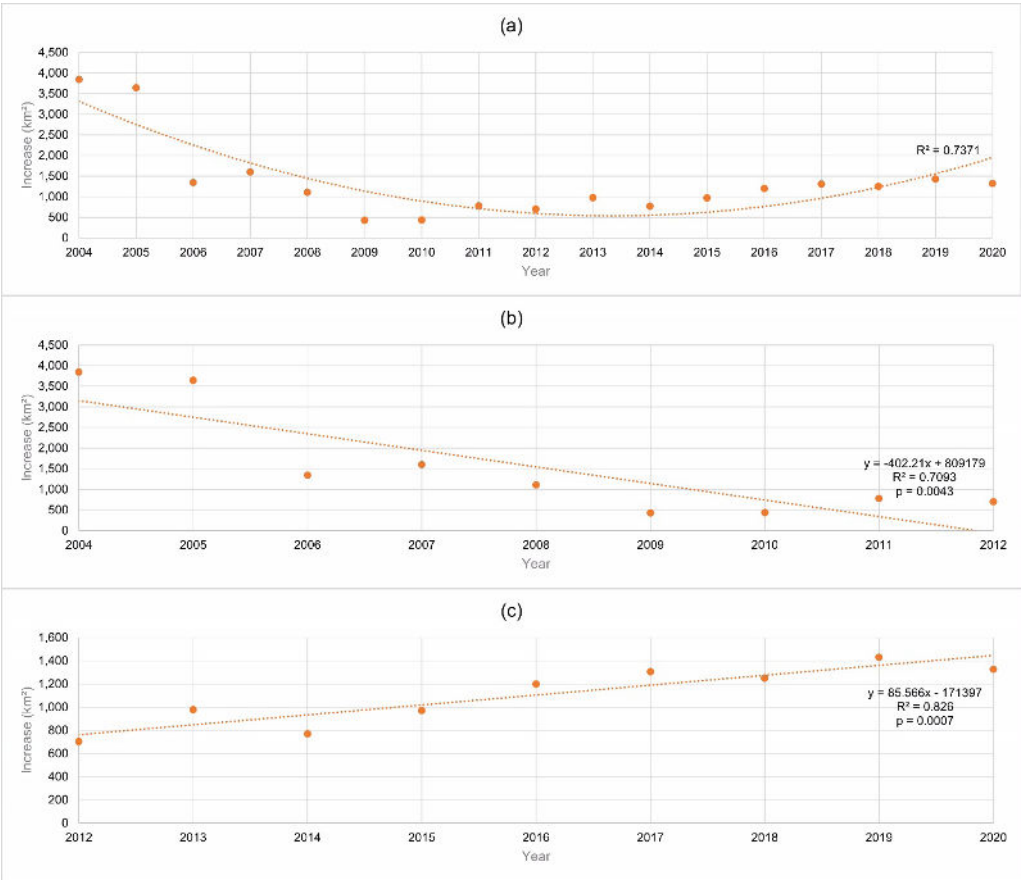
In order to analyze whether deforestation in the areas follows some kind of trend, the data collected were analyzed from the testing of mathematical prediction models by linear, polynomial, exponential, logarithmic and potential regression. The R^2 greater than or equal to 70% and 95% confidence level were established as criteria for model approval, therefore p-values lower than 0.05 were considered statistically significant.

To perform a comparative analysis between the RESEX studied and its reference region, deforestation increment values were also collected for 15 other RO RESEX that have data available in PRODES. The deforestation history of RESEX Rio Preto-Jacundá was also compared with the deforestation values recorded at the boundaries of the REDD+ Project within RESEX, from the *shapefile* "Annual Increase in Deforestation (2008 to 2021)" made available by INPE on the TerraBrasilis platform.

Results

The historical series of deforestation increments in the state of Rondônia indicates that the year 2004 was the most critical, followed by a downward trend that continued at least until 2012, when there was an inflection in the curve, with a change from a downward trend to an increase in deforestation (Figure 1a).

