3. Geomorphology

The forms existent geomorphologic in the Study Area (Fig. 3.3.1) :

Accumulation: resulting Topography of deposit of sediments, in fluvial areas, paludais and lacustrine, usually subjects the flood. This Study Area presents the following:

- Fluvial accumulation of Plain
- Fluvial accumulation of Plain and Terrace

Erosive forms: typography Forms constituted starting from processes predominantly erosive, where there was a lowering of the saliencies, tending to the leveling of typography. This Study Area presents the following:

- Aplanamento of Pediplano Degraded Undressed
- Aplanamento of Pediplano Degraded Interred
- Aplanamento of Pediplano Retouched Undressed

Dissection: typography forms carved by the erosive agents, having a dissection differential of the relief, mainly along the net hydrographic. The Study Area presents the following:

- Dissection in Ravines
- Structural dissection or Differential
- Homogeneous dissection with Features of the Top Sharpened
- Homogeneous dissection with Features of the Convex Top
- Homogeneous dissection with Features of the Top Tabulate

(1) Inclination

Being considered only 3 levels of grades that will be used in this analysis of GIS, we can divide the Study Area as the following:

Grades	Characteristic
Less than 15%	Mecanizável
15 to 30%	Difícil Mecanização
30% or more	Não Mecanizável

As we can verify in the fig. 4.1.7, the largest concentrations of slopes "30% or more" are in area of Xambioa and Babaculandia, but in general, this Study Area possesses slope little accentuated.

4. Geological Features

The geological atmosphere in this Study Area (fig. 3.4.1), it is constituted as the following:

Coverings Cenozoicas: they Refer the coverings debris-lateriticas and aluvionares. The covering debris-lateritica understands the sediments areno-pelitosos predominantly inconsolidados and partially / totally laterizados, with levels of concrecoes ferruginosas or bolsoes of cangas lateriticas. The areas of coverings aluvionares, restricted the gutters of the main rivers that drain Tocantins, come characterized by the presence of the sediments of fine sand measured her, gravels, siltes and argilas. In general, the including areas of the sedimentacao aluvionar are composed of sediments badly selected, with angular grains the very round ones.

Sedimentary basin of Parnaía: it Presents the following geological formations: Pimenteiras, Heads,

Long, Poti, Piau · Stone of Fire, Motuca, Sambaiba, Mosquito, Rope and Codo. In general it presents formations that contain sandstones fine, medium or rude, calciferos or no, varied pamphlets, argilitos, microconglomerados, cherts, limestones, dolomitos, gipsita levels, clasto-chemical sediments, silex levels, basalts amigdaloidais and diabasicos (dikes). They are also verifiable collations of basaltic hemorrhages (sills) and sandstones. Such litologias flow of continental and sea sedimentacao with lacustrine and fluvial participations, haul of sporadic events eolicos.

Strip of Dobramentos of Superior Medium Proterozoico: Associated the strips of dobramentos of Proterozoico are found Supergrupo Araguaia that includes the groups Roar and Tocantins Lower. This supergrupo comes with a fort controls structural associated Dobramentos Araguaia-Tocantins's Strip. Grupo Roar's main litologias are the schists quartz-feldspaticos, anfibolio schists, migmatitos, gnaisses and quartzitos and associations of bodies maficos. In the group Tocantins is found filitos, clorita schists, metarcoseos and metagrauvacas, quartzitos, jaspers, marbles, metassiltitos and metargilitos.

Complex Metamorphic of Arqueano and Proterozoico Inferior: The main lands correspond the units estratigraficas of the compound Goiano that has great importance in the regional geological context due to width of space distribution. His/her litologia It can be said that the market problems plows related with the quality of the products and with the animal diseases. it presents varied gnaisses, migmatitos, ranodioritos, tonalitos, quartzitos inserted micaceos and associated afibolitos, hornblenditos and grenade-piroxenio granulitos.

5. Erosion

The erodibilidade level was divided in :

- Very weak to weak
- Quick
- Medium
- Strong
- Very strong
- Special

The we can observes in the fig. 3.5.1, the area west, the area around of Babaculandia and of Besiege New they present soils with high erodibilidade.

