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ABSTRACT

In July 2010, SAD detected 155 square kilometers of deforestation in the Legal Amazon. This represented a reduction of 71% in comparison to July 2009 when the deforestation totaled 532 square kilometers.

During the year (August 2009 to July 2010) the deforestation reached 1,488 square kilometers. In comparison to the previous period (August 2008 to July 2009) when the deforestation totaled 1,766 square kilometers, there was a reduction of 16%.

In July 2010, majority (51%) of the deforestation occurred in Pará, followed by Mato Grosso (23%), Rondônia (9%), Amazonas (8%), Acre (8%), and Tocantins (1%).

The accumulated deforestation from August 2009 to July 2010 resulted in a commitment of 95.6 million tons of C0 equivalents, which are subject to direct and future emissions by burning and decomposition. This represents a reduction of 20% in relation to the previous period (August 2008 to July 2009) when forest carbon affected by deforestation was about 121 million tons of C0 equivalent.

The degraded forests (forests intensely explored by wood and/or burning activities) in Legal Amazon totaled 159 square kilometers in July 2010. From this total, majority (57%) occurred in Pará, 32% in Mato Grosso, 5% in Rondônia, 3% in Acre, and 3% in Amazonas.

We analyzed the situation of 43 "critical deforestation" municipalities. According to SAD, the deforestation of August 2009 to July 2010 in these municipalities was 631 square kilometers. If compared to the same previous period (August 2008 to July 2009), when the deforestation in these municipalities reached 1,033 square kilometers, there was a reduction of 40% in the deforestation.

In July 2010, it was possible to monitor 79% of the area with forest cover in the Legal Amazon.

This bulletin also presents results of the SAD data check through flyovers in partnership with Greenpeace, and the field surveys conducted by technicians of the municipality of Paragominas.

Deforestation Statistics

According to the Deforestation Alert System (SAD) of Imazon, the deforestation in July 2010 in the Legal Amazon reached 155 square kilometers.
(Figure 1 and Figure 3). This represented a 71% reduction in the deforestation of July 2010 in comparison to the deforestation detected in July 2009 when the deforestation totaled 532 square kilometers.

Until June 2010, the accumulated deforestation presented an 8% increase in comparison to the previous period (August 2008 to June 2009) (Figure 1). However, with a significant drop in the deforestation in July 2010 in comparison to July 2009, there was also a drop in the accumulated deforestation in the year (August 2009 to July 2010). Actually, the accumulated deforestation during this period reached 1,488 square kilometers, which represented a reduction of 16% in deforestation in comparison to the same period
the previous year (August 2008 to July 2009) when it was 1,766 square kilometers.

In July 2010, majority (51%) of the deforestation occurred in the State of Pará. Next is Mato Grosso with 23% and Rondônia with 9%. The rest occurred in Acre (8%), Amazonas (8%) and Tocantins (1%) (Figure 4).

[1] The official deforestation measurement calendar begins in the month of August and ends in the month of July.

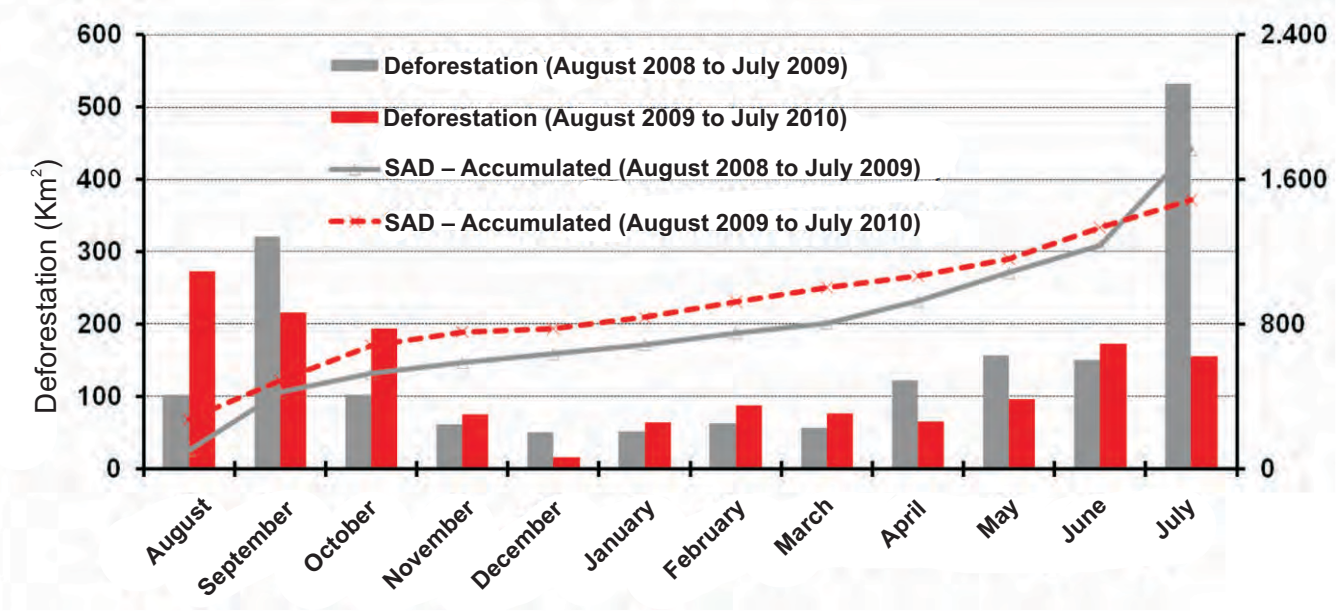

Figure 1. Deforestation of August 2008 to July 2010 in Legal Amazon (Source: Imazon/SAD). In the month of July 2010, we observed the trend of reversed deforestation increase that had been stable since August 2009.