Figure 1 - Annual increase in deforestation in Rondônia between 2004-2020 (a) and between the periods of 2004-2012 (b) and 2012-2020 (c). Data from PRODES/INPE



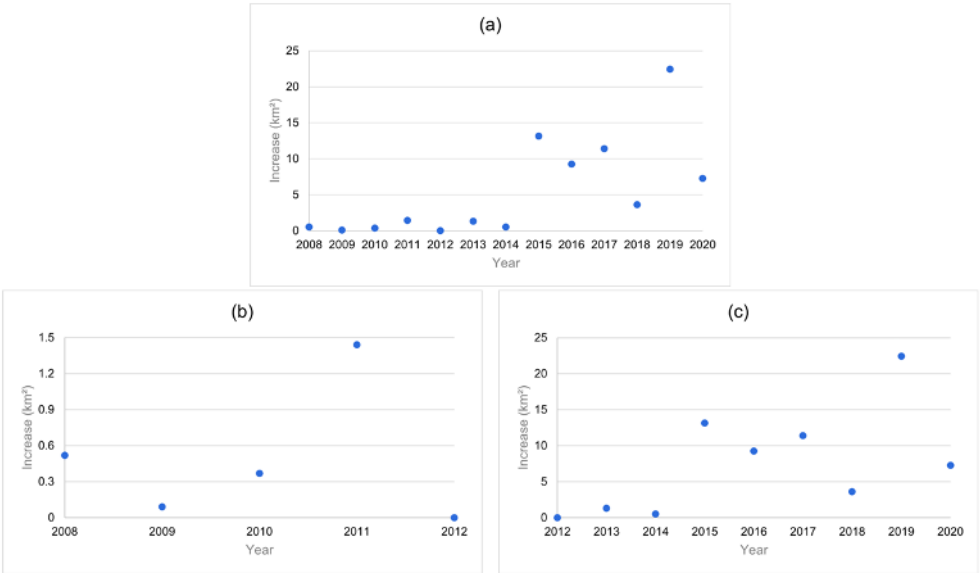
Source: Authors (2021).

In the analysis of the period 2004-2012 (Figure 1B) there is a linear decrease in deforestation and the equation of the straight line has the angular coefficient of -402.2: a high and negative value, which indicates a high rate of decrease in annual deforestation in RO in the period.

For the period between 2012-2020 (Figure 1C), the equation of the straight line has an angular coefficient of 85.6: a positive value that indicates a linear growth of deforestation in RO, but at a lower speed than the decrease that occurred between 2004-2012.

On the local scale of RESEX RP-Jacundá, in the period between 2008 and 2020, deforestation increments in the PA totaled 71.54 km², corresponding to about 7.5% of the area. Much of this deforestation (94%) occurred between 2015-2020 (Figure 2A), although there is no clear trend of rather irregular increases in deforestation in both 2008-2012 (Figure 2B) and 2012-2020 periods (Figure 2C).

