

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

SUMMARY

In October 2012, SAD has detected 487 square km of deforestation in the Legal Amazon. This represented a 377% increase compared to October 2011 when deforestation summed 108 square kilometers up. Due to cloud covering it was possible to monitor 83% of the territory, an amount quite higher than October 2011 (51%).

Accumulated deforestation from August 2012 to October 2012, summed 1,151.6 square kilometers up. A 125% increase was observed compared to the former period [August 2011 to October 2011], when deforestation summed 511 square meters.

In October 2012, a little over a third (36%) of deforestation occurred in the State of Pará, and a little less (30%) in the State of Mato Grosso. The remaining occurred in Amazonas [17%], Rondônia (12%) and other states (Acre, Tocantins and Roraima)

Degraded forests in Legal Amazon

summed 266.5 square km in October 2012. Compared to October 2011, a reduction of 42% was observed, when forest degradation summed 456 square kilometers.

Accumulated forest degradation in the period from August 2012 to October 2012 summed 611 square meters. Compared to the former period - August 2011 to October 2011, when forest degradation summed 1,245 square km, a 51% reduction was noticed.

In October 2012, SAD detected a deforestation involving 26 million tons of equivalent CO₂. The accumulated of the period (from August 2012 to October 2012) of equivalent CO₂ issued compromised by deforestation summed 57 million tons what represents a 27% increase compared to the former period (august 2011 to October 2011).

Deforestation Statistics

According to Imazon's Deforestation Alert System [SAD], deforestation (forest total suppression for other alternative uses of the soil) has reached 487 square km in Legal Amazon in October 2012 (Figure 1

and Figure 2). This represented a 377% increase compared to the deforestation detected in October 2011, when deforestation reached 102 square km.

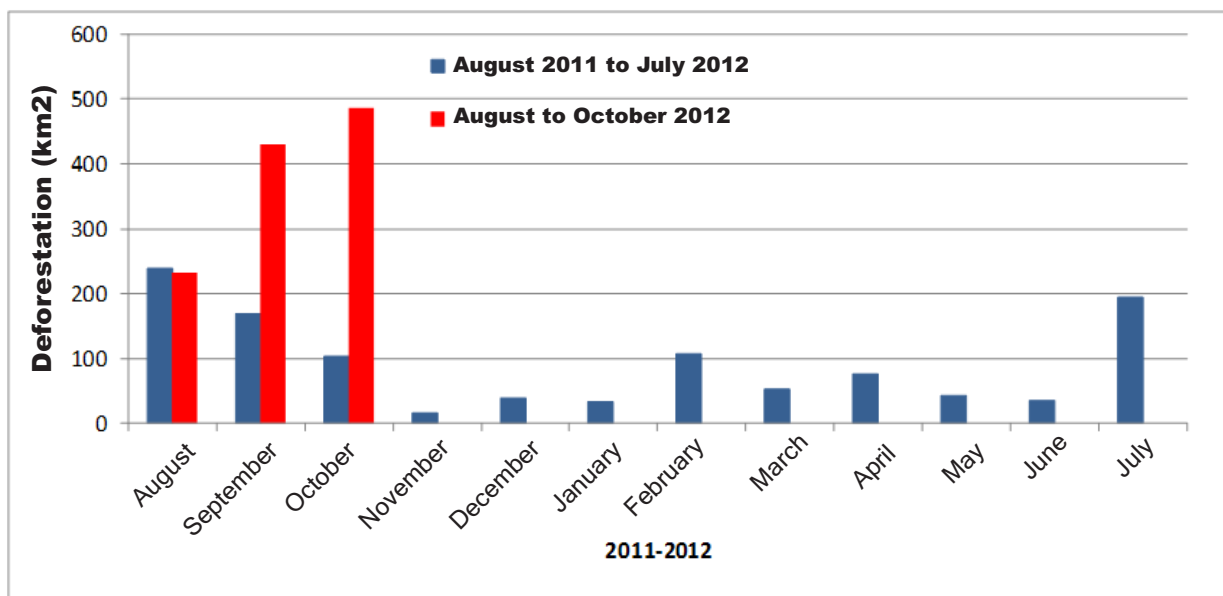


Figure 1: Deforestation from August 2011 to October 2012 in Legal Amazon (Source: Imazon/SAD)



Figure 2: Deforestation and Forest Degradation in October 2012 in Legal Amazon (Source: Imazon/SAD).

Accumulated deforestation in the period from August 2011 to October 2012¹, corresponding to three months of the official calendar of deforestation measurement, reached 1,151.6 square kilometers. A 125% increase of deforestation was observed, compared to the former period [from August 2011 to October 2011], when it reached 511.7 square kilometers.

