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SUMMARY

In September 2012, SAD has detected 431 square km of deforestation in the Legal Amazon. This represented a 154% increase compared to September 2011. Out of this total, most (68%) took place in Pará, followed by Mato Grosso (14%), Rondônia (12%), Amazonas (3%), and Tocantins (2%). Among the counties, deforestation was more concentrated in Altamira (PA) and Cumaru do Norte (PA).

Accumulated deforestation from August to September 2012, corresponding to the two first months of current deforestation calendar summed 663 square meters. Compared to the previous year [August to September 2011], when deforestation summed 410 square meters, a 62% increase was observed.

Degraded forests in Legal Amazon summed 283 square km in September 2012. Compared to September 2011, a reduction of 57% was

observed, when forest degradation summed 658 square kilometers; forest degradation was mainly observed in Pará (45%) and Amazonas and Rondônia.

Accumulated forest degradation from August 2012 to September 2012 summed 343 square meters. Compared to the former period - August 2011 to September 2011, when forest degradation summed 789 square km, a 57% reduction was noticed.

In September 2012, deforestation detected by SAD involved 6.7 million tons of carbon [with error margin of 505 tons], what corresponds to 24.7 million tons of equivalent CO₂.

In September 2012, cloud covering was significantly reduced what allowed to monitor up to 80% of the Legal Amazon.

Deforestation Statistics

According to Imazon's Deforestation Alert System [SAD], deforestation (forest total suppression with soil exposure) has reached 431 square km in Legal Amazon in September 2012 (Figure 1 and Figure 2).

This represented a 154% increase compared to the deforestation detected in September 2011, when deforestation reached 170 square km.

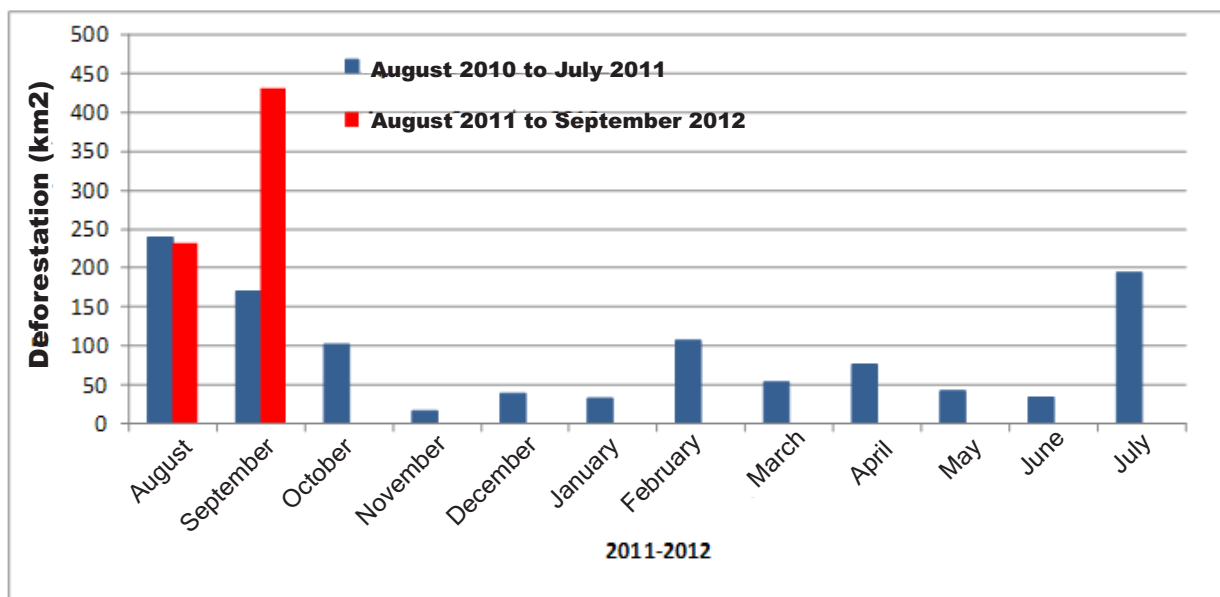


Figure 1: Deforestation from August 2011 to August 2012 in Legal Amazon (Source: Imazon/SAD)