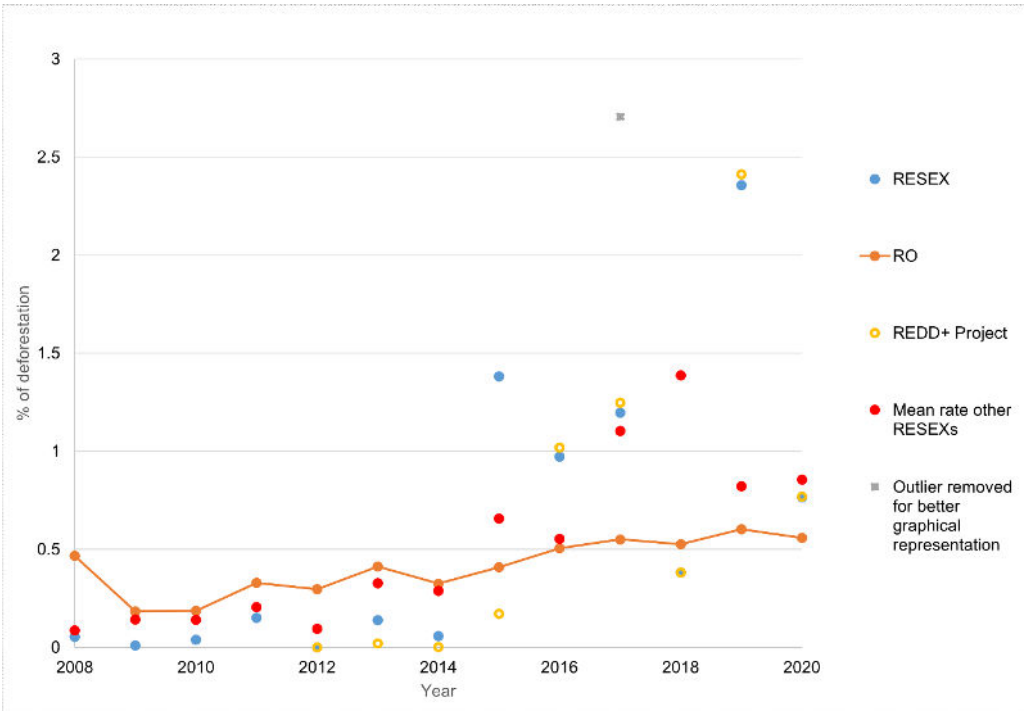
Figure 2 - Annual increase in deforestation in RESEX RP-Jacundá between 2008-2020 (a) and between the periods of 2008-2012 (b) and 2012-2020 (c). Data from PRODES/INPE



Source: Authors (2021).

The comparison between the deforestation dynamics of the studied areas/scales indicated that until 2014 the state of RO and the RESEX RP-Jacundá followed similar deforestation patterns, with increases and decreases in the same years, although the state always had a higher relative deforestation rate than in the PA (Figure 3). As of 2015, there was an inversion of these rates and the proportion of deforestation in RESEX became, on average, 2.5 times higher than in the state, except in 2018.

Figure 3 - Percentage of annual deforestation compared between the state of Rondônia (RO), the RP-Jacundá RESEX, the REDD+ Project, and the other state RESEX taking into account the respective areas

