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SUMMARY

In May 2012, the Sistema de Alerta de Desmatamento (SAD - Deforestation Alert System) has detected 42,5 square km of deforestation in the Legal Amazon. This represented a decrease of 74% compared to May 2011 when deforestation totaled 165 square km. Due to the cloud cover, it was possible to monitor only 46% of the territory, a value almost equal to May 2011 (47%).

The accumulated deforestation from August 2011 to May 2012 totaled 873 square km. There was a reduction of 39% over the previous period (August 2010 to May 2011) when deforestation totaled 1,435 square kilometers.

In May 2012, half of the deforestation occurred in Pará. Then appears Mato Grosso with 26% and Rondônia with 9%. The remainder (15%) occurred in the Amazon, Tocantins and Acre.

The degraded forests in the Amazon

amounted to only 370,5 square kilometers in May 2012. Compared to May 2011, when forest degradation totaled 249 square km, there was a reduction of 50%. Almost all (98%) of this degradation occurred in Mato Grosso.

The forest degradation accumulated in the period (August 2011 to May 2012) reached 1,960 square kilometers. In the previous period (August 2010 to May 2011), when degradation amounted to 6,081 square kilometers, a reduction of 68%.

In May 2012, the deforestation detected by SAD endangered 1.06 million tons of CO₂ equivalent. In the accumulated of the period (August 2011 – May 2012) the equivalent CO₂ emissions endangered with deforestation totaled 60.2 million tons, representing a reduction of 28% over the previous period (August 2010 to May 2011).

Deforestation Statistics

According to SAD, deforestation (total suppression of forest to other alternative land uses) reached 42,5 square kilometers in May 2012 (Figure 1

and Figure 2). This represented a decrease of 74% compared to May 2011 when deforestation totaled 165 square km.

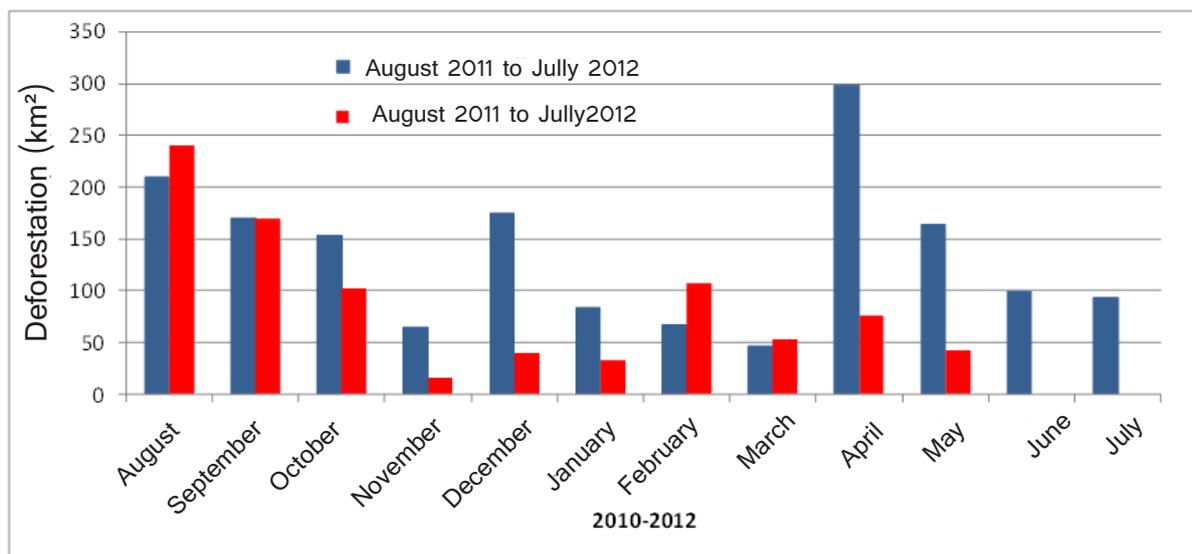


Figura 1. Desmatamento de agosto de 2010 a maio de 2012 na Amazônia Legal (Fonte: Imazon/SAD).

