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Monitoring Soy Plantations in the Amazon Biome – the Soy Moratorium Initiative

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Abstract: The Soy Moratorium is an initiative to reduce deforestation in the Amazon Biome based on the hypothesis that soybeans are a deforestation driver. Farmers who planted soybeans in that Biome, in areas opened after its declaration on July 24th, 2006, would not have their production traded or financed through purchases or crop financing by the member companies of the Brazilian Vegetable Oil Industries Association (ABIOVE) and the National Grain Exporters Association (ANEC). These two Associations represent about 90% of Brazil's soybean market. Brazil has a long-term project that uses remote sensing images to monitor yearly deforestation in the Brazilian Amazon Biome (www.prodes.inpe.br). Over 98% of the soybeans planted in this Biome are concentrated in 53 towns, where a total of 3,571 fields with over 25 hectares (62 acres), a total area of 375,500 hectares (1,450 sq.miles), were deforested from mid-2006 to mid-2010. Each of these deforested fields was monitored early in the crop season to detect the rapid growth of annual summer crops (green up) on the high temporal resolution images of the MODIS sensor, showing the presence of an annual crop. Of the deforested fields, 293 fields (8.2%) were found to have annual crops, based on the analysis of MODIS images supported by available Landsat images. After the aerial survey, soybeans were detected in 146 of the 293 pre-selected fields, covering an area of 11,698 hectares (45 sq.miles) of soy plantations in crop year 2010/11. This area corresponds to 0.39% of the fields deforested in the Amazon Biome during the Soy Moratorium. In terms of total soybean acreage in Brazil and in the Amazon Biome, the 11,698 hectares represent 0.05% and 0.60%, respectively. It is difficult to conclude whether the Soy Moratorium is actually having an inhibitory effect on recent deforestation in the Amazon Biome but, from the figures, it is quite evident that the soy crop was not a significant deforestation driver during the Soy Moratorium. The present work demonstrates that geotechnology can significantly contribute to the governance process of Brazilian natural resources.

Keywords: Remote sensing, Annual crops, Deforestation, Amazon Forest, MODIS.

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1. Introduction

The process of colonizing the Brazilian Amazon, started in the 1960s, intensified in the following two decades due to the creation of public policies to stimulate occupation of the region, such as *Avança Brasil* (Forward Brazil) and *PRÓ-TERRA: Programa de Redistribuição de Terras e de Estímulo à Agroindústria do Norte* (Program for Land Redistribution and Stimulation of Agribusiness in the North). The objective of these programs was to people the region through creation of better working conditions in the field, to foment agribusiness and to provide the necessary infrastructure (roads, energy and the distribution of energy, expansion of telecommunication networks, etc.) to develop the Amazon and integrate the region into the domestic economy. At the same time, the government offered tax incentives and credits for developing agriculture and livestock farming [1-2] and the lumber industry, with consequent deforestation on a large scale [3]. With the start of an economic recession at the end of the 1980s and the beginning of the 1990s, the government reduced tax incentives, which resulted in a fall in the Amazon's deforestation rates that went from ~20,400 sq.kilometers (7,876 sq.miles) a year in the 1980s to ~13,700 sq.kilometers (5,290 sq.miles) a year between 1990 and 1994. With the introduction of the *Plano Real* economic plan in 1994 and the stabilization of the Brazilian economy, offers of credits with low interest rates increased and this, together with new government investments in infrastructure, led to an increase in deforestation, which reached 27,772 sq.kilometers (10,723 sq.miles) in 2004 [2,4-8].

Several works have dealt with the Amazon deforestation problem, showing its direct causal relationship with the expansion of agriculture and livestock farming, especially cattle farming [2,9-11] and soybean production [12-17]. In this context, Greenpeace led a campaign for the conservation and reduction of deforestation in the Amazon Biome, entitled "*Eating up the Amazon*" [18]. The scope of this campaign included publication of a report revealing that approximately one-quarter of the soybeans harvested in the Amazon were used in feed for chickens that were later traded by the big fast-food chains.

Because of the repercussion this evidence had on the international scenario, several fronts, especially the importer markets, pressured the productive soy chain sector to include in their agenda a commitment to preserve the forests. Consequently, in July 2006, Brazilian Vegetable Oil Industries Association (ABIOVE) and National Grain Exporters Association (ANEC) announced the signing of the Soy Moratorium, an agreement that committed the member companies of ABIOVE and ANEC not to purchase soybeans produced in areas of the Amazon Biome that were deforested after July 2006 [19-20].