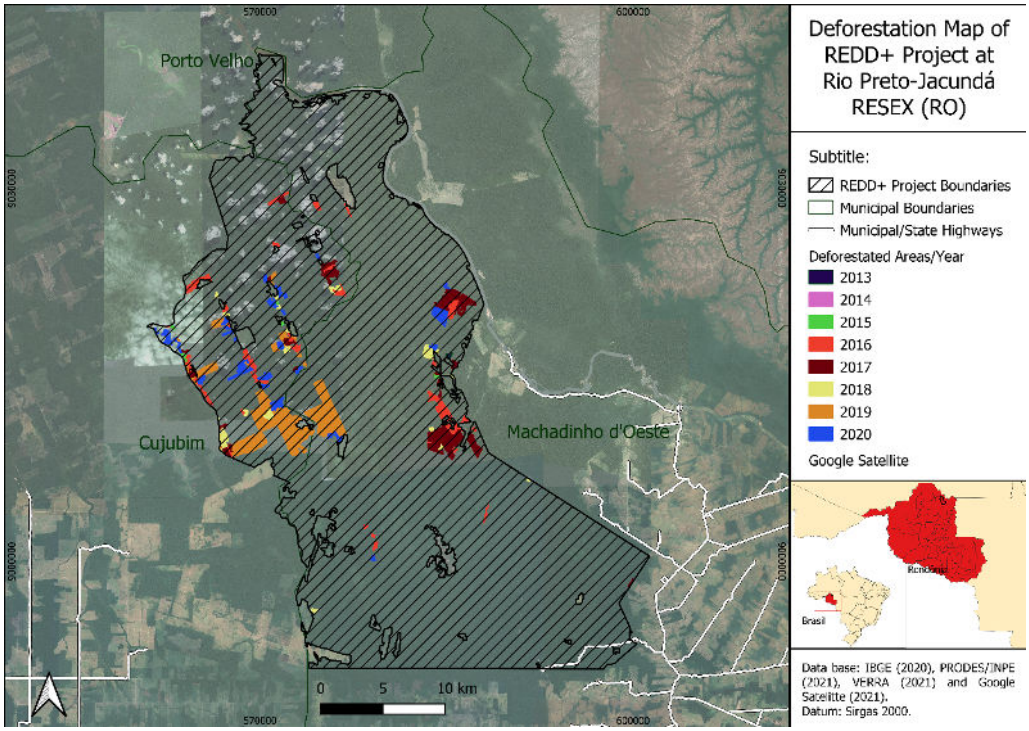


Source: Authors (2021).

When we analyzed whether the same phenomenon occurred in the other RO state RESEXEs, it was found that, just as it occurred in the RP-Jacundá RESEX, after 2015, the average deforestation of the other RESEXEs also presented rates above those observed throughout the state (Figure 3). Among the 15 RESEXs considered, the high rates of deforestation in the period (2008-2020) in the RESEX Jacy-Paraná (45%), Ipê (48%) and Angelim (17%) stand out, with rates above that observed in the RESEX RP-Jacundá (7.5%).

When analyzing the limits of the Jacundá REDD+ Project, it was found that between 2013 and 2015 the deforestation of RESEX (13.21 km2) occurred mostly outside the REDD+ Project (87.8% of deforestation in the period). On the other hand, between 2016 and 2019 the opposite occurred, with all deforested areas (100% of deforestation in the period), mainly in the central area of the project, with emphasis on the year 2019 in which more than 22 km^2 were deforested.

Figure 4 - History of annual deforestation occurred between 2013-2020 within the limits of the REDD+ Project of RESEX RP-Jacundá (RO)



Source: Authors (2021).

Discussion

Deforestation records of the Legal Amazon and the state of Rondônia

PRODES began recording deforestation in the Legal Amazon in 1988 and since then the most critical year was 1995, when more than 29 thousand km^2 of forest were deforested, followed by the year 2004 in which there was more than 27 thousand km^2 of deforestation in the Legal Amazon (INPE, 2021b). In the state of Rondônia, in the entire historical series, 96,093.27 km^2 were deforested, which corresponds to about 40% of the total area and 44.9% of the state's forest area (INPE, 2021b).

Our results indicated that, between 2004 and 2012, there was a positive scenario for forest conservation in the state of Rondônia, with gradual reductions in the deforestation rate, which decreased by 82%. This scenario, apparently optimistic, happened throughout the Brazilian Amazon in this period, but Fearnside (2020) did not attribute this phenomenon to an improvement in government administration. The author believes that the decrease in deforestation can be explained by other factors, and in particular by market forces, such as: i) the fall in the prices of export products, such as soybeans and beef; ii) the 80% increase in the value of the Brazilian currency compared to the US dollar, which made exports less profitable for landowners; and iii) the adoption of a resolution

by the Central Bank of Brazil (resolution n° 3545 of 2008) to subordinate the granting of credits for agriculture and livestock to the condition of not having outstanding fines for illegal deforestation (BRASIL, 2008; FEARNSIDE, 2020).