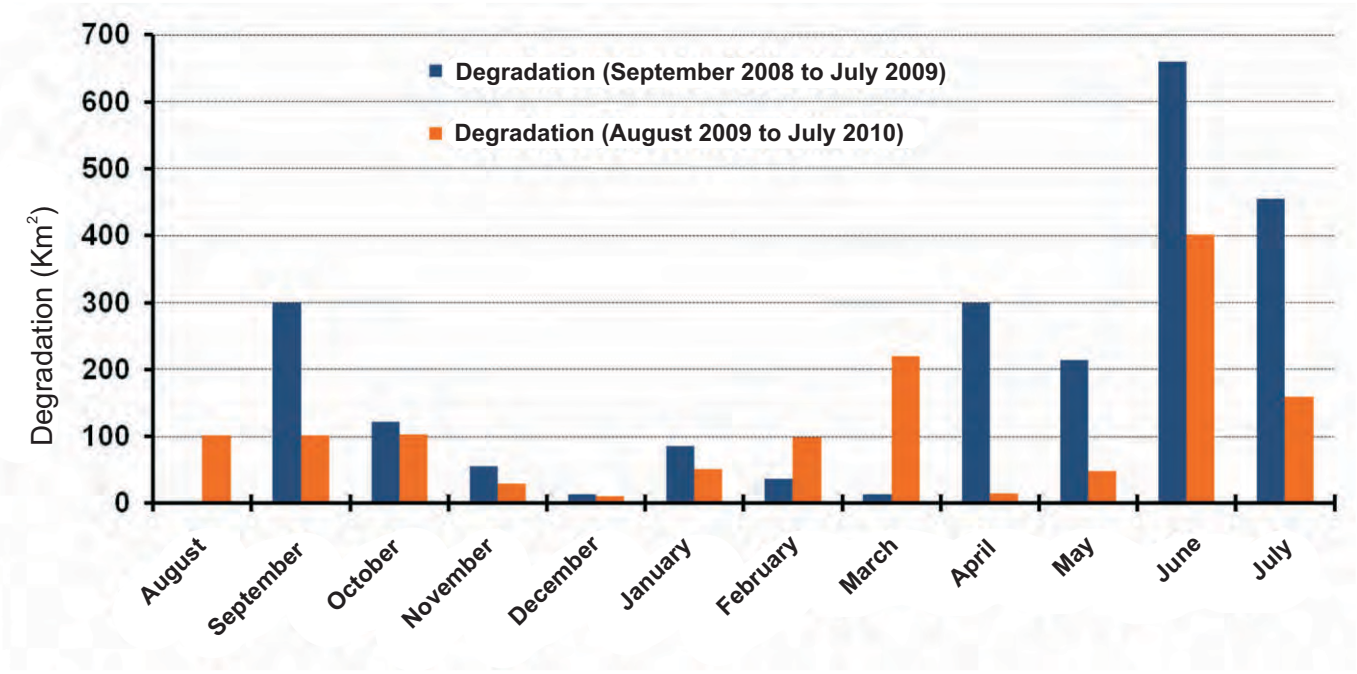

Figure 2. Degradation of September 2008 to July 2010 in Legal Amazon (Source: Imazon/SAD).

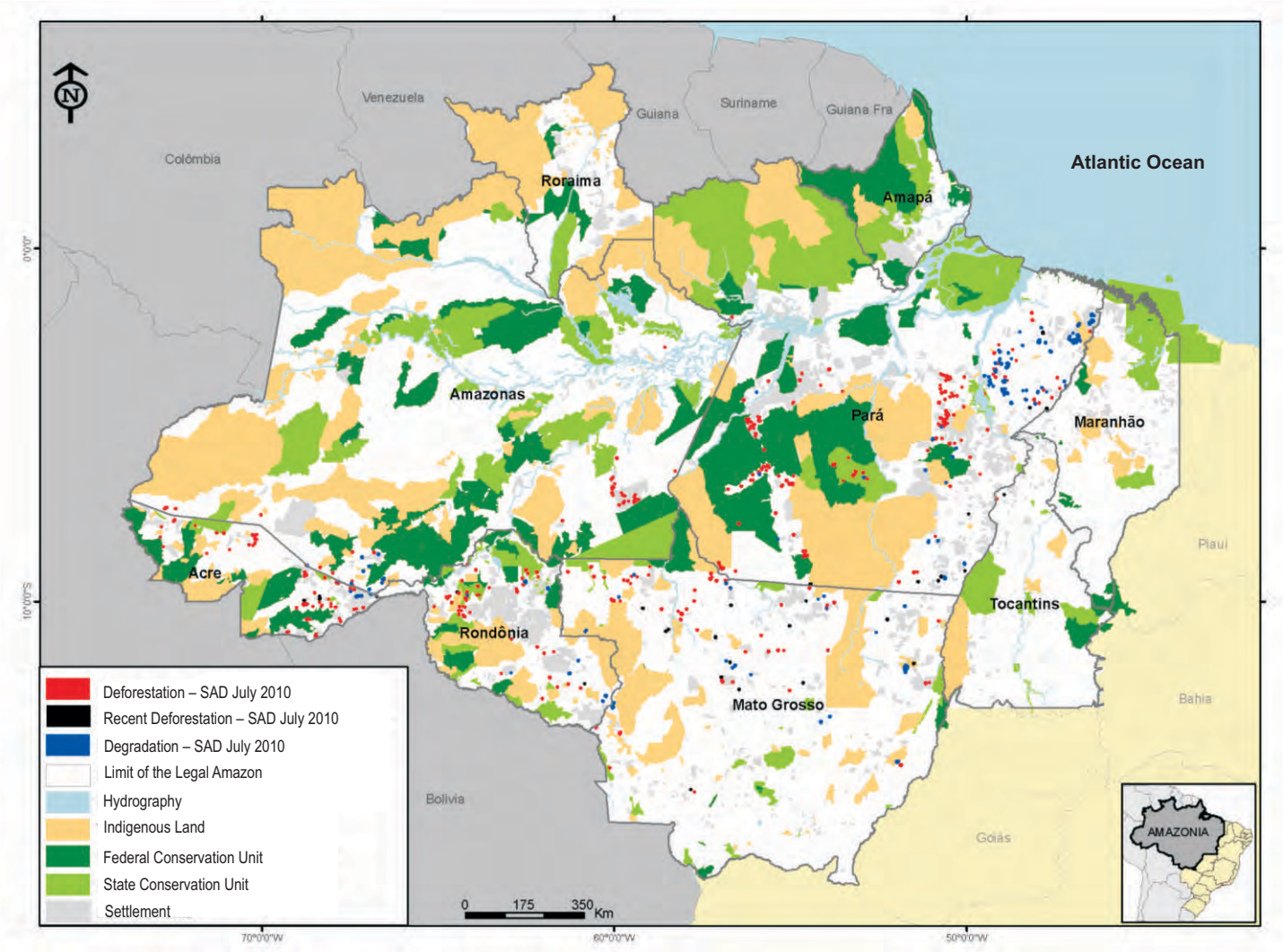

Figure 3. Deforestation and Forest Degradation in July 2010 in the Legal Amazon (Source: Imazon/SAD).

Regarding the forest degradation (that is, forests that suffered intense wood exploration and/or forest fire), SAD registered 159 square kilometers in July 2010 (Figures 2 and 3). From this total, 57% occurred in Pará, 32% in Mato Grosso, 5% in Rondônia, 3% in Acre, and 3% in Amazonas.

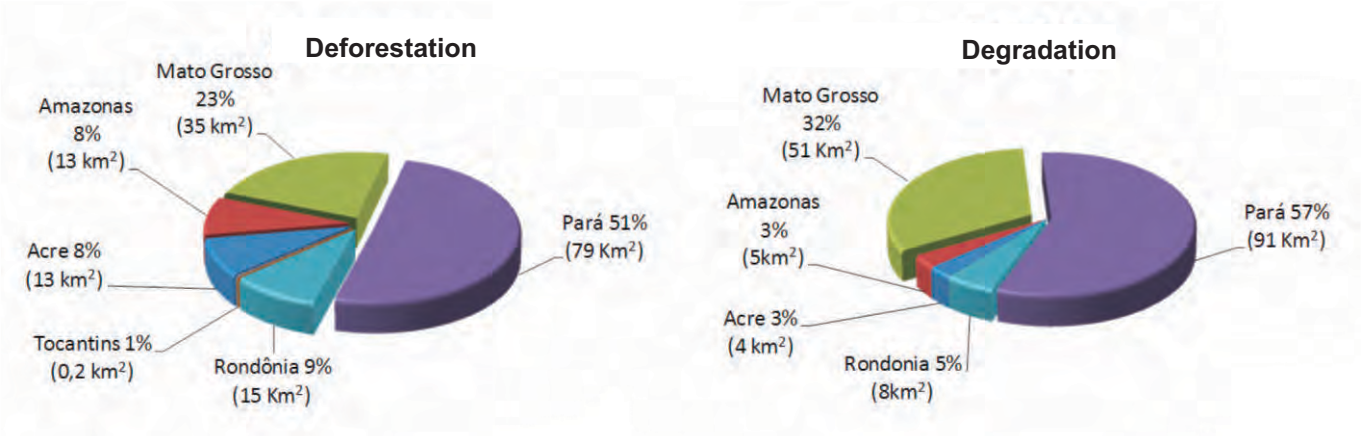

Figure 4. Participation (%) of the States of Legal Amazon in the deforestation and degradation in July de 2010 (Source: Imazon/SAD).