Soon after the declaration of the Soy Moratorium, in October 2006, the Soy Task Force (GTS) was formed, consisting of representatives from the soy productive chain sector (ABIOVE, ADM, ANEC, Algar Agro, Amaggi, Baldo, Bunge, Cargill, IMCOPA, Louis Dreyfus and Óleos Menu) and from the civil society (Greenpeace, International Conservation, IPAM, The Nature Conservancy and WWF-Brasil). The GTS mission was to plan and coordinate the Soy Moratorium's activities. In addition to the Coordination Group, the Soy Moratorium also had the following three subgroups:

i) EDUCATION, INFORMATION & FOREST CODE: This subgroup disseminates the adoption of good soybean production practices in the Amazon Biome. It ensures that the actions generated by the Soy Moratorium reach the rural producers and the other economic, social and political agents involved, mainly those with local relevance, and contributes to agribusiness keeping the proper balance between economic and social-environmental needs, thus ensuring compliance with legislation;

ii) INSTITUTIONAL RELATIONS: This subgroup brings the GTS closer to the members of government entities, with a view to improving sustainable development policies for the Amazon Biome and to stimulating legislative advancements to improve the region's command and control mechanisms;

iii) MAPPING & MONITORING: This subgroup supports the development of a system to map and monitor the Amazon Biome, defining the methods and the criteria necessary to assure compliance with the commitment not to trade soybeans originating in deforested areas.

Over the last few years, institutions such as the Ministry of the Environment, Banco do Brasil and National Institute for Space Research (INPE) began to collaborate with the Soy Moratorium. Starting in 2009, INPE assumed the responsibility for developing and applying a methodology for monitoring soy plantations in deforested areas of the Amazon Biome through the use of satellite images.

It is worth highlighting the fact that, since the Moratorium's inception in 2006, the Brazilian government has implemented a comprehensive set of measures to fight illegal deforestation in the country, mainly in the North Region. These public policies include the Ecologic-Economic Zoning (ZEE) established by the states, a listing of degrading working conditions kept by the Ministry of Labor, a listing of embargoed areas kept by the Ministry of the Environment, reinforcement of supervision by environmental entities and a big advance in real-time monitoring of deforestation and forest fires using satellite images. With the use and expansion of these new tools, the improvement in public governance over the last five years has been very significant.

In this panorama, the objective of this work is to report the methodology and the results of the fourth year of monitoring and mapping soybean plantations in deforested areas of the Amazon Biome.

