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SUMMARY

The SAD detected 184 km ² of deforestation in the Brazilian Amazon in June 2013. This represented an increase of 437% compared to June 2012 when the deforestation totaled 34km ². Due to the low cloud cover, it was possible to monitor 88% of the territory in June 2013 while in June 2012 there were more clouds and it was possible to monitor 73% of the territory.

The accumulated deforestation from August 2012 to June 2013 totaled 1.855km ². There was an increase of 103% over the previous period (August 2011 to June 2012) when the deforestation totaled 907km ².
In June 2013, deforestation mainly occurred in Pará (42%), Amazon (32%), Mato Grosso (18%) and Rondônia (5%).

The degraded forests in Legal Amazon totaled 169 km2 in June 2013. Compared to June 2012, when the forest degradation totaled 15 km ², an increase of 1078%.

The accumulated forest degradation period (August 2012 to June 2013) reached 1.462km ² In the previous period (August 2011 to June 2012), when degradation totaled 1.974km ², a reduction of 26%.

In June 2013, the deforestation detected by SAD compromised 3.5 million tons of CO ² equivalent. Accumulated in the period (August 2012 to June 2013) the emissions of CO ² equivalent committed to deforestation totaled 97 million tons, representing an increase of 90% over the previous period (August 2011 to June 2012).

Deforestation Statistics

According to the SAD, the deforestation (total suppression of forest to other alternative land uses) reached 184 km² in June 2013 (Figure 1 and Figure 2).

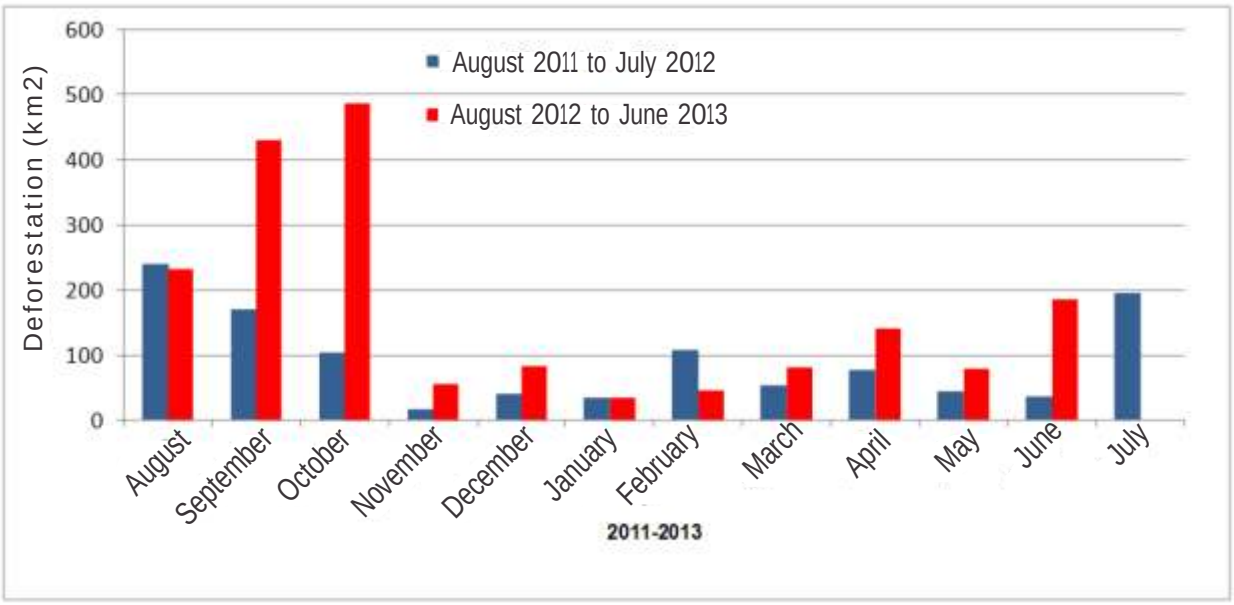

Figure 1. Deforestation of August 2012 to June 2013 in the Legal Amazon (Source: Imazon/SAD).

