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SUMMARY

SAD detected 152 square kilometers of deforestation in the Legal Amazon in July 2013. That represented an increase of 9% in relation to July 2012 when deforestation totaled 139.5 square kilometers. It was possible to monitor 92% of the forest area in the Legal Amazon while in July 2012 there were more clouds and it was possible to monitor 80% of the territory.

The deforestation accumulated during the period of August 2012 to July 2013 totaled 2,007 square kilometers. There was a 92% increase in relation to the previous period (August 2011 to July 2012) when deforestation totaled 1,047 square kilometers.

In July 2013, deforestation occurred principally in Pará (38%), Amazonas (28%), Mato Grosso (24%) and Rondônia (9%).

Degraded forests in the Legal Amazon

totaled 93 square kilometers in July 2013. In relation to July 2012, when forest degradation totaled 27.5 square kilometers, there was an increase of 237%.

Forest degradation accumulated during the period (August 2012 to July 2013) reached 1,555 square kilometers. In relation to the previous period (August 2011 to July 2012), when degradation totaled 2,002 square kilometers, there was a 22% reduction.

In July 2013, deforestation detected by SAD committed 3 million tons of equivalent CO². In the accumulated period (August 2012 to July 2013) emissions of equivalent CO² produced by with deforestation totaled 100 million tons, which represents an increase of 60% in relation to the previous period (August 2011 to July 2012).

Deforestation Statistics

According to SAD, deforestation (total suppression of forest for other alternative land uses)

reached 152 square kilometers in July 2013 (Figure 1 and Figure 2).

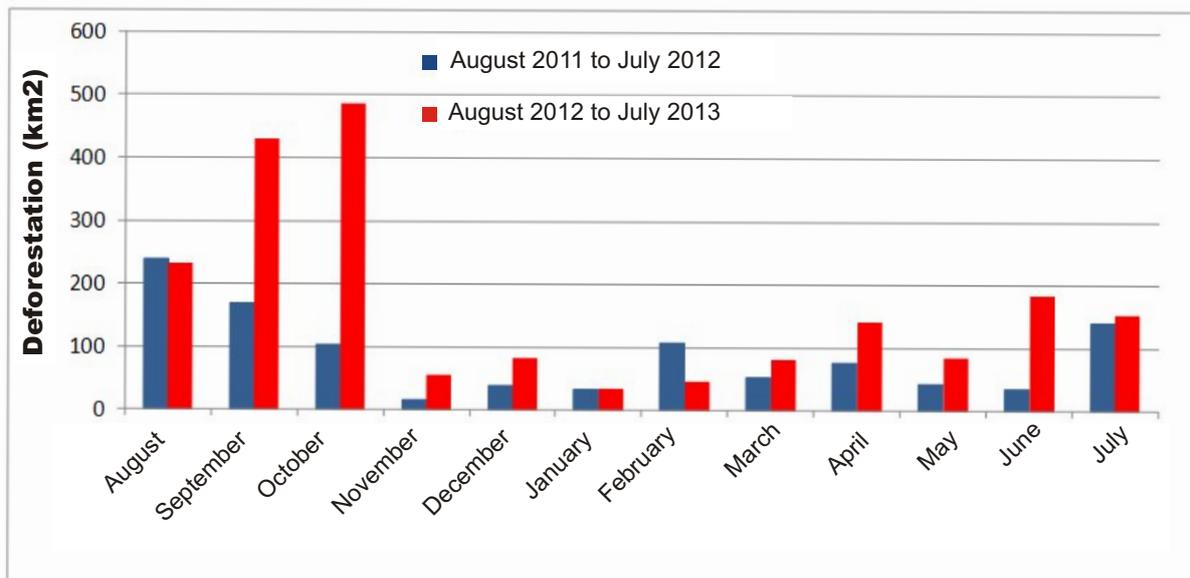


Figure 1. Deforestation from August 2012 to July 2013 in the Legal Amazon (Source: Imazon/SAD).

