Heron Martins, Antônio Fonseca; Carlos Souza Jr.; Márcio Sales & Adalberto Veríssimo (Imazon)

SUMMARY

In June 2012, the Sistema de Alerta de Desmatamento (SAD - Deforestation Alert System) has detected 34,5 square km of deforestation in the Legal Amazon. This represented a 66% decrease in CO2 equivalents totaled committed to 100.5 square km. Due to the cloud cover, it was possible to monitor only 73% of the territory, a value greater than June 2011 (65%). The accumulated deforestation from August 2011 to June 2012 totaled 907 square km. There was a reduction of 41% over the previous period (August 2010 to June 2011) when deforestation totaled 1,534 square kilometers.
In June 2012, 60% of the deforestation occurred in Pará. Then appears the Amazon with 28%.

The remainder (12%) occurred in Rondônia (6%) and Mato Grosso (6%).
The degraded forests in the Amazon amounted to only 14,5 square kilometers in June 2012. Compared to June 2011, when forest degradation totaled 193 square km, there was a reduction of 93%. Most (45%) of this degradation occurred in Mato Grosso.

The forest degradation accumulated in the period (August 2011 to June 2012) reached 1,974 square kilometers. In the previous period (August 2010 to June 2011), when degradation amounted to 6,274 square kilometers, a reduction of 69%.

In June 2012, the deforestation detected by SAD pledged 960,000 km of CO2 equivalent. Accumulated in the period (August 2011 to June 2012) emissions compared to June 2011 when deforestation totaled 74 million tons, representing a reduction of 18% over the previous period (August 2010 to June 2011.)

Google SAD-EE

In June the detection of deforestation and forest degradation of the SAD was performed on the platform of Google Earth Engine. This system was developed in collaboration with Google and use the same process already used by the SAD, with reflectance images of MODIS to generate alerts from deforestation and forest degradation. Called SAD-EE (Earth Engine), the new platform will provide the data and tools for processing of satellite images, editing digital maps and mapping validation that run on Google's cloud of computers.

This will reduce the time for preprocessing, analysis and dissemination of data and may even reach 50% of the time to generate alerts, giving greater flexibility in information processing and enabling the detection of deforestation in areas beyond the borders of the Brazilian Amazon because all these technologies and satellite data will be available to institutions in other countries, enabling monitoring on a global scale.

Deforestation Statistics

According to SAD, deforestation (total suppression of forest to other alternative land uses) reached 34,5 square kilometers in June 2012 (Figure 1 and Figure 2). This represented a decrease of 66% compared to June 2011 when deforestation totaled 100,5 square km.

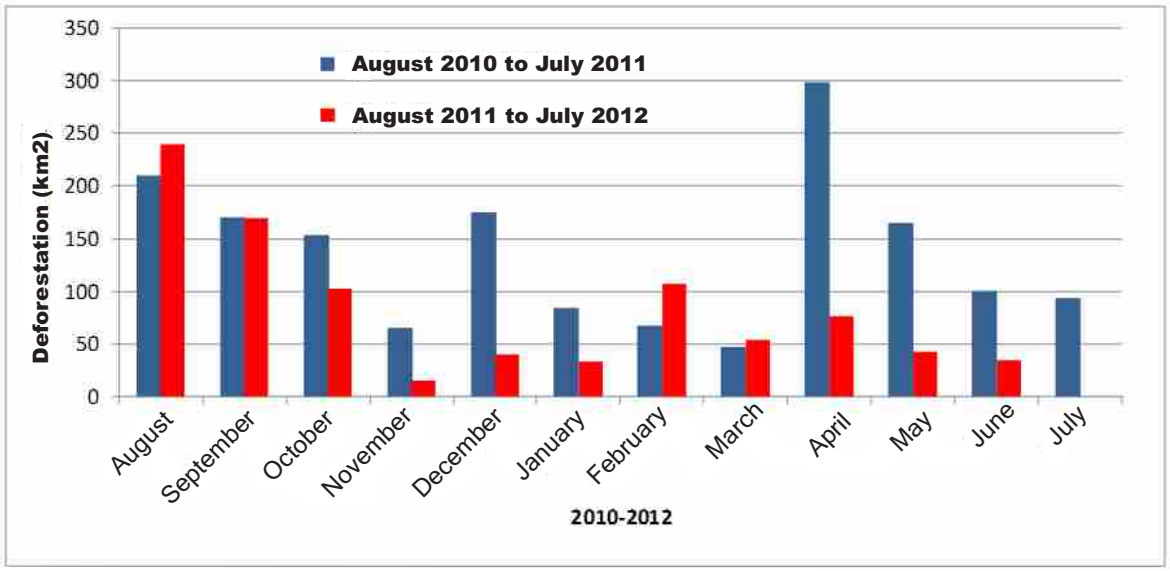

Figure 1. Deforestation from August 2010 to June 2012 in the Legal Amazon (Source: Imazon/SAD).