On the other hand, studies converge to the affirmation that public policies are fundamental for the control of deforestation (SOARES-FILHO; RAJÃO, 2018; ASSUNÇÃO; GANDOUR; ROCHA, 2015). Assunção, Gandour and Rocha (2015) found results that suggest that environmental policies implemented in Brazil between 2004 and 2008 prevented more than 73,000 km2 of deforestation in the Amazon during this period. Messias et al. (2021) also highlight important projects that were implemented in 2004 and may have contributed to the drop in deforestation. Among them, two command and control projects stand out: i) The Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), in order to promote the continuous reduction of deforestation through a set of integrated actions between federal, state, municipal, civil society and private sector agencies; and ii) the Real Time Deforestation Detection System (DETER), which issues daily warnings of changes in forest cover and has since been used in the planning of enforcement actions (MESSIAS et al., 2021).

In 2008, the decrease in deforestation continued, which can be attributed to the emergence of new laws in the country, such as: i) the creation of the Amazon Fund, aiming to raise funds for projects to combat deforestation and promote sustainable use; ii) the approval of the National Climate Change Law, in which Brazil committed to reduce greenhouse gas emissions between 36.1 and 38.9% by 2022; and iii) the regulation of the environmental crimes law, which instituted fines of R$ 5,000,00 per hectare for those who practice any illegal logging action without prior approval from the competent environmental body or in disagreement with the approval granted (SOUZA et al., 2020; MESSIAS et al., 2021).

Souza et al. (2020) observed that normative actions aimed at containing deforestation had visibly effective results soon after the creation of these laws, with positive effects between 1 and 3 consequent years, and, therefore, this may have been the reason for the decrease in deforestation in the state of Rondônia that was maintained, at least, until the year 2012.

It is not by chance that the state's deforestation trend scenario has changed abruptly since 2012. This year was marked by the enactment of a law that weakened the Brazilian Forest Code, eliminating important restrictions on deforestation, especially in the Amazon (CASTELO, 2015; BRASIL, 2012). The Law on the Protection of Native Vegetation (Federal Law No. 12,651 of 2012), was enacted at a time of increasing political influence of rural landowners, which led to substantial changes in the old Forest Code, which forgave illegal felling carried out until 2008 and fines, creating an expectation of future "amnesties", in addition to disengaging the recovery of risk areas and native forests (FEARNSIDE, 2020; RODRIGUES; MATAVELLI, 2020; BRASIL, 2012). In 2012, the rise in the price of soybeans may also have contributed to the increase in deforestation (FEARNSIDE, 2020), since contexts of increased agricultural prices simultaneously with a drop in production costs are favorable to the suppression of vegetation in agricultural

frontiers in the Amazon (NASCIMENTO et al., 2019).

After the growth of deforestation in Rondônia started in 2013, the state has, since 2016, had a trend of stabilization of rates, although it is still among the states that most deforested in the country (MESSIAS et al., 2020; MESSIAS et al., 2021).

Throughout the Brazilian Amazon, a gradual increase in deforestation has been observed in recent years, with a remarkable annual increase rate of 29% between 2015 and 2016 (SANTOS et al., 2021; CARVALHO et al., 2019). This phenomenon, also verified in this study from 2013 in the state of Rondônia, may have been caused by the cuts of 72% of the resources allocated to PPCDAm in 2013, which weakened the program (MESSIAS et al., 2021) and its command and control effects on Amazon deforestation.

Deforestation records of RESEX RP-Jacundá and the Redd+ Jacundá Project area

In the analysis of the local scale of the RESEX RP-Jacundá, legally created in 1996, the historical deforestation series of the area (1988-2020) suggests that this RESEX fulfills more convincingly its role as a protected area only until 2014, when deforestation rates were low and lower than the state of Rondônia. Between 1988 and 2007 (the period prior to the one analyzed in this study), accumulated deforestation was approximately 13.7 km^2, which corresponded to only 1.44% of the area (INPE, 2021b), with rates close to those observed between 2008-2014.

Since the PAs are not isolated areas of their regional context, it is already expected that the pressures within the protected area reflect what they see occurring in their surroundings (LAURANCE et al., 2012). This was observed in the period from 2008 to 2014, when the RESEX RP-Jacundá followed the pattern of deforestation variation throughout the state. On the other hand, as of 2015, there is an inversion of this relationship with the surroundings and deforestation in the RESEX has since become proportionally greater than in the entire state.

