ANNEX II

NATURAL CONDITIONS

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Tocantins State is located in the northern region of Brazil between latitudes 5° and 13° south and between longitudes 46° and 51° west, with an area of 278.4 thousand km^2, equivalent to 3.26% of Brazil total area. The borders of the state are Maranhão state to the north, Piauí and Bahia states to the east, Goiás state to the south and the states of Pará and Mato Grosso to the west. The predominant climate of this state is tropical semi-humid, with well defined dry and rainy periods, except the northern region which is hot and humid during the whole year, and the southern region which has low humidity during the dry period. The vegetation varies from tropical forest in the north to savanna in the south. Its geomorphology has an uniform variation and is divided into two big basins; the Araguaia river basin and the Tocantins river basin.

1 Meteorology

Tocantins State is characterized by intensive rainfall during the rainy period and drought during the dry period. The following meteorological data were collected from the main measurement stations.

Table II-1.1(1) Meteorological indicators from the Main Stations

Station	Annual Rainfall (mm)	Rainy Period	Dry Period (Monthly Rainfall < 50mm)	Mean Annual Temperature (°C)	Mean Annual Humidity (%)
Conceição do Araguaia	1,754	Sep-May	Jun - Aug	25.7	85.0
Porto Nacional	1,668	Sep-Apr	May - Aug	26.1	72.0
Peixe	1,723	Oct-Apr	May - Sep	25.6	73.0
Taguatinga	1,666	Oct-Apr	May - Sep	24.5	67.0
Paranã	1,330	Oct-Apr	May - Sep	25.0	70.0
Carolina	1,719	Oct-May	Jun - Sep	26.1	72.0
Imperatriz	1,463	Oct-May	Jun - Sep	26.4	74.0

1.1 Climate

Tocantins State has a tropical climate, semi-humid with a mean annual temperature of 26°C during the whole year. The maximum registered annual temperature reached 42°C, and the minimum was 8°C. Rainfall in the Tocantins state increases from East to West with a mean annual rainfall of 1,700 mm in the region of Araguaína. The lowest rainfall is registered in the regions of Paranã and Pedro Afonso with a mean annual rainfall of 1,200 mm.

Rainfall is mainly measured at the meteorological stations of the state; only a few stations take measurements of wind speed, humidity, sunshine and temperature. The locations of the main meteorological stations is shown in Figure II-1.1(1). The measurement periods, except Porto Nacional, are short without measurements in certain periods making it difficult to analyze the data for common periods.

(1) Rainfall

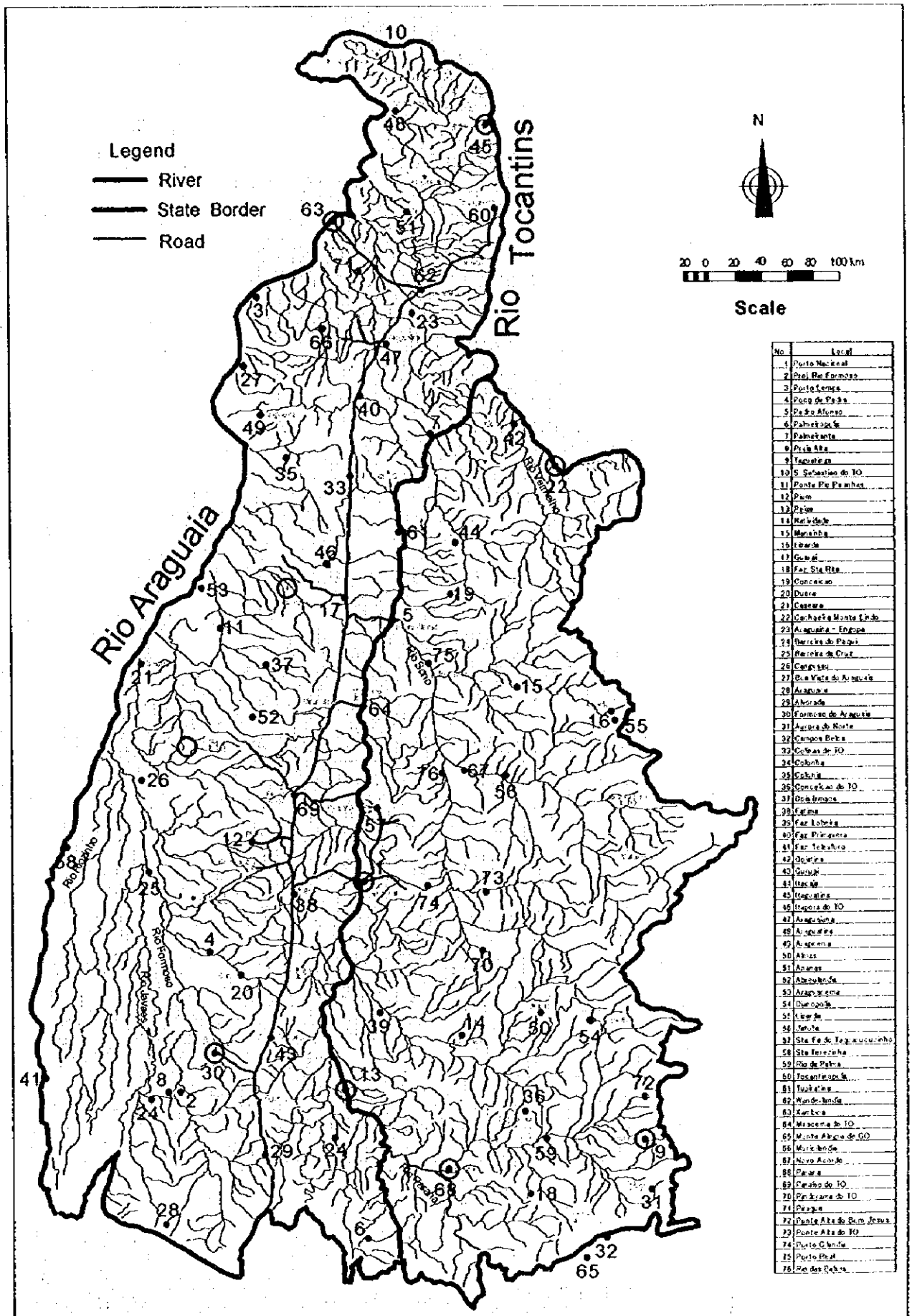
The higher annual rainfall (2,500 mm) is registered in the region of Abreulândia and Pium, Araguaia river basin, and the lower annual rainfall (1.200 mm) in the region limiting Goiás state. The rainfall regime can be divided into two large regions, the Araguaia river with higher rainfall and the lower rainfall of the Tocantins river. The mean annual rainfall is shown in Figure II-1.1(2).

Table II-1.1(2): Total Rainfall (mm)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	222.8	270.2	240.5	275.4	210.6	283.0	226.5
FEB	235.6	238.7	241.8	234.2	181.9	270.5	227.7
MAR	268.6	224.6	253.1	221.6	179.9	278.7	279.0
APR	193.4	120.7	148.7	115.2	96.1	188.6	197.3
MAY	66.7	26.1	36.2	16.2	14.8	51.8	55.0
JUN	18.6	6.0	4.3	1.6	0.6	12.6	16.2
JULY	18.0	3.1	4.0	1.1	0.7	9.0	6.4
AUG	19.3	3.5	4.1	2.2	1.2	16.9	10.2
SEP	79.1	32.7	40.3	19.5	18.1	49.8	37.7
OCT	169.0	139.3	150.9	139.0	120.1	156.7	85.5
NOV	193.2	229.1	203.0	213.3	200.2	166.8	123.5
DEC	270.6	274.9	254.1	306.8	217.3	234.3	198.7
YEAR	1,754.9	1,569.0	1,581.2	1,546.1	1,241.5	1,718.7	1,463.5

The probability of occurrence of veranicos (rainfall lower than 5 mm after five consecutive days) in the main region of the state is shown in Figure II-1.1 (3). There is the probability of the occurrence of a veranico longer than 5 days in Goianorte and Marianópolis municipalities, center-west region. In Taguatinga at the south-east region, the probability is lower than 80% and this rate increases towards the north, in Imperatriz and in Paranã at the south.

In case of maize plantation, when the dry period extends for 3 consecutive days during flowering, there could be a damage of 70% to 80% in the production. Therefore, as the probability of occurrence of veranico is approximately 80%, an irrigation system shall be very important even during the rainy season.



No.	Local
1	Porto Nacional
2	Proj.Rio Formoso
3	Porto Lemos
4	Poco de Pedra
5	Pedro Afonso
6	Palmeirópolis
7	Palmeirante
8	Pyia Alta
9	Taguatinga
10	S. Sebastiao do TO
11	Ponte Rio Palmas
12	Paum
13	Peixe
14	Natividade
15	Miranlha
16	Lavanda
17	Guaral
18	Faz Sta Rita
19	Conceicao
20	Duere
21	Caseara
22	Cachoeira Monte Lindo
23	Araguaina - Empopa
24	Barreira do Piaui
25	Barreira da Cruz
26	Carrasco
27	Boa Vista do Araguaia
28	Araguacu
29	Alvorada
30	Formoso do Araguaia
31	Aurora do Norte
32	Campos Belos
33	Colinas do TO
34	Colonia
35	Colunia
36	Conceicao do TO
37	Goiatinopolis
38	Fatima
39	Faz Lobeira
40	Faz Primavera
41	Faz Tabuleiro
42	Goiatins
43	Guraupi
44	Itacaja
45	Itaguatins
46	Itapora do TO
47	Araguatins
48	Augustinopolis
49	Abras
50	Axixas
51	Arapoema
52	Arapoembinha
53	Dueropolis
54	Uberlandia
55	Tocantinopolis
56	Sta Fe do Tocantinzinho
57	Sta Terezinha
58	Rio de Pedra
59	Tocantinopolis
60	Tupiratins
61	Wanderlandia
62	Xambioa
63	Miracema do TO
64	Monte Alegre de GO
65	Maricilandia
66	Novo Acordo
67	Paraiso
68	Paraiso do TO
69	Pindorama do TO
70	Pequiza
71	Ponte Alta do Bom Jesus
72	Ponte Alta do TO
73	Porto Cleuda
74	Porto Real
75	Rio das Pedras

Figure II-1.1(1): Location of Measurement Stations

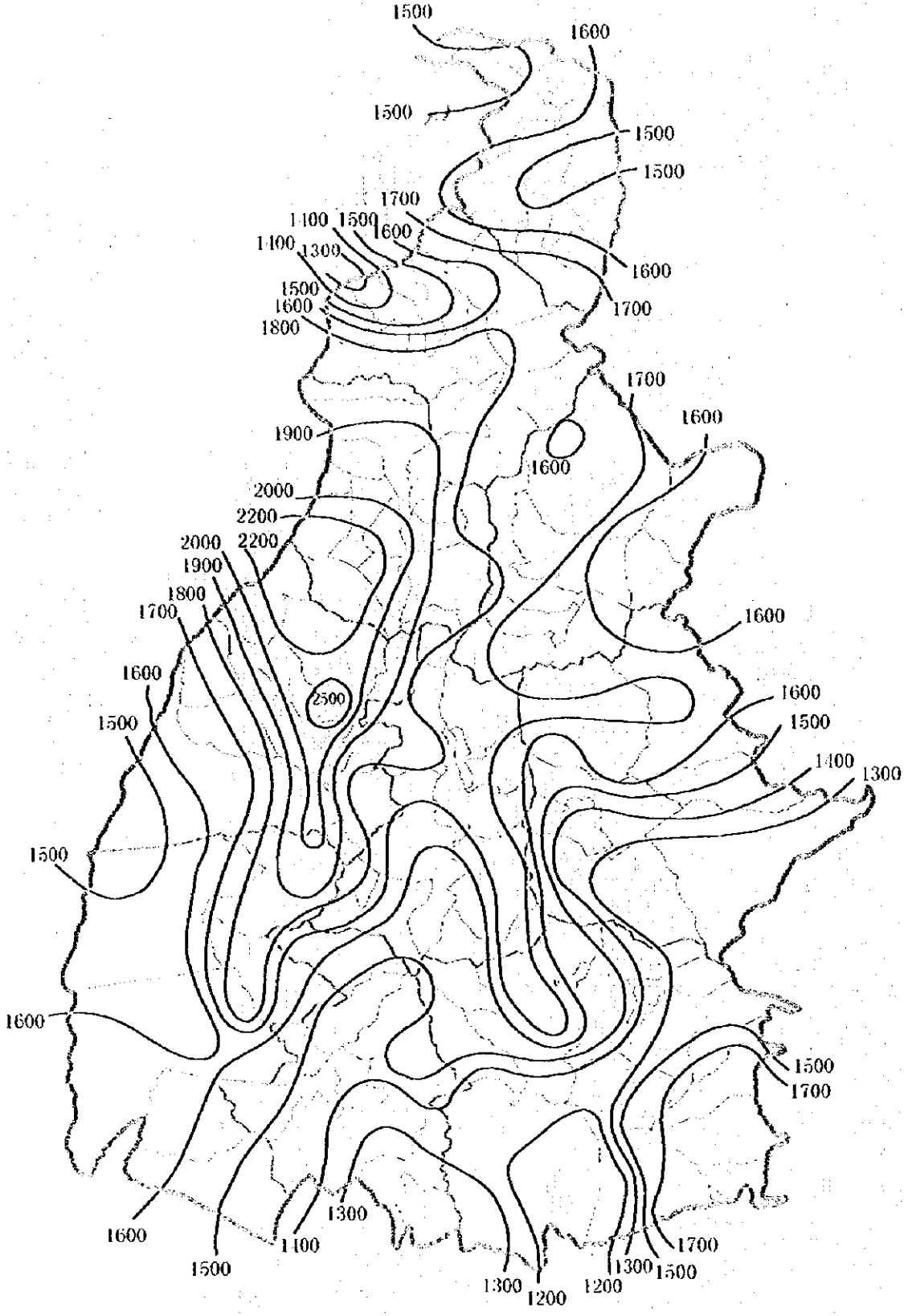
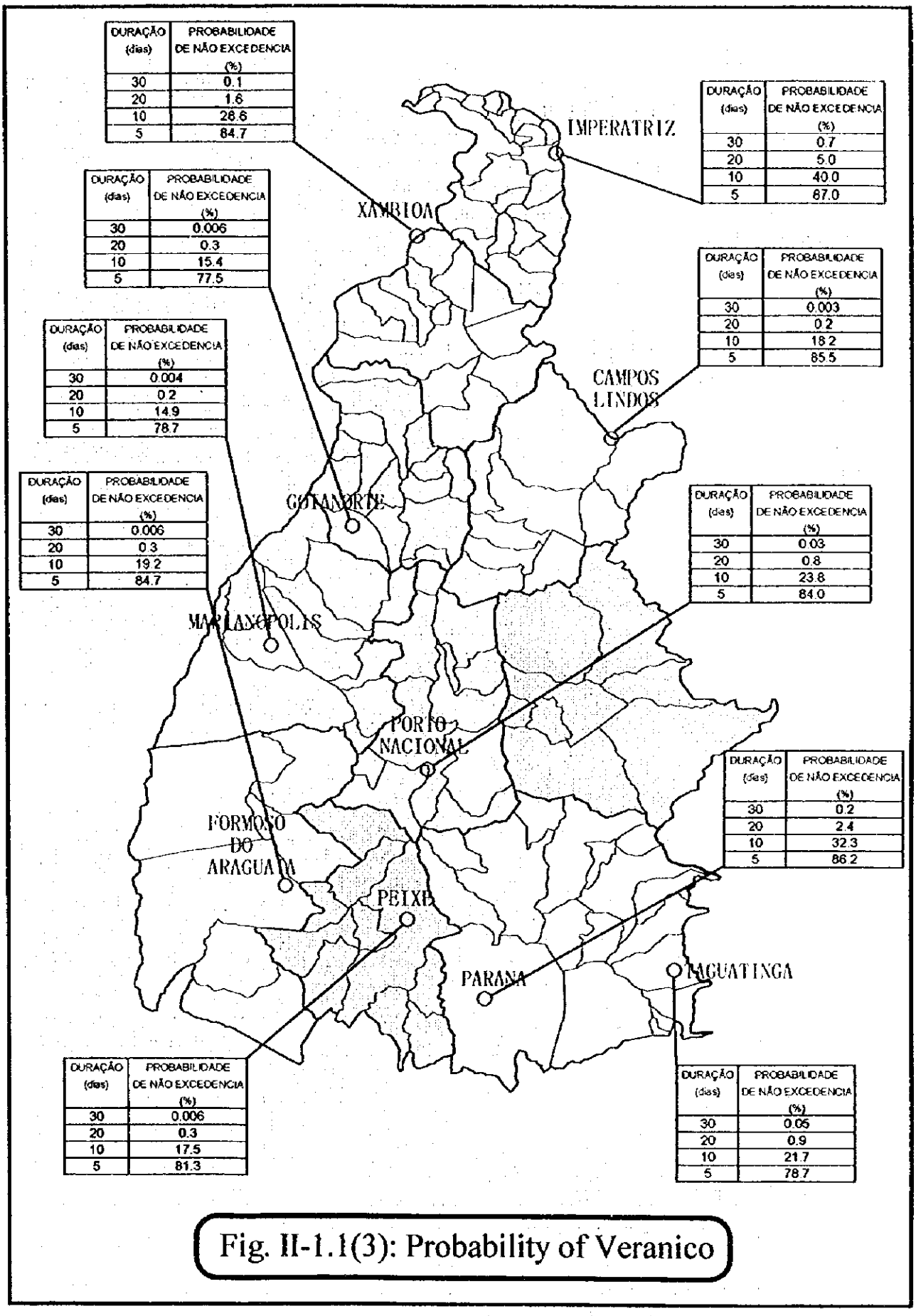


Fig. II-1.1(2): Mean Annual Rainfall



DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.1
20	1.6
10	26.6
5	84.7

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.7
20	5.0
10	40.0
5	87.0

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.006
20	0.3
10	15.4
5	77.5

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.003
20	0.2
10	18.2
5	85.5

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.004
20	0.2
10	14.9
5	78.7

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.006
20	0.3
10	19.2
5	84.7

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.03
20	0.8
10	23.8
5	84.0

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.2
20	2.4
10	32.3
5	86.2

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.006
20	0.3
10	17.5
5	81.3

DURAÇÃO (dias)	PROBABILIDADE DE NÃO EXCEDENCIA (%)
30	0.05
20	0.9
10	21.7
5	78.7

Fig. II-1.1(3): Probability of Veranico

(2) Temperature

Annual temperature is constant with mean values varying from 24°C to 26°C. Maximum temperature coincides with the dry period at the end of September and beginning of October, reaching 40°C up to 42°C at the north of the state. There is a big variation of temperatures during the day, especially due to the continental position of the state, mainly during the dry season. Monthly mean, maximum and minimum temperatures are shown as follows.

Table II-1.1(3): Mean Temperatures (°C)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	25.1	25.5	25.5	24.3	25.4	25.2	26.0
FEB	25.2	25.5	25.5	24.3	25.1	25.3	25.9
MAR	25.4	25.7	25.6	24.4	25.4	25.9	26.0
APR	25.8	26.0	26.1	24.6	25.6	25.9	26.2
MAY	26.1	25.6	26.2	24.3	24.4	26.2	26.6
JUN	25.5	24.1	25.5	23.6	23.1	26.1	26.2
JUL	25.4	24.1	25.4	23.4	23.1	26.4	26.4
AUG	26.1	25.6	27.0	25.1	24.4	27.5	27.0
SEP	26.4	27.1	28.0	26.5	26.4	27.8	27.0
OCT	26.0	26.8	26.8	25.4	26.1	26.6	27.3
NOV	25.8	26.1	26.2	24.5	25.7	25.9	26.9
DEC	25.3	25.5	25.8	24.0	25.2	25.9	26.4
YEAR	25.7	25.6	26.1	24.5	25.0	26.1	26.4

Table II-1.1 (4): Maximum Temperatures (°C)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	31.2	31.1	31.3	30.3	31.0	30.1	31.1
FEB	31.1	31.2	32.5	30.2	30.7	30.3	31.1
MAR	31.3	31.5	31.2	30.4	31.2	30.5	31.2
APR	31.9	32.0	32.2	30.7	31.8	31.2	31.6
MAY	33.0	32.4	33.0	31.0	31.9	32.3	32.3
JUN	33.6	32.4	33.4	30.4	32.0	33.2	32.8
JUL	34.3	33.1	33.8	30.8	32.4	33.8	33.5
AUG	35.2	35.0	34.1	32.6	34.4	34.7	34.4
SEPT	34.2	35.3	35.6	33.6	35.2	34.2	34.1
OCT	32.7	33.5	33.2	32.1	33.3	32.1	33.2
NOV	32.1	31.9	32.1	30.8	31.1	31.0	32.3
DEC	31.5	31.0	31.4	30.0	30.6	30.4	31.4
YEAR	32.7	32.5	32.8	31.1	32.1	31.9	32.4

Table II-1.1(5): Minimum Temperatures (°C)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	20.2	21.7	21.7	20.1	21.2	21.9	22.2
FEB	20.3	21.8	22.5	20.5	20.8	22.0	22.2
MAR	20.5	22.0	24.0	20.2	20.9	22.2	22.2
APR	20.8	21.8	22.0	20.3	20.7	22.3	22.4
MAY	20.3	20.5	20.9	19.4	18.8	21.5	21.8
JUN	18.3	17.9	18.9	18.3	16.3	20.0	20.2
JUL	17.7	17.5	18.0	18.0	15.4	19.5	19.4
AUG	17.9	18.2	19.2	19.5	16.1	20.6	19.9
SEP	19.7	20.7	21.6	21.3	19.1	22.3	21.4
OCT	20.8	21.8	22.3	21.0	21.0	22.2	22.4
NOV	20.5	21.8	22.1	20.4	21.4	22.1	22.3
DEC	20.3	21.7	22.0	20.0	21.2	21.8	22.2
YEAR	19.8	20.6	21.3	19.9	19.4	21.5	21.5

(3) Relative Humidity

The relative humidity is higher during the rainy period, with a monthly mean value varying from 60 to 85%. In the eastern region, the humidity reaches values lower than 50%.