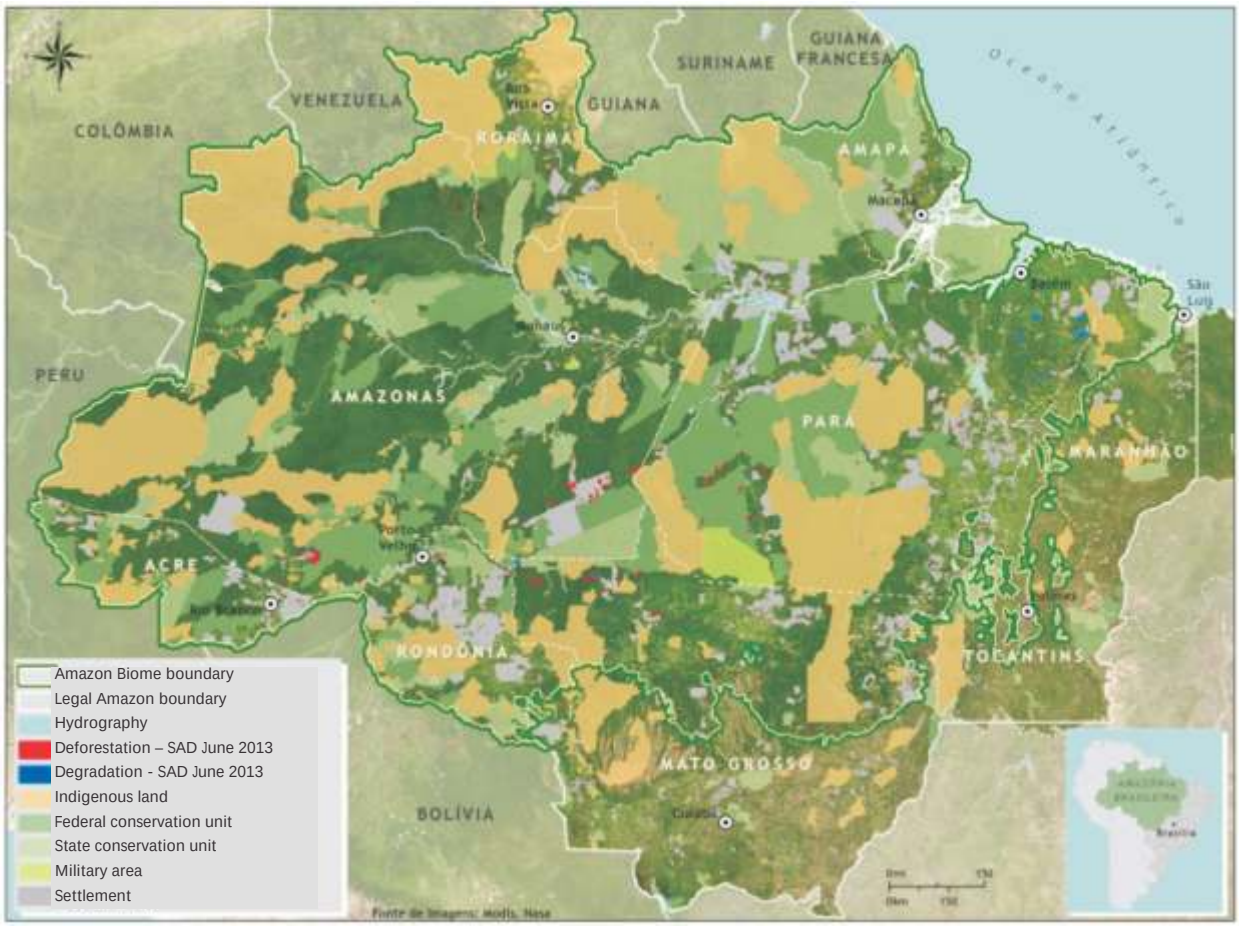

Figure 2. Deforestation and Forest Degradation in June 2013 in the Legal Amazon (Source: Imazon/SAD).

The accumulated deforestation in the period of August 2012 to June 2013[1], corresponding to the ten months of the official calendar of measuring deforestation reached 1.855 km². There was an increase of 103% of deforestation in the previous period (August 2011 to June 2012) when it reached 907 km².

In June 2013, the deforestation occurred in Pará (42%), Amazonas (32%), Mato Grosso (18%), Rondônia (5%) and Roraima (3%).