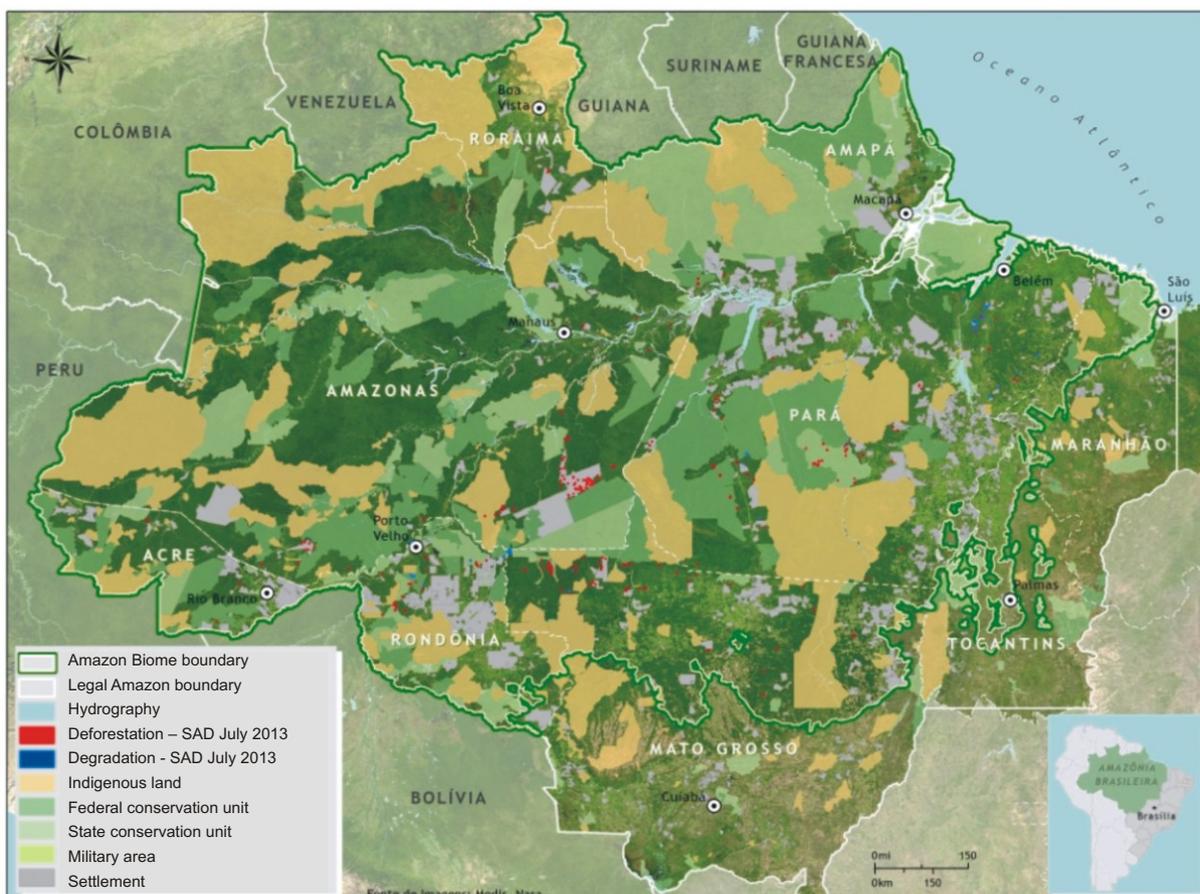


Figure 2. Deforestation and Forest Degradation in July 2013 in the Legal Amazon (Source: Imazon/ SAD).

The deforestation accumulated during the period of August 2012 to July 2013, corresponding to the twelve months of the official calendar for measuring deforestation, reached 2.007 square kilometers. There was a 92% increase in deforestation in relation to the

previous period (August 2011 to July 2012) when it reached 1,047 square kilometers.

In July 2013, deforestation occurred in Pará (38%), Amazonas (28%), Mato Grosso (24%), Rondônia (9%), Roraima (1%) and Acre (1%).

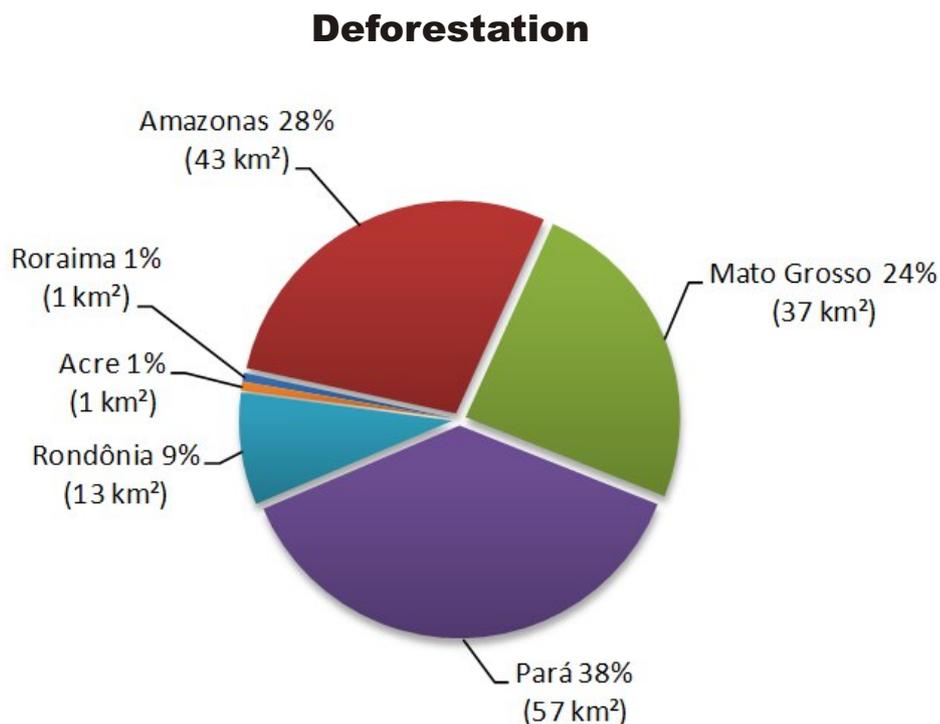


Figure 3. Percentage of deforestation in the States of the Legal Amazon Legal in July 2013 (Source: Imazon/SAD).

In the deforestation accumulated in the twelve months of the current deforestation calendar (August 2012 to July 2013), Pará leads the ranking with 40% of the total deforested. Next come Mato Grosso with 31%, Amazonas with 14% and Rondônia with 13%. Those four states were responsible for 98% of deforestation occurred in the Legal Amazon in that period.

In relative terms, there was 32% reduction in Acre and 18% in Roraima. On the other hand,

there were increases in Amazonas (+223%), Mato Grosso (+102%), Pará (+91%), Tocantins (+74%) and Rondônia (+42%).