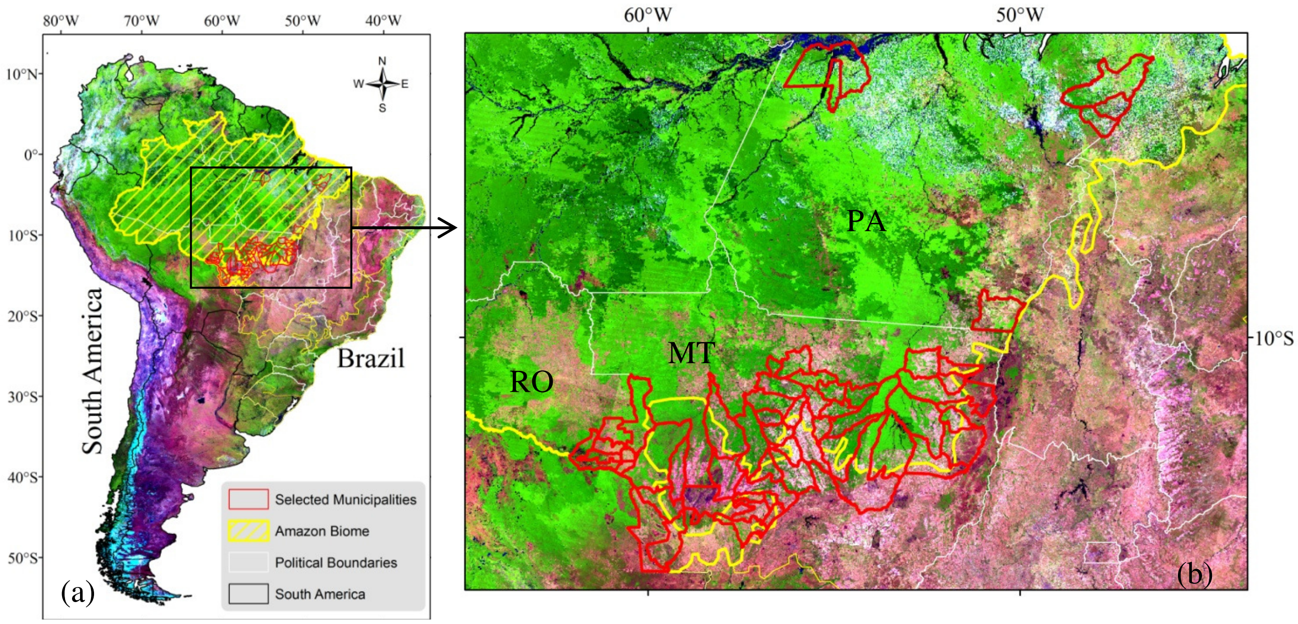
2. Material and Methods

2.1. Study area

The study area is the Amazon Biome, which covers nine states with 553 towns and an area of 4.2 million square kilometers (1.6 sq.miles), representing approximately half of Brazil's territory. This Biome is made up of the world's largest tropical rain forest, with a very significant biodiversity and quantity of carbon accumulated in the form of biomass. According to [21], the quantity of carbon stored in the Amazon in the form of biomass is equivalent to 15 years of anthropic emissions of carbon dioxide (CO_2) at current emission levels. Currently, 7.5% of Brazil's soybeans [22] are grown in the Amazon Biome, in the States of Mato Grosso (MT), Rondônia (RO) and Pará (PA), which have 99% of the production area.

To select the municipalities that should be monitored, one criterion was a minimum area of 5,000 hectares (19 sq.miles) planted with soybeans, according to the survey made by Brazilian Geographic & Statistical Institute (IBGE). In this way, for the year 2011, 53 towns (41 in MT, 6 in RO and 6 in PA) were selected, representing 98% of the Amazon Biome acreage planted with soybeans (Figure 1).

Figure 1. (a) Location of the study area, highlighting the Amazon Biome. **(b)** 53 municipalities that planted soybeans on over 5,000 hectares in the Amazon Biome.



2.2. Preprocessing of deforested polygons - PRODES

Program for Amazon Deforestation Calculations (PRODES), developed and conducted by INPE, identifies and monitoring the deforested polygons in the Amazon region. The international scientific community considers PRODES to be the world's major tropical forest monitoring program. Since 1988, INPE has monitored, mapped and estimated the annual deforestation rate for Brazil's entire Legal Amazon region. Starting in 2002, the deforestation mapping procedure converted to a digital system, in which Landsat images are automatically classified and later edited through visual interpretation on a computer screen. Deforestation maps are inserted into a georeferenced data bank and made available on the internet (http://www.obt.inpe.br/prodes/) [5,23-24]. Table 1 shows the data supplied by PRODES for MT, RO and PA states, related to deforested areas in the Amazon Biome during the Soy Moratorium.

Table 1. Total annual deforested area, in hectares, in MT, RO and PA states for the period since the inception of the Soy Moratorium in the Amazon Biome.

State	Year of evaluation during the Soy Moratorium*				
	2007	2008	2009	2010	Subtotal
MT	237,142	317,123	68,438	65,757	**688,460**
RO	161,100	113,600	48,200	43,500	**366,400**
PA	552,600	560,700	428,100	377,000	**1,918,400**
Subtotal	**950,842**	**991,423**	**544,738**	**486,257**	**2,973,260**

* The PRODES mapping year refers to the period from August of the prior year to July of the year in question. For example, the data for 2007 refer to the deforestation observed in images from August 2006 to July 2007. Source: Adapted from [5]

All the polygons deforested between 2007 and 2010, related to MT, RO and PA states, were selected from the PRODES data bank. Then, the deforested polygons mapped by PRODES were intersected with the boundaries of the selected towns and the Amazon Biome, in order to select only those deforested polygons located in the Amazon Biome and the previously selected towns.

The GTS agreed to accompany all polygons with an area equal to or greater than 25 hectares (62 acres), since the method for identifying polygons with agricultural crops is based on images from MODIS, the Moderate Resolution Imaging Spectroradiometer sensor on board Earth satellites with a moderate spatial resolution (250x250 meters, or 820x820 ft). However, smaller areas of deforestation that begin in specific spots very often are not isolated events that occur in a single year, but gradually increase through deforestation of adjacent areas in the following years, thus forming a larger deforested area [1, 19, 25]. Therefore, annual deforested areas of less than 25 hectares (62 acres) are now monitored when the sum of annual and adjacent deforested areas is equal to or greater than 25 hectares. For this reason, adjacent polygons were aggregated, according to the methodology described by [19].

2.3. Selection of polygons with agricultural crops through satellite images

Because of the high probability of cloud formations over the Brazilian Amazon [26-27] during key periods for identification of soybean plantations in optical remote sensing images, mapping this crop through temporal resolution images similar to Landsat images (16 days) is not operationally feasible. Part of this difficulty can be resolved with the use of images from high temporal resolution sensors, thus increasing the probability of obtaining cloud-free images. In this sense, the MODIS sensor is an alternative as it has an almost daily temporal resolution and moderate spatial resolution (250 meters, or 820 ft), as well as a geometric [28] and radiometric [29] qualities that produce images in 36 spectral bands, with products generated by means of tested algorithms and the generation of validated products [30]. Allying the geometric quality of the images, which allows the composition of temporal series with guaranteed pixel geolocation, with the attributes of the radiometric and spectral quality of validated products, one can ensure that the MODIS data is of good quality [28,31-32].