Table II-1.1 (6): Relative Humidity (%)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	90.0	81.0	83.0	79.0	78.0	84.0	83.0
FEB	91.0	83.0	84.0	80.0	76.0	85.0	84.0
MAR	87.0	84.0	84.0	79.0	77.0	85.0	84.0
APR	90.0	80.0	80.0	75.0	75.0	81.0	83.0
MAY	83.0	74.0	72.0	65.0	72.0	73.0	78.0
JUN	83.0	67.0	64.0	57.0	68.0	61.0	72.0
JUL	77.0	61.0	56.0	53.0	65.0	55.0	64.0
AUG	78.0	55.0	50.0	46.0	57.0	50.0	61.0
SEPT	83.0	57.0	56.0	49.0	57.0	57.0	65.0
OCT	83.0	71.0	74.0	66.0	67.0	74.0	70.0
NOV	88.0	77.0	79.0	75.0	75.0	80.0	75.0
DEC	90.0	82.0	80.0	79.0	77.0	83.0	80.0
YEAR	85.0	73.0	72.0	67.0	70.0	72.0	74.0

(4) Wind

The wind regime is characterized by the predominance of calm winds during most of the year and absence of strong winds. Except the meteorological stations of Porto Nacional and Formoso Project, there is no measurement of wind in the remaining stations of the Tocantins state. Therefore, water requirement was calculated by the Thorntwaite method, and not by the modified method of Penman or Penman Montheith. The values of the measured velocity of wind are the following.

Table II-1.1(7): Mean Wind Speed in Porto Nacional Station (m/s)

Station	J	F	M	A	M	J	J	A	S	O	N	D
Porto Nacional	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Projeto Formoso	0.41	0.41	0.42	0.40	0.39	0.47	0.55	0.57	0.57	0.50	0.49	0.45

(5) Atmospheric Pressure

Distribution of atmospheric pressure is typical of continental latitudes in tropical regions where there is no intensive cyclones with a predominance of a regular behavior year after year.

Table II -1.1(8): Atmospheric Pressure (hPa)

MONTH	STATION						
	Conceição Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	992.1	983.2	984.6	943.9	979.8	988.9	994.7
FEB	992.2	983.2	984.8	944.0	979.9	988.9	994.8
MAR	992.2	983.2	985.1	944.1	979.8	988.8	994.7
APR	992.5	983.5	985.4	944.5	980.5	988.7	994.7
MAY	993.1	984.5	985.9	945.7	981.7	989.4	995.2
JUN	994.1	986.3	986.8	947.2	983.3	990.9	996.8
JUL	994.6	986.3	987.0	947.5	983.4	990.9	996.9
AUG	993.6	985.1	985.8	946.4	982.3	990.1	996.2
SEP	992.9	983.8	984.6	945.0	980.7	989.4	995.5
OCT	992.1	983.2	984.6	944.0	979.8	988.8	994.7
NOV	991.4	982.9	984.3	943.5	979.4	988.4	994.2
DEC	991.8	983.0	984.7	943.6	979.4	988.4	994.3
YEAR	994.6	984.0	985.3	945.0	980.8	989.3	995.2

(6) Sunshine

Table II-1.1 (9): Total Sunshine Period (h)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	139.2	166.2	153.0	154.2	139.7	135.5	140.8
FEB	123.6	152.1	128.6	141.6	159.9	121.3	118.5
MAR	136.2	172.5	149.5	170.3	178.3	134.5	141.6
APR	157.5	234.4	190.4	196.8	212.9	163.6	168.8
MAY	223.9	274.0	265.7	240.1	252.3	246.2	235.6
JUN	258.6	296.3	276.5	244.5	272.7	277.4	265.8
JUL	286.9	317.7	287.7	268.0	288.9	286.9	274.9
AUG	206.1	309.5	289.4	258.3	272.5	265.4	241.9
SEP	152.9	204.0	207.6	209.7	198.3	201.9	167.0
OCT	162.8	191.1	176.2	169.2	179.3	156.2	141.9
NOV	150.6	171.4	165.4	146.6	150.1	142.0	141.5
DEC	128.2	155.0	153.3	139.3	153.1	129.5	141.5
YEAR	2,126.4	2,644.2	2,443.3	2,338.6	2,458.0	2,239.4	2,179.8

(7) Evaporation

Monthly evaporation values measured through class A pan are shown as follows.

Table II-1.1(10): Evaporation (mm)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	53.5	77.1	81.0	85.0	84.4	67.3	81.5
FEB	50.6	67.4	70.1	78.0	73.2	61.0	69.0
MAR	55.8	75.6	74.8	80.0	87.9	79.1	79.9
APR	63.7	92.8	93.3	100.2	92.0	80.5	84.7
MAY	82.8	125.6	162.8	143.9	113.9	136.2	122.3
JUN	122.6	175.7	187.1	184.9	106.4	201.8	151.0
JUL	160.4	210.8	231.5	223.9	152.9	271.9	182.8
AUG	164.9	238.6	271.0	269.5	163.3	289.7	193.7
SEP	123.1	218.4	234.8	257.0	173.8	220.5	159.3
OCT	84.4	136.5	138.7	160.7	141.2	120.6	132.6
NOV	67.9	97.0	101.9	103.3	95.0	80.9	107.8
DEC	60.4	76.7	93.2	85.2	81.5	69.3	96.0
YEAR	1,090.1	1,592.2	1,740.2	1,771.6	1,365.5	1,678.8	1,460.6

(8) Evapotranspiration and Water Requirement

Utilizing this data, the referential evapotranspiration was estimated. These values shall be recalculated after collection of more reliable data because of the limitation in quantity of the exiting data.

Table II-1.1(11): Referential Evapotranspiration (mm/day)

MONTH	STATION						
	Conceição do Araguaia	Peixe	Porto Nacional	Taguatinga	Paranã	Carolina	Imperatriz
JAN	3,4	3,9	3,7	3,8	3,7	3,4	3,5
FEB	3,3	3,8	3,6	3,7	4,0	3,4	3,5
MAR	3,3	3,7	3,5	3,6	3,8	3,4	3,5
APR	3,3	3,9	3,6	3,6	3,8	3,5	3,6
MAY	3,5	3,8	3,9	3,6	3,6	3,9	3,8
JUN	3,6	3,8	3,9	3,6	3,5	4,2	4,1
JUL	3,9	4,0	4,2	3,8	3,7	4,5	4,3
AUG	3,7	4,6	4,8	4,4	4,2	4,9	4,5
SEP	3,6	4,6	4,8	4,8	4,5	4,8	4,3
OCT	3,8	4,4	4,2	4,6	4,3	4,0	4,0
NOV	3,6	4,1	4,0	4,0	3,9	3,7	3,8
DEC	3,3	3,8	3,8	3,6	3,9	3,4	3,6

Table II-1.1(12): Water Requirement

IMPERATRIZ (Altitude 123.2, Latitude 5.32, Longitude 47.3)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	26.0	25.9	26.0	26.2	26.6	26.2	26.4	27.0	27.0	27.3	26.9	26.4
Humidade (%)	83.0	84.0	84.0	83.0	78.0	72.0	64.0	61.0	65.0	70.0	75.0	80.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	140.8	118.5	141.6	168.8	235.6	265.8	274.9	241.9	167.0	141.9	141.5	141.5
Eto (mm/dia)	3.5	3.5	3.5	3.6	3.8	4.1	4.3	4.5	4.3	4.0	3.8	3.6
ETP arroz (mm/dia)	3.5	3.5	3.5	3.6	3.8	4.1	4.3	4.5	4.3	4.0	3.8	3.6
soja (mm/dia)	3.5	3.5	3.5	3.6	3.8	4.1	4.3	4.5	4.3	4.0	3.8	3.6
milho (mm/dia)	3.3	3.3	3.3	3.4	3.6	3.9	4.1	4.3	4.1	3.8	3.6	3.4

CAROLINA(Altitude 192.83, Latitude 7.2, Longitude 47.28)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	25.2	25.3	25.9	25.9	26.2	26.1	26.4	27.5	27.8	26.6	25.9	25.9
Humidade (%)	84.0	85.0	85.0	81.0	73.0	61.0	55.0	50.0	57.0	74.0	81.0	83.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	135.5	121.3	134.5	153.6	246.2	277.4	286.9	265.4	201.9	156.2	142.0	129.5
Eto (mm/dia)	3.4	3.4	3.4	3.5	3.9	4.2	4.5	4.9	4.8	4.0	3.7	3.4
ETP arroz (mm/dia)	3.4	3.4	3.4	3.5	3.9	4.2	4.5	4.9	4.8	4.0	3.7	3.4
soja (mm/dia)	3.4	3.4	3.4	3.5	3.9	4.2	4.5	4.9	4.8	4.0	3.7	3.4
milho (mm/dia)	3.2	3.2	3.2	3.3	3.7	4.0	4.3	4.7	4.6	3.8	3.5	3.2

CONCEICAO DO ARAGUAIA (Altitude 156.85, Latitude 8.15, Longitude 49.17)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	25.1	25.2	25.4	25.8	26.1	25.5	25.4	26.1	26.4	26.0	25.8	25.3
Humidade (%)	90.0	91.0	87.0	90.0	83.0	83.0	77.0	78.0	83.0	83.0	88.0	90.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	139.2	123.6	136.2	157.5	223.9	258.6	286.9	206.1	152.9	162.8	150.6	128.2
Eto (mm/dia)	3.4	3.3	3.3	3.3	3.5	3.6	3.9	3.7	3.6	3.8	3.6	3.3
ETP arroz (mm/dia)	3.4	3.3	3.3	3.3	3.5	3.6	3.9	3.7	3.6	3.8	3.6	3.3
soja (mm/dia)	3.4	3.3	3.3	3.3	3.5	3.6	3.9	3.7	3.6	3.8	3.6	3.3
milho (mm/dia)	3.2	3.1	3.1	3.1	3.3	3.4	3.7	3.5	3.4	3.6	3.4	3.1

PORTO NACIONAL (Altitude 239.2, Latitude 10.43, Longitude 48.25)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	25.5	25.5	25.6	26.0	26.2	25.5	25.4	27.0	28.0	26.8	26.2	25.8
Humidade (%)	83.0	84.0	84.0	80.0	72.0	64.0	56.0	50.0	56.0	74.0	79.0	80.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	153.0	128.6	149.5	190.4	265.7	275.5	287.7	289.4	207.6	176.2	165.4	153.3
Eto (mm/dia)	3.7	3.6	3.5	3.6	3.9	3.9	4.2	4.8	4.8	4.2	4.0	3.8
ETP arroz (mm/dia)	3.7	3.6	3.5	3.6	3.9	3.9	4.2	4.8	4.8	4.2	4.0	3.8
soja (mm/dia)	3.7	3.6	3.5	3.6	3.9	3.9	4.2	4.8	4.8	4.2	4.0	3.8
milho (mm/dia)	3.5	3.4	3.3	3.4	3.7	3.7	4.0	4.6	4.6	4.0	3.8	3.6

PEIXE (Altitude 242.49, Latitude 12.03, Longitude 48.32)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	25.5	25.5	25.7	26.0	25.6	24.1	24.1	25.6	27.1	26.8	26.1	25.5
Humidade (%)	81.0	83.0	84.0	80.0	74.0	67.0	61.0	55.0	57.0	71.0	77.0	82.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	166.2	152.1	172.5	234.5	274.0	296.3	317.7	309.5	204.0	191.1	171.4	155.0
Eto (mm/dia)	3.9	3.8	3.7	3.9	3.8	3.8	4.0	4.6	4.6	4.4	4.1	3.8
ETP arroz (mm/dia)	3.9	3.8	3.7	3.9	3.8	3.8	4.0	4.6	4.6	4.4	4.1	3.8
soja (mm/dia)	3.9	3.8	3.7	3.9	3.8	3.8	4.0	4.6	4.6	4.4	4.1	3.8
milho (mm/dia)	3.7	3.6	3.5	3.7	3.6	3.6	3.8	4.4	4.4	4.2	3.9	3.6

TAGUATINGA (Altitude 603.59, Latitude 12.24, Longitude 46.26)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	24.3	24.3	24.4	24.6	24.3	23.6	23.4	25.1	26.5	25.4	24.5	24.0
Humidade (%)	79.0	80.0	79.0	75.0	65.0	57.0	53.0	46.0	49.0	66.0	75.0	79.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	154.2	141.6	170.3	196.8	240.1	244.5	268.0	258.3	209.7	169.2	146.6	139.3
Eto (mm/dia)	3.8	3.7	3.6	3.6	3.6	3.6	3.8	4.4	4.8	4.6	4.0	3.6
ETP arroz (mm/dia)	3.8	3.7	3.6	3.6	3.6	3.6	3.8	4.4	4.8	4.6	4.0	3.6
soja (mm/dia)	3.8	3.7	3.6	3.6	3.6	3.6	3.8	4.4	4.8	4.6	4.0	3.6
milho (mm/dia)	3.6	3.5	3.4	3.4	3.4	3.4	3.6	4.2	4.6	4.4	3.8	3.4

PARANA (Altitude 275.0, Latitude 12.33, Longitude 47.5)

	JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEZ
Temperatura Media (°C)	25.4	25.1	25.4	25.6	24.4	23.1	23.1	24.4	26.4	26.1	25.7	25.2
Humidade (%)	78.0	76.0	77.0	75.0	72.0	68.0	65.0	57.0	57.0	67.0	75.0	77.0
Vento (m/s)	1.00	1.21	1.00	0.99	1.12	1.39	1.47	1.48	1.52	1.37	1.21	1.31
Insolacao (h)	139.7	159.9	178.3	212.9	252.3	272.7	288.9	272.5	198.3	179.3	150.1	153.1
Eto (mm/dia)	3.7	4.0	3.8	3.8	3.6	3.5	3.7	4.2	4.5	4.3	3.9	3.9
ETP arroz (mm/dia)	3.7	4.0	3.8	3.8	3.6	3.5	3.7	4.2	4.5	4.3	3.9	3.9
soja (mm/dia)	3.7	4.0	3.8	3.8	3.6	3.5	3.7	4.2	4.5	4.3	3.9	3.9
milho (mm/dia)	3.5	3.8	3.6	3.6	3.4	3.3	3.5	4.0	4.3	4.1	3.7	3.7

2 Hydrology

The Araguaia river, with its riverhead in the Caiapó mountain range in Goiás state, flows into the Tocantins river in the state of Pará close to São João do Araguaia city. After the confluence, the Itacaiúnas river flows into Tocantins river which finally flows into the Amazonas river. The basin covers approximately 767 thousand km^2 up to the confluence with the Amazonas river which includes 36.2% across the state of Tocantins, 24% in Mato Grosso State, 21.8% in Goiás state, 13% in the state of Pará, 4% in Maranhão and 1% in the Federal District. The Araguaia-Tocantins River Basin is shown in Figure II-2.1(1).

The average discharge of Tocantins river in Tucuruí, with an approximate area of 758 thousand km^2 is 10,972 m^3/s, the average discharge of Araguaia river in Santa Isabel is 4,870 m^3/s, with an area of 372 thousand km^2, and in Santo Antônio do rio Tocantins it is 5,444 m^3/s with an area of 302 thousand km^2. This discharge is not constant, with a dry period during the month of September for both rivers; for the Araguaia river, the discharge in September is only 13.5% of the mean discharge, while the discharge of Tocantins river records a value corresponding to 30.9% of the mean discharge for the same period. Mean monthly discharges at the main stations are shown in the following table.

Table II-2.1 (1): Mean Monthly Discharges at the Main Stations (m^3/s)

Stations	Area	J	F	M	A	M	J	J	A	S	O	N	D	Annual
São Felix	58,730	1,497	1,765	1,631	1,180	610	438	349	275	247	359	696	1,189	857
Paraña	60,580	1,405	1,637	1,470	969	443	338	296	265	260	318	568	1,133	762
Peixe	131,600	3,324	4,029	3,803	2,755	1,239	869	773	701	689	859	1,432	2,467	1,921
Porto National	177,900	4,273	5,163	5,060	3,550	1,691	1,058	789	620	546	739	1,567	3,278	2,361
Carolina	279,200	6,733	8,281	8,438	6,526	3,415	2,145	1,652	1,320	1,137	1,452	2,641	4,984	4,060
Santo Antonio	302,800	7,854	9,590	9,847	8,145	4,385	2,699	2,073	1,706	1,503	1,783	3,019	5,512	4,870
Santa Isabel	372,200	6,550	10,356	12,836	13,421	8,695	3,713	1,738	1,056	737	906	1,642	3,246	5,444
Maraba	704,800	13,636	19,572	23,133	21,655	13,803	7,044	4,053	2,590	1,680	2,278	4,172	8,109	10,204
Tucurui	758,000	14,341	21,406	25,087	24,692	15,323	7,331	4,244	2,919	2,194	2,363	4,053	7,84	10,983

A brief description of each river is presented as follows:

- Tocantins River

The Tocantins river has an extension of approx. 2,500 km, with the following main tributaries: Bagagem, Tocantinzinho, Paranã, Manoel Alves de Natividade, Rio do Sono, Manoel Alves Grande, Farinha and Santa Tereza. The relief of Tocantins river has altitudes between 200 to 500 m except its riverhead which has an altitude of more than 1,000 m and the downstream which has an altitude of 100 m. Slopes are more conspicuous, if compared with Araguaia river. Drainage density is reasonable and its tributaries have remarkable discharges. On its way, there is no swampy areas making possible the occurrence of floods. The average discharge is estimated as 5,000 m^3/s before its confluence with the Araguaia river and the drained area is around 343,000 km^2.

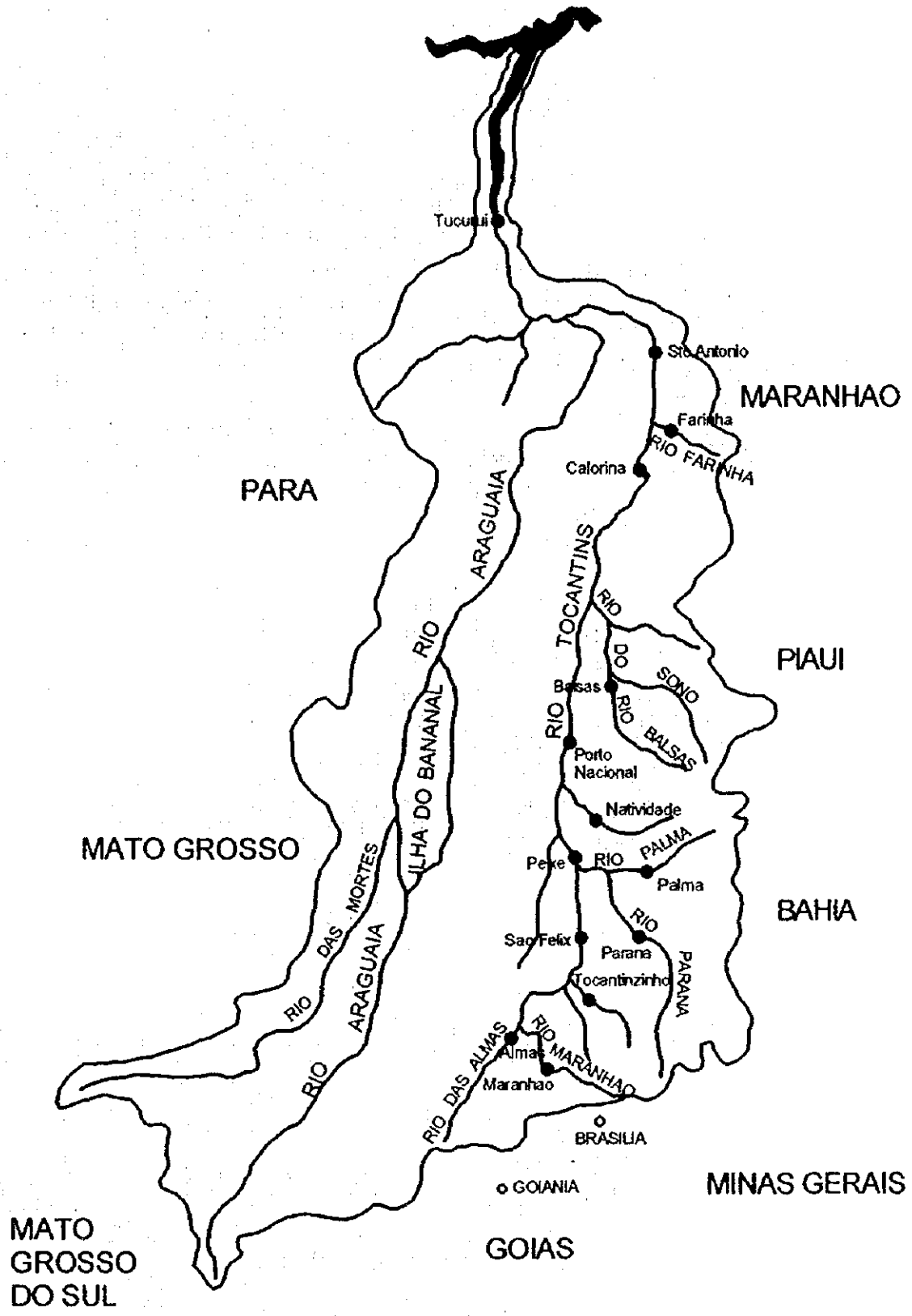


Fig. II-2.1(1): Basin of Araguaia-Tocantins River

- Araguaia River

The Araguaia river has an extension of approx. 2,115 km. The upstream is in the Serra do Caiapó (Caiapó mountain range) in Goiás state having the Das Mortes river as its largest tributary. Along the way of this river, there is a predominance of soft slopes with some river rapids in the upper parts, standing out the Cachoeira Alta (high fall). Due to the soft slopes, the Araguaia river has reduced drainage density and tributaries are short, except Das Mortes and Javaés rivers. Its flowing characteristics enables the formation of large swampy areas, standing out the Bananal island (80x350 km), being verified a high capacity of defluents regularization. The average discharge of this river is estimated in 5,500 m^3/s and the drained area is around 382,000 km^2.

In the following Figures II-1.2(2) and (3) the annual discharge oscillation and specific discharge of Tocantins and Araguaia rivers are presented. It is noted that the specific discharge of Tocantins river is higher than the Araguaia river.

The following figures are presented as a comparison of the specific discharge of Conceição do Araguaia river (Araguaia) and Carolina river (Tocantins).