In absolute terms, Pará leads the ranking for accumulated deforestation with 810 square kilometers, followed by Mato Grosso (621 square kilometers), Amazonas (273 square kilometers), Rondônia (247 square kilometers), Tocantins (24 square kilometers), Roraima (19 square kilometers) and Acre (13 square kilometers).

¹ The official calendar for measuring deforestation begins in the month of August and ends in the month of July.

Table 1. Evolution of deforestation among States in the Legal Amazon from August 2011 to July 2012 and from August 2012 to July 2013 (Source: Imazon/SAD).

State	August 2011 to July 2012	August 2012 to July 2013	Variation (%)
Pará	425	810	+91
Mato Grosso	308	621	+102
Rondônia	173	247	+42
Amazonas	84	273	+223
Roraima	23	19	-18
Acre	20	13	-32
Tocantins	14	24	+74
Amapá	-	-	-
Total	1,047	2,007	+92

* Data from the State of Maranhão has not been analyzed.

Forest Degradation

In July 2013, SAD recorded 93 square kilometers of degraded forests (forests intensely

exploited by logging and/or burned) (Figures 2 and 4).

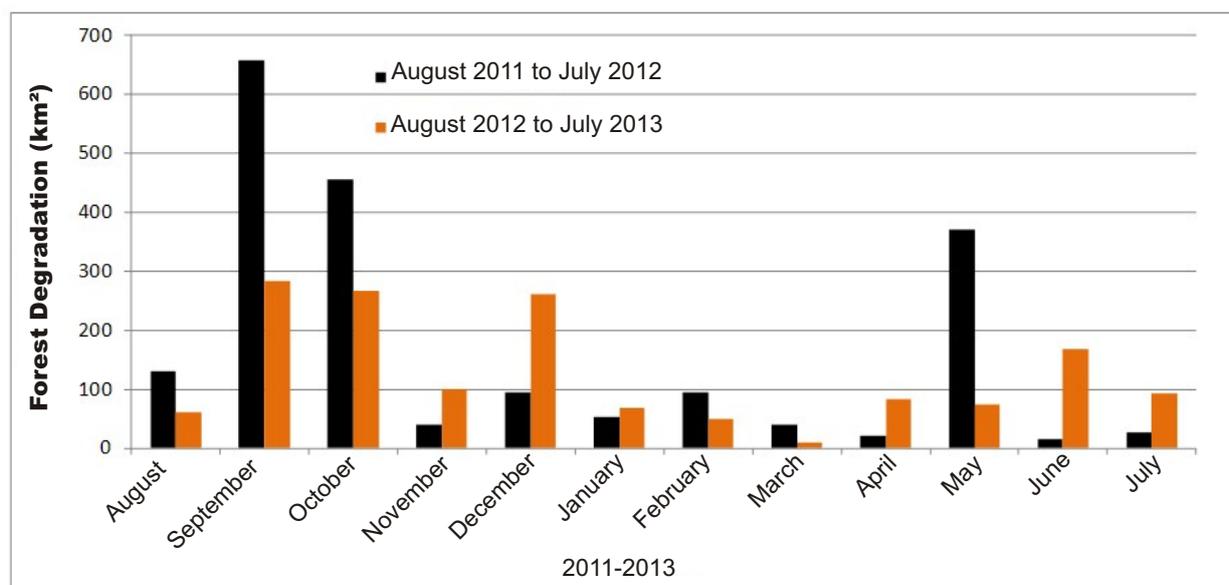


Figure 4. Forest Degradation from August 2011 to July 2013 in the Legal Amazon (Source: Imazon/SAD).

Forest degradation accumulated during the period of August 2012 to July 2013 reached 1,555 square kilometers.

In absolute terms, Mato Grosso leads the ranking in accumulated forest degradation with 752 square kilometers (48%), followed by Pará

with 616 square kilometers (40%). The remainder (12%) occurred in Rondônia (128 square kilometers), Amazonas (24 square kilometers), Tocantins (25 square kilometers) and Roraima (8 square kilometers).

Table 2. Evolution of forest degradation among States in the Legal Amazon from August 2011 to July 2012 and from August 2012 to July 2013 (Source: Imazon/SAD).

State	August 2011 to July 2012	August 2012 to July 2013	Variation (%)
Mato Grosso	1,602	752	-53
Pará	248	616	+149
Rondônia	105	128	22
Amazonas	30	24	-21
Roraima	15	8	-44
Acre	3	3	-
Tocantins	-	25	-
Amapá	-	-	-
Total	2,202	1,555	-22

* Data from the state of Maranhão was not analyzed.

² The official calendar of measuring deforestation begins in August and ends in July.

Carbon Affected by the Deforestation

In July 2013, the 152 square kilometers de deforestation detected by SAD in the Legal Amazon committed 3 million tons of carbon (with a margin of error of 670 thousand tons of carbon). That amount of carbon affected results in 10 million tons of equivalent CO₂(Figure 6).

The forest carbon committed by deforestation during the period of August 2012 to

July 2013 was 48 million tons (with a margin of error of 610 thousand tons), which represented around 100 million tons of equivalent CO₂ (Figure 6). In relation to the same period in the previous year (August 2011 to July 2012) when the forest carbon committed was 30 million tons there was a 60% increase in the amount of carbon committed by deforestation.