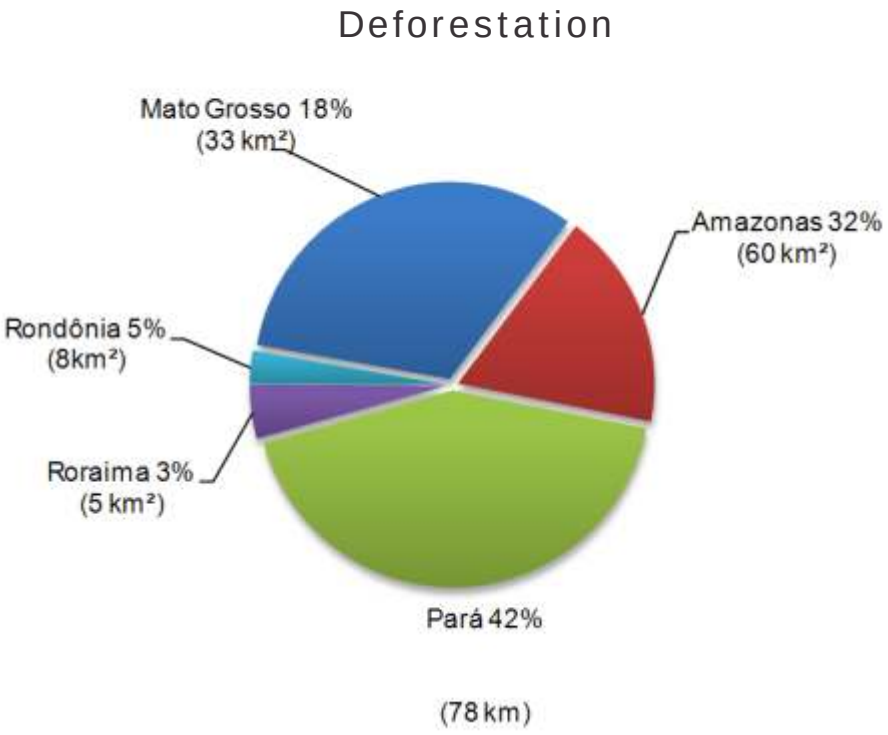

Figure 3. Percentage of deforestation in the Legal Amazon Stated in June 2013 (Source: Imazon/SAD).

Considering the accumulated deforestation in the ten months of the current calendar deforestation (August 2012 to June 2013), Pará leads the ranking with 41% of the total deforested. Then appears the Mato Grosso with 31%, with 13% Rondônia and Amazonas with 12%. These four states accounted for 97% of deforestation occurred in Amazon in this period.

In relative terms, there was a reduction in Acre (28%) and Roraima (22%). On the other hand, there was an increase in Amazonas (+185%), Pará (+143%), Mato Grosso (+99%), Tocantins (+74) and Rondônia (40%).

In absolute terms, the Pará leads the ranking of accumulated deforestation with 753 km², followed by Mato Grosso (584 km²), Rondônia (234 km²), Amazonas (230 km²), Tocantins (24 km²), Acre (12km²) and Roraima (18 km²).

[1] The official calendar of measuring deforestation begins in August and ends in July.

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

State	August 2011 to June 2012	August 2012 to June 2013	Variation (%)
Pará	309	753	+143
Mato Grosso	293	584	+99
Rondônia	167	234	+40
Amazonas	81	230	+184
Roraima	23	18	-22
Acre	20	12	-37
Tocantins	14	24	+74
Amapá	-	-	-
Total	**907**	**1.855**	**+104**

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

Forest Degradation

In June 2013, SAD recorded 169 km² of degraded forests (forests intensively exploited by logging and/or burning) (Figures 2 and 4).