Compared to a PA, higher relative deforestation was expected throughout the state territory, which has different land uses. This expectation is based on previous studies, such as the study carried out by IPAM Amazônia, which showed that of the 21 million hectares deforested between 1997 and 2020 on public lands in the Brazilian Amazon, only 7% occurred in CUs, which, like Indigenous lands, are the most preserved land categories in the biome (SALOMÃO et al., 2021). On the contrary, deforestation in the RP-Jacundá RESEX and in the other RESEX in the state has increased considerably since 2015, and in 2019 the percentage of deforestation in the study area was almost four times higher than in the entire territory of Rondônia.

Understanding why these RESEXs do not fulfill the expected role in controlling deforestation involves many issues of functionality of these spaces and current socioeconomic demands.

According to Freitas et al., (2018), the creation of extractive reserves in the Amazon did not induce efficient change in reducing forest degradation. For example, the Chico Mendes Extractive Reserve, in Acre, where more than 6.3% of the area was deforested

to accommodate about 10 thousand head of cattle, representing an 11-fold expansion of the pasture area since this RESEX was created in 1990 (PERES, 2011).

Contextualizing livestock in the period, in 2015, despite the political and economic crisis, livestock activity represented 6.8% of the Brazilian GDP, and came from a constant increase in meat exports and the cattle herd that in the period from 1990 to 2015 grew 42.38% (CARVALHO; ZEN, 2017; FREITAS JUNIOR; BARROS, 2021; FEARNSIDE, 2020), especially in the North region, which between 1975 and 2016 had 2015 recorded a growth rate of the herd that reaches 2,174%, accompanied by 525% expansion of pastures (SOUZA, 2017).

Freitas et al. (2018, 2021), associate deforestation and frequent forest degradation by fires in the Amazon RESEXs with the effects of the growth of Brazilian agriculture and the devaluation of the extractive chain. According to them, traditional communities, which previously focused on harvesting non-wood forest products and subsistence agriculture, have switched to other activities incompatible with sustainable use, especially livestock farming (FREITAS et al., 2018; FREITAS et al., 2021).

According to the President of the Residents' Association of RESEX RP-Jacundá, since 2018 there are risks of land fraud and illegal logging in the territory, some areas are already being deforested to open wood stockyards after illegal removal (CONSERVAÇÃO INTERNACIONAL, 2020).

The highest percentage of deforestation in RESEX RP-Jacundá regarding the state of RO, seems to be incompatible with a PA that has a project focused on reducing deforestation and forest degradation, as is the case of the REDD+ Jacundá Project, created in 2012, and which unexpectedly reaches a percentage of deforestation even higher than that of RESEX. This comparison surprises since 2016 and in 2019 deforestation within the REDD+ Project reached its highest value, with a loss of more than 2.4% of forest area. Despite this, the REDD+ Project foresaw a deforestation threshold 1.7 times higher than what occurred, with a loss of 99.84 km^2 between 2013 and 2020 (BIOFÍLICA, 2016). Only in 2019 was the actual deforestation higher than expected by the project, with a difference of more than 9 km^2 (BIOFÍLICA, 2016).

This result raises a warning about the potential contributions of this project to its central objective of reducing emissions from deforestation and forest degradation, a concern already reported in other studies such as by West et al., (2020). The authors, when analyzing the deforestation that occurred within the limits of REDD+ Projects in the Brazilian Amazon between the years 2000 and 2018, did not find significant evidence that these projects have mitigated forest loss, in addition to reporting that the RESEX RP-Jacundá presented a significant increase in forest cover loss after the implementation of the project (WEST et al., 2020).