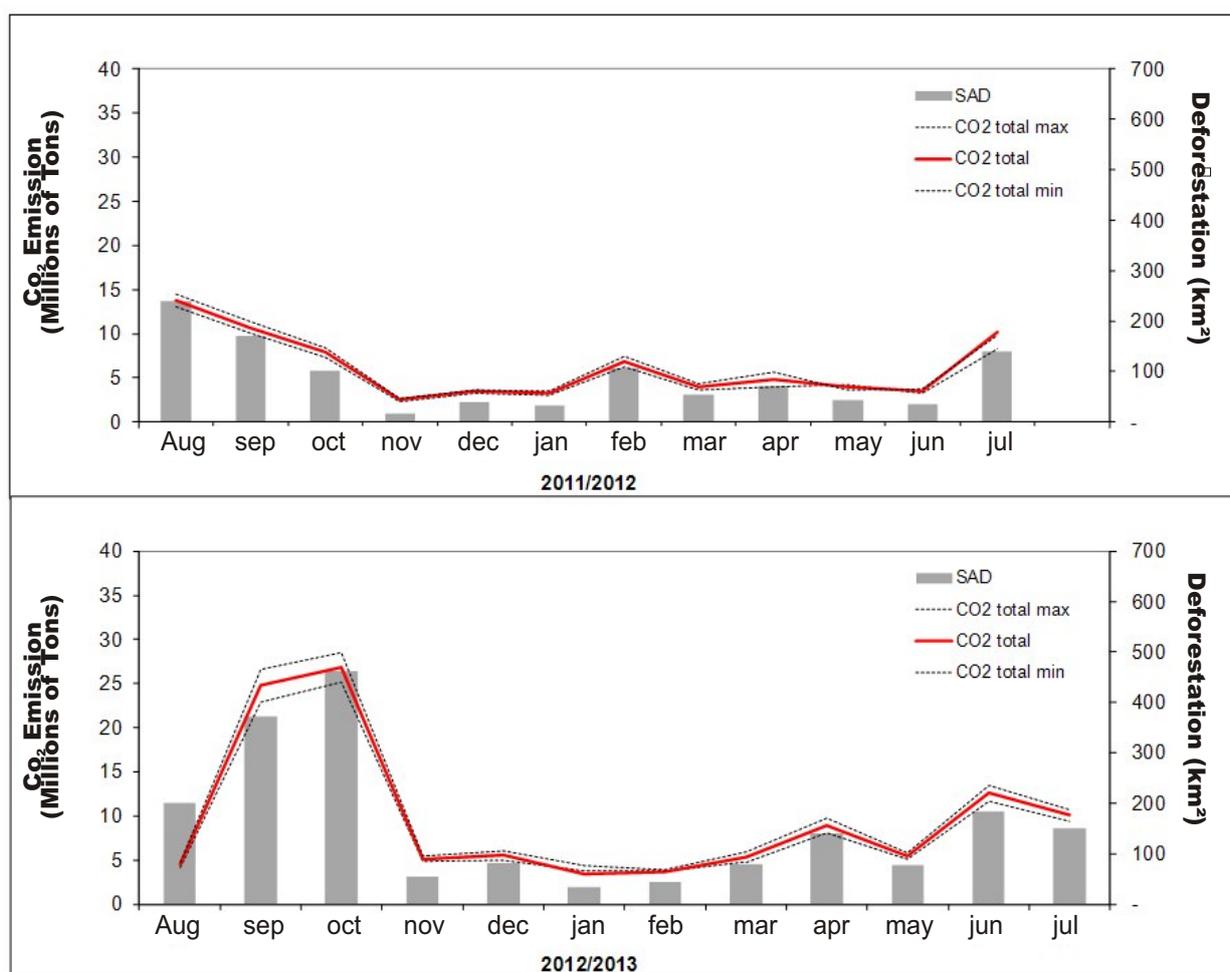


Figure 5. Deforestation and total emissions of equivalent Carbon Dioxide (CO₂) from August 2011 to July 2013 in the Legal Amazon (Source: Imazon).

Deforestation Geography

In July 2013, the great majority (55%) of deforestation occurred in areas that were private or under various stages of possession. The remainder of

deforestation was recorded in Land Reform Settlements (20%), Conservation Units (24%) and Indigenous Lands (1%) (Table 3).

Table 3. Deforestation by land category in July 2013 in the Legal Amazon (Source: Imazon/SAD).

Category	July 2013	
	km ²	%
Land Reform Settlement	30	20
Conservation Units	37	24
Indigenous Lands	1	1
Private, Possession & Untitled public lands	84	55
Total (km²)	152	100

Reform Settlements

SAD recorded 30 square kilometers of deforestation in Land Reform Settlements in July 2013 (Figure 6). The Settlements most affected by

deforestation were PA Rio Juma (Apuí; Amazonas), PA Acari (Novo Aripuanã, Amazonas) and PA Monte (Boca do Acre, Amazonas).