Considering the current twelve months of the deforestation calendar (August 2009 to July 2010), Pará continues to lead in the ranking with 51% of the total deforestation registered in the period. It is followed by Mato Grosso with 23%, Rondônia with 9% , Amazonas with 8%, Acre with 8%, and Tocantins with 1%. Negative emphasis on the participation increase of Amazonas and Acre in the total deforestation composition of Legal Amazon.

In absolute terms, Pará leads the accumulated deforestation ranking with 700 square kilometers, followed by Mato Grosso (342 square kilometers), Rondônia (164 square kilometers) and Amazonas (162 square kilometers).

In relative terms, there was Tocantins (-91%), followed by Roraima (-36%), Pará (-27%), and Mato Grosso (-21%). On the other hand, there was an increase in Acre (+93%), Rondônia (+36%) and in Amazonas (+23).

Table 1. Evolution of the deforestation between the States of Legal Amazon from August 2008 to July 2009 and August 2009 to July 2010 (Source: Imazon/SAD).

State	August 2008 to July 2009	August 2009 to July 2010	Variation (%)
Acre	28	54	+ 93
Amazonas	132	162	+ 23
Mato Grosso	435	342	- 21
Pará	957	700	- 27
Rondônia	120	164	+ 36
Roraima	79	51	- 36
Tocantins	14	1	- 91
Amapá	-	15	-
Total	**1,766**	**1488**	**- 16**

*The data of Maranhão were not analyzed.

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Carbon Affected by the Deforestation

In July 2010, the 155 square meters of deforestation detected by SAD in Legal Amazon affected 2.5 million tons of carbon (with an error margin of 998 thousand tons). This amount of affected carbon results in 9.2 million tons of CO2 equivalent (Figure 5). This represents a drop of 74% in relation to July 2009 when the affected forest carbon was 9.8 million tons. This reduction in carbon affected by deforestation was proportional to the reduction of 71% of the deforestation detected by SAD this month.

The forest carbon affected by the deforestation from August 2009 to July 2010 (twelve months of the current deforestation calendar) was 26 million tons (with an error margin of 469 thousand tons), which represented about 95.6 million tons of CO2 equivalent (Figure 5). In relation to this same period last year (August 2008 to July 2009) there was a 20% reduction in the amount of carbon affected by the deforestation.

In comparison to last year, the relative reduction of forest carbon affected by the deforestation was greater than the 16% deforestation reduction at that same period.

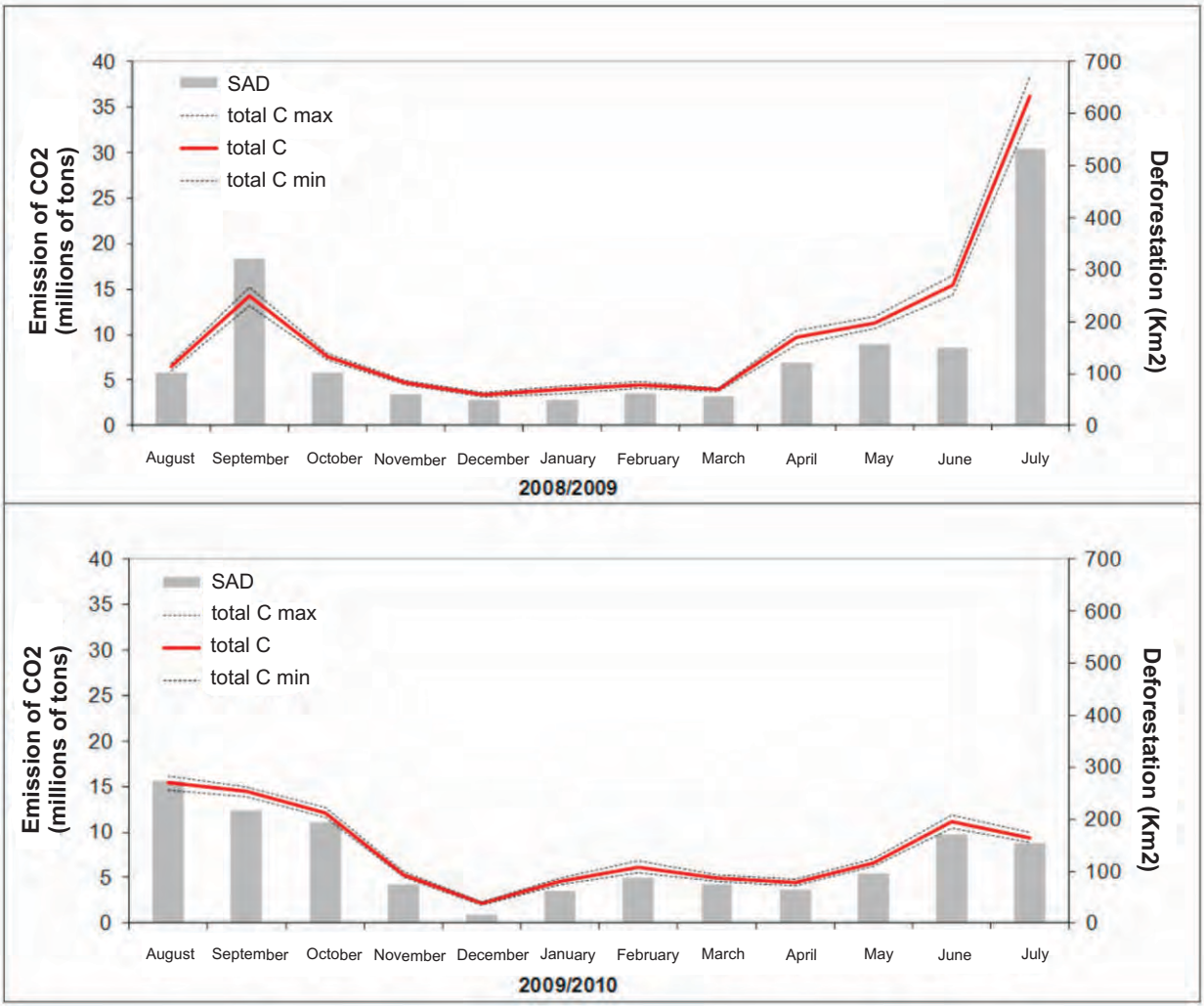

Figure 5. Deforestation and total emissions of Carbon Dioxide (CO) equivalent from August 2008 to July 2010 in Legal Amazon (Source: Imazon).

Geography of the Deforestation

Regarding the land title status in June 2010, majority of the deforestation occurred in private areas or in areas under different stages of ownership. The remaining deforestation was recorded in Agrarian Reform Settlements (20%), followed by Conservation Units (9%) and Indigenous Lands (4%) (Table 2).

Agrarian Reform Settlements

SAD registered 31 square kilometers in the Agrarian Reform Settlements during July 2010. The Settlements most affected by the deforestation were Jacaré-Açú (Novo Repartimento; Pará), Rio Juma (Apuí; Amazonas), and Campos de Pilar (Aveiro; Pará) (Figure 6).

Table 2. Deforestation per land title category in July 2010 in the Legal Amazon (Source: Imazon/SAD).