Fig. II-2.1 (2): Mean Specific Discharge ($m^3/s/km^2$)

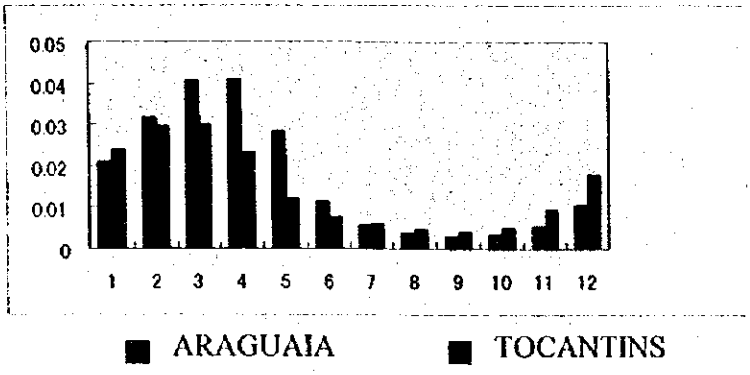
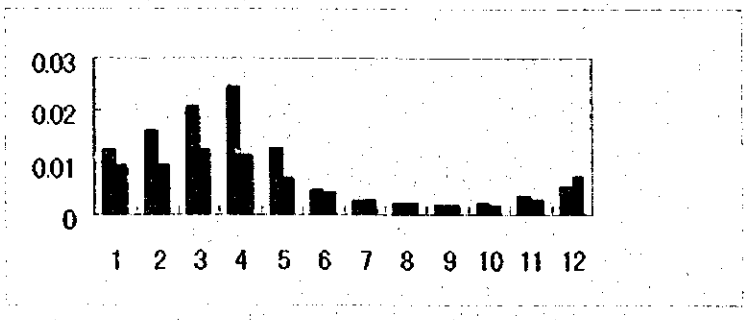


Fig. II-2.1 (3): Mean Specific Discharge ($m^3/s/km^2$)



In both figures, it can be inferred that Araguaia river overpasses the Tocantins river. This is supposedly due to the higher rainfall level on the Araguaia course, although during the dry season, the specific discharge of Tocantins river is higher.

The same comparison is made in the area of Luiz Alves in Araguaia and Peixe in Tocantins as shown in the following figures.

Fig. II-2.1 (4): Mean Specific Discharge ($m^3/s/km^2$).

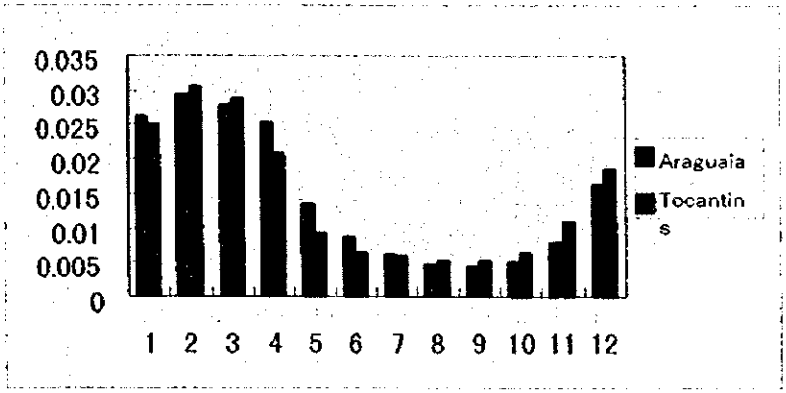
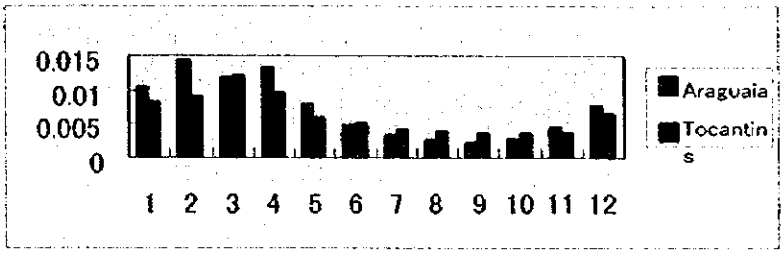


Fig. II-2.1 (5): Minimum Mean Specific Discharge ($m^3/s/km^2$)



Similar behavior is inferred between both rivers, with the Tocantins river showing a higher value of mean specific discharge, although the minimum mean specific discharge is higher for the Araguaia river.

The higher mean discharge of Araguaia river is caused by the high rainfall level registered around the region of Conceição do Araguaia, but after this point, the discharge of the Tocantins river is higher.

A comparison of the upstream and downstream of both rivers is shown below:

Fig. II-2.1 (6): Specific Mean Discharge of Araguaia River ($m^3/s/km^2$)

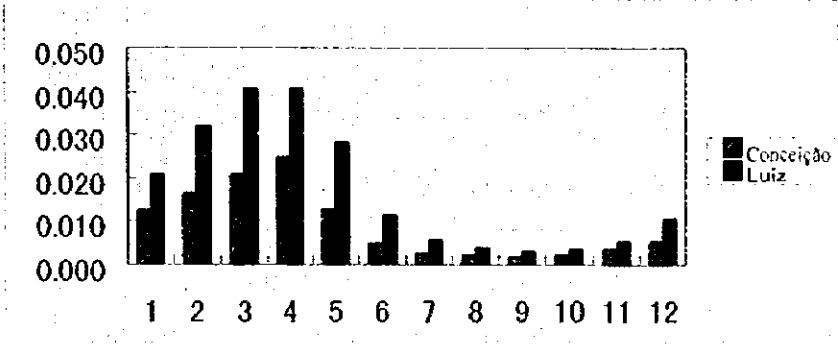
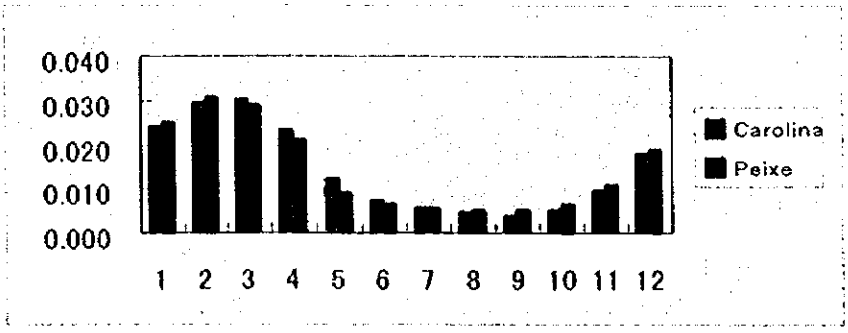


Fig. II-2.1 (7): Specific Mean Discharge of Tocantins River ($m^3/s/km^2$)



As shown in Fig. II-2.1(6), the Araguaia river has a higher specific discharge at the downstream side which might be caused by Das Mortes river with its riverhead in Mato Grosso and rainfalls occurring in the middle course of this river, besides the inundation water during the rainfall period.

On the other hand, there is no remarkable difference in the Tocantins river between the upstream and downstream sides, since there are no big tributaries, rainfalls are more constant; besides there is no inundated area in the river course, and therefore, the discharge is affected only by rainfall.

3 Geomorphology

Four large Geo-environmental Units, resulting from climatic factors and also conditioned by lithological factors, compose the morphology of Tocantins State.

3.1 Plateaus of the São Francisco Sedimentary Basin

This Relief Unit, a narrow and elongated strip in the North-South direction, occupies a great part of the frontier with Bahia State to the east, and bordering with the depressions of Araguaia-Tocantins to the west.

The Mangabeiras Tableland and the stair like Platforms, the first one with the mountain ridge grading level, and the second one of intermediary level, are two geomorphic surfaces of the Plateaus of the São Francisco Sedimentary Basin.

The Mangabeiras Tableland has altitudes varying from 600 to 800 meters and is characterized by residuals worked out by the ascending erosion. The most known ones are the mountain ranges of Meio, Espírito Santo and Lapinha.

The stair like platforms show levels varying from 400 to 600 meters and from 100 to 200 meters. These last ones are dissected due to the presence of calcareous rocks.

3.2 Depressions of Araguaia-Tocantins

This unit is composed of a group of depressions opened by Araguaia and Tocantins rivers drainage. They are delimited by ornamented slopes and/or surfaces lowered by

erosions of the Parecis Plateau (to the west), Plateau of the Paranã Sedimentary Basin (to the southeast), Plateau of the São Francisco Sedimentary Basin (to the east) and Goiano Plateau (to the south).

Residual relieves - inselbergs and/or pontoons as well as a group of mountain ranges with average altitudes varying between 200 and 300 meters, occupy the depressions of Araguaia-Tocantins.

3.3 Bananal Plain

It is a depression of the Araguaia from the Cenozoic era, covering a large area of recent quaternary deposits of the Bananal formation. Its erosive fluvial and pluvial dynamics is of the deposit type, comprehending the fluvial plains and accumulation areas periodically submitted to floods.

The Bananal Island is in this area, with a surface over 19,000 km^2, plain relief, with occurrence of recent sedimentation due to periodical floods occurring during the rainy season (November to April).

3.4 Residual Plateaus of the area in between the Araguaia and Tocantins rivers

It is a longitudinal mountain range group with an average altitude varying between 360 to 600 meters, where Serra do Estrondo and Serra do Paraíso are standing out. This Unit is contoured to the east by the Tocantins depression and to the west by the Araguaia depression. The Tocantins Residual Plain, to the east of the Tocantins river, is still considered as pertaining to this unit. The Lageado and Carmo, Malhada Alta and Maria Antonia mountain ranges, with average altitudes of 500 m, are compartments which surround the same unit to the east.

4 Geology

Based on existing surveys and studies, it is verified that the Tocantins State has several geological environments from different ages, registered at the Èons Archean age, Proterozoicam and Fanerozoicam age. Ancient terrain as greenstone-granitic (crystal rocks and metal-volcanic sediments) was found; sequence of meta-sediments distributed in the Araguaia-Tocantins area and also sedimentary covering in the basin of Parnaíba and São Francisco and paleontological and neogenetic covering were identified through the analysis of these studies.

The main archean lands correspond to stratified units of the Goiano, Colmeia, Porto Nacional and Gameleira complex, such as the *greenstone belt* type Metavolcano-sediments sequence of Natividade-Almas, Conceição do Norte and Rio do Côco.

Due to the great amplitude of the spatial distribution, the Goiano Complex has great importance in the regional geological context. This complex is represented by lithotypes of low and medium metamorphic degrees, being the main lithologies: tonalitica composition gnaisses and granodiorítica, migmatitos, granodioritos and tonalitos.

In general, such lithologies are cut by granitical intrusions, basis and/or ultra-basics.

The auriferous minerals associated to this complex are generally restricted to quartz The same as auriferous mineralization, they are generally found associated to that complex.

Porto Nacional Complex is constituted by granulitic rocks and granulated máfica-ultramáfica. The main lithology of Porto Nacional Complex are gnaisses granodioríticos granulitic, anortosític and enderbític (Costa et al., 1984; Hasui et al., 1987), hornblenditos and granulitic garnet-piroxenium.

The metavolcanic-sedimentary sequence of *greenstone belt type from* Natividade-Almas, Conceição do Norte and Dianópolis (Group Conceição do Norte), located close to the cities of the same names, are generically represented by meta-acid metabasic and ultrabasic rocks, (amphibolites, talco schist, serpentines, tremolititos) intercalation of cherts, carbonated rocks and grafitosed filitos. Besides this lithologies, the following ones are also found: filitos grafitosos ferríferos, sericita-quartzo xisto and quartzities. These rocks are porter of the main auriferours mineralization associated with iron (Fe), manganese (Mn), zinc (Zn), copper (Cu) and lead (Pb), which are economically important for the state

The Rio do Côco sequence, also classified as *greenstone belt* type, is located to the east of Paraiso do Tocantins city. This sequence was divided into two units: one is the inferior unit and the other is the superior one. According to Costa et al. (1983), the inferior unit is represented by a sequence of metassediments pelitic basically composed by quartz-mica schist with or without garnet. The superior unit is composed by feldspar intensely deformed and meta-ultra morphic rocks, mainly chlorite and actinolita schist.

In the areas of proterozoican rocks, the Metamorphic Complex Aruanã-Pindorama, the Metavolcano-Sedimentary Sequence of Palmeirópolis, Suíte Ipueiras, Serra da Mesa Group, Supergroup Down Araguaia (Groups Estrondo and Tocantins) are found, besides the Araí groups, Natividade, Peixe Alcaline and Porto Nacional, Paranoá and Bambuí Groups and Ipameri type Intrusive Granitic.

According to MME (1987), the Metamorfic Aruanã-Pindorama Complex is divided into three segments represented by basic metavolcanic rocks, acids and intermediaries and meta-sedimentary detritus. The basic metavolcanic rocks are represented by: amphiboles (clinopiroxênio amphiboles, epidoto amphiboles, quartzo-epidoto amphibole), hornblenditos, schist magnesianean (meta-ultrabasitos), such as: talco-tremolita schist and tremolititos. The acid metavolcanic rocks and intermediaries refer to meta-riodacitos and sericita schist, followed by gnaisses and associated to chemical metassediments, ferroseous formations, *metachert* and grafita schist. At the top of the complex the detritics metassediments: metarenitos feldsparic and metarcóseos, garnet-biotita schist, schist calcíticos, feldspathic and aluminosum, quartzits and granulits are found.

The Metavulcano-Sedimentary Sequence of Palmeirópolis with different characteristics of the archean metavulcano-sedimentaries is found next to Palmeirópolis city. This sequence was divided into three units: one superior, one intermediary and another basal, being characterized by the presence of basic metavolcanic rocks and ultrabasic and, acid

and intermediary, besides the intercalated micaschist with amphibolium schist feldspars, calcossilicated, metacherts and quartzitics. They appear associated to a metavolcano-sedimentary sequence of Palmeirópolis, mineralization of Zn-Cu sulfated polideformed (massif and disseminated) intimately related with rock of dacític composition from the intermediary unit (Marques and Marques, 1986).

The Ipueiras Granitic Suite is located next to Porto Nacional city, and is composed by various granitic plutons (granites biotita, leuco-granites) disposed on the NE-SW direction. The rocks of this unit are deformed presenting cataclástic and milonític leaves besides various joint systems (Costa et al., 1982).

The Serra da Mesa Group, located at the domain of Uruaçu band, has its section type defined at the border of the Serra da Mesa mountain range (North of Goiás). This sub-group was divided into two units being one basal and the other superior, composed by micaschist, quartzitics, schist grafitosos and amphibolic schist.

The Lower Araguaia Super Group (Abreu, 1978) is composed by the groups Estrondo (inferior member) and Tocantins (superior member). This group, a packet of meta sedimentary rocks with igneous and associated metamorphosed, is available in the NS direction along the Araguaia river valley. Besides, they have strong structural control associated to the Araguaia-Tocantins band. The main lithologies of the Estrondo group are the schist quatzo-feldspars, amphibole schist, migmatitos, gnaisses and quartzitics, and associations of maficos corps. In the Tocantins groups filitos, chlorite schist, metarcoseos and metagrauvacas, quartzitics, jáspers, mármores, metassiltitos and metargilitos are found.

The Araí Group is referring to a packet of metasedimentary and metavolcanic of fácies xisto green. This sequence is divided into the formations of Arraias (base) and Traíras (top). The Arraias is constituted by fine and gross quartzitics intercalated by metapelitos with of characteristics metaconglomerated in the most basal part, however the Traíras formation is predominantly pelitic (calco-filitos and filitos with intercalation of impure calcareous, metassiltios and some level of medium and gross quartzite).

The Natividade Group is formed by a packet of pure quartzite, conglomerated and with level of restricted archean (metarcosic); dolomitic marble, filitics; ardosias and archean quartzite.

The alkaline rocks of Peixe and Porto Nacional, of medium proterozoic, correspond to the white sienetos nefelina in magnetit. The metasedimentary sequence of the superior proterozóico, refers to the Monte do Carmo formations and to the groups Paranoá and Bambuí. The Paranoá Group is a psamitic sequence and pelitic with dolomitic intercalation and silex without dolomitic or with low contents of metamorphic grade with sedimentary structures of continental origin. Their main lithologies are quartzite, metarenitos, metassilito, filitos and ardosias.

The Bambuí Group (Barbosa et al., 1966) is characterized as a sequence of the pelito-sandy-carbonic rocks of low metamorphic grade. In Tocantins, the Bambuí Group is represented by the Paraopeba Subgroup, which generically involves the following lithotypes: metassiltitos, metarcoseos, ardosias, metargilitos and calcareous dolomitic.

Their calcareous source use for cement making, ironworks, agriculture and civil construction industry has a great economic importance for the State.

The Monte do Carmo Formation, located next to Monte do Carmo and Fátima cities, is represented by demolished terrain and topography of aligned mountains in NE-SW direction. This unit has as essential lithologies basal polimitic metaconglomerates grading to archean metarinites, and there are metadacitos and metavolcanic breach also intercalated in the metaconglomerates.

The Fanerozoic in Tocantins is represented by paleozoic and mesozoic lithologies of the sedimentary basin of Parnaíba and São Francisco, besides paleogenic and neogenic covering. The sedimentary basin of Parnaíba presents the following geological formations in the state of Tocantins: Serra Grande, Pimenteiras, Cabeças, Longá, Poti, Piauí, Pedra de Fogo and Motuca.

The Serra Grande Formation is composed by medium sandstones and micro-conglomerites and subordinated silites; regarding the Pimenteiras Formation, with a wide distribution in the state, it is characterized as a clastic with pelitic predominance sequence where the following lithologies are found: stratified clayish, argylic, siltitos, fine to medium and microconglomerates sandstones. The dominion terrain of the Pimenteiras formations are very demolished and their lithologies are strongly laterizated.

The Cabeças Formation is overlapped by the Pimenteiras formation, maintaining a grading relation contact. This formation, such as the Pimenteira Formation is placed along the North-South direction, being specially composed by fine to medium sandstone with crossed stratification, tilitos, siltitos and stratified clayish subordinated.

The Longá Formation is mainly found as narrow bands also disposed in NS direction. This formation is a siltic-clayish sequence with three sediments level (lower, intermediary and superior). The inferior level is represented by siltitos and stratified clayish intercalation containing conglomerated levels. In the intermediary level, there is a predominance of sandstone with intercalation of silitits and stratified clayish but, the superior level is mainly composed by stratified clayish with fine calcíferan sandstone and intercalated argylits.

The Poti Formation is a clastic sequence predominantly composed by intercalated sandstone of stratified clayish and siltits and, locally, conglomerates. The Piauí Formation presents in its basal part, sandstone with subordinated stratified clayish and in the superior part, siltitos and stratified clayish with subordinated sandstone and occasionally calcareous.

The Pedra de Fogo Formation, in general, covers small superficial extensions and involves lithologies such as: siltits, sands, stratified clayish, *cherts*, calcareous and dolomits. Such lithologies derived from sea sediments with subordinated lacustrine and fluvial participation, besides sporadic aeolian events.

The paleozoic sedimentation of Parnaíba Basin is characterized by the disposition of the Motuca Formation, a clasto-chemical sequence of the superior permian overlapped by

the Pedra do Fogo formation in transition contact. Three sedimentary levels lithologically characterized are identified in this formations such as sandstone (basal level), termos pelito-evaporíticos (intermediary level) and, sandstone again (superior level).

During the Mesozoic era, the Bacia do Parnaíba sedimentation has continued, being found in Tocantins the following formations: Sambaíba, Mosquito, Corda, Sardinha, Codó and Itapecuru.

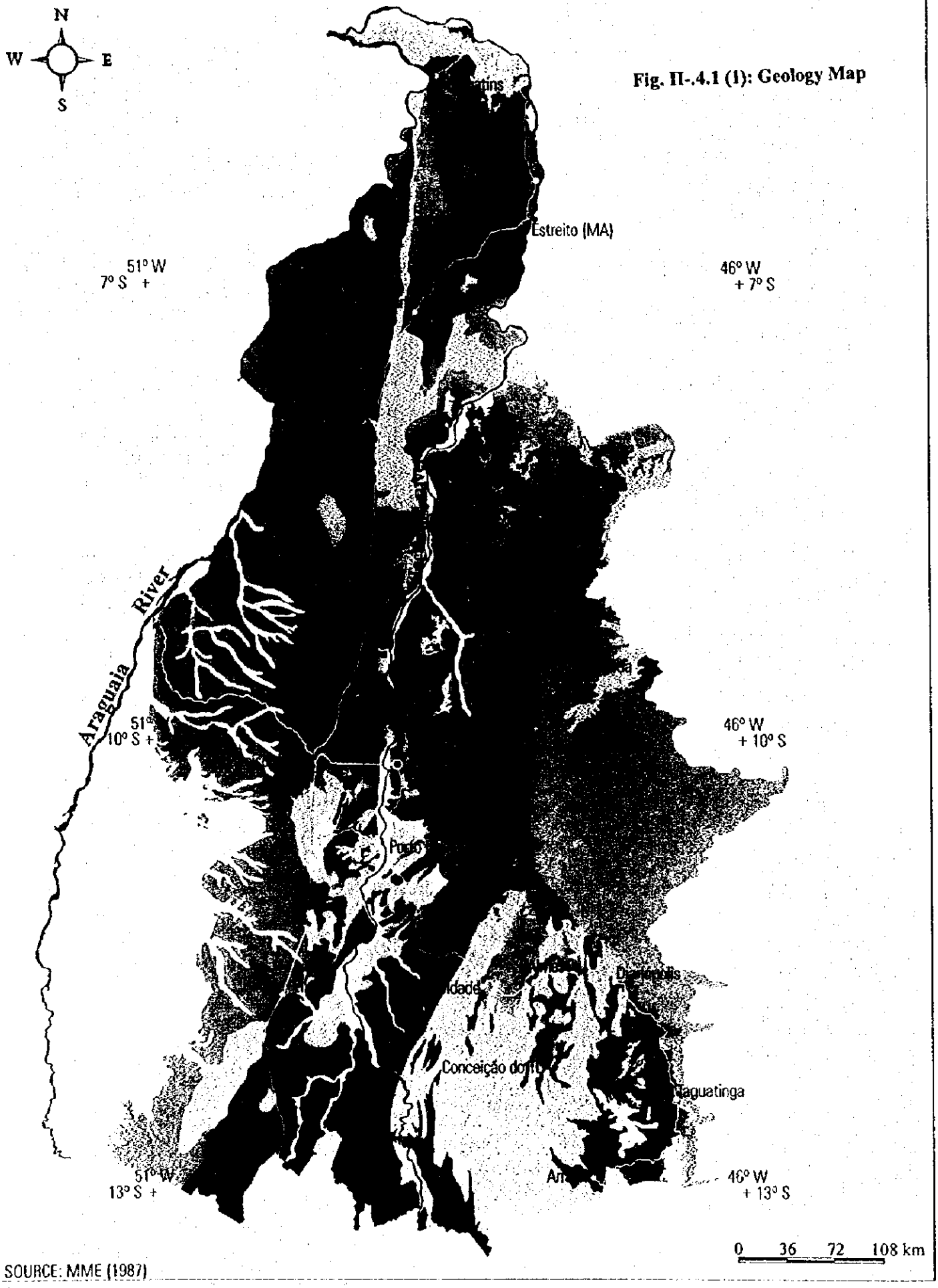
The Sambaíba Formation involves lithologies such as sandstone with silex level, and the Mosquito Formation is composed by amigdaloidais basalts, sandstone and diabasios (dams). Intercalation of basaltic (sills) and sandstone are also identified in this formation.