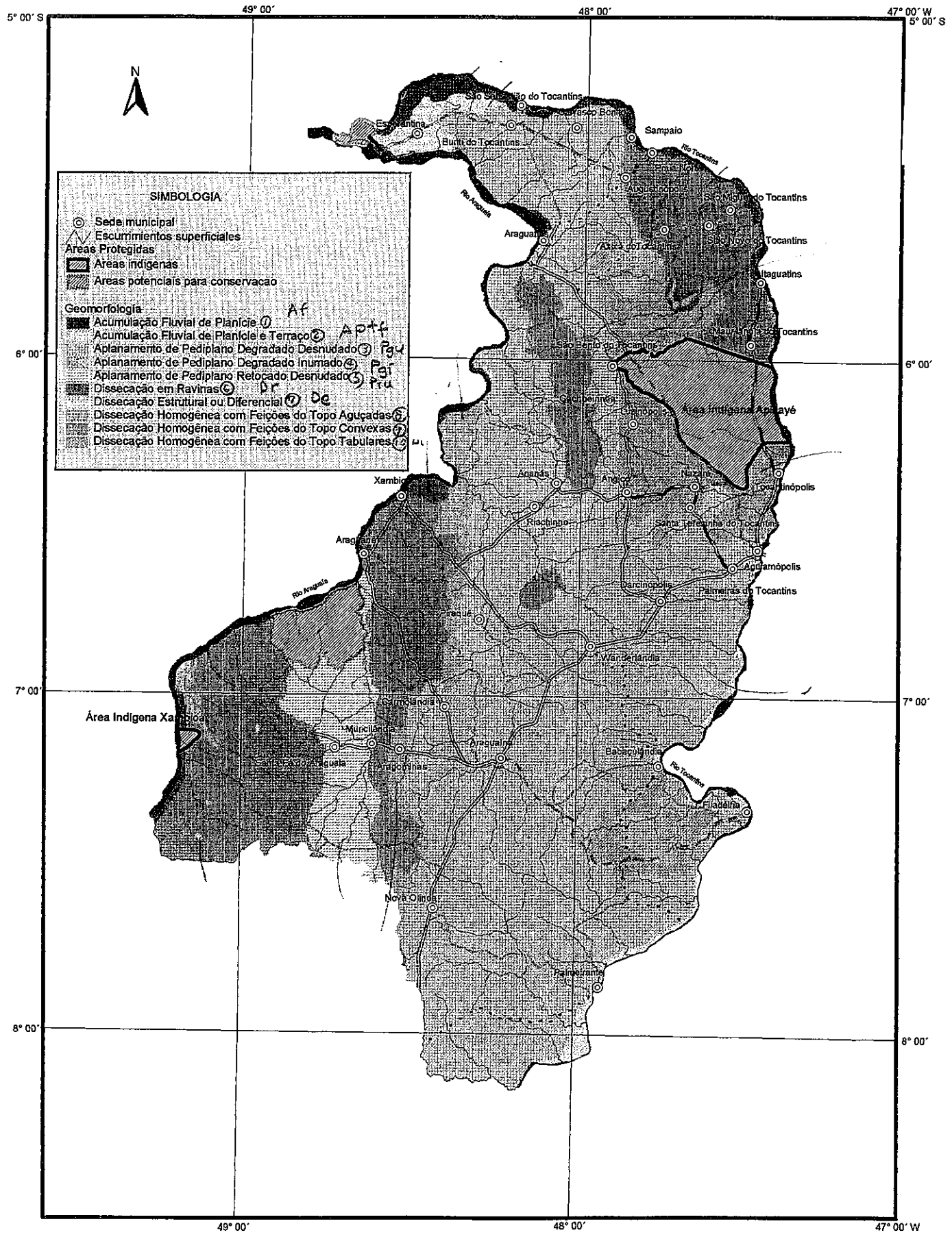


Fig. 3.3.1: Geomorphology

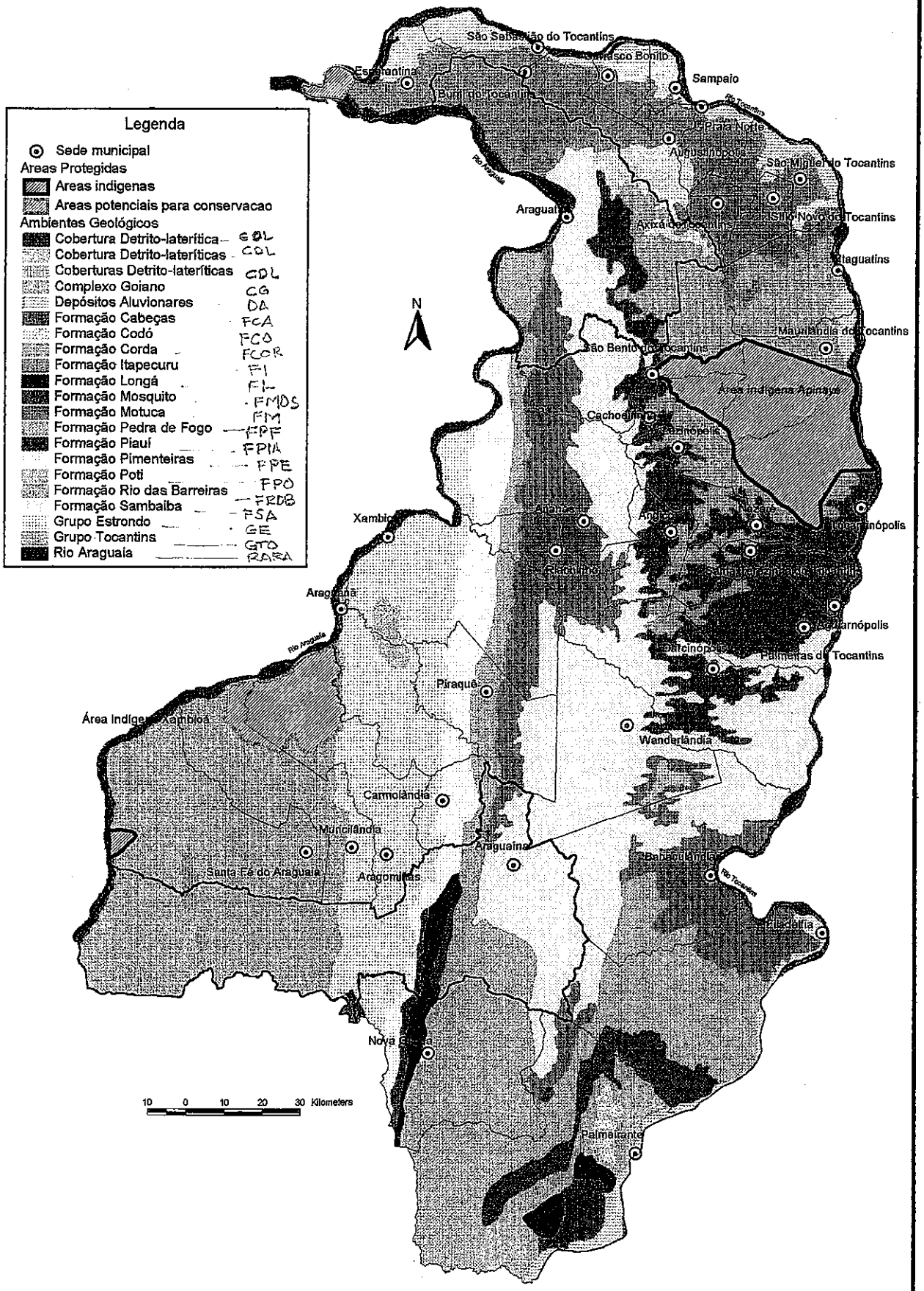


Fig. 3.4.1: Geology

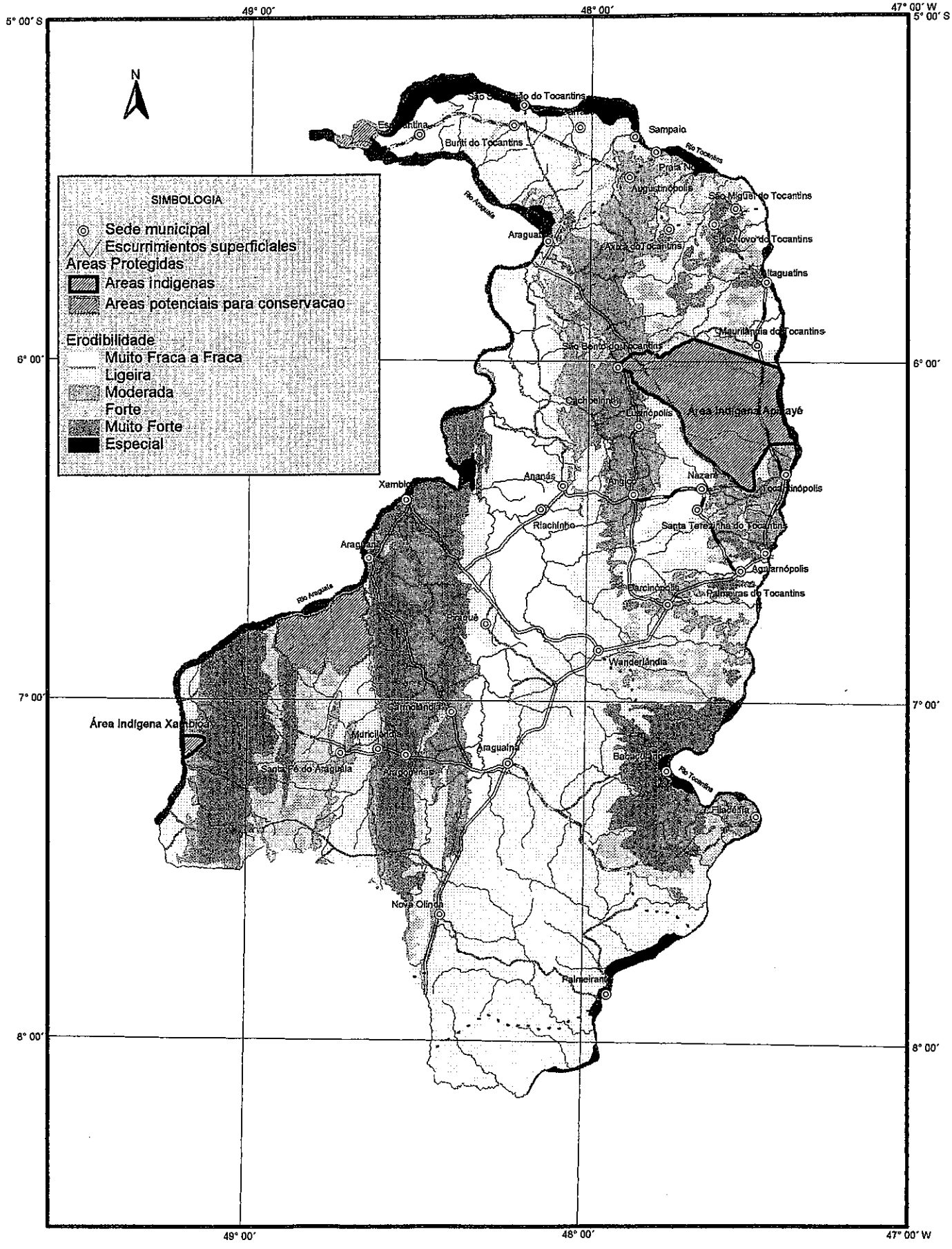


Fig. 3.5.1: Erosion Potential

6. Soil

(1) Soil Map and Land Suitability Map

Regarding the soil map of northern part of Brazil, the soil map prepared by Radambrasil (IBGE) during 1970's is considered as a base map. On 1981, EMBRAPA prepared Mapa de Solos do Brasil of national level (1:5,000,000) by combining various soil maps including the above-mentioned map. The state government of Tocantins then prepared soil map (1:250,000) (SEPLAN, 1999) and land use potential map was also derived from the soil map.

Under the recent project (PGAI) for the preparation of detailed soil map, IAC (Instituto Agronomico de Campinas) carried out the soil analysis of 800 samples taken from 400 points distributed in the northern part of Tocantins state. By taking the results of such soil analysis into the information of available soil map, the soil map and soil suitability map of 1:100,000 accuracy were prepared. The mapping area of this project is, however, not including 4 municipalities of Babaçulandia, Filadelfia, Palmeirante, and Nova Olinda out of the current study area. For this development study, therefore, the new soil map was created by combining 1:100,000 map as a base map with 1:250,000 map only for 4 municipalities to be used for the GIS analysis.

(2) Soil Characteristics of the Study Area

Fig. 3.6.1 shows the combined soil map with the map legend in Table 3.6.1. Table 3.6.2 shows the area distribution of each soil type in the municipalities within the study area and the characteristic of each soil type is shown in Table 3.6.3. Table 3.6.4 shows physical and chemical properties of sample soils. According to these information, the dominant soil type distributed in the study area is sandy soil (Areia Quartzosa) that occupies 30% of the total area. Such sandy soils are mainly distributed in the eastern part of route 153 in between Nova Olinda and Wanderlandia. Following to the sandy soils, podzolic soils such as red-yellow podzol occupy more than 25% of the total area. Red-yellow podzol is specific for the area on the right bank of Araguaia River in the northern region. Latosol soils including red-yellow latosol occupy approximately 15% of the total area. These soils are mainly distributed in the left bank of Tocantins River of the lower stream from Babaculandia.

(3) Soil Suitability for Agriculture

The most important factor to investigate the soil suitability for agriculture in the study area seems clay contents in the soil. For example, Embrapa prepared the distribution map of dangerous zone for cultivation of several field crops according to the past climate data including veranico occurrence. In addition to the variety of crop and the sowing period, the characteristic of soil is selected as a most important factor. The damage of veranico can be reduced for the area with the soil of high water holding capacity due to sustainable provision of water. The water holding capacity is expressed as 30mm, 50mm and 70mm and this figure is determined by the clay contents of the soil. The more the clay contents of the soil is, the less the damage of the veranico to the crop is. The data on clay contents of the soil is thus meaningful.

Through the field survey of pasture management, furthermore, it became clear that "good soil" means high clay soil and "bad soil" means low clay soil usually according to the farmers' opinion. Pasture is hardly drying after the end of rainy season at the area of the soil with high clay contents. Also at the area of the soil with high clay contents, fattening is being carried out. On the other hand, it is rather difficult to carry out fattening at the area of the soil with low clay contents and farmers are usually producing calf. It is thus concluded that the clay contents of the soil is very important factor to investigate the soil suitability for agriculture.

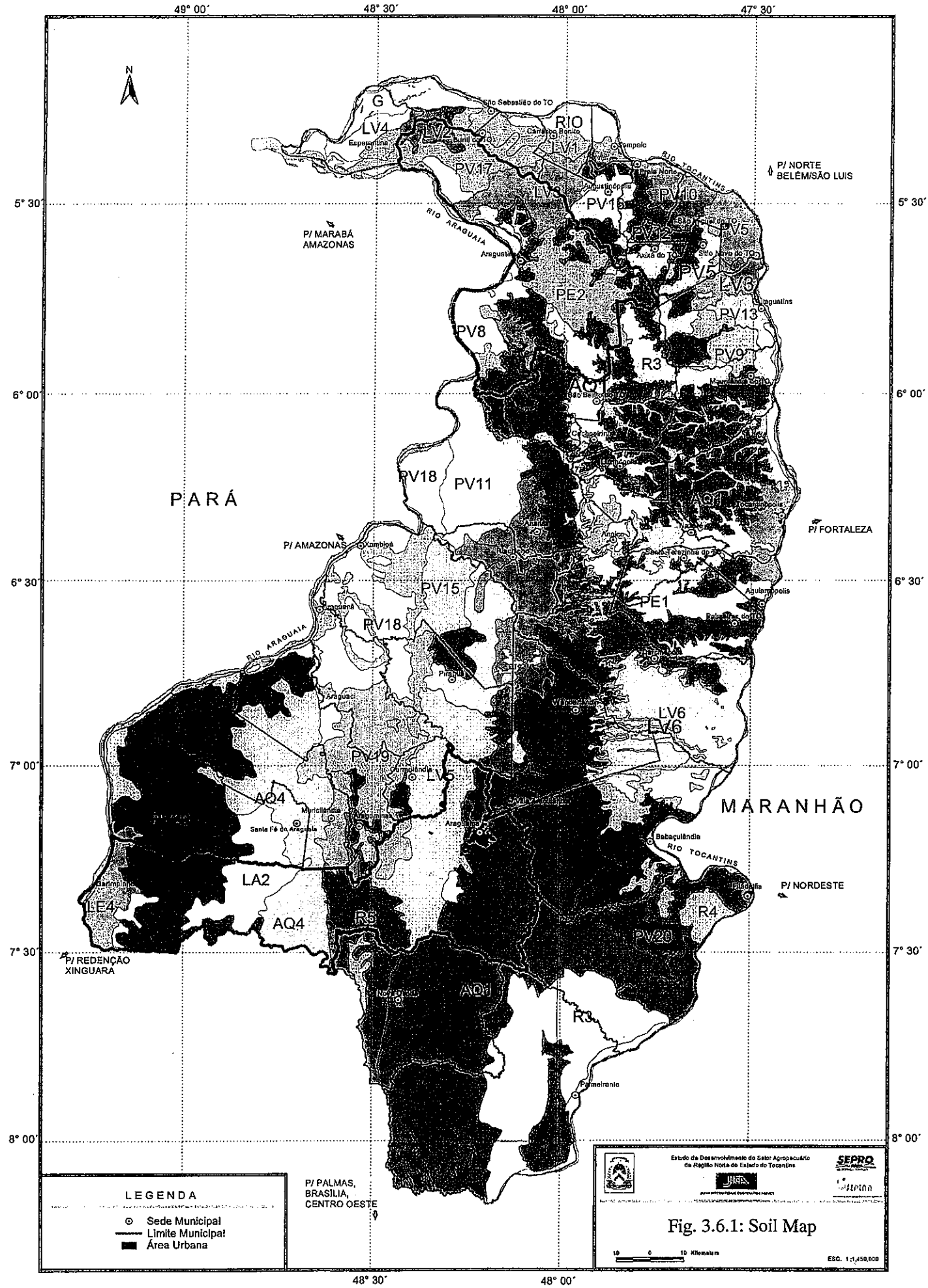
When the municipality-wise data was collected, therefore, the investigation was carried out focusing