Category	July 2010	
	Km²	%
Agrarian Reform Settlement	31	20
Conservation Units	13	9
Indigenous Lands	6	4
Private, Owned & Vacant2	105	67
Total (km²)	155	100

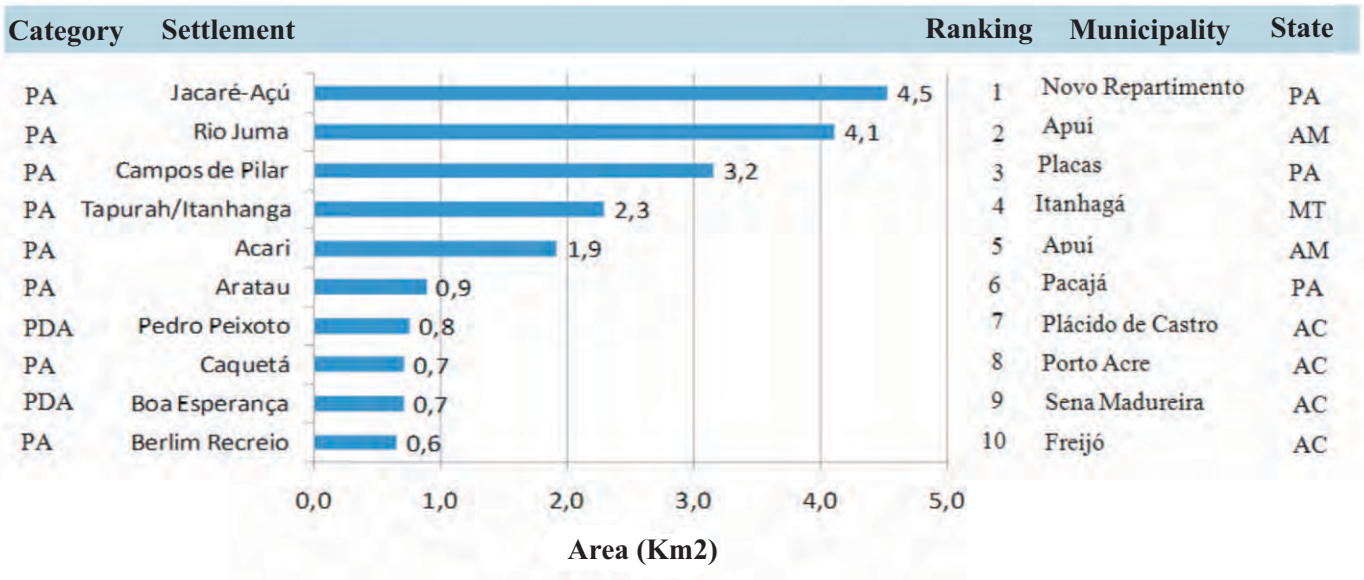

Figure 6. Most deforested Agrarian Reform Settlements in July 2010 in Legal Amazon (Source: Imazon/SAD).

[2] Includes private areas (owned or not) and unprotected public forests.

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Protected Areas

SAD detected 13 square kilometers of deforestation in the Conservation Unit (Figure 7). The Conservation Units that suffered the most deforestation were APA Triunfo do Xingu (Pará), Resex do Rio Jaci-Paraná (Rondônia) and Rebio Nascente Serra do Cachimbo (Pará).

In the case of the Indigenous Lands, six square kilometers were detected in July 2010. The most affected were Kayabi (Pará), Maraiwatsede (Mato Grosso) and Xambioá (Rondônia) (Figure 8).

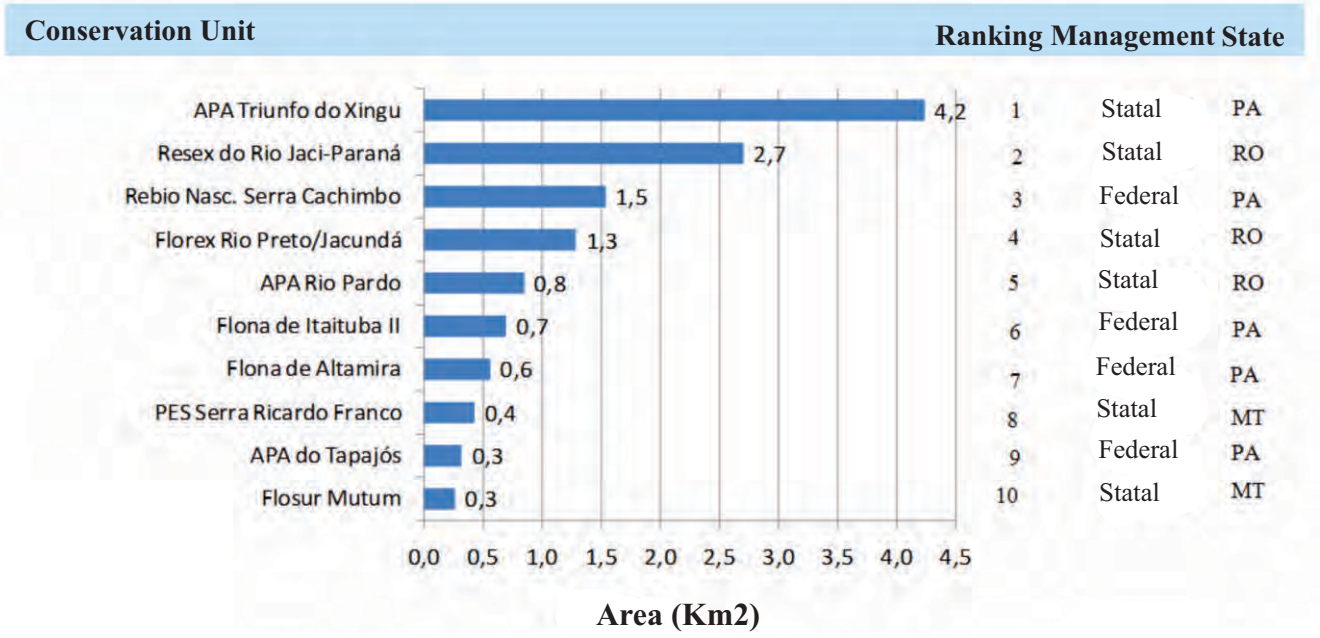

Figure 7. Most deforested Conservation Units in Legal Amazon in July 2010 (Source: Imazon/SAD).

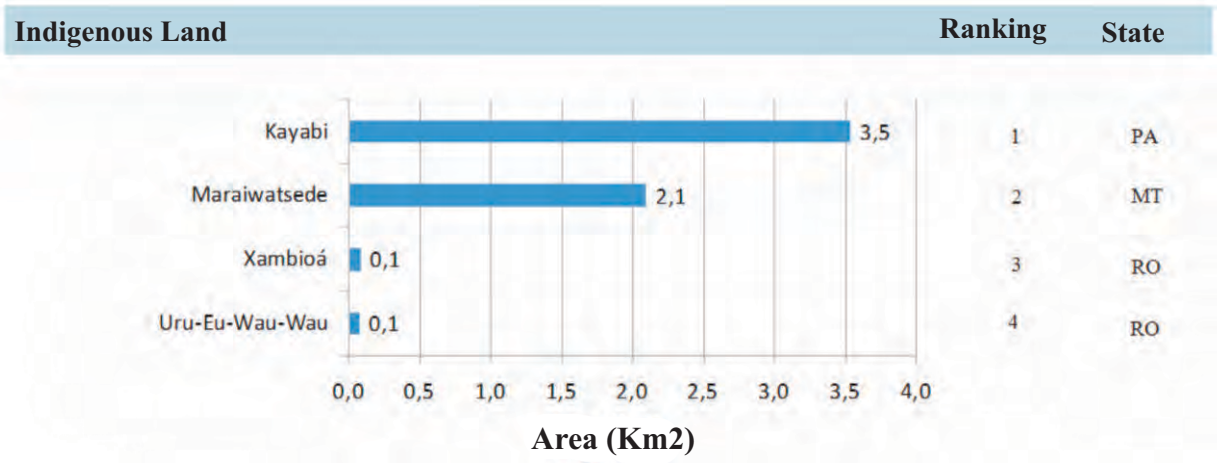

Figure 8. Most deforested Indigenous Lands in Legal Amazon in July 2010 (Source: Imazon/SAD).

Critical Municipalities

The first three municipalities most affected by deforestation in July 2010 are located in Pará, with the first being Altamira with 21 square kilometers, followed by Novo Repartimento with 11 square kilometers and Itaituba with 8 square kilometers. (Figure 9 and Figure 10).