In October 2012, a little over a third (36%) of deforestation occurred in the State of Pará, and a little less (30%) in the State of Mato Grosso. The remaining occurred in Amazonas [17%], Rondônia (12%), Acre [2%], Tocantins (2%), and Roraima (0.5%)

Deforestation

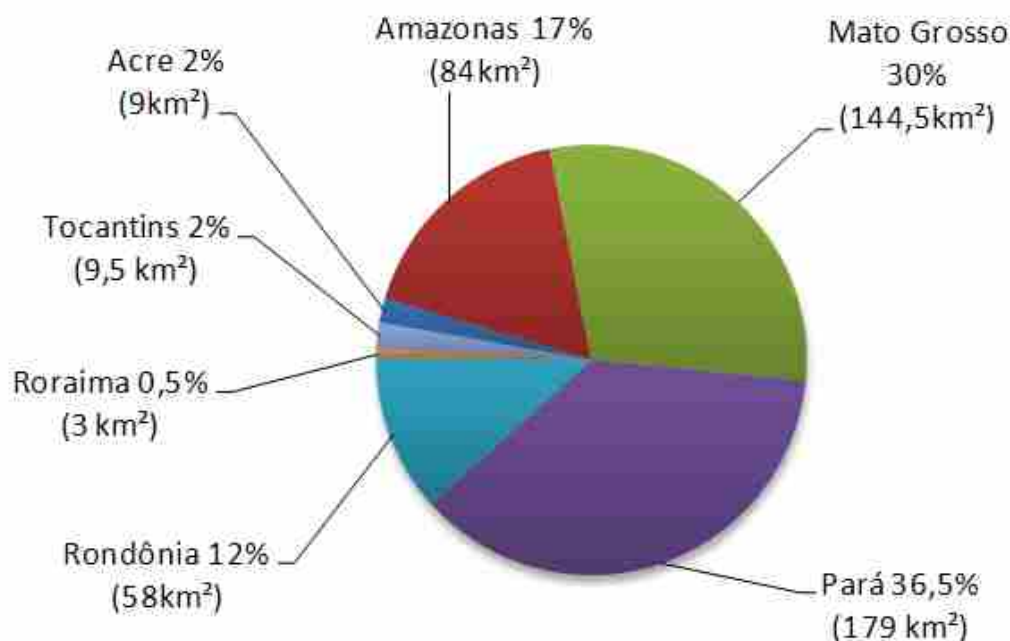


Figure 3: Percentage of deforestation in the states of Legal Amazon, in October 2012 (Source: Imazon/SAD)

Taking into account the three months of current deforestation calendar [August 2012 to October 2012], the State of Pará leads the ranking with 51% of the total deforested in the period. Then, Mato Grosso pops up with 22%, followed by Rondônia (13%), Amazonas (12%). Those four states are accountable for 97% of deforestation occurred in Legal Amazon during that period.

A 125% deforestation increase was observed from August 2012 to September 2012, compared to the former period [from August 2011 to October 2011) (Table 1). Relatively, a 73% reduction was

observed in the State of Roraima, and a 41% in the State of Acre. On the other hand, a 235% increase was observed in Amazonas, 167% in the State of Pará, 154% in Mato Grosso, 82% in Tocantins, and 27% in Rondônia.

In absolute terms, Pará leads the ranking of accumulated deforestation with 591 square KM, followed by Mato Grosso (249 square km), Rondônia (145 square km), Amazonas (134 square km), Tocantins (20 square km), Acre (10 square km), and Roraima (3 square km).

¹ The official calendar of deforestation measurements starts in August and ends in July

Table 1: Deforestation evolution across the states of Legal Amazon from August 2011 to October 2011, and from August 2012 to October 2012 [Source: Imazon/SAD]

State	August 2011 to October 2011	August 2012 to October 2012	Variation (%)
Pará	221	591	+167
Mato Grosso	98	249	+154
Rondônia	114	145	+27
Amazonas	40	134	+235
Roraima	11	3	-73
Acre	17	10	-41
Tocantins	11	20	+82
Amapá	-	-	nd
Total	512	1.152	+125

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

Forest Degradation

In October 2012 SAD recorded 266.5 square km of degraded forests [forests that are extremely exploited by wood activities and/or burnings] (Figures 2 and 4). Compared to the same period of the former year

(August 2011 to October 2011) a 42% reduction was observed, when forest degradation reached 456 square kilometers.

