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REDD+ AS A POSSIBLE SOLUTION FOR CONSERVATION OF BRAZILIAN SAVANNA (CERRADO)

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Abstract – Cerrado (Brazilian savanna) is the second largest biome in Brazil and holds a high diversity of species, including many endemic ones. Despite the ecological importance of Cerrado, almost half of this biome was already deforestated for the establishment of agriculture and cattle raising activities. Policies, that promote the valuation of standing forests and compensate opportunity costs of land use changes, could be an instrument to curb deforestation in Cerrado. One of these policies is REDD+ (reducing emissions from deforestation and forest degradation), which has been widely considered for the Amazon biome. However, relatively little is known about the potential for the implementation of REDD+ in Cerrado areas. We aim to contribute to fill this gap by making a literature review on the potential, challenges and constraints linked with the inclusion of Cerrado areas in REDD+ projects. International and Brazilian literature, as well as national data and reports focused on REDD+ and related subjects were used as support material. Initially we briefly characterize the occupation of the Cerrado biome, present the main physiognomies and point the ones most promising for the establishment of REDD+ projects. The inception of REDD+, its development in Brazil and implemented projects are reviewed next. Thereafter we identify key points that need to be addressed for the implementation of REDD+ projects in Cerrado considering political, economic and environmental issues. Finally we discuss about incentives that could stimulate the inclusion of Cerrado in REDD+ projects. Our analysis shows Cerrado has mainly two physiognomies that would be attractive in the first moment for the implementation of REDD+ projects: *cerrado sensu stricto* and *cerradão*. The expressive tree component in both physiognomies would facilitate monitoring, reporting and verification (MRV) activities, especially the monitoring component as most methodologies focus on the arboreal pool. Beside this, we believe investors would rather finance the maintenance of areas with trees than areas predominantly with grass. REDD+ in Brazil is still incipient with less than ten REDD+ projects being developed. Among them, only one is located in Cerrado. Despite being a carbon reservoir and a pool of biodiversity, Cerrado is still a marginalized biome in Brazil. Great effort by the Brazilian government is needed to change the way society see and conceives development in the biome area. Issues like illegal logging, expansion of

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urban occupation and agriculture/cattle raising areas must be contemplated and minimized. An assessment of suitable areas for the development of REDD+ projects is also necessary. Policies designed considering the peculiarities of the biome and its inhabitants should be created to incentive the establishment of REDD+ projects in the selected areas. More investments are also needed to enhance the productivity of areas already used for agriculture and cattle raising in order to avoid the displacement of these activities to new areas. It is clear that standard public policies were not able to restraint deforestation in Cerrado. Therefore, we believe that new approaches, like REDD+ projects, are necessary and will be effective in reclamation and conservation of Cerrado areas

Keywords: REDD+; Cerrado; conservation.

1. Introduction

Brazil will undoubtedly be one of the main destinies for REDD+ projects investments in the near future. The country has high carbon stock vegetation which is under severe deforestation pressure. Taking a closer look, among the six different biomes that compose Brazil (Amazon, Cerrado, Caatinga, Atlantic Forest, Pantanal and Pampa), the ones that would be eligible for REDD+ projects in a first glance would be Amazon and Cerrado. As both biomes have an operating deforestation monitoring system, Brazil decided to start with them the implementation of the Brazilian national REDD+ strategy (Brasil/MMA, 2011).

Savannas vegetation type have a wide distribution in the world (16.1 million km^2 or 11.5% of the global land surface), including an extensive zone between the evergreen tropical forests and deserts. Most of the savannas areas are established across dry areas which usually suffer fire effect (Scholes and Hall, 1996). The savanna formation in Brazil constitutes the Cerrado which is, after Amazon, the second largest biome of Brazil (Klink and Machado, 2005).

Beside of its great extension, Cerrado also has high species richness with many endemic species. Cerrado has been severely fragmented and degraded, despite of its biological importance. A recent remote sensing study pointed that about 47.9% of Cerrado's original cover had been cleared until 2008 (Brasil/MMA, 2009). After the Atlantic Forest, Cerrado is the Brazilian biome that most suffered anthropogenic impacts. The biological importance associated with the high levels of deforestation contributed to the classification of Cerrado as a hotspot (Myers et al., 2000; Mittermeier et al., 2005).