on the clay contents of the soil. The staff of Ruraltins working in the field usually expresses the soil characteristics distributed in the municipality by the ratio of three different type of soil. Those are sandy soil (clay contents less than 15%), silty soil (clay contents between 15–35%) and clayey soil (clay contents more than 35%). The data on the distribution ratio of those 3 different soils in each municipality was available. The data collected from all municipalities in the study area was summarized and plotted on the map and shown in Fig. 3.6.2. The distribution of high clay contents soil coincides with the distribution of latosol and podzolic soils. This also coincides with the distribution of farmers who carry out fattening to be mentioned in the following chapter.

Land use potential map was prepared by SEPLAN based on the soil map mentioned above. The classification is followed by the grouping (1-6) based on the suitability for crop production, planted pasture, silviculture, natural pasture and conservation. Indicators for this grouping are soil fertility, water condition, erodibility, mechanization suitability and effective soil depth. Under this study, the soil suitability for agriculture was classified into 5 classes from A to E according to the grouping (1-6) as shown in Table 3.6.5. Class A consists of group 1 to 3 and is basically suitable for agricultural production (group 3 needs more input than group 1). Class B coincides with group 4 and is suitable for cultivated pasture. Class C and D derived from group 5 and Class C is suitable for natural pasture, whereas Class D is suitable for silviculture. Class E coincides with group 6 and is subject to be conserved. The distribution of Class A from E in the study area is shown in Fig. 3.6.3. and this suitability map was used as one of the materials for GIS analysis. The area distribution in each municipality is shown in Table 3.6.6. According to the table, Class A, B and C occupies approximately 30% of the total area respectively. The distribution of Class D and E is consequently limited within the study area. Class A is mainly distributed in the extreme northern region and in the left bank of Tocantins river. Class B can be found mainly in the right bank of Araguaia river. Class C is typical in the south eastern part of the study area specially in between route 153 and Tocantins river.

(4) Analysis of Soil

As it is emphasized in the chapter on integration system of agriculture and animal husbandry, one of the important pre-condition for this system is necessary fertilization of insufficient element such as lime and phosphate according to the analysis results of soil samples taken from degraded pasture land. Soil analysis is also necessary for each cropping in order to perform an appropriate farm management. Although the support services for farmers on soil analysis are so far carried out by the staff of Ruraltins, the facilitiy necessary for soil analysis seems insufficient. There is only one private soil laboratory in Palmas and analyzable items and the analyzable number of samples is both limited. Furthermore, Ruraltins is still using the manual for fertilization design based on the results of soil analysis that was prepared on 1988 during the period of Goias State. Renewal of such manual by adding the recent technologies and findings becomes quite important. It is thus recommended to review the integrated system of soil analysis facilities and the evaluation method of analysis results.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PV13
PV8
PV9
R3
AQ1
PV18
PV11
PARÁ
PE1
LV6
PV15
PV18
PV19
LV5
AQ4
MARANHÃO
LA2
LE4
AQ4
R3
R4
PV20
AQ1
R3
P/ MARABÁ AMAZONAS
P/ AMAZONAS
P/ REDENÇÃO XINGUARA
P/ NORTE BELÉM/SÃO LUIS
P/ FORTALEZA
P/ NORDESTE
P/ PALMAS, BRASÍLIA, CENTRO OESTE
RIO ARAGUAIA
RIO TOCANTINS
Araguatins
Augustinópolis
Axixá do Tocantins
Sítio Novo do Tocantins
Tocantinópolis
Esperantina
Carrasco Bonito
Tempo
Pedro Afonso
Xambioá
Araguanã
Piraquê
Araguaína
Santa Fé do Araguaia
Marabá
Babaçulândia
Filadélfia
Palmeirante
Sítio Novo do TO
Aguiarnópolis
LEGENDA
Sede Municipal
Limite Municipal
Área Urbana
Estudo do Desenvolvimento do Setor Agropecuário da Região Norte do Estado do Tocantins
SEPRO
JICA
Fig. 3.6.1: Soil Map
10 0 10 Kilometers
ESC. 1:1,450,000