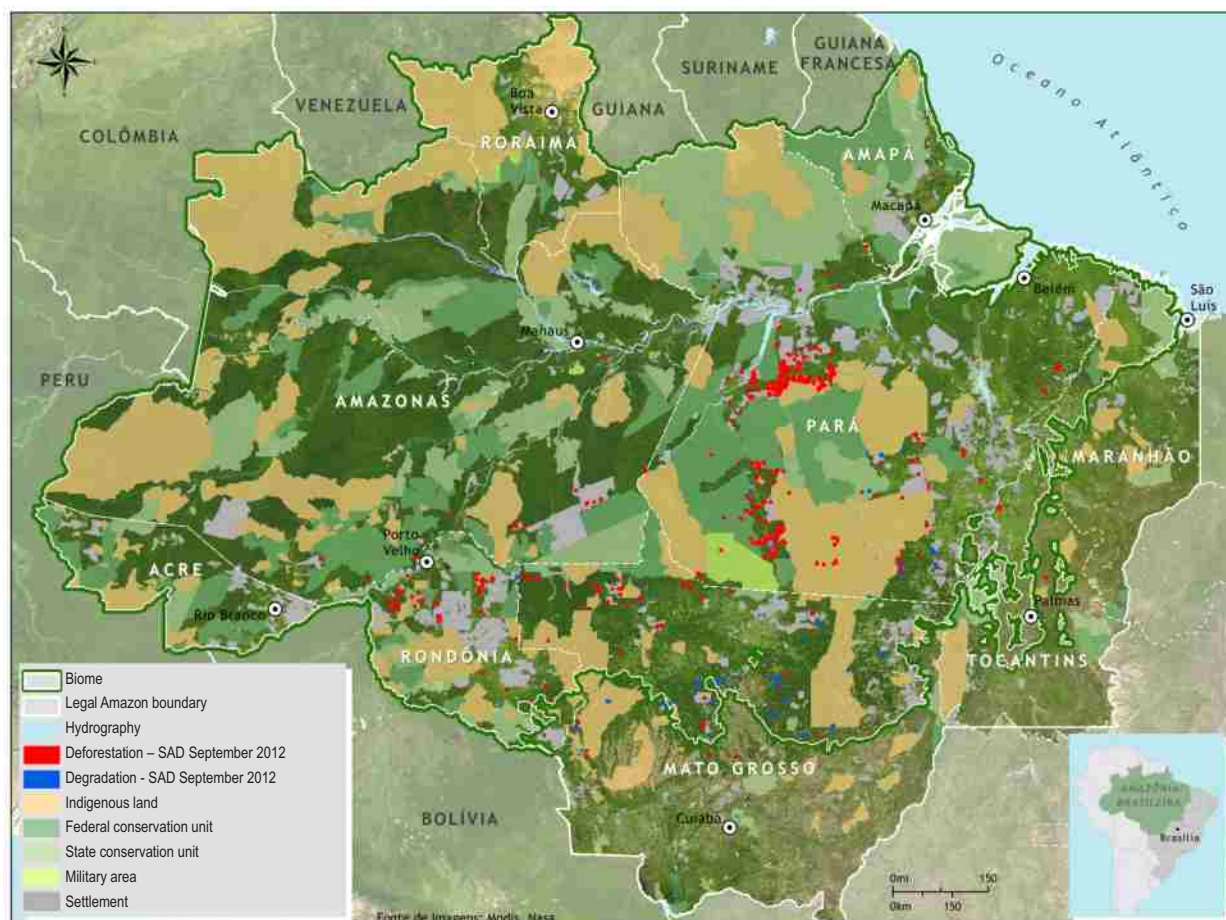


Figure 2: Deforestation and Forest Degradation in September 2012 in Legal Amazon (Source: Imazon/SAD).

Accumulated deforestation in the period from August 2011 to September 2012¹, corresponding to the two first months of the official calendar of deforestation measurement, reached 663 square kilometers. A 62% increase of deforestation was observed, compared to the former period [from August 2011 to September

2011], when it reached 410 square kilometers.

In September 2012 the State of Pará led the deforestation reaching a 68% level, followed by Mato Grosso (15%), Rondônia (12%), Amazonas (3%), and Tocantins (2%) (Figure 3).