The human occupation in the Cerrado was more intensive in the 60s, with the construction of Brasília and highways to give access to the new national capital. At this time the migration to Brasília increased due to employment opportunities created with the construction of the new capital. The population growth in Brasília and in the region nearby stimulated the implementation of agricultural activities in this biome.

The expansion of intensive agriculture contributed to the advance of deforestation in Cerrado areas. Furthermore, parallel to agriculture, there was an increase in the cattle ranching activities in the region over the years. Nowadays, pasture is the most common land use in Cerrado (more details about the Cerrado occupation are provided by Klink and Moreira, 2002).

Cerrado vegetation is not a homogeneous one: it is characterized by a gradient of grassland, savanna and forest formations. According to Coutinho (1978) and Miranda et al. (1997), Cerrado physiognomies range from *campo* form (grassland formation), and the typical *cerrado sensu stricto* (savanna formation) to the *cerradão* (forest formation).

Cerrado physiognomies can be divided in five main types: *campo limpo*, *campo sujo*, *campo cerrado*, *cerrado sensu stricto* and *cerradão*. *Campo limpo* represents the *campo* form. It is constituted by grassland without visible taller woody plants. The

savanna formation encompasses *campo sujo, campo cerrado* and *cerrado sensu stricto*. *Campo sujo* is similar to *campo limpo*, except for the presence of scattered woody shrubs or palms. *Campo cerrado* usually presents sparse shrubs and trees along a continuous grass layer. *Cerrado sensu stricto* is the most typical physiognomy of Cerrado. It has trees and shrubs up to 8–10 m high and with a grass understory. *Cerradão* is considered a forest formation with trees up to a height of 20 m and may have a closed or semiopen canopy (Eiten, 1972).

Due to the inherent differences among Cerrado physiognomies, the carbon stock potential of each one of them will be different. Vegetation's carbon stock is intrinsically related to the biomass. Issues like site quality (e.g. water and nutrients), species composition and conservation status influence the magnitude of vegetation's biomass/carbon stock. There are few studies that assessed Cerrado biomass/carbon stock in different physiognomies.

Castro and Kauffman (1998) assessed the aboveground biomass in three different physiognomies of Cerrado in Distrito Federal, Brazil: *campo limpo, campo sujo and cerrado sensu stricto*. The authors found an aboveground biomass of 5.5 Mg ha^{-1}, 9.3 Mg ha^{-1} and 24.8 Mg ha^{-1}, respectively. For *cerradão*, Santos et al. (2002) found an aboveground biomass ranging from 37.0 to 110.8 Mg ha^{-1} in areas located in the states of Roraima and Mato Grosso. Grace et al. (2006) studied the carbon fluxes of savannas worldwide. The authors observed that the aboveground carbon stock may vary widely, according to tree cover: from 1.8 MgC ha^{-1} (trees are absent) to over 30 MgC ha^{-1} (substantial tree cover).

Regarding the belowground biomass, roots biomass usually follows a similar pattern of increasing biomass along *campo limpo* (16.3 Mg ha^{-1}), *campo sujo* (30.1 Mg ha^{-1}) and *cerrado sensu stricto* (46.6 Mg ha^{-1}; Castro and Kauffman, 1998). The carbon

stock from soil seems to be the most expressive carbon pool in Cerrado. For instance, Paiva et al. (2011) estimated the carbon stock from soil (until 2m depth) in a *cerrado sensu stricto* in Distrito Federal, Brazil, and found a carbon stock of 269.1 MgC ha^{-1}. This result suggests soil as an important carbon pool in Cerrado.

An alternative to maintain the carbon stored in Cerrado areas is through REDD+, which has been widely considered for the Amazon biome. However, relatively little is known about the potential for the implementation of REDD+ in Cerrado areas. In this study, our aim is to contribute to fill this gap by making a literature review on the potential, challenges and constraints linked with the inclusion of Cerrado areas in REDD+ projects. International and Brazilian literature, as well as national data and reports focused on REDD+ and related subjects were used as support material.

2. A little about REDD+

Projects that increase removals by sinks under the CDM are only eligible in the afforestation/reforestation (A/R) category. In general, these kinds of projects imply the human induced conversion of non-forested land to forested land (UNFCCC, 2001). Despite the importance of A/R activities in the mitigation of greenhouse gases (GHG) in the atmosphere, this scope does not address one of the main forest problems in tropical countries: deforestation.