Zwick (2019) discussed the first carbon project implemented in an Indigenous protected area in 2009: the Suruí Forest Carbon Project, located between the states of Rondônia and Mato Grosso. In its first 5 years of operation, the Project was able to drastically reduce deforestation, in addition to generating, by 2018, more than 299 thousand carbon credits certified by the VCS and CCB standards (ZWICK, 2019). Despite the

positive results, in 2015 the indigenous association of the area reported to several instances the occurrence of illegal gold mining and, in 2018, the REDD+ initiative was suspended after the increase in deforestation for gold extraction (ZWICK, 2019). For the author, among the lessons learned was the need for greater government cooperation since these projects depend on the performance of strong institutions and the application of laws.

In principle, the Jacundá REDD+ Project can generate several benefits for biodiversity, with the protection of ecological corridors and endemic species, and for society, with the improvement of the quality and livelihoods of the traditional population. Despite this, the lack of regulation and synergy between local governments, the private sector and civil society may be the reason why REDD+ Projects have not yet shown their best results in relation to deforestation and forest degradation (AGUIAR, 2018; GEBARA et al., 2014). It is warned that REDD+ Projects in Brazil are not regulated by law and that the carbon credits market is still a voluntary, immature and incipient market, in which there is no specific demand (AGUIAR, 2018).

To exemplify the potentials of legal regulation of REDD + Projects, in Guyana, a study demonstrated that a REDD + Project was able to reduce tree cover loss by 35%, equivalent to 12.8 million tons of greenhouse gas emissions. (ROOPSIND; SOHNGEN; BRANDT, 2019). This project was implemented at the national level since 2009, with financial incentive from Norway, and advances in forest regulations were considered fundamental for reducing forest loss, protecting biodiversity and preventing environmental degradation (ROOPSIND; SOHNGEN; BRANDT, 2019).

It is believed that, although deforestation rates in the Jacundá REDD+ Project were proportionally higher than in the entire state, this initiative should not be invalidated, but strengthened with government support. It is considered that, as the Project has less than 10 years of implementation, the future scenario may be different if there is legal regulation and strengthening of monitoring and supervision actions of the PA. Measures such as these may be relevant to reducing deforestation throughout the Brazilian Amazon.

Perhaps the main challenge for the successful implementation of REED + initiatives in Brazil is the country's current scenario of insecurity in national environmental protection decisions and policies. In the United Nations Paris Agreement, Brazil initially committed to reduce greenhouse gas (GHG) emissions by 43% by 2030, by ending illegal deforestation and carrying out reforestation of large areas (CARVALHO et al., 2019). Despite this, the current government presented to the Paris Agreement a new climate target that allows the country to deforest 13.4 thousand km^2 per year in the Amazon, until 2025, and still remain within the commitment (RAJÃO et al., 2021) and more recently, during COP 26, extended the GHG reduction from 43% to 50% by 2030, despite not presenting the basis for calculating this reduction (BETIM, 2021).

The concern of researchers and environmentalists in the country is to understand how we will have this increase in GHG reduction in the current context of increasing deforestation. The same week as COP 26, INPE released an estimate of 13,235 km^2 of deforestation by clearcutting in the Legal Amazon in 2021, an increase of 21.97% compared to the previous year and the worst value since 2006 (INPE, 2021a). In Rondônia,

the deforestation situation in 2021 is even worse, with an increase of 32.05% compared to 2020 (INPE, 2021a).

Conclusions

Rondônia is among the states that most deforest in Brazil, mainly in the Legal Amazon, but the creation of public policies and monitoring tools, in addition to the crisis of agricultural products and the appreciation of the national currency, contributed to a drastic reduction in deforestation between 2004 and 2012. However, since 2013, a new worrying trend of increasing deforestation rates in RO has begun, demonstrating the direct relationship between government administration and the creation of laws for the conservation of the largest and most important biome in the country.