Deforested polygons with signs of agricultural crops were selected under the Crop Enhancement Index (CEI) methodology, proposed by [36], as presented by [19]. CEI considers the Enhanced Vegetation Index (EVI) [37] values of the MODIS images acquired in the periods of minimum and maximum EVI values, those observed in the off-season and during the agricultural crop's maximum development, respectively.

Within the scope of the Soy Moratorium, this method had to be adapted in terms of the MODIS images chosen to obtain maximum EVI value. Detection of annual crops in deforested polygons needs to occur during the phase before the agricultural crops reach maximum EVI but after they are already green up due, to the significant variation between minimum and maximum EVI values (Figure 2). This is important so that the following stages of aerial surveys and field work are done on a timely basis, before the harvest. With the experience acquired in the first monitoring cycle that used remote sensing images, i.e., in the crop year 2010/2011, it became apparent that the soybean planting period was similar in MT and RO states, but different in PA state. Considering the MT and RO soybean planting window, the EVI maximum values were obtained based on an analysis of MODIS images (MOD09 product, 8-day composition) acquired in the period from December 18, 2010 to March 5, 2011. To refine the MODIS-image analysis, the selected polygons were submitted to a visual interpretation based on cloud-free images acquired by the Landsat satellites (TM and ETM+ sensors) and Resourcesat-1 (AWIFS and LISS3 sensors). However, this refinement can only be made for polygons where cloud-free images are available. In this respect, the 2010/2011 crop year was particularly favorable.

In the 2010/2011 crop year, deforested polygons in settlements, indigenous lands and conservation units were also monitored to verify the presence of agricultural crops.

2.4. Identification of areas planted with soybeans in the selected polygons

The polygons with evidence of annual agricultural crops, selected using satellite images, were subjected to overflights using airplanes equipped with GPS, computers and photographic equipment to obtain panoramic photographs. In the panoramic photographs of the polygons selected for overflights, the occurrence of soybeans was identified and mapped, together with other land uses, in accordance with the following definitions: (1) soybeans and/or rice and/or corn: areas planted partially or totally with soybeans and/or rice and/or corn; (2) deforestation: areas whose native vegetation was exploited, with the forest cleared totally or partially; (3) forest: areas with native vegetation in different stages of succession, but which can be altered by anthropic activities; (4) pasture: areas with pastures for livestock activities; (5) slash-and-burn: areas with scars from recent fires; (6) reforestation: areas planted with eucalyptus or pine forests; (7) natural regeneration: areas that became fallow after deforestation or slash-and-burn activities and which now have native species developing naturally. To complete this work, 157 hours of aerial monitoring were carried out between December 21, 2010 and April 19, 2011, a total of 20,400 kilometers (12,677 miles) in 29 municipalities in MT, RO and PA states.

3. Results and Discussion

In the Amazon Biome, soybeans are grown in the states of MT, RO and PA, which together are responsible for 78.7% of the deforestation mapped by PRODES since the start of the Soy Moratorium [5]. In these three states, 53 towns answer for 98% of soy planting and for 13.2% of the deforestation in the Amazon Biome. Table 2 shows the number and area in hectares of the deforested polygons mapped by PRODES since the start of the Soy Moratorium, before and after the aggregation of adjacent polygons. The results shown in Table 2 are presented by class of deforestation, areas of less and more than 25 hectares (62 acres). The methodology defined that polygons with less than 25 hectares are not monitored. Table 2 shows that, after aggregation, polygons in the less-than-25-hectares class decreased in number and, consequently, in area. This means that the area of polygons with an area equal to or greater than 25 hectares increased

16.9% after aggregation, agreeing with what is shown in [1,25]. Table 2 further shows that the total area of deforested polygons in the study area, before and after aggregation, is practically the same and corresponds to about 486,000 hectares (1,876 sq.miles). Of this total, the area effectively monitored was 375,500 hectares (1,450 sq.miles), divided into 3,571 polygons of 25 or more hectares (62 acres). In other words, 77.3% of the deforested area was monitored, and the remaining 22.7% that was not monitored corresponds to deforestation in polygons of less than 25 hectares.

Table 2. Number (n) of polygons and deforested area (ha) for classes with areas less than 25 hectares and equal to or greater than 25 hectares, before and after aggregation of polygons with adjacent deforestation.