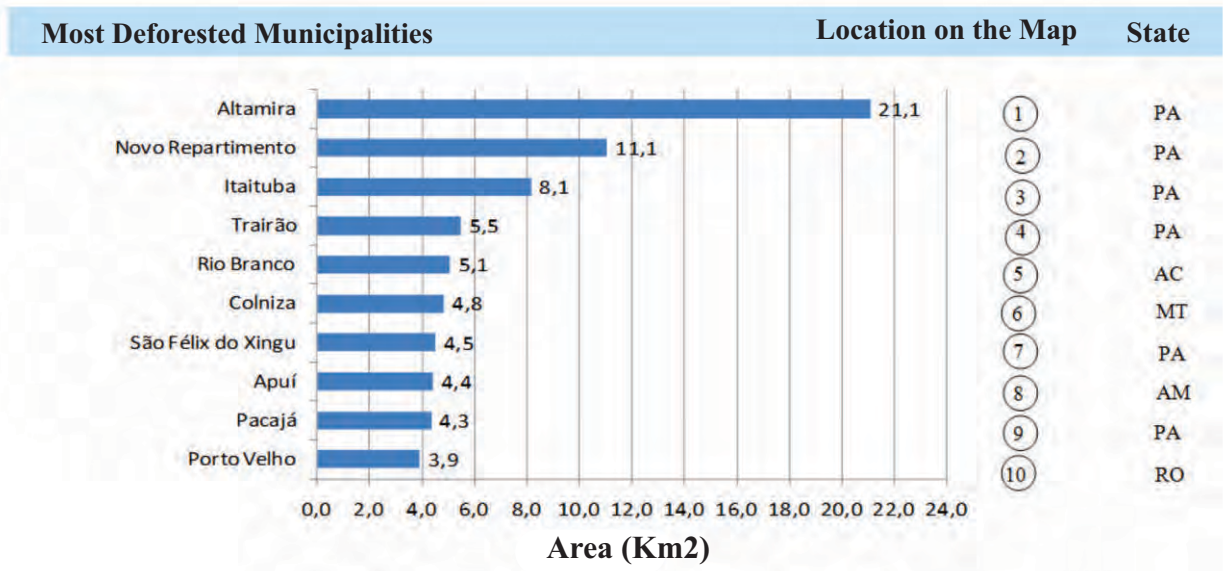

Figure 9. Most deforested Indigenous Lands in Legal Amazon in July 2010 (Source: Imazon/SAD).

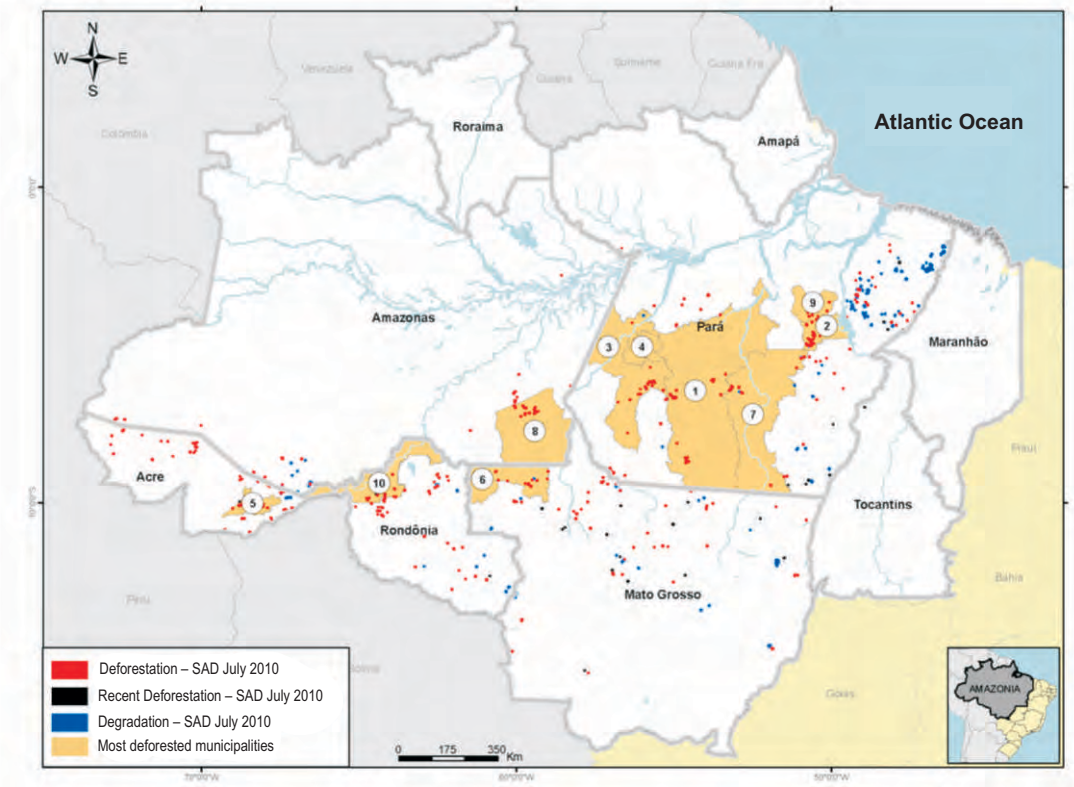

Figure 10. Most deforested municipalities in July 2010 (Source: Imazon/SAD).

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Deforestation in the Critical

As a strategic combat against the illegal deforestation in Legal Amazon, the Government published the Federal Decree no. 6321, in December 21, to regulate on the actions related to the prevention, monitoring and control of the deforestation. This Decree that was disclosed in January 2008 presented a list containing 36 municipalities with greater area of deforestation and higher rates of deforestation in the last years. In March 2009 this list was increased to 43 municipalities. The seven municipalities included in this list were: Amarante do Maranhão (MA), Feliz Natal (MT), Itupiranga (PA), Marabá (PA), Pacajá (PA), Tailândia (PA), and Mucajaí (RR).

The 43 municipalities of the list had the deforestation licensing clearance embargo (Ordinance no. 28/2008 of the MMA) and the convocation for re-registration of rural property that, in case it does not fulfill the requirements mentioned in the Normative Instruction no. 44/2008 of Incra, the Rural Property Registry Certificates lost their power. Furthermore, there was also a restriction to the public and private credit grant for rural properties in environmental status and irregular land title (Resolution no. 3545/2008 of the National Monetary Council)

Since June 2009, we have been analyzing the situation of the included municipalities to follow-up the impact that the measures taken by the Government in the last years are having an impact in the deforestation reduction. According to SAD data, the accumulated deforestation in the 43 municipalities from August 2009 to July 2010 (period after the disclosure of the list of 43 most deforested municipalities in Legal Amazon) was 631 square kilometers. If compared to the same previous period (August 2008 to July 2009), when the deforestation in these municipalities reached 1,033 square kilometers, there was a reduction of 40% in the current deforestation calendar in these critical municipalities (Figure 11 and Table 3).

Based on the general deforestation analysis in the 43 municipalities published in March 2009, it was possible to distribute the municipalities into three groups (Table 3). This classification considers the comparison of the deforested area in each municipality during two periods: August 2008 to July 2009 and August 2009 to July 2010. The analysis was carried out based on the SAD data. Group 1 contains the municipalities that represent the deforestation reduction between the two analyzed periods. Group 2 contains the municipalities that had a slight increase (1% to 30%). In turn, group 3 contains the municipalities that had a significant increase in deforestation between the analyzed periods, meaning an increase of over 30%.