In the last decade near 13 million of hectares of forest were converted to other land uses or lost through natural causes, mainly in South America and Africa (FAO, 2010). The opportunity to reduce carbon emissions caused by deforestation and forest degradation is a great possibility to mitigate climate change. IPCC highlights the reduction of deforestation and degradation is the forest mitigation option with the

largest and most immediate carbon stock impact in the short term per ha and per year globally (Nabuurs et al., 2007).

REDD (Reducing emissions from deforestation and forest degradation) was formally first mentioned in the eleventh session of the Conference of the Parties (COP) in 2005. The idea behind this mechanism is to give an economic value to the carbon stored in the forests. Thus, forest-rich countries would have an economic incentive to reduce GHG emissions from forest areas while promoting sustainable development.

After some discussion in UNFCCC meetings in 2008 and 2009, it was decided to widen the concept of REDD to also include the sustainable management of forests and the enhancement of forest carbon stocks (REDD+). REDD+ has arisen as a key issue in the international climate change negotiations and entered into the public media. Although activities related to REDD+ are encouraged, the methodology to be followed under the UNFCCC is not properly established. Issues linked with measuring, reporting and verification of anthropogenic forest-related emissions and removals, forest carbon stocks and forest area changes are still being formulated by the Subsidiary Body for Scientific and Technological Advice of the UNFCCC.

Nonetheless, despite of the absence of consolidated guidance on how to implement and conduct a REDD+ project, innumerous initiatives are being developed in different parts of the world. Cerbu et al. (2011) made a global survey of REDD+ (including REDD) activities (Figure 1). The authors divided the REDD+ activities in REDD+ demonstration activities and REDD+ readiness activities. The first one includes activities developed in sub-national regions or units with the intention of reducing deforestation or forest degradation in that particular area. REDD+ readiness activities usually have a national approach and aim capacity building, policy development or

land-cover change monitoring, although the activity may be concentrated in particular sub-national locations.