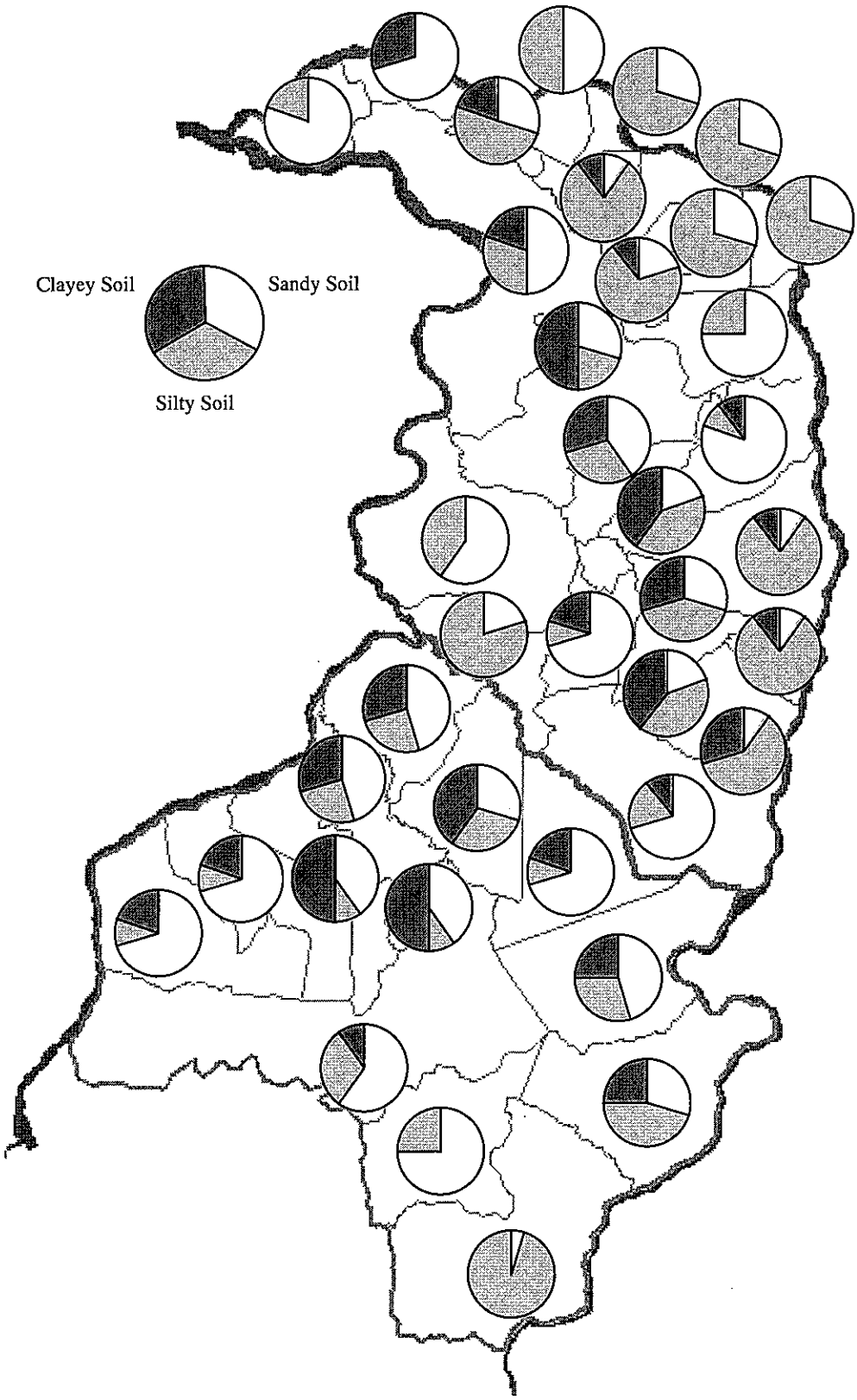

Fig. 3.6.2: Distribution of Soil Texture in each Municipio

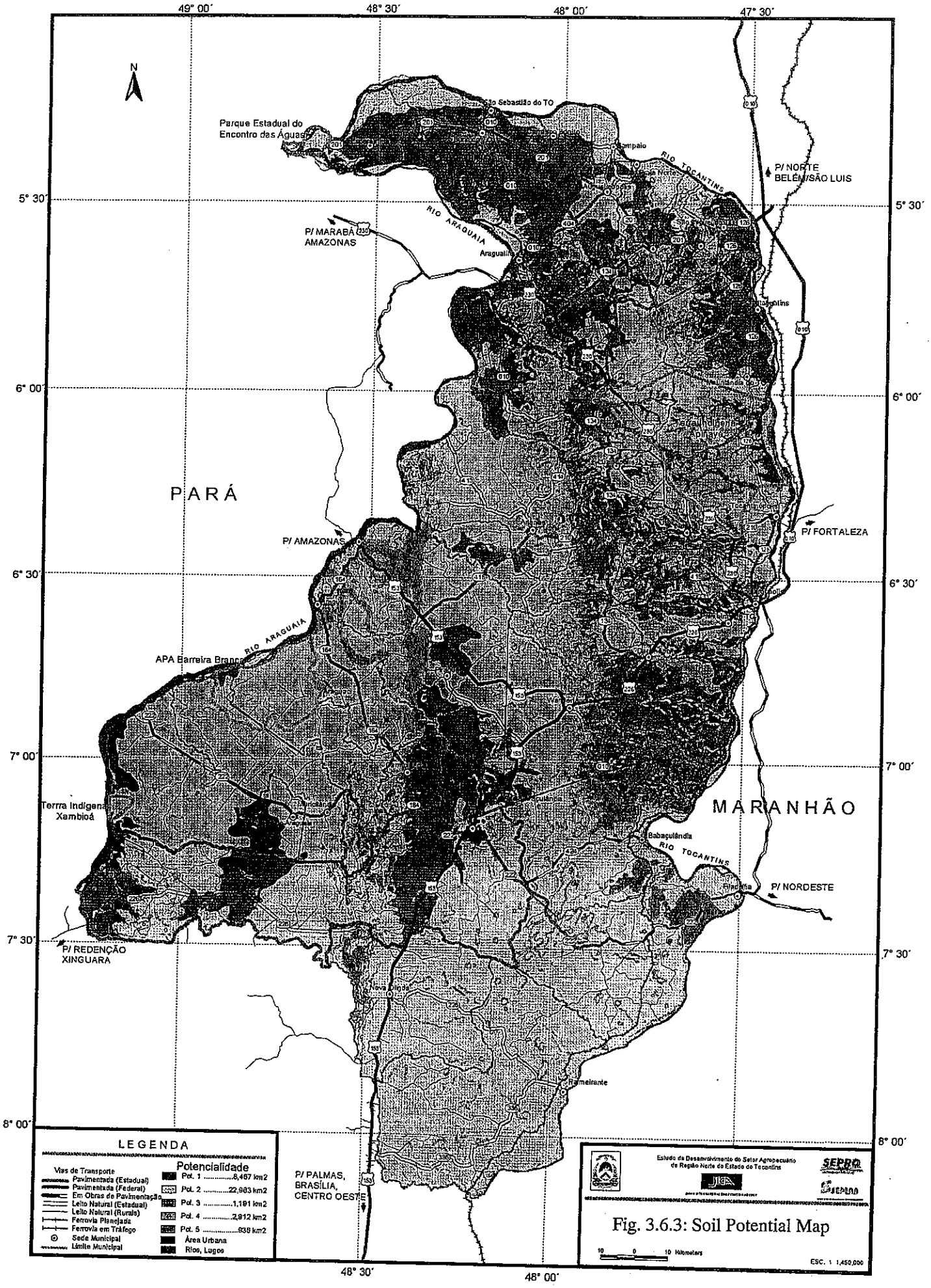

Fig. 3.6.3: Soil Potential Map

Table 3.6.1: Legend of the Soil Map

Symbol	Soil/Soil Associations	Aptidao	
		Group	Class
AQ1	Areia Quartzosa Distrófico e Álico A moderado	5(n)	C
AQ2	Associação de Areia Quartzosa Podzólica Álico e Distrófico A moderado + Areia Quartzosa Álico A húmico	6	E
AQ3	Associação de Areia Quartzosa Distrófico e Álico A moderado + Podzólico Vermelho Amarelo Distrófico A moderado textura arenosa/média	4(p)(2)	B
AQ4	Associação de Areia Quartzosa Álico e Distrófico A moderado + Latossolo Amarelo Álico e Distrófico A moderado textura média + Latossolo Vermelho Amarelo Álico e Distrófico A moderado textura média	4(p)(2)	B
G	Associação de Gleissolo + Solo Aluvial ambos álicos e distróficos, textura indiscriminada	5(n)	C
LA1	Latossolo Amarelo Plíntico Álico A moderado textura média	3(c)(1)	A
LA2	Associação de Latossolo Amarelo Plíntico Álico A moderado textura média + Plintossolo Álico e Distrófico A moderado textura média	3(c)(1)	A
LE1	Latossolo Vermelho-Escuro Distrófico A moderado textura média	1abC	A
LE2	Associação de Latossolo Vermelho-Escuro Distrófico A moderado textura média + Latossolo Vermelho-Amarelo Distrófico A moderado textura média	4P(1)	B
LE3	Associação de Latossolo Vermelho-Escuro Eutrófico e Distrófico A moderado textura argilosa + Latossolo Vermelho-Escuro Petroplíntico Eutrófico A moderado textura argilosa	4P(1)	B
LE4	Associação de Latossolo Vermelho-Escuro Distrófico A moderado textura argilosa + Podzólico Vermelho-Amarelo Álico A moderado textura média/argilosa cascalhenta	1abC	A
LV1	Latossolo Vermelho-Amarelo Eutrófico A moderado textura média	1abC	A
LV2	Latossolo Vermelho-Amarelo Álico e Distrófico A moderado textura média	2(b)c	A
LV3	Associação de Latossolo Vermelho-Amarelo Álico A moderado textura média + Latossolo Amarelo Álico A moderado textura média	2c	A
LV4	Associação de Latossolo Vermelho-Amarelo Plíntico Álico A moderado textura média + Latossolo Amarelo Álico A moderado textura média	3(c)	A
LV5	Associação de Latossolo Vermelho-Amarelo Plíntico Distrófico e Álico A moderado textura média cascalhenta + Latossolo Amarelo Distrófico e Álico A moderado textura média	3(c)	A
LV6	Associação de Latossolo Vermelho-Amarelo Distrófico A moderado textura média + Areia Quartzosa Distrófico A moderado	3(abc)	A
PA1	Podzólico Amarelo Distrófico A moderado textura arenosa/média	2(b)c	A
PA2*	Associação de Podzólico Amarelo Plíntico Distrófico A moderado textura arenosa/argilosa + Plintossolo Distrófico A moderado textura média cascalhenta		
PE1	Associação de Podzólico Vermelho-Escuro Eutrófico A moderado e proeminente textura média/argilosa e média/muito argilosa + Podzólico Vermelho-Escuro Eutrófico A moderado e proeminente textura arenosa/média e arenosa/argilosa + Solo Litólico Eutrófico A moderado e proeminente textura argilosa e média	2abc(1)	A
PE2	Associação de Podzólico Vermelho-Escuro Eutrófico A moderado textura média + Podzólico Vermelho-Amarelo Eutrófico A moderado textura arenosa/média	1abC	A
PE3	Associação de Podzólico Vermelho-Escuro Eutrófico A moderado textura argilosa + Podzólico Vermelho-Amarelo Álico e Distrófico A moderado textura média	2abc(1)	A
PP1	Petroplintossolo Álico A moderado e proeminente textura média/argilosa	5(n)	C
PP2*	Associação de Petroplintossolo Distrófico A moderado textura arenosa/média + Podzólico Vermelho-Amarelo Petroplíntico Distrófico A moderado textura arenosa/média cascalhenta		
PP3*	Associação de Petroplintossolo Distrófico e Álico A moderado textura arenosa e média + Podzólico Vermelho-Amarelo Álico A moderado textura média		
PV1	Podzólico Vermelho-Amarelo Álico A moderado textura média	4p	B
PV2	Podzólico Vermelho-Amarelo Eutrófico e Distrófico A moderado textura arenosa/média	2(b)c	A
PV3*	Podzólico Vermelho-Amarelo A moderado textura média/argilosa e arenosa/média		
PV4	Podzólico Vermelho-Amarelo Plíntico ou Pedregoso Eutrófico A moderado textura arenosa/média	4p	B
PV5	Associação de Podzólico Vermelho-Amarelo Distrófico A moderado textura média + Podzólico Vermelho-Amarelo Plíntico Distrófico A moderado textura média	2(b)c(1)	A
PV6	Associação de Podzólico Vermelho-Amarelo Álico A moderado textura média álico + Solo Litólico Pedregoso Eutrófico A moderado textura média	2(b)c(1)	A
PV7	Associação de Podzólico Vermelho-Amarelo Álico A moderado textura arenosa/média + Podzólico Amarelo Álico A moderado textura arenosa/média	4P	B
PV8	Associação de Podzólico Vermelho-Amarelo Álico A moderado textura arenosa/média + Podzólico Amarelo Plíntico Álico A moderado textura arenosa/média	3(c)(1)	A
PV9	Associação de Podzólico Vermelho-Amarelo Álico A moderado textura arenosa/média + Podzólico Vermelho-Escuro Álico A moderado textura arenosa/média	3(bc)	A
PV10	Associação de Podzólico Vermelho-Amarelo Álico A moderado textura arenosa/média + Areia Quartzosa Álico e Distrófico A moderado	4p(1)	B
PV11	Associação de Podzólico Vermelho-Amarelo Álico A moderado textura arenosa/média e média/argilosa + Podzólico Vermelho-Amarelo Plíntico ou Pedregoso Álico e Distrófico A moderado textura arenosa/média e média/argilosa	4P	B
PV12	Associação de Podzólico Vermelho-Amarelo Eutrófico A moderado textura arenosa/média + Podzólico Vermelho-Escuro Eutrófico A moderado textura arenosa/média	2abc	A
PV13	Associação de Podzólico Vermelho-Amarelo Eutrófico e Distrófico A moderado textura arenosa/média + Solo Litólico Eutrófico A moderado textura arenosa	3(abc)(1)	A
PV14	Associação de Podzólico Vermelho-Amarelo Distrófico A moderado textura média cascalhenta + Solo Litólico Pedregoso Distrófico A moderado textura arenosa	4(p)(1)	B
PV15	Associação de Podzólico Vermelho-Amarelo Distrófico A moderado textura arenosa/média cascalhenta + Petroplintossolo Álico A moderado textura arenosa/média	4p(1)	B
PV16	Associação de Podzólico Vermelho-Amarelo Plíntico Álico e Distrófico A moderado textura arenosa/média + Podzólico Vermelho-Amarelo Álico e Distrófico A moderado textura arenosa/média	4(p)	B
PV17	Associação de Podzólico Vermelho-Amarelo Plíntico Eutrófico e Distrófico A moderado textura média/argilosa + Cambissolo Álico e Eutrófico A moderado textura média	2b(c)	A
PV18	Associação de Podzólico Vermelho-Amarelo Plíntico ou Pedregoso Distrófico A moderado textura média/argilosa cascalhenta + Petroplintossolo Pedregoso Distrófico A moderado textura média	4(p)(1)	B
PV19	Associação de Podzólico Vermelho-Amarelo Plíntico ou Cascalhento Distrófico A moderado textura média e arenosa/média + Latossolo Vermelho-Amarelo Plíntico Distrófico e Álico A moderado textura média	4p	B
PV20	Associação de Podzólico Vermelho-Amarelo Plíntico ou Pedregoso Álico A moderado textura média + Petroplintossolo Álico e Distrófico A moderado textura média + Cambissolo Pedregoso Álico A moderado textura média	4(p)(2)	B
R1	Solo Litólico Distrófico A moderado textura arenosa	6	E
R2	Solo Litólico Álico A moderado textura média	6	E
R3	Associação de Solo Litólico Distrófico e Eutrófico A moderado textura média e arenosa + Podzólico Vermelho-Amarelo Distrófico e Álico A moderado textura arenosa/média	5N	C
R4	Associação de Solo Litólico Distrófico e Eutrófico A moderado e proeminente textura média e arenosa + Podzólico Vermelho-Amarelo Pedregoso Distrófico e Eutrófico A moderado textura arenosa/média	5S	D
R5	Associação de Solo Litólico com ou sem cascalho Álico e Distrófico A moderado textura média + Podzólico Vermelho-Amarelo Pedregoso Distrófico e Álico A moderado textura arenosa/média e arenosa/argilosa	4(p)	B

