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Deforestation within the Higher Paraguay River Basin – Brazilian Pantanal Wetland – until 1976.

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Resumo O estudo foi realizado na Bacia do Alto Paraguai no Brasil (BAP), onde encontra-se inserido o Pantanal, abrangendo uma área total de 361.666 km^2. Objetivou mapear e quantificar o desmatamento nessa região até 1976. Foram utlizadas imagens de satélite Landsat MSS, coloridas, nas bandas 4,5,7 (RGB), escala de 1:250.000. A interpretação das imagens foi de modo visual. Para geração de mapas e a quantificação das áreas desmatadas utilizou-se um Sistema de Informações Geográficas (SIG). Como resultados obtiveram-se 34 cartas temáticas de desmatamento na escala de 1:250.000, disponíveis em formato digital. O desmatamento da BAP foi quantificado em 11.439 km^2 ou 3,16% e o desmatamento do Pantanal em 635 km^2 ou 0,46%. O desmatamento no planalto é 17 vezes maior do que no Pantanal. Também são apresentados resultados quantitativos por Estado (MT e MS), planalto, sub-regiões e municípios.
Palavras chaves: Sensoriamento Remoto, geoprocessamento, impacto ambiental.

Introduction

The vegetation in the the Higher Paraguay river Basin (HPB) isn't constituted exclusively by woody material (bushes and trees), but also by great extensions of gramineae fields and aquatic vegetation, found mainly in the lowlands of Pantanal. The disappearance of the vegetation covering doesn't always characterize a deforestation (removal of woody material), however, the historical progress of cattle handling in this region began in the *forest* (Decidous and Semidecidous), *cerrado* (bushy savanna) and *cerradão* (forested savanna) areas. Therefore, due to the historical handling of the land in this region, to the difficulty in identifying the original covering and to the current use of the term deforestation in literature, the word deforestation was adopted to express modifications in the original vegetation of the HPB.

Deforestation, or removal of native vegetation for human needs (constructions, agriculture, planted pastures, etc) has negative influences in the structure and functioning of ecosystems. In the biological scope, the removal of vegetation covering is directly associated with the elimination of wild animal habitats, therefore causing a drastic reduction in biodiversity. According to Conesa Fdez - Vitora (1997), the vegetation maintains important relationships with the biotic and abiotic elements of the ecosystem, such as, stabilization of slopes, retardation of soil erosion, influence in the amount and quality of water, maintenance of microorganisms, filtering of the atmosphere, noise attenuation and as habitat for animal species. The removal of the vegetation covering has many impacts, as the reduction of atmospheric CO2 fixation and

recycling. Besides that, we may consider the effects over the visual quality, recreational potential, scientific and educational interest, quality of life, environmental health, faunal index, climatic regime, etc.

Tommasi (1994) mentions a series of effects caused by riverine vegetation reduction, culminating in an increase of eutrophication of the bodies of water. The cumulative effects of the agricultural expansion presented (Tommasi, 1994) may cause soil erosion; fertility loss, intensive application of herbicides and fertilizers; drainage of humid areas; destruction of natural habitats; shalification of bodies of water, reducing the quality of water; elimination of cultures of subsistence; isolation and fragmentation of habitats.

Many projects (activities) may cause unexpected impacts over terrestrial and aquatic ecosystems. In addition to the substitution of the original vegetation, follows, degradation of natural habitats due to excessive grazing practices; drainage of humid areas for agriculture; habitat alterations with significant consequences over the fauna (Canter, 1998).

According to Hogan (1996), in addition to the unregistered loss in biodiversity and lack of recreation areas in the basin of Piracicaba river, São Paulo, deforestation contributed to the removal of good soils and the shalification of rivers. The soil is cultivated as far as the margin of the rivers, and the measures for the recovery of ciliary forests are still crawling.