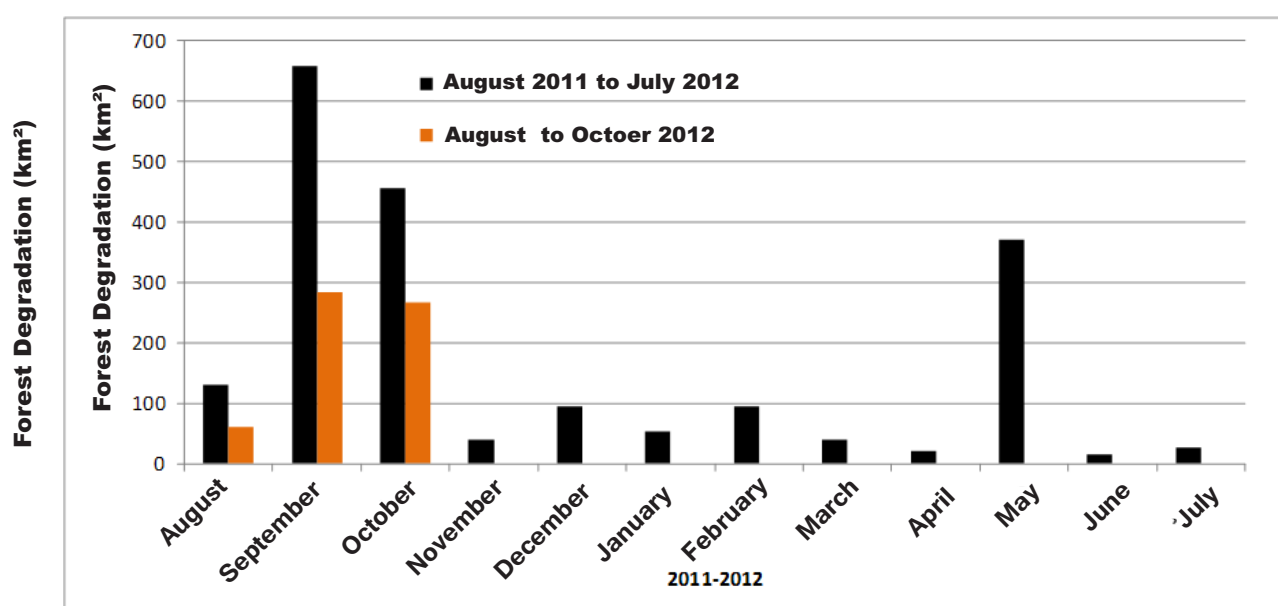


Figure 4: Forest degradation from August 2011 to October 2012 in Legal Amazon (Source: Imazon/SAD)

Forest degradation accumulated from August 2012 to October 2012² reached 611 square km, this represents a 51% reduction in forest degradation accumulated in that period [From August 2012 to October 2012], compared to the same former period [August 2011 to October 2011], when forest degradation summed 1,245 square km [Table 2].

The states that showed larger reductions were Acre (-100%), Mato Grosso (-71%), Amazonas (-69%), and Rondônia (-25%). The State of Pará

showed a 33% increase.

In absolute terms, Mato Grosso leads the ranking of accumulated forest degradation with 283 square km (46%), followed by the State of Pará (41%) - 162 square km); the remaining (13%) took place in the states of Rondônia (48.5 square km), Tocantins (25 square km), and Amazonas (4.7 square km).

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

State	August 2011 to October 2011	August 2012 to October 2012	Variation (%)
Mato Grosso	969	283	-71
Pará	188	250	+33
Rondônia	65	48	-25
Amazonas	15	5	-69
Roraima	6	-	-100
Acre	3	-	-100
Tocantins	-	25	-
Amapá	-	-	-
Total	1.245	611	-51

* Data from the state of Maranhão was not analyzed.

² The official calendar of deforestation measurements starts in August and ends in July

Carbon Affected by the Deforestation

In October 2012, the 487 square kilometers of deforestation detected by SAD in Legal Amazon endangered 7 million tons of carbon (with a margin of error of 451 thousand tons). This amount of endangered carbon may result in emissions of 26 million tons of equivalent CO₂ (Figure 6).

Deforestation-endangered forest carbon in the period from August 2012 to October 2012 was of

15 million tons (with a margin of error of 385 thousand tons), what represented about 57 million tons of equivalent CO₂ (Figure 6). Compared to the same period of the former year (August 2011 to October 2011), when endangered forest carbon was of 8.7 million ton, a 72% increase was observed in the quantity of carbon endangered by deforestation.