* Outside of study area

Table 3.6.2: Area Distribution of each Soil Type in Municipio

(Unit:km2)

	Município	AQ1	AQ2	AQ3	AQ4	G	LA1	LA2	LE1	LE2	LE3	LE4	LV1	LV2	LV3	LV4	LV5	LV6	PA1	PE1	PE2	PE3	PP1	PV1	PV2	PV4	PV5	PV6	PV7	PV8	PV9	PV10	PV11	PV12	PV13	PV14	PV15	PV16	PV17	PV18	PV19	PV20	R1	R2	R3	R4	R5	RIO	Outros	TOTAL
1	Araguatins	361.2	0.0	0.0	0.0	14.4	15.1	0.0	0.0	0.0	0.0	0.0	71.9	260.6	258.2	0.0	0.0	0.0	66.5	117.8	445.8	0.0	38.6	0.0	0.0	0.0	0.0	23.0	0.0	206.9	0.0	0.0	2.8	17.1	0.0	40.9	0.0	3.5	218.0	0.0	0.0	0.0	23.4	0.0	13.3	0.0	0.0	5.6	92.6	2297.0
2	Cachoeirinha	105.6	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.0	0.0	0.0	0.0	157.6	354.0
3	Esperantina	0.0	0.0	0.0	0.0	109.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.9	0.0	145.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	104.7	482.5
4	São Bento do Tocantins	658.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	149.7	0.0	0.0	0.0	0.0	0.0	196.7	16.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.6	0.0	234.2	0.0	0.0	0.0	148.9	1438.0
5	São Sebastião do Tocantins	0.0	0.0	0.0	0.0	142.4	0.0	0.0	0.0	0.0	0.0	0.0	33.3	47.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	27.1	288.5
6	Augustinópolis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	81.2	0.0	0.0	0.0	4.9	0.0	36.9	0.0	0.0	0.0	158.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	0.0	0.0	0.1	395.0
7	Axixá do Tocantins	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.0	0.0	0.0	0.0	0.0	105.0
8	Buriti do Tocantins	0.0	0.0	0.0	0.0	26.1	0.0	0.0	0.0	0.0	0.0	0.0	117.0	0.0	23.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	9.3	272.0
9	Carrasco Bonito	0.0	0.0	0.0	0.0	80.2	0.0	0.0	0.0	0.0	0.0	0.0	69.4	0.0	32.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	6.7	196.0
10	Praia Norte	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	120.7	0.0	110.0	0.0	0.0	0.0	42.8	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	7.7	295.0
11	Sampaio	0.0	0.0	0.0	0.0	78.9	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.7	0.0	32.1	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	17.4	202.0
12	São Miguel do Tocantins	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	0.0	219.5	0.0	0.0	0.0	0.0	118.4	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0	0.3	13.7	408.5
13	Sítio Novo do Tocantins	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	12.8	0.0	0.0	0.0	0.0	1.4	0.0	129.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.1	0.0	0.0	0.0	0.0	274.5
14	Aguiarnópolis	77.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.4	14.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	2.1	9.3	240.0
15	Angico	126.6	0.0	0.0	0.0	0.0	0.0	0.0	85.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	0.0	181.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.9	0.0	0.0	0.0	0.0	0.0	0.0	564.0
16	Darcinópolis	514.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	754.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	160.4	0.0	0.0	0.0	0.0	0.5	15.8	1555.0
17	Itaguatins	168.3	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	85.6	0.0	0.0	0.0	216.7	0.0	0.0	0.0	155.1	0.0	0.0	0.0	0.0	0.0	0.0	99.0	0.0	0.0	0.5	21.7	828.0
18	Luzinópolis	175.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.0	0.0	0.0	0.0	0.0	0.0	281.0
19	Maurilândia do Tocantins	91.4	2.7	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.5	0.0	0.0	0.0	57.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.9	0.0	0.0	0.6	550.5	792.0
20	Nazaré	65.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.6	0.0	174.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	392.0
21	Palmeiras do Tocantins	208.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	171.2	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	345.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.6	5.6	751.0
22	Santa Terezinha do Tocantins	63.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.7	0.0	164.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	277.0
23	Tocantinópolis	107.5	3.7	0.0	0.0	2.1	0.0	0.0	0.0	189.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.3	0.0	75.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	677.3	1082.0
24	Ananás	273.1	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	12.4	7.2	0.0	0.0	0.0	0.0	31.6	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	162.1	0.0	0.0	0.0	653.8	0.0	0.0	0.0	0.0	0.0	0.0	219.4	0.0	0.0	2.0	0.0	0.0	0.0	0.0	1.2	34.7	1398.0
25	Araguanã	0.0	0.0	0.0	0.0	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	320.4	353.1	0.0	0.0	0.0	0.0	131.2	0.0	0.5	22.2	869.0
26	Piraquê	97.7	0.0	209.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.9	0.0	0.0	353.8	0.0	0.0	2.7	0.0	49.5	0.0	0.0	0.0	0.0	0.0	0.0	52.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4	0.0	0.0	146.8	20.3	0.0	0.0	0.0	0.0	144.5	0.0	0.0	2.8	1179.0
27	Riachinho	26.4	0.0	7.7	0.0	23.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	137.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	402.9	0.0	0.0	0.0	82.0	0.0	0.0	0.0	0.3	0.0	0.0	2.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	2.5	686.0
28	Xambioá	0.0	0.0	231.3	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.2	0.0	0.0	411.5	0.0	0.0	0.0	0.0	13.3	269.6	0.0	0.0	27.3	1388.0
29	Aragominas	0.0	0.0	0.0	82.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.6	289.1	0.4	0.0	0.0	0.0	0.0	115.3	0.1	442.8	1067.0
30	Araguaína	891.3	0.0	0.0	379.7	0.0	0.0	338.0	0.0	0.0	0.0	241.5	0.6	0.0	0.0	0.0	671.7	0.0	0.0	0.0	0.0	83.5	0.0	35.6	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	103.8	687.5	0.0	59.2	0.0	0.0	397.5	0.0	24.1	3920.0
31	Babaçulândia	813.5	0.0	0.0	0.0	27.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	340.1	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	425.7	9.1	0.0	0.0	259.5	0.0	2.3	33.4	1916.0
32	Carmolândia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.2	0.0	0.0	0.0	0.0	8.4	54.5	0.0	0.0	354.0
33	Filadélfia	926.7	257.6	0.0	0.0	29.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230.7	0.0	0.0	341.6	170.1	0.0	2.6	38.2	1996.5
34	Muricilândia	0.0	0.0	0.0	478.2	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.0	367.9	0.0	0.0	0.0	0.0	20.3	0.0	157.8	1248.0
35	Nova Olinda	1227.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.3	0.0	379.3	0.0	0.0	1724.0		
36	Palmeirante	1244.0	130.7	0.0	0.0	65.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1013.2	0.0	0.0	1.0	17.5	2472.0		
37	Santa Fé do Araguaia	0.0	0.0	0.0	244.1	0.0	0.0	201.7	0.0	0.0	0.0	23.5	0.0	0.0	0.0	0.0	95.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1035.1	0.0	0.0	0.0	0.0	0.0	0.1	83.9	1684.0
38	Wanderlândia	785.8	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	165.2	0.0	24.6	0.0	142.4	0.0	0.0	0.0	0.0	0.0	0.0	157.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.1	0.0	17.8	0.0	0.0	0.0	0.1	1379.0
	TOTAL	9021.6	412.1	450.8	1184.1	641.4	15.1	545.9	111.3	246.9	185.8	265.1	301.6	647.6	646.6	145.7	1427.0	1481.4	66.5	1529.8	462.3	280.0	38.9	35.6	80.4	203.0	317.9	111.0	1050.4	206.9	256.2	320.2	743.6	377.3	212.2	40.9	281.9	209.1	386.6	1151.1	892.6	2747.2	420.6	59.2	2104.0	983.4	966.8	31.5	2753.7	37050.6
	(%)	24.3	1.1	1.2	3.2	1.7	0.0	1.5	0.3	0.7	0.5	0.7	0.8	1.7	1.7	0.4	3.9	4.0	0.2	4.1	1.2	0.8	0.1	0.1	0.2	0.5	0.9	0.3	2.8	0.6	0.7	0.9	2.0	1.0	0.6	0.1	0.8	0.6	1.0	3.1	2.4	7.4	1.1	0.2	5.7	2.7	2.6	0.1	7.4	100.0
	TYPE				1068.7	641.4		561.0				809.1						4649.9	66.5			2272.1	38.9																				9624.0					4533.9	31.5	2753.7	0.0
	(%)				29.9	1.7		1.5				2.2						12.6	0.2			6.1	0.1																				26.0					12.2	0.1	7.4	100.0

