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Summary

In this bulletin *Transparency in Forest Management in Pará* we assess the timber harvesting in the State from August, 2008 to July, 2009. To do that we used information from the forest control systems at Sema (Pará State Environmental Secretariat - *Secretaria de Estado de Meio Ambiente do Pará*): Simlam (Integrated System for Environmental Licensing and Monitoring - *Sistema Integrado de Licenciamento e Monitoramento Ambiental*) and Sisflora (System for Marketing and Transporting of Forest Products - *Sistema de Comercialização e Transporte de Produtos Florestais*). That information was also crossed with information generated by Simex (System for Monitoring Timber Harvesting developed by Imazon) (Box 1) within the Forest Management Support Program (Box 2).

According to Simlam, forest production in the State of Pará in 2008 was approximately 3.5 million cubic meters of logwood and 4.4 million cubic meters of forest residues. In 2009, the State produced approximately 3.8 million cubic meters of logwood and 2.3 million cubic meters of forest residues. For both years, the great majority (98% in 2008 and 89% in 2009) of that production came from managed native forest and the remainder from managed plantation forest (2% in 2008 and 11% in 2009).

Analysis of satellite images revealed that approximately 128,500 hectares of forests were logged from August, 2008 to July, 2009. Of that total, 94,385 hectares (73%) were not authorized by Sema, as against 34,171 authorized hectares (27%). Of the non-authorized total, the majority (83%) occurred in private areas, vacant areas or lands in dispute; another 11% occurred in land reform settlements; and 6%, in Protected Areas. When compared to the previous period analyzed (August, 2007 to July, 2008), we observed a

75% reduction (278,209 hectares) in the area logged without authorization.

In the areas logged with authorization from Sema we evaluated the situation of the AUTEFs (Timber Harvesting Authorization-*Autorizações de Exploração Florestal*) and verified that the majority (91%) were regular. The remaining 9% presented some sort of inconsistency, such as management authorized for an already deforested area, management authorized for an area already logged, and area authorized greater than the total managed area. In comparing the proportion of AUTEFs with inconsistencies between 2008 and 2009, we observed a 76% reduction in the cases of areas authorized in deforested areas, of 53% in areas authorized in logged areas, of 53% in the cases of authorized areas larger than managed areas and 100% in those with credit sold greater than the amount authorized.

To evaluate the quality of forest management in the authorized areas, we selected 59 AUTEFs in whose areas it was possible to detect signs of logging in the satellite images. Analysis of images showed that in most (64%) of those areas was of intermediate quality; in another 14% quality was good; and only in 22% was logging of low quality. When we compared those results for the periods of August, 2007 to July, 2008 and August, 2008 to July, 2009 we observed that the areas with good quality logging dropped by 71% and those with intermediate and low quality increased 194% and 28%, respectively.

Finally, we verified in the satellite images from 2009 (August, 2008 to July, 2009) that in 97% of the forest management areas evaluated from August, 2007 to July, 2008 the forest was maintained, while there was deforestation in only 3%.

Forest Control Systems

According to Simlam at Sema/Pa, in 2008 approximately 203 AUTEFs were issued out of a total of 191 forest management plans covering an area of 155.9 thousand hectares of forest. In terms of volume of timber, that represented 3.5 million cubic meters of logwood and 4.4 million cubic meters of forest residues. In 2009, there were approximately 170 AUTEFs issued for a total of 165 forest management plans covering 157.2 thousand hectares of forest. That represented 3.8 million cubic meters of logwood and 2.3 million cubic meters of forest residues. The great majority (98% in 2008 and 89% in 2009) of that timber came from native forest and the remaining 2% and 11% were from planted forest.

In 2008 Sisflora recorded and cleared¹ approximately 3,3 million cubic meters of logwood and 4.1 million cubic meters of forest residues. In 2009, those amounts were approximately 3.5 million cubic meters of logwood and 2.2 million cubic meters of forest residues. That difference in volumes between the two systems occurred because not all credits recorded in Simlam had been cleared in Sisflora because the holder of the forest management plan had not been recorded in Ceprof² (Record for Harvesters and Consumers of Forest Products - *Cadastro de Exploradores and Consumidores de Produtos Florestais*).

Geography of Timber Harvesting in Pará

To identify non-authorized (illegal and predatory) and a authorized (forest management) timber harvesting in the State from August, 2008 to

July, 2009, we overlaid the boundaries of the forest management plans on NDFI images (Figure 1 and Box 1). There were 128,556 hectares of logged forest detected, of which 94,385 hectares (73%) had no authorization and 34,171 hectares (27%) were authorized for forest management.

Non-authorized timber harvesting (illegal) was detected in all regions of the State: 49% in the southeast, 29% in the northeast, 12% in the southwest, 6% in the Marajó region and 4% on the lower Amazon (Figure 1).

However, when we compare the areas logged during the periods of August, 2007 to July, 2008 and August, 2008 to July, 2009 we observe a reduction in both the area of authorized timber harvesting and of illegal harvesting. The reduction in the area of illegal logging was quite significant: from 372,594 hectares to 94,385 hectares (Figure 2).

Critical municipalities

Of the 94,385 hectares of forest logged without authorization in Pará from August, 2008 to July, 2009, the majority (74%) occurred in 10 municipalities (Figures 3 and 4). The remaining 26% were distributed in a more scattered fashion among another 41 municipalities.

Part of the municipalities of Vitória do Xingú, Portel, Anapú, Pacajá and Senador José Porfírio were not mapped in 2009 due to the high cloud densities over those municipalities, which made it impossible to capture satellite images (Figure 3 and 4). Considering that those municipalities produce between 100 and 600 thousand cubic meters of logwood per year³, it is thus possible that the total timber harvesting area is underestimated.

¹ Timber credits are only cleared in Sisflora after approval through Simlam and Ceprof.

² O Ceprof is an electronic system containing information on: i) enterprise and property; ii) parties responsible for enterprise/owner; iii) addresses for correspondence; iv) technical party responsible; v) legal representative; and vi) description of the activity to be licensed.

³ A atividade madeireira na Amazônia Brasileira: produção, receita e mercados/Serviço Florestal Brasileiro e Instituto do Homem e Meio Ambiente da Amazônia. Belém, PA: SFB e Imazon, 2010, 20p.