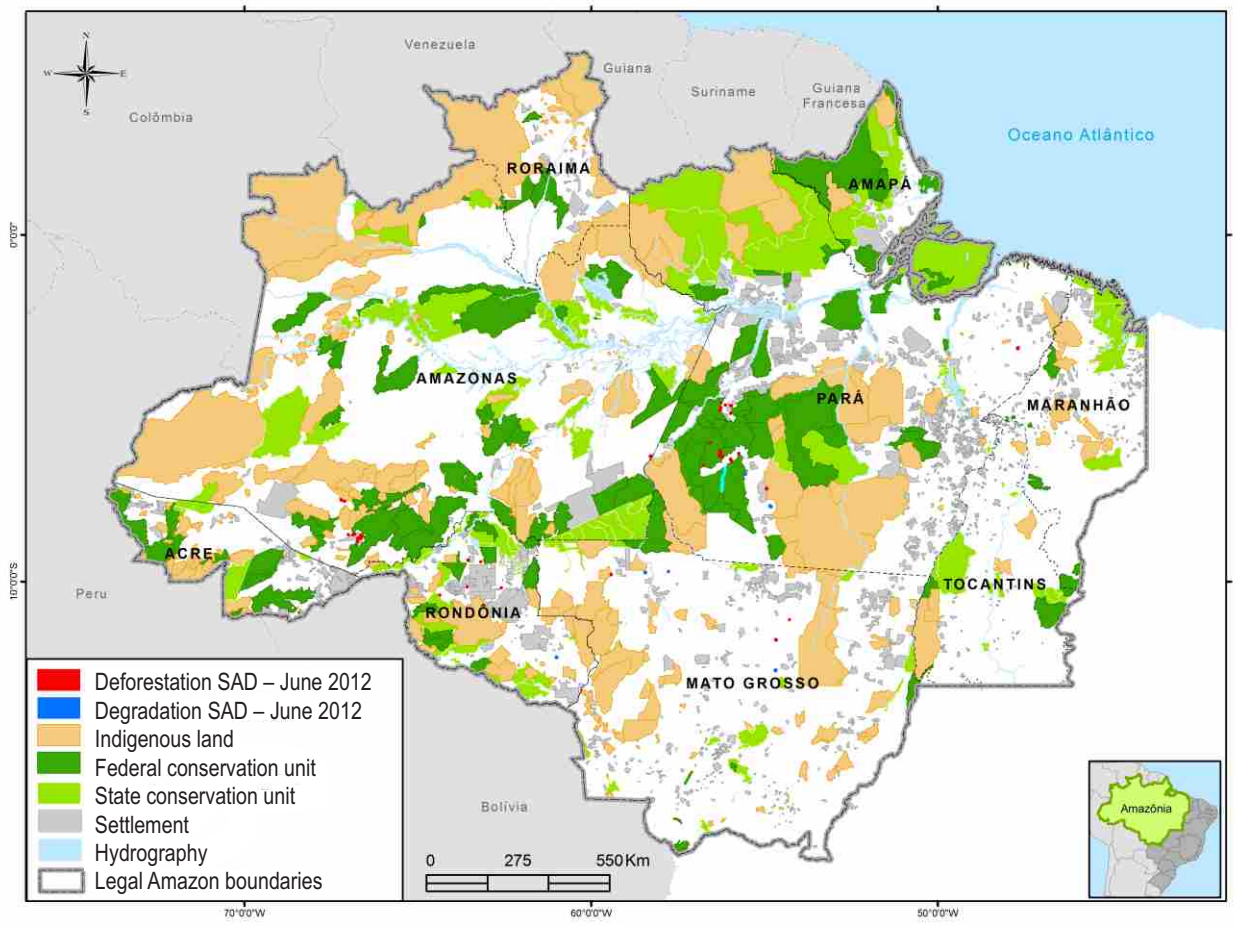

Figure 2. Deforestation and degradation from August 2010 to June 2012 in the Legal Amazon (Source: Imazon/SAD).

The accumulated deforestation from August 2011 to May 2012, corresponding to eleven months of the official calendar of measuring deforestation, reached 907 square km.

There was a 41% reduction in deforestation over the previous period (August 2010 to June 2011) when it reached 1,534 square kilometers.

In June 2012, 60% of the deforestation occurred in Pará, followed by Amazonas (28%), Rondônia (6%) and Mato Grosso (6%).