Table3.6.3 : Soil classification and the characteristic of each soil type distributed in the study area

Soil Types	Symbols	Area Occupied	Characteristic
Areia Quartzosa (Quartz Sands)	AQ1/AQ2/AQ3/AQ4	11,068.7Km^2 (29.9%)	This soil belongs to Entisol which is strongly affected by the parent material and not affected by the environmental factors. This type of soil is formed on recent topographic conditions such as recent alluvial soils. It shows high erodability on steep topography.
Gleissolo (Gley Soils)	G	641.4 Km^2 (1.7%)	This soil is blackish in color and rich in organic matter and base contents including humic glay soils. This soil is basically suitable for crop production with some problems such as shortage of available water in dry season and less drainability in lowland.
Latossolo Amarelo (Yellow Latosols)	LA1/LA2	561.0Km^2 (1.5%)	This soil is highly weathered tropical soils specifically distributed in the area with dry and temperature steady summer. It is mainly utilized for shifting cultivation, extensive agriculture/animal production and plantation of sugarcane, banana, pineapple and coffee. An appropriate soil management is needed due to poor fertility and water holding capacity.
Latossolo Vermelho-Escuro (Dark Red Latosols)	LE1/LE2/LE3/LE4	809.1Km^2 (2.2%)	
Latossolo Vermelho-Amarelo (Red-Yellow Latosols)	LV2/LV2/LV3/LV4/LV5/LV6	4649.9Km^2 (12.6%)	
Podozolico Amarelo (Yellow Podzolic Soils)	PA1/PA2	66.5Km^2 (0.2%)	This soil has gray to brown colored surface layer and is usually formed under forest and grass land vegetation with the climate of hot/dry summer and clear dry and wet seasons. This soil is widely used for crop production and pasture land due to rather high fertility derived from cation accumulated layer (C layer).
Podozolico Vermelho-Escuro (Dark Red Podzolic Soils)	PE1/PE2/PE3	2,272.1Km^2 (6.1%)	
Podozolico Vermelho-Amarelo (Red-Yellow Podzolic Soils)	PA1～PV20	9,624.0 Km^2 (26.0%)	
Concretionary Soils (Petroplinthic Soils)	PP1/PP2/PP3	38.9Km^2 (0.1%)	This soil is a part of latosol which has organic matter poor and Fe-rich concretionary layer within 1m from soil surface. This soil is formed under the repetition of dry and wet conditions.
Litholic Soils (Dystrophic Litholic Soils)	R1/R2/R3/R4/R5	4,533.9Km^2 (12.2%)	This soil is gravelly soils belongs to Entisol and the organic matter contents reduces in deeper layer. It shows high erodability on steep topography similar to the case of Quarts Sands.
Others	Rio etc.	2,785.2 Km^2 (7.5%)	
Total		37,050.5Km^2 (100.0%)	

Table 3.6.4: Physical and chemical properties of sample soils (1)

CEC:Cation Exchange Capacity, m%:Aluminium Saturation %, V%:Base Saturation %, C%:Carbon %

Symbol	AQ1		AQ2		AQ3		AQ4		G		LA1		LA2		LE1		LE2		LE3		LE4	
Point	64		105		62		1047		132		158		1021		1154		85		76		24	
UTM (norte/leste)	9240243/813065		9329096/226036		9244530/803608		9227586/751253		9410444/175407		9358500/811843		9187755/741951		9292527/181249		9299246/228063		9265915/208158		9181432/699224	
Depth (cm)	0-20	100-120	0-20	100-120	0-20	80-100	0-15	80-100	0-20	70-80	0-20	60-80	0-20	40-60	0-20	60-80	0-20	80-100	0-20	70-90	0-20	80-100
Color	7.5YR3/3	5YR6/8	7.5YR3/2	10YR5/2	5YR2/4	7.5YR4/6	10YR3/2	2.5Y6/6	10YR4/1	2.5YR6/1	10YR2/2	10YR5/4	10YR4/4	2.5Y6/6	2.5YR3/4	2.5YR3/5	2.5YR3/3	2.5YR3/6	2.5YR3/6	2.5YR3/4	5YR4/4	2.5YR4/6
Sand (%)	96	93	90	92	94	90	89	85	15	25	61	50	63	62	43	22	74	60	60	41	40	30
Silt (%)	1	0	4	2	0	1	4	4	54	22	26	28	16	18	15	15	12	12	7	6	27	21
Clay (%)	3	7	6	6	6	9	7	11	27	53	13	22	21	20	42	63	14	28	33	53	33	49
Silt/Clay ratio	0.33	0.00	0.67	0.33	0.00	0.11	0.57	0.36	2.00	0.42	2.00	1.27	0.76	0.90	0.36	0.24	0.86	0.43	0.21	0.11	0.82	0.43
Texture	Areia	Areia	Areia	Areia	Areia	Areia	Areia	Areia-Franca	Franco-Argilo-Siltosa	Argila	Argila	Argila	Franco-Argilo-Arenosa	Franco-Arenosa	Argila	Muito Argilosa	Franco-Arenosa	Franco-Argilo-Arenosa	Franco-Argilo-Arenosa	Argila	Franco-Argilosa	Argila
Density	2.63	2.53	2.63	2.67	2.70	2.56	2.50	2.53	2.53	2.78	2.56	2.56	2.53	2.60	2.74	2.74	2.53	2.74	2.67	2.63	2.63	2.78
pH (H2O)	4.70	5.00	4.90	4.50	4.80	4.70	5.30	5.10	5.60	4.40	5.20	4.90	-	-	5.40	5.30	5.60	5.20	5.10	4.90	-	-
pH (KCl)	4.00	4.30	4.00	3.70	4.00	4.30	4.40	4.00	4.00	3.50	4.00	3.80	-	-	4.40	4.80	4.90	4.90	4.00	4.20	-	-
Ca (meq/100g)	0.20	0.20	0.90	0.20	0.30	0.20	1.60	0.30	3.60	0.20	2.40	1.00	-	-	3.20	0.80	2.80	1.00	1.20	0.20	-	-
Mg (meq/100g)	0.00	0.00	0.30	0.40	0.10	0.00	1.00	0.20	1.60	0.10	0.30	0.40	-	-	1.60	0.40	0.60	0.10	0.40	0.20	-	-
Na (meq/100g)	0.03	0.01	0.07	0.09	0.01	0.00	0.06	0.04	0.23	0.29	0.03	0.03	-	-	0.02	0.00	0.02	0.01	0.01	0.01	-	-
K (meq/100g)	0.03	0.01	0.16	0.02	0.02	0.02	0.41	0.08	0.22	0.22	0.14	0.11	-	-	0.17	0.01	0.07	0.05	0.13	0.04	-	-
T-Cation (meq/100g)	0.26	0.22	1.43	0.71	0.43	0.22	3.07	0.62	5.65	0.81	2.87	1.54	-	-	4.99	1.21	3.49	1.16	1.74	0.45	-	-
Al (meq/100g)	0.40	0.20	0.40	1.10	0.30	0.20	0.00	0.30	0.40	6.90	0.70	4.00	-	-	0.00	0.00	0.00	0.00	0.20	0.10	-	-
H (meq/100g)	3.50	1.10	4.90	3.00	3.90	3.30	3.40	0.90	5.50	-1.30	5.30	1.30	-	-	4.60	1.90	2.10	1.00	3.50	1.80	-	-
CEC	4.16	1.52	6.73	4.81	4.63	3.72	6.47	1.82	11.55	6.41	8.87	6.84	-	-	9.59	3.11	5.59	2.16	5.44	2.35	-	-
m%	60.61	47.62	21.86	60.77	41.10	47.62	0.00	32.61	6.61	89.49	19.61	72.20	-	-	0.00	0.00	0.00	0.00	10.31	18.18	-	-
V%	6.25	14.47	21.25	14.76	9.29	5.91	47.45	34.07	48.92	12.64	32.36	22.51	-	-	52.03	38.91	62.43	53.70	31.99	19.15	-	-
C%	0.60	0.10	0.90	0.20	0.50	0.30	1.80	0.20	1.90	0.30	1.80	0.40	-	-	2.40	0.40	1.60	0.30	1.10	0.30	-	-