The Corda Formation overlapping the Mosquito and Sambaíba formation is composed by intercalated sandstone, argilitos, siltits and well laminated stratified clayish. The Sardinha Formation is represented by amigdaloidais basaltic originated from the last magmatogênese basic of the Parnaíba Basin. The Codó Formation is composed by lithologies such as: dark gray to black and greenish gray intercalated with silits, fine sandstone and calcareous besides level of gipsita.

Closing the cycle of Mesozoic sedimentation of Parnaíba Basin, the Itapecuru Formation was deposited, which was overlapped by the Codó Formation. This formation presents as main lithologies fine to gross sandstone and levels of silits and argilitos.

At the end of the Mesozoic, the sedimentation of São Francisco Basin appears in Tocantins represented by Urucuia Formation. This formation is characterized by a sequence of sandstone layers predominantly red, aulínicos; red argilitos finally laminated and margoso calcareous.

The Paleogenic and Neogenic covering refers to the detritus-lateritic, bananal and alluvioned coverings. The detritus-lateritic covering involves the sandy-pelitosos sediments predominantly not consolidated and partial/completely laterized, with level of ferruginous concretions or packets of lateritics cangas. The Sedimentary Covering of Bananal is composed of sandy-clayish sediments predominantly not consolidated with varied coloration, sometimes in advanced laterization condition. The Alluvionaire Covering areas restricted to the base of the main rivers that drain the Tocantins rivers are characterized by the presence of fine to medium sands, pebbles, silts and clays. In general, the most found alluvional sedimentation is composed of bad selected sediments with angular and well round grains.


N
W
E
S
Fig. II-.4.1 (I): Geology Map
Estreito (MA)
51° W
7° S +
46° W
+ 7° S
Araguaia River
51° W
10° S +
46° W
+ 10° S
Conceição do
Araguatinga
51° W
13° S +
46° W
+ 13° S
0 36 72 108 km
SOURCE: MME (1987)

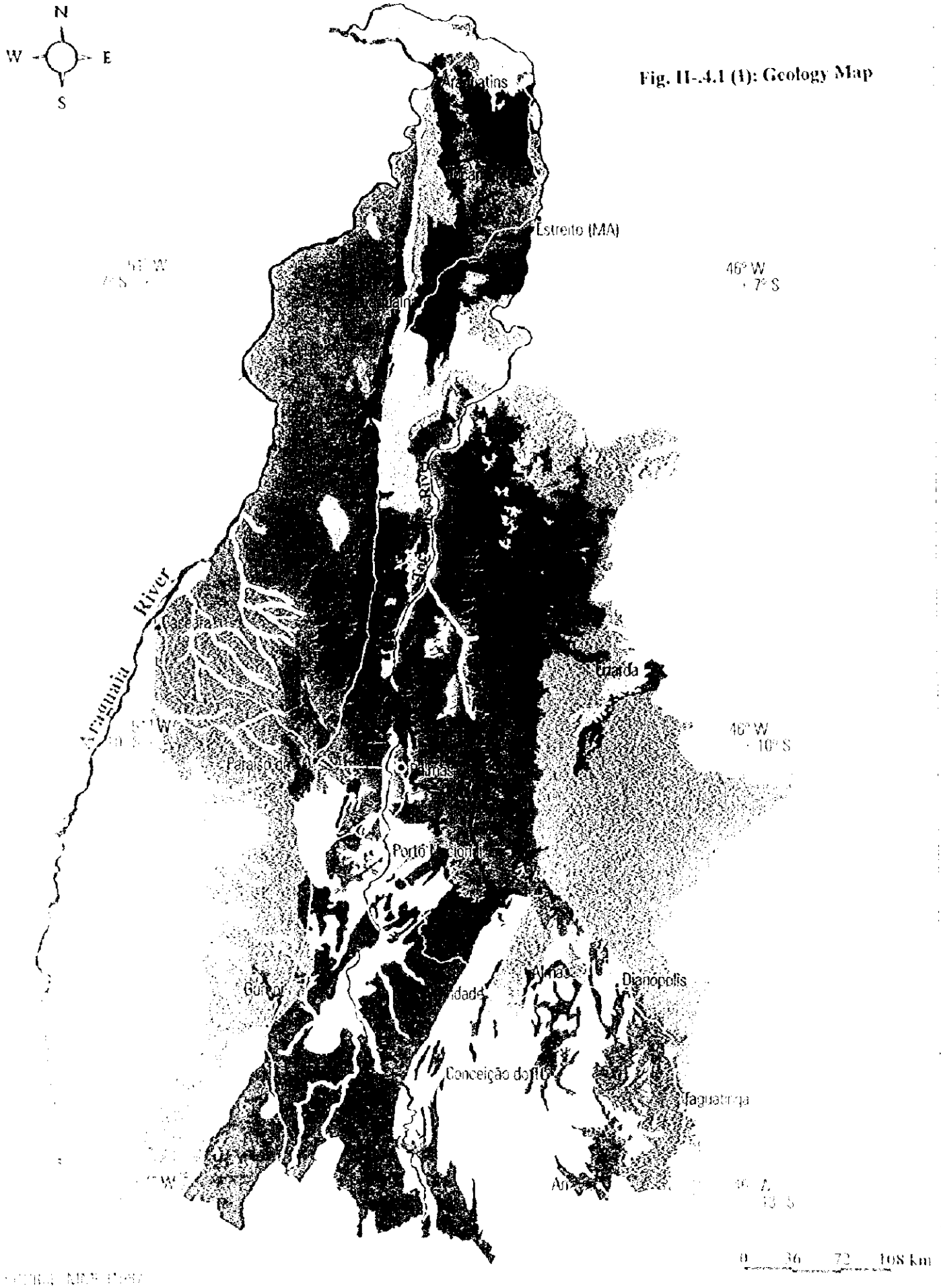


Fig. II-4.1 (1): Geology Map

Fig. II-4.1 (1b): Geology Map (Continuation)

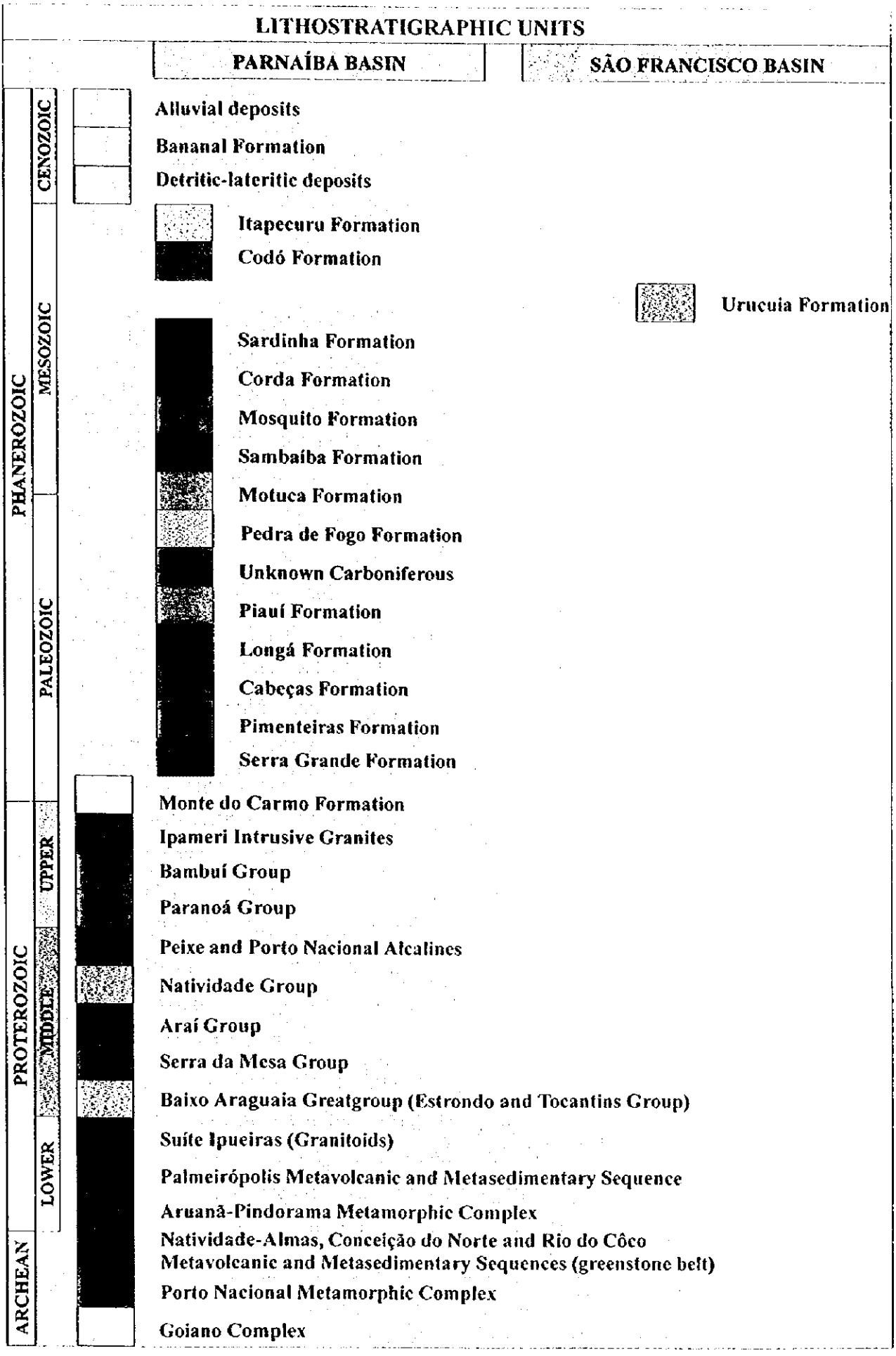
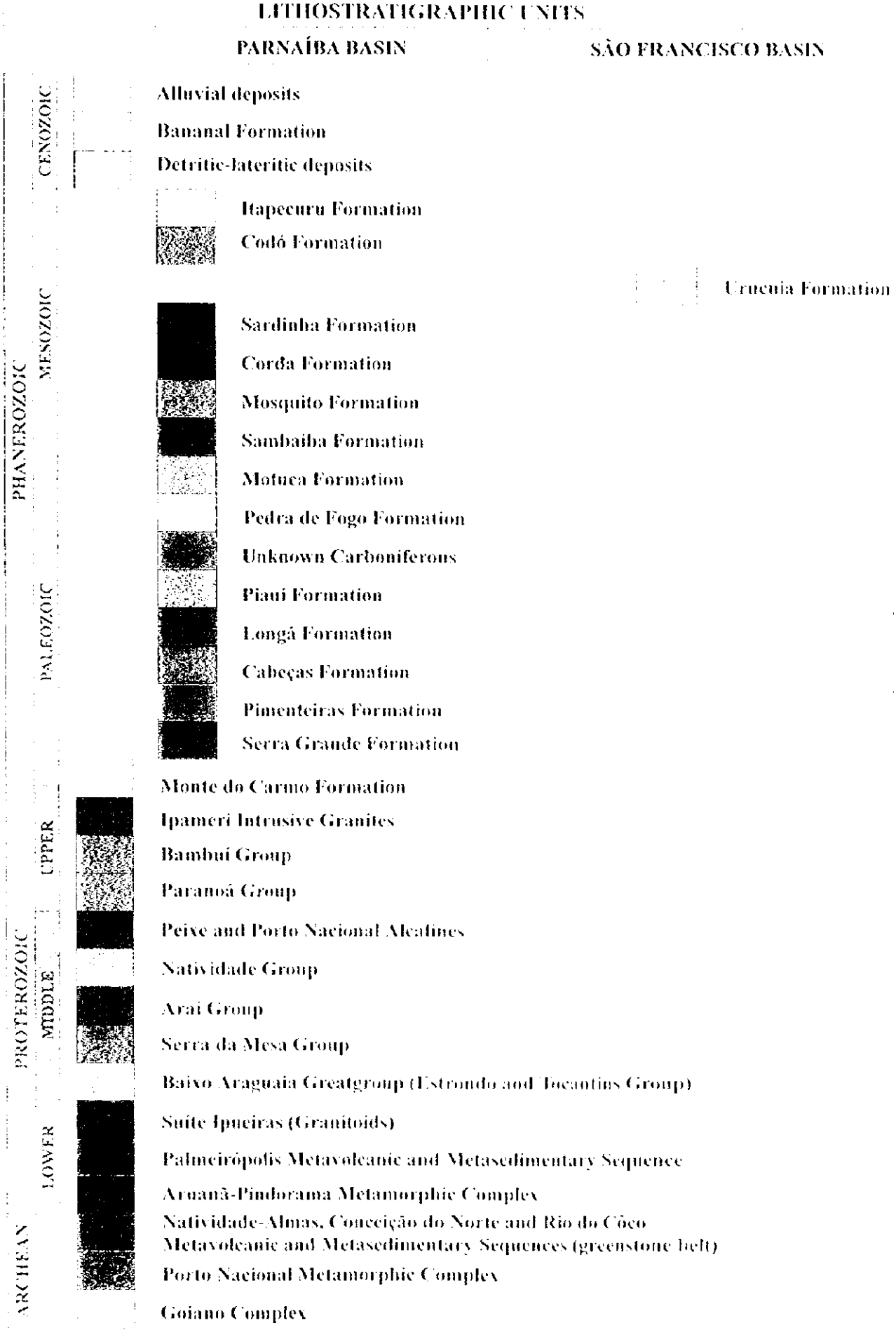


Fig. II-4.1 (1b): Geology Map (Continuation)



5 Soils

The information on the Tocantins State soils was collected in order to identify the regions suitable for agriculture cultivation. A preliminary evaluation of the soils and the land suitability in the State was carried out through the interpretation of data collected on the morphological, physical and chemical characteristics of the soil and thereby the potential areas suitable for agriculture, silviculture and pasture use were identified. The information on the soils is available in different sources based on the soil surveys and studies carried out as discussed below.

5.1 Previous Soil Surveys and Studies Carried out in the Tocantins State

The first soil mapping in the valley of Araguaia, Tocantins, Xingú and Tapajós rivers was elaborated as a preliminary design based on the geomorphologic and geological characteristics within the FAO-UNESCO Project. In this study, Oxisols, hydromorphic laterites and hydromorphic soils of the Araguaia river plain and the areas with Podzolic soils in the dissected areas with undulated terrain were identified.

The soil mapping of the North, Middle North and Center West regions of Brazil included the first systematic soil mapping of the Araguaia-Tocantins basin, and it was the first evaluation of the land suitability for agriculture use (EMBRAPA, Centro de Pesquisas Pedológicas, Schematic Map of the North, Middle North and Center West regions of Brazil, Guidebook, 1975). The mapping was based on preliminary surveys executed by FAO missions in specific areas of the Amazon and by the Pedologic Team of the Agriculture Ministry and other institutions and individual surveys.

At the beginning of the systematic mapping of the Amazon natural resources, the RADAM project (1971) included a pedologic survey at the exploratory level in 1:1,000,000 scale, together with an evaluation of agriculture suitability of soils for the areas of Belém, Araguaia, Tocantins, Teresina and Jaguaribe. The remaining areas in the south of Brazil were identified by the RADAMBRASIL Project. More surveys have been carried out later in Paraná Valley (EMBRAPA/SNLCS), Bananal Island (FUNAI), micro-region of Mato Grosso de Goías (State of Goías), program-region of Rondonópolis-MT (EDIBAP) and Geo-economical region of Brasília (EMBRAPA/CPAC). The information obtained from these surveys were used to compile the soil map of the Tocantins State in a scale 1:1,000,000 (PRODIAT). As one of the basic information of the map, a selection of the most representative profiles of the region were described. The major soil distribution, and its morphological, physical, and chemical characteristics are summarized as shown in Table II-5.1(1).

At this point it is also necessary to emphasize that the soil classes described in the above mentioned reports and the soil maps contain the information which were obtained at a large scale level and therefore, in most of the cases, there are also other classes associated with the principal soil classes. However they are in smaller extension and they were not included in the maps because of the scale of these soil maps.

Table II-5.1(1) MORPHOLOGICAL, PHYSICAL AND CHEMICAL CHARACTERIZATION OF THE SOILS FOR THE PRODIAT REGION (1/2)

INDICATION IN THE MAP	1		2		3		4		5		6		7		8		9		10		11	
Unit	PLINTHIC YELLOW OXISOL		RED YELLOW OXISOL		DARK RED OXISOL		PURPLE OXISOL		CONCRETIONARS SOILS		RED BRUNIZEN SOILS		STRUCT. PURPLE OXISOL		EXTRA PURPLE OXISOL		RED YELLOW PODZOLIC		DYSTROPHIC CAMBISOL		EUTROPHIC CAMBISOL	
Symbol	LA		LV		LE		LR		SC		BV		TR		TRL		PV		CD		CE	
Profile	IB-01		No. 4		Go-17		Go-16		Go-12		GO-39		GO-31		Go-29		No. 9		No. 38		No. 14	
Location	Ilha do Bananal-GO		S. Felix do Xingu-PA		Itaberai-GO		Taquaral-GO		Anapolis-GO		Ceres-GO		Rialma-GO		Rubiataba-GO		Conc. do Araguaia-PA		Monte Alegre-GO		Monte Alegre-GO	
Vegetation	Cerrado		Forest		Forest		Forest		Cerrado		Forest		Forest		Forest		Forest		Cerrado		Forest	
Present Use	Natural Pasture		Capoeira*		Crop		Pasture		Pasture		Pasture		Pasture		Pasture		Forest		Cerrado		Pasture	
Relief	Plain		Slightly Undulated		Slightly Undulated		Slightly Undulated		Slightly Undulated		Slightly Undulated		Strongly Undulated		Undulated		Strongly Undulated		Strongly Undulated		Slightly Undulated	
Horizon	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Depth (cm)	0-26	23-163	0-50	50-120	0-45	45-160	0-30	30-160	0-45	45-180	0-18	18-145	0-17	17-220	0-20	20-155	0-30	30-120	0-15	15-35	0-10	10-40
Color	ce	bac	ba	ba	bae	v	ve	ve	be	bf	ba	ve	vea	ve	vea	ve	be	v	bac	bam	p	ba
Sand (%)	46	36	20	16	43	40	28	22	56	36	33	23	19	25	13	10	22	10	35	23	12	17
Silt (%)	24	30	19	15	10	10	12	11	6	9	24	24	31	14	26	20	37	35	40	46	42	45
Clay (%)	30	34	61	69	47	50	60	67	38	53	43	53	50	61	61	70	41	55	25	31	46	38
Natural Clay	2	0	3	2	26	3	24	0	10	2	36	7	29	0	40	0	30	21	16	25	32	21
Textural Class	fa	fa	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	arg	fs	f	arg	arg
Structure	bsa	bsa	gr	ma	gr	gr	gr	gr	gr	gr	bsa	bsa	bsa	bsa	bsa	bsa	gr	bsa	bsa	bsa	bsa	bsa
Relative Humidity	15	17	-	-	20	21	25	26	16	21	27	37	30	30	31	32	-	-	24	24	33	27
Flocculation Degree	93	100	95	97	48	94	60	100	72	97	28	87	42	100	34	100	26	61	36	19	30	45
Silt/Clay Ratio	0.80	0.88	0.31	0.21	0.47	0.50	0.20	0.16	0.15	0.17	0.55	0.45	0.62	0.22	0.42	0.28	0.90	0.63	1.60	1.48	0.91	1.18
pH H2O (1:1)	5.0	5.2	3.7	4.0	5.3	5.5	5.7	5.6	5.3	5.0	5.8	6.5	6.1	6.6	6.3	6.6	6.0	6.1	6.1	5.6	7.0	6.8
pH KCl (IN)	3.8	3.8	3.0	3.0	4.5	5.4	5.0	5.1	4.3	5.0	4.7	4.9	4.9	5.4	5.3	5.6	5.3	5.5	4.8	4.2	6.0	5.6
Ca (mE/100g)	0.25	0.20	0.61	0.30	0.80	0.15	2.00	0.20	0.10	0.10	8.90	8.60	13.90	6.90	9.50	4.90	8.50	3.55	2.70	0.50	23.60	13.90
Mg (mE/100g)	0.25	0.20	0.50	0.14	0.40	0.15	0.60	0.20	0.10	0.10	2.80	3.00	2.80	2.00	2.20	1.00	0.85	0.62	2.30	1.10	2.00	1.90
K (mE/100g)	0.04	0.02	0.80	0.02	0.04	0.02	0.14	0.03	0.40	0.20	0.69	0.10	0.14	0.03	0.49	0.12	0.20	0.18	0.37	0.21	0.66	0.37
Na (mE/100g)	0.01	0.01	0.02	0.01	0.04	0.04	0.04	0.01	0.01	0.01	0.20	0.05	0.04	0.02	0.03	0.04	0.04	0.05	0.02	0.02	0.10	0.05
Basis Addition (mE/100g)	0.55	0.23	1.93	0.47	1.28	0.36	2.78	0.44	0.41	0.41	12.59	11.75	16.88	8.95	12.22	6.06	9.59	4.40	5.39	1.83	26.36	16.22
H + Al (mE/100g)	2.30	5.40	8.12	5.41	4.90	1.80	4.60	2.50	5.60	3.13	4.00	2.90	6.30	2.00	5.40	2.40	2.80	1.90	4.00	5.60	0.00	3.40
Cations exchange cap.T (mE/	2.35	5.63	10.05	5.88	6.18	2.16	7.38	2.94	6.01	3.54	16.59	14.65	23.18	10.95	17.62	8.46	12.39	6.30	9.39	7.43	26.36	19.62
Basis Saturation V%	23	4	19	7	20	17	37	15	6	11	75	80	72	81	69	71	77	69	57	24	100	83
Organic Contents %	0.88	0.23	1.61	0.80	1.30	0.64	1.20	0.63	1.34	0.74	1.42	0.47	3.81	0.57	2.48	0.69	1.70	0.53	1.30	0.80	4.49	2.51
N (%)	0.06	0.03	0.05	0.03	0.07	0.05	0.11	0.05	0.80	0.05	0.15	0.70	0.28	0.70	0.23	0.70	0.18	0.05	0.14	0.14	0.38	0.22