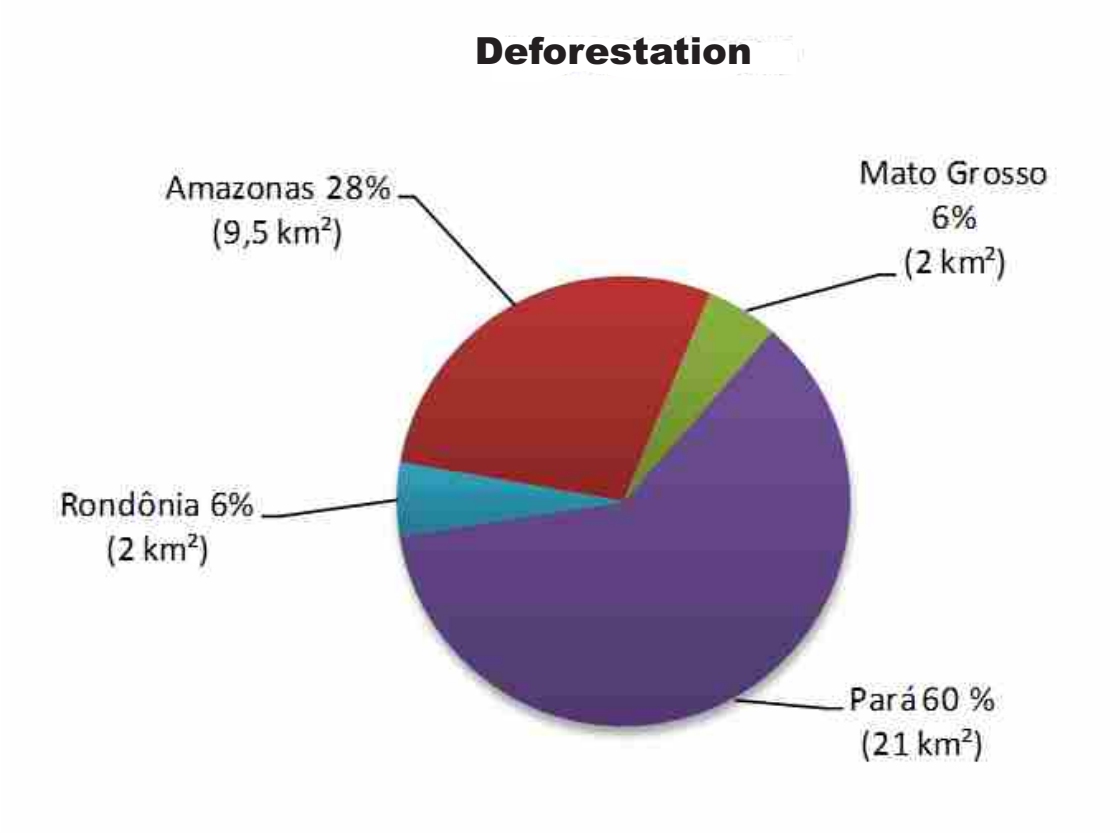

Figure 3. Percentage of deforestation in the Amazon in June 2012 (Source: Imazon/SAD).

Considering the accumulated deforestation in the eleven months of the current calendar year of deforestation (August 2011 to June 2012), Pará leads the ranking with 34% of total deforestation. Then is Mato Grosso with a 32%, Rondônia with 18% and Amazonas with 9%. These four states accounted for 93% of Amazon deforestation occurred in that period.

There was a 41% reduction in deforestation occurred from August 2011 to June 2012 compared with the previous period (August 2010 to June 2011) (Table 1). In relative terms, occurred a reduction of 64% in Acre, 54% in Amazonas, 50% in Mato Grosso, 48% in Rondônia and 20% in Pará. On the other hand, there was an increase of 194% in Roraima and 61% in Tocantins.

In absolute terms, Pará leads the ranking of accumulated deforestation with 309 square kilometers, followed by Mato Grosso (293 square kilometers), Rondônia (167 square kilometers), Amazonas (81 square kilometers), Roraima (23 square kilometers), Acre (20 square kilometers) and Tocantins (14 square kilometers).

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

Table 1. Evolution of deforestation among states in the Amazon from August 2010 to June 2011 and August 2011 to June 2012 (Source: Imazon/SAD).

State	August 2010 to June 2011	August 2011 to June 2012	Variation (%)
Pará	384	309	-20
Mato Grosso	558	292	-48
Rondônia	322	167	-48
Amazonas	174	81	-9
Roraima	8	23	+194
Acre	55	20	-64
Tocantins	9	14	+61
Amapá	-	-	-
Total	**1.534**	**907**	**-41**

* Os dados do Maranhão não foram analisados.

Forest Degradation

In June 2012, the SAD recorded 14,5 square kilometers of degraded forest (heavily exploited forests by logging activities and/or burned) (Figures 2 and 4). Over the same period last year (June 2011) there was a decrease of 93% when forest degradation reached 193 square kilometers. 45% of the areas of degradation in June occurred in Mato Grosso.

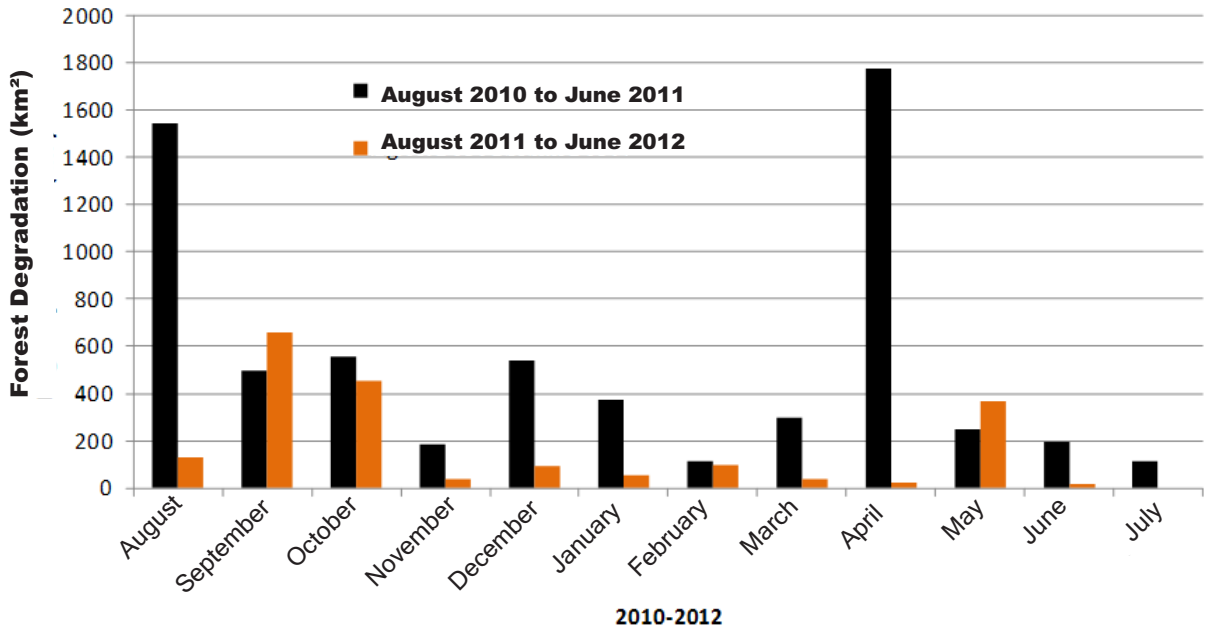

Figure 4. Forest degradation from August 2010 to June 2012 in the Legal Amazon (Source: Imazon/SAD).