Class of Deforestation	Before Aggregation (a)		After Aggregation (b)		Variation {(b-a)/a}	
	Number (n)	Area (ha)	Number (n)	Area (ha)	Number (n)	Area (ha)
<25 ha	12,579	165,156	8,470	110,612	-32.7%	-33.0%
≥25 ha	3,618	321,079	3,571	375,500	-1.3%	16.9%
Total	16,197	486,234.66	12,041	486,112.16	-25.7%	0.0%

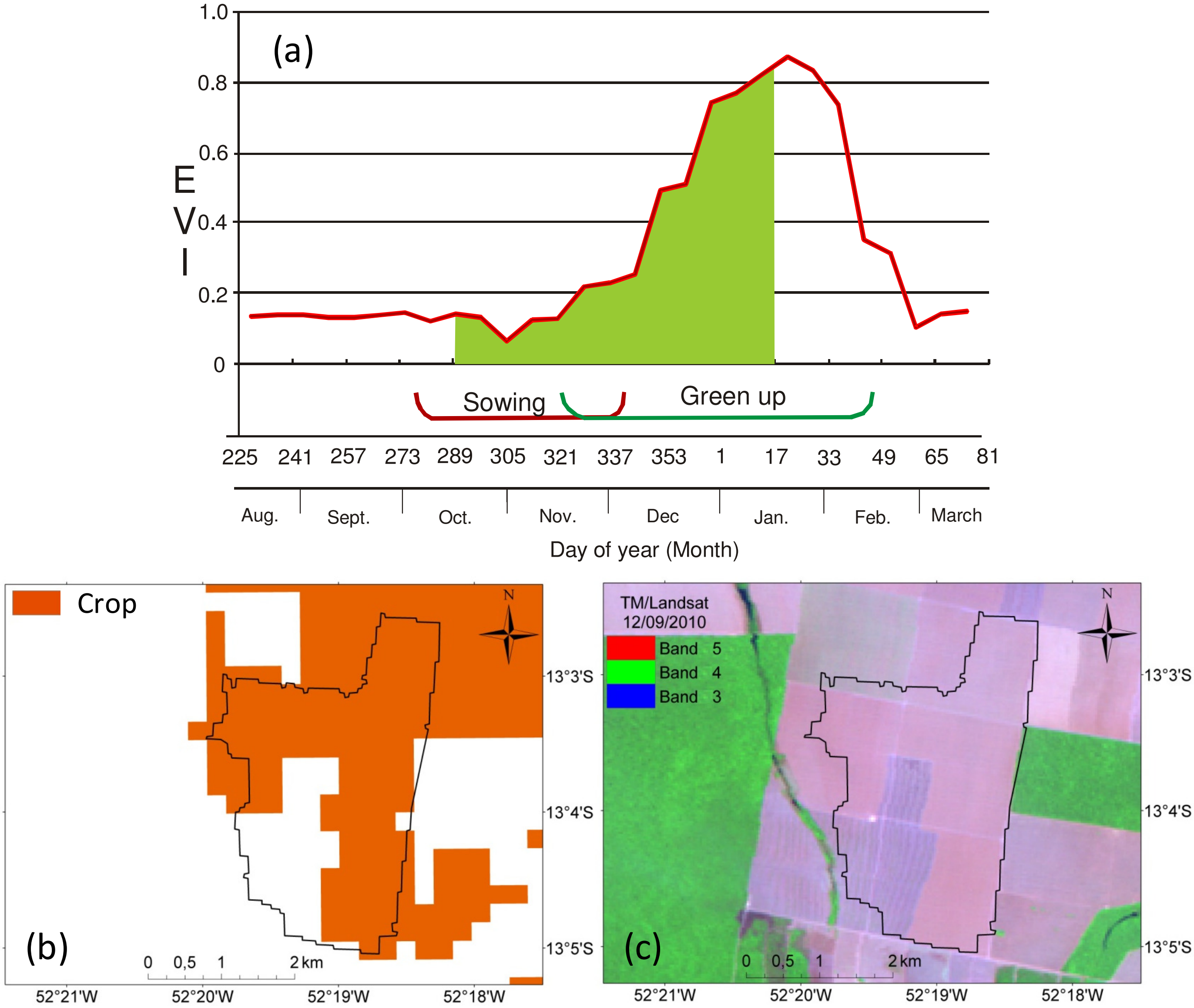
The 3,571 polygons with an area equal to or greater than 25 hectares (62 acres) were analyzed individually, based on the MODIS images and aided by Landsat images. Of this total, 3,236 polygons, corresponding to 90.6% of the deforested polygons, did not show any signs of an agricultural crop. In the remaining 335 polygons, the presence of an agricultural crop was identified (Table 3). Forty-two of the deforested polygons with the presence of an agricultural crop were located in settlements and were not selected for an overflight because the GTS participants agreed that the Soy Moratorium would not penalize agrarian reform settlers, based on the principle that economic development and social inclusion should walk hand-in-hand with environmental conservation. Therefore, 293 deforested polygons (8.2%) were selected for overflights. It should be pointed out that no deforested polygon with agricultural crop characteristics was found inside Indigenous Lands or Conservation Units.