From the 43 analyzed municipalities with SAD data, majority (23 municipalities; 53% of the total) are under group 1, meaning that they had a significant reduction in the deforestation, with an average reduction percentage of 64% (Table 4). This group is being able to meet the reduction expectations since the disclosure of the first list in January 2009. A highlight of this group is the municipality of Novo Progresso that had a considerable reduction (81%) in the deforested, able to remain below 40 square kilometers from August 2009 to July 2010.

In the previous analysis (see forest transparency bulletin of June 2009) Novo Progresso presented the highest deforestation in the two analyzed periods (August 2007 to June 2008 and August 2008 to June 2009) and was not able to reduce the deforestation in that region. The municipalities of Altamira and São Félix do Xingu, however, still suffered a deforestation of more than 40 square kilometers during the last analysis period even after a significant deforestation reduction (an average of 55%).

The municipalities in group 2, even with an average deforestation increase of 14%, are being able to keep the deforested area below the 40 square kilometers. This group includes the municipality of Paragominas (PA) that was removed from the list in 2010.

Lastly, group 3 contains the municipalities that had an average deforestation increase of 157%. The municipalities of Feliz Natal (MT), Nova Mamoré (RO), Novo Repartimento (PA), and Porto dos Gaúchos (MT) presented an increase higher than 400%, but they are keeping the absolute values below the 40 square

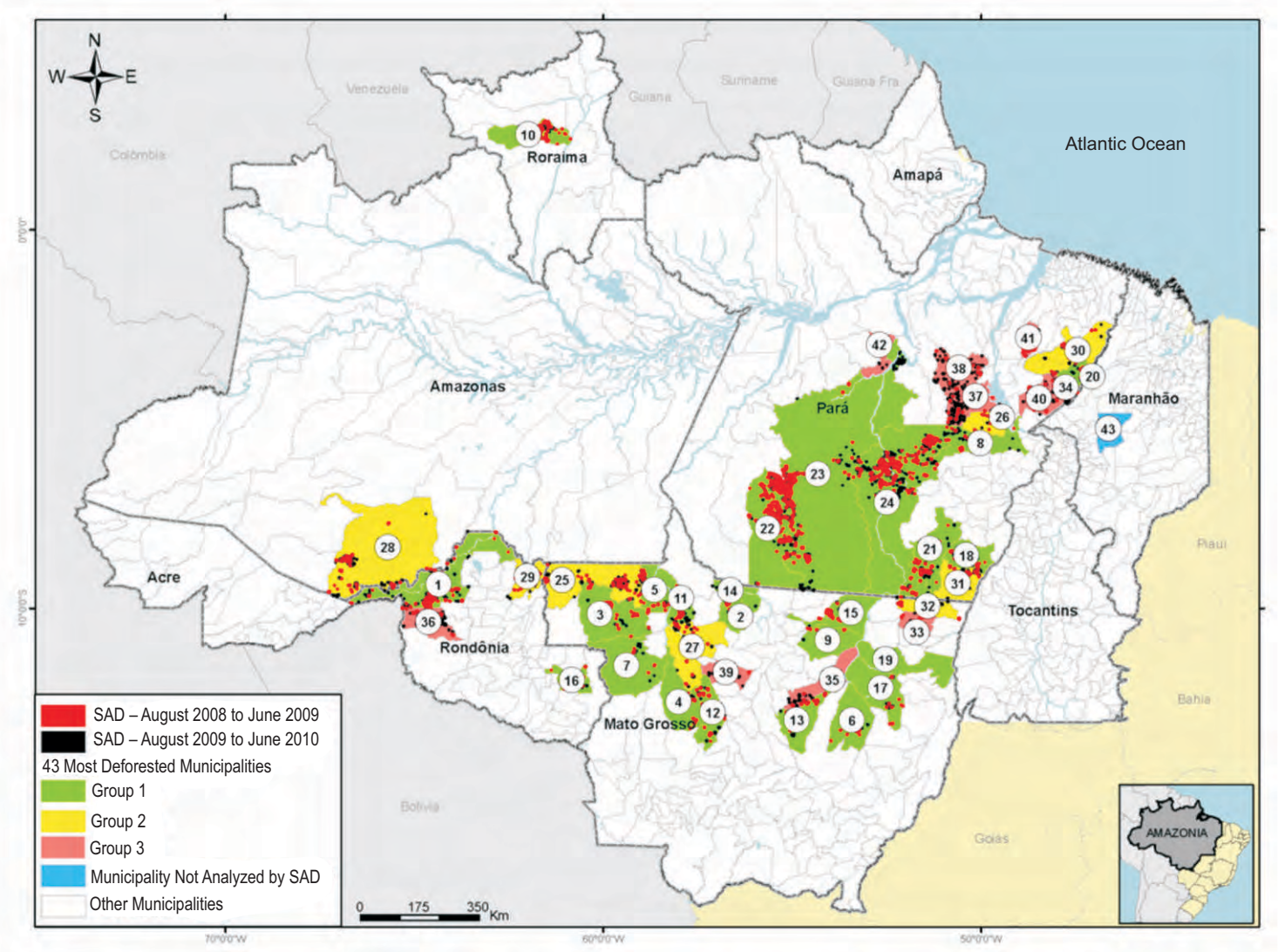

Figure 11. Deforestation (August 2008 to July 2010) in the 43 most deforested municipalities in Legal Amazon (Source: Imazon/SAD). Group 1 corresponds to the municipalities that presented a deforestation reduction between the two analyzed periods (August 2008 - July 2009 and August 2009 – July 2010); Group 2 are the municipalities that had a slight increase (1% to 30%); Group 3 corresponds to the municipalities that had a significant increase (over 30%).

Table 3. Evolution of the deforestation (August 2008 to July 2009 and August 2009 to July 2010) among the 43 most deforested municipalities in the Amazon (Source: Imazon/SAD).

No.	Municipalities	State	August 2008 to July 2009	August 2009 to July 2010	Variation (%)	Group
1	Porto Velho	RO	36	48	+35	1
2	Alta Floresta	MT	2	2	-10	1
3	Aripuanã	MT	13	10	-23	1
4	Brasnorte	MT	12	3	-74	1
5	Cotriguaçu	MT	12	3	-75	1
6	Gaúcha do Norte	MT	5	1	-70	1
7	Juína	MT	5	4	-20	1
8	Marabá	PA	10	5	-47	1
9	Marcelândia	MT	4	1	-66	1
10	Mucajaí	RR	11	5	-55	1
11	Nova Bandeirantes	MT	23	10	-55	1
12	Nova Maringá	MT	23	6	-72	1
13	Nova Ubiratã	MT	24	13	-44	1
14	Paranaíta	MT	4	3	-26	1
15	Peixoto de Azevedo	MT	10	5	-47	1
16	Pimenta Bueno	RO	14	2	-86	1
17	Querência	MT	7	6	-18	1
18	Santa Maria das Barreiras	PA	27	7	-73	1
19	São Félix do Araguaia	MT	7	-	-100	1
20	Ulianópolis	PA	6	5	-6	1
21	Cumaru do Norte	PA	64	10	-84	1
22	Novo Progresso	PA	205	39	-81	1
23	Altamira	PA	225	102	-55	1
24	São Félix do Xingu	PA	152	68	-55	1
25	Colniza	MT	21	22	+2	2
26	Itupiranga	PA	2	2	+18	2
27	Juara	MT	13	16	+20	2
28	Lábrea	AM	22	27	+19	2
29	Machadinho D´Oeste	RO	6	7	+25	2
30	Paragominas	PA	4	5	+17	2
31	Santana do Araguaia	PA	6	6	+15	2
32	Vila Rica	MT	6	7	+12	2
33	Confresa	MT	3	4	+36	3
34	Dom Eliseu	PA	6	11	+78	3
35	Feliz Natal	MT	3	26	+737	3
36	Nova Mamoré	RO	4	23	+479	3
37	Novo Repartimento	PA	7	38	+439	3
38	Pacajá	PA	9	28	+198	3
39	Porto dos Gaúchos	MT	2	18	+650	3
40	Rondon do Pará	PA	7	13	+80	3
41	Tailândia	PA	9	13	+49	3
42	Brasil Novo	PA	-	4	-	-
43	Amarante do Maranhão	MA	-	-	-	-
	Total		**1.033**	**631**	**- 40**	

Table 4. Deforestation variation between August 2008 and July 2010 in the 43 most deforested municipalities in Legal Amazon (Source: Imazon/SAD).