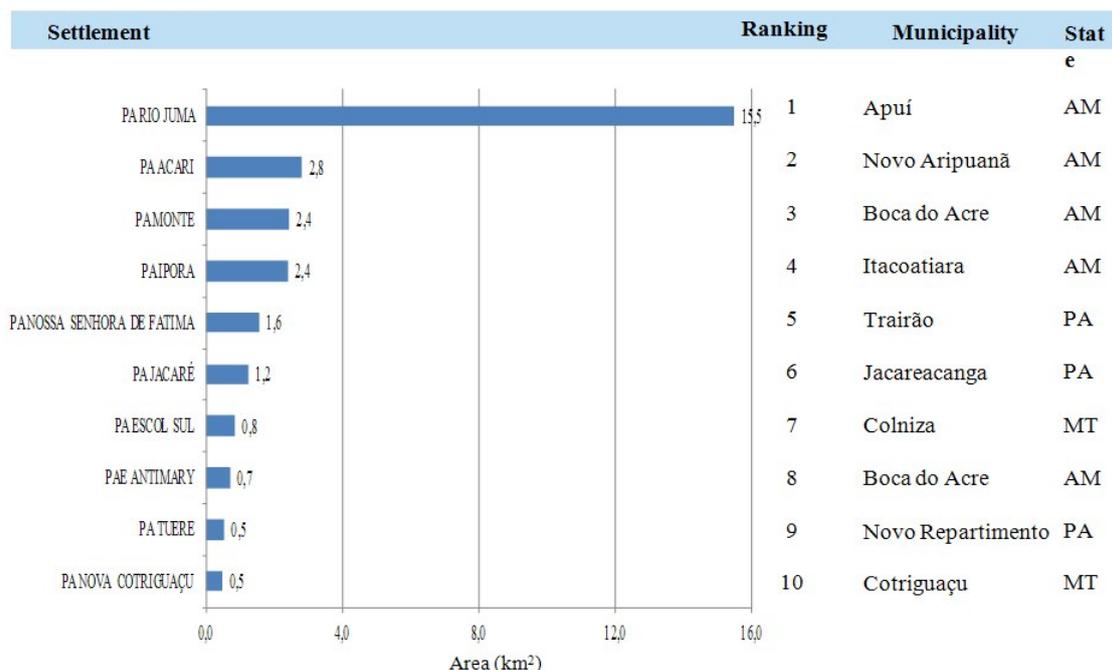


Figure 6. Reform Settlements cleared in July 2013 in the Legal Amazon (Source: Imazon/SAD)

Protected Areas

In the month of July 2013, SAD detected 37 square kilometers of deforestation in the Conservation Units of APA Triunfo do Xingu (Pará), Flona do Jamanxim (Pará), Flona de Saracá-Taquera (Pará), Florex Rio Preto-Jacundá (Rondônia), PES Guajará-Mirim (Rondônia), Resex Jaci Paraná

(Rondônia) and APA Rio Pardo (Rondônia) (Figure 7). In the case of Indigenous Lands, in July 2013 1 square kilometer of deforestation was detected in the Tenharim/Marmelos and Tenharim/Marmelos (Gleba B) Lands, both located in the State of Amazonas (Figure 8).

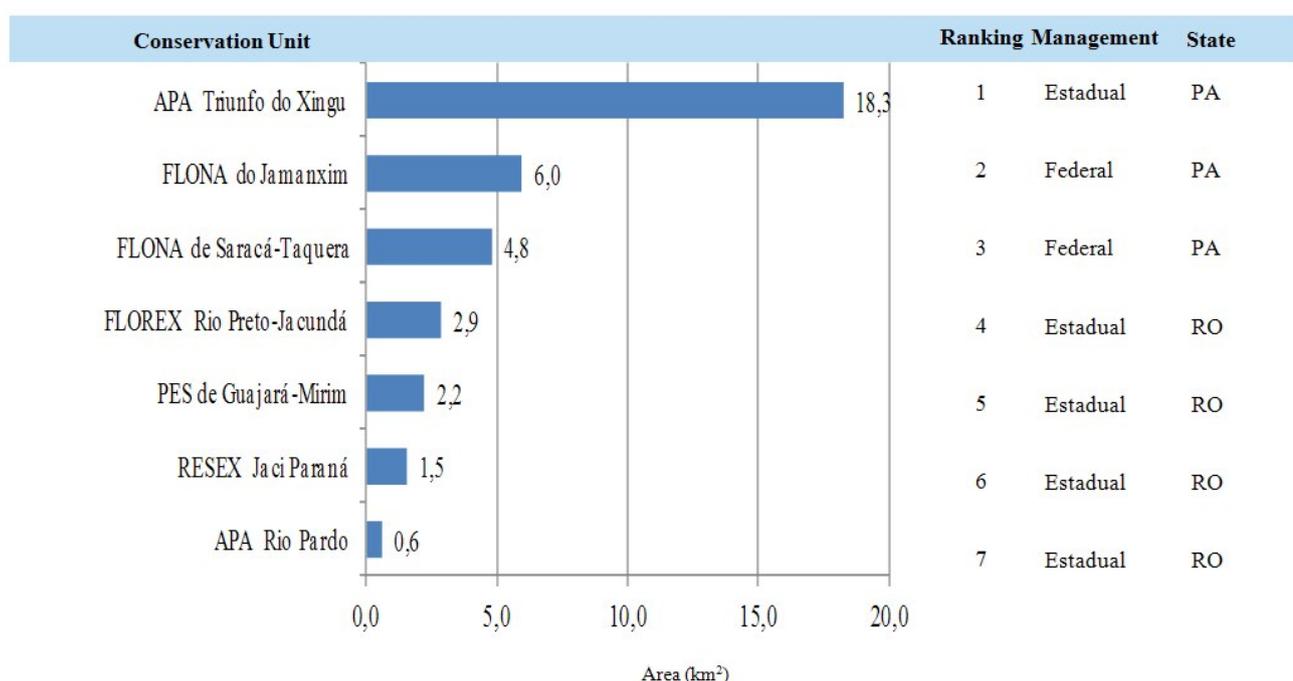


Figure 7. Conservation Units deforested in the Legal Amazon in July 2013 (Source: Imazon /SAD).