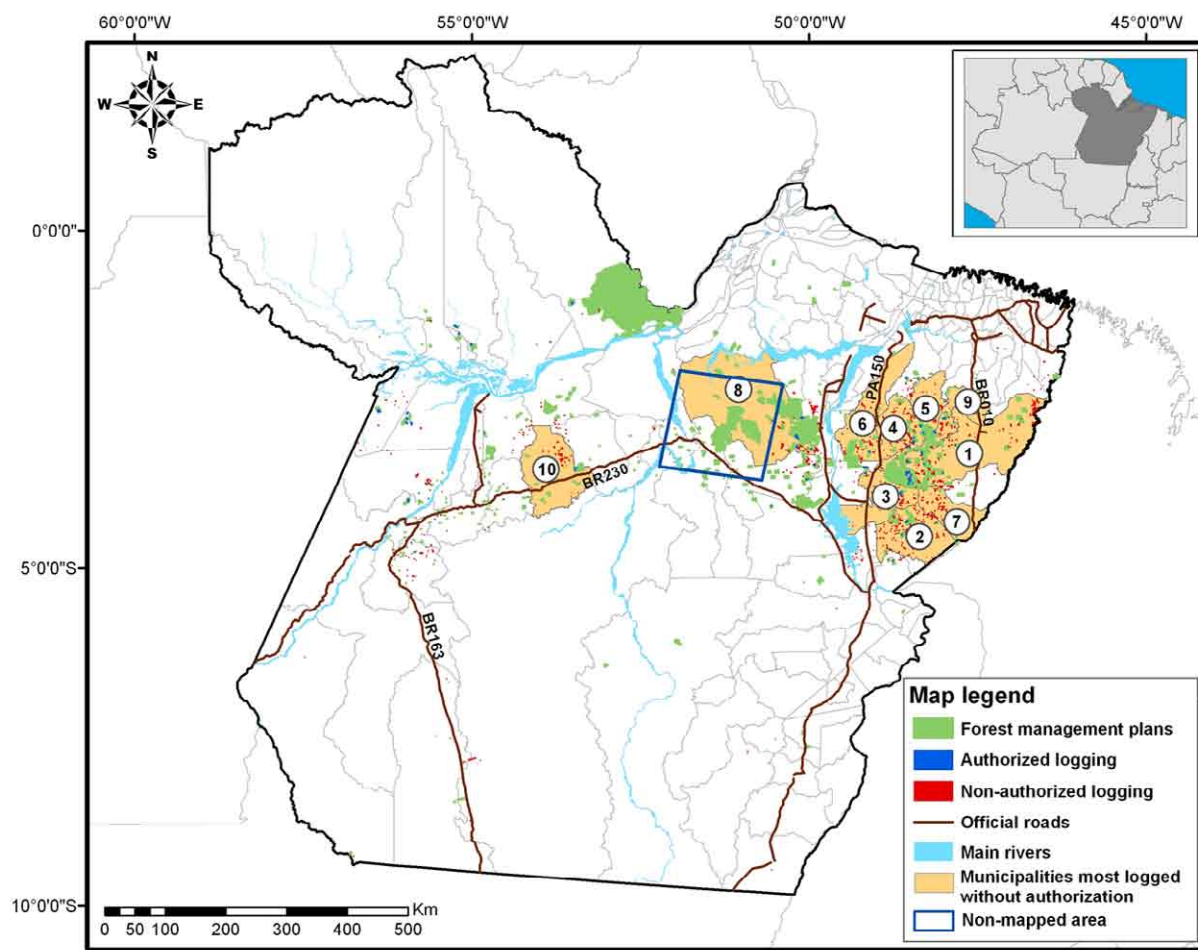


Figure 1. Spatial distribution of authorized (forest management) and non-authorized (predatory) timber harvesting in the State of Pará from August/2008 to July/2009 (Source: Imazon/Simex).

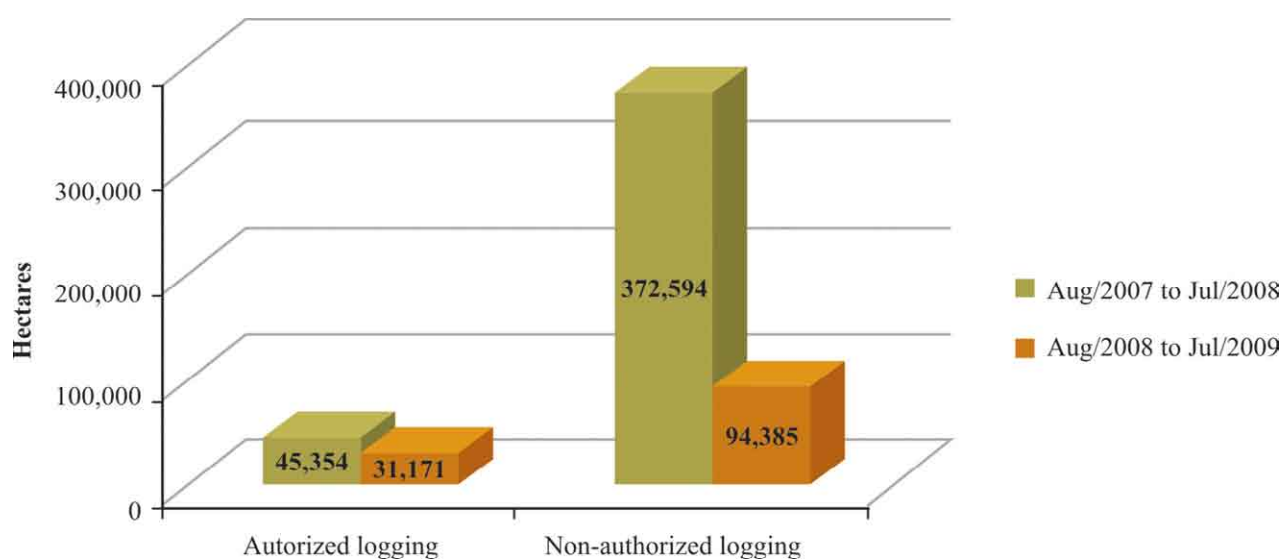


Figure 2. Comparison between the areas logged with authorization and without authorization in the State of Pará from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex).

The five municipalities with the greatest area of non-authorized timber harvesting are, in decreasing order: Paragominas (Belém-Brasília highway), Rondon do Pará (BR-222), Goianésia do Pará (PA-150), Tailândia (PA-150), Mojú (PA-150) and Dom Eliseu (Belém-Brasília) (Figures 3 and 4).

In observing the two periods analyzed (August, 2007 to July, 2008 and August, 2008 to July, 2009), we find a significant reduction in illegal logging in Paragominas (43,586 hectares), Rondon do Pará (21,705 hectares), Tailândia (14,826 hectares), Tomé-açu (15,370 hectares), Dom Eliseu (9,311 hectares), Portel⁴ (62,972 hectares), Ipixuna do Pará (17,458 hectares), Uruará (5,090 hectares) and Altamira (9,686 hectares) (Figure 5).

Protected Areas

Illegal timber harvesting affected 5,286

hectares of forest in TIs (Indigenous Lands). The great majority (89%) of that logging occurred in the TI Alto Rio Guamá, located in eastern Pará, on the border with Maranhão. That TI occupies part of the territory of the municipalities of Garrafão do Norte, Nova Esperança do Piriá, Paragominas and Santa Luzia do Pará. Next comes the TI Sarauá situated in the municipality of Ipixuna do Pará, with 7% of the total logged (Figure 6).

The area with illegal logging in the Pará TIs dropped considerably in the most recent period analyzed when compared to the previous period. That drop was most noticeable in the TI Alto Rio Guamá, where there was a reduction of 18,326 hectares. On the other hand, the TI Munduruku, which did not appear among the areas having the largest areas logged without authorization during the previous period, entered the list for the most recent period (Figure 7).

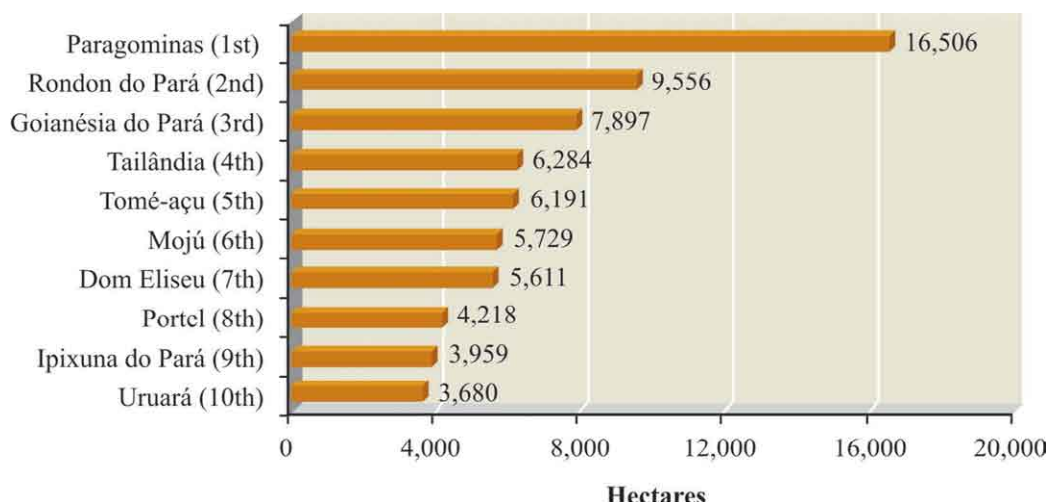


Figure 3. Municipalities with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 (Source: Imazon/Simex).

⁴ We note that only 43% of the municipality of Portel was mapped due to the unavailability of satellite images for 2009.