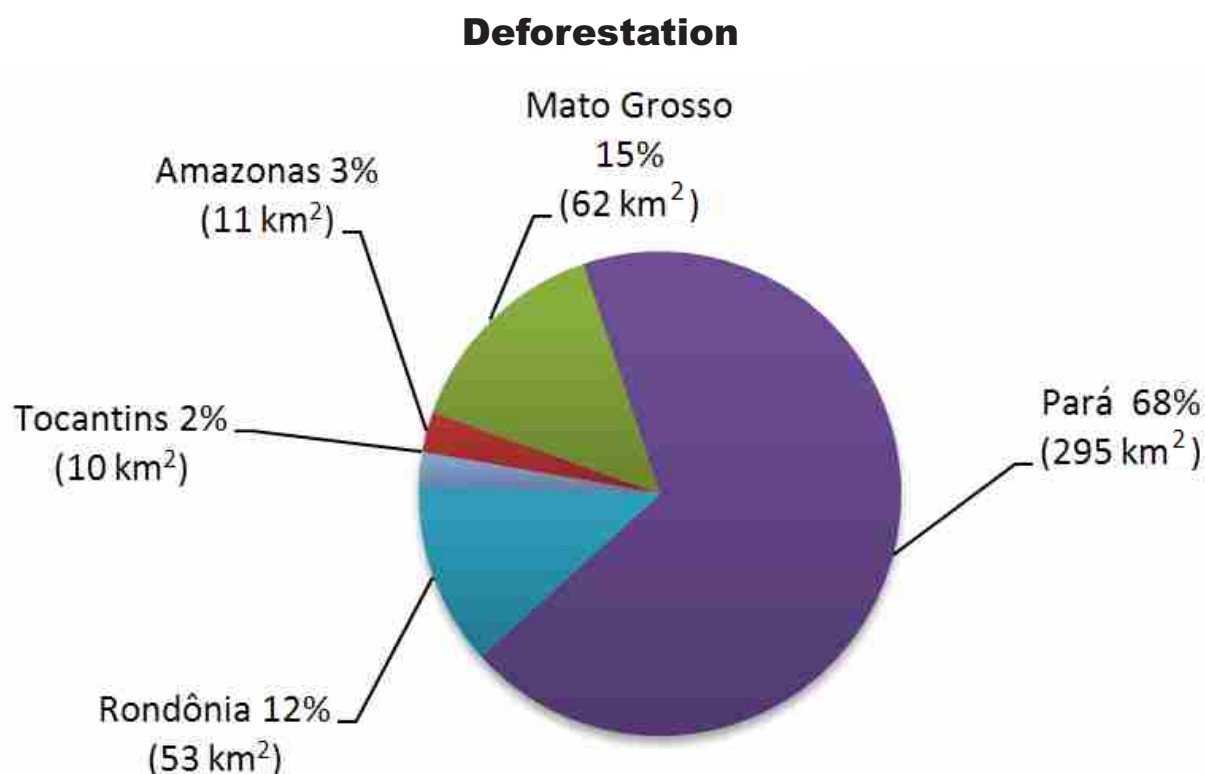


Figure 3: Percentage of deforestation in the states of Legal Amazon, in September 2012 (Source: Imazon/SAD)

Taking into account the first two months of current deforestation calendar [August 2012 to September 2012], Pará leads the ranking with 62% of the total deforested in the period. Then, Mato Grosso pops up with 15%, followed by Rondônia (13%), Amazonas (7%), and eventually Tocantins (1%). Those four states are accountable for 100% of deforestation occurred in Legal Amazon during that period.

A 62% deforestation increase was observed from August 2012 to September 2012, compared to the former period [from August 2011 to September 2011)

(Table 1). Relatively, a 568% increase was observed in Tocantins, 109% in Pará, 62% in Mato Grosso, and 30% in Amazonas. On the other hand, a 100% reduction was observed in Roraima and 92% in Acre.

In absolute terms, Pará leads the ranking of accumulated deforestation with 411 square KM, followed by Mato Grosso (105 square km), Rondônia (87 square km), Amazonas (49 square km), Tocantins (10 square km), and Acre (1 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 September 2011 [Source: Imazon/SAD]

State	August 2010 to September 2011	August 2011 to September 2012	Variation (%)
Acre	14	1	-92
Amazonas	38	49	+30
Mato Grosso	64	105	+62
Pará	196	411	+109
Rondônia	87	87	0
Roraima	87	0	-100
Tocantins	1	10	+568
Amapá	-	-	-
Total	410	663	+62

* Data from the State of Maranhão has not been analyzed

Forest Degradation

In September 2012 SAD recorded 283 square km of degraded forests [forests that are extremely exploited by wood activities and/or burnings] (Figures 2 and

4). Out of that total, most (52%) took place in the state of Pará (45%), Rondônia (2%), and Amazonas (1%).

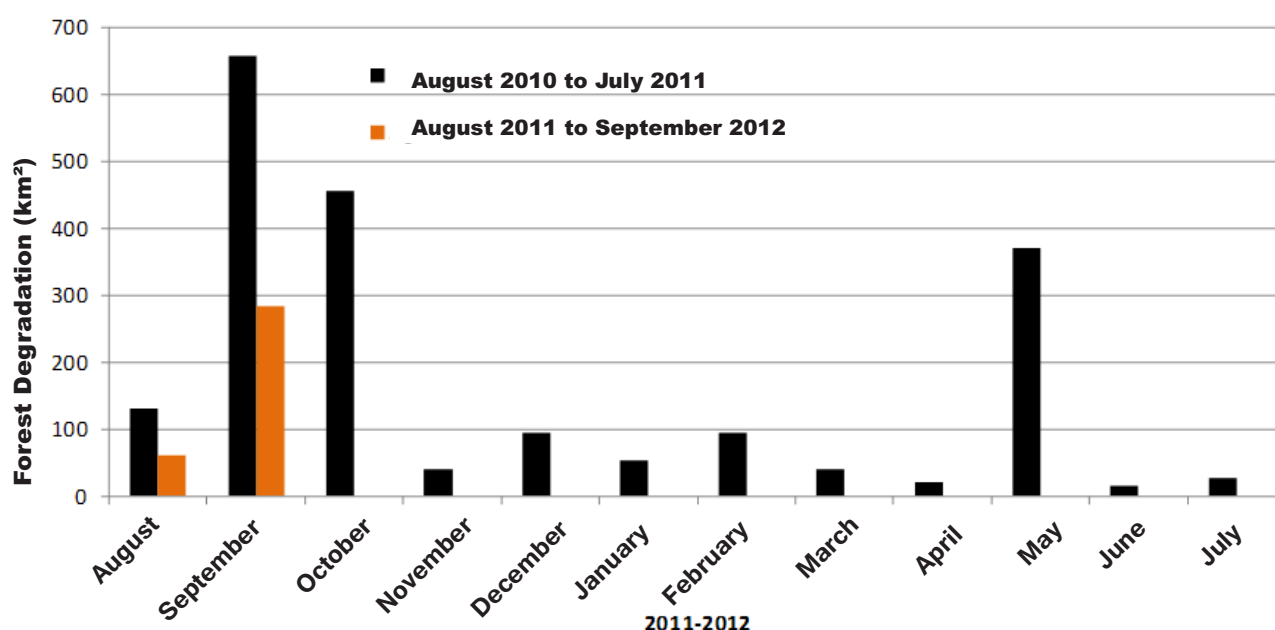


Figure 4: Forest degradation from August 2011 to September 2012 in Legal Amazon (Source: Imazon/SAD)