Table II-5.1(1) MORPHOLOGICAL, PHYSICAL AND CHEMICAL CHARACTERIZATION OF THE SOILS FOR THE PRODIAT REGION (2/2)

INDICATION IN THE MAP	12 DYSTROPHIC LITHOSOL		13 EUTRHOPHIC LITHOSOL		14 QUARTZ SAND		15 ALLUVIAL SOIL		16 HUMIC GLEY		17 LOW HUMIC GLEY		18 VERTISOL		19 HYDRO MORPHIC LATERITIC		20 RENDIZINE		21 SOLONETZ SOLODIZED	
Unit																				
Symbol	R		RE		AQ		A		HGH		HGP		V		HL		RZ		SS	
Profile	No. 22(*)		No. 34		No. 18(*)		No.33		IB-08		No. 02		BS-14		No. 12		No.12		No. 15	
Location	Araguaina-GO		Formoso-GO		Maraba-PA		Flores-GO		Ilha do Bananal-GO		Formosa-GO		Colmeia		Arraias-GO		Arraias-GO		Arraias-GO	
Vegetation	Cerrado		Forest		Forest		Forest		Alluvial Field		Alluvial Field		Forest		Cerrado		Forest		Field	
Present Use	Pasture		Pasture		Forest		Reservation		Natural Pasture		Natural Pasture		Forest		Natural Pasture		Forest		Natural Pasture	
Relief	Slightly Undulated		Strongly Undulated		Plain		Plain		Plain		Plain		Plain		Slightly Undualted		Plain		Plain	
Horizon	A	C	A	R	A	C	A	C	A	B	A	C	A	B	A	B	A	C	A	B
Depth (cm)	0-16	16-36	0-20	20cm	0-75	75-145	0-28	28-75	0-15	15-100	0-10	10-210	0-3	3-94	0-30	30-90	0-30	30-55	0-30	30-50
Color	bsa	bsa	bae	-	cbc	v	be	b	p	cbc	c	c	ce	c	ce	cc	pa	bae	-	-
Sand (%)	53	35	6	-	76	74	10	10	3	20	5	5	12	34	59	57	25	30	40	30
Silt (%)	22	28	42	-	19	13	61	61	30	12	55	46	22	25	17	19	41	36	52	46
Clay (%)	25	37	52	-	5	13	29	29	67	68	40	49	66	41	24	24	34	34	8	24
Natural Clay	16	29	37	-	1	5	27	28	52	85	34	48	2	34	9	0	28	23	6	23
Textural Class	faa	fa	arg	-	af	af	fas	fas	arg	arg	arg	arg	arg	arg	faa	faa	fa	fa	fs	fr
Structure	bsa	bsa	bsa	-	gs	ma	gr	bsa	ba	pr	ba	ba	bsa	pr	gr	bsa	gr	bsa	-	-
Equivalent Humidity	-	-	42	-	-	-	24	25	51	30	33	31	-	-	13	19	48	34	15	17
Flocculation Degree	36	22	29	-	90	62	7	6	22	0	15	2	97	17	31	100	28	23	25	4
Silt/Clay Ratio	0.88	0.75	0.81	-	3.80	1.00	2.10	2.10	0.44	0.17	1.38	0.94	0.30	0.61	0.70	0.79	1.20	1.05	6.50	1.92
pH H2O (1:1)	4.6	4.8	6.1	-	4.0	4.7	6.1	6.4	4.7	5.4	5.7	6.4	5.1	5.7	5.7	5.4	8.2	8.5	6.6	7.5
pH KCl (IN)	3.4	3.8	5.2	-	3.6	4.1	5.2	4.9	3.7	3.6	4.4	4.4	4.1	3.5	4.5	4.1	6.7	7.4	4.3	5.3
Ca (mE/100g)	0.40	0.30	12.90	-	0.50	0.15	8.50	6.50	7.40	9.90	5.50	5.10	12.83	3.56	0.30	0.30	25.30	15.81	1.00	2.20
Mg (mE/100g)	0.40	0.30	3.70	-	0.35	0.05	1.70	1.90	4.40	6.20	3.10	4.20	3.80	2.69	0.80	0.06	3.50	1.30	0.60	1.60
K (mE/100g)	0.13	0.15	0.76	-	0.06	0.03	0.29	0.10	0.26	0.08	0.29	0.20	0.42	0.08	0.17	0.01	0.14	0.02	0.04	0.07
Na (mE/100g)	0.01	0.02	0.11	-	0.01	0.01	0.04	0.03	0.10	0.10	0.22	0.57	0.34	0.35	0.01	0.01	0.18	0.17	0.08	1.13
Basis Addition (mE/100g)	0.94	0.77	17.47	-	0.92	0.24	10.53	8.53	12.16	16.28	9.11	10.07	17.39	6.68	1.28	0.38	29.12	17.30	1.72	5.00
H + Al (mE/100g)	7.26	11.22	7.00	-	5.44	2.31	2.60	2.00	20.40	6.70	5.00	4.20	16.09	8.74	3.20	4.10	0.00	0.00	1.20	0.00
Cations exchange cap.T (mE/	8.20	11.99	24.47	-	6.36	2.55	13.13	10.53	32.56	22.98	14.11	14.27	33.48	15.42	4.48	4.48	29.12	17.30	2.92	5.00
Basis Saturation V%	11	6	71	-	14	9	80	81	37	70	65	71	52	43	28	8	100	100	59	100
Organic Contents %	2.64	0.69	3.98	-	0.60	0.28	1.29	0.45	4.80	0.78	1.53	1.04	5.00	-	0.84	0.17	5.65	2.27	0.41	0.44
N (%)	0.06	0.07	0.36	-	0.08	0.02	0.14	0.06	0.52	0.12	0.16	0.12	-	-	0.06	0.02	0.60	0.21	0.05	0.06

5.2 Brazilian Soil Classification and Its Comparison with other Soil Classifications

In Brazil, the Soils are classified according to the Brazilian System of Soil Classification. At present, this system is under review and the modifications/ adjustments are executed by EMBRAPA/SNLCS (National Topographic survey and Conservation of Soils), and therefore classification being used now is subject to modifications. A comparison of the current soil classification system in Brazil with their approximate equivalents of USA soil taxonomy and FAO classification for the soils of the Cerrado region and the transition areas is shown in Table II-5.2.(1).

Table II-5.2(1) Brazilian Classification of Soils and their Approximate Equivalents of US and FAO Classifications

NO.	CURRENT CLASSIFICATION IN BRAZIL	USA SOIL TAXONOMY (*)	FAO WORLD CLASSIFICATION	SYMBOL
1	Plinthic Yellow Oxisol	Petroferric Plinthic Haplustox		LA
2	Red-Yellow Oxisol	Typic Acrustox	Humic Acric Ferralsols	LV
3	Dark-Red Oxisol	Typic Acrustox	Humic Ferralsols	LE
4	Purple Oxisol	Typic Acrustox		LR
5	Concretionares Soil	Petroferric Acrustox	Plinthic Ferralsols	SC
6	Red Brunizem Soil	Mollic Argiustoll		EV
7	Structured Purple Soil	Oxic Rhodustalf		TR
8	Oxisol Structured Purple Soil	Oxic Rhodustalf	Eutric Nitosols	TRL
9	Red-Yellow Podzolic	Tropeptic Rodustalf	Orthic Acrisols	PV
10	Dystrophic Cambisol	Ustoxic Dystropepts	Dystric Cambisols	Cd
11	Eutrophic Cambisol	Ustox, Humitropept	Haplic Phaeozems	Ce
12	Dystrophic Lithosol	Lithic Ustorthent		Rd
13	Eutrophic Lithosol	Lithic Ustorthent		Re
14	Quartz Sand	Ustoxic Quartzpsament	Arenosols	AQ
15	Alluvial Soil	Typic Ustifluvent	Eutric Fluvisols	AQ
16	Humic Gley	Aquic Haplustoll		HGH
17	Low Humic Gley	Fluvaquents	Eutric Gleysols	HGP
18	Vertisols	Vertic Tropalqualf		V
19	Hydromorphic Laterites	Plinthaquox	Plinthic Acrisols	HL
20	Rendzine	Haplustolls	Rendzinas	RZ
21	Solonetz-Solodized			SS

(*) USTIC soil moisture regime is prevailing in the basin of Cerrado region and the transition areas. In the Amazon Environment, UDIC soil moisture regime prevails.

5.3 Major Classification of Soils in the Tocantins State

The Classification of Soils in the State is shown in Fig.II-5.3(1) and the predominant soil classes and their associations are shown in Table II-5.3(1).

Table II-5.3 (1) Predominant Soil Classes in the State and their Associations

PREDOMINANT CLASS OF SOILS		CLASS OF SOILS WITH SMALLER EXTENSION THAN THE DOMINANT SOIL
SYMBOL	CLASSIFICATION	SOIL ASSOCIATIONS
LA	Yellow Oxisols	Red-Yellow Oxisols, quartz sands and Red-Yellow podzolic.
LV	Red-Yellow Latosols	Red-Yellow podzolic, Dark red Oxisol, quartz sands , Petroplinthtic soils, Dystrophic Litholic Soils and Gley Soils
BV	Reddish Brunizem	Dark-Red Oxisol, and Red Oxisol
PV	Red-Yellow Podzoilc	Dark-Red Podzolic, quartz sands , Red-Yellow Oxisols, Dark-Red Oxisols, Cambiosoil, Dystrophic Litolic Soil , and Petroplinthic Soils.
PT	Plinthic soils	Quartz sands, Alluvial Soil, Dystrophic Litholic Soil, and Red-Yellow Podzolic.
C	Cambisols	Red-Yellow Podzolic, Dark Red Podzolic, Dark Red Oxisols, Red Yellow Oxisol, Petroplinthic Soils and Dystrophic Litholic Soil
SC	Concretionary soil - Petroplintic Soils	Red-Yellow Oxisols , Yellow Oxisols, Red-Yellow Podzolic, Dark Red Oxisol, Alluvial Soils and Dystrophic Litolic Soil.
AQ	Quartz sands	Petroplintic Soils, Dystrophic Litolic Soil, Dark Red Oxisols, Hydromorfic Quartz sands , Gley Soils and Dark red Podzolic.
R	Dystrophic Litholic Soils	Red-Yellow Oxisols , Red-Yellow Podzolic, Dark Red Oxisol, Plintosoil, Yellow Oxisol and Red soil.
G	Gley Soils	Alluvial soils, Organic Soils and Quartz hydromorfic Sands.

The prominent classes of the soils in the State are Red-Yellow Oxisols, Quartz sands and Dystrophic Litolic soils which comprehend together about 63.8% of the State surfaces.

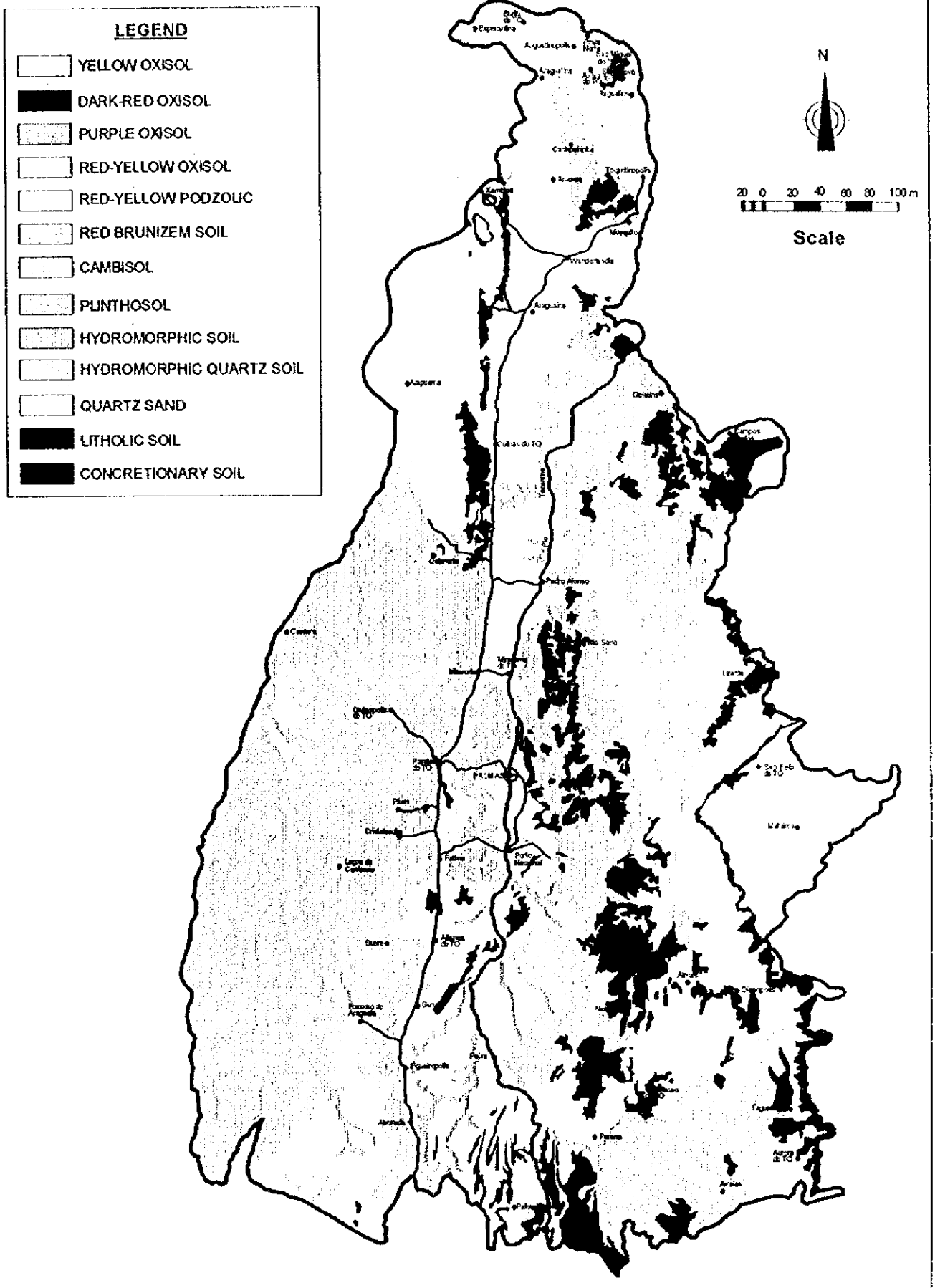


Fig. II-5.3(1): Soil Classification Map

Table II-5.3(2) Type of Soil and respective Area (km²) in Tocantins State, According to Homogeneous Micro-regions

TYPE OF SOILS	HOMOGENEOUS MICRO-REGIONS								
	BICO DO PAPAGAIO	ARAGUAINA	MIRACEMA DO TOCANTINS	JALAPAO	PORTO NACIONAL	RIO FORMOSO	GURUPI	DIANOPOLIS	TOTAL
LV	5,067	7,506	7,141	4,637	12,235	20,950	17,551	16,223	91,310
LE	604	-	-	-	404	289	708	1,326	3,331
LR	214	-	-	-	-	-	-	-	214
LA	-	-	-	-	-	1,696	-	-	1,696
PV	185	7,423	17,273	269	-	-	-	1,137	26,287
HG	529	370	1,292	93	-	14,355	120	-	16,759
AQ	7,776	7,072	4,834	26,478	-	190	-	3,531	49,881
A	30	-	-	-	100	2,873	1,397	888	5,288
SC	549	1,402	-	15,188	2,574	130	-	2,005	21,848
R	304	2.421	2.519	5.697	5.986	439	4.405	14.076	35.847
HL	-	-	589	-	-	7,881	-	7,174	15,644
C	-	-	688	-	-	4,888	180	299	6,055
TR	-	-	-	-	-	-	-	2,663	2,663
BV	464	35	-	-	-	-	-	-	499
TOTAL	15,722	26,229	34,336	52,362	21,299	53,691	24,361	49,322	278,421

LV: Red-Yellow Oxisols; **LE**: Dark red Oxisols; **LR**: Purple Oxisols; **LA**: Yellow Oxisols; **PV**: Red Yellow Podzolic soil; **HG**: Gley Soils; **AQ**: Quartz Sand; **A**: Alluvial Soils; **SC**: Concretionary Soils; **R**: Dysrtrophic Litholic soils; **HL**: Hydromorphic laterites; **C**: Cambisols; **TR**: Purple Soil; **BV**: Red Brunizen soil.

The Red-Yellow oxisols represent 32.9% or 91,130 km² of the state surface. They appear with inclusions and associated with Concretionary soils, Quartz sands, Red-Yellow podzolic and Dystrophic Litholic soils. They appear in all micro-regions of the state, specially in Rio Formoso, Gurupi, Dianópolis, and Porto Nacional.

Oxisols are almost always located in tablelands or stabilized erosion surfaces and also in flat relieves and pluvial plains. At the North of the region such as at the State of Pará and part of Maranhão State, these soils are of the yellow type, and frequently associated to plinthites and related to tertiary and sub recent sediments. They are generally acidic with aluminum toxicity and application of lime (calcium carbonate or oxides, hydroxides and silicates of calcium and magnesium) is necessary to raise their pH (lessen the acidity) and to improve these soils.

The Quartz Sands represent 18% or 49,881 km² of the state surface and they are in the micro-regions of Jalapão, Bico do Papagaio and mainly Araguaína. They appear to be associated with Red-Yellow Oxisols, Yellow Oxisols, Hydromorphic Laterites, Podzolic soils and Concretionary soils.

The Dystrophic Litholic soils similar to Red-Yellow Oxisols also appear in all micro-regions of the state, and it is the third large class of soil of the state representing 12.9% or 35,847 km². They are associated with Red-Yellow Podzolic soils, Concretionary soils, Red-Yellow latosols, and rock sediments. They predominate in the micro-region of Dianópolis, representing 28.5% of this location soils.

The Red-Yellow Podzolic soils seem to be associated with Red-Yellow Oxisols, Yellow Oxisols, Dystrophic Litolic soils soils, Concretionary soils and Cambissols. They represent about 9.5% of the state and 50.3% of it is located in the micro-region of Miracema do Tocantins.

The Concretionary soils which represent around 7.9% of the State soils seem to be associated with Red-Yellow Oxisols, Red-Yellow Podzolic, Hydromorphic laterites and indiscriminate Quartz Sands, specially in the micro-region of Jalapão.

Hydromorphic Laterites and Gley soils appear more frequently in the micro-region of Rio Formoso, representing 6% of the micro-region soils and 6.5% of the state soils, respectively. They are found to be associated with Alluvial and Hydromorphic soils.

In some micro-regions there are areas with purple Oxisol (Bico do Papagaio),Yellow Oxisol, (Formoso River), and Red Brunizen (Bico do Papagaio and Araguaína).

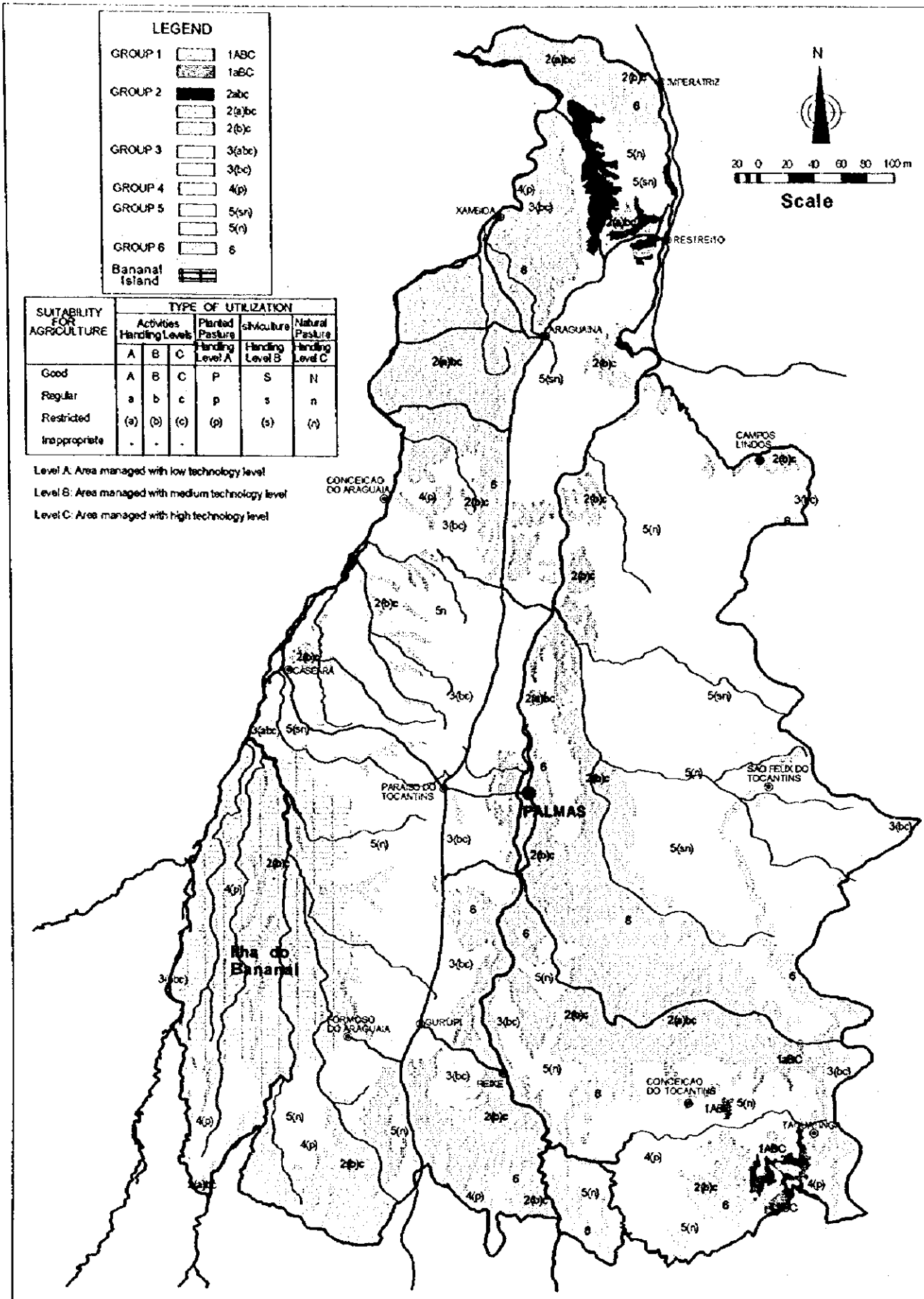
5.4 Description of the Soil Characteristics

Taxonomically, the fertility levels and other characteristics of the Cerrado soils are not so different from the Amazon region soils. In general, the Cerrado soils have high acidity level with frequent aluminium toxicity and low level of nutrients except those which are derived from basaltic rocks, calcareous or other mineral composition. The main remarkable difference is related to the negative soil water balance in the Savannah region as a result of the long dry season for a period of 5 to 6 months. The physical and chemical characteristics of the most representative soils of the cerrado region and the transition area are illustrated in Table II-5.1(1).