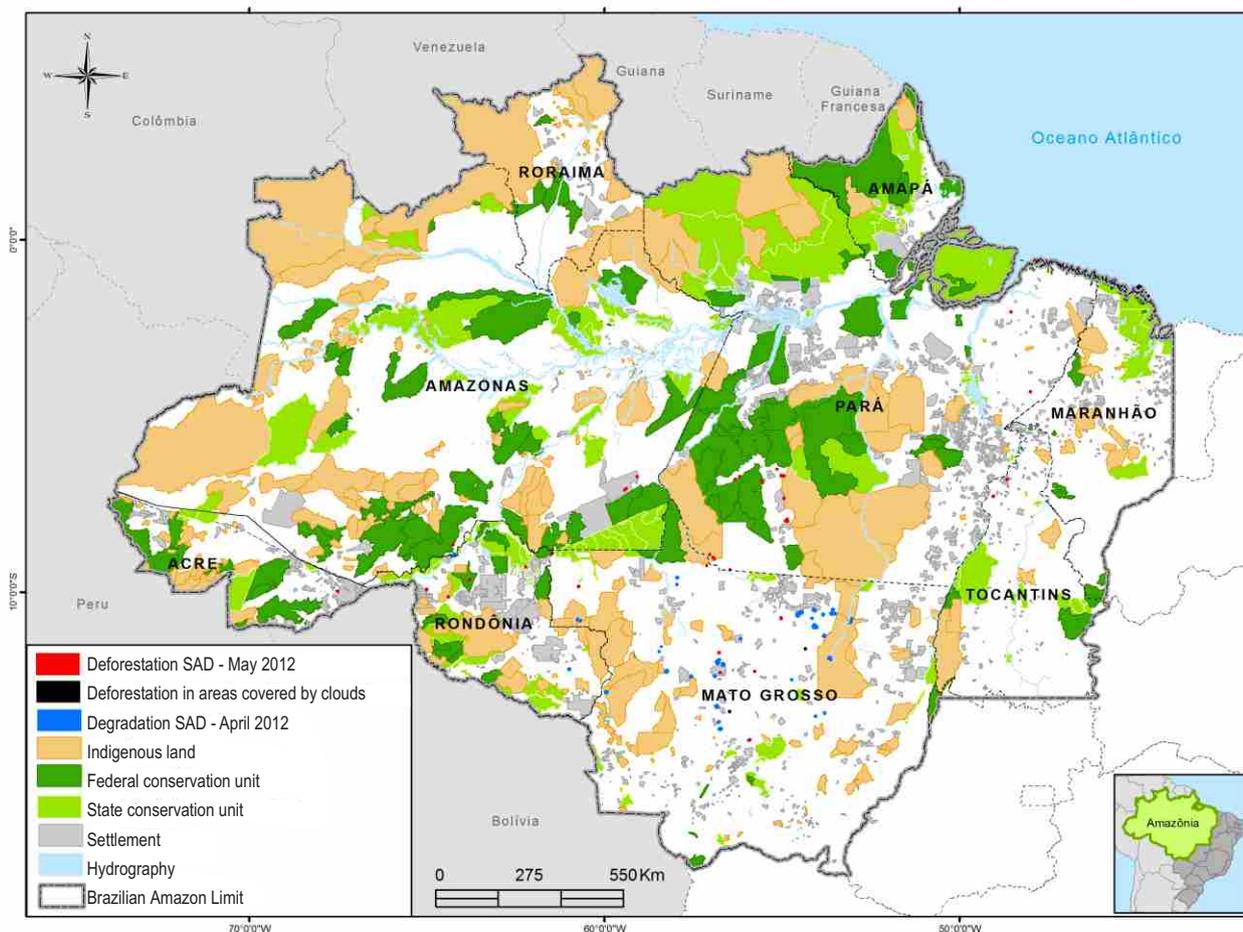


Figure 2. Deforestation and degradation from August 2010 to May 2012 in the Legal Amazon (Source: Imazon/SAD).

¹The deforestation in areas covered by clouds may have occurred in May 2012 or previous months, but it was only possible to detect it now when there were less clouds in the specifically observed area.

The accumulated deforestation from August 2011 to May 2012, corresponding to ten months of the official calendar of measuring deforestation, reached 873 square km.

There was a 39% reduction in deforestation over the previous period (August 2010 to May 2011)

when it reached 1,435 square kilometers.

In May 2012, half of the deforestation occurred in Pará, followed by Mato Grosso (26%), Rondônia (9%), Amazonas (7%), Tocantins (6%) and Acre (2%) (Figure 3).