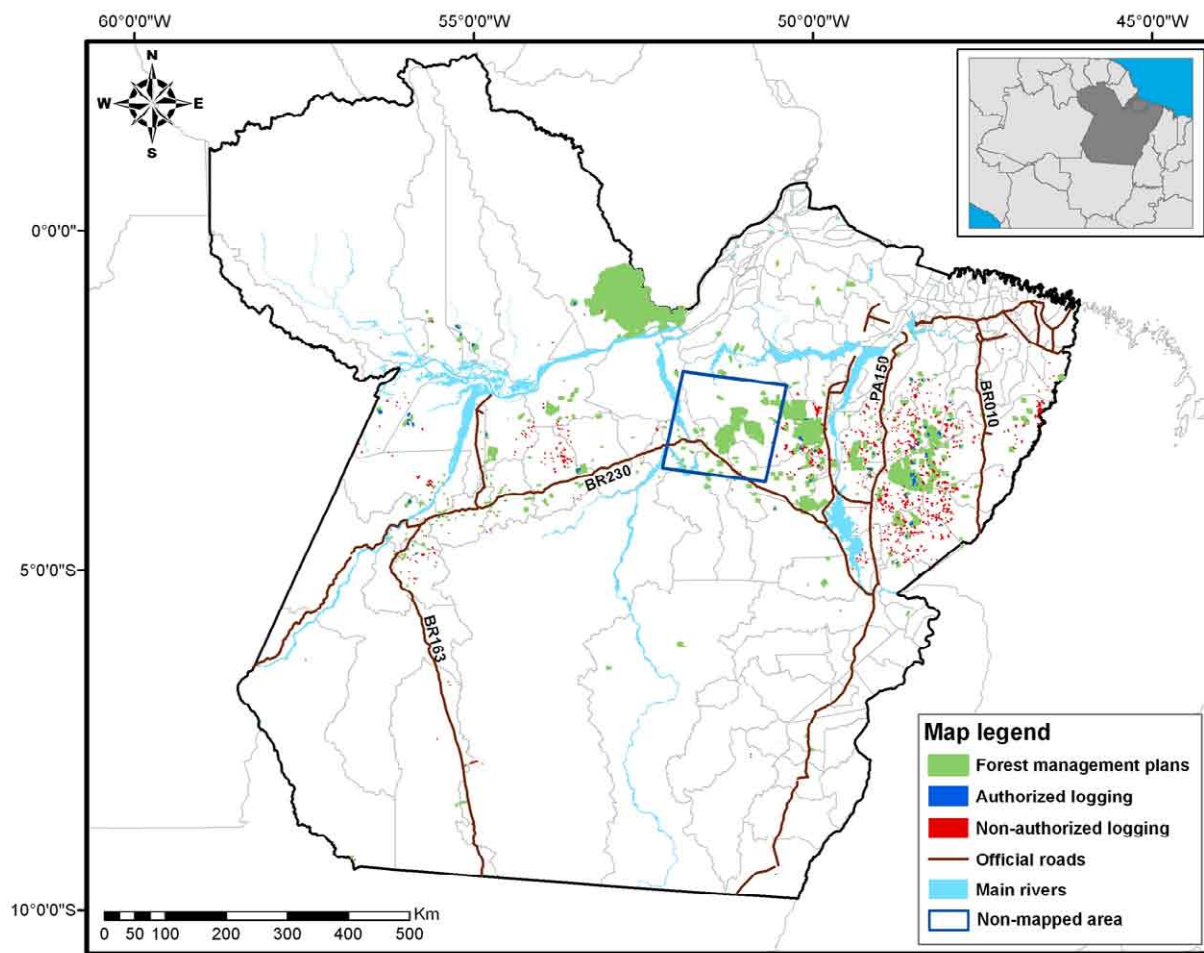


Figure 4. Location of the most municipalities with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 (Source: Imazon/Simex).

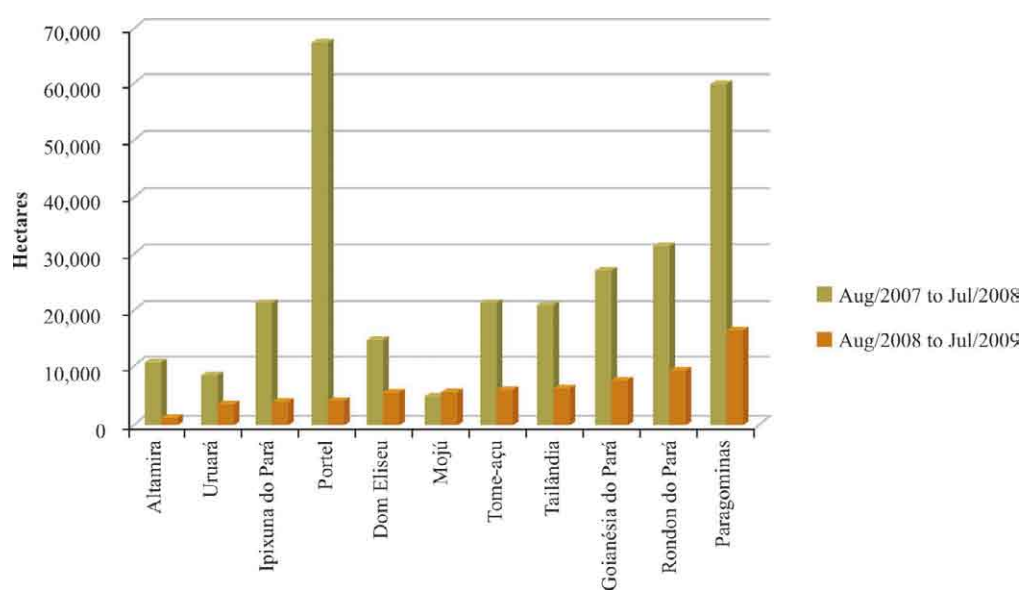


Figure 5. Comparison of municipalities with the largest areas logged without authorization in the State of Pará from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex).

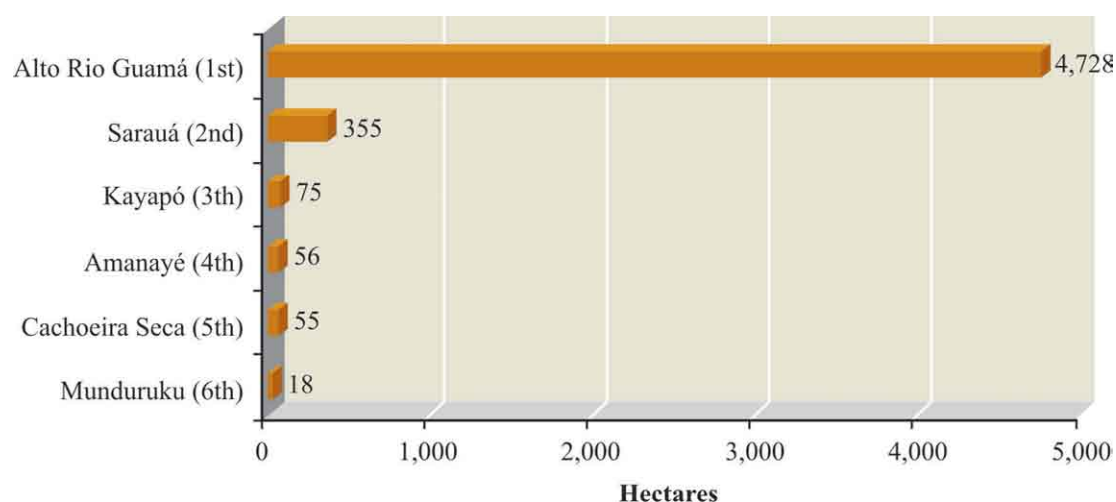


Figure 6. Indigenous Lands with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 (Source: Imazon/Simex).