Forest degradation accumulated from August 2012 to September 2012² [two first months of the official calendar of deforestation measurement] reached 343 square km. this represents a 57% reduction in forest degradation accumulated in that period [From August 2012 to September 2012], compared to the same former period [August 2011 to September 2011], when forest degradation summed 789 square km [Table 2].

The state of Acre presented a 100% reduction in forest degradation from August 2012 to September 2012, compared to the period from August 2011 to September 2012. In Rondônia and Amazonas the reduction was of 75%, followed by Mato Grosso with

a 72% reduction.

Mato Grosso leads the forest degradation with 49% of the total in the period from August 2012 to September 2012. Then, Pará pops up with 47%.

Those two states were accountable for 96% of the forest degradation in Legal Amazon during the period under assessment. The remaining (4%) occurred in Rondônia and Amazonas.

In absolute terms, Mato Grosso also leads the ranking of accumulated forest degradation with 167 square km, followed by Pará (162 square km), Rondônia (10 square km), and Amazonas (4 square km).

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

State	August 2010 to September 2011	August 2011 to September 2012	Variation (%)
Acre	3	-	-100
Amazonas	15	4	-73
Mato Grosso	599	167	-72
Pará	127	162	28
Rondônia	40	10	-75
Roraima	6	-	100
Tocantins	-	-	-
Amapá	-	-	-
Total	790	343	-57

* 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 September 2012, the 431 square kilometers of deforestation detected by SAD in Legal Amazon endangered 6.7 million tons of carbon (with a margin of error of 505 thousand tons). This amount of endangered carbon results in emissions of 24.7 million tons of equivalent CO₂ (Figure 6).

Deforestation-endangered forest carbon in the period of August 2012 to September 2012 (two

first months of current deforestation calendar) was of 7.9 million tons (with a margin of error of 273 thousand tons), what represented about 30 million tons of equivalent CO₂ (Figure 6). Compared to the same period of the former year (August 2011 to September 2011) a 25% increase was observed in the quantity of carbon endangered by deforestation.