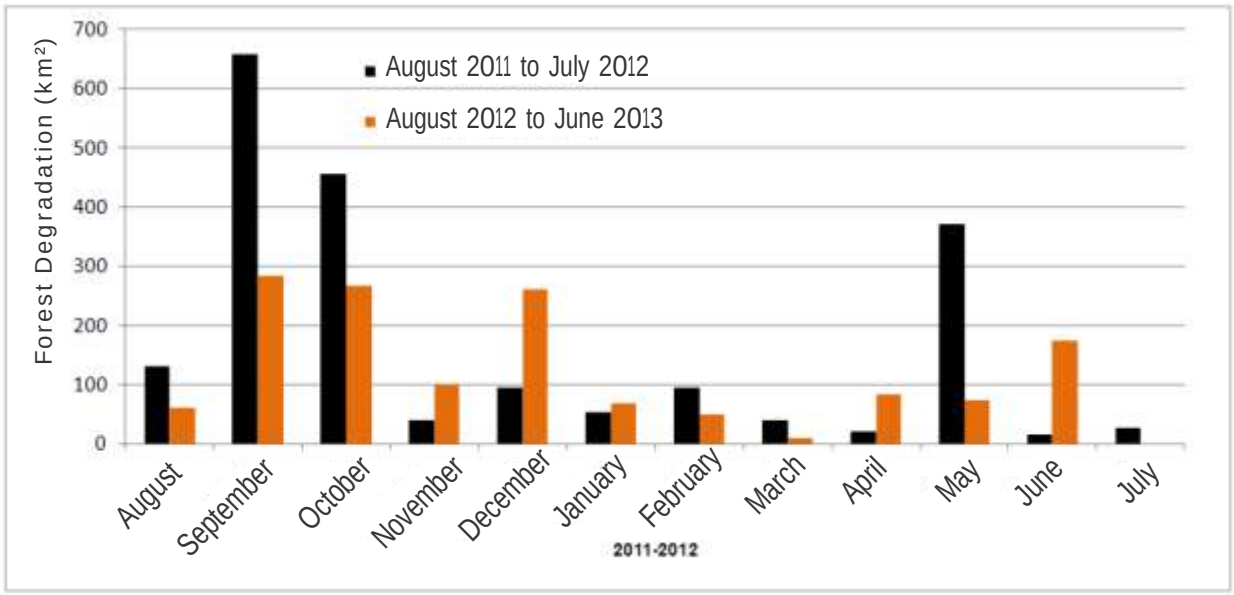

Figure 4. Forest Degradation from August 2012 to June 2013 in the Legal Amazon (Source: Imazon/SAD).

Forest degradation accumulated in the period August 2012 to June 2013 reached 1.462km².

In absolute terms, the Mato Grosso leads the ranking of forest degradation accumulated with 726km² (49%), followed by Pará with 566km² (39%). The rest (12%) occurred in Rondônia (115km²), Amazon (19 km²), Tocantins (11km²), and Roraima (8km²).

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

State	August 2011 to June 2012	August 2012 to June 2013	Variation (%)
Mato Grosso	1.587	726	-54
Pará	239	566	+136
Rondônia	101	115	14
Amazonas	29	19	-34
Roraima	15	8	-44
Acre	3	3	-
Tocantins	-	25	-
Amapá	-	-	-
Total	**1.974**	**1.462**	**-26**

***** 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 June 2013 the 184km² of deforestation detected by SAD in Amazon pledged 3.5 million tons of carbon (with a margin of error of 910 tons of carbon). This amount of carbon affected resulting in 12 millions of tons of CO² equivalent (Figure 5).

The forest carbon compromised by deforestation from August 2012 to June 2013 was 38 million tons (with a margin of error of 620 thousand tons), representing around 97 million tons equivalent of CO² (Figure 6). Compared to the same period last year (August 2010 to June 2012) when forest carbon committed was 20 million tons increased by 90% for carbon compromised by deforestation.