Rio Preto-Jacundá RESEX emerged from a strategy valid in social terms and interesting for the environment, as it provides for the sustainable use of natural resources. However, what has been verified in Rondônia is that the Extractive Reserves of the State, in general, since 2015 have been losing their value of conserving nature, with the realization of activities incompatible with sustainable use, such as livestock and illegal logging. It is noteworthy that even the implementation of a private REDD+ Project has not been able to stop deforestation.

The REDD+ Project in the area possibly generates several social benefits, but this work pointed out that in relation to the climatic benefits, represented by the maintenance of carbon stocks and sequestration, and those for biodiversity, such as the reduction of forest degradation, the project, since 2016, has had difficulties to fulfill this differentiated role expected for a protected area. The contribution of the project to assist in the urgent fight against the climate crisis that we find ourselves are less than its potential, probably influenced by the lack of regulation of this type of project and support from the local and federal government.

The comparison of deforestation rates in the three scales of analysis suggests a chain effect of trend change and perception of forest conservation from regional to local scale, in which deforestation becomes critical initially in the state of RO (2013) and then in RESEX (2015) and within the limits of the REDD+ Project (2016).

Although the current situation of the Rio Preto-Jacundá RESEX is alarming, it is understood that the increase in deforestation is a phenomenon of a complex nature that cannot be attributed to a single factor, although apparently it can be reversed with efficient governance and public policies. It is suggested to carry out work that analyzes the causes of deforestation specifically in this area and may assist the managers of the unit and the REDD+ Project in the conservation and maintenance of the forest.

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Impacto da certificação REDD+ nas taxas de desmatamento da RESEX Rio Preto-Jacundá na Amazônia

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Resumo: No Brasil, o papel da Amazônia na regulação do clima terrestre, decorrente da conversão de dióxido de carbono (CO_2) da atmosfera em biomassa, está ameaçado pelos altos índices de desmatamentos. Avaliou-se o impacto de um Projeto REDD+ para a conservação de floresta da RESEX Rio Preto-Jacundá, em Rondônia – RO, a partir da análise comparativa entre os desmatamentos ocorridos antes (2004-2012) e após o Projeto (2012-2020) na escala local e regional (RO) conforme valores do Programa de Cálculo do Desflorestamento da Amazônia. Os resultados demonstraram que, a partir de 2015 há maior tendência de desmatamento dentro da RESEX do que no estado de RO, e que entre 2016 e 2019, todos os desmatamentos ocorreram dentro dos limites do Projeto. Concluiu-se que este Projeto REDD+, sem a devida regulamentação e apoio, não vem sendo capaz de cessar os desmatamentos e, consequentemente, auxiliar na urgente crise climática que enfrentamos.

Palavras-chave: Mercado de carbono; conservação de floresta; PRODES; unidade de conservação; Rondônia.

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Impacto de la certificación REDD+ en las tasas de deforestación de la RESEX Rio Preto-Jacundá en la Amazonia

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Resumen: En Brasil, el papel de la Amazonía en la regulación del clima terrestre, resultante de la conversión de dióxido de carbono (CO_2) de la atmósfera en biomasa, se ve amenazado por las altas tasas de deforestación. Se evaluó el impacto de un Proyecto REDD+ para la conservación de floresta en la RESEX Rio Preto-Jacundá, en Rondônia – RO, a partir del análisis comparativo entre la deforestación ocurrida antes (2004-2012) y después del Proyecto (2012-2020), en un escala local y regional (RO) basados en datos proporcionados por el Programa de Cálculo de Deforestación Amazónica (PRODES). Los resultados mostraron que, a partir de 2015, existe una mayor tendencia de deforestación dentro de la RESEX que en el Estado de RO, y que entre 2016 e 2019 toda la deforestación ocurrió dentro de los límites del Proyecto. Se concluyó que este Proyecto REDD+, sin la debida regulación y apoyo gubernamental, no ha podido detener la deforestación y, en consecuencia, ayudar en la urgente crisis climática que enfrentamos.

Palabras-clave: Mercado de carbono; conservación de floresta; PRODES; unidad de conservación; Rondônia.