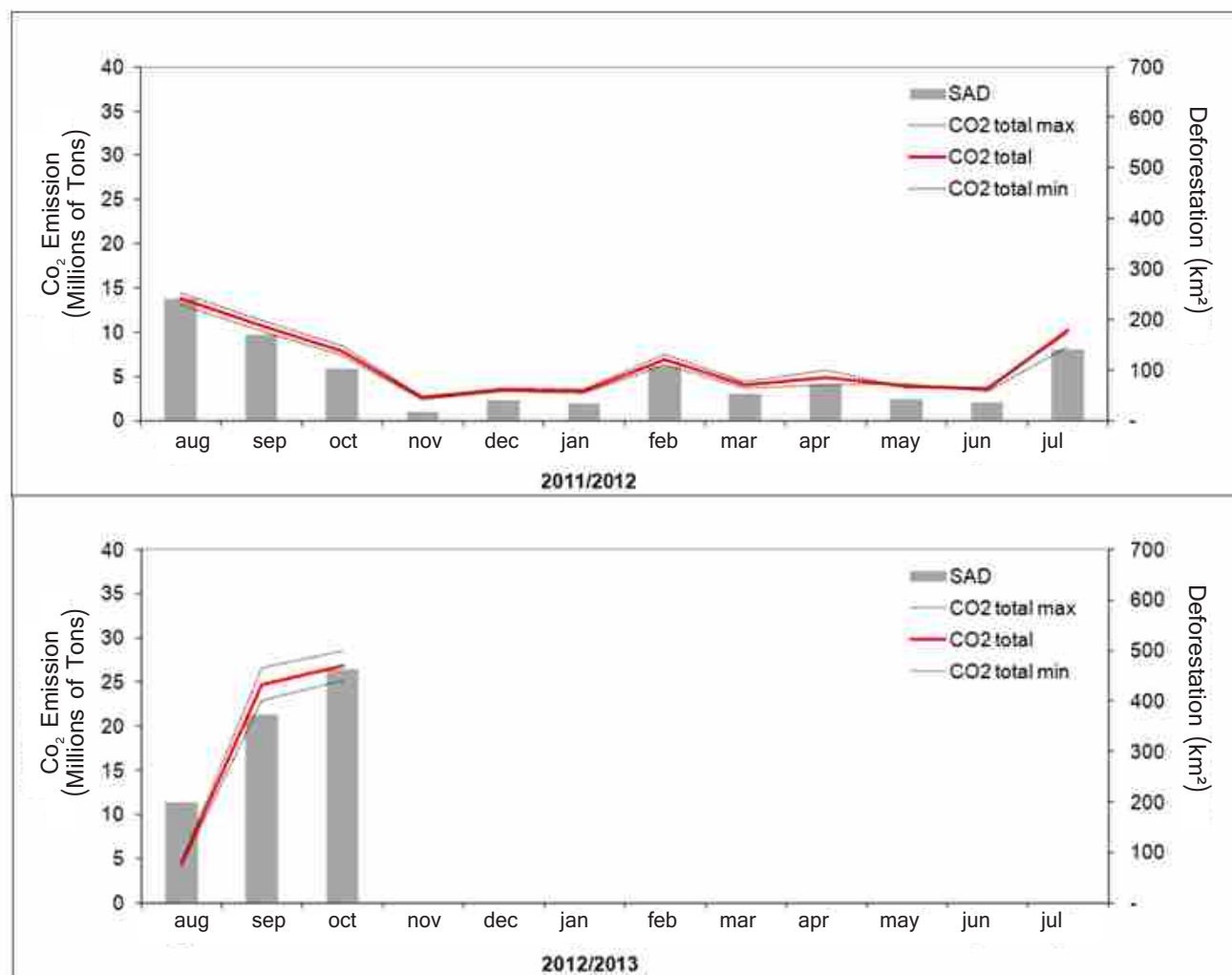


Figure 6: Deforestation and emissions of total equivalent carbon dioxide (CO₂) from August 2011 to October 2012, in Legal Amazon (Source: Imazon).

Deforestation Geography

In October 2012, most (62%) of deforestation took place either in private areas or under different stages of ownership. The remaining deforestation was

registered in Land Reform Settlements (23%) Conservation Units (12%), and Indigenous lands (3%) (Table 3).