Table 3. Number of deforested polygons with and without agricultural crops, per state.

Polygons	States			Total (%)
	MT	PA	RO	
Without agricultural crops	1,929	1,133	174	3,236 (90.6%)
With agricultural crops	191	78	1	270 (7.6%)
With agricultural crops – bordering settlements	23	0	0	23 (0.6%)
With agricultural crops – in settlements	42	0	0	42 (1.2%)
Total	2,185	1,211	175	3,571 (100%)

A typical example of the standard procedure used in MT state for selecting a deforested polygon with signs of agricultural crops is shown in Figure 2. Figure 2a shows the evolution of EVI vegetation index values, obtained from MODIS images from the planting in October through harvest in February of the following year, for the polygon's central pixel. The analysis period of the MODIS images to select this polygon is emphasized in Figure 2a (289th day of the year, October 15, 2010, to the 16th day of the following year, January 16, 2011). Figure 2b shows the presence of agricultural crops in the selected polygon, after classification by CEI. The TM image from Landsat-5 shown in Figure 2c, even though it was acquired after the soybean planting period, shows evidence that this polygon is an agricultural area, reinforcing its selection for an overflight.

Figure 2. **(a)** Graph of the evolution of EVI values. **(b)** Result of the MODIS images classification by the CEI method. **(c)** TM image used in visual interpretation.



From the aerial survey of the 293 selected polygons, soybean plantations were found in 146 polygons, corresponding to an area of 11,698 hectares (45 sq.miles) (Table 4), indicating a conversion of forest to soybeans in the Amazon Biome during the Soy Moratorium, which corresponds to: 0.28% of total deforestation; to 0.39% of the deforestation in the three states under evaluation; to 2.4% of the deforestation in the 53 towns that produce soybeans; or yet to 3.1% of the deforestation in areas equal to or greater than 25 hectares (62 acres) in these same towns.

Table 4. Number (n) of polygons with soybeans and soybean acreage in hectares (ha) by class of polygon, per state.

Classes	MT		PA		RO		Total	
(ha)	(n)	(ha)	(n)	(ha)	(n)	(ha)	(n)	(ha)
25 – 50	40	1,149	17	418	1	29	58	1,567
50 – 100	23	1,340	10	445	-	-	33	1,785
>100	42	5,896	13	2,421	-	-	55	8,346
Total	105	8,385	40	3,284	1	29	146	11,698

In MT state, 105 polygons were identified as not meeting the Soy Moratorium's requirements, representing 8,385 hectares (32 sq.miles) planted with soybeans (Table 4). This corresponds to 72% of the soybeans detected in this year's monitoring, but only 1.2% of the total deforested area in the Amazon Biome located in MT state (688,460 hectares, or 2,658 sq.miles) (Table 1). In PA state, 41 polygons were identified as having planted soybeans, representing 3,284 hectares (13 sq.miles) (Table 4). This corresponds to 28% of the soybeans detected in this year's monitoring, but only 0.17% of the deforested area in PA state (1,918,400 hectares, or 7,407 sq.miles) (Table 1). Only one polygon with soybeans was identified in RO state, representing 29 hectares (0.1 sq.miles) (Table 4) of a total deforested area of 366,400 hectares (1,415 sq.miles) (Table 1). It should be emphasized that, of the 293 polygons selected for aerial survey, 113 were classified as areas with over 100 hectares (0.4 sq.miles), of which 55 were identified as having planted soybeans. The soy acreage of these polygons was 8,346 hectares (32 sq.miles) (Table 4), which corresponds to 71% of the total soybeans planted in deforested areas, thus indicating that the great majority of soybean plantations in deforested polygons occurred in the over-100-hectares classification. Greater details on the selected and overflown polygons can be found in http://www.abiove.com.br/english/ss_relatoriouso10_us.asp.