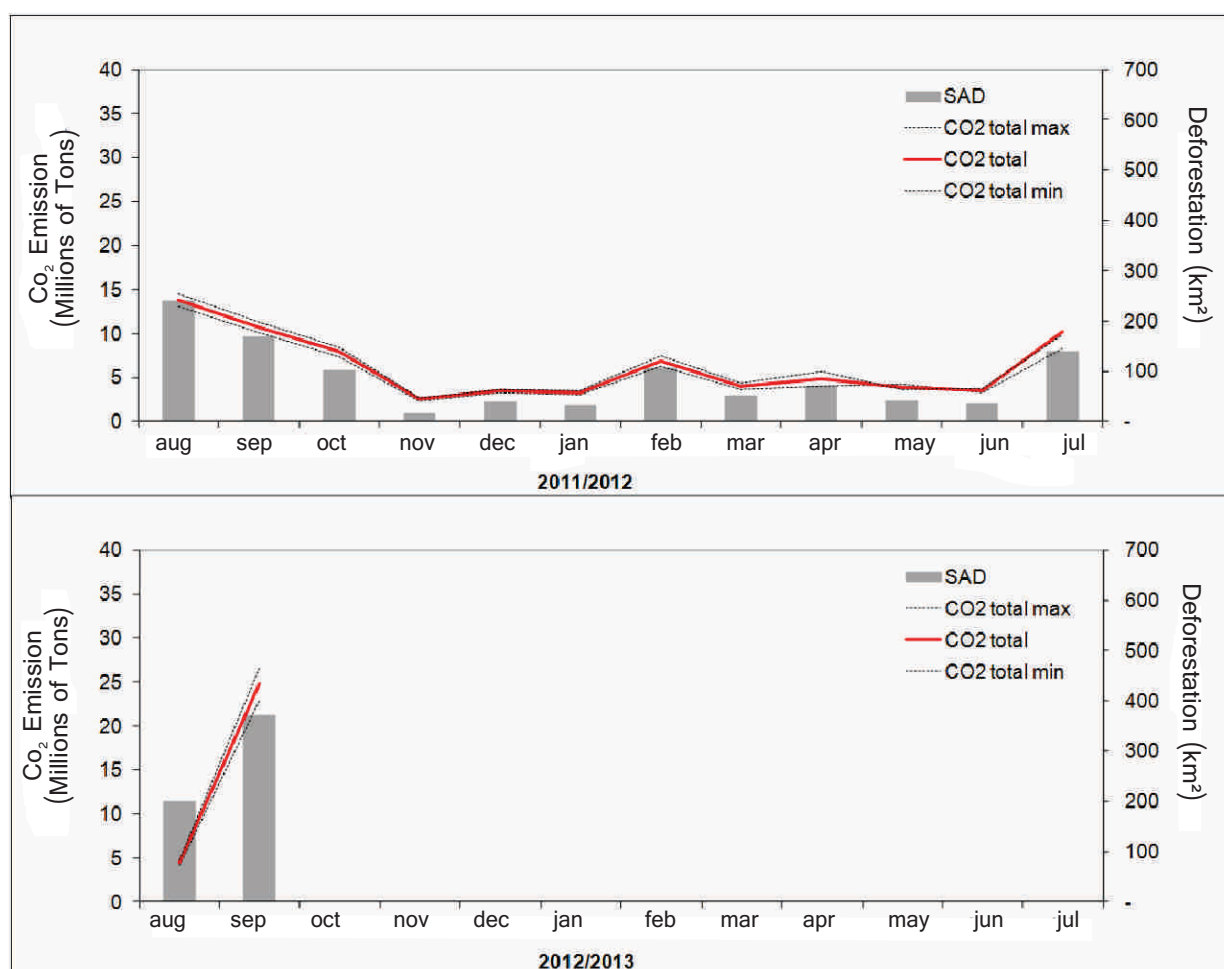


Figure 6: Deforestation and emissions of total equivalent carbon dioxide (CO₂) from August 2011 to September 2012, in Legal Amazon (Source: Imazon).

Deforestation Geography

As far as the land situation is concerned, in September 2012, most (68%) of deforestation took place either in private areas or under different stages of

ownership. The remaining deforestation was registered in Land Reform Settlements (15%) Conservation Units (11%), and Indigenous lands (6%) (Table 3).

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

Category	September 2012	
	km ²	%
Agrarian Reform Settlement	65	15
Conservation Units	50	11
Indigenous Lands	23	6
Private, Owned and in Abeyance ³	293	68
Total (km²)	431	100

Agrarian Reform Settlements

SAD has recorded 23 square kilometers of deforestation in Agrarian Reform Settlements in September 2012. The settlements affected the most by

deforestation were Mãe Maninha (Altamira, Pará), Vida Nova II (Peixoto Azevedo, Mato Grosso), and Esperança (Altamira, Pará) (Figure 7).

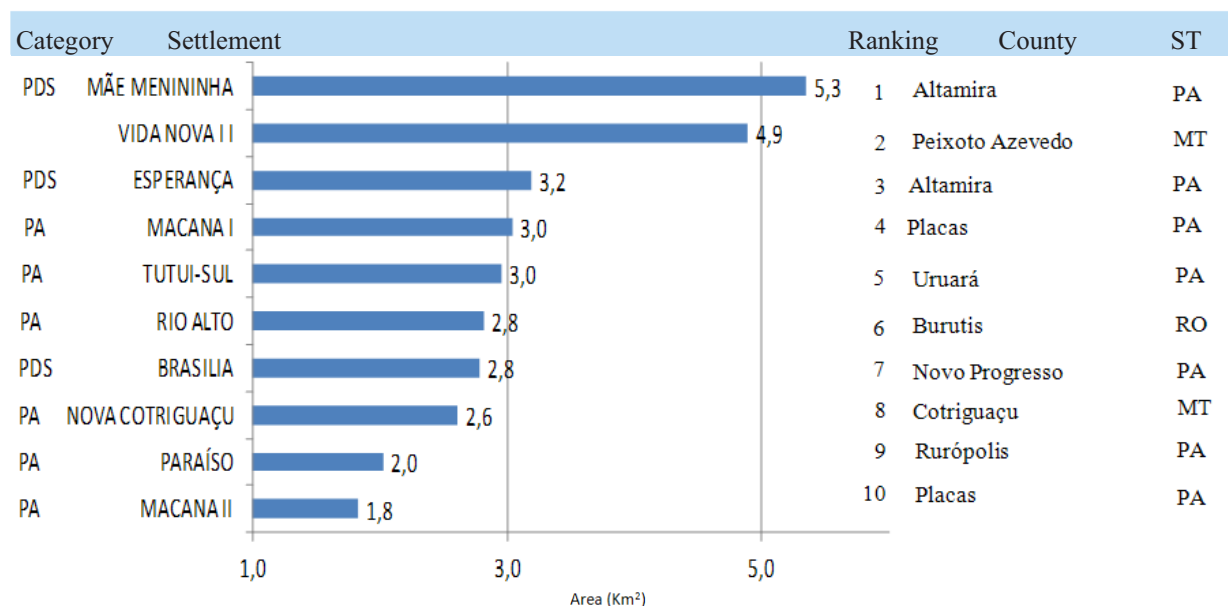


Figura 7. Assentamentos de Reforma Agrária mais desmatados em setembro de 2012 na Amazônia Legal (Fonte: Imazon/SAD).

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

Protected Areas

SAD has detected 50 square km of deforestation in Conservation Units (Figure 8). Deforested Conservation Units were: Flona de Altamira (Pará), Flona do Jamanxim (Pará), and Florsu Mutum (Rondônia). As far as Indigenous Lands is concerned, a

deforestation of less than 23 square km was identified.