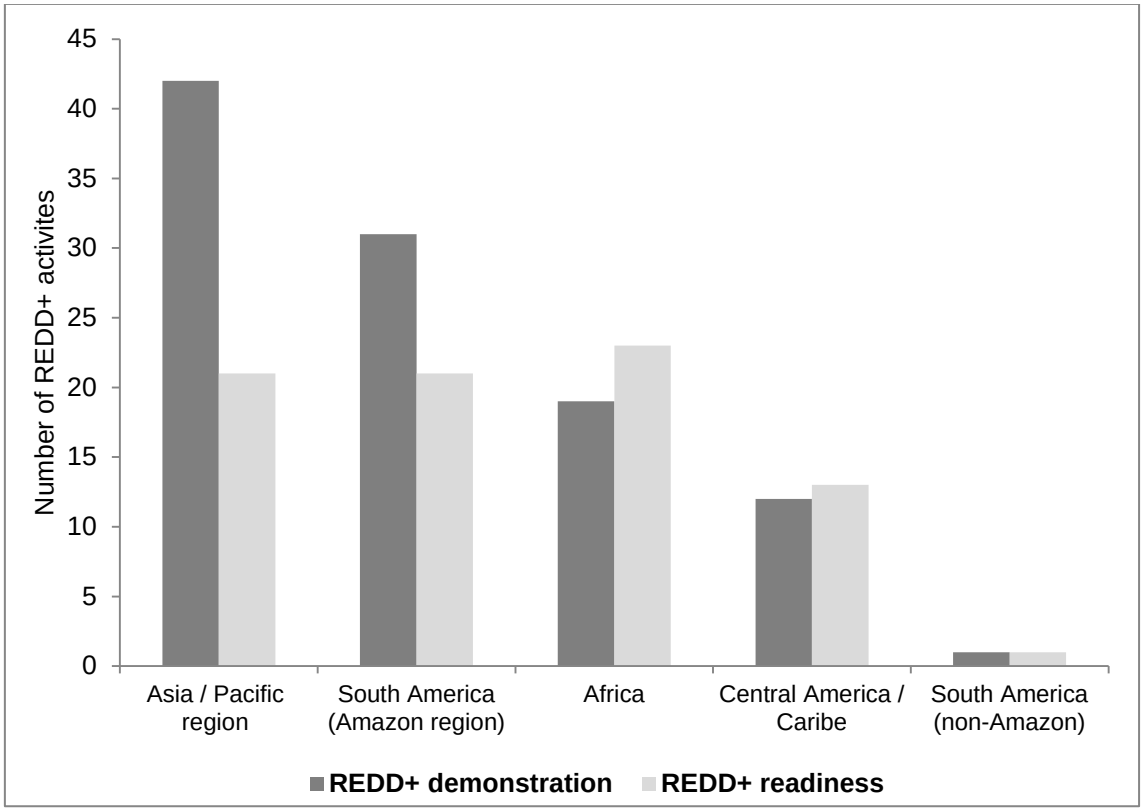

Fig. 1 – Distribution of REDD+ demonstration and REDD+ readiness activities in the world (Adapted from Cerbu et al., 2011).

Most of REDD+ activities (demonstration + readiness) are located in Asia, Africa and South America. In Asia, REDD+ readiness activities occur mainly in Indonesia, Vietnam and Papua New Guinea. Madagascar, Tanzania, Democratic Republic of Congo and Cameroon are the countries with the highest number of projects in Africa. In the Amazon region (South America), Paraguay, Guyana and Brazil stand out.

Regarding REDD+ demonstration activities, in Asia Indonesia also excels, followed by Papua New Guinea and Philippines. In Africa, Madagascar, Democratic Republic of Congo and Cameroon have the highest number of projects. In South

America, in the Amazon region, Brazil leads followed by Ecuador, Peru, Colombia and Bolivia.

The site selection of most of the REDD+ activities mentioned above was motivated by the possibility of generation of biodiversity and community benefits, threat of deforestation, environmental value of the site, demonstration of user need and climate benefits. Other factors that contributed to the selection of sites were good governance/institutional setting, interest of other parties (e.g. non-governmental agencies - NGOs), prior relation with country/region/stakeholders and previous experience in related sectors/projects (Cerbu et al., 2011).

2.1. REDD+ in Brazil

In the COP 16, which occurred in 2010, UNFCCC requested developing countries to establish a national REDD+ strategy or action plan. This plan should encompass issues related with the drivers of deforestation and forest degradation, land tenure, forest governance and gender considerations. The effective participation of relevant stakeholders (e.g. indigenous people and local communities) must also be assured (UNFCCC, 2010).

According to Brasil/MMA (2011), Brazil is already taking action to comply with the requirements of REDD+, despite this is not clearly shown. Some indicators of this, inter alia, are: i) Brazil's nationally appropriate mitigation action, ii) Brazilian National Policy on Climate Change (law nº 12.187/09; Brasil 2009), iii) development of deforestation monitoring systems for Amazon and Cerrado region, iv) proposals of social and environmental criteria for REDD+. Thus, gradually the country is forging a path of a National REDD+ Strategy.

Currently, in Brazil there are several REDD+ activities underway. In general, these activities are being developed with the participation of the Brazilian government and NGOs. However, there are also private initiatives. According to Cenamo et al. (2009), Brazil has 7 REDD+ activities under development (Table 1).

Among these projects, only one is being developed in the Cerrado region. Considering that Cerrado is the second largest biome of Brazil and that its deforestation rates may be two or three times greater than the ones registered in Amazon (Sawyer, 2009), it is alarming the lack of interest in developing REDD+ projects in this biome. In this context, an analysis of the challenges and constraints linked with the inclusion of Cerrado areas in REDD+ projects is important.

3. REDD+ in Cerrado areas

3.1. Main barriers for the inclusion of Cerrado in the REDD+ strategy

Although Cerrado area is considered one of the priorities for the establishment of REDD+, in practice is noted that the biome is not receiving the same attention as Amazon (table 1). This fact is deeply associated with the way society views and conceives development in the Cerrado area.

Most people view Cerrado as dull vegetation because it is not exuberant as the Amazon forest, for example. Even the persons who are born in areas with natural occurrence of Cerrado usually do not recognize this biome as a biodiversity pool. The media (national and international) continuously report about Amazon deforestation, but little is mentioned about the high deforestation rates of Cerrado. The result is the lack of interest in maintaining natural areas of Cerrado and the conversion of them into other land uses due to expansion of agriculture/cattle raising activities and urban occupation.