Figure 3 shows the number of deforested polygons and the monitored area in each of the years evaluated under the Soy Moratorium. A comparison can only be made of the results of the first two years and of the second two years because the methodologies used in these two periods were very different. Figure 3 shows that, in the first Moratorium cycle, approximately 50,000 hectares (193 sq.miles) in 265 polygons were monitored, of which 195 had an area over 100 hectares (247 acres) and 70 were part of a small sample of polygons with areas less than 100 hectares. In the Soy Moratorium's second year, the monitored area increased to 158,000 hectares (610 sq.miles) in 560 polygons with more than 100 hectares, in addition to the sample of 70 polygons with an area smaller than 100 hectares, selected using the same criteria as those used in the first year.

Starting in the Soy Moratorium's third year (crop year 2009/2010), with the use of remote sensing images, all deforested polygons with an aggregated area larger than 25 hectares (62 acres) were monitored. Sixty-one polygons with over 100 hectares and 133 polygons with an area between 25 hectares and 100 hectares were selected for overflights (Figure 3) [19]. In the fourth year, there was an increase of 21% in monitored polygons and of 51% in the number of polygons selected for overflights, compared to the previous year (Table 5). There was an increase of 35% in the number of selected polygons with an area of between 25 hectares and 100 hectares, while in the over-100-hectares classification the increase was 85%, indicating a significant increase in the presence of agricultural crops in these polygons, compared with the prior year (Figure 3). An important factor associated with this increase is the longer length of time since the start of the Soy Moratorium, since in the first years after deforestation rice crops often precede soybeans, which are typically planted in the third year [14,38]. This can be seen from an analysis of the number of polygons with soybeans, which went from 76 to 146, an increase of 92%; while the area planted with soybeans increased from 6,295 hectares (24 sq.miles) to 11,698 hectares (45 sq.miles), an increase of about 86% (Table 5). This increase can be attributed to the following factors: (i) an increase in the monitored area, going from 302,149 hectares (1,167 sq.miles) in 2009/2010 to 375,500 hectares (1,450 sq.miles) in 2010/2011; (ii) favorable market scenario that stimulated soybean planting; and (iii) more time elapsed between deforestation and soybean plantings, as rice crops are usually planted for a year or two before soybeans are planted in recently deforested areas [14,38].

Figure 3. Number of polygons selected, and not selected, for overflights, and the deforested area monitored in the four years of the Soy Moratorium.