Deforested indigenous lands were Cachoeira Seca do Iriri (Pará), Kayapó (Pará) and Menkragnoti (Pará) (Figure 9).

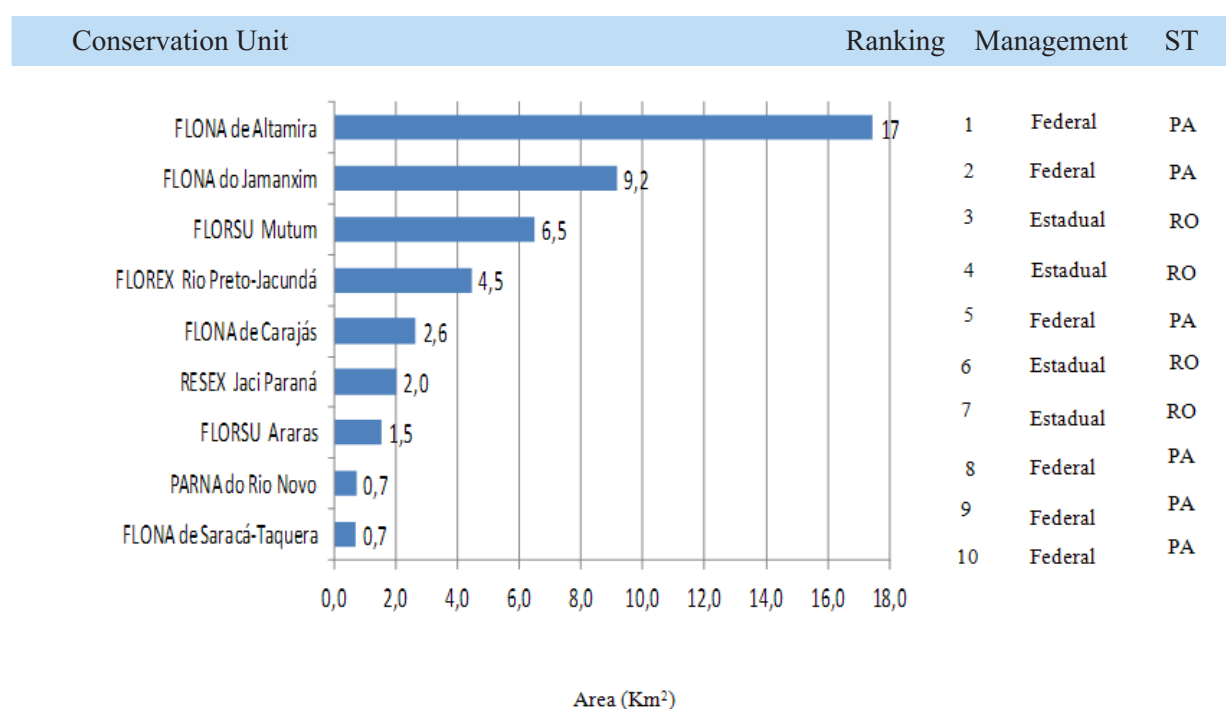


Figure 8: Conservation Unit deforested in Legal Amazon in September 2012 (Source: Imazon/SAD).

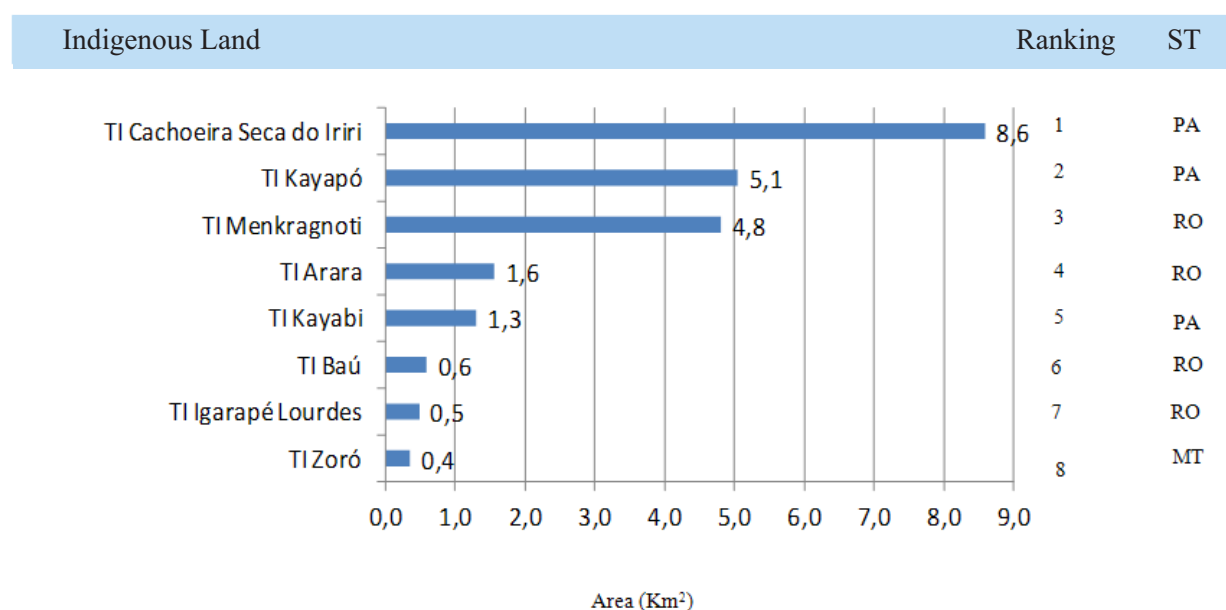


Figure 9: Deforested Indigenous lands in Legal Amazon in September 2012 (Source: Imazon/SAD).