The forest degradation accumulated in the period of August 2011 to June 2012[2] reached 1,974 square kilometers. This represents a 69% reduction in forest degradation accumulated during this period (August 2011 to June 2012) over the same period last year (August 2010 to June 2011) when the forest degradation amounted to 6,274 kilometers square (Table 2). The largest reductions were in Acre (-98%), Rondônia (-90%), Amazonas (-84%), Mato Grosso (-78%) and Pará (-58%).

In absolute terms, the Mato Grosso leads the ranking of forest degradation, with an accumulated total of 1,587 square kilometers (80%), distantly followed by Pará with 239 square kilometers (12%). The remainder (8%) occurred in Rondônia (101 square kilometers), Amazonas (29 square kilometers), Roraima (15 square kilometers), and Acre (3 square kilometers).

Table 2. Evolution of forest degradation among states in the Amazon from August 2010 to June 2011 and August 2011 to June 2012 (Source: Imazon/SAD).

State	August 2010 to June 2011	August 2011 to June 2012	Variation (%)
Mato Grosso	3.779	1.587	-58
Pará	1.075	239	-78
Rondônia	1.061	101	-90
Amazonas	178	29	-84
Roraima	2	15	+865
Acre	148	3	-98
Tocantins	31	-	-
Amapá	-	-	-
Total	**6.274**	**1.974**	**-68**

* The data from Maranhão were not analyzed.

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

Carbon Affected by the Deforestation

In April 2012, the 34.5 square kilometers of deforestation detected by SAD in the Amazon endangered 960 thousands tons of carbon (with a margin of error of 233,000 tons of carbon). This amount of endangered carbon may result in emissions of 3.5 million tons of CO2 equivalent (Figure 6).

The carbon from forest endangered by deforestation from August 2011 to May June 2012 was 20 million tons (with a margin of error of 369,000 tons), representing approximately 74 million tons of CO^2 equivalent (Figure 6). Over the same period last year (August 2010 to June 2011) there was a 18% reduction in the amount of carbon endangered by deforestation. The reduction (18%) of forest carbon endangered by deforestation from August 2011 to June 2012, compared to previous period (August 2010 to June 2011), was less than the 41% reduction of deforestation detected by SAD during the same period.