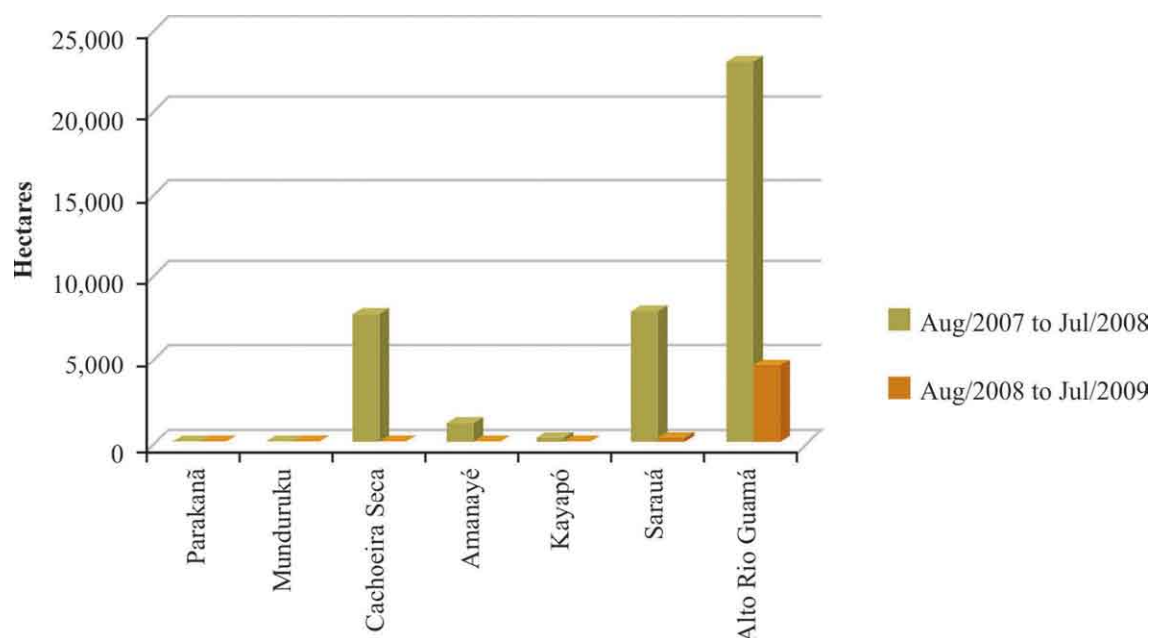


Figure 7. Comparison of Indigenous Lands with the largest areas logged without authorization in the State of Pará from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex).

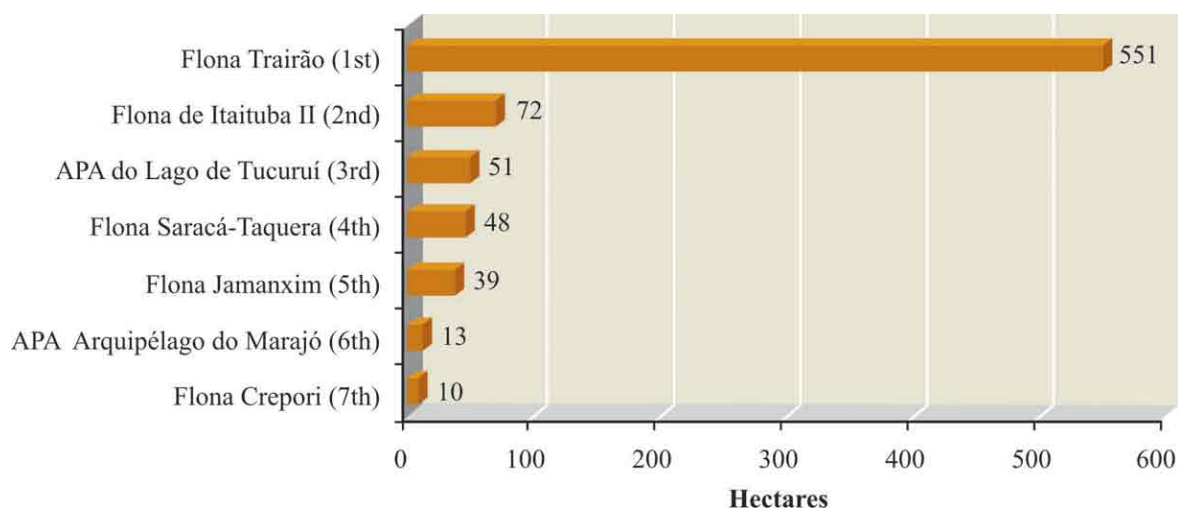


Figure 8. Conservation Units with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 (Source: Imazon/Simex).

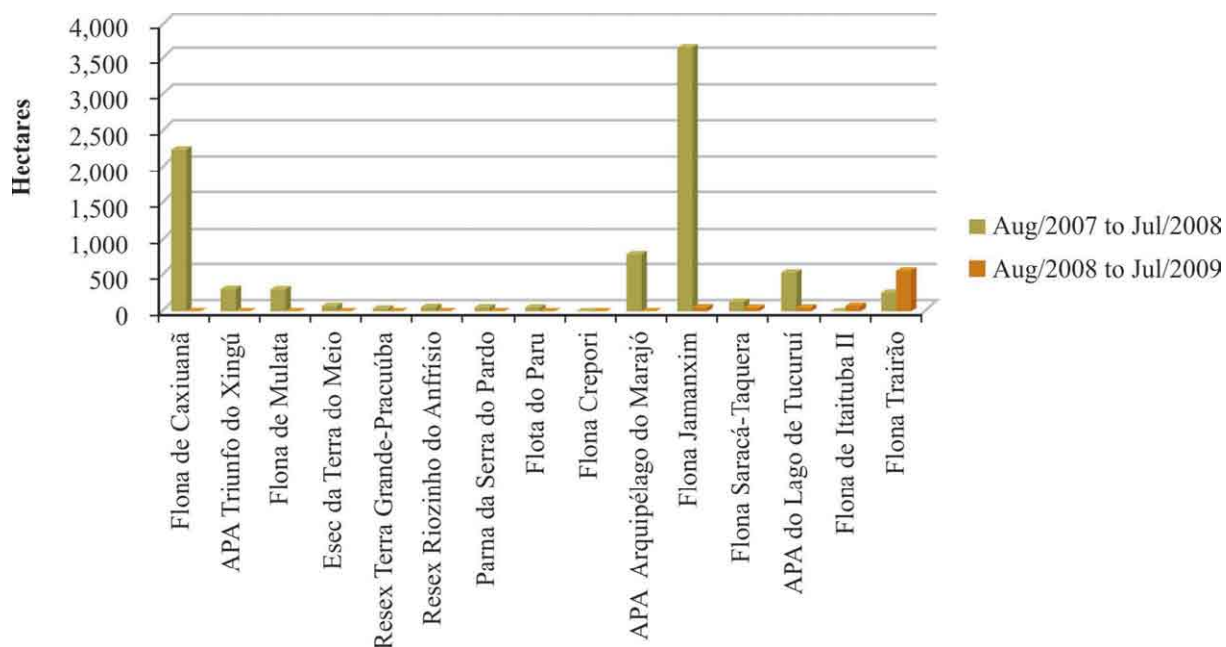


Figure 9. Comparison of Conservation Units with the largest areas logged without authorization in the State of Pará from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex).

In the UCs (Conservation Units) in Pará, 785 hectares of illegally logged forest were detected from August, 2008 to July, 2009. The greatest proportion was in the Flona (National Forest) Trairão, with 70% of the total. There was also non-authorized logging in the Flona Itaituba (9%), APA (Environmental Protection Area) Lago de Tucuruí (7%), Flona Saracá-Taquera (6%) and Flona Jamanxim (5%) (Figure 8).

Illegal logging in UCs diminished for the last period (August, 2008 to July, 2009) when compared to the previous period (August, 2007 to July, 2008). The most significant reductions were observed in Flona Jamanxim (3,605 hectares) and Flona de Caxiuanã (2,239 hectares). On the other hand, the Flonas in Trairão, Itaituba II and Crepori, which had not been recorded for the previous period, entered the list during the current period (Figure 9).

Settlements

In land reform settlements in Pará, timber harvesting without authorization occurring from August, 2008 to July, 2009 encompassed 10,334 hectares of forest. The situation was most critical in PAC (Collective Settlement Project) Ouro Branco I (15% of the total harvested), in the municipality

of Uruará, and PDS (Project for Sustainable Development) Liberdade (12%), in Portel (Figure 10).

In the majority of settlements where logging without authorization was identified for the period of August, 2008 to July, 2009 there was a reduction of this illegal activity in relation to the previous period (August, 2007 to July, 2008). However, in the PAs (Settlement Projects) of São Paulo das Cachoeiras, Bom Futuro and Águia and in PDS Mário Braule there was an increase in the area logged without authorization (Figure 11).

Legal Regularity for the Authorized Areas

We evaluated the regularity or consistency of the AUTEFs and timber credits issued from January to December, 2009 and made available by Sema for the forest control systems.