Critical Municipalities

In September 2012 the counties deforested the most were: Altamira (PA);

Cumaru do Norte (Pará), and Placas (Pará) (Figures 10 and 11).

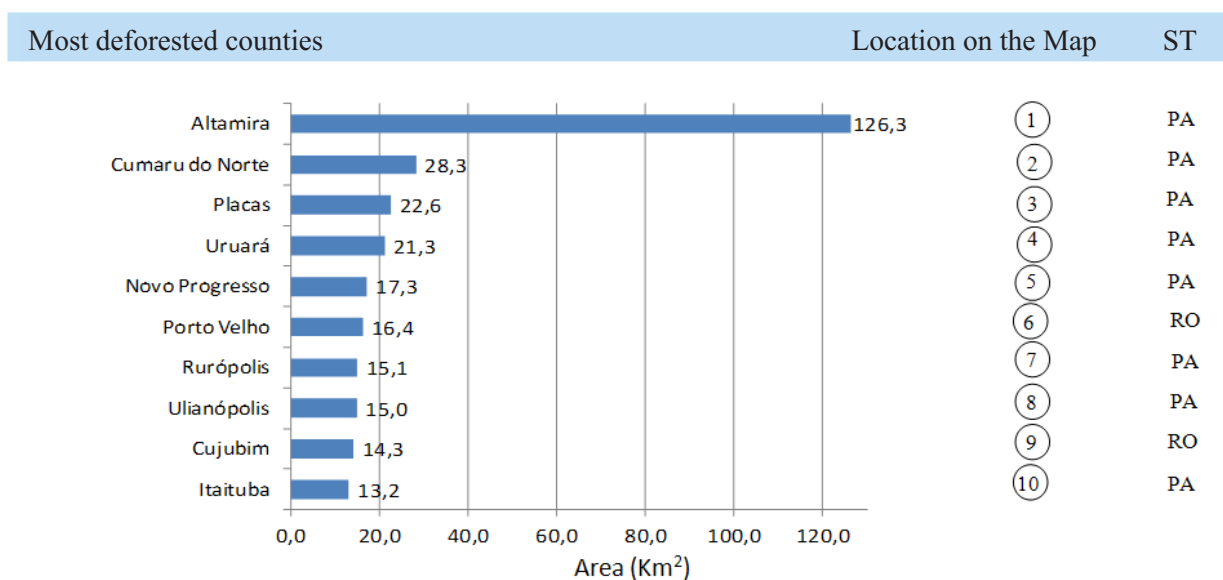


Figure 10: Counties deforested the most in Legal Amazon in September 2012 (Source: Imazon/SAD).