5.5 Land Suitability and Identification of Areas Suitable for Agriculture

The Land Suitability map of the Tocantins State is shown in Fig.II-5.5(1). The land suitability is divided into six groups and sub-groups and the area corresponding to each sub-group is shown in Table II-5.5(1).

Regarding the land suitability for agriculture, about 35.9% (9,984,600 ha) of the Tocantins state surface is classified as suitable for agriculture which include classes 1 to 3; 16.4% (4,569,400 ha) is suitable for cultivated pastures (class 4); 40.7% (11,324,300 ha) is suitable for silviculture and natural pasture, and 7.0% (1,963,700 ha) is not qualified for agriculture use. Within the area suitable for agriculture (group 1 to 3), 0.5% have high suitability (class 1), 27.2% have regular suitability (class 2) and 8.2% have restricted suitability (class 3). Land classification in each region of the State is shown in Table II-5.5(2)



SUITABILITY FOR AGRICULTURE	TYPE OF UTILIZATION					
	Activities Handling Levels			Planted Pasture	silviculture	Natural Pasture
	A	B	C	Handling Level A	Handling Level B	Handling Level C
Good	A	B	C	P	S	N
Regular	a	b	c	p	s	n
Restricted	(a)	(b)	(c)	(p)	(s)	(n)
Inappropriate	-	-	-			

Fig. II-5.5(1): Land Suitability Map

LEGEND FOR THE LAND SUITABILITY MAP

LEVEL A — Area managed with low tecnology level

LEVEL B — Area managed with medium technology level

LEVEL C — Area managed with high technology level

TABLE CORRESPONDING TO THE CLASS OF SOIL AVAILABLE FOR AGRICULTURE

SUITABILITY FOR AGRICULTURE	TYPE OF UTILIZATION					
	Activities Handling Levels			Planted Pasture	Silviculture	Natural Pasture
	A	B	C	Handling Level A	Handling Level B	Handling Level C
Good	A	B	C	P	S	N
Regular	a	b	c	p	s	n
Restricted	(a)	(b)	(c)	(p)	(s)	(n)
Inappropriate	-	-	-			

GROUPS OF LAND SUITABILITY

Group 1	Good Suitability for Agriculture	Group 4	Good, Regular or Restricted Suitability for planted pastures with medium technology
	Good suitability in A, B or C levels	4 (p)	Restricted suitability for pastures
	Good suitability in B or C levels		
Group 2	Regular Suitability for Agriculture	Group 5	Good, Regular or Restricted Suitability or unsuitable for silviculture or natural pasture considering B and A technology level
	Regular suitability in A, B or C Levels		Restricted suitability for planted pastures
	Regular suitability in B and C levels but Restricted in A	5 (n)	Restricted suitability for natural pastures
2 (b) c	Regular Suitability in C and restricted and B		
Group 3	Restricted Suitability for Agriculture at least in one handling level A, B or C	Group 6	Not suitable for Agriculture use, except for special case used for preservation of flora and fauna or recreation activities
3 (abc)	Restricted suitability in A, B or C levels		Not suitable for Agriculture
	Restricted suitability in B and C levels		

ADDITIONAL CONVENTIONS

Land suitable for irrigated rice, but not available for short and long period crops Unsuitable for silviculture

Marked on the symbol indicates smaller proportion of components with higher suitability than shown in the map

Marked on the symbol indicates smaller proportion of components with lower suitability than shown in the map

Limit among Groups

Table II-5.5(1) Group and Sub-groups of Land Suitability for Agriculture in Tocantins State

GROUPS	SUB GROUPS	AREA	
		1000 ha	%
1	1 ABC	68.2	0.24
	1 aBC	70.5	0.25
		138.7	0.50
2	2 abc	354.1	1.27
	2 (a) bc	2,630.8	9.45
	2 (b) c	4,579.5	16.45
		7,564.4	27.17
3	3 (abc)	285.1	1.02
	3 (bc)	1,996.3	7.17
		2,281.5	8.19
4	4 (p)	4,569.4	16.41
5	5 (sn)	4,934.1	17.72
	5 (n)	6,390.2	22.95
		11,324.3	40.67
6	6	1,963.7	7.05
Total		**27,842.0**	**100.0**

Table 5.5 (2) Land Classification Area in the different regions of the State of Tocantins

Class	Extreme-North		North		Northeast		Northwest		East		Central west	
	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%
1	-	-	-	-	-	-	-	-	-	-	-	-
2	8,840.81	11.69	10,810.73	14.29	3,152.01	4.17	7,168.16	9.48	149.23	0.20	3,441.74	4.55
3	109.24	0.48	64.86	0.28	676.96	2.97	2,030.06	8.90	2,238.61	9.81	4,153.54	18.21
4	260.51	0.57	-	-	-	-	629.46	1.38	-	-	4,184.82	9.16
5	6,563.36	5.80	9,233.31	8.15	20,106.06	17.75	8,025.83	7.09	29,298.24	25.87	18,569.68	16.40
6	193.27	0.98	973.20	4.96	97.78	0.50	1,227.48	6.25	2,427.12	12.36	109.52	0.56
Total	15,967.20	5.73	21,082.10	7.57	24,032.81	8.63	19,080.99	6.85	34,113.20	12.25	30,459.30	10.94

Class	Central		Southeast		Southwest		South		State		Percentage of
	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%	Area, sq.km	%	Class Area / Total Area
1	-	-	1,386.59	100.00	-	-	-	-	1,386.59	100.00	0.50
2	9,484.91	12.54	11,789.84	15.59	10,711.35	14.16	10,096.05	13.35	75,644.83	100.00	27.17
3	2,739.19	12.01	1,868.47	8.19	2,708.55	11.87	6,225.30	27.29	22,814.78	100.00	8.19
4	-	-	13,631.08	29.83	24,983.63	54.68	2,004.45	4.39	45,693.95	100.00	16.41
5	7,950.79	7.02	8,077.14	7.13	2,093.26	1.85	3,325.43	2.94	113,243.10	100.00	40.67
6	2,904.51	14.79	10,679.77	54.38	-	-	1,024.78	5.22	19,637.44	100.00	7.05
Total	23,079.40	8.29	47,432.90	17.04	40,496.79	14.55	22,676.01	8.14	278,420.70	100.00	100.00

6 Vegetation

The variation of the vegetation depends on the geomorphologic conditions and rainfall variation. The northern region has a dense vegetation of babaçú and the southern and southeastern regions have cerrado vegetation, predominant in the Central Plain of Brazil.

The State vegetation can be represented by the Cerrado which occupies a great part of the State; Dense Forest is predominant in the Northern and Northwest part, and Mix Open Forest is predominant in the Extreme-North region. The main vegetation is presented bellow.

The ecological regions characterize the vegetation distribution in primary terms. In the Tocantins State they are represented by: Savanna, Dense Pluvial Forest and Semi-deciduous stationary Forest. There are also areas of ecological tension in various regions.

Description of the Vegetation

Domain	Symbol	Dominant Formation or Sub-formation
Pluvial Forest	Fp1	Hydrophil Forest
	Fp5	Dense Forest
	Fp6	Mix Open Forest
Savanna	C1	Cerrado
	C2	Dirty Field and Clean Field
	C3	Field with Murundú
	Ce	Cerradão
Stationary Forest	Fsd1	Latifoliate High Xingú Forest
	Fsd2	Mix Forest
	Fd	Deciduous Forest

The Hydrophil Forest (Fp1) includes the Várzea Forest, predominantly inundated, and Igapó, with permanent water. The predominant vegetation is characterized by Açai, Buriti, etc. The area is protected by the environmental legislation, especially the area of Açai Palm trees.

The Dense Forest (Fp5) is a forest with emergent trees 50 m high and condominium type trees about 30 m high, predominant in the northern region. The predominant vegetation is composed by Angelim, Arocira, Breus, Mogno, etc.

The Mix Open Forest (Fp6) is mostly scarce, with low density characterized by Babaçú, Bacaba and Inajá. It mainly occurs in the north of the State - "Bico do Papagaio" . The Babaçu is one of the income resources for the region inhabitants. The complete abate of Babaçú is prohibited, through the consolidation of a Extractive Activity Reservation Area.

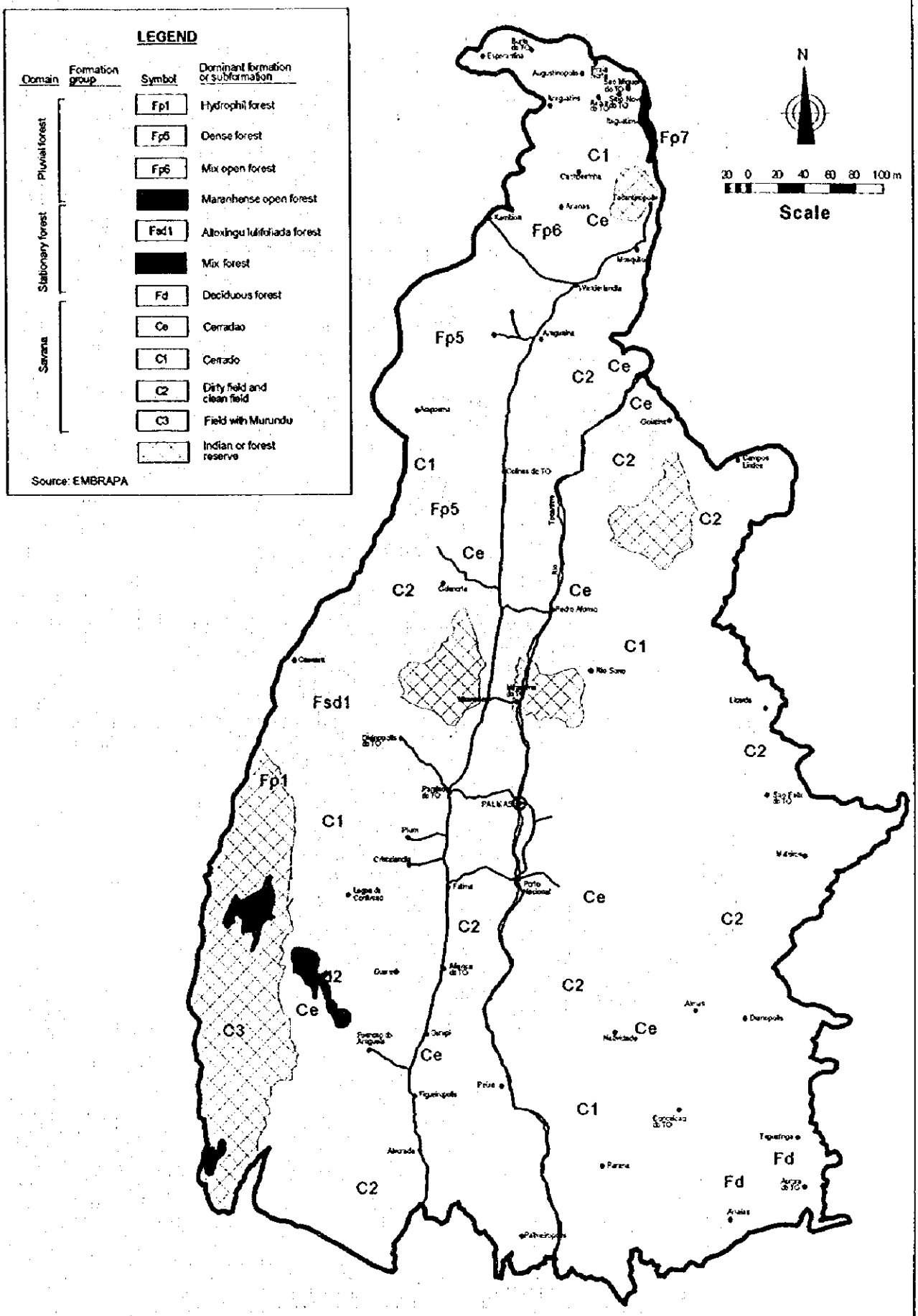


Fig. II-6.1(1): Vegetation

The Cerrado (C1) practically occurs in all regions of the State, being predominant the presence of scattered arboretum stratum of 4 to 8 m, shrubby stratum of 1 to 2 m and compost herbaceous stratum, mainly composed by grassy crops. The vegetation is characterized by the presence of Araticum, Mangabeira, Ipês, Pau-Santo, Pau-Terra, Pequi, etc.

The Dirty Field and Clean Field (C2) are vegetation dominated by grass, with degradation characteristics, where there is a clear presence of small size shrubby-arboretum species separating each other.

The field with Murundú (C3) is represented by floodable holms, mainly in the Bananal Island region.

The Cerradão (Ce) is found in the southern and western regions, inserted in the forest vegetation. It is characterized by the forest formation of trees 10 to 15 m high with continuous form structure, represented by Angico, Jacarandá, Pindaíba, etc.

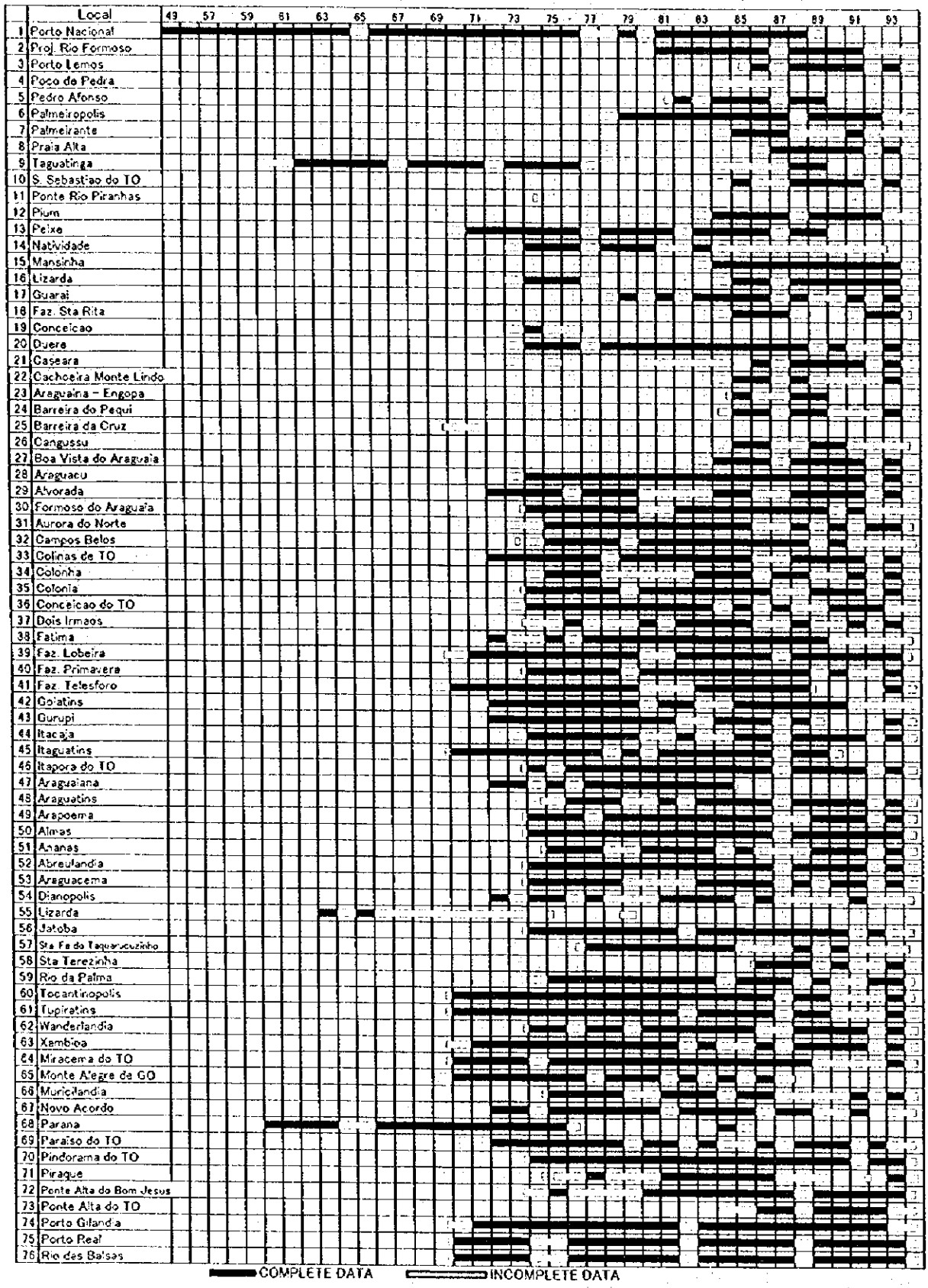
The Semi-deciduous Latifoliate Forest of High Xingú (Fsd1) is represented by a semi-compact forest formation, of ramified crow with discontinuous projection, condominium type stratum reaching 20 to 25 m and emergent stratum till 35 m. The main vegetation is represented by Aroeira, Cedro, Tamboril trees, etc.

The mixed Semi-deciduous Forest (Fsd2) is composed of trees which ramified crows are clearly more spaced, dominating the shrubby-arboretum stratum, dense and low, covered partially by cipo.

The Deciduous Forest is a vegetal formation partially opened, and during the dry period, great part of the species loses the leaves. The main species are Angico, Cedro, Jacarandá, etc.