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

Category	October 2012	
	km ²	%
Agrarian Reform Settlement	111	23
Conservation Units	58	12
Indigenous Lands	17	3
Private, Owned and in Abeyance ³	301	62
Total (km²)	487	100

Agrarian Reform Settlements

SAD has recorded 111 square kilometers of deforestation in Agrarian Reform Settlements in October 2012 (Figure 7). The ten settlements affected the most by deforestation were PA Rio Juma (Apuí, Amazonas), PA Nova Cotriguaçu (Cotriguaçu, Mato Grosso), PA Tibaji (Brasnorte, Mato Grosso), PA

Monte (Lábrea, Amazonas), PA Acari (Novo Aripuanã, Amazonas), PA Boa Esperança I and II (Nova Ubiratã, Mato Grosso), PDS Terra Nossa (Altamira, PA), PA Mutupi (Manicoré, Amazonas), PDS Cernambi (Machadinho do Oeste, Rondônia), and PDS Mãe Menininha (Altamira, Pará).

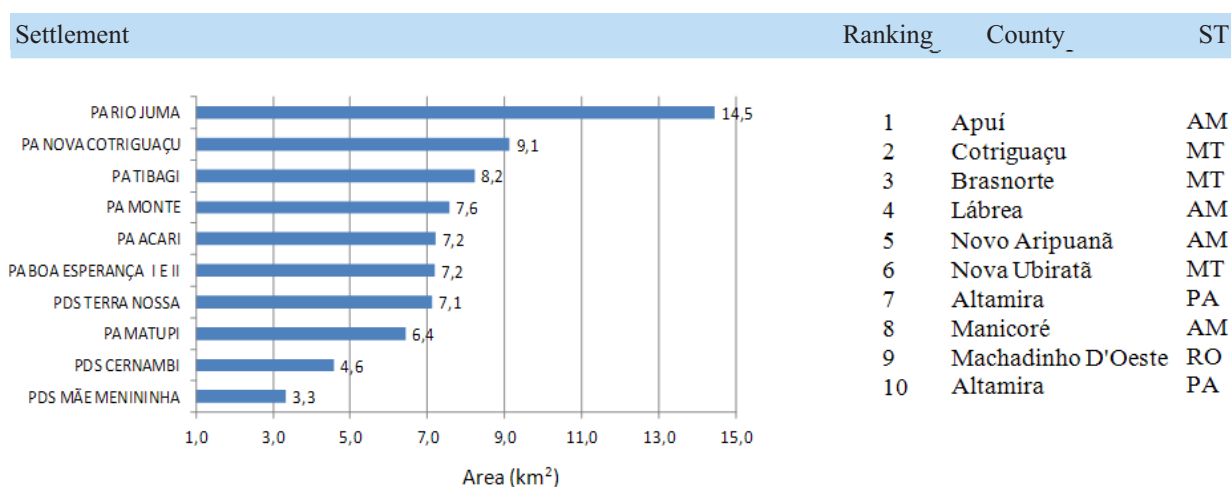


Figure 7: Land Reform Settlements deforested the most in October 2012 in Legal Amazon (Source: Imazon/SAD). PA (Settlement Project).

³ includes private areas (titled or not) and unprotected public forests.

Protected Areas

SAD has detected 58 square km of deforestation in Conservation Units in October (Figure 8)⁴. Conservation Units deforested the most were: APA Triunfo do Xingu (Pará), FLOREX Rio Preto-Jacundá (Rondônia), APA Rio Pardo (Rondônia), and FLONA do Jamanxim (Pará). FLONA do Bom Futuro (Rondônia), FLORSU Mutum (Rondônia), APA do Igarapé São Francisco (Acre), APA Rio Negro's left side (Amazonas), APA Caverna do Maroaga

(Amazonas), and APA Leandro (Bananal Island / Cantão) (Tocantins). As far as Indigenous Lands is concerned, in October 2012 a deforestation of 17 square km was identified in Apyterewa Lands (Pará), Poyanawa (Acre), Panará (Mato grosso), Kayabi (Pará), Gavião (Amazonas), Arara do Rio Branco (Mato Grosso), Tenharim Marmelos (Gleba B) (Amazonas), and Karitiana (Rondônia) (Figure 9).