Symbol	LV1		LV2		LV3		LV4		LV5		LV6		PA1		PE1		PE2		PE3		PP1	
Point	144		61		180		154		33		72		1133		1088		1146		51		162	
UTM (norte/leste)	9416962/809903		9254806/799824		9286447/815695		9414600/775964		9210559/790546		9247765/189730		9393970/797400		9324853/178396		9363014/170307		9216691/815827		9347035/809909	
Depth (cm)	0-20	60-80	0-20	40-60	0-20	80-100	0-20	80-100	0-20	80-100	0-20	80-100	0-20	80-100	0-20	80-100	0-15	40-60	0-20	80-100	0-20	40-60
Color	5YR2/2	7.5YR4/6	7.5YR4/4	7.5YR4/6	10YR2/2	10YR5/4	7.5YR5/2	2.5YR7/2	5YR2/4	5YR5/8	5YR3/4	5YR4/8	7.5YR3/2	10YR5/6	2.5YR3/4	2.5YR3/6	5YR4/4	5YR4/8	5YR2/3	3.5YR4/8	5YR4/3	5YR5/8
Sand (%)	67	71	88	79	52	45	83	72	47	41	24	19	83	77	25	14	85	66	80	62	71	38
Silt (%)	24	17	4	6	45	27	8	7	30	16	17	9	7	7	26	16	5	4	4	3	15	22
Clay (%)	9	12	8	15	3	28	9	20	23	43	59	72	10	16	49	70	10	3	16	35	14	40
Silt/Clay ratio	2.67	1.42	0.50	0.40	15.00	0.96	0.89	0.35	1.30	0.37	0.29	0.13	0.70	0.44	0.53	0.23	0.50	1.33	0.25	0.09	1.07	0.55
Texture	Franco-Arenosa	Franco-Arenosa	Areia-Franca	Franco-Arenosa	Franco-Arenosa	Franco-Argilo-Arenosa	Areia-Franca	Franco-Argilo-Arenosa	Franco	Argila	Argila	Muito Argilosa	Areia-Franca	Franco-Arenosa	Argila	Muito Argilosa	Areia-Franca	Franco-Argilo-Arenosa	Franco-Arenosa	Franco-Argilo-Arenosa	Areia	Franco-Argilo-Arenosa
Density	2.56	2.67	2.63	2.56	2.47	2.67	2.53	2.74	2.70	2.63	2.67	2.82	2.53	2.53	2.74	2.50	2.67	2.67	2.60	2.74	2.67	2.74
pH (H2O)	5.80	5.50	5.10	5.80	5.50	4.80	4.50	4.50	-	-	5.20	4.90	5.70	5.30	6.10	6.00	5.80	5.60	-	-	4.40	4.30
pH (KCl)	4.70	4.60	4.10	4.50	4.40	3.70	3.70	3.70	-	-	4.20	4.50	4.30	4.10	4.90	5.00	4.50	4.90	-	-	3.80	3.80
Ca (meq/100g)	4.30	1.60	1.40	3.50	2.80	0.60	0.50	0.40	-	-	2.70	0.40	2.60	1.00	10.30	6.80	3.70	2.50	-	-	0.60	0.10
Mg (meq/100g)	1.70	0.60	0.20	0.20	0.70	0.70	0.00	0.10	-	-	1.90	0.60	0.50	0.40	2.50	3.70	0.80	0.60	-	-	0.40	0.10
Na (meq/100g)	0.22	0.24	0.04	0.04	0.04	0.02	0.07	0.04	-	-	0.02	0.01	0.01	0.00	0.08	0.05	0.09	0.03	-	-	0.03	0.03
K (meq/100g)	0.30	0.11	0.06	0.05	0.43	0.14	0.10	0.00	-	-	0.13	0.01	0.07	0.03	0.16	0.12	0.30	0.17	-	-	0.22	0.10
T-Cation (meq/100g)	6.52	2.55	1.70	3.79	3.97	1.46	0.67	0.54	-	-	4.75	1.02	3.18	1.43	13.04	10.67	4.89	3.30	-	-	1.25	0.33
Al (meq/100g)	0.00	0.00	0.30	0.10	0.90	4.40	1.10	1.90	-	-	0.20	0.00	0.00	0.10	0.00	0.00	0.00	0.00	-	-	1.00	2.60
H (meq/100g)	2.50	1.20	4.20	2.60	2.30	2.50	3.70	1.20	-	-	4.20	2.50	4.40	2.70	4.40	1.60	2.20	1.00	-	-	5.20	2.00
CEC	9.02	3.75	6.20	6.49	7.17	8.36	5.47	3.64	-	-	9.15	3.52	7.58	4.23	17.44	12.27	7.09	4.30	-	-	7.45	4.93
m%	0.00	0.00	15.00	2.57	18.48	75.09	62.15	77.87	-	-	4.04	0.00	0.00	6.54	0.00	0.00	0.00	0.00	-	-	44.44	88.74
V%	72.28	68.00	27.42	58.40	55.37	17.46	12.25	14.84	-	-	51.91	28.98	41.95	33.81	74.77	86.96	68.97	76.74	-	-	16.78	6.69
C%	2.00	0.40	1.10	0.70	1.70	0.40	1.50	0.20	-	-	2.70	0.30	1.60	0.30	3.20	0.40	0.60	0.20	-	-	1.50	0.40

Source: Solos da regiao do bico do papagaio (Instituto Agronomico de Campinas)

Table 3.6.4: Physical and chemical properties of sample soils (2)

CEC:Cation Exchange Capacity, m%:Aluminium Saturation %, V%:Base Saturation %, C%:Carbon %

Symbol	PV2		PV4		PV5		PV6		PV7		PV8		PV9		PV10		PV11		PV12		PV13	
Point	150		27		121		1113		1163		156		111		1123		173		1119		114	
UTM (norte/leste)	9412110/781985		9210751/765044		9385724/217819		9375000/180700		9272732/822372		9366347/817765		9345667/222443		9390148/202580		9308855/804281		9381431/203064		9360021/224627	
Depth (cm)	0-20	80-100	0-20	60-80	0-20	80-100	0-15	30-50	0-20	40-60	0-20	80-100	0-20	60-80	0-20	40-60	0-20	80-100	0-20	60-80	0-20	60-80
Color	10YR3/2	10YR5/4	7.5YR4/4	5YR5/8	7.5YR3/2	7.5YR5/6	10YR4/3	10YR5/6	10YR2/2	10YR5/4	10YR3/2	10YR6/3	10YR3/3	7.5YR5/8	10YR4/2	7.5YR6/4	10YR3/4	7.5YR5/6	7.5YR3/2	7.5YR5/8	7.5YR3/4	5YR4/8
Sand (%)	91	77	74	53	81	67	68	47	93	87	93	81	90	76	75	69	88	77	77	50	88	73
Silt (%)	2	4	12	19	7	11	22	19	1	3	6	17	3	5	4	4	5	3	12	14	5	3
Clay (%)	7	19	14	28	12	22	10	34	6	10	1	2	7	19	21	27	7	20	11	36	7	24
Silt/Clay ratio	0.29	0.21	0.86	0.68	0.58	0.50	2.20	0.56	0.17	0.30	6.00	8.50	0.43	0.26	0.19	0.15	0.71	0.15	1.09	0.39	0.71	0.13
Texture	Areia	Franco-Arenosa	Franco-Arenosa	Franco-Argilo-Arenosa	Franco-Arenosa	Franco-Argilo-Arenosa	Franco-Arenosa	Franco-Argilo-Arenosa	Areia	Areia-Franca	Areia	Areia-Franca	Areia	Franco-Arenosa	Franco-Argilo-Arenosa	Franco-Argilo-Arenosa	Areia	Franco-Arenosa	Franco-Arenosa	Argilo-Arenosa	Areia-Franca	Franco-Argilo-Arenosa
Density	2.56	2.70	2.50	2.60	2.74	2.53	2.47	2.63	2.56	2.50	2.67	2.56	2.67	2.67	2.67	2.47	2.63	2.50	2.63	2.56	2.67	2.70
pH (H2O)	5.50	5.40	-	-	5.20	4.80	5.80	4.20	5.00	4.90	5.20	4.90	5.30	4.50	5.00	4.80	5.40	4.40	6.10	5.10	5.30	5.00
pH (KCl)	4.50	4.30	-	-	4.30	4.00	4.80	3.70	4.10	4.20	4.30	4.20	4.30	3.90	4.20	4.10	4.70	3.90	4.70	4.10	4.40	4.30
Ca (meq/100g)	1.30	1.40	-	-	1.40	0.10	2.80	0.00	0.30	0.20	0.80	0.40	0.90	0.50	0.40	0.00	2.10	0.20	3.70	0.70	1.10	0.30
Mg (meq/100g)	0.20	0.20	-	-	0.40	0.10	1.00	0.60	0.10	0.10	0.30	0.00	0.80	0.70	0.30	0.10	0.70	0.10	0.90	1.40	0.20	0.20
Na (meq/100g)	0.06	0.01	-	-	0.24	0.24	0.11	0.05	0.00	0.00	0.01	0.01	0.16	0.15	0.02	0.00	0.06	0.04	0.11	0.06	0.20	0.22
K (meq/100g)	0.16	0.02	-	-	0.16	0.12	0.40	0.07	0.15	0.02	0.04	0.02	0.28	0.16	0.17	0.05	0.53	0.16	0.21	0.17	0.29	0.09
T-Cation (meq/100g)	1.72	1.63	-	-	2.20	0.56	4.31	0.72	0.55	0.32	1.15	0.43	2.14	1.51	0.89	0.15	3.39	0.50	4.92	2.33	1.79	0.81
Al (meq/100g)	0.00	0.10	-	-	0.20	0.40	0.00	4.00	0.20	0.90	0.10	0.40	0.10	2.00	0.30	0.50	0.00	1.70	0.00	0.50	0.00	0.10
H (meq/100g)	1.40	1.40	-	-	4.40	1.80	3.90	0.90	2.60	1.00	2.40	1.80	4.40	-0.80	2.30	1.40	4.20	0.60	3.20	0.90	2.50	1.40
CEC	3.12	3.13	-	-	6.80	2.76	8.21	5.62	3.35	2.22	3.65	2.63	6.64	2.71	3.49	2.05	7.59	2.80	8.12	3.73	4.29	2.31
m%	0.00	5.78	-	-	8.33	41.67	0.00	84.75	26.67	73.77	8.00	48.19	4.46	56.98	25.21	76.92	0.00	77.27	0.00	17.67	0.00	10.99
V%	55.13	52.08	-	-	32.35	20.29	52.50	12.81	16.42	14.41	31.51	16.35	32.23	55.72	25.50	7.32	44.66	17.86	60.59	62.47	41.72	35.06
C%	0.70	0.40	-	-	1.20	0.30	1.70	0.50	1.00	0.40	0.50	0.20	0.60	0.40	0.90	0.40	1.30	0.30	2.30	0.30	0.60	0.30