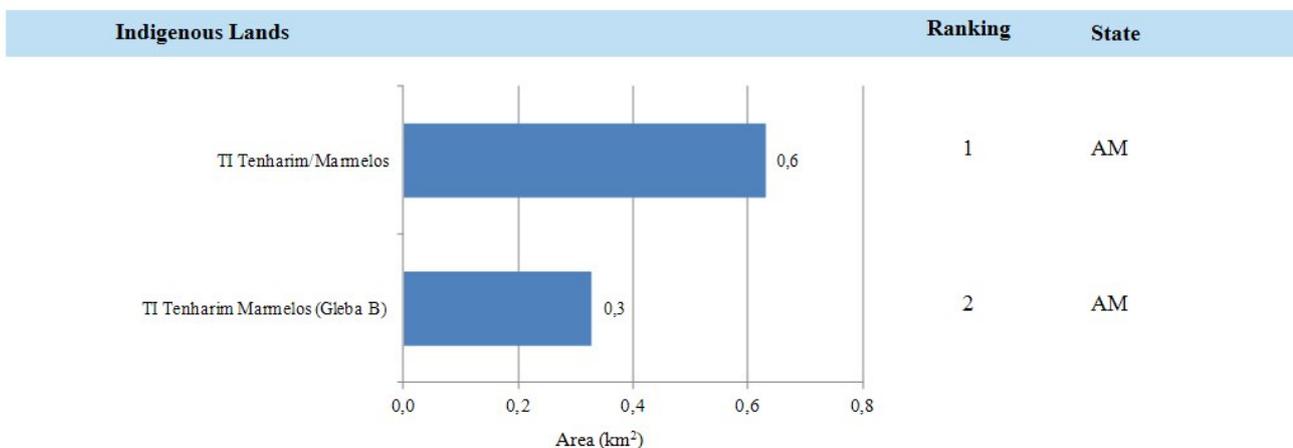


Figure 8. Indigenous Lands deforested in the Legal Amazon in July 2013 (Source: Imazon /SAD).

Municipalities Critics

In July 2013, the most municipalities with the most deforestation occurring were: Apuí

(Amazonas) and Altamira (Pará) (Figure 9 and 10).

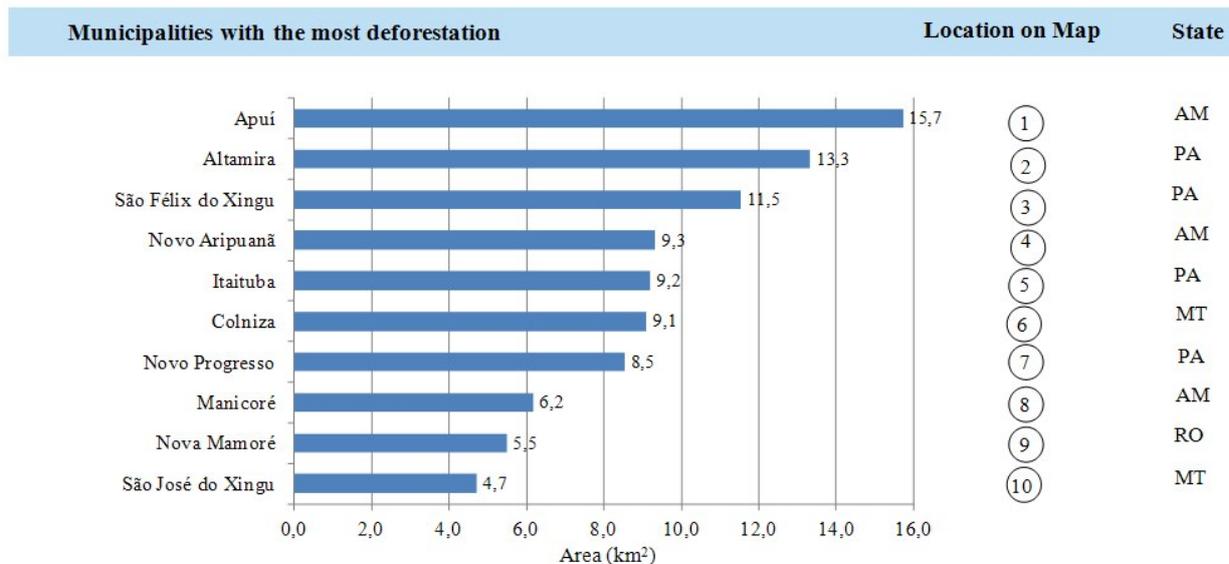


Figure 9. Municipalities with the most deforestation in the Legal Amazon in July 2013 (Source: Imazon /SAD).