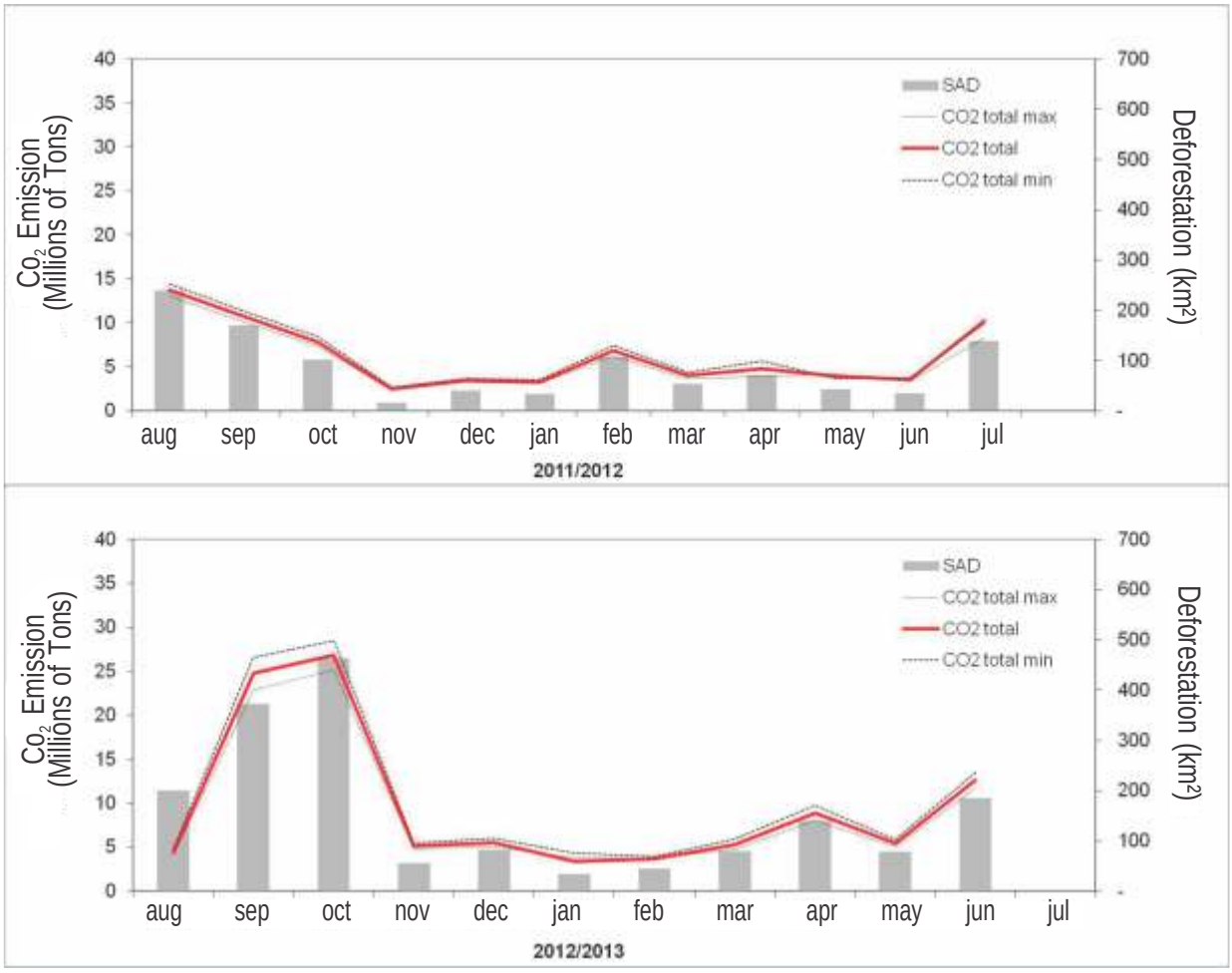

Figure 5. Deforestation and emissions of Carbon Dioxide (CO2) total equivalent of August 2011 to June 2013 in the Legal Amazon (Source: Imazon).

Deforestation Geography

In June 2013, the vast majority (63%) of the deforestation occurred in private or under various stages of ownership. The rest of deforestation was registered in Land Reform Settlements (23%), Conservation Unities (14%) and there was not detection on Indigenous Lands (Table 3).

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

Category	June 2013	
	km²	%
Agrarian Reform Settlement	43	23
Conservation Units	25	14
Indigenous Lands	-	-
Private, Owned and in Abeyance[3]	116	63
Total (km²)	**184**	**100**

Reform Settlements

The SAD registered 43km² of deforestation in Land Reform Settlements in June 2013 (Figure 6). Settlements were most affected by deforestation PA Rio Juna (Apuí; Amazonas), PA Monte (Lábrea, AMAZONAS) AND pds Laranjal (Jacareacanga, Pará).