Sevá Filho et al. (1998) express their concern with the conversion of the natural vegetation stating that "the alteration of the vegetation covering, due to the human action, was so intense that one can say that the planet is no longer the same, nor will it work the same way". Those authors argue that great extensions of native vegetation it comes being transformed into firewood and coal for energy ends, in use with planted pasture and cultures, mining, urban constructions, highways, railroads, channels, dams, etc; and that, several regions of the planet became fragile, sterile and even desertified due to erosion. A similar concern is mentioned by Medeiros (1998) regarding the conversion of native forests into vegetable coal for the Brazilian metallurgy.

In the Higher Paraguay river Basin (HPB), where Pantanal is located, the conversion of native areas into human uses was intensified in the 70's, stimulated by the Federal politics of expansion of the agricultural border. The plateaus adjacent to the Pantanal, due to it's physiography and fertility, where preferentially occupied.

Deforestation mapping and quantification, in the HPB area, began in 1994, with a research project at Embrapa-CPAPantanal (*"Evolução espaço-temporal do desmatamento nas diversas fitofisionomias do Pantanal"* , meaning: Time&space evolution of deforestation in Pantanal's diverse phytophysiognomies). Recent material on vegetation covering and deforestation in Pantanal may be found in Silva et al. (1996), Silva et al. (1997), Silva e Abdon (1997) e Silva et al. (1998).

Evaluations about deforestation, until 1976, will be presented in this article, representing the decade of the 70s. Being this, the first of a series of three evaluations, that will include the decades of the 80s and the 90s. In this context, the objective of this research is to map and quantify deforested areas in the Higher Paraguay river Basin (HPB), providing the resuls per State (MT and MS), Pantanal, plateau, sub-regions and counties.

Materials and Method

The evaluated area comprehends the Higher Paraguay river Basin in Brazil, with its 361,666 km^2, located between the latitudes $15^o30'$ and $22^o30'$ South and longitudes $54^o45'$ and $58^o30'$ West, at the center of South America. The States of Mato Grosso and Mato Grosso do Sul are located in this region, including 81 of its counties, as well as the physiographic plains of the

Brazilian Pantanal and its sub-regions, totalizing an area of about 138,183 km^2, according to (Silva e Abdon 1998).

Satelite images from Landsat and topographic charts of the region where used for the quantification and mapping of the deforested areas. Images from Landsat where used because it was the only satelite available back then, that supplied reasonable information for this research.

Thirty MSS-Landsat (1 and 2) images were used, with a colored composition of 4,5,7 (RGB), and in 1:250,000 scale, corresponding with 34 topographic charts in the same scale. Due to the low quality of the images, images from the years of 1973, 1975, 1976 and 1977 where gathered to compose the covering of the whole evaluated basin. This hindered the analysis and interpretation sensitively. In spite of that, the option was to keep on the research with these data, otherwise there wouldn't be any information concerning deforestation until that decade. Even though this may incur errors, the acquired results where stipulated to serve as a reference of the deforestation in HPB until 1976.

The visual interpretation of the images was based on the following aspects: color; texture; form; context; relationship of aspects; and location, and also complemented by current interpretations over the years of 1984, 1991 and 1994, accomplished with TM images.

Initially, a cartographic chart, concerning deforestation until 1994, was used as a reference for the mappings of 1976. To do this, all 34 topographic charts of 1994 where printed on polyester paper and superposed with the images from the decade of the 70s. After the interpretation, yet in the checking phase, it was verified that most of the polygons of the year 1976 couldn't be inscribed in the polygons of the year 1994. This material was abandoned and a search for new alternatives was initiated. The first attempt was to adopt specific maps from the Brazilian Vegetation classification Adapted to a Universal System, Veloso et al. (1991), basically a derivation of RADAMBRASIL'S Project classification. These maps furnish, among other classifications, the following types of polygons in the vegetation chart:

- natural formations: Bushy savanna without forested galleries (Sas); Bushy savanna without forested galleries + Forested savanna (Sas+Sd), etc.
- natural formations + anthropic areas: Bushy savanna without forested galleries + Pastureland (Sas+Ap); Bushy savanna without forested galleries + Forested savanna + Pastureland (Sas+Sd+Ap), etc.
- anthropic areas + natural formations: Pastureland + Bushy savanna without gallery forest (Ap+Sas); Pastureland + Bushy savanna without forested galleries + Forested savanna (Ap+Sas+Sd); Pastureland + Recurrent cultures + Bushy savanna without forested galleries (Ap+Acc+Sas), etc.
- anthropic areas: Pastureland in savanna (ApS), Recurrent cultures in forests (AccF), Pastureland in savanna + Recurrent cultures in savanna (ApS+AccS), etc.

Based on this legend, the polygons, corresponding to anthropic formations, where selected on three charts. Then these informations where digitalized and quantified. The size of the deforested area, obtained by this method, exceeded all expectations for that time, because most of the polygons of the year 1976 wheren't totally inscribed in the polygons of the year 1994. Unfortunately, this method was also inadequate for this research.

The next alternative was to return the MSS images obtained in 1976, utilizing th TM images obtained in 1984 instead of the ones obtained in 1994. The same procedure adopted at the beginning was again repeated in order to identify deforestation polygons in the year of 1984. The deforested areas pertaining to the year of 1984 where ploted over the 34 topographic charts that constitute the HPB, and then superposed with the images corresponding to the year of 1976. Following this procedure, it happened that in some cases, the polygons, corresponding to the

year of 1976, wouldn't correspond to the ones of the year 1984. But this wasn't quantitatively significant. This is probably due to: sensor alteration (MSS to TM); differences in year of acquisition, composing a reference for the year of 1976 (explained earlier); and regeneration of some areas, within the period of 8 to 10 years.

The procedure, mentioned above, presented the best results, consequently, it was chosen to map and quantify the deforested areas until 1976. It is pointed out that a new evaluation was made in the classification key used initially, adapting the patterns of the image with the deforestation patchs, because the datas and closer.

After the interpretation, all data where stored and later manipulated by the Geographical Information System (SGI) of the Instituto Nacional de Pesquisas Espaciais (INPE).

Each topographic chart, containing its deforested areas, was digitalized on a layer named DS76. After the conclusion of all digitalization processes, adjustments and editing, new charts where generated and printed for the auditing process and final corrections. Later on, a table was elaborated, containing information about the deforestation in the basin; in part of the states of MT and MS; and also on the Plain; Plateau; sub-regions; and counties.

The vector-raster conversion, followed by layer crossings, causes slight data alterations, due to the dimension of the pixels, and consequently, causing slight area differences on the derived layers summation. A correction factor was introduced to reduce these distortions. It takes the area of the original layer as a reference for all other calculations. The area of the HPB, determined by Silva e Abdon (1998), is 361,666 km^2. The size of the deforested area was evaluated for each group type: HPB (11,439.13 km^2), HPB in MT (6,538.17 km^2), HPB in MS (4,900.96 km^2), Pantanal in MT (243.13 km^2) and Pantanal in MS (391.59 km^2). According to this values, the following factors where created:

1. ICbap = 361,666/363,252 = 0.995634, correction factor for the HPB area;
2. ICMT = 6,538.17/6,531.24 = 1.001061, correction factor for the deforested areas within the counties of Mato Grosso;
3. ICMS = 4,900.96/4,853.05 = 1.009873, correction factor for the deforested areas within the counties of Mato Grosso do Sul;
4. ICpantMT = 243.13/242.1504 = 1.004045, correction factor for the deforested areas strictly in the counties of Mato Grosso inside Pantanal;
5. ICpantMS = 391.59/389.5992 = 1.005110, correction factor for the deforested areas strictly in the counties of Mato Grosso do Sul inside Pantanal;

Results and Discussion

The quantitative results may be observed in **tables 1 to 4** and spatialized results are available in digital format in the Remote Sensoring and Geoprocessing Laboratory (Laboratório de Geoprocessamento e Sensoriamento Remoto) of Embrapa Pantanal, in Corumbá, MS.