Deforestation

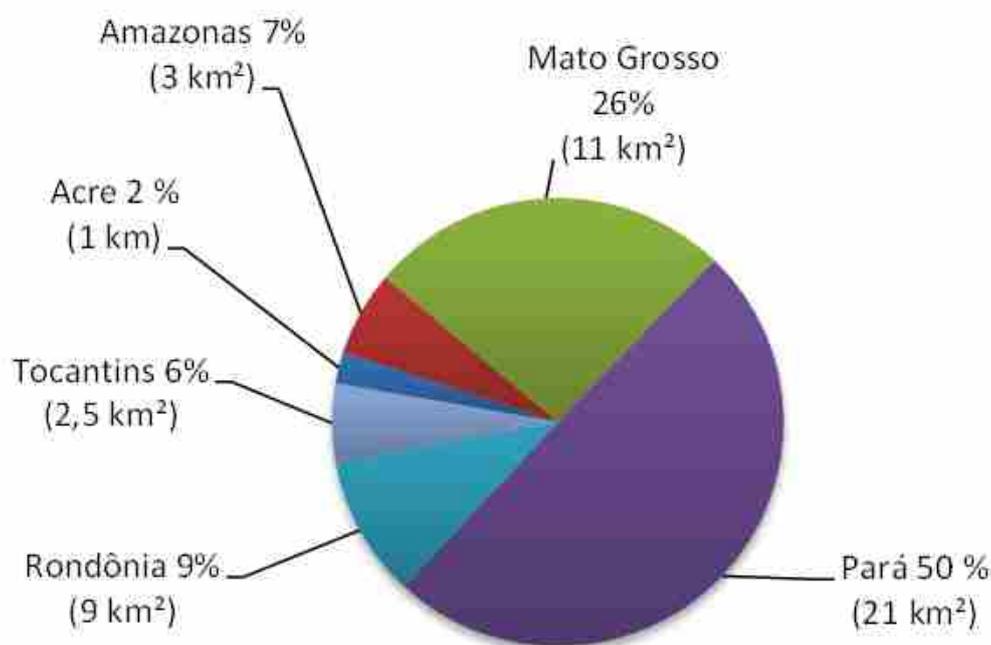


Figure 3. Percentage of deforestation in the Amazon in May 2012 (Source: Imazon/SAD).

Considering the accumulated deforestation in the ten months of the current calendar of deforestation (August 2011 to May 2012), Mato Grosso and Pará lead the ranking with 33% each of total deforestation. Then appears Rondônia with 19% and Amazonas with 8%. These four states accounted for 93% of Amazon deforestation occurred in that period.

There was a 39% reduction in deforestation occurred from August 2011 to May 2012 compared with the previous period (August 2010 to May 2011) (Table 1). In relative terms, occurred a reduction of

64% in Acre, 54% in Amazonas, 48% in Mato Grosso, 47% in Rondônia and 15% in Pará. On the other hand, there was an increase of 194% in Roraima and 61% in Tocantins.

In absolute terms, Mato Grosso leads the ranking of accumulated deforestation with 292 square kilometers, followed by Pará (288 square kilometers), Rondônia (165 square kilometers), Amazonas (71 square kilometers), Roraima (23 square kilometers), Acre (20 square kilometers) and Tocantins (14 square kilometers).

² 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 May 2011 and August 2011 to May 2012 (Source: Imazon/SAD).

State	August 2010 to May 2011	August 2011 to May 2012	Variation (%)
Mato Grosso	558	292	-48
Pará	339	288	-15
Rondônia	312	165	-47
Amazonas	155	71	-54
Roraima	8	23	+194
Acre	55	20	-64
Tocantins	9	14	+61
Amapá	-	-	-
Total	1.435	873	-39

* Data from Maranhão were not analyzed.

Forest Degradation

In May 2012, the SAD recorded 370,5 square kilometers of degraded forest (heavily exploited forests by logging activities and/or burned) (Figures 2 and 4). Over the same period last year (May 2011)

there was an increase of 49% when forest degradation reached 249 square kilometers. 98% of the areas of degradation in May occurred in Mato Grosso.