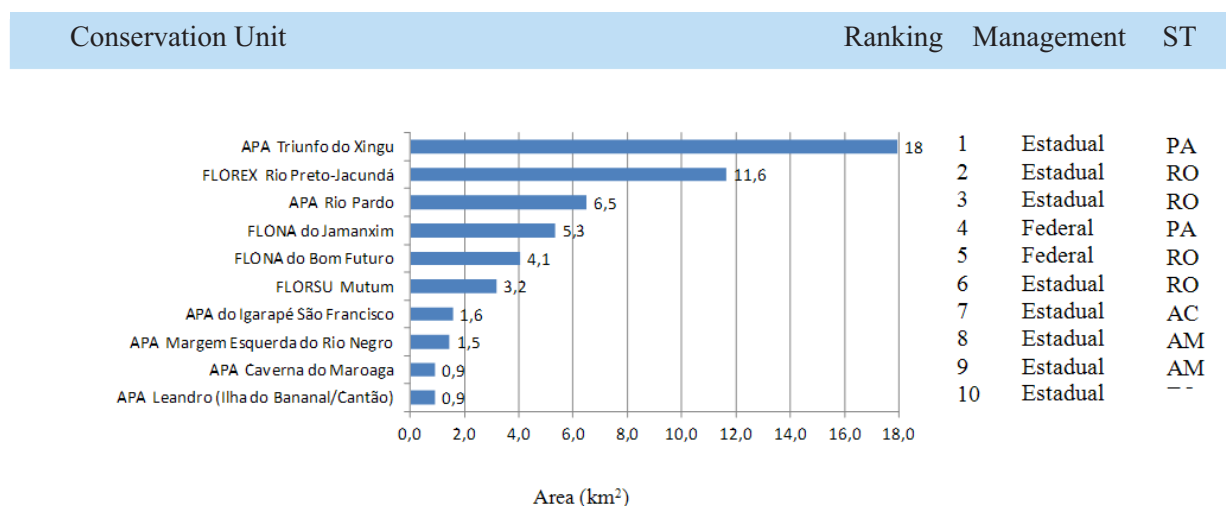


Figure 8: Conservation Unit deforested in Legal Amazon in October 2012 (Source: Imazon/SAD).

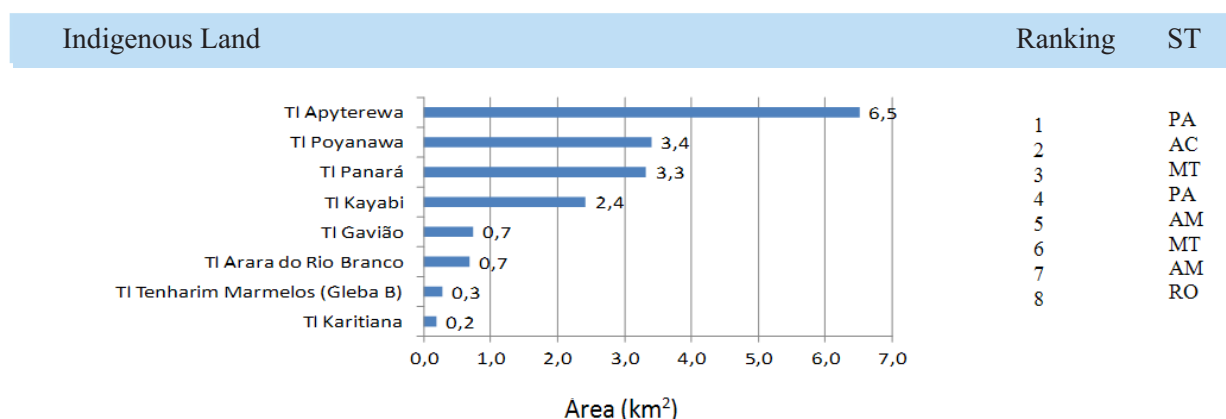


Figure 9: Deforested Indigenous lands in Legal Amazon in October 2012 (Source: Imazon/SAD).

⁴In the month of October we adopted the limit as defined by ICMBio for Flona de Altamira (<http://www.icmbio.gov.br/portal/biodiversidade/unidades-de-conservacao/biomas-brasileiros/amazonia/unidades-de-conservacao-amazonia/1923-flona-altamira.html>).

Critical Municipalities

In October 2012 the counties deforested the most were: Colniza (Mato

Grosso) and São Félix do Xingu (Pará) (Figures 10 and 11).