Table 1 – REDD+ projects under development in Brazil.

Project	Goal	Vegetation type	Size	Net emission reductions	Project status
Acre state carbon project – payment for environmental services	Add value to the standing forests of Acre and turn them into a viable source of environmental services for current and future generations.	Amazon forest	5,800,000 ha	62.5 million tCO_2e in 15 years	Design
Ecomapuá Amazon REDD project	Conservation and restoration of an Amazon forest area that belonged to a timber company before the purchase of the property by the project owners.	Amazon forest	94,171 ha	6.0 million tCO_2e in 20 years	Design
Genesis REDD project	Guarantee the protection of a natural Cerrado area located in the *Serra do Lajeado* environmental protected area located in the state of Tocantins, northern Brazil.	Cerrado (Brazilian savanna)	121,415 ha	57,389 tCO_2e in 20 years	Implemented /under validation
Avoided deforestation on small rural properties in the region of the Trans-amazon highway	Transform the historic model of development for rural properties in the region, currently based on slash and burn agriculture with low productivity and minimal value added production, into a model that primarily involves improvements in agricultural and ranching practices and decreasing pressures for new deforestation.	Amazon forest	31,745 ha	3,136,953 tCO_2e in 10 years	Design
Juma reserve REDD project	Consists of the creation and implementation of a sustainable development reserve, to contain deforestation on a region under strong pressure of land use, located in the Novo Aripuanã municipality, in the south of Amazonas State, Brazil.	Amazon forest	589,612 ha	189 million tCO_2e in 44 years	Validated / sale of VERs (voluntary emissions reductions)
Conservation of the Atlantic rainforest, pilot project for reforestation in Antonina and the action project against global warming in Antonina	Transform areas originally used for raising buffalo into privately owned nature reserves. Implement reforestation, protection and enforcement measures against land grabs and impacts from external activities, as well as degradation caused by the buffalos in primary forests. This is a collection of three projects that takes place in different Atlantic rainforest locations in the municipalities of Antonina and Guaraqueçaba, in the State of Paraná, in southern Brazil.	Atlantic forest	• Atlantic rainforest conservation project: 8,600 ha. • Pilot project for reforestation in Antonina: 3,300 ha. • Action project against global warming in Guaraqueçaba: 6,700 ha.	• Atlantic rainforest conservation project: 181,095 tCO_2e in 40 years. • Pilot project for reforestation in Antonina: 65,456 tCO_2e in 40 years. • Action project against global warming in Guaraqueçaba: 137,713 tCO_2e in 40 years.	Implemented / sale of VERs
Suruí project	Protect the Indigenous Territory *Sete de Setembro* which is currently under great threat of deforestation from land grabbing and illegal logging. The project is located in the municipalities of Cacoal and Espigão d'Oeste in Rondonia State and Rondolândia in Mato Grosso State.	Amazon forest	248,000 ha	16.5 million tCO_2e in 44 years	Design

Prior to the establishment of agriculture/cattle raising activities, the area is often deforested and the wood used for the production of coal. When agricultural activities are not present, illegal logging occurs also aiming the production of coal. Beside this, there is the urban occupation. The construction of Brasília is an example of this. The city is located in the core area of Cerrado. Millions of hectares of Cerrado were deforested for the creation of the new capital. Even today, large portions of Cerrado remnants around the city are deforested for the construction of luxury condominiums or expansion of infrastructure.

Brazilian society is aware of this, but not mobilizes. Until 2009, the Brazilian Government did not take strong actions to curb deforestation in Cerrado areas. Nonetheless, in 2010 was launched the Action Plan for Prevention and Control of Deforestation and Forest Fires in Cerrado (PPCerrado). This plan has some goals to be reached until 2020: reduction of deforestation rates in 40%, decrease of forest fires, dissemination of sustainable practices, monitoring of Cerrado remnants and creation of protected areas (Brasil, 2010).

It is important to point that this plan was launched six years after the one created for the Amazon forest (Action Plan for Prevention and Control of Deforestation in the Legal Amazon - PPCDAM – started in 2004). This highlights the imbalance that exists between policies for Amazon and Cerrado biome. Other interesting feature is the targets for reduction of deforestation in 2020: for Cerrado they are of 40%, while for the Amazon biome of 80%. Considering that Cerrado has lost nearly 50% of its original cover, the targets should be more ambitious. Anyway, the creation of PPCerrado was an important step to promote the valuation of Cerrado. This plan is also inserted in the scope of the National REDD+ Strategy as a policy to curb deforestation and forest degradation in the country.