Symbol	PV14		PV15		PV16		PV17		PV18		PV19		PV20		R1		R3		R4		R5	
Point	1130		184		138		1135		185		1056		1039		1063		108		1170		1007	
UTM (norte/leste)	9389944/809100		9270024/793814		9391482/174892		9405375/801730		9273169/761253		9244250/773656		9226791/722036		9257815/192217		9344849/214143		9279175/782392		9176709/774586	
Depth (cm)	0-15	-	0-20	80-100	0-20	80-100	0-20	80-100	0-20	80-100	0-20	60-80	0-15	30-55	0-20	80-100	0-20	80-100	0-20	40-60	0-20	80-100
Color	7.5YR3/3	-	7.5YR4/4	4YR5/8	5YR3/2	7.5YR4/4	7.5YR3/3	2.5YR4/6	7.5YR2/2	5YR6/6	10YR3/3	7.5YR4/6	7.5YR3/3	7.5YR5/6	5YR4/4	3.5YR4/6	5YR4/6	2.5YR3/6	5YR3/4	4YR4/8	7.5YR4/4	4YR4/8
Sand (%)	66	-	52	21	70	61	75	56	83	28	81	67	60	34	95	93	95	80	55	46	78	67
Silt (%)	21	-	23	13	15	12	13	7	5	16	5	7	11	8	1	2	2	1	14	17	6	7
Clay (%)	13	-	25	66	15	27	12	37	12	56	14	26	29	58	4	5	3	19	31	37	16	26
Silt/Clay ratio	1.62	-	0.92	0.20	1.00	0.44	1.08	0.19	0.42	0.29	0.36	0.27	0.38	0.14	0.25	0.40	0.67	0.05	0.45	0.46	0.38	0.27
Texture	Franco-Arenosa	-	Franco-Argilo-Arenosa	Muito Argilosa	Franco-Arenosa	Franco-Argilo-Arenosa	Franco-Arenosa	Argilo-Arenosa	Areia-Franca	Argila	Franco-Arenosa	Franco-Argilo-Arenosa	Franco-Argilo-Arenosa	Argila	Areia	Areia	Areia	Franco-Arenosa	Franco-Argilo-Arenosa	Argilo-Arenosa	Franco-Arenosa	Franco-Argilo-Arenosa
Density	2.56	-	2.53	2.74	2.53	2.82	2.50	2.53	2.56	2.67	2.56	2.70	2.70	2.70	2.53	2.53	2.70	2.67	2.60	2.74	2.60	2.60
pH (H2O)	5.50	-	5.20	4.70	5.70	4.50	5.70	4.30	5.60	4.80	5.50	4.80	4.80	4.30	5.10	5.20	5.50	4.50	5.80	5.70	-	-
pH (KCl)	4.30	-	4.00	4.20	4.30	3.80	4.40	3.80	4.70	3.70	4.30	4.10	3.70	3.70	4.40	4.50	4.60	4.10	4.90	5.50	-	-
Ca (meq/100g)	1.60	-	1.90	0.10	3.90	0.70	3.20	0.10	3.10	0.20	2.10	0.40	1.10	0.20	0.10	0.00	1.30	0.20	3.90	2.50	-	-
Mg (meq/100g)	0.70	-	0.40	0.20	1.60	0.30	1.10	0.60	0.60	0.10	0.40	0.20	0.40	0.10	0.00	0.00	0.20	0.10	2.30	1.20	-	-
Na (meq/100g)	0.00	-	0.03	0.03	0.29	0.27	0.05	0.02	0.23	0.03	0.03	0.03	0.06	0.05	0.02	0.00	0.11	0.09	0.00	0.00	-	-
K (meq/100g)	0.17	-	0.22	0.06	0.43	0.31	0.33	0.11	1.69	0.03	0.24	0.12	0.31	0.06	0.03	0.01	0.14	0.14	0.07	0.06	-	-
T-Cation (meq/100g)	2.47	-	2.55	0.39	6.22	1.58	4.68	0.83	5.62	0.36	2.77	0.75	1.87	0.41	0.15	0.01	1.75	0.53	6.27	3.76	-	-
Al (meq/100g)	0.00	-	0.30	0.30	0.00	2.40	0.00	2.50	0.00	2.00	0.10	0.40	0.70	1.30	0.10	0.00	0.00	1.20	0.00	0.00	-	-
H (meq/100g)	3.30	-	4.20	2.60	4.60	1.00	4.80	1.80	3.20	2.30	7.30	5.10	4.90	2.90	1.20	0.00	5.10	1.70	2.20	0.30	-	-
CEC	5.77	-	7.05	3.29	10.82	4.98	9.48	5.13	8.82	4.66	10.17	6.25	7.47	4.61	1.45	0.01	6.85	3.43	8.47	4.06	-	-
m%	0.00	-	10.53	43.48	0.00	60.30	0.00	75.08	0.00	84.75	3.48	34.78	27.24	76.02	40.00	0.00	0.00	69.36	0.00	0.00	-	-
V%	42.81	-	36.17	11.85	57.49	31.73	49.37	16.18	63.72	7.73	27.24	12.00	25.03	8.89	10.34	100.00	25.55	15.45	74.03	92.61	-	-
C%	1.90	-	1.60	0.30	1.70	0.30	4.70	0.30	1.90	0.30	1.60	0.50	2.30	1.10	0.40	0.00	0.30	0.20	1.70	0.60	-	-

Source: Solos da regiao do bico do papagaio (Instituto Agronomico de Campinas)

Table 3.6.5: Relation between suitability group and class

Group	Conservation	Pasto Natural	Silviculture	Pasto Plantado	Lavouras			Class
					Aptidao Restricta	Aptidao Regular	Aptidao Boa	
Good Regular Restriction Unsuitable		N n (n) -	S s (s) -	P p (p) -	C c (c) -	B b (b) -	A a (a) -	
1								**A**
2								
3								
4								**B**
5								**C**
								D
6								**E**

Table 3.6.6: Aptidao da Terra (km2)

Municipio	A	B	C	D	E	Outros	Total
01-Araguatins	1,700.8	47.1	427.5		23.4	98.2	2,297.0
02-Cachoeirinha	63.2		105.6		27.6	157.6	354.0
03-Esperantina	265.5		109.9			107.1	482.5
04-Sao Bento do Tocantins	371.6	5.1	892.5		19.9	148.9	1,438.0
05-Sao Sebastiao do Tocantins	114.0		142.4			32.1	288.5
06-Augustinopolis	211.7	162.9	20.3			0.1	395.0
07-Axixa do Tocantins	36.7		68.4				105.0
08-Buriti do Tocantins	234.6		26.1			11.3	272.0
09-Carrasco Bonito	108.1		80.2			7.6	196.0
10-Praia Norte	110.2	163.5	13.5			7.7	295.0
11-Sampaio	41.0	64.5	78.9			17.6	202.0
12-Sao Miguel do Tocantins	265.4	118.4	10.8			13.9	408.5
13-Sitio Novo do Tocantins	147.9	1.4	125.2				274.5
14-Aguiarnopolis	76.1	72.1	77.4		2.9	11.4	240.0
15-Angico	289.0	73.5	126.6		74.9		564.0
16-Darcinopolis	754.6	109.7	514.0		160.4	16.3	1,555.0
17-Itaguatins	530.5		275.3			22.3	828.0
18-Luzinopolis	75.5	15.0	175.5		15.0		281.0
19-Maurilandia do Tocantins	96.6		141.6		2.7	551.1	792.0
20-Nazare	317.0		65.0		10.0		391.9
21-Palmeiras do Tocantins	357.1	171.2	208.2		8.3	6.2	751.0
22-Santa Terezinha do Tocanti	211.7		63.9		1.3		277.0
23-Tocantinopolis	99.1	189.5	109.7		3.7	680.0	1,082.0
24-Ananas	51.5	1,035.2	273.4		2.0	35.9	1,398.0
25-Araguana	29.9	673.5	11.6	131.2		22.7	869.0
26-Piraque	488.8	445.1	97.7	144.5		2.8	1,179.0
27-Riachinho	137.9	495.3	50.2	0.0	0.1	2.5	686.0
28-Xambioa	72.9	1,000.6	17.5	269.6		27.3	1,388.0
29-Aragominas	37.5	585.8	0.7			442.9	1,067.0
30-Araguaina	1,335.3	1,610.1	891.3		59.2	24.1	3,920.0
31-Babaçulandia	344.8	425.7	841.2	259.5	9.1	35.7	1,916.0
32-Carmolandia	230.9	114.7		8.4		0.0	354.0
33-Filadelfia		230.7	1,555.0	170.1		40.8	1,996.5
34-Muricilandia	9.2	1,081.0				157.9	1,248.0
35-Nova Olinda	4.6	379.3	1,268.8	71.3			1,724.0
36-Palmeirante			2,453.5			18.5	2,472.0
37-Santa Fé do Araguaia	320.9	1,279.2				84.0	1,684.0
38-Wanderlandia	332.3	160.0	803.7		83.1	0.1	1,379.0
Total	9,874.3	10,710.1	12,122.9	1,054.7	503.6	2,785.0	37,050.5
(%)	26.7	28.9	32.7	2.8	1.4	7.5	100.0

7. Vegetation

The research of division of the vegetable covering of the area of the study accomplished by SEPLAN/ZEE is shown in the following picture.

	Área Total	Floresta Estacional		Floresta Tropical		Cerrado		
	(Km^2)	Decidual	S-Decidual	Florestas	Matas	Arborizada	Parque	Gramineo Lenhosa
Total no estado		0.6%	1.9%	5.4%	4.3%	87.8%		
Área do estudo		1.7%	-	28.5%	20.0%	29.8%	11.8%	8.2%
Região de Araguatins		0.0%	-	54.4%	6.0%	32.1%	6.9%	0.6%
Região de Augustinópolis		16.9%	-	51.2%	6.0%	25.9%	0.0%	0.0%
Região de Tocantinópolis		3.4%	-	16.2%	0.0%	37.4%	22.2%	20.8%
Região de Xambioá		0.0%	-	62.1%	17.1%	9.0%	11.8%	0.0%
Região de Araguanã		0.1%	-	12.8%	33.9%	33.2%	10.8%	9.2%

As for vegetation in this Study Area, the parts which are left as the primeval woods are few and original vegetation is left in the cerrado area in second vegetation partially but the great part becomes vegetation which underwent influences such as too much field burn. Main vegetation in this Study Area is about 30% of Cerrado Arbolizada (Cerradão), and next, it becomes 28% of tropical open tree then tropical close tree. A tropical rain tree zone is distributed over the Araguaina river basin and the Tocantins river basin is covered with cerrado vegetation.

Tropical rain tree zone is classified into jungle or open tree zone from the density of forest. Vegatation which is seen in this area is as the following.

- Tree (Parica, Marupa, Sumauma, Paumucato, Virola, Parapara, Taxi-Branco, Freij Cinza、Mogno, Mogno Africano, Andrioba, Cedro, Tauari, Pau Amarelo, Castanae、Massandura, Ipé, Angelim, Acapu, Jatoba, Sucpira)
- Coco (Babaçu, Inajá, Pupunha, Açai, Bacaba,Buriti)
- Shrub (Escada de Jabuti, Unha de Gato, Cipo de Fogo)

A lot of tropical rain tree zones are distributed over the Araguaina river basin. A lot of useful tree existed in this Study Area but it is hardly left by indiscriminate deforestation in the 70s and original vegetation is left partially. The great part of these vegetation areas is utilized as stock farm now.