In that period 170 AUTEFs were approved of a total of 165 forest management plans covering 157,229 hectares. Of those, the majority (91%) presented no problems, while 9% revealed inconsistencies (Figures 12 and 13), such as:

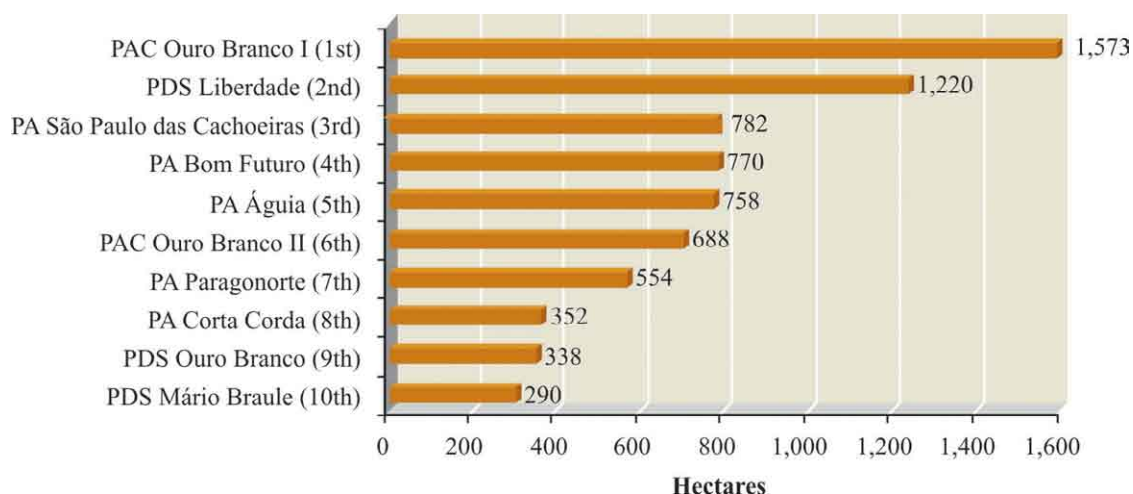


Figure 10. Land reform settlements with the largest areas logged without authorization in the State of Pará entre August/2008 and July/2009 (Source: Imazon/Simex).

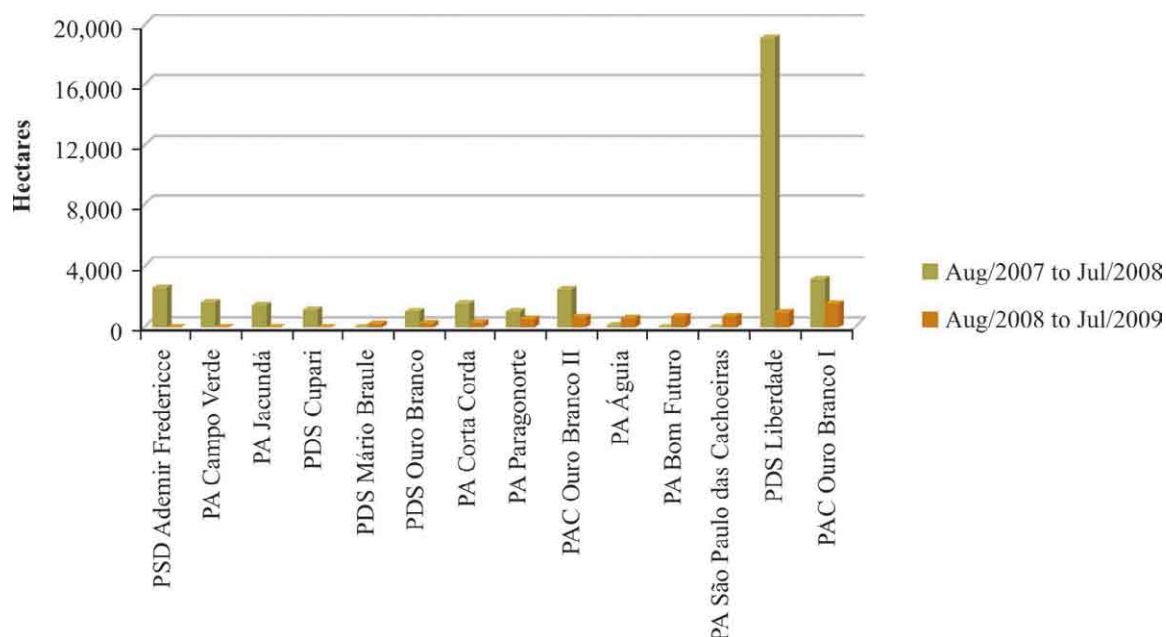


Figure 11. Comparison of Land reform settlements with the largest areas logged without authorization in the State of Pará from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex).

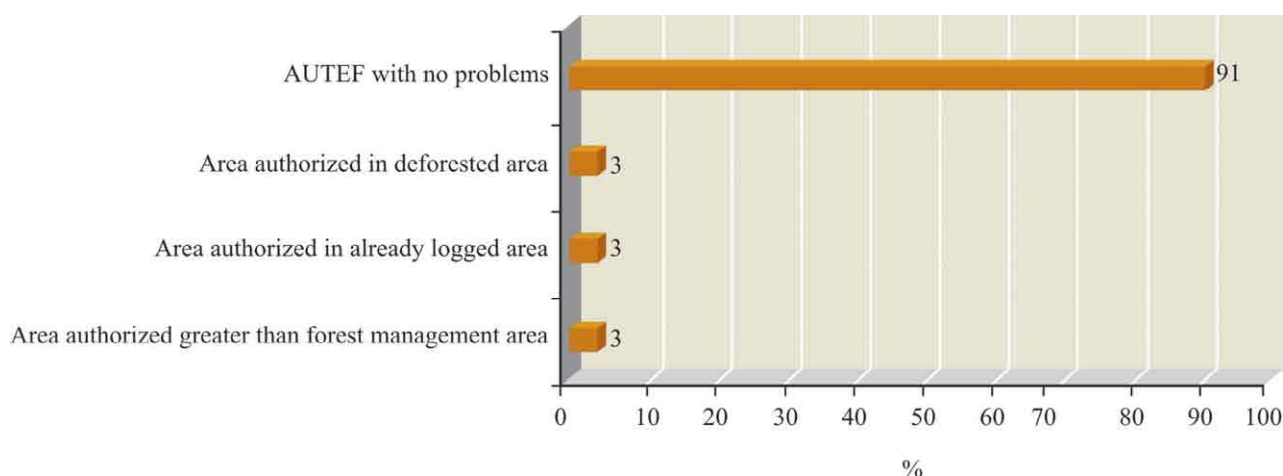


Figure 12. Evaluation of consistency in information from AUTEFS in 2009 in Sema/PA forest control systems (Source: Imazon/Simex).

- i. *Area authorized in a deforested area.* Around 3% of the cases evaluated (6,680 hectares) corresponded to authorization for forest management in a partly deforested area.
 - ii. *Area authorized in harvested area.* In 3% of the cases evaluated (5,386 hectares) harvesting was authorized for an area already harvested for timber.
 - iii. *Area authorized greater than forest management area.* In 3% of the cases (4,659 hectares) the area authorized was greater than the total area in forest management.
- We found that in 2008 and 2009 the proportion of AUTEFs with inconsistencies was reduced by: 76% for cases with Area authorized in a deforested

area; 53% for those with area authorized in a harvested area; 53% for those with area authorized greater than management area; and 100% for those with credit commercialized greater than that authorized (Figure 14).