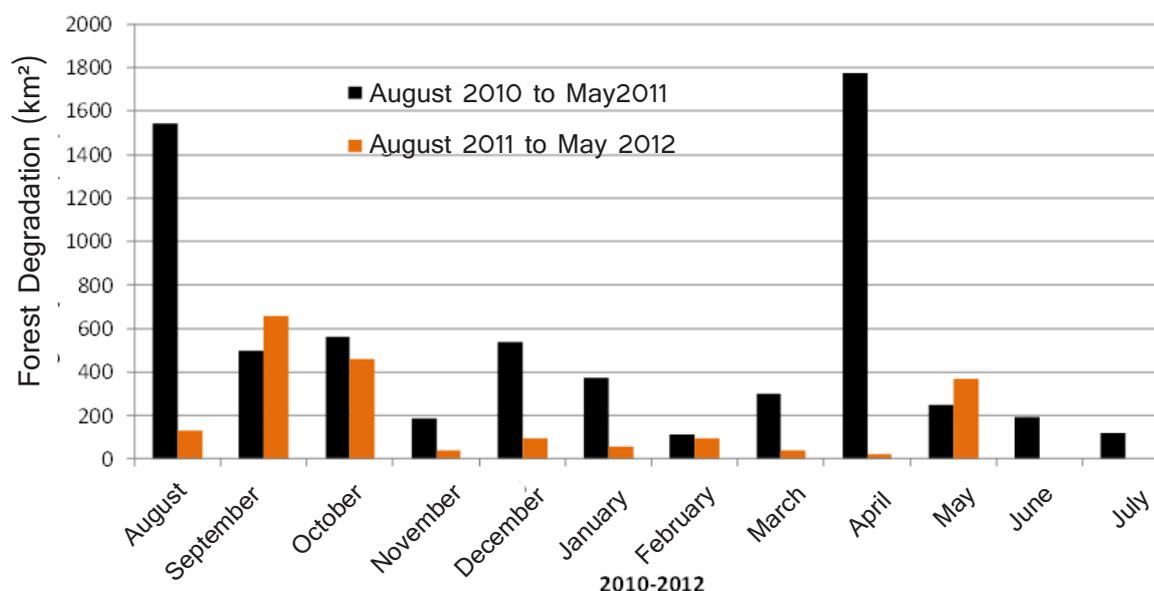


Figure 4. Forest degradation from August 2010 to May 2012 in the Legal Amazon (Source: Imazon/SAD).

The forest degradation accumulated in the period from August 2011 to May 2012 reached 1,960 square kilometers. This represents a 68% reduction in forest degradation accumulated during this period (August 2011 to May 2012) over same period last year (August 2010 to May 2011) when the forest degradation amounted to 6,081 kilometers square (Table 2). The largest reductions were in Acre (-98%), Rondônia (-90%), Amazonas (-82%), Mato Grosso (-

77%) and Pará (-57%).

In absolute terms, the Mato Grosso leads the ranking of forest degradation, with an accumulated total of 1,580 square kilometers (81%), distantly followed by Pará with 235 square kilometers (12%). The remainder (7%) occurred in Rondônia (97 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 May 2011 and August 2011 to May 2012 (Source: Imazon/SAD).

State	August 2010 to May 2011	August 2011 to May 2012	Variation (%)
Mato Grosso	3.695	1.580	-57
Pará	1.021	235	-77
Rondônia	1.021	97	-90
Amazonas	166	29	-82
Roraima	2	15	+865
Acre	145	3	-98
Tocantins	31	-	-
Amapá	-	-	-
Total	6.081	1.960	-68

* Data from Maranhão were not analyzed.

³ The official calendar of measuring of deforestation begins in August and ends in July.

Carbon Affected by the Deforestation

In May 2012, the 2.5 square kilometers of deforestation detected by SAD in the Amazon endangered 1.06 million tons of carbon (with a margin of error of 250,000 tons of carbon). This amount of endangered carbon may result in emissions of 3.9 million tons of CO₂ equivalent (Figure 6).

The carbon from forest endangered by deforestation from August 2011 to May 2012 was 16.36 million tons (with a margin of error of 353,000

tons), representing approximately 60,20 million tons of CO₂ equivalent (Figure 6). Over the same period last year (August 2010 to May 2011) there was a 28% reduction in the amount of carbon endangered by deforestation. The reduction (28%) of forest carbon endangered by deforestation from August 2011 to May 2012, compared to previous period (August 2010 to May 2011), was less than the 39% reduction of deforestation detected by SAD during the same period.