Tab. 01

Table 1 exhibits the total deforested area in the HPB, estimated as 11,439 km^2, or 3.16% of the area of the basin. In this area, 635 km^2 (0.46%) happened within the Pantanal and 10,804 km^2 (4.83%) within the adjacent plateau. The same estimation for the States of Mato Grosso and Mato Grosso do Sul are: 6,538 km^2 (3.77%) and 4,901 km^2 (2.60%), respectively. These values aren't so alarming if compared with the deforestation rates in the region of the Atlantic forest, with just 8,11% of its original forests (Fundação, 1993), or with the Cerrado, where only 35% of its original vegetation are still preserved, according to Mantovani e Pereira (1998).

In the fifth column of **table 1**, the participation of each sub-region, in regard to the whole deforested area, can be evaluated. It reveals that deforestation in Pantanal contributes with just

5.55% of the whole deforested area in the HPB, while the plateau contributes with the remaining (94.45%). Yet, the deforested areas among the States of MT ans MS are quite similar. Mato Grosso contributes with 57.16% and Mato Grosso do Sul with 42.84%.

The deforestation analysis in the different sub-regions of Pantanal can be used to subsidize st the creation of environmental legislations and for localization. **Table 2** shows the physiographic area and deforested areas of each sub-region, and their corresponding participation in the deforestation of Pantanal. In the fourth column, the values indicate that the sub-region of Poconé (20.68%) and Barão de Melgaço (15.84%), both located on the North, and Nhecolândia (18.07%) located on the Center of Pantanal, were the most deforested areas, responsible for more than 50% of all deforested areas within Pantanal. On the other hand, the sub-region of Abobral didn't present any trace of deforestation at all, and very few were detected in the sub-regions of Paraguay (0.55%) and Cáceres (1.77%).

Tab. 02

The fifth column of **table 2** indicates relative deforestation within various sub-regions. As we may see, the sub-regions of Porto Murtinho (2.46%), on the South; Aquidauana (1.01%), on the Southeast; and Poconé (0.82%), on the North, are the most deforested regions. The sub-regions with the lowest rates of deforestation are: Abobral, which didn't present traces of deforestation; Paraguay (0.04%); and Cáceres (0.09%).

The evaluation of the deforestation in counties within Pantanal are presented in **table 3**. The analyses are attributed to the physiographic area of Pantanal's lowlands, which is comprehended by 16 counties. The seven counties within Pantanal in the State of Mato Grosso contribute with 38.31% of its deforested area, while the nine counties within Pantanal in the State of Mato Grosso do Sul contribute with 61.69%.

Tab. 03

The counties with the highest rates of deforestation in Pantanal are: Poconé, MT (12,942 ha), Corumbá, MS (11,415 ha), Porto Murtinho, MS (9,613 ha) and Aquidauana, MS (7,719 ha). Together they contribute with 65.68% of all deforested areas within the lowlands. The same counties present a much lower rate of deforestastion within the Pantanal wetland. These rates are: 0.93%, 0.18%, 2.04% and 0.60%, respectively. The counties presenting the highest rates of deforestation within the Pantanal swampland-wetland are: Sonora, MS (2.31%); Porto Murtinho, MS (2.04%); Coxim, MS (1.21%); and Rio Verde do Mato Grosso, MS (1.11%).

Concerning all the deforested areas of each state, we may get to the conclusion that they are proportional to the area that Pantanal occupies in each of the territories. Therefore, there is no significant difference that would allow one to say that one State deforests more than the other, at least at that time.

Table 4 lists all 81 counties that enclose the HPB, 48 in MT and 33 in MS. Some counties are completely within the basin territory, the remaining counties cover only a partial area of the HPB. This table has information about deforested and physiographic areas of each county of the HPB region, as well as the rates and relative frequency of deforestation in each county.