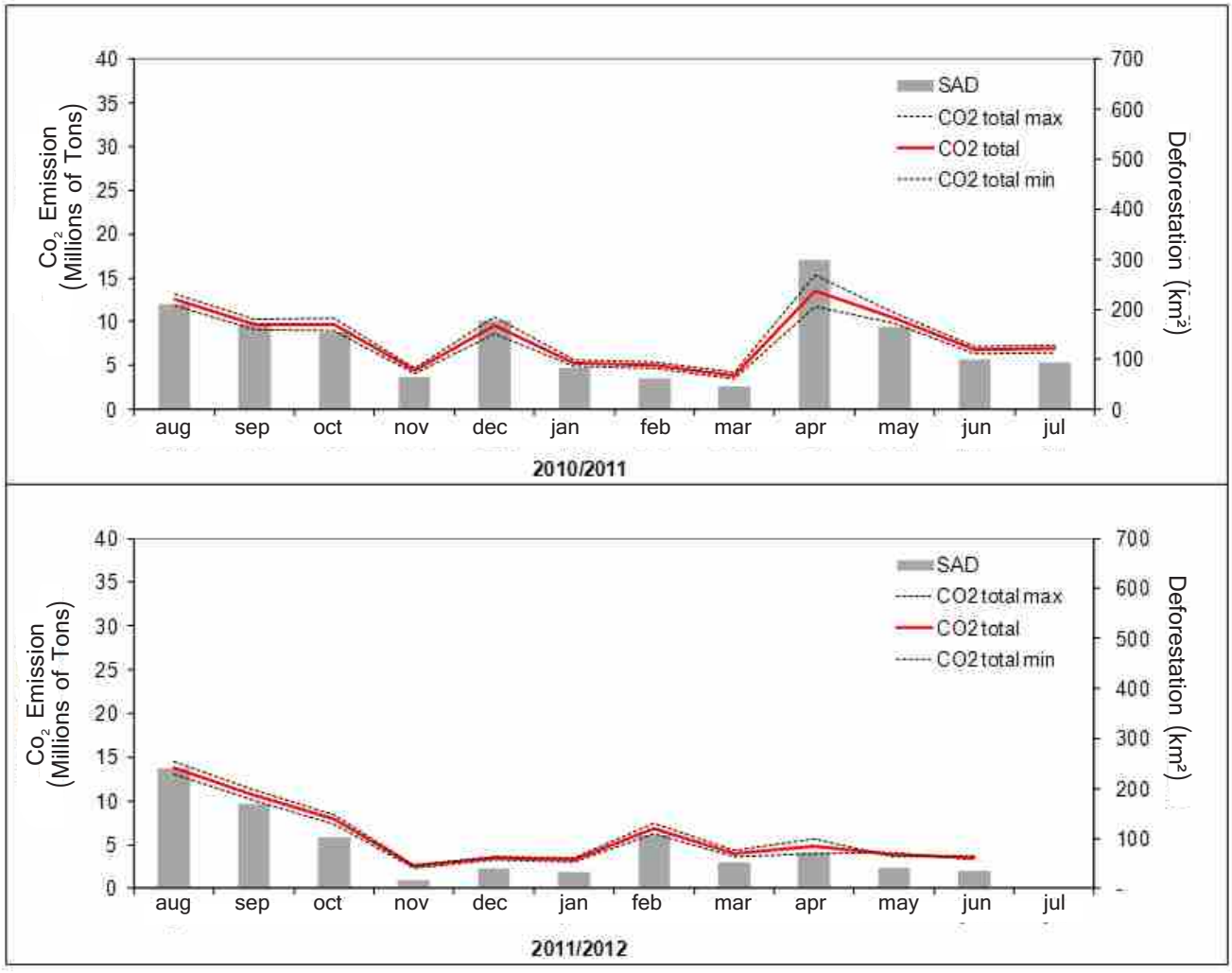

Figure 6. Deforestation and emissions of carbon dioxide (CO^2) equivalent total in August 2010 to June 2012 in the Legal Amazon (Source: Imazon).

Deforestation Geography

In June 2012, most (70.5%) of the deforestation occurred in private areas or under various stages of ownership. The rest of deforestation was registered in Conservation Areas (30,5%) Indigenous land (1.5%) and Land Reform Settlements (26%) (Table 3).

Table 3. Deforestation by agrarian category in June 2012 in the Legal Amazon (Source: Imazon/SAD).

Category	June 2012	
	km²	%
Agrarian Reform Settlement	9	26
Conservation Units	10,5	30,5
Indigenous Lands	0,5	1,5
Private, Owned and in Abeyance[3]	14,5	42
Total (km²)	34,5	100

Agrarian Reform Settlements

The SAD has recorded only 9 square kilometers of deforestation in the Agrarian Reform Settlements in June 2012. The Settlements affected by deforestation were PA Monte (Lábrea; Amazonas) and PDS Terra Nossa (Altamira; Pará).

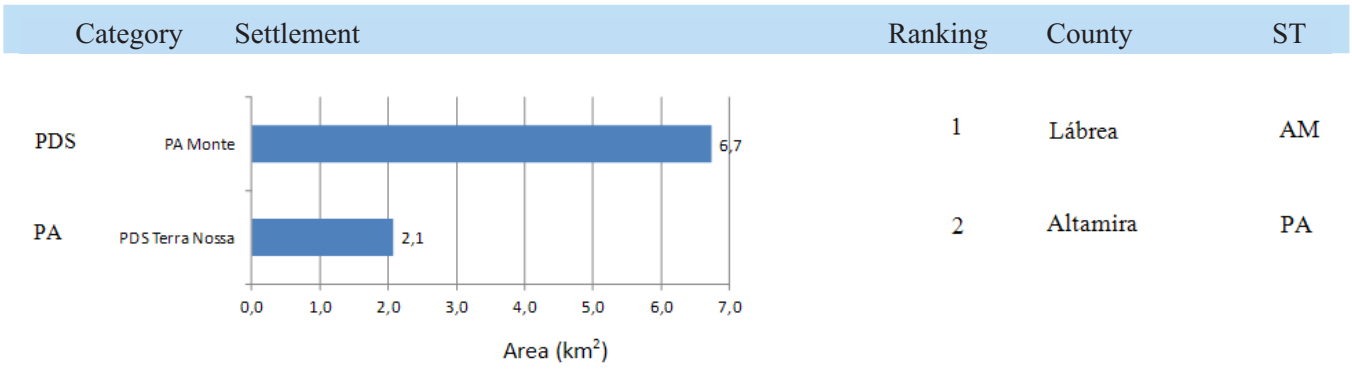

Figure 7. Land Reform Settlements in June 2012 deforested in the Amazon (Source: Imazon/SAD). PA (Settlement Project).

[3] Includes private areas (titled or not) and unprotected public forests.

Protected Areas

The SAD detected 10.5 km square of deforestation in conservation areas (Figure 8). The Conservation Units were deforested were APA Tapajós (Pará) and Flona de Itaituba II (Pará). In the case of Indigenous Lands in April 2012 was detected 0.5 km square of deforestation in the Terras Arara do Rio Branco (Pará) and Baú (Mato Grosso) (Figure 9).