7 Data Book

MEASUREMENT PERIOD IN EACH STATION



MONTHLY PRECIPITATION

No	Local	MONTH												TOTAL
		J	F	M	A	M	J	J	A	S	O	N	D	
1	Porto Nacional	249.5	241.8	253.1	148.7	36.2	4.3	4.0	4.1	40.3	150.9	203.0	254.1	1581.2
2	Proj. Rio Formoso	278.0	217.7	256.9	82.1	25.0	3.7	2.1	5.9	38.2	140.6	195.2	326.7	1572.1
3	Porto Lemos	97.7	199.9	206.2	197.0	64.4	26.8	10.5	26.7	66.3	132.0	89.1	236.0	1352.4
4	Poco de Pedra	292.5	207.6	240.3	126.3	28.3	0.0	0.0	12.0	90.0	309.0	177.4	286.6	1769.9
5	Pedro Afonso	311.1	237.1	254.1	181.4	25.3	7.9	1.2	19.6	48.1	191.0	223.0	281.7	1781.4
6	Palmeiropolis	323.9	245.5	189.3	90.8	15.2	6.1	1.9	7.3	35.4	97.6	238.0	318.0	1569.1
7	Palmeirante	259.5	171.2	281.9	201.6	36.5	11.1	2.2	5.1	62.6	123.0	172.6	190.6	1518.0
8	Praia Alta	210.8	212.4	240.6	121.2	16.1	2.5	0.1	6.9	47.1	94.3	155.2	255.4	1362.8
9	Taguatinga	275.4	234.2	221.6	115.2	16.2	1.6	1.1	2.2	19.5	139.0	213.3	306.8	1546.1
10	S. Sebastiao do TO	220.3	262.4	288.9	239.7	65.3	32.1	9.3	4.7	49.9	89.9	162.5	233.9	1658.8
11	Ponte Rio Piranhas	-	-	-	-	-	-	0.0	18.4	-	-	-	-	18.4
12	Pium	322.4	276.1	297.1	163.1	75.2	8.6	3.7	10.5	54.1	182.8	293.0	345.6	2032.2
13	Peixe	270.2	238.7	224.6	120.7	26.1	6.0	3.1	3.5	32.7	139.3	229.1	274.9	1569.0
14	Natividade	311.6	261.6	214.7	113.5	27.6	13.8	5.0	12.3	40.7	171.2	229.9	258.6	1660.5
15	Mansinha	241.8	286.1	267.6	174.9	40.4	3.8	4.8	3.0	50.5	132.8	170.2	311.0	1686.9
16	Lizarda	170.5	194.4	177.8	90.5	35.5	5.5	0.0	0.0	4.6	94.6	97.6	174.5	1045.5
17	Guarai	333.6	296.5	274.1	155.9	30.4	9.5	3.0	8.2	74.0	172.8	217.3	279.9	1855.2
18	Faz. Sta Rita	248.0	165.0	178.7	29.1	14.1	0.0	0.0	0.1	15.5	104.4	139.3	270.8	1165.0
19	Conceicao	216.6	207.8	181.9	119.0	89.8	10.4	20.2	9.3	30.4	158.0	162.4	158.1	1363.9
20	Ducre	257.2	281.8	270.6	160.2	34.0	6.2	5.7	10.6	36.7	162.2	174.4	292.5	1692.1
21	Caseara	216.5	194.2	206.1	181.6	57.1	7.3	2.6	13.9	43.4	163.6	207.0	306.0	1600.2
22	Cachoeira Monte Lindo	242.9	198.6	293.4	188.0	51.4	11.4	7.5	9.1	42.5	161.5	167.1	200.9	1574.4
23	Araguaina - Engepa	294.3	242.6	304.0	265.6	104.2	47.5	14.6	19.8	61.2	191.1	214.3	326.8	2086.0
24	Barreira do Pequi	248.6	218.0	256.5	102.8	35.5	3.4	2.4	7.0	30.8	116.2	255.7	383.6	1660.6
25	Barreira da Cruz	400.0	178.4	206.9	131.2	24.5	29.4	3.2	0.0	47.6	228.6	117.2	182.6	1549.4
26	Cangussu	213.5	215.4	245.0	185.3	35.2	7.0	2.2	9.1	52.1	151.4	181.9	237.6	1535.6
27	Boa Vista do Araguaia	263.5	193.6	305.1	236.0	90.3	40.1	9.9	14.7	48.9	183.1	181.1	259.7	1825.9
28	Araguacu	270.6	225.5	221.5	96.4	22.5	1.6	1.5	7.1	42.5	126.5	209.4	290.9	1516.0
29	Alvorada	259.1	223.2	227.5	91.0	26.1	2.6	2.2	12.1	31.2	127.2	181.9	259.1	1443.2
30	Formoso do Araguaia	287.4	259.3	258.9	135.2	42.0	6.3	0.7	11.3	38.4	156.9	222.7	352.5	1771.5
31	Aurora do Norte	358.4	287.1	241.4	132.1	27.6	4.4	2.4	3.2	25.6	144.6	250.1	340.8	1817.9
32	Campos Belos	276.1	216.3	222.2	110.5	26.7	10.1	1.9	4.5	28.4	119.9	217.5	287.8	1523.1
33	Colinas de TO	271.5	287.7	253.2	198.1	85.1	18.8	4.4	23.2	78.0	178.8	220.4	250.0	1869.1
34	Colonha	260.4	178.3	203.0	88.7	18.7	3.9	2.7	4.5	26.0	117.0	192.6	246.3	1341.9
35	Colonia	274.1	299.4	280.2	211.3	80.5	19.3	5.8	28.9	89.2	203.4	192.9	244.4	1929.3
36	Conceicao do TO	233.5	218.0	175.7	78.2	20.7	3.3	3.7	4.0	18.1	99.4	181.6	242.8	1279.1
37	Dois Irmaos	367.8	374.3	371.8	235.6	49.6	10.2	2.0	18.1	63.4	168.1	261.2	270.6	2192.8
38	Fatima	331.8	273.0	305.6	177.8	42.0	8.7	2.9	10.0	42.4	166.2	209.9	309.7	1880.1
39	Faz. Lobeira	273.9	226.8	239.7	117.1	25.9	5.4	0.6	6.3	42.7	136.8	199.1	225.7	1500.6
40	Faz. Primavera	280.9	295.1	272.1	226.3	69.4	22.0	15.7	21.5	82.9	174.9	174.8	200.9	1836.5
41	Faz. Telesforo	276.2	215.6	224.4	123.2	28.9	6.3	2.7	10.1	49.6	154.1	236.4	289.8	1616.4
42	Goiatins	298.9	267.9	298.5	205.2	36.6	22.4	7.0	14.8	62.4	156.3	175.1	235.2	1780.1
43	Gurupi	223.6	218.9	235.1	127.8	13.3	8.4	4.1	7.3	36.2	131.7	203.0	221.5	1430.8
44	Itacaja	341.5	307.4	314.5	240.9	55.2	12.7	6.3	12.2	38.5	185.7	235.1	295.3	2045.1
45	Itaguatins	227.3	274.5	300.1	243.6	75.7	23.0	14.0	14.8	47.1	86.2	112.8	158.7	1577.9
46	Itapora do TO	324.3	301.5	263.2	189.4	56.8	11.9	9.6	26.8	90.3	201.0	242.4	295.1	2017.3
47	Araguaiana	305.3	314.8	295.3	192.7	76.5	33.9	10.5	29.4	71.4	142.9	179.7	238.3	1890.7
48	Araguatins	244.8	291.8	254.5	217.1	91.6	15.6	11.9	10.2	50.9	91.3	112.2	176.4	1568.3
49	Arapoema	264.9	300.6	279.6	206.9	67.5	16.6	10.8	21.0	82.9	175.9	173.5	264.5	1864.8
50	Almas	256.2	230.3	208.9	108.3	27.7	6.0	3.2	5.9	30.4	118.9	220.3	297.2	1513.3
51	Ananas	226.0	320.9	223.1	132.8	86.4	24.8	28.7	20.5	56.8	106.5	144.4	181.7	1552.7
52	Abreulandia	403.7	369.3	386.8	221.5	66.2	7.6	4.7	13.1	78.5	236.9	267.2	401.8	2457.1
53	Araguacema	322.0	312.5	321.5	251.1	82.8	20.8	6.0	20.4	80.6	203.0	243.8	311.0	2175.6
54	Dianopolis	260.1	238.7	214.3	131.1	22.8	4.0	2.3	4.0	31.7	134.3	185.2	268.0	1499.6
55	Lizarda	296.0	232.2	222.8	143.0	46.7	3.5	0.9	6.7	36.6	155.2	201.1	275.6	1620.3
56	Jatoba	276.1	248.5	227.7	180.5	35.6	7.2	1.3	2.3	43.6	129.2	210.3	279.3	1641.6
57	Sta. Fe do Taquaruzinho	317.0	276.6	277.5	137.5	41.7	7.7	1.6	7.5	62.1	169.0	236.7	293.4	1828.4
58	Sta Terezinha	238.0	281.3	262.6	149.1	41.7	6.9	7.0	13.4	60.5	135.6	163.9	240.5	1603.4
59	Rio da Palma	279.2	224.5	173.5	89.2	20.8	8.2	3.3	5.7	30.6	127.3	232.1	283.0	1477.4
60	Tocantinopolis	256.6	238.6	276.4	203.8	76.7	22.2	8.1	16.3	43.9	94.0	126.8	161.5	1525.0
61	Tupiratins	251.1	236.7	271.3	170.3	45.2	8.7	9.0	13.8	63.8	192.8	198.8	239.2	1700.8
62	Wanderlandia	240.0	290.2	284.0	224.2	86.9	29.3	12.9	27.9	65.7	133.8	148.5	222.0	1765.5
63	Xambioa	242.0	236.7	276.5	183.6	83.1	37.9	22.4	23.7	57.0	134.6	133.9	202.8	1639.4
64	Miracema do TO	265.2	244.8	268.0	166.2	45.1	7.7	3.1	8.9	54.0	167.2	206.0	275.6	1711.8
65	Monte Alegre de GO	307.9	230.9	242.2	124.5	24.3	14.1	2.1	4.2	46.7	151.6	249.5	238.4	1636.3
66	Muricilandia	201.3	194.6	250.3	179.4	68.6	24.3	16.4	22.9	67.7	154.3	130.7	200.9	1511.4
67	Novo Acordo	243.3	227.4	209.9	163.9	33.2	2.5	1.8	5.6	42.7	148.8	180.9	248.5	1508.5
68	Parana	210.6	181.9	179.9	96.1	14.8	0.6	0.7	1.2	18.1	120.1	200.2	217.3	1241.5
69	Paraiso do TO	277.7	313.9	275.8	159.7	47.7	5.1	6.9	14.2	54.8	165.5	242.2	346.0	1909.4
70	Pindorama do TO	257.8	241.5	236.3	142.0	41.7	6.9	2.8	4.7	31.3	140.8	210.8	262.6	1582.2
71	Piraque	227.0	295.1	295.4	205.5	71.4	35.9	13.3	25.3	52.6	137.0	167.0	189.4	1714.8
72	Ponte Alta do Bom Jesus	422.6	347.0	319.1	186.3	31.9	11.0	3.9	2.4	38.6	163.7	276.1	384.3	2186.7
73	Ponte Alta do TO	294.3	214.6	245.7	119.0	19.1	0.0	0.6	1.2	38.5	96.6	125.4	287.7	1442.8
74	Porto Gilandia	268.9	288.7	271.0	154.0	31.9	8.7	3.1	3.5	42.1	172.8	240.4	285.7	1770.7
75	Porto Real	258.7	277.3	239.1	178.7	45.0	10.5	2.8	5.9	69.0	155.4	208.4	241.2	1682.1
76	Rio das Balsas	244.5	275.9	222.3	164.5	45.3	3.3	1.8	10.7	31.5	128.6	190.5	262.1	1583.9

Station: Porto Nacional Local: Abatia

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949	312.6	242.7	107.4	126.1	24.5	0.0	0.0	0.0	0.0	101.2	240.0	266.5	1421.0
1950	88.8	246.5	265.2	222.6	0.0	0.0	0.0	0.0	40.8	201.3	186.2	339.8	1591.2
1951	186.0	92.3	245.6	180.7	68.5	0.0	0.0	0.0	0.0	65.5	117.5	313.4	1269.5
1952	136.0	172.1	281.6	209.6	54.8	0.0	0.0	0.0	19.5	86.5	121.6	516.5	1598.2
1953	131.6	123.7	271.9	61.0	0.4	0.0	0.0	0.0	118.5	112.4	126.4	425.9	1371.8
1954	150.7	124.0	195.4	164.3	28.5	0.0	0.0	0.0	25.6	53.0	203.1	135.7	1080.3
1955	280.0	131.0	211.2	131.4	0.0	0.0	0.0	0.0	0.3	159.9	360.5	250.2	1524.5
1956	279.6	259.1	284.1	286.9	97.2	0.2	0.0	0.0	14.6	91.7	537.3	215.1	2065.8
1957	272.1	268.3	425.0	230.2	22.2	0.0	0.0	0.0	80.2	62.5	276.4	114.9	1751.8
1958	304.7	293.4	326.0	110.9	0.0	0.0	31.1	0.0	11.6	136.3	127.3	430.3	1771.6
1959	363.6	261.2	341.7	75.1	0.3	7.8	0.0	0.0	28.2	127.5	139.0	98.3	1442.7
1960	331.1	272.1	431.6	101.2	46.3	0.0	0.0	0.0	25.2	98.2	123.4	375.9	1805.0
1961	325.8	0.0	121.5	75.3	25.7	0.0	0.0	0.0	5.4	49.9	67.9	351.1	1022.6
1962	241.8	323.6	0.0	145.5	16.4	0.0	0.0	0.2	16.7	137.9	103.4	270.8	1256.3
1963	187.5	352.0	134.9	200.0	86.7	0.0	0.0	0.0	5.0	56.8	127.5	333.3	1483.7
1964	417.1	276.8	196.3	130.2	45.9	0.0	0.0	0.0	0.0	108.7	247.8	162.2	1585.0
1965				145.3	0.0	0.0	0.0	0.0	0.2	343.7	342.1	176.7	
1966	216.5	299.5	173.5	175.9	41.9	0.0	0.0	0.0	52.1	160.7	151.8	332.4	1604.3
1967	140.9	229.1	266.6	241.6	6.6	2.5	0.0	0.0	85.6	119.6	219.7	30.3	1342.5
1968	228.3	457.5	206.4	109.9	125.3	0.0	0.0	1.0	8.6	105.3	469.7	242.9	1954.9
1969	231.7	246.3	201.6	81.7	81.7	0.0	1.5	29.4	34.4	189.4	96.0	353.9	1547.6
1970	306.6	160.8	319.6	77.0	0.0	0.0	0.0	0.0	30.2	151.4	154.0	122.3	1321.9
1971	84.9	117.2	149.6	105.7	10.2	48.8	0.0	0.0	10.8	303.9	140.1	162.9	1134.1
1972	93.1	143.5	300.9	148.1	3.0	1.8	75.8	8.1	34.4	167.4	132.8	314.3	1423.2
1973	169.3	274.3	299.8	134.2	117.5	23.4	3.2	18.5	64.0	267.6	122.5	239.6	1733.9
1974	144.0	143.3	269.9	158.2	37.2	7.7	0.0	13.2	11.7	137.7	269.1	348.2	1540.2
1975	292.0	410.2	287.0	196.3	60.4	0.0	18.3	0.0	7.3	111.6	315.6	138.1	1836.8
1976	152.5	249.6	179.2	68.6	98.0	0.0	0.0	0.0	97.2	305.9	243.7	109.3	1504.0
1977	254.0	218.7	199.9	174.6	78.9	12.7	0.0	2.6	88.2	141.4			
1978	284.1	429.7	194.9	100.6	50.7	50.0	15.9	0.0		179.7	199.6	314.6	
1979	228.4	301.5	318.7	137.0	4.4	0.0	0.0	22.2	93.6	88.1	155.9	161.2	1511.0
1980	353.2	480.9	178.4	59.1	1.2		0.0	0.0	58.2	82.7	301.0	272.6	
1981	265.8	184.1	425.5	150.9	4.6	17.3	4.1	1.2	0.0	154.4	247.1	138.1	1593.1
1982	418.7	232.8	258.4	94.6	4.2	0.0	0.0	5.0	87.5	112.6	117.0	219.6	1550.4
1983	289.6	330.9	316.1	13.2	8.2	0.0	0.0	0.0	39.7	194.5	243.5	167.8	1603.5
1984	118.1	184.5	261.6	329.6	14.7	0.0	3.5	2.2	59.5	184.1	83.7	169.7	1411.2
1985	424.3	251.6	329.5	187.8	80.6	0.0	11.7	19.2	168.5	333.8	208.5	511.5	2527.0
1986	218.1	338.8	301.0	99.0	18.7	1.0	0.0	23.4	27.2	197.4	160.4	261.8	1646.8
1987	256.4	144.2	350.2	203.9	46.1	0.0	0.0	0.0	120.0	148.0	187.8	307.3	1763.9
1988	156.8	230.9	228.5	284.0	36.9	0.0	0.0	0.0	13.4	137.3	157.0	214.9	1459.7
1989	285.2	172.7	267.6	168.5		0.2	0.0	23.1	28.8	220.7	297.0		
1990													
1991													
1992													
1993													
1994													
1995													
Max.	424.3	480.9	431.6	329.6	125.3	50.0	75.8	29.4	168.5	343.7	537.3	516.5	2527.0
Average	240.5	241.8	253.1	148.7	36.2	4.3	4.0	4.1	40.3	150.9	203.0	254.1	1557.0
Min.	84.9	0.0	0.0	13.2	0.0	0.0	0.0	0.0	0.0	49.9	67.9	30.3	1022.6
Med.	247.9	246.4	265.9	145.3	25.1	0.0	0.0	0.0	27.7	137.7	173.3	250.2	1543.9
Stdes	91.8	102.1	88.9	67.9	36.3	11.6	13.1	8.3	40.7	74.7	102.1	114.3	281.1

Station: PORTO LEMOS Local: AGUA CLARA

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
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1958													
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1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983													
1984													
1985						39.4	14.9	4.0	47.2	250.9	163.3	505.1	
1986	139.3	212.1	249.8	271.5	8.0	62.5	0.0	7.0	204.8	238.2	99.7	84.2	1577.1
1987	54.0	162.3	175.0	147.1	39.8	0.0	0.0	52.5		103.8			
1988	56.1	176.2	141.6	90.2	19.6	10.6	7.6	8.2	69.3	131.9	54.8	53.3	819.6
1989	14.0	36.7	99.4	186.9	23.7	11.8	11.7	18.4	4.7	37.1	40.1	401.7	886.2
1990	29.2	148.5	150.7	199.4	56.8	2.2	54.0	7.5	18.1	118.5	83.7	208.2	1076.8
1991	270.1	116.0	374.4	210.3	167.0	15.2	0.0	0.0	30.7	25.3	54.9	152.7	1416.6
1992	88.1										68.6	152.3	
1993	74.0	444.4	104.5	204.5	41.2	25.2	5.7	140.1	71.0	149.9	147.5	330.7	1738.7
1994	154.2	303.0	353.8	265.9	158.7	74.7	0.0	2.8	84.6				
1995													
Max.	270.1	444.4	374.4	271.5	167.0	74.7	54.0	140.1	204.8	250.9	163.3	505.1	1738.7
Average	97.7	199.9	206.2	197.0	64.4	26.8	10.5	26.7	66.3	132.0	89.1	236.0	1252.5
Min.	14.0	36.7	99.4	90.2	8.0	0.0	0.0	0.0	4.7	25.3	40.1	53.3	819.6
Med.	74.0	169.3	162.9	202.0	40.5	15.2	5.7	7.5	58.3	125.2	76.2	180.5	1246.7
Stdes.	79.6	124.7	108.2	59.2	62.6	26.6	17.3	45.4	62.4	82.0	45.1	160.3	379.8

Station: POCO DE PEDRA Local:

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
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1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983													
1984		77.9	244.5	203.3	18.5	0.0	0.0	12.0	90.0	309.0	177.4	286.6	
1985	446.2	250.8	236.0	116.0	38.0	0.0	0.0						
1986	138.8	218.4											
1987		283.4		59.6									
1988													
1989													
1990													
1991													
1992													
1993													
1994													
1995													
Max.	446.2	283.4	244.5	203.3	38.0	0.0	0.0	12.0	90.0	309.0	177.4	286.6	
Average	292.5	207.6	240.3	126.3	28.3	0.0	0.0	12.0	90.0	309.0	177.4	286.6	
Min.	138.8	77.9	236.0	59.6	18.5	0.0	0.0	12.0	90.0	309.0	177.4	286.6	
Med.	292.5	234.6	240.3	116.0	28.3	0.0	0.0	12.0	90.0	309.0	177.4	286.6	
Stdes	217.4	90.5	6.0	72.4	13.8	0.0	0.0						

Station: PEDRO AFONSO Local: ABELARDO LUZ

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
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1964													
1965													
1966													
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1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981							0.0	2.1	0.0	169.3	191.6	182.9	
1982	420.2	78.5	304.6	189.1	0.0	0.0	0.0	5.0	127.8	131.7	202.7	362.0	1821.6
1983	449.9		269.5	39.1	0.3	0.0	0.0	9.7	61.1	169.4	212.9	203.9	
1984	93.7	318.6	240.5	172.2	14.5	0.0	0.0	20.7	28.3	92.5	83.9	176.8	1241.7
1985	640.1	303.6	265.9	147.2	46.6	4.8	1.0	2.3	85.6	215.9	308.7	459.8	2481.5
1986	213.1	321.0	390.7	213.9	31.3	0.0	0.0	90.4	8.2	262.5	204.3	224.2	1959.6
1987	117.9	198.9		167.3	6.5				42.7	169.1	346.8	220.5	
1988	265.6	146.5	141.6	292.8	0.0	19.2	0.0	0.0	6.7	324.9	145.3	169.5	1512.1
1989	288.1	292.3	165.9	229.5	102.8	31.1	8.6	26.6	72.7	184.1	310.8	535.6	2248.1
1990													
1991													
1992													
1993													
1994													
1995													
Max.	640.1	321.0	390.7	292.8	102.8	31.1	8.6	90.4	127.8	324.9	346.8	535.6	2481.5
Aver.	311.1	237.1	254.1	181.4	25.3	7.9	1.2	19.6	48.1	191.0	223.0	281.7	1877.4
Min.	93.7	78.5	141.6	39.1	0.0	0.0	0.0	0.0	0.0	92.5	83.9	169.5	1241.7
Med.	276.9	292.3	265.9	180.7	10.5	0.0	0.0	7.4	42.7	169.4	204.3	220.5	1890.6
Stdes	183.7	96.6	83.9	73.2	35.6	12.4	3.0	30.2	42.7	69.2	84.9	136.5	458.2

Station: PALMEIROPOLIS Local: ADAMANTINA

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
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1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978			195.9	90.1	1.4	0.8	26.8	0.0	1.0	87.8	77.2	133.1	
1979	140.6	158.7	107.5	26.4	1.9	0.0	0.0	52.9	16.4	90.8	169.9	178.7	943.8
1980	295.0	769.0	51.2	117.4	9.3	0.0	0.0	0.0	56.4	44.8	357.2	452.3	2152.6
1981	463.1	66.0	295.8	85.9	5.8	44.8	0.0	1.1	4.8	185.1	303.8	323.5	1779.7
1982	474.4	113.1	203.5	29.1	0.0	0.0	0.0	6.0	14.1	17.7	103.6	176.8	1138.3
1983	345.4	241.9	162.9	53.1	1.8	0.0	0.0	0.0	9.6	102.5	316.5	308.0	1541.7
1984	182.8	113.0	158.0	127.1	18.4	0.0	0.0	21.6	46.8	147.6	131.6	135.7	1082.6
1985	536.1	128.5	344.5	78.5	5.9	0.0	0.0	0.1	20.7	157.5	194.9	601.1	2067.8
1986	296.0	223.5	215.8	79.2	0.0	0.0	0.0	22.4	12.6	94.4	217.0	396.8	1557.7
1987	166.4	165.1	480.6	129.1	0.0	0.0	0.0	0.0	37.4	139.0	228.2	169.7	1515.5
1988													
1989	323.3	265.5	160.6	160.9	21.3	0.0	2.2	0.0	34.9	103.5	644.6	683.4	2400.2
1990	75.8	460.2	55.4	18.0	71.7	0.0	1.3	6.0	36.6	70.1	98.1	284.0	1177.2
1991	218.6	208.5	235.5	104.9	2.5	0.0	0.0	0.0	95.2	87.3	239.6	255.7	1447.8
1992	516.6	301.0	78.9	67.1	0.0	0.0	0.0	0.0	46.6	106.8	203.2	457.7	1777.9
1993		110.8	79.8	149.3	98.2	0.0	0.0	6.1	97.7	29.7	285.3	213.7	
1994	500.3	358.2	203.5	136.3	4.8	52.3	0.0	0.0					
1995													
Max.	536.1	769.0	480.6	160.9	98.2	52.3	26.8	52.9	97.7	185.1	644.6	683.4	2400.2
Aver.	323.9	245.5	189.3	90.8	15.2	6.1	1.9	7.3	35.4	97.6	238.0	318.0	1583.3
Min.	75.8	66.0	51.2	18.0	0.0	0.0	0.0	0.0	1.0	17.7	77.2	133.1	943.8
Med.	309.7	208.5	179.4	88.0	3.7	0.0	0.0	0.1	34.9	94.4	217.0	284.0	1541.7
Stdes	154.0	179.5	113.7	44.5	28.4	16.6	6.7	14.2	29.9	46.6	140.2	169.5	442.6