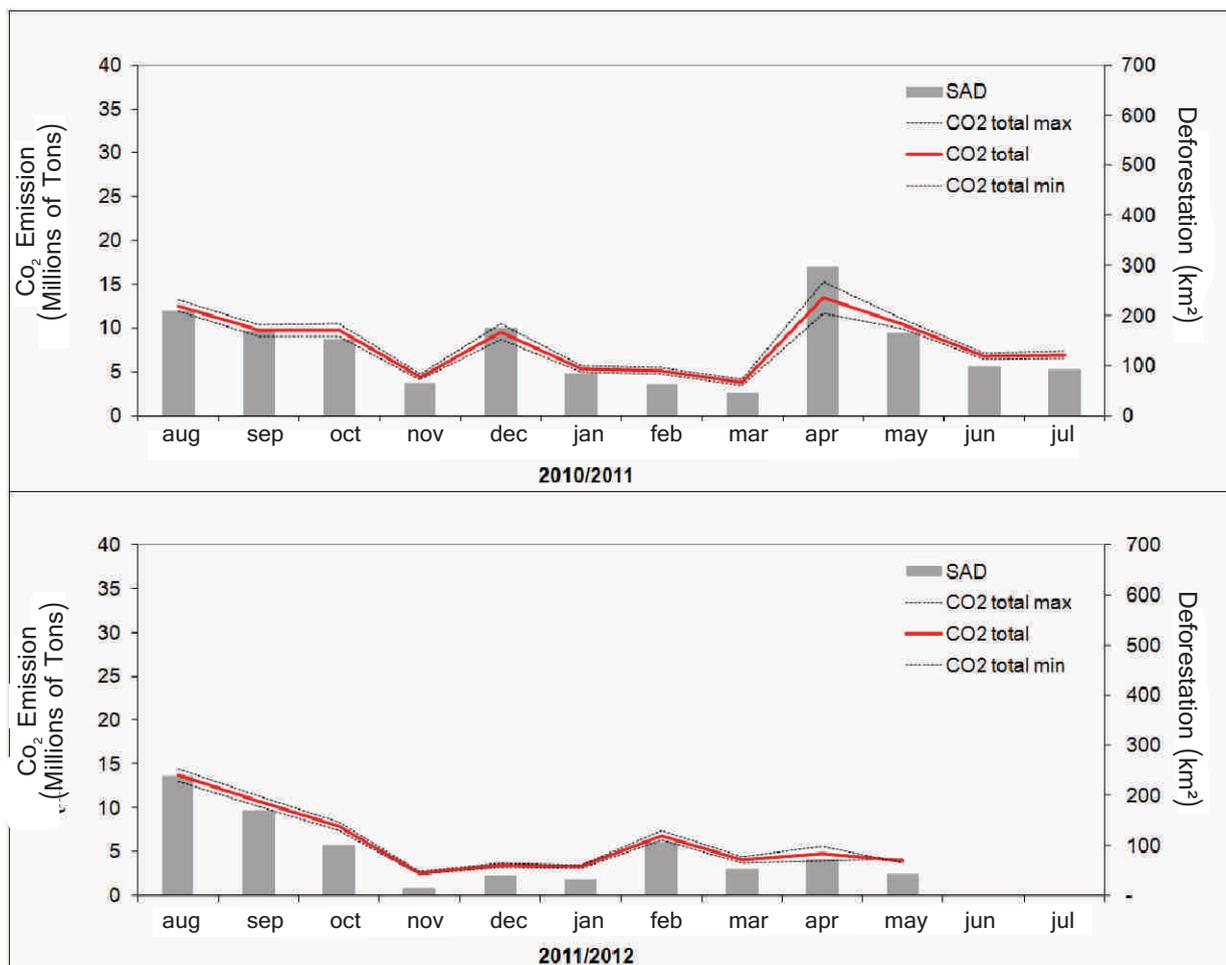


Figure 6. Deforestation and emissions of carbon dioxide (CO₂) equivalent total in August 2010 to May 2012 in the Legal Amazon (Source: Imazon).

Deforestation Geography

In May 2012, the majority (70.5%) of the deforestation occurred in private areas or under various stages of ownership. The rest of deforestation was

registered in Conservation Areas (8%) Indigenous land (9.5%) and Land Reform Settlements (12%) (Table 3).

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

Category	May 2012	
	km ²	%
Agrarian Reform Settlement	5	12
Conservation Units	3,5	8
Indigenous Lands	4	9,5
Private, Owned and in Abeyance ³	30	70,5
Total (km²)	42,5	100

Agrarian Reform Settlements

The SAD has recorded only 5 square kilometers of deforestation in the Agrarian Reform Settlements in May 2012. The settlements that have been affected by deforestation were PDS Terra Nossa

(Apuí, Amazonas), PA Rio Juma (Apuí, Amazonas), PA Baixa Verde (Rio Branco, Acre); PA Tapurah/Itanhangá (Itanhangá, Mato Grosso) (Figure 7).

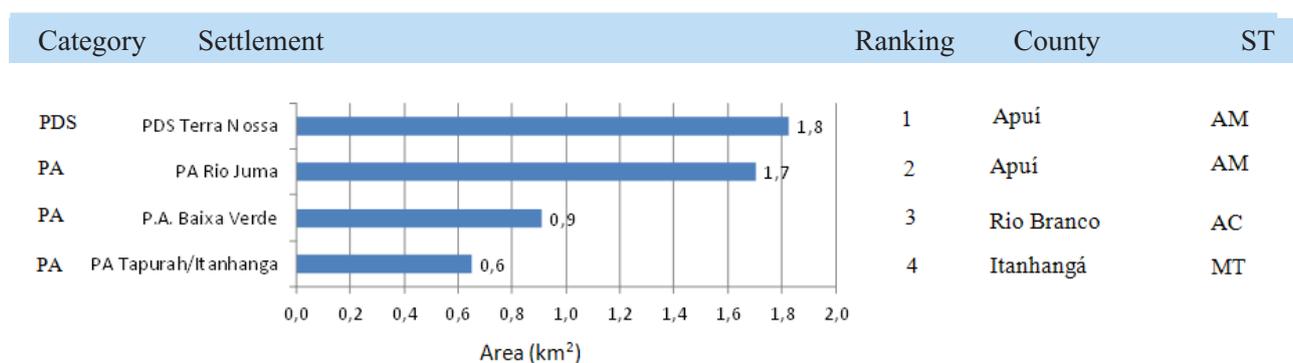


Figure 7. Land Reform Settlements in May 2012 deforested in the Amazon (Source: Imazon/SAD). PA (Settlement Project).