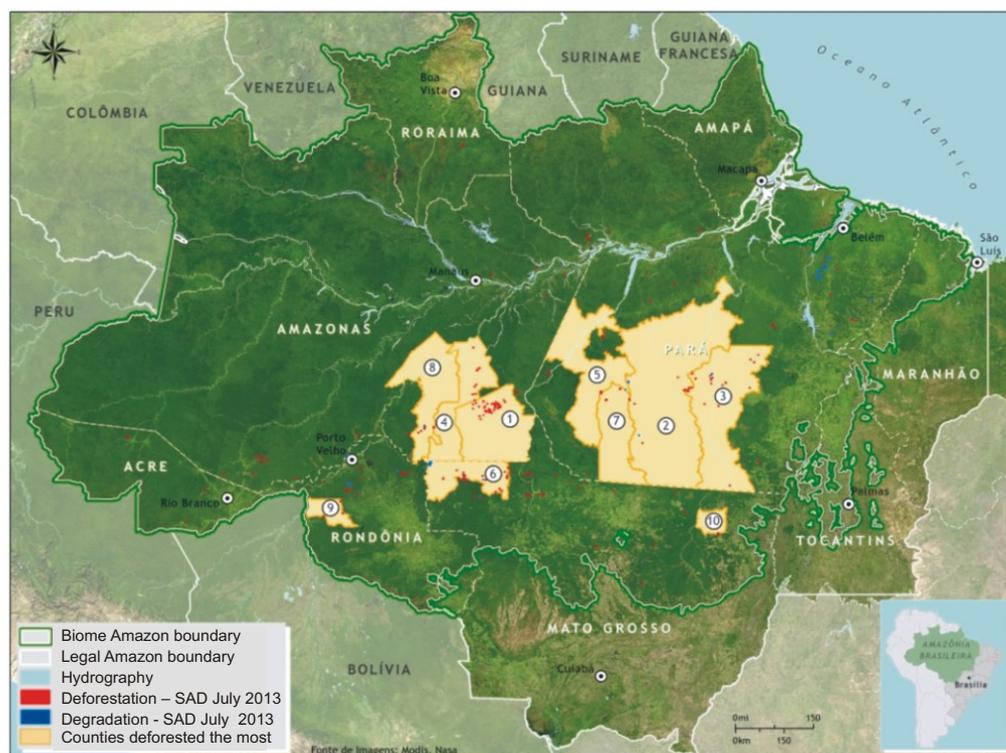


Figure 10. Municipalities with the largest areas deforested in July 2013 (Source: Imazon/SAD).

Coverage by clouds and Shade

In July 2013, it was possible with SAD to monitor SAD 92% of the forest area in the Legal Amazon. The other 8% of forest territory was covered by clouds that complicated detection of deforestation and forest degradation. The

States with the largest cloud cover Roraima (44%), Amapá (20%) and Pará (8%). Because of that, the data on deforestation and forest degradation in July 2013 may be underestimated (Figure 11).

* Data related to the state of Maranhão, that integrates Legal Amazon, was not analyzed.

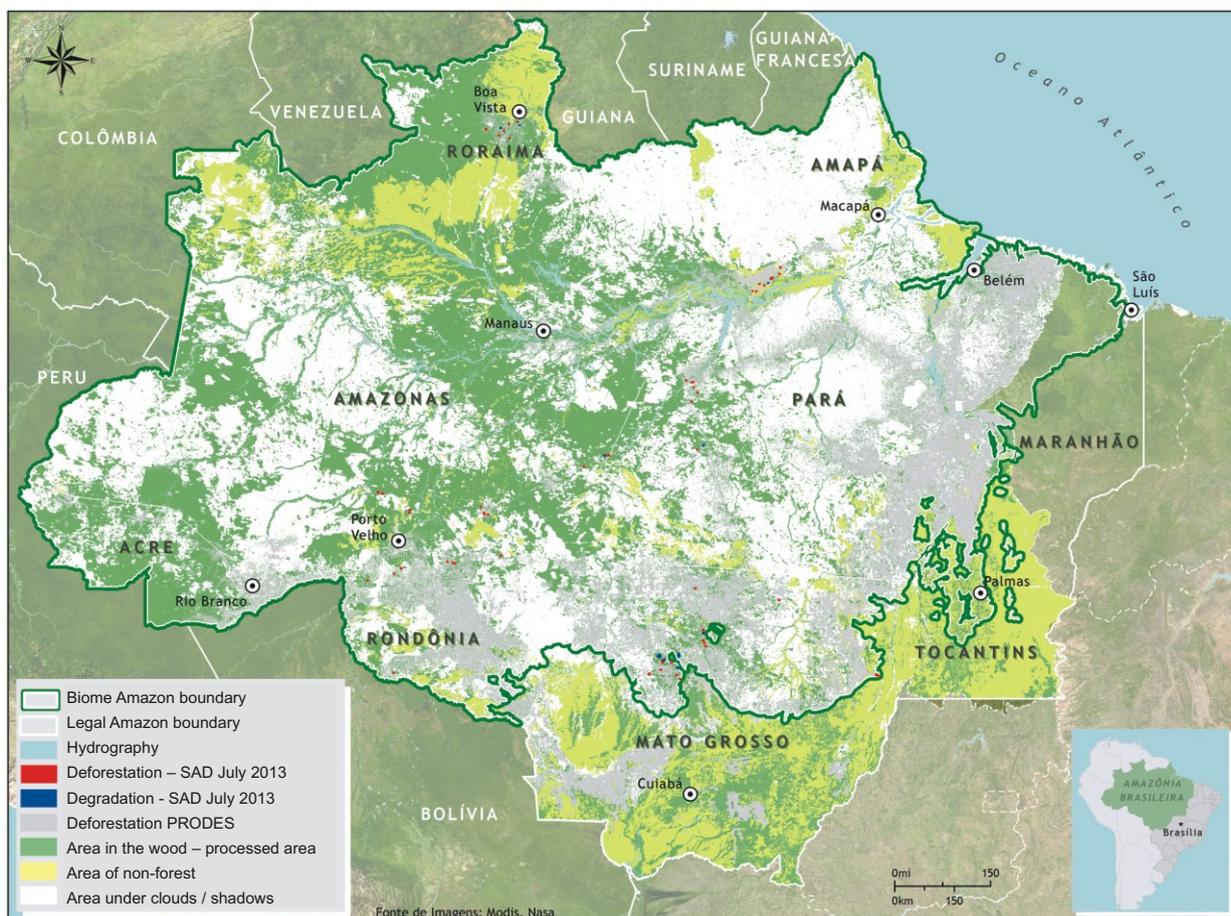


Figure 11. Area with cloud and shade in July 2013 in the Legal Amazon.