The physiognomies that encompass Cerrado vegetation are other issue that may be restricting the implementation of REDD+ projects in Brazil. Among the five Cerrado physiognomies detailed in the beginning of this paper, only two of them would be attractive in the first moment for the implementation of REDD+ projects: *cerrado sensu stricto* and *cerradão*. The expressive tree component in both physiognomies would facilitate monitoring, reporting and verification (MRV) activities, especially the monitoring component as most methodologies focus on the arboreal pool.

Further, we believe investors would rather finance the maintenance of areas with trees than areas predominantly with grass. The social appeal for the conservation of areas with trees is greater than in areas with grass. Beside this, it is expected that areas with tree coverage will have a greater carbon stock than grass areas.

3.2. Next steps

The inclusion of Cerrado areas in a REDD+ strategy may be facilitated if some points are addressed. The first one is to determine which and where are located the suitable areas for the development of REDD+ projects. Cerrado originally occupied nearly 25% of Brazil's territory (≈ 2.037.000 km^2). Currently, this biome has nearly half of this extension due to deforestation. Thus, it would be important the accurate mapping of these remaining areas.

Information like size of the remnant, type of physiognomy, conservation (or degradation) status is essential to estimate the number of potential areas for the establishment of REDD+ projects. This assessment could be performed based on remote sensing images, supported by information provided by field teams. A federal agency and a NGO, for example, could be in a charge for this assessment.

A second issue that is relevant refers to the development of policies that stimulates the establishment of REDD+ projects in the identified areas. In the design of these policies must be considered the peculiarities of the biome and its inhabitants. As Cerrado has a long extension and Brazil is characterized as a multicultural and multiethnic country, it is natural that under Cerrado region there are different social realities. The biome has areas within regions with a high level of urbanization (central part), others located in Indian areas (east) or in typical agricultural lands (west).

Therefore, at federal level the Brazilian government could clearly defend the importance of the establishment of REDD+ projects in Cerrado areas. However, the government should also requisite that state governments elaborate their own mechanisms to stimulate these projects. For instance, in areas with the presence of traditional communities or Indians, it is essential to promote their empowerment to guarantee their effective participation in the design of the REDD+ projects. So, a state policy that only allows the development of a REDD+ project if it is assured the inclusion of these communities would be an option in this case.

Regarding regions in which the remnants are inserted in an agricultural matrix, in order to avoid conflicts it is essential the awareness of farmers about the importance of the establishment of REDD+ projects. State governments through agricultural extension services could promote seminars with this purpose.

Financial investments would also be necessary to avoid the displacement of agricultural activities to new areas. It is very important that the government shows farmers that it is not necessary to move to new areas to increase the profit of their business. The use of sustainable practices allied with a more intensive production enables the enhancement of productivity in areas already in use. Beside, as most of

Cerrado's carbon stock is located in soil, the use of sustainable practices is essential to prevent the carbon release into the atmosphere. Nonetheless, investments are needed to adapt these areas to this new way of production.

4. Conclusion

Standard public policies clearly were not able to restraint deforestation in Cerrado. Therefore, we believe that new approaches, such as REDD+ projects, are necessary and effectively represent opportunities for the recovery and protection of Cerrado areas. However, a strong action of the Brazilian government is needed. An assessment of the suitable areas for the development of REDD+ projects in Cerrado, including information such as their location and conservation status is essential.

The development of policies that stimulate the establishment of REDD+ projects in the identified areas, considering the peculiarities of the biome and its inhabitants would be the next step. The participation of state governments in this stage would be important to better capture the local reality of each region.

Financial investments to enhance the productivity of agricultural areas through the use of sustainable practices are also necessary to prevent the displacement of agricultural activities to new areas and avoid the release of carbon stocked in the soil to the atmosphere. REDD+ is a great chance for Brazil to conserve vegetation areas that are under severe deforestation pressure, such as Cerrado. Nonetheless, REDD+ will only be a reality for Cerrado if the Brazilian government truly commit to implement this mechanism in Cerrado areas.

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