Group	Period	Total (Km²)	Variation (%)
1 (N=23)	August 2008 to July 2009	865	- 64
	August 2009 to July 2010	313	
2 (N=8)	August 2008 to July 2009	81	+ 14
	August 2009 to July 2010	93	
3 (N=11)	August 2008 to July 2009	86	+ 157
	August 2009 to July 2010	221	

Cloud and Shade Cover

In June 2010, it was possible to monitor 75% of the area with forest cover in the Legal Amazon, since only 25% of the territory was covered by clouds (Figure 10). The unmapped region corresponds to the forest area of Roraima and Amapá.

* The part of Maranhão that is part of the Legal Amazon was not analyzed.

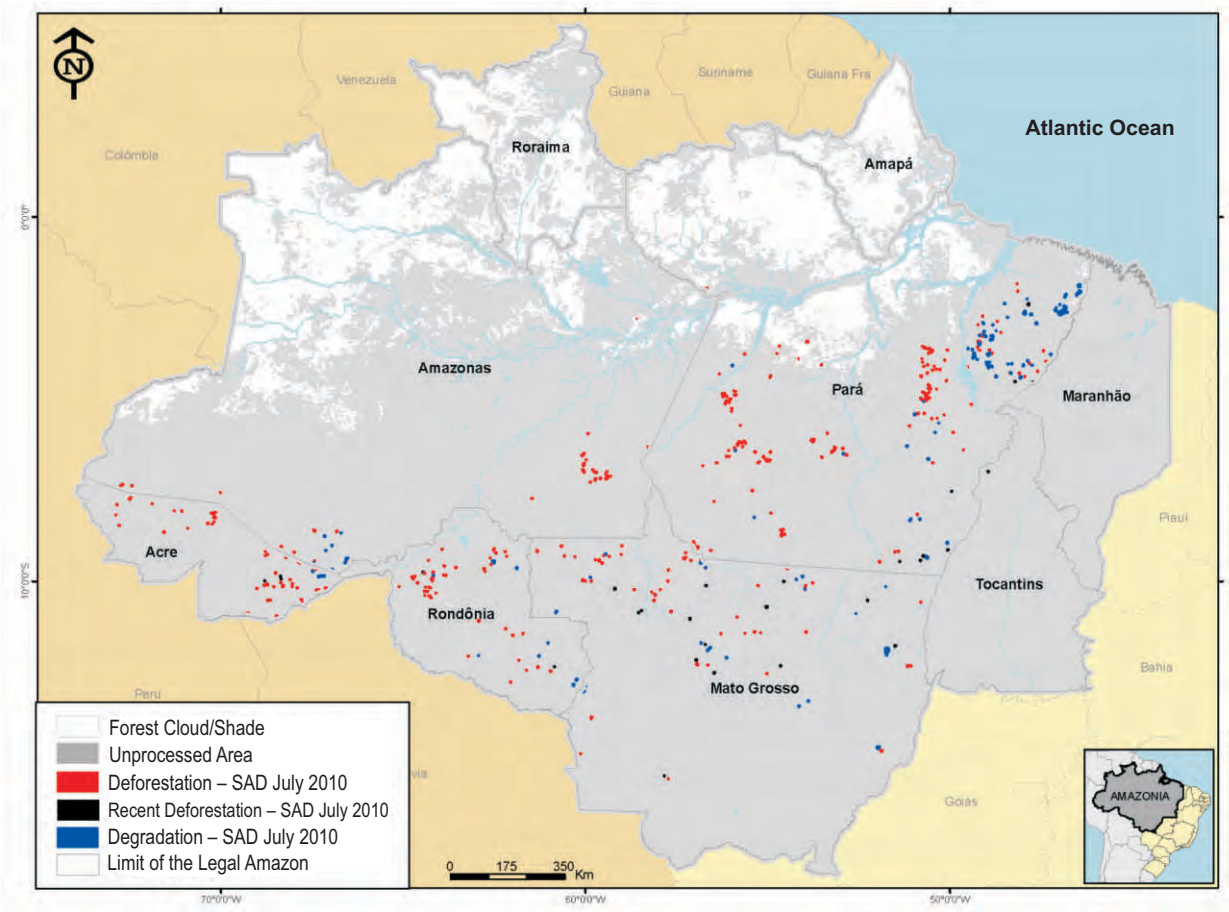

Figure 12. Area with cloud and shade in July 2010 in Legal Amazon.
*The Recent Deforestation may have occurred in July or in previous months, however, it was only possible to detect it now when there was no cloud over the region.

Validation of the SAD data using Landsat and Cbers Imaging

In 2008, Imazon improved the validation of the SAD data using CBERS and Landsat imaging with finer spatial resolution (20 and 30 meters, respectively). The images available soon after the month analyzed by SAD were used. All the deforestation polygons detected by SAD are checked using the detailed images. Deforestation less than 6.25 hectares, that is, below the detection capacity of SAD, are not included in the statistics, in case they occur in the images with more detailed resolution. However, if false signs of deforestation detected by SAD are confirmed, these are removed from the monthly statistics. The innovation in the SAD validation process is that this methodology was applied almost in real time due to the availability of the CBERS and Landsat satellite images by Inpe (National Space Research Institute).

In July 2010, 98% of the deforestation detected by SAD was confirmed with the Landsat images (Figure 13). Only 2% were not confirmed due to the unavailability of Landsat and CBERS images at that time.

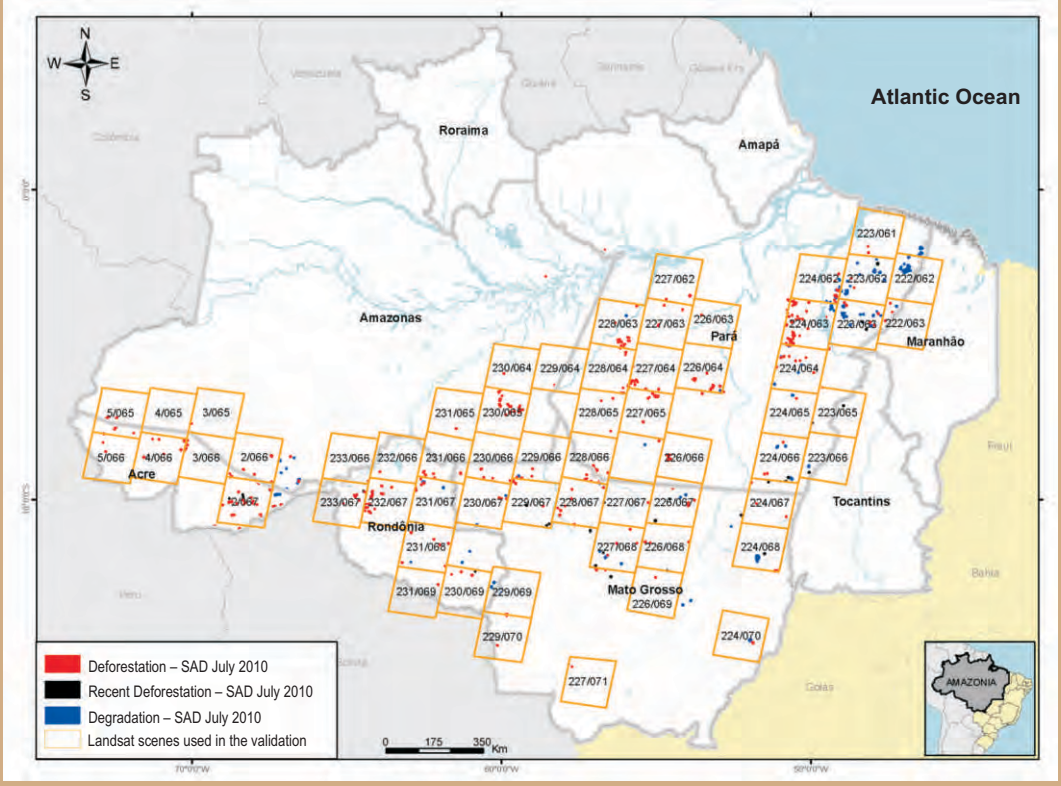

Figure 13. Landsat scenes used in the validation of the deforestation polygons detected by SAD in July 2010.