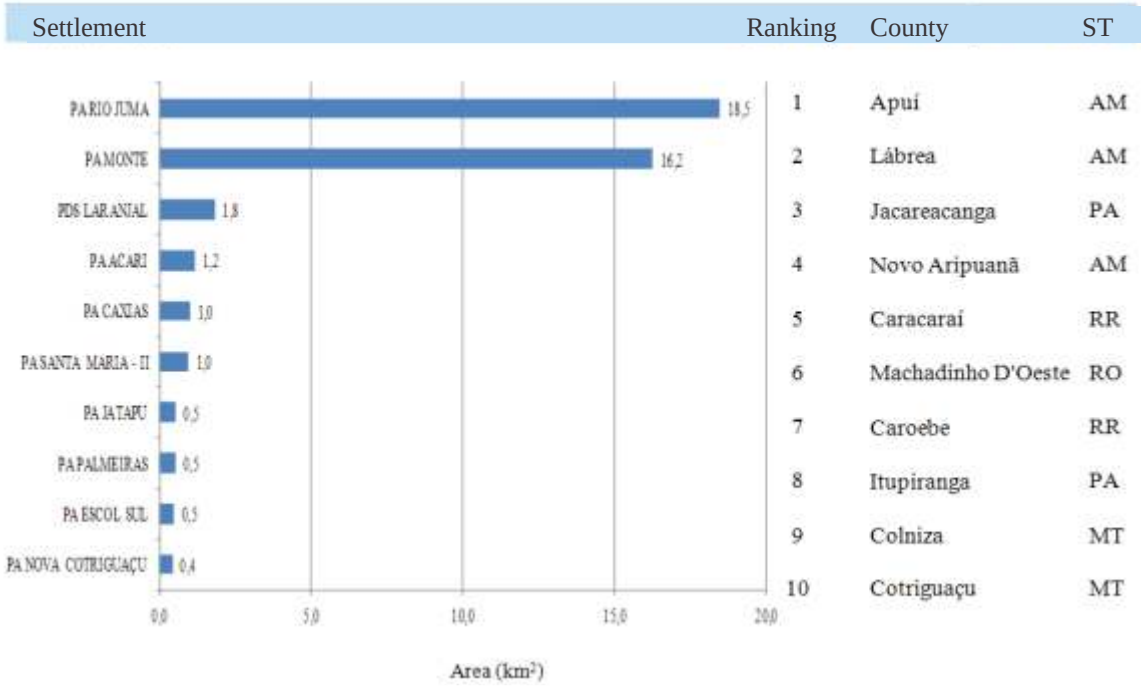

Figure 6. Reform Settlements cleared in January 2013 in the Legal Amazon (Source: Imazon/SAD)

[3] It includes private areas (tittered or not) and unprotected public forests.

Protected Areas

In June 2013, SAD detected 25km² of deforestation in protected areas APA Tapajós (Pará). Flona do Jamanxim (Pará). PES de Guajará-Mirim (Rondônia), APA Triunfo do Xingu (Pará), Resex Jaci Paraná (Rondônia), Flores Rio Preto-Jacundá (Rondônia), REBIO Nascentes da Serra d Cchimbo (Pará), APA Caverna do Moroag (AMAZONAS) e Flona do Bom Futuro (Rondônia) (Figura 7).

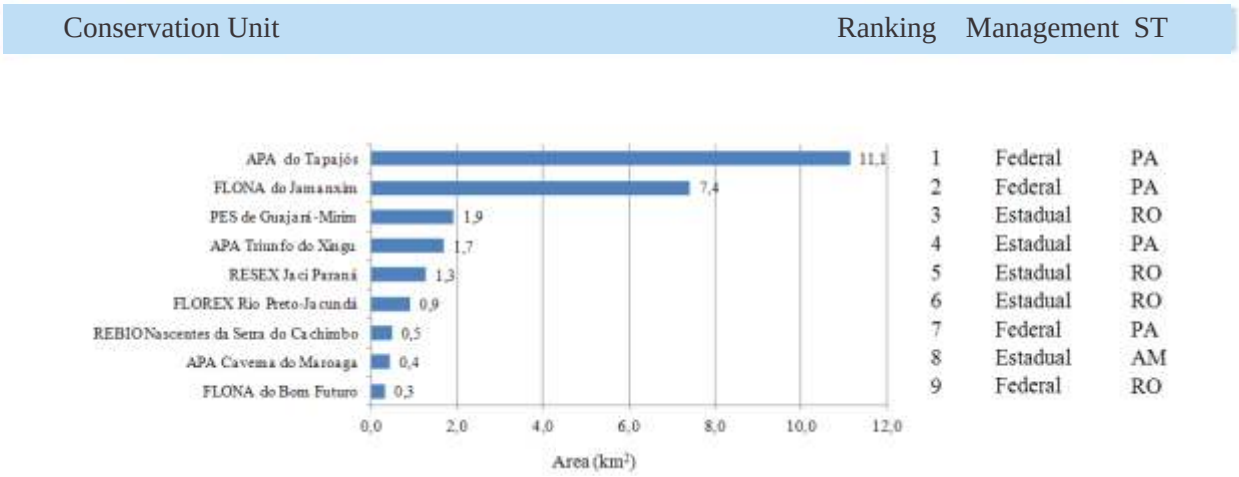

Figure 7. Conservation unit cleared in Legal Amazon in June 2013 (source: Imazon/SAD)

Municipalities Critics

In June of 2013 the most deforested municipalities were: Itaituba (Pará) and Lábrea (Amazonas)(Figure7and8).