⁴ Includes private areas (titled or not) and unprotected public forests.

Protected Areas

The SAD detected 3.5 km square of deforestation in conservation areas (Figure 8). The Conservation Units deforested were Resex Jaci Parana (Rondonia), the Flona of the Jamanxim (Pará), the APA

of the Rio Pardo (Rondônia) and APA of the Tapajós (Pará). In the case of Indigenous Lands, in April 2012, was detected 4.2 square kilometers of deforestation in Indigenous Lands of Kayabi (Pará) (Figure 9).

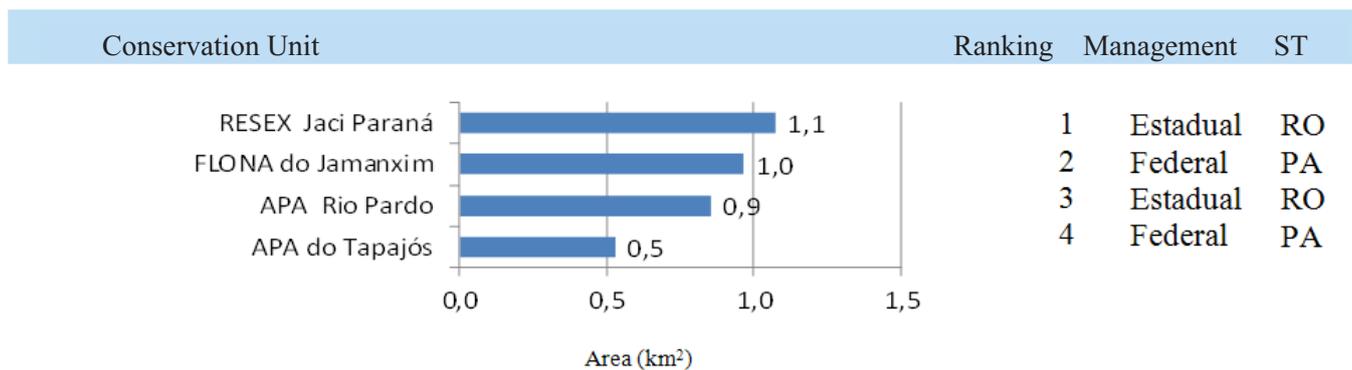


Figure 8. Conservation Unit area deforested in the Amazon in May 2012 (Source: Imazon/SAD).

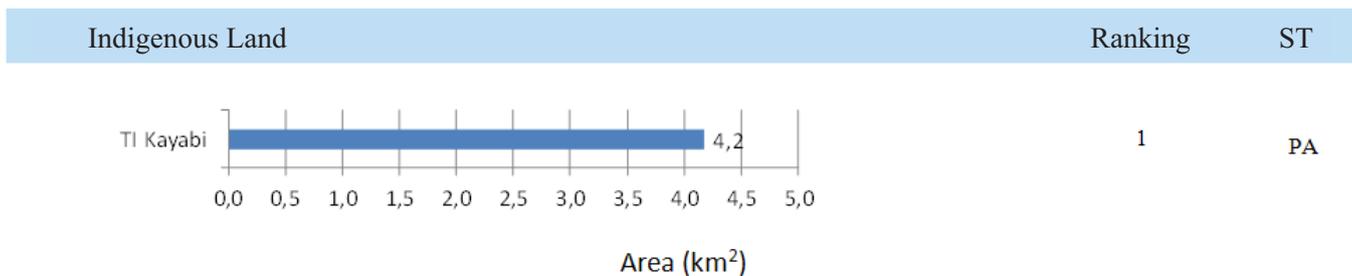


Figure 9. Indigenous land deforested in the Amazon in May 2012 (Source: Imazon/SAD).

Critical Municipalities

In May 2012, the most deforested counties were: Altamira (Pará); Jacareacanga (Pará); and

Porto Velho (Rondônia) (Figures 10 and 11).