Google SAD-EE

Since June 2012 the detection of alerts of deforestation and forest degradation has been carried out in the Google's Earth Engine – EE – platform, with the new version: SAD EE. This system was developed in

collaboration with Google and uses the same process already used by SAD, with MODIS' reflectance images, in order to generate alerts of deforestation and forest degradation.

Table I: SAD 3.0

Since August 2009, SAD has been introducing some news. First, we created a graphical interface to integrate all image processing programs used in SAD. Second, we started computing deforestation in areas that were covered by clouds in the previous months, under a new class. Finally, deforestation and degradation are detected with pairs of NDFI images in a change detection algorithm. The main method remains the same as SAD 2, as described here below.

SAD generates a temporal mosaic of daily MODIS images of MOD09GQ and MOD09GA products to filter the clouds. Afterwards, we used a technique of different spectral resolution band merge, i.e., pixels of different sizes. In that case, we changed the 500 meter 5-band scale of MODIS to 250 meters. This allowed to enhance the spectral model of pixel mixture, thus supplying ability to estimate the abundance of vegetation, soils and non-active photo-synthetically vegetation (NPV, for Non-Photosynthetic, in English) components (vegetation, soil and Shadow) so to be able to calculate the NDFI with the following equation:

$$\text{NDFI} = \frac{\text{VGs} - (\text{NPV} + \text{Soil})}{\text{VGs} + \text{NPV} + \text{Soil}}$$

Where VG is the standardized component of vegetation for shadow given by:

$$\text{VGs} = \text{Vegetation} / (1 - \text{Shadow})$$

NDFI ranges from -1 (pixel with 100% of exposed soil) to 1 (pixel with >90% with forest vegetation). Thus, we could have a continuous image showing the transition from deforested areas, crossing the degraded forests, reaching the forest with no warning signs of disturbance.

Detection of both deforestation and degradation was shown this month with the difference of NDFI images related to the consecutive months. Hence, a reduction in NDFI values ranging from -200 to -50 indicates possibly cleared areas, and a reduction ranging from -49 to -20 indicates signs of degradation.

SAD 3.0 Beta is compatible with the previous versions (SAD 1.0 and 2.0), because the detection threshold of deforestation was calibrated so to generate the same type of response obtained by the former method.

SAD is already operating in the State of Mato Grosso since August 2006 and in the Amazon since April 2008. In this report, we present the monthly data generated by the SAD from August 2006 to July 2013.

Table II: Carbon affected by deforestation

Since January 2010 we have been reporting the estimates of carbon endangered (i.e., of forest carbon subject to emissions due to burnings and decomposition of forest biomass residues) arising from the deforestation detected by SAD in Legal Amazon.

Carbon estimates are generated based on the combination of SAD deforestation maps and simulations of spatial distribution of biomass for Amazonia. We have developed a model of estimates of carbon emissions based on stochastic simulation (Morton et al, in prep.), named Carbon Emission Simulator (CES). We generated 1000 simulations of biomass spatial distribution in Amazon using a geo-statistic model (Sales et al., 2007), and transformed such biomass simulations in C stocks using biomass conversion factors for C – as stated in the literature, according to the formula below:

$$C_t = \sum C(S)_t$$

$$C_t(S) = S_D \times \left[(BVAS - BPF) \times (1 - fc) \times (t == 0) + (BAS_0 \times pd \times e^{(-pd \times t)}) \right]$$

$$BPF = ff * AGLB$$

$$BAS_0 = bf * AGLB$$

where:

t: time (month)

C_t: Carbon emitted in the month t.

C_t(S): Carbon emitted of a deforested polygon in time t.

SD: Deforest area.

BVAS: Biomass above the soil of the deforested region SD.

BPF: Biomass of forest products removed from the forest before the deforestation.

fc: charcoal fraction (3 to 6%).

BAS₀: Biomass below the soil before the deforestation.

pd: monthly decomposition parameter of the biomass below the soil after the deforestation (0.0075).

$pd \times e^{(-pd \times t)}$: monthly decomposition rate of the biomass below the soil after the deforestation.

In order to apply CES model using data from SAD, we considered only the carbon endangered by deforestation, i.e., the fraction of forest biomass consisting of carbon (50%) subject to instantaneous issuances due to burnings of forests by deforesting and/or the future decomposition of the remaining forest biomass. Furthermore, we have adapted the CES model so to be able to estimate – on monthly basis - the forest carbon endangered by deforestation. Finally, simulations have allowed us to estimate the uncertainty of carbon endangered, represented by the standard deviation (± 2 times) of the simulations of carbon affected every month.

To convert carbon values into CO₂ equivalent, we applied a 3.68 value.

References:

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Sales, M.H. et al., 2007 - Improving spatial distribution estimation of forest biomass with geo-statistics: A case study for Rondônia, Brazil. *Ecological Modeling*, 205(1-2), 221-230.

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Data Source:

The deforestation statistics are generated using data from the SAD (Imazon);

INPE Data -Deforestation (Prodes)

<http://www.obt.inpe.br/prodes/>

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State Prosecutor of Amapá

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