We selected 187 AUTEFs operational in 2008 and 2009 with potential for being evaluated using satellite images, meaning, authorizations issued

before the date of image capture by the satellite. The images revealed that 49% (66,327 hectares) of that total present no problems; 20% (23,732 hectares) revealed inconsistencies (Figure 15 and 16); and in the remaining 31% (55,402 hectares) it was not possible to do the analysis because of cloud cover, meaning that there was a lack of quality images. We next describe the situation in the areas under forest management according to the satellite images analyzed:

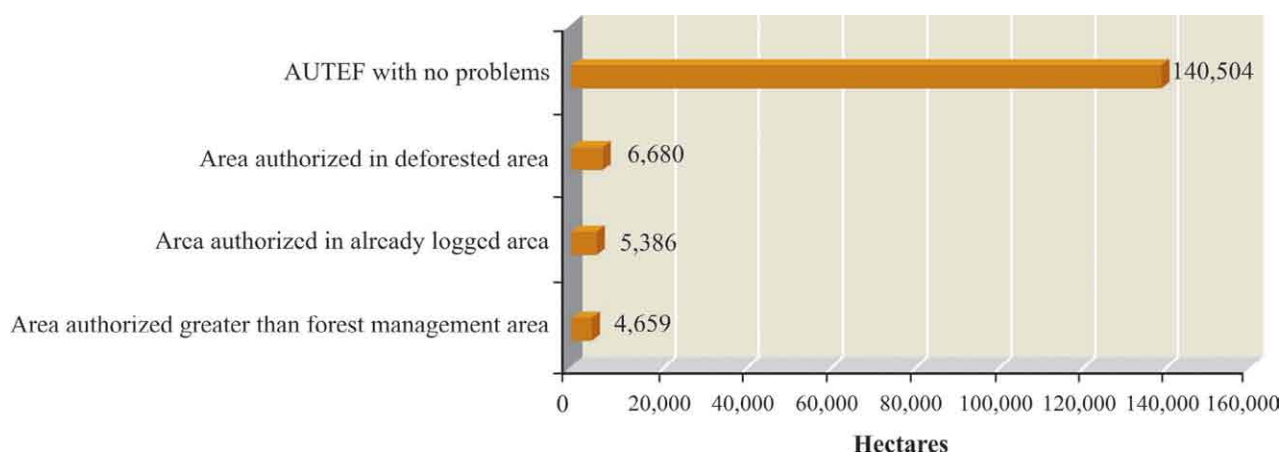


Figure 13. Evaluation of consistency in information from AUTEFS in 2009 (in hectares) in Sema/PA forest control systems (Source: Imazon/Simex).

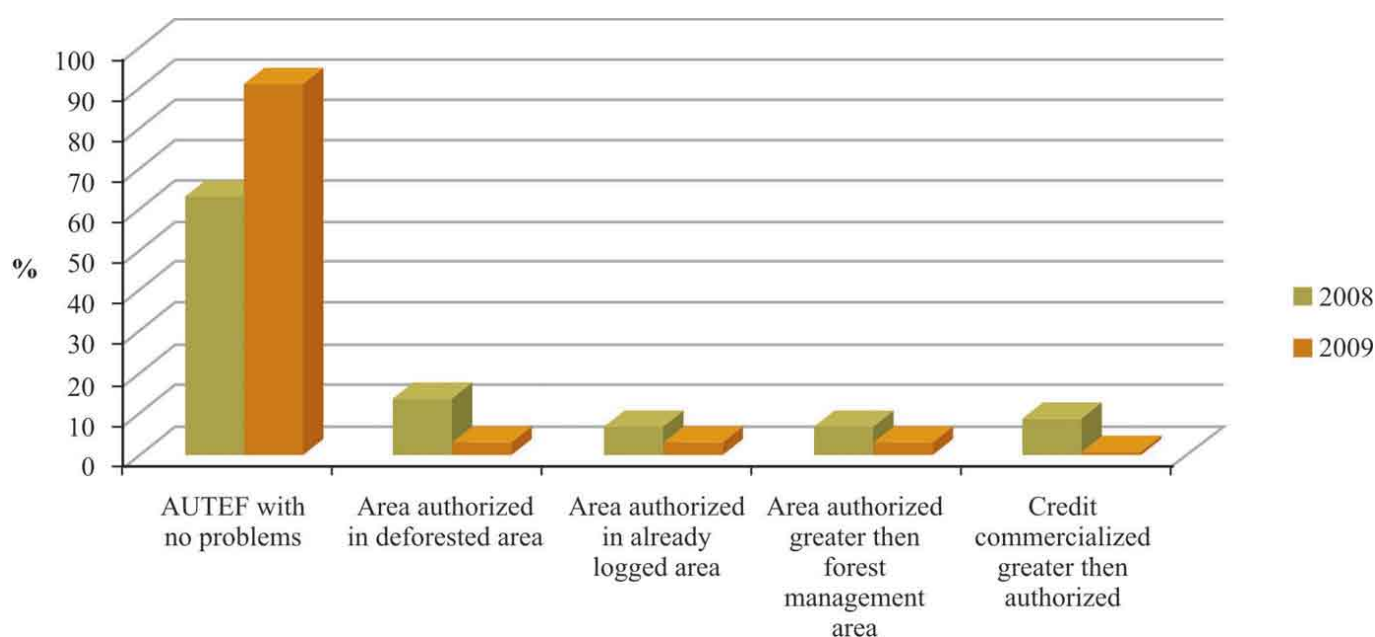


Figure 14. Comparison of situation with AUTEFs in 2008 and 2009.



- i. *No signs of timber harvesting.* No logging scars were identified in the images for the period in which logging authorization as valid. However, timber sold with reference to that authorization was verified. We identified 19% (21,030 hectares) of the cases with this problem.
- ii. *Area deforested before authorization.* In 1% (2,702 hectares) of the cases the area licensed for forest management was deforested before receiving authorization.

When we compared the AUTEFs with inconsistencies for the periods analyzed (August, 2007 to July, 2008 and August, 2008 to July, 2009), we observed a 100% reduction in the cases of areas harvested above the limits authorized, of harvesting carried out before authorization and of plans overlapping Protected Areas. The proportion of cases with area deforested before authorization remained stable (2%) for both periods (Figure 17).

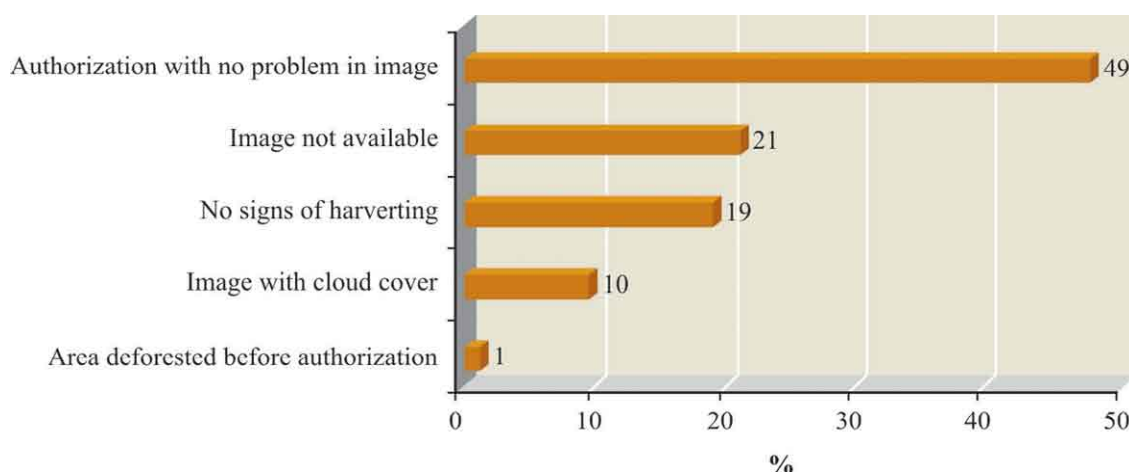


Figure 15. Forest management situation in the State of Pará in 2008 and 2009, obtained by integrating information from Sema/PA control systems with satellite images (Source: Imazon/Simex).

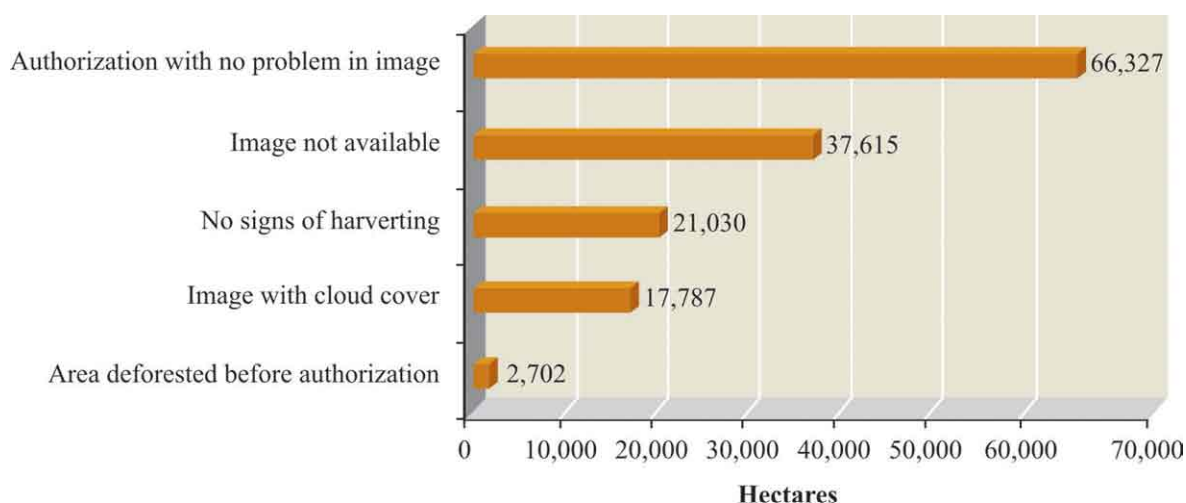


Figure 16. Forest management situation in the State of Pará in 2008 and 2009, in hectares, obtained by integrating information from Sema/PA control systems with satellite images (Source: Imazon/SIMEX).