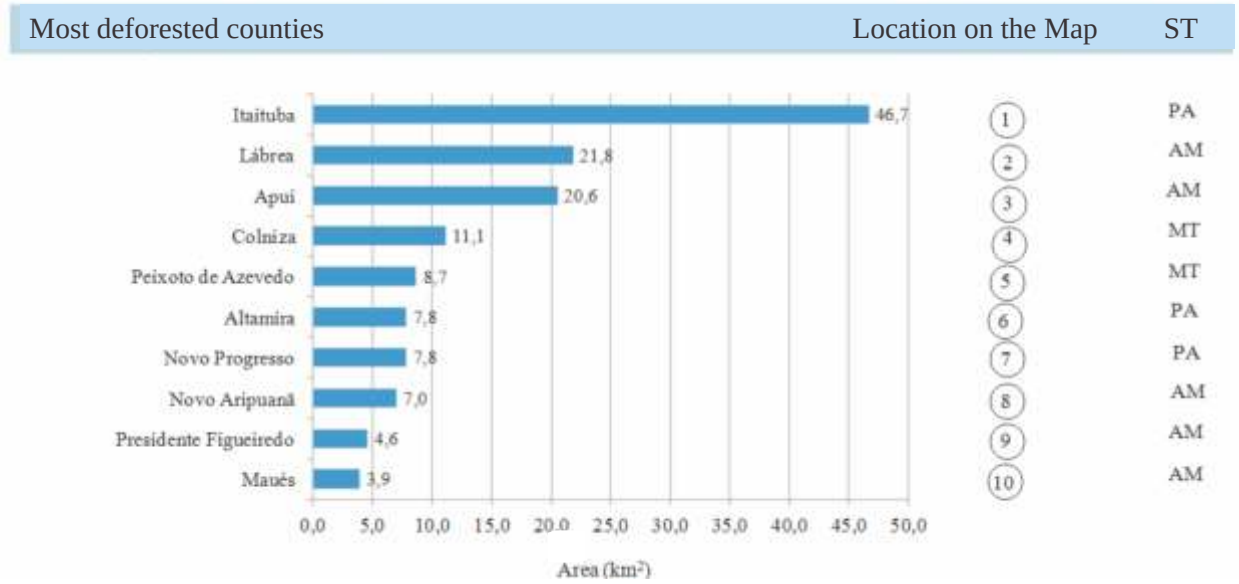

Figura 8. Municípios mais desmatados na Amazônia Legal em junho de 2013 (Fonte: Imazon /SAD).

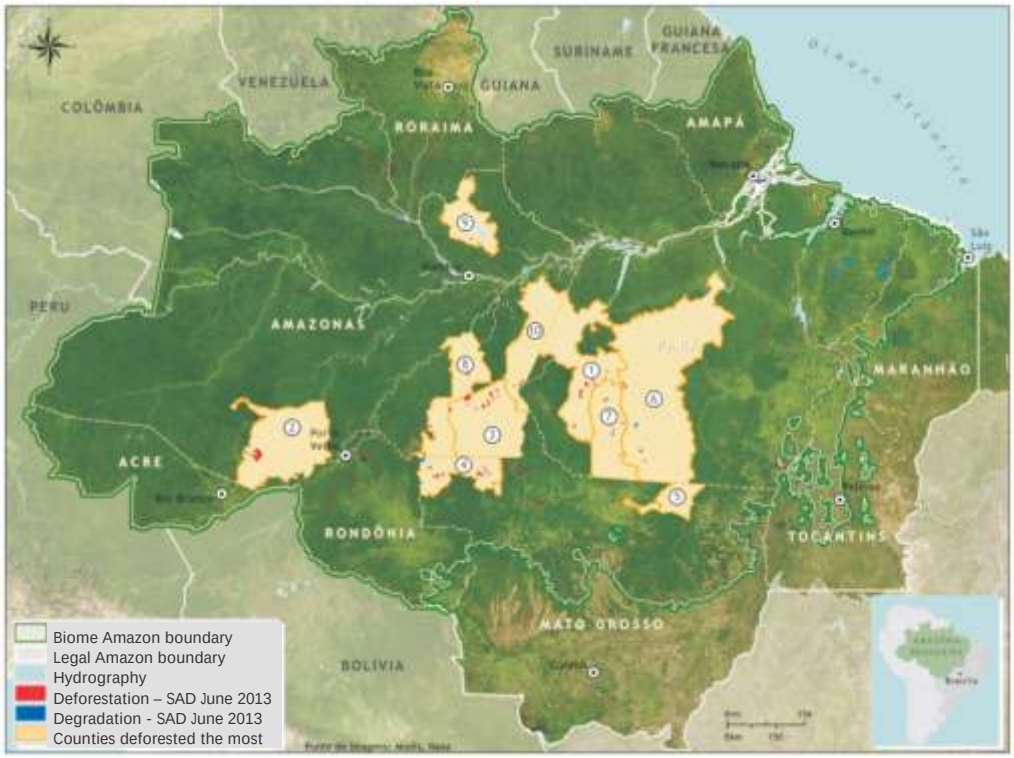

Figure 9. Most deforested municipalities in June 2013 (Source: Imazon / SAD).