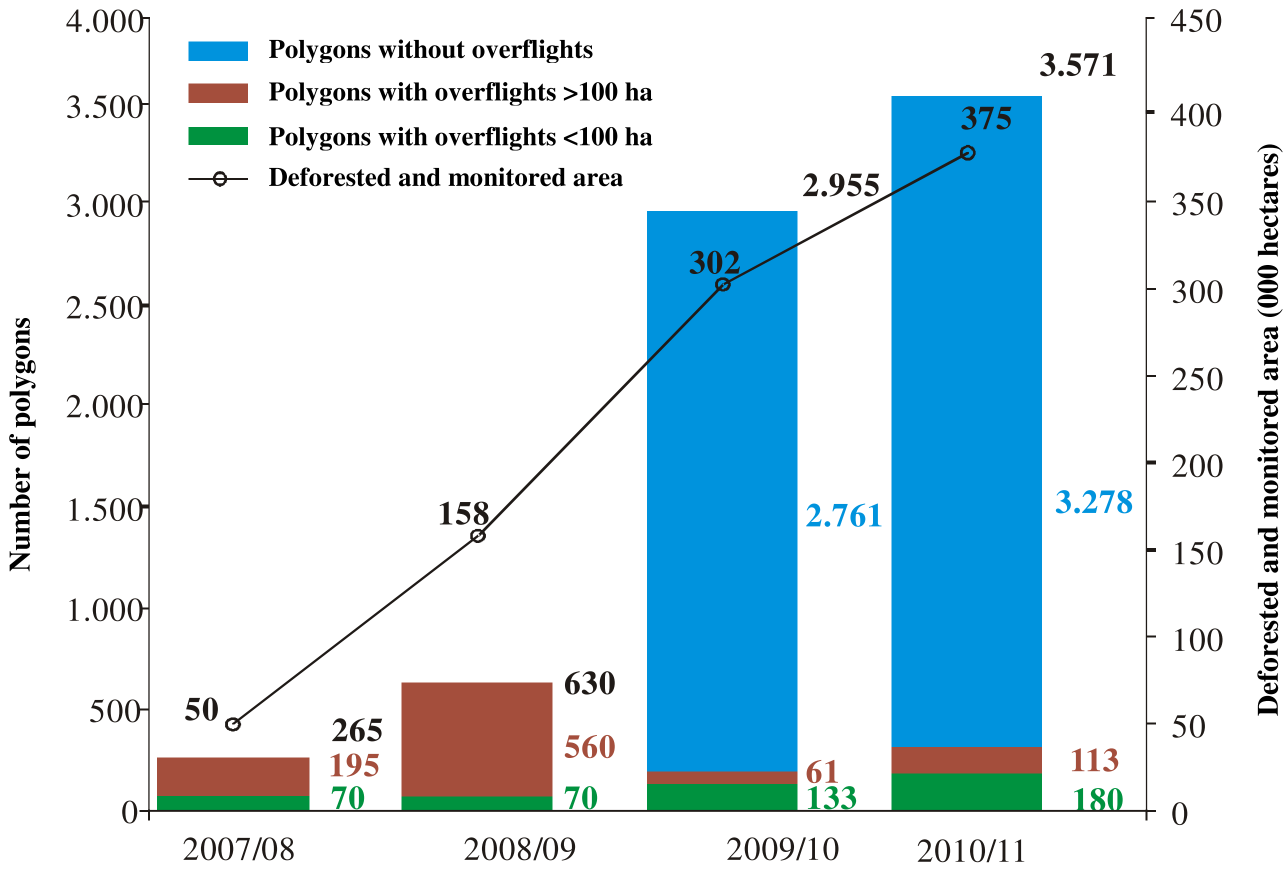


Table 5 shows the increase of 24.3% in monitored area, going from 302,149 hectares (1,167 sq.miles) in 2009/2010 to 375,500 hectares (1,450 sq.miles) in 2010/2011, due both to new deforestations and to the deforestations of previous years as a result of the aggregation of polygons.

Table 5. Comparison between the 2009/2010 and 2010/2011 monitoring cycles of the Soy Moratorium.

	2009/10 (a)	**2010/11** (b)	**Variation** {(b-a)/a} (%)
Total monitored area (hectares)	302,149	375,500	24%
Number of deforested polygons	2,955	3,571	21%
Number of polygons selected for overflight	194	293	51%
Number of polygons with agricultural crops	116	209	80%
Number of polygons with soybean planting	76	146	92%
Area of soybean planting (hectares)	6,295	11,698	86%

The results obtained in this fourth monitoring cycle show that soybean planting occurs in only 0.39% of the total deforested area since the inception of the Soy Moratorium. Considering Brazil's total soybean acreage in the 2010/2011 crop year, this represents a mere 0.05%. In view of the results, there are strong indications that the Soy Moratorium has, for the last four years, inhibited the advance of deforestation for the purpose of planting soybeans in the Amazon Biome. In the 2010/2011 crop year, soybean acreage in deforested polygons during the Soy Moratorium represents 0.6% of the total soybean acreage in the Amazon

Biome (Table 6). It should be pointed out that, in MT state, which is responsible for 88% of the Amazon Biome's soybean acreage, soybeans planted in deforested areas during the Soy Moratorium represent just 0.49% of the state's soybean acreage within the Amazon Biome (Table 6).

Table 6. Soybean acreage in deforested polygons during the Soy Moratorium and soybean acreage in the Amazon Biome.

State	**Soybean Acreage (hectares)**		
	Deforested Polygons in the Moratorium	**Amazon Biome**(a)	**% of Soybeans in Polygons in relation to Biome Soybeans**
MT	8,385	1,704,963	0.49%
PA	3,284	104,800	3.13%
RO	29	132,300	0.02%
Total	11,698	1,942,063	0.60%

Source: (a) adapted from [39]

4. Conclusions

The states of Mato Grosso (MT), Pará (PA) and Rondônia (RO) are responsible for 99% of the soybeans planted in the Amazon Biome. During the four-year period (2007-2008-2009-2010) of the Soy Moratorium, 2.974 million hectares (11,483 sq.miles) have been deforested and, while deforestation was still high in this four-year period, it has also had the lowest deforestation rates in the Legal Amazon region in an historic series of 22 years [5].

Monitoring deforested areas revealed that soybean planting occupied an area of 11,698 hectares (45 sq. miles) in the 2010/2011 crop year, which corresponds to 0.39% of the fields deforested in the Amazon Biome during the Soy Moratorium. In terms of the total soybean acreage in Brazil and in the Amazon Biome, the 11,698 hectares represent 0.05% and 0.60%, respectively. It is difficult to conclude whether the Soy Moratorium is actually having an inhibitory effect on recent deforestation in the Amazon Biome but, from the figures, it is quite evident that the soy crop was not a significant deforestation driver during Soy Moratorium.

Monitoring soybean plantings in recently deforested fields in the Amazon Biome allowed the industries and exporters that participate in the Soy Moratorium to comply with their commitment not to acquire soybeans from areas that were deforested after July 24, 2006. The present work also demonstrates that geotechnology can significantly contribute to the governance process of Brazilian natural resources.

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Conflict of Interest

The authors declare there is no conflict of interest.

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