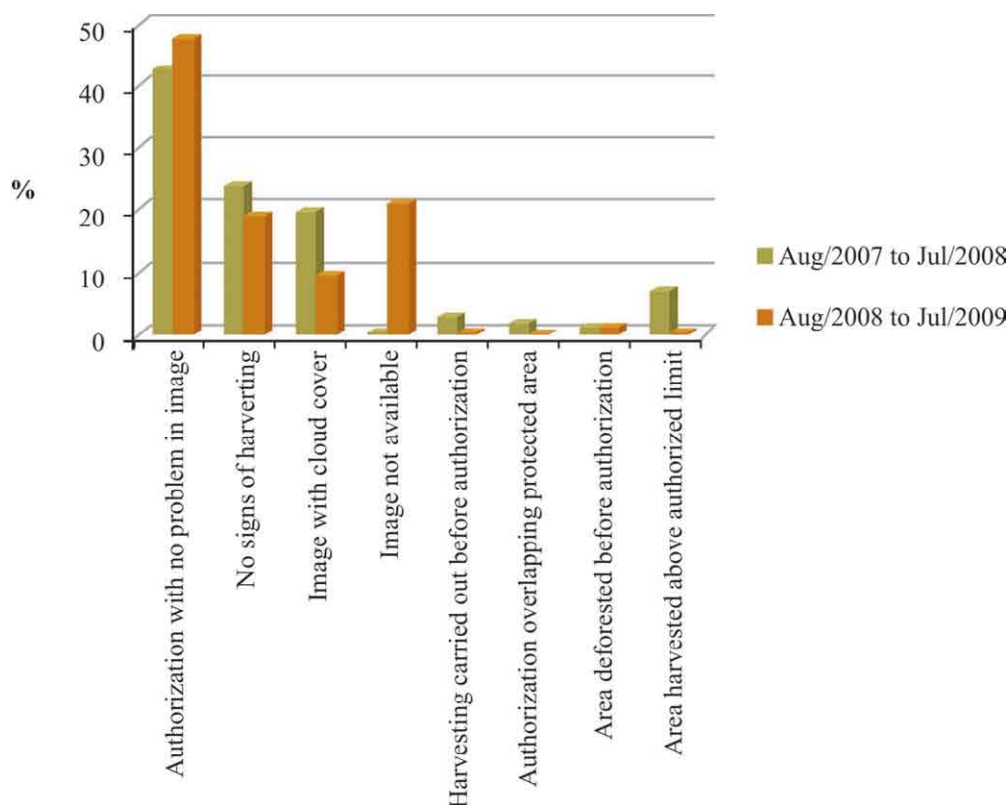


Figure 17. Comparison of the forest management situation in the State of Pará from August/2007 to July/2008 and August/2008 to July/2009, obtained by integrating information from Sema/PA control systems with satellite images (Source: Imazon/Simex).

Quality of Timber Harvesting

We evaluated timber harvesting in the NDFI images (Box 1), for which we determined quality thresholds⁵, such that: $NDFI \leq 0.84$ represents low quality logging (predatory logging); $NDFI = 0.85-0.89$, intermediate quality logging (there was an attempt at adopting management, but the configurations of roads, log landings and clearings reveal serious problems with execution); and $NDFI \geq 0.90$, good quality logging, meaning that the configurations of roads, log landings and clearings shows a pattern of managed logging.

From the forest management plans operational from 2008 and 2009, we selected 59 (55,689

hectares) in whose images it was possible to visualize scars from timber harvesting and evaluate the logging quality from the images. Of those, 14% presented good quality, 64% presented intermediate quality and 22% were classified as being low quality (predatory logging). In terms of the area harvested, 6,781 hectares were classified as being good quality; 36,155 hectares, as of intermediate quality; and 12,753 hectares, as of low quality (Figure 18).

Comparing the quality of timber harvesting for the two periods analyzed in this study, we observed a reduction in the area with good quality logging, a significant increase in the area with intermediate quality logging and a slight increase in the area with low quality logging (Figure 19).

⁵ Monteiro, A; Brandão Jr., A; Souza Jr., C; Ribeiro, J.; Balieiro, C; Veríssimo, A. Identificação de áreas para produção florestal sustentável no noroeste do Mato Grosso. 2008. Imazon, Belém. ISBN: 978-85-86212-24-6. 68p

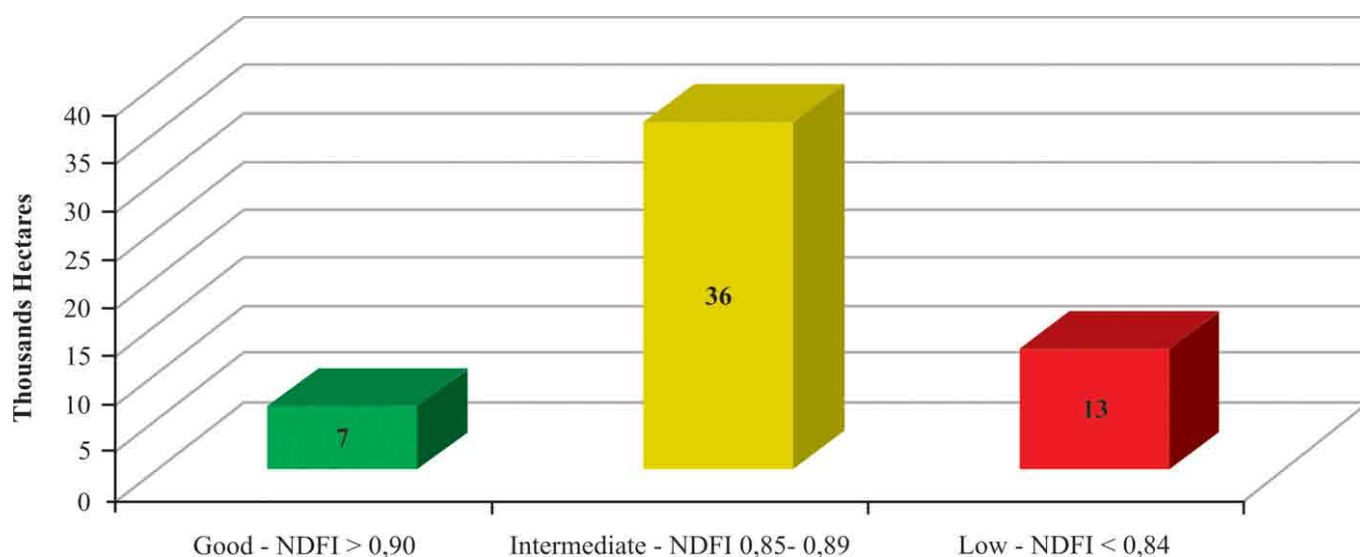


Figure 18. Quality, in area, of timber harvesting in 59 forest management plans in the State of Pará, evaluated using satellite images (Source: Imazon/Simex).