Tab. 04

Columns 2 and 3 of **table 4**, have the deforestation values and rates per county. Below is an ordered list of 10 counties with the highest deforestation rates: São Gabriel D'Oeste (7.38%); Tangará da Serra (5.93%); Itiquira (4.73%); Corumbá (4.34%); Arenápolis (4.16%); Barra dos Bugres (3.99%); Nortelândia (3.85%); Rondonópolis (3.76%); Miranda (3.55%); and Rio Verde do Mato Grosso (3.22%). Together, they contribute with 45.16% of all the deforested areas in the HPB. 60% of these counties belong to the State of Mato Grosso, and the remaining, to the State of Mato Grosso do Sul.

Columns 4 and 5 of **table 4**, show the physiographic areas and its deforestation rates. The following deforestation rates belong to the 10 counties that most converted the original vegetation into planted pastures. Nortelândia (34.73%); Arenápolis (33.19%); Denise (27.29%);

Alto Taquari (23.12%); São Gabriel D'Oeste (20.83%); Araputanga (16.58%); São José dos Quatro Marcos (14.09%); Salto do Céu (13.86%); Nova Olímpia (12.05%); and Jaciara (11.96%). Nine of these counties belong to the State of Mato Grosso.

Conclusions

Although the images used in this research didn't present the expected quality, they allowed accurate mappings and quantification of the deforested areas.

Deforestation at the HPB wetlands and plateau is inexpressive until the year of 1976, with such levels suggesting little environmental on the area.

Deforestation at the HPB is concentrated within the adjacent plateau, which is 17 times greater than in the plain (Pantanal wetland).

Deforestation in the plateau is dispersed, where 10 counties are responsible for 45,16% of all deforested areas within the HPB, representing 31,3% of its physical area.

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Table 1. Deforestation within the brazilian Higher Paraguai river Basin (HPB) until 1976.

Region	Total Area (A) *		Deforested Area (B)		% (B/A)
	km^2	%	Km^2	%	
Pantanal	138,183	38.21	635	5.55	0.46
Plateau	223,483	61.79	10,804	94.45	4.83
Mato Grosso	173,276	47.91	6,538	57.16	3.77
Mato Grosso do Sul	188,390	52.09	4,901	42.84	2.60
HPB	361,666	100.00	11,439	100.00	3.16

* SOURCE: Physiographic area of the HPB, Pantanal and plateau, extracted from Silva & Abdon, 1998.

Obs.: Correction factor for the HPB area: 0.995634.

Table 2. Deforestation per sub-region of the brazilian Pantanal wetland, until 1976.

Sub-regions	Area (km^2)		Deforestation Rates (%)	
	of the sub-region*	Deforested	per sub-region	of the sub-region
1. Cáceres	12,456.00	11.25	1.77	0.09
2. Poconé	16,066.00	131.28	20.68	0.82
3. Barão de Melgaço	18,167.00	100.56	15.84	0.55
4. Paraguai	8,147.00	3.33	0.55	0.04
5. Paiaguás	27,082.00	82.40	12.98	0.30
6. Nhecolândia	26,921.00	114.70	18.07	0.43
7. Abobral	2,833.00	0	0.00	0.00
8. Aquidauana	5,008.00	50.54	7.96	1.01
9. Miranda	4,383.00	13.25	2.09	0.30
10. Nabileque	13,281.00	33.02	5.20	0.25
11. Porto Murtinho	3,839.00	94.41	14.87	2.46
TOTAL	138,183.00	634.74	100.00	0.46

* SOURCE: Physiographic areas of the sub-regions, extracted from Silva & Abdon, 1998.

Table 3. Deforested area (A) and physiographic area (B) per county in the region of brazilian Pantanal, until 1976. Values in ha.