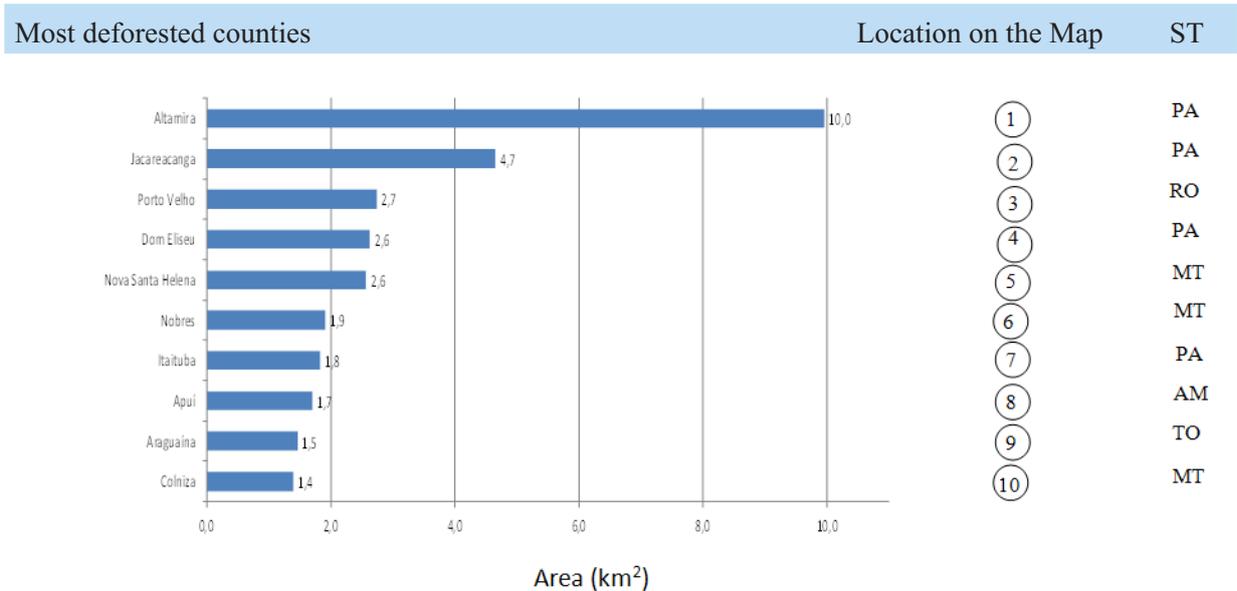


Figure 10. Most deforested counties in the Amazon in May 2012 (Source: Imazon/SAD).

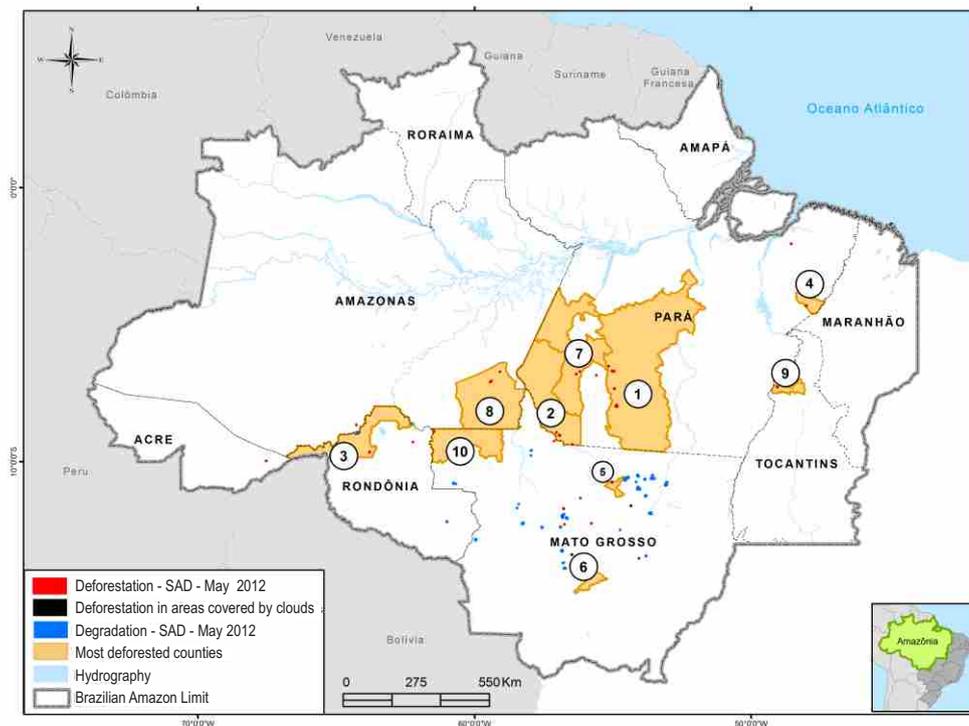


Figure 11. Counties with largest deforested areas in May 2012 (Source: Imazon/SAD).

*Deforestation in the Areas Covered by Clouds may have occurred in May or in previous months; however, it was only possible to detect it now, when there were clouds over the region.