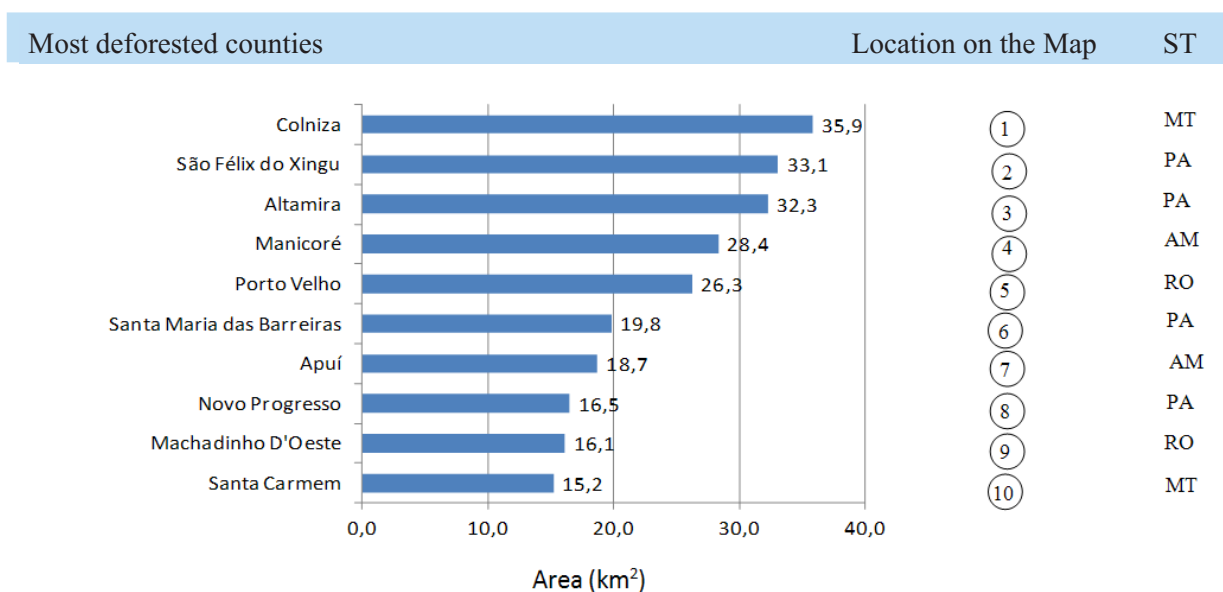


Figura 10. Municípios mais desmatados na Amazônia Legal em outubro de 2012 (Fonte: Imazon /SAD).

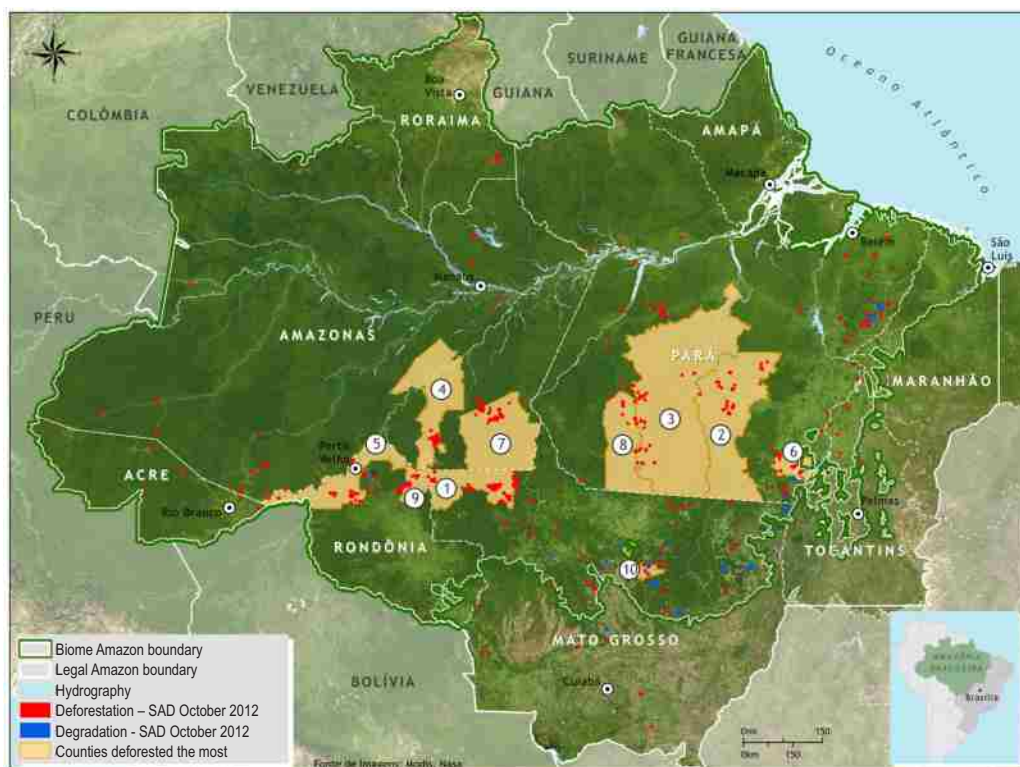


Figure 11: Counties deforested the most in October 2012 (Source: Imazon/SAD).