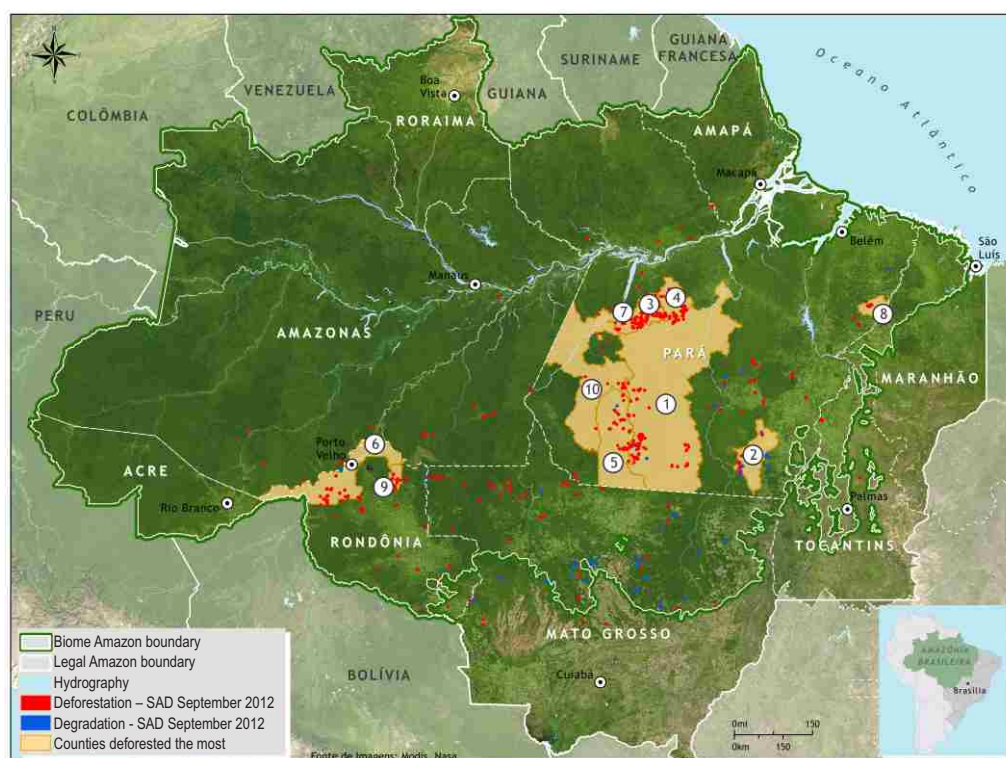


Figure 11: Counties with the largest deforested areas in September 2012 (Source: Imazon/SAD).

Coverage by clouds and Shade

In September 2012, it was possible to monitor, along with SAD, 80% of Legal Amazon forest area. The remaining 20% of forest territory

were covered by clouds what hampered the monitoring, mainly in Amapá, where 39% of the forest area were covered by clouds (Figure 12).

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

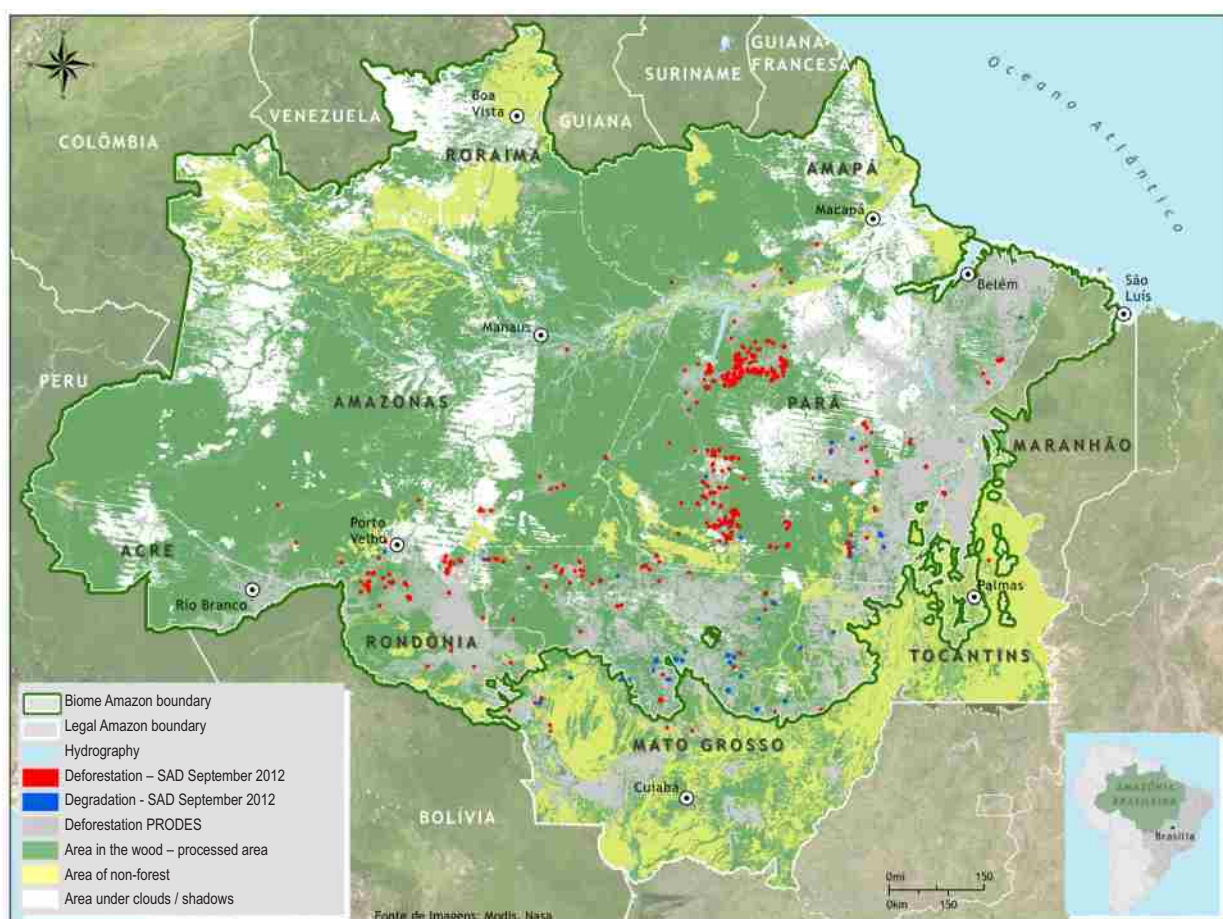


Figure 12: Area covered by clouds and shadows in September 2012 in Legal Amazon.

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:

- D.C. Morton¹, M.H. Sales², C.M. Souza, Jr.², B. Griscom³. Baseline Carbon Emissions from Deforestation and Forest Degradation: A REDD case study in Mato Grosso, Brazil – undergoing preparation.
- 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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<http://earthengine.google.org/>

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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

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