Coverage by clouds and Shade

In May 2012, it was possible to monitor with SAD only 46% of forest area in the Amazon. The other 54% of forest area was covered by clouds which hampered the detection of deforestation and forest degradation. The states with greater cloud cover were Amapá (75%), Roraima (69%), Acre (65%) and Pará (61%). The other states had less than 10% of the

territory covered by clouds. As a result, data from deforestation and forest degradation in April 2012 may be underestimated (Figure 12). The period from December to May is characterized as a rainy season in the Amazon region, which make it difficult to monitor deforestation through satellite imagery operating in the optical range of the electromagnetic spectrum.

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

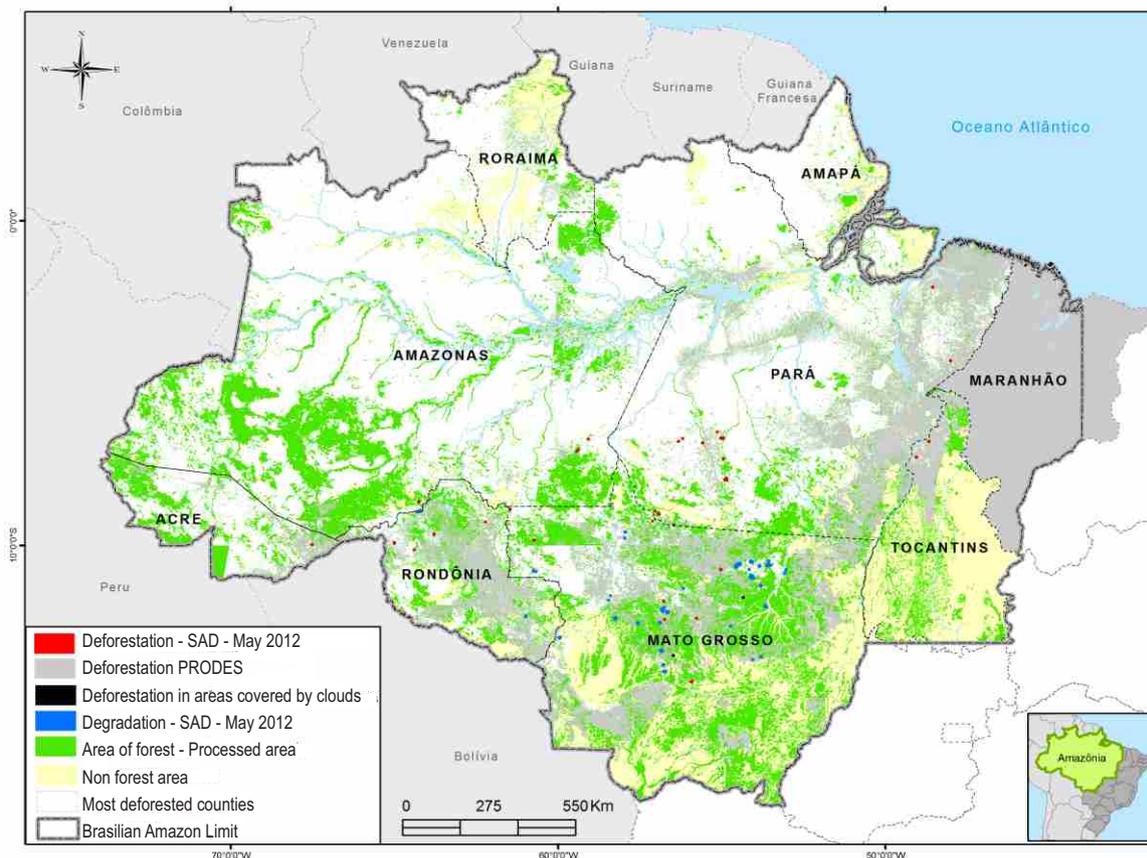


Figure 12. Area with clouds and shadow in May 2012 in the Amazon.

*O desmatamento em áreas cobertas por nuvens pode ter ocorrido em maio de 2012 ou meses anteriores, porém só foi possível detectá-la agora quando não havia mais nuvens na área especificamente observada.

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 not Photosynthetically Active (NPV of English - Non-Photosynthetic) components (vegetation, soil and Shadow) to calculate the NDFI with the equation below:

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

Where VGs is the standard component of vegetation for shadow given by:
 $\text{Vgs} = \text{Vegetation} / (1 - \text{Shadow})$

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 April 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.), 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:

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

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

$$BPF = ff * AGLB$$

$$BAS_0 = bf * AGLB$$

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%).

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.

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

References:

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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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Partnerships

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Secretary of State for the Environment Mato Grosso (SEMA)
Federal Public Attorney's office of the Pará
State Public Attorney's office of the Pará
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