Coverage by clouds and Shade

In October 2012, it was possible to monitor, along with SAD, 83% of Legal Amazon forest area. The remaining 17% of forest territory were covered by clouds what hampered the detection of deforesting and forest degradation. The states with larger coverage

were: Amapá (50%), Pará (20%), Amazonas (17%), and Acre (17%). In virtue of that, data related to both deforestation and forest degradation in October 2012 may be underestimated (Figure 12).

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

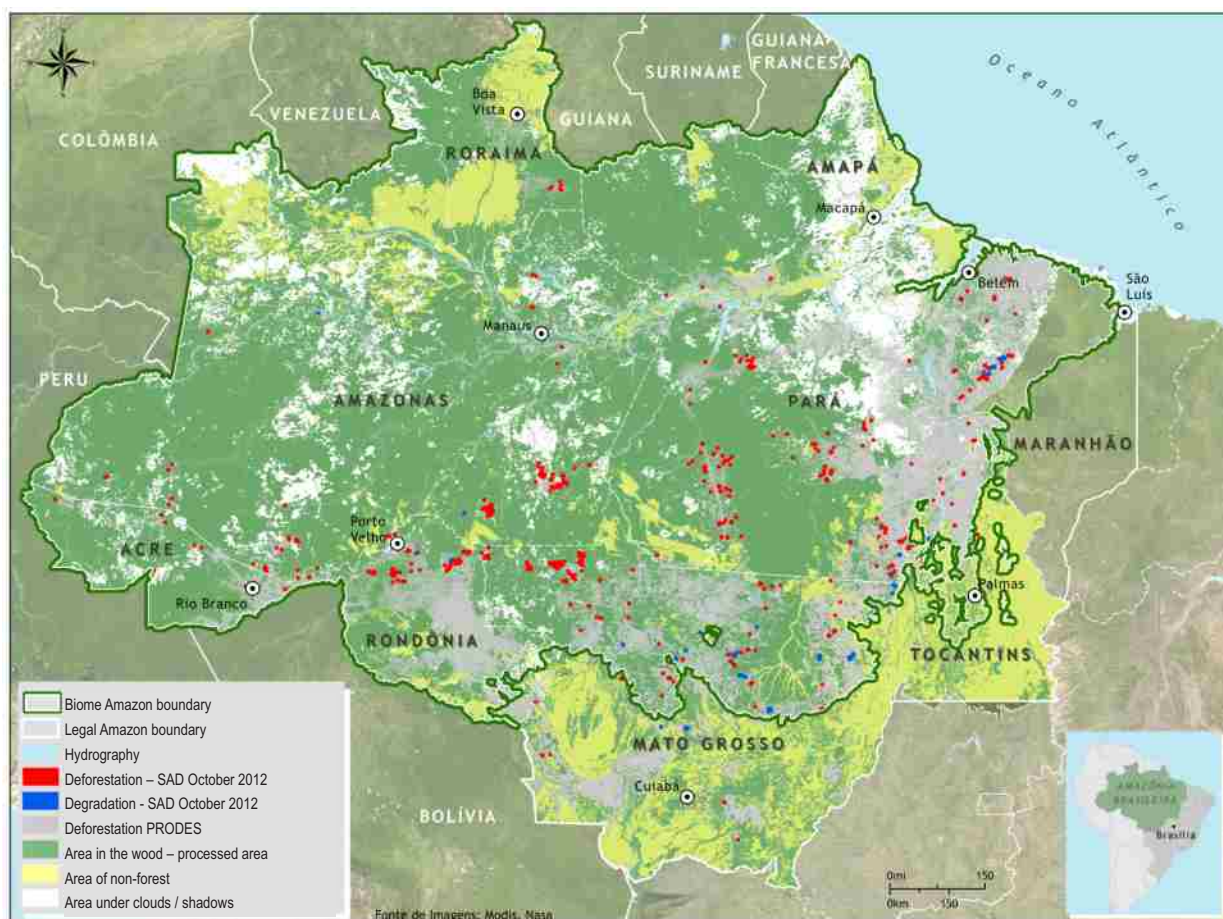


Figure 12: Area covered by clouds and shadows in October 2012 in Legal Amazon.

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 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 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.

S_D: Deforest area.

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

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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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:

The deforestation statistics are generated using data from the SAD (Imazon);
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<http://www.obt.inpe.br/prodes/>

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State Public Attorney's office of the Roraima
State Public Attorney's office of the Amapá
State Public Attorney's office of the Mato Grosso
Instituto Centro de Vida (ICV- Mato Grosso)