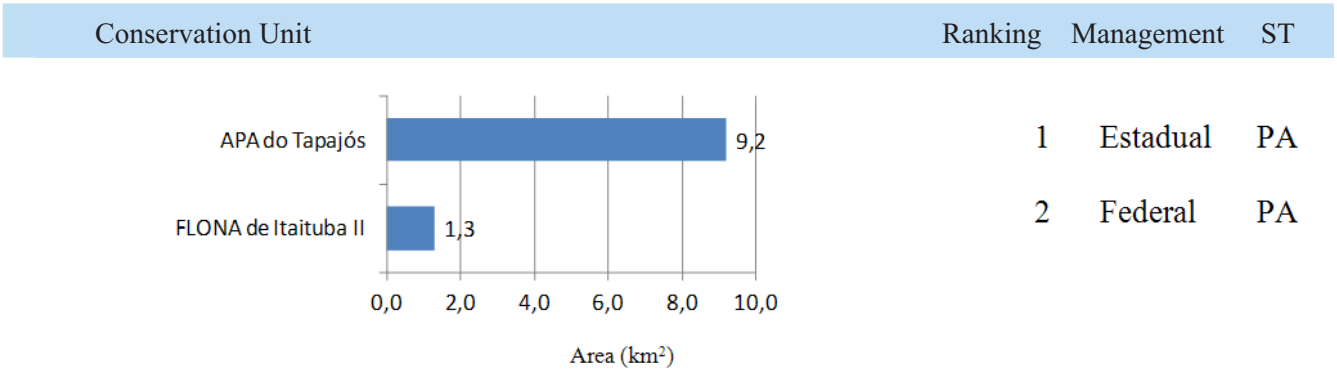

Figure 8. Conservation Unit area deforested in the Amazon in June 2012 (Source: Imazon/SAD).

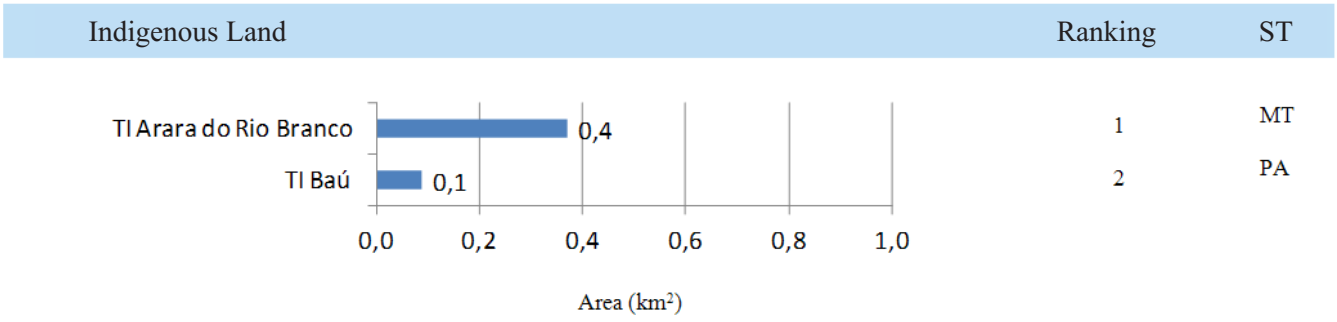

Figure 9. Indigenous land deforested in the Amazon in June 2012 (Source: Imazon/SAD).

In April 2012, the most deforested counties were: Bom Jesus do Araguaia (Mato Grosso); Gaúcha do Norte (Mato Grosso); and Guajará Mirim (Rondônia) (Figures 10 e 11).

Critical Municipalities

In June 2012, the most deforested counties were: Itaituba (Pará); Lábrea (Amazonas); and Trairão (Pará) (Figure 10 e 11)[4].

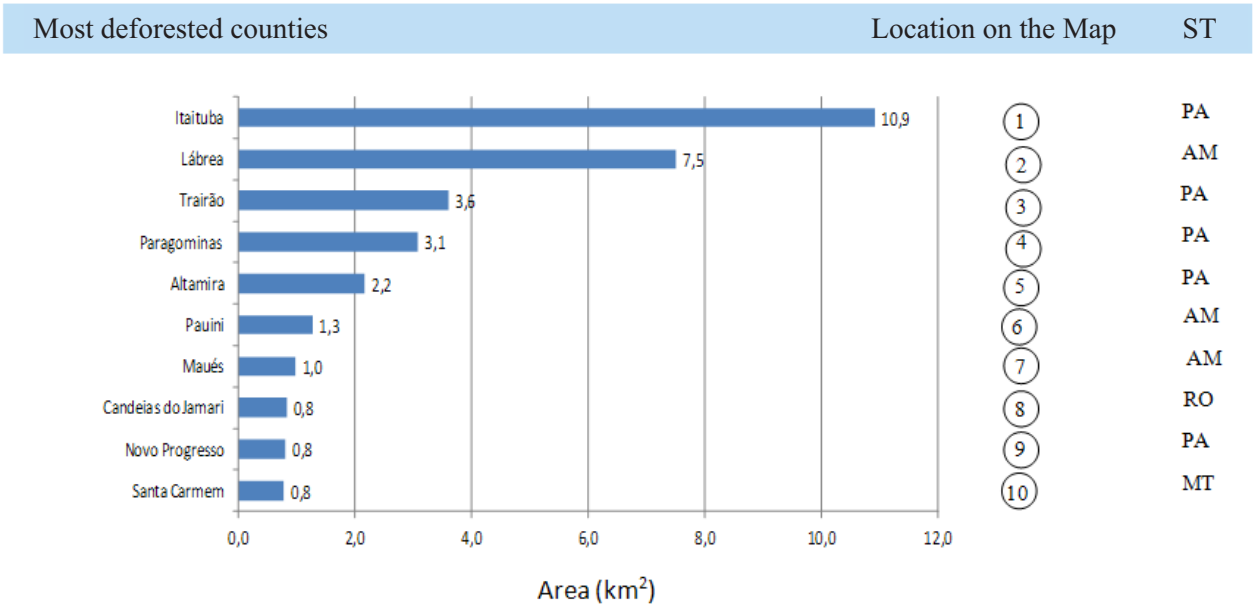

Figure 10. Most deforested counties in the Amazon in June 2012 (Source: Imazon/SAD).