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Field check

In addition to the Landsat and CBERS images, the SAD data are being independently checked by partner institutions. This is being performed since March 2008 by the municipality hall of Paragominas. Therefore, Imazon trained local environmental agents (technicians of the municipality hall) to check the field data using GPS. After confirming the environmental violation, a responsibility process is initiated at the competent bodies by the municipality hall of Paragominas. From the start of the partnership, all the polygons detected in the municipality were checked on field and confirmed. In June 2010, an area with advanced degradation (illegal wood exploration) was detected that had its activities permanently suspended in addition to the TAC (conduct adjustment agreement) signature to replace the clearings made by those responsible.

The second partnership was with Greenpeace that checked the SAD results through flyovers with the aid of digital photographs and GPS. The first flyover was executed in May 2010 to check the SAD data of January to March 2010. The flyover regions were along BR-163, in Pará, and in the center region of Mato Grosso (Figure 14). From the total 108 polygons checked, 100 (93%) were confirmed through the flyovers.

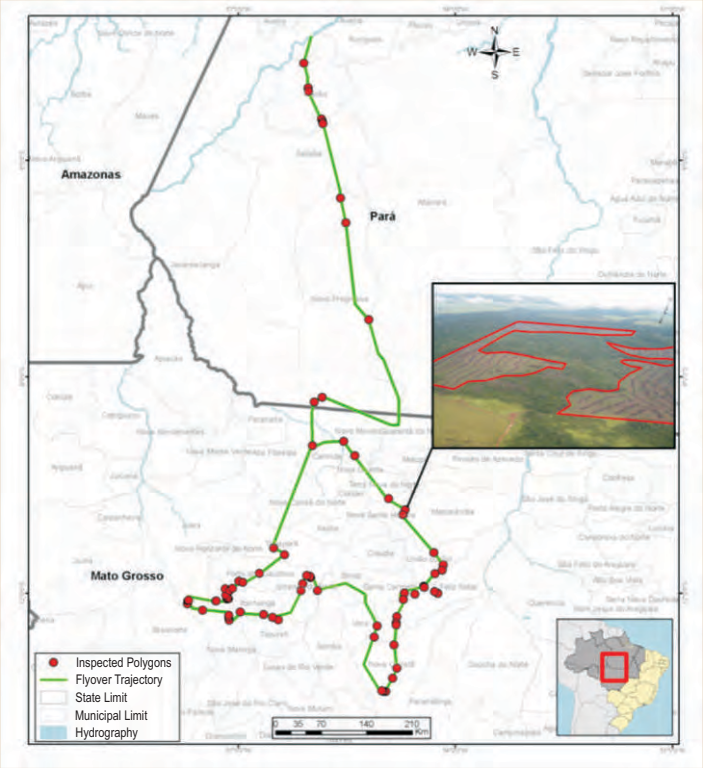

Figure 14. Trajectory of the flyover performed by the Greenpeace to check the SAD polygons (January, February and March 2010) in Pará and Mato Grosso.

Section I: SAD 3.0

Since August 2009, SAD presented some innovations. First, a graphic interface was created to integrate all the image processing programs used in the SAD. Secondly, we began computing the deforestation in areas that were covered by clouds in the previous months under a new class. Lastly, the deforestation and degradation were detected with pairs of NDFI images in a change detection algorithm. The main methodology continues to be the same as SAD 2 as shown below.

SAD generates temporary MODIS images daily from the products MOD09GQ and MOD09GA for cloud filtration. A fusion technique for different spectral resolution bands, that is, with pixels of different sizes, was then used. In this case, the 5 bands scale with a pixel of 500 meters of the MODIS was changed to 250 meters. This allowed the improvement of the spectral pixel mixture model, providing the ability to estimate the abundance of Vegetation, Soils and Non-Photosynthetic components (NPV) (Vegetation, Soil and Shade) to calculate the NDFI with the equation below.

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

Where VGs is the Vegetation component normalized for shade given by:

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

NDFI varies from –1 (pixel with 100% of exposed soil) to 1 (pixel with > 90% with forest vegetation). Therefore, we have a continuous image showing the transition of the deforested areas, passing through degraded forest until it reaches forests without signs of disturbance.

This month the detection of the deforestation and degradation had different NDFI images of consecutive months. Therefore, a reduction in the NDFI values between –200 and –50 indicated possibly deforested areas and between –49 and –20 with signs of degradation.

SAD 3.0 Beta is compatible with the previous versions (SAD 1.0 and 2.0) because the deforestation detection threshold 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 Legal Amazon since April 2008. This bulletin presents the monthly data generated by SAD from August 2006 to July 2010.

Section II: Carbon affected by the deforestation

Since January 2010, the affected carbon (that is, the forest carbon subject to emissions due to burning and decomposition of forest biomass waste) estimates from the deforestation detected by SAD in Legal Amazon was reported.

The carbon estimates are generated based on the combination of SAD deforestation maps with simulations of the spatial biomass distribution for the Amazon. A carbon emission estimation model called Carbon Emission Simulator (CES) was developed based on the stochastic simulation (Morton et al, in prep.). One thousand (1000) spatial biomass distribution simulations in the Amazon were generated using a geostatic model (Sales et al., 2007), and these biomass simulations were transformed into C-stocks using biomass conversion factors for C from literature, according to the formula below:

$$Ct = \Sigma\, C(S)t$$
$$Ct\,(S) = SD \times [(BVAS - BPF)\, X\, (1 - fc) \times (t == 0) + (BAS0 \times pd \times e(-pdxt))]$$
$$BPF = ff^{*}\, AGLB$$
$$BAS0 = bf^{*}\, AGLB$$

where:
t: time (month)
Ct: Carbon emitted in month t.
Ct(S): Carbon emitted from a deforested polygon at time t.
SD: Deforested area:
BVAS: Biomass aboveground at the deforested region SD.
BPF: Biomass from forest products removed from forests before the deforestation.
fc: coal fraction (3 to 6%).
BAS0: Underground biomass before deforestation.
pd: monthly decomposition parameter of the underground biomass after deforestation (0.0075).
pd x e(-pdxt) : Monthly decomposition rate of underground biomass after deforestation.

To apply the CES model using the SAD data, only the carbon affected by the deforestation was considered, which is the fraction of forest biomass made up of carbon (50%) subject to instant emissions caused by forest fires from the deforestation and/or future decomposition of the remaining forest biomass. Also, the CES model was modified to estimate the forest carbon affected by the deforestation on a monthly scale. Lastly, the simulations enabled the estimation of the affected carbon uncertainty, represented by the standard deviation (+/-2 fold) the simulations of the carbon affected each month.

Apply the value 3.68 to convert the carbon values for CO equivalent.

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