States and Counties	Deforested area (A)	%(A/C)	Physiographic area (B) *	%(A/B)
Mato Grosso	**24,313**	**38.31**	**4,886.500**	**0.50**
Barão de Melgaço	4,246	6.69	1,078,200	0.39
Cáceres	1,063	1.68	1,410,300	0.08
Itiquira	1	0.00	173,100	0.00
Lambari D'Oeste	94	0.15	27,200	0.35
Nsa. Sra. Do Livramento	62	0.10	111,500	0.06
Poconé	12,942	20.39	1,397,200	0.93
Santo Antonio do Leverger	5,905	9.30	689,000	0.86
Mato Grosso do Sul	**39,158**	**61.69**	**8,931,800**	**0.40**
Aquidauana	7,719	12.16	1,292,900	0.60
Bodoquena	0	0.00	4,600	0.00
Corumbá	11,415	17.98	6,181,900	0.18
Coxim	2,571	4.05	213,200	1.21
Ladário	19	0.03	6,600	0.29
Miranda	855	1.35	210,600	0.41
Sonora	1,659	2.61	71,900	2.31
Porto Murtinho	9,613	15.15	471,700	2.04
Rio Verde de MT	5,307	8.36	478,400	1.11
Total (C)	**63,471**	**100**	**13,818,300**	**0.46**

* SOURCE: Physiographic area in the counties within Pantanal, extracted from (15).
Obs.: Correction factors for the deforestation in MT=1.004045 and in MS=1.005110.

Table 4. Deforestation in km^2, in the counties of the brazilian HPB, until 1976.

States and Counties	Deforested area (A)	%(A/C)	Physiographic area (B)	%(A/B)
MATO GROSSO	**6,538.17**	**57.37**	**173,275.70**	**3.77**
1.Tangará da Serra*	675.43	5.93	6,164.75	10.94
2.Barra dos Bugres*	454.40	3.99	7,568.03	6.00
3.Reserva do Cabacal	28.57	0.25	976.63	2.92
4.Nova Marilândia*	106.41	0.93	1,249.27	8.51
5.Arenápolis	473.53	4.16	1,425.33	33.19
6.Nova Olimpia	196.49	1.72	1,628.31	12.05
7.Denise	248.65	2.18	910.25	27.29
8.Diamantino*	103.98	0.91	940.49	11.04
9.Alto Paraguai	58.77	0.52	2,394.07	2.45
10.Nortelândia*	438.74	3.85	1,262.07	34.73
11.Nobres*	26.28	0.23	2,047.84	1.28
12.Rosário Oeste*	29.08	0.26	7,211.38	0.40
13.Acorizal	0.00	0.00	844.18	0.00
14.Chapada dos Guimarães	39.31	0.34	5,766.11	0.68
15.Nova Brasilândia*	35.85	0.31	2,623.22	1.37
16.Planalto da Serra*	5.00	0.04	286.37	1.74
17.Jauru*	336.97	2.96	2,902.68	11.60
18.Araputanga	217.31	1.91	1,309.09	16.58
19.São José dos Quatro Marcos	184.46	1.62	1,307.66	14.09
20.Glória D'Oeste	32.28	0.28	841.17	3.83
21.Porto Espiridião	65.39	0.57	5,628.41	1.16
22.Cáceres	130.14	1.14	25,159.28	0.52
23.Salto do Céu	50.42	0.44	363.49	13.86
24.Lambari D'Oeste	32.33	0.28	1,705.20	1.89
25.Mirassol D'Oeste	42.11	0.37	1,123.83	3.74
26.Porto Estrela	16.19	0.14	2,051.26	0.79
27.Nossa Sra. Do Livramento	11.81	0.10	4,703.64	0.25
28.Poconé	184.88	1.62	17,287.67	1.07
29.Jangada	4.04	0.04	1,250.21	0.32
30.Várzea Grande	47.86	0.42	936.32	5.11
31.Cuiabá	67.61	0.59	3,442.25	1.96
32.Santo Antonio do Leverger	243.06	2.13	11,873.14	2.04
33.Campo Verde*	61.96	0.54	1,203.01	5.14
34.Jaciara	201.60	1.77	1,683.29	11.96
35.Dom Aquino	34.86	0.31	1,666.08	2.09
36.São Pedro da Cipa	3.11	0.03	149.34	2.08
37.Juscimeira	90.50	0.79	2,467.92	3.66
38.Poxoreu*	42.64	0.37	5,062.10	0.84
39.Tesouro*	0.52	0.00	101.97	0.51
40.Vila Bela Stma. Trindade*	0.00	0.00	227.07	0.00
41.Barão de Melgaço	43.30	0.38	11,243.90	0.38