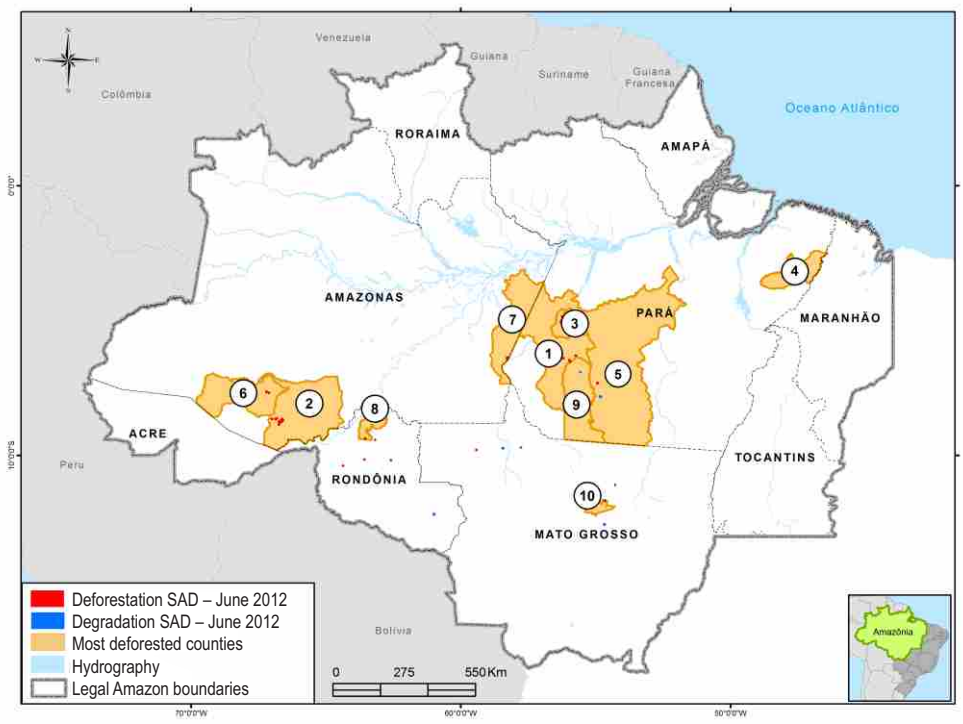

Figure 11. Counties with largest deforested areas in June 2012 (Source: Imazon/SAD).

[4] The 3.1 km² detected as deforestation in Paragominas were authorized by the Secretary of State for the Environment (SEMA) of Para for the expansion of mining area of the company Norsk Hydro ASA.

Coverage by clouds and Shade

In June 2012, it was possible to monitor with SAD only 73% of forest area in the Amazon. The other 27% of forest area was covered by clouds which hampered the detection of deforestation and forest degradation. The states with greater cloud cover were Amapá (83%), Acre (58%), Roraima (51%), and Pará (33%). As a result, data from deforestation and forest degradation in June 2012 may be underestimated (Figure 12).

* The portion of Maranhão that integrates the Amazon was not analyzed.