Coverage by clouds and Shade

In June 2013 it was possible to monitor the SAD 88% of the forest area in the Legal Amazon. The other 12% of the forest area was covered by clouds, which hampered the detection of deforestation and forest degradation. The states with the largest cloud cover were Roraima (26%), Amapá (53%) and Pará (15%). As a result, data from deforestation and forest degradation in June 2013 may be underestimated (Figure 9).

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

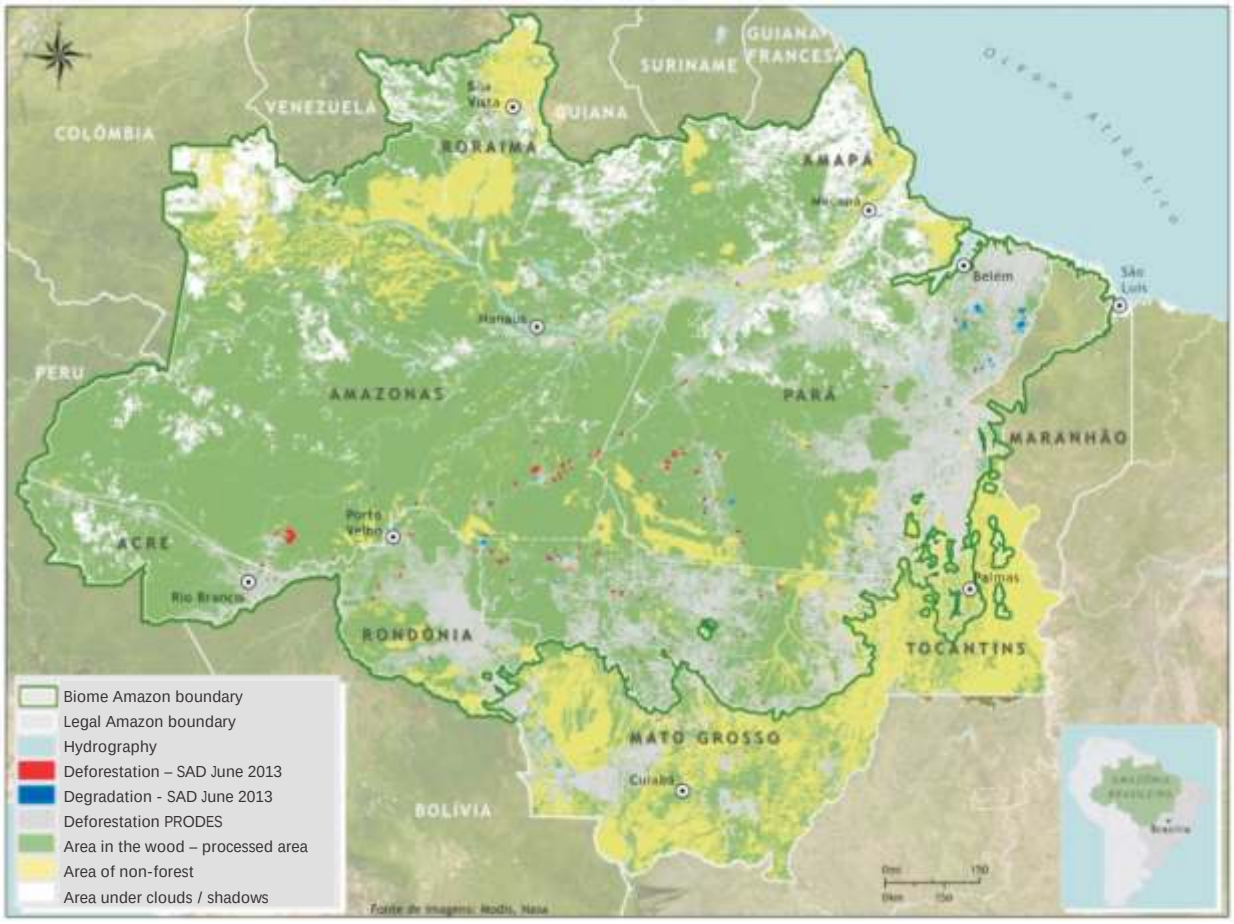

Figure 10. Area with cloud and shade in June 2013 in the Legal Amazon.

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:

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

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

$$VGs = Vegetation / (1 - Shadow)$$

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 August 2012.

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 develop 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:

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

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

$$BPF = ff * AGLB$$

$$BAS_0 = bf * AGLB$$

where:
t: time (month)
Ct: 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%).
BAS_0: Biomass below the soil before the deforestation.
pd: monthly decomposition parameter of the biomass below the soil after the deforestation (0.0075).
$pd \times e^{(-pdxe)}$: 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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