Continuation table 4...

States and Counties	Deforested area (A)	%(A/C)	Physiographic area (B)	%(A/B)
42.Rondonópolis	428.93	3.76	4,600.96	9.31
43.Guiratinga*	26.91	0.24	1,271.69	2.11
44.Pedra Preta	178.04	1.56	3,978.53	4.47
45.Alto Garças*	68.41	0.60	1,832.47	3.73
46.Itiquira	538.99	4.73	8,657.23	6.22
47.Alto Araguaia*	84.92	0.75	3,314.99	2.56
48.Alto Taquari*	146.14	1.28	631.55	23.12
MATO GROSSO DO SUL	**4,900.96**	**42.63**	**188,390.30**	**2.60**
1.Corumbá	499.20	4.34	64,593.89	0.77
2.Ladário	25.68	0.22	370.83	6.90
3.Sonora	318.52	2.77	3,774.98	8.36
4.Pedro Gomes	133.19	1.16	3,936.60	3.35
5.Coxim	249.72	2.17	6,380.45	3.88
6.Costa Rica*	1.67	0.01	1,239.56	0.13
7.Rio Verde de MT*	370.33	3.22	8,127.91	4.51
8.São Gabriel D'Oeste	848.17	7.38	4,031.20	20.83
9.Rio Negro	33.75	0.29	1,180.73	2.83
10.Corguinho	172.50	1.50	3,028.43	5.64
11.Rochedo	82.96	0.72	1,555.42	5.28
12.Camapuã*	162.29	1.41	7,212.15	2.23
13.Bandeirantes*	115.35	1.00	1,181.27	9.67
14.Jaraguari*	15.21	0.13	847.47	1.78
15.Terenos*	158.32	1.38	2,753.55	5.69
16.Campo Grande*	50.03	0.44	589.66	8.40
17.Dois Irmãos do Buriti	102.94	0.90	2,316.97	4.40
18.Aquidauana	239.20	2.08	16,870.50	1.40
19.Anastácio	264.73	2.30	2,902.40	9.03
20.Miranda	408.07	3.55	5,377.97	7.51
21.Bodoquena	32.41	0.28	2,509.53	1.28
22.Bonito	48.53	0.42	4,894.68	0.98
23.Nioaque	58.74	0.51	4,768.73	1.22
24.Guia Lopes da Lacuna	43.32	0.38	1,925.92	2.23
25.Jardim	45.23	0.39	2,487.55	1.80
26.Porto Murtinho	240.16	2.09	17,669.01	1.35
27.Caracol	14.31	0.12	2,918.74	0.49
28.Bela Vista	45.07	0.39	5,172.26	0.86
29.Antônio João*	7.66	0.07	705.42	1.08
30.Maracaju*	4.45	0.04	145.46	3.03
31.Sidrolândia*	39.71	0.35	973.94	4.04
32.Ribas do Rio Pardo*	47.49	0.41	1,588.28	2.96
33.Alcinópolis	22.03	0.19	4,358.83	0.50
TOTAL (C)	**11,439.13**	**100.00**	**361,666.00**	**3.16**

Obs.: *County with part of its territory inside the HPB. Correction factors adopted for the summation of the deforested areas in MT=1.001061 and in MS=1.009873.