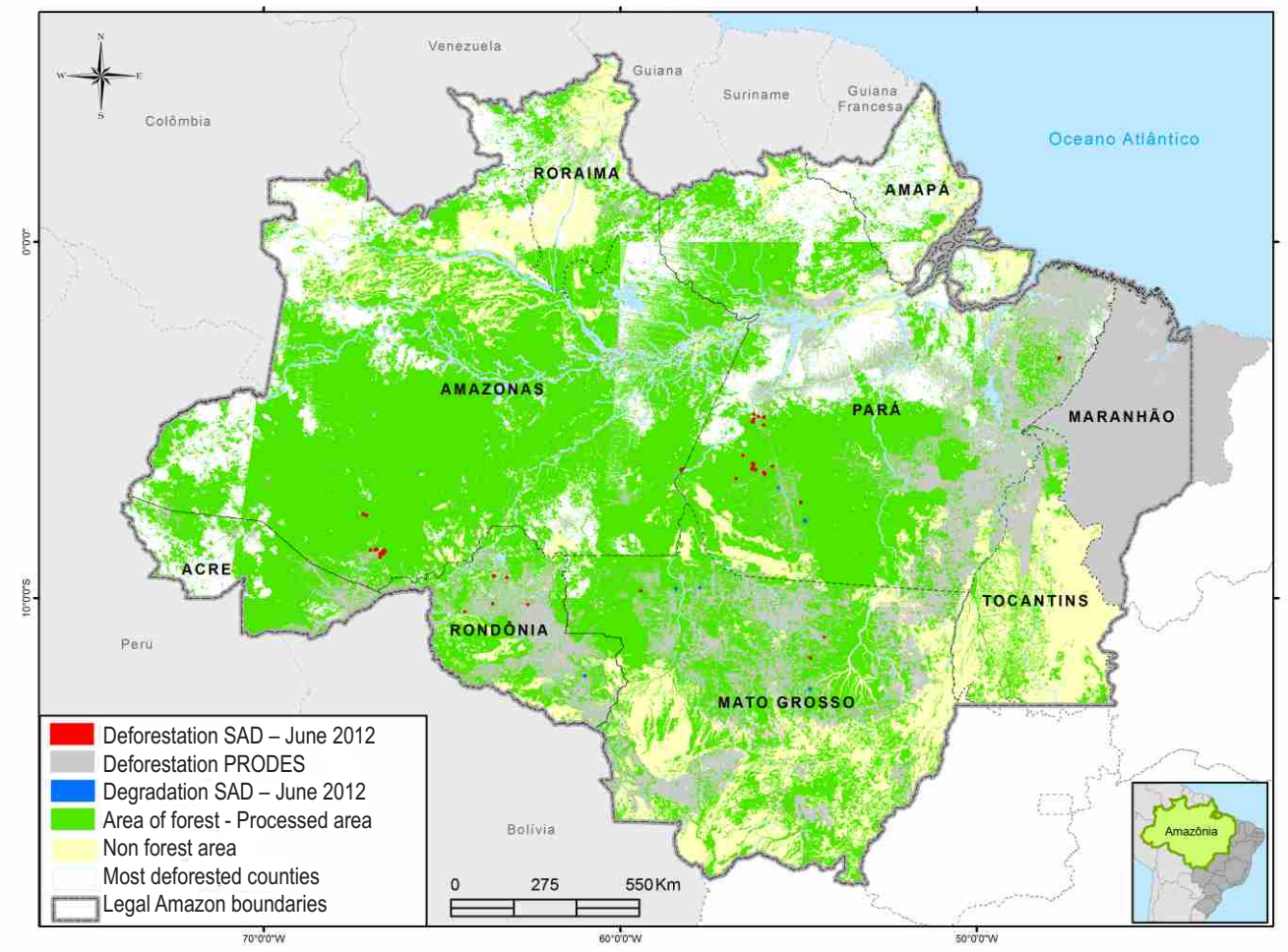

Figure 12. Area with clouds and shadow in June 2012 in the Amazon.

Table I: SAD 3.0

Since August 2009, the SAD had some news. First, we created a graphical interface for integrating all image processing programs used in the SAD. Second, we begin to compute the deforestation in areas that were covered by clouds in the previous months in a new class. Finally, deforestation and degradation are detected with pairs of NDFI images in a change detection algorithm. The primary method remains the same as the SAD 2 as described below.
The SAD generates temporal mosaic of daily MODIS of the products MOD09GQ and MOD09GA for filtering of the clouds. In the following, we used a technique of the fusion of different resolution spectral bands, e.g., pixels of different sizes. In that case, we change the scale of five bands with 500 meters MODIS pixels to 250 meters. This allowed to improve the spectral model of mixed pixels, providing the ability to estimate the abundance of vegetation, soil and vegetation Photosynthetically Non Active (NPV of English - Non-Photosynthetic) components (vegetation, soil and Shadow) to calculate the NDFI with the equation below:

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

Where VGs is the standard component of vegetation for shadow given by:

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

The NDFI ranges from -1 (pixel with 100% of exposed soil) to 1 (pixel with >90% with woody vegetation). Thus, we get a continuous image that shows the transition from deforested, degraded forests through until you reach the forest with no warning signs of disturbance.

The detection of deforestation and degradation began this month with the difference of NDFI images of consecutive months. Thus, a reduction in NDFI values between -200 and -50 indicates possibly cleared areas and between -49 and -20 with warning signs of degradation.

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

SAD is already operating in the State of Mato Grosso since August 2006 and in the Legal Amazon since April 2008. In this report, we present the data generated by the SAD monthly from August 2006 to June 2012.

Table II: Carbon affected by Deforestation

Since January 2010 we reported the estimates of carbon endangered (e.g., subject to the forest carbon emissions due to burning and decomposition of forest biomass residues) from deforestation detected by SAD in the Amazon.
The carbon estimates are generated based on the combination of deforestation maps of the SAD with simulations of the spatial distribution of biomass for Amazonia. We develop a model of the estimates of carbon emissions, based on stochastic simulation (Morton et al, in prep.), and called Carbon Emission Simulator (CES). We generated 1000 simulations of the spatial distribution of biomass in the Amazon using a geostatistic model (Sales et al., 2007), and transformed these biomass simulations in C stocks using conversion factors for biomass for C of the literature, according to the formula below:

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

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

$$BPF = ff * AGLB$$

$$BAS_0 = bf * AGLB$$

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.

For the application of the CES model using data from SAD, we consider only the carbon endangered by deforestation, e.g. the fraction of forest biomass composed of carbon (50%) subject to instantaneous emissions due to burning of forests by logging and/or further decomposition of remaining forest biomass. In addition, we adapted the model to estimate the CES for the forest carbon endangered by deforestation in a monthly scale. Finally, the simulations allowed to estimate the uncertainty of carbon endangered, represented by the standard deviation (+/- 2 times) of the simulations of carbon affected in each month.

For the conversion of carbon to CO equivalent value of the applied 3.68:2

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Responsible Team:
General Coordination: Antônio Fonseca, Heron Martins, Carlos Souza Jr, and Adalberto Veríssimo (Imazon)
Team: Marcio Sales (Modeling and Statistics), Rodney Salomão, Amintas Brandão Jr. (Geoprocessing), João Siqueira, Marcelo Justino and Júlia Ribeiro (Image Interpretation), Kátia Pereira and Victor Lins (ImazonGeo), Bruno Oliveira e Stefânia Costa (Communication)

Data Source:
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http://www.obt.inpe.br/prodes/

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State Public Attorney's office of the Pará
State Public Attorney's office of the Roraima
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State Public Attorney's office of the Mato Grosso
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