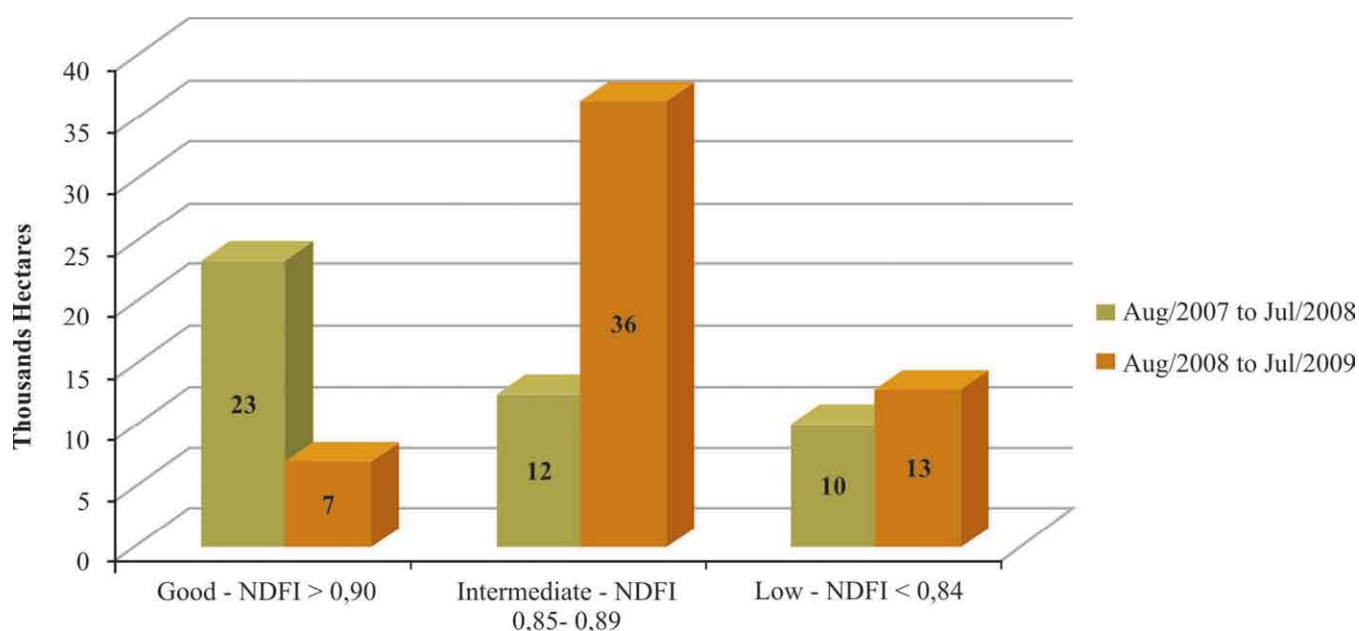


Figure 19. Comparison of quality, in area, of timber harvesting carried out from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex).

Maintenance of Forest Management Areas

We analyzed in satellite images from 2009 if the areas of the forest management plans operation from August, 2007 to July, 2008 are

being maintained for the next cutting cycle⁶. Of 235 forest management plans evaluated in that period (187,980 hectares), in 97% (173,435 hectares) the areas remain conserved and the remaining 3% (14,545 hectares) have already been deforested (clear cut) (Figure 20).

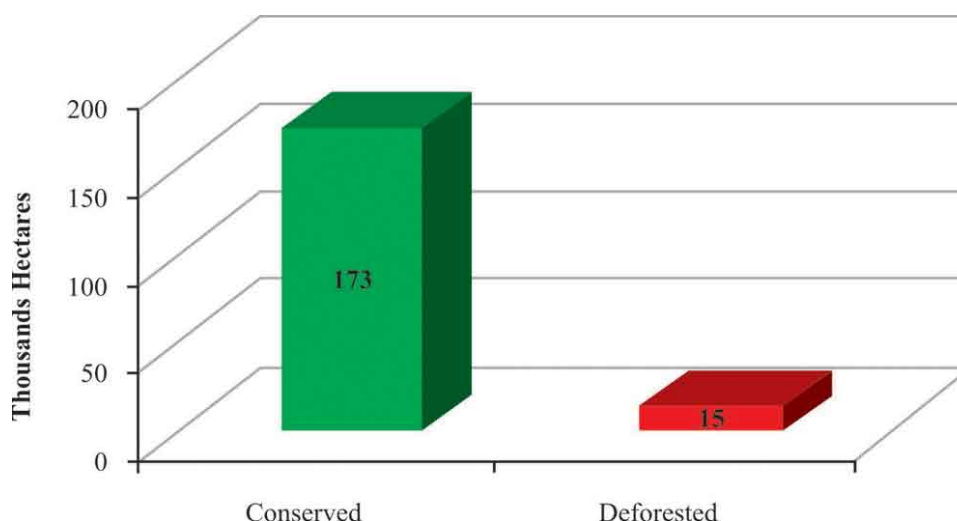


Figure 20. Situation of the forest management areas from August/2007 to July/2008 evaluated in images from 2009.

⁶ Cutting cycle is the minimum time for returning to the same area to harvest timber. This time is estimated at 30 years (Amaral, P., Veríssimo, A., Barreto, P., Vidal, E. Floresta para Sempre. Manual de Produção de Madeira na Amazônia. Imazon: Belém, 2008, 137p.).



Box 1. System for Monitoring Timber Harvesting – Simex

Simex was developed by Imazon for monitoring forest management and non-authorized timber harvesting. The system utilizes Landsat 5 images (with 30 meters of spatial resolution) to detect select logging, although it can be applied to other optic sensors (SPOT, ASTER and ALOS-VNIR).

The Landsat images are processed to generate a spectral mix model (abundance of vegetation, soils, shadow and NPV - Non-Photosynthetic Vegetation) and later to calculate the NDFI⁷ (Normalized Difference Fraction Index), defined by:

$$\text{NDFI} = \frac{(\text{VEGnorm} - (\text{NPV} + \text{Soils}))}{(\text{VEGnorm} + \text{NPV} + \text{Soils})}$$

Where VEGnorm is the vegetation component normalized for shadow, determined by:

$$\text{VEGnorm} = \text{VEG} / (1 - \text{Shadow})$$

The information extracted from the satellite images is crossed information from Simlam and

Sisflora to evaluate the situation of licensed management plans⁸. First, documentation available on forest control systems is analyzed in order to identify possible inconsistencies. Next, the forest management plans are evaluated, overlaying their boundaries on the satellite images. Later on that information is associated with information from the forest control systems. Simex makes it possible to evaluate the occurrence of: i) area authorized in a deforested area; ii) area authorized in a previously logged area; iii) area authorized greater than the management area; iv) credit commercialized greater than that authorized; v) area with no signs of logging; vi) area logged above the authorized limit; vii) area deforested before authorization; viii) management carried out before authorization; and ix) plan overlapping Protected Area. Simex enables identification of evidence in irregularity in licensing and in carrying out forest management, meaning, the consistency of licensing and the degree of adoption of forest management. For example, plans with few inconsistencies and errors in licensing but with evidence of low implementation of management practices, need to be verified in the field to identify problems in execution.

Box 2. Program for Supporting Forest Management - Pamflor

On November 27, 2009 Decree number 1.976 creating the Program for Supporting Forest Management–Pamflor was signed. This program is designed to promote and support development of sustainable forest management in the State of Pará (http://www.ioepa.com.br/site/mat/mostraMateria2.asp?ID_materia=353437&ID_tipo=21). Pamflor is managed by an Executive Committee made up of Sema/PA,

Ideflor (Institute for Forest Development), Fiepa (Industrial Federation of the State of Pará), Imazon (Institute for People and the Environment in the Amazon), Apef/PA (Professional Association of Forest Engineers in Pará) and IFT (Tropical Forest Institute). In this program, Imazon has the task of remote monitoring of forest management plans in the State of Pará.

⁷ Souza Jr., C; Roberts, D. A; Cochrane, M. A. Combining spectral and spatial information to map canopy damage from selective logging and forest fires. *Remote Sensing of Environment* 98, 2005, 329-343.

⁸ Monteiro, A. & Souza Jr., C. Imagens de satélite para avaliar planos de manejo florestal. *O Estado da Amazônia* n.9. Imazon: Belém. 4p.

Project Team:

General Coordination: André Monteiro, Dalton Cardoso, Denis Conrado, Adalberto Veríssimo and Carlos Souza Jr.

Data source:

Statistics on timber harvesting are generated from Imazon data;

Data from Sema-PA (Simlam and Sisflora)
<http://monitoramento.sema.pa.gov.br/simlam/>
<http://monitoramento.sema.pa.gov.br/sisflora/>

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Brazilian Institute for the Environment and Renewable Natural Resources (Ibama)
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Federal Public Prosecution Service in Pará (MPF)