Station: PALMEIRANTE Local: ABELARDO LUZ

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
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1982													
1983													
1984		160.9	240.9	374.0	27.1	18.0	0.0	5.5	173.7	133.2	134.6	86.7	
1985	656.9	224.9	178.8	415.6	120.2	4.5	5.0	5.6	70.3	177.8	326.2	419.6	2605.4
1986	172.1	209.9	452.2	184.2	20.0	0.0	0.0	0.0	25.2	269.2	133.6	214.1	1680.5
1987	251.3	123.9	317.8	93.5	28.6	0.0	0.0	3.0	59.5	94.6	122.5	152.7	1247.4
1988	242.7	187.6	279.0	241.0	21.6	17.1	0.0	0.0	15.6	151.3		196.6	
1989	104.0	108.5	379.2			17.3	15.0	8.3	17.1	88.8	249.8	241.2	
1990		266.7	228.5	52.3	18.3							113.9	
1991	201.6	100.7	332.7	91.5	17.6	0.0	0.0	0.0	65.7	0.0	68.8	58.6	937.2
1992	158.4											226.5	
1993	95.7	158.0	112.4	222.0	45.2	16.1	0.0	23.6	28.2	51.8		196.5	
1994	452.7		297.5	140.5	30.0	26.5	0.0	0.0	108.2	140.7			
1995													
Max.	656.9	266.7	452.2	415.6	120.2	26.5	15.0	23.6	173.7	269.2	326.2	419.6	2605.4
Aver.	259.5	171.2	281.9	201.6	36.5	11.1	2.2	5.1	62.6	123.0	172.6	190.6	1617.6
Min.	95.7	100.7	112.4	52.3	17.6	0.0	0.0	0.0	15.6	0.0	68.8	58.6	937.2
Med	201.6	160.9	288.3	184.2	27.1	16.1	0.0	3.0	59.5	133.2	134.1	196.6	1464.0
Stdes	183.0	56.1	98.0	126.3	32.5	10.0	5.1	7.6	51.7	77.3	95.7	101.4	725.6

Station: PRAIA ALTA Local:

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
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1975													
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1978													
1979													
1980													
1981													
1982													
1983													
1984													
1985													
1986						0.0	0.2	3.8	47.1	120.1	147.8	127.6	
1987	215.5	104.5	274.2	61.6	24.4	0.0	0.0	0.0	37.1	143.4	205.1	359.1	1424.9
1988	108.2	174.3	335.2	91.6	6.6	10.8	0.0	0.0	54.1	196.5	99.2	313.8	1390.3
1989	139.1	178.9	312.9	88.5	31.3	2.7	0.9	6.3	48.7	123.6	243.1	305.7	1481.7
1990	240.0	132.9	41.2				0.0	32.0	40.4	33.6	164.3	123.1	807.5
1991	391.8	359.6	395.9	147.5	0.0	0.0	0.0	0.0	23.6	3.9	112.0	225.3	1659.6
1992												162.5	
1993	142.5	329.8	188.6	182.1	22.8	0.0	0.0	13.3	26.9	91.1	115.1	426.4	1538.6
1994	238.7	206.7	136.3	156.0	11.7	3.7	0.0	0.0	98.7	42.3			
1995													
Max.	391.8	359.6	395.9	182.1	31.3	10.8	0.9	32.0	98.7	196.5	243.1	426.4	1659.6
Aver.	210.8	212.4	240.6	121.2	16.1	2.5	0.1	6.9	47.1	94.3	155.2	255.4	1383.8
Min.	108.2	104.5	41.2	61.6	0.0	0.0	0.0	0.0	23.6	3.9	99.2	123.1	807.5
Med.	215.5	178.9	274.2	119.6	17.3	0.0	0.0	1.9	43.8	105.6	147.8	265.5	1453.3
Stdes	95.5	96.6	124.3	47.1	11.9	4.0	0.3	11.2	23.4	64.3	53.2	113.0	297.8

Station: TAGUATINGA 1 Local: LUPERCIO

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960	433.6	247.5	481.7	16.3	0.0	0.0	0.0	0.0	25.5	49.2	260.1		
1961				0.0	0.0	0.0	0.0	0.0	0.0	40.0	45.2		
1962	217.8	224.1	219.6	149.2	9.4	0.0	0.0	0.0	27.9	157.9	0.0	330.0	1335.9
1963	247.5	251.9	132.8	0.0	51.0	0.0	0.0	0.0	0.0	12.6	144.3	126.3	966.4
1964	682.4	269.0	229.9	119.0	18.5	0.0	2.0	0.0	6.3	148.5	273.9	155.6	1905.1
1965	350.9	147.2	299.7	73.3	7.2	3.1	7.2	0.0	0.0	181.0	155.7	262.4	1487.7
1966	269.6	247.0	243.8	240.5	0.0	0.0	0.0	0.0	21.6	113.6	218.7	301.8	1656.6
1967	76.6	242.4	273.0	105.2	0.0	3.4	0.0	0.0	32.1			301.6	
1968	169.0	434.1	234.6	86.0	15.5	0.0	0.0	10.7	45.7	83.8	289.1	447.9	1816.4
1969	193.3	241.5	111.3	75.0	20.8	0.0	0.0	28.6	5.5	97.6	202.9	510.3	1486.8
1970	472.9	253.7	170.4	189.8	0.0	0.0	0.0	0.0	29.0	123.2	215.6	115.2	1569.8
1971	198.6	193.8	217.6	301.0	3.2	1.2	0.0	0.0	0.6	104.1	294.3	288.9	1603.3
1972	215.3	290.1	129.7	3.0	0.0	0.0	0.0	0.0					
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	325.8	267.6	196.3	789.7
1974	370.2	241.4	446.0	152.1	93.0	0.0	0.0	6.0	0.0	234.9	324.3	223.5	2091.4
1975	316.8	222.0	176.2	116.8	3.2	0.0	1.6	0.0	3.0	226.4	270.1	159.4	1495.5
1976	159.4	338.8	123.6	114.1	61.9	0.0	0.0	0.0	109.8	197.8	397.1	206.3	1708.8
1977	379.3	314.7	243.2	84.2	29.0	26.6	0.0	0.0					
1978													
1979													
1980													
1981													
1982													
1983													
1984	294.4	163.4		104.9	21.6	0.0			41.4	151.2	96.2	231.5	
1985	561.3		227.1	310.9	16.9	0.0	0.0	0.0	44.2	248.2	185.6	452.7	
1986	287.7	240.5	221.7	165.4	2.3	0.0	1.3	4.5	9.2	112.6	65.6		
1987	95.0	83.1		179.3	13.1	0.0	0.0	0.0	16.3	28.3	303.6	438.0	
1988	228.1	352.9	330.2	72.5	2.5	0.0	0.0	0.0	0.0	144.4	152.0	476.0	1758.6
1989	113.7	154.3	142.4	106.6	20.2	3.0	14.1	0.0	10.0	138.2	316.4	606.1	1625.0
1990													
1991													
1992													
1993													
1994													
1995													
Max.	682.4	434.1	481.7	310.9	93.0	26.6	14.1	28.6	109.8	325.8	397.1	606.1	2091.4
Aver.	275.4	234.2	221.6	115.2	16.2	1.6	1.1	2.2	19.5	139.0	213.3	306.8	1553.1
Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	0.0	115.2	789.7
Med.	247.5	242.0	221.7	105.9	8.3	0.0	0.0	0.0	9.6	138.2	218.7	288.9	1603.3
Stdes	159.6	91.4	109.1	86.7	23.0	5.4	3.2	6.3	25.6	78.5	102.8	143.3	333.2

Station: S.SEBASTIAO DO TO Local: ABELARDO LUZ

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
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1981													
1982													
1983													
1984		287.1	352.3	265.1	155.1	1.6	6.3	5.5	54.6	66.3		132.0	
1985	542.8	458.5	334.2	262.9	96.5	17.8	0.1	0.0	106.7	131.6	254.3	333.4	2538.8
1986	240.4	324.8		600.7	18.0	169.2	0.0	2.8	3.2	201.3	124.3	362.3	
1987	115.2	183.3	314.6	74.0	42.0	14.5	0.0	0.0	66.8	17.2			
1988	168.5	180.9	358.0	259.0	16.1	28.1	1.3	0.0	24.9	59.3	341.0	211.1	1648.2
1989	93.3	279.4	330.1	420.6	142.8	29.0	10.2	12.9	40.6	80.4	217.4	269.7	1926.4
1990	60.2	312.8	137.4	89.3	7.9	0.4	61.9	0.0	138.3	142.2	50.9	116.7	1118.0
1991	249.0	87.4	118.2	216.6	76.4	0.0	0.0	0.0	0.0	31.4	58.2	135.3	972.5
1992	252.7	358.0										128.8	
1993	217.9	205.7	174.5	40.9	38.4	0.0	1.1	26.1	62.6	79.6	91.2	415.7	1353.7
1994	262.7	208.5	481.2	167.5	59.3	60.6	12.0	0.0	1.1				
1995													
Max.	542.8	458.5	481.2	600.7	155.1	169.2	61.9	26.1	138.3	201.3	341.0	415.7	2538.8
Aver.	220.3	262.4	288.9	239.7	65.3	32.1	9.3	4.7	49.9	89.9	162.5	233.9	1592.9
Min.	60.2	87.4	118.2	40.9	7.9	0.0	0.0	0.0	0.0	17.2	50.9	116.7	972.5
Med.	229.2	279.4	330.1	237.8	50.7	16.2	1.2	0.0	47.6	79.6	124.3	211.1	1501.0
Stdes	134.8	102.3	120.1	169.9	52.1	51.8	19.0	8.6	46.3	58.4	110.4	115.2	579.1

Station: PONTE RIO PIRANHAS Local: ABELARDO LUZ

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
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1966													
1967													
1968													
1969													
1970													
1971													
1972													
1973													
1974							0.0	18.4					
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983													
1984													
1985													
1986													
1987													
1988													
1989													
1990													
1991													
1992													
1993													
1994													
1995													
Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	0.0	0.0	0.0	0.0	
Aver.	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.0	18.4	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	0.0	0.0	0.0	0.0	
Med	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	0.0	18.4	#NUM!	#NUM!	#NUM!	#NUM!	
Stdes	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	

Station: PIUM Local:

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
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1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983		349.6	239.2	32.9	34.3	0.0	0.0	0.0	54.4	236.0	318.1	362.4	
1984	230.6	216.2	330.5	190.1	57.8	9.2	0.0	23.9	87.4	124.4	173.2	222.9	1666.2
1985	437.8	212.1	444.0	347.6	140.5	0.0	21.8	0.0	24.6	335.2	254.6	408.9	2627.1
1986	485.0	360.2	344.0	263.8	40.6	12.4	0.0	57.4	33.0	252.5	245.2	277.2	2371.3
1987	271.2	155.2	413.6	192.9	5.8	0.0	0.0	13.5	63.1	100.5	361.4	349.6	1926.8
1988													
1989	219.1	235.8	405.2	196.8	96.3	17.9	0.0	6.8	97.7	138.4	420.7	559.3	2394.0
1990	315.6	279.3	227.5	64.0	216.3	0.0	18.4	3.5	65.0	65.4	141.3	225.6	1621.9
1991	367.6	214.2	252.6	89.6	53.1	0.0	0.0	0.0	33.8	29.3	408.7	285.1	1734.0
1992	395.3	506.6	194.7	107.3	30.4	0.0	0.0	0.0	28.3	363.5	313.9	487.0	2427.0
1993	141.4	292.3	232.8	86.5	101.3	0.0	0.0					278.2	
1994	359.9	215.8	183.7	222.3	50.8	55.2	0.0	0.0					
1995													
Max.	485.0	506.6	444.0	347.6	216.3	55.2	21.8	57.4	97.7	363.5	420.7	559.3	2627.1
Aver.	322.4	276.1	297.1	163.1	75.2	8.6	3.7	10.5	54.1	182.8	293.0	345.6	2096.0
Min.	141.4	155.2	183.7	32.9	5.8	0.0	0.0	0.0	24.6	29.3	141.3	222.9	1621.9
Med	337.8	235.8	252.6	190.1	53.1	0.0	0.0	1.8	54.4	138.4	313.9	317.4	2149.1
Stdes	107.0	98.6	93.7	95.7	60.3	16.7	8.2	18.3	26.5	118.9	97.8	111.7	401.0

Station: PEIXE Local: ABATIA

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
1963													
1964													
1965													
1966													
1967													
1968													
1969													
1970				49.3	4.5	4.7	0.0	0.0	27.3	207.7	210.1	105.4	
1971	136.0	183.7	334.2	222.0	20.0	19.3	0.0	0.0	52.2	116.8	397.1	314.9	1796.2
1972	170.2	194.8	97.9	82.1	58.4	0.0	0.0	9.0	76.6	100.0	209.8	414.7	1413.5
1973	268.3	272.1	133.6	130.6	10.0	29.8	0.0	0.0	19.1	165.6	249.8	164.2	1443.1
1974	309.2	163.4	303.4	177.8	29.0	0.0	0.0	0.0	2.8	173.9	227.5	194.6	1581.6
1975	177.7	259.4	213.2	91.7	40.9	0.0	6.1	0.0	3.3	181.9	233.2	236.9	1444.3
1976	58.1	287.3	127.5	49.9	27.4	0.0	0.0	0.0	98.2	110.1	423.1	235.6	1417.2
1977		223.2	112.7	291.0	21.9	2.5	0.0	4.5	55.3		191.0	305.3	
1978	238.2	495.3	216.9	116.4	176.1	13.0	35.0	0.0	19.6	93.3	198.6	236.7	1839.1
1979	322.0	250.2	124.0	66.2	1.4	0.0	0.0	43.8	72.1	108.0	134.3	165.5	1287.5
1980	316.0	551.6	134.8	70.8	0.5	0.0	0.0	0.0	34.9	94.6	293.4	394.8	1891.4
1981	306.2	101.6	303.7	70.9	0.3	40.0	0.0	0.2	0.0	175.8	216.8	118.5	1334.0
1982	484.7	111.6	249.0	123.3	0.0	0.0	0.0	0.0	85.6	159.6		140.8	
1983	293.4	256.7	435.4	79.8	21.3	0.0	0.0	0.0	11.2	104.9	261.6	244.1	1708.4
1984	195.8	115.2	294.6	132.1	35.4	0.0	0.0	0.3	22.9	193.7	187.4	186.4	1363.8
1985	500.7	184.0	172.6	116.2	20.0	0.0	0.0	0.1	2.8	142.3	179.1	340.5	1658.3
1986	290.2	243.8	292.1	85.7	30.1	0.0	1.8	3.9	8.3	135.2	149.9	217.8	1458.8
1987	120.8				7.2	0.0	0.0	0.0	30.7	33.8	183.5	332.6	
1988	334.4	246.7	292.8	201.7	8.9	2.3	0.0	0.0	12.8	207.0	190.2	464.2	1961.0
1989	342.2	156.6	205.0	135.1	8.2	7.8	18.8	9.1	19.1	143.0	217.0	683.5	1945.4
1990													
1991													
1992													
1993													
1994													
1995													
Max.	500.7	551.6	435.4	291.0	176.1	40.0	35.0	43.8	98.2	207.7	423.1	683.5	1961.0
Aver.	270.2	238.7	224.6	120.7	26.1	6.0	3.1	3.5	32.7	139.3	229.1	274.9	1596.5
Min.	58.1	101.6	97.9	49.3	0.0	0.0	0.0	0.0	0.0	33.8	134.3	105.4	1287.5
Med.	291.8	233.5	215.1	116.2	20.0	0.0	0.0	0.0	21.3	142.3	210.1	236.8	1520.2
Stdes	115.7	118.6	94.4	63.6	38.6	11.3	8.7	9.9	30.2	46.0	73.8	138.6	231.9

Station: NATIVIDADE Local: PONTA GROSSA

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
1963													
1964													
1965													
1966													
1967													
1968													
1969													
1970													
1971													
1972													
1973									25.7	229.1	194.9	166.5	
1974	217.8	250.8	311.3	187.8	15.5	7.3	0.0	0.2	33.4	308.4	270.2	252.9	1855.6
1975	229.5	222.8	288.3	59.0	88.4	0.0	8.2	0.0	0.0	168.8	280.9	91.8	1437.7
1976	114.2	257.7	128.8	52.1	28.1	0.0	0.0	4.0	140.8	197.7	251.1	206.4	1380.9
1977	459.5	226.9	131.7	170.1		0.1	0.0	2.7	48.2		166.6	334.8	
1978	356.9	492.7	263.4	100.9	82.3	29.9	43.8	0.0	10.1	148.8	191.8	241.7	1962.3
1979	414.3	443.0	181.5	85.0	47.9	0.0	0.0	71.8	48.3	72.7	208.7	181.2	1754.4
1980	403.4	505.8	214.1	181.1	22.9	0.0	0.0	0.0	30.2	24.0	381.2	599.1	2361.8
1981	456.0	68.0		72.9	0.0	116.2	0.4	0.4		273.1	257.7	167.0	
1982	414.1	165.1	179.7	54.7		0.0	0.0	1.0	47.8	136.3	245.1	170.5	
1983	359.0	171.1	294.5	43.7	0.0	0.0	0.0	4.7	0.5	118.6	121.0	246.3	1359.4
1984	106.2		408.3	144.3	12.0	0.0	0.0	29.5	29.9			226.4	
1985											249.6		
1986								33.4	28.9	303.8			
1987		133.9								171.0	179.5		
1988	319.9	248.4			2.6	33.6							
1989	322.1	181.3			25.7	0.5	7.6						
1990	142.0	308.4										298.6	
1991				214.3									
1992	512.3	248.2	112.8	109.3	6.3	5.0			85.1	73.1	219.6	437.6	
1993	158.7		62.5										
1994													
1995													
Max.	512.3	505.8	408.3	214.3	88.4	116.2	43.8	71.8	140.8	308.4	381.2	599.1	2361.8
Aver.	311.6	261.6	214.7	113.5	27.6	13.8	5.0	12.3	40.7	171.2	229.9	258.6	1730.3
Min.	106.2	68.0	62.5	43.7	0.0	0.0	0.0	0.0	0.0	24.0	121.0	91.8	1359.4
Med.	339.5	248.2	197.8	100.9	19.2	0.1	0.0	1.9	30.2	168.8	232.4	234.1	1754.4
Stdes	133.1	127.9	100.5	59.2	30.3	31.6	12.6	22.1	37.6	89.6	62.4	129.5	368.4

Station: MANSINHA Local:

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
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1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983		256.0	252.7	4.8	0.0	0.0	0.0	0.0	23.5	159.1	256.0	279.4	
1984	104.3	273.0	355.3	155.2	12.0	0.0	3.0	10.0	64.6	127.3	78.4	112.0	1295.1
1985	363.7	179.9	213.3	295.0	142.8	3.0	17.5	0.0	50.5	193.8	345.0	394.3	2198.8
1986	208.1	199.7	335.4	223.1	12.5	0.0	0.0	0.0	8.5	194.0	133.7	232.2	1547.2
1987	197.8	363.8	294.1	249.2	38.7	0.0	0.0	5.0	48.0	54.2	204.0	295.2	1750.0
1988	212.2	304.5	348.5	301.4	0.0	11.0	0.0	0.0	84.1	147.4	168.3	202.9	1780.3
1989	255.2	222.1	300.3	231.2	132.9	29.6	36.5	0.0	14.8	190.2	154.3	739.9	2307.0
1990	173.7	287.3	260.7	70.5	77.5	0.0	0.0	17.5	35.0	116.9	52.6	188.7	1280.4
1991	390.0	176.0	211.0	126.0	16.0	0.0	0.0	0.0	28.5	46.5	176.1	189.3	1359.4
1992	316.0	424.5	62.5	54.5	13.0	0.0	0.0	0.0	38.5	113.0	182.5	360.0	1564.5
1993	113.3	513.2	152.7	151.5	19.1	0.0	0.0	4.0	159.5	118.0	121.5	427.5	1780.3
1994	325.5	233.5	424.5	236.0	20.0	2.5	0.0	0.0					
1995													
Max.	390.0	513.2	424.5	301.4	142.8	29.6	36.5	17.5	159.5	194.0	345.0	739.9	2307.0
Aver.	241.8	286.1	267.6	174.9	40.4	3.8	4.8	3.0	50.5	132.8	170.2	311.0	1686.3
Min.	104.3	176.0	62.5	4.8	0.0	0.0	0.0	0.0	8.5	46.5	52.6	112.0	1280.4
Med.	212.2	264.5	277.4	189.2	17.6	0.0	0.0	0.0	38.5	127.3	168.3	279.4	1657.3
Stdes	96.7	102.7	98.6	96.7	50.0	8.7	11.2	5.5	42.3	51.2	80.9	171.9	354.1

Station: LIZARDA Local:

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
1963													
1964													
1965													
1966													
1967													
1968													
1969													
1970													
1971													
1972													
1973					94.5	1.4	0.0	0.8	10.0	248.6	208.2	160.6	
1974	347.5	278.0	286.6	164.6	140.8	17.0	0.0	7.5	5.8	180.8	254.5	281.0	1964.1
1975	149.5	169.5	246.4	203.7	8.0	0.0	4.9	0.0	14.2	219.9	184.9	155.7	1356.7
1976	186.9	284.4	132.7	127.0	37.4	0.0	0.0	9.2	58.0	195.8	286.8	233.2	1551.4
1977	409.2	136.2	145.4	168.8	68.6	11.4	0.0	24.6					
1978													
1979													
1980													
1981													
1982													
1983													
1984		164.0	263.1	101.9	0.6	0.9	0.9	3.9	62.4	145.5	58.4	158.2	
1985	406.3	212.5	173.7	170.9	84.7	0.0	0.0	0.3	51.9	266.2	342.7	415.5	2124.7
1986	320.1	152.0	228.3	196.4	5.2	0.0	0.0	0.0	6.4	146.2	96.6	170.1	1321.3
1987	198.5		258.7	91.5	34.7	0.0	0.0	0.0	3.7	89.8	320.2	258.4	
1988	416.9	220.5	185.9	138.4	1.0	11.3	0.0	0.0	12.5	150.0	59.5	268.3	1464.3
1989	199.9	219.7	236.5	239.8	76.9	9.3	5.4	38.5	55.9	58.2	311.7	676.9	2128.7
1990	160.5	377.3	328.6	67.5	36.0	0.0	0.0	8.1	15.2	96.0	112.1	280.6	1481.9
1991	529.8	178.2	341.3	112.5	1.4	0.0	0.0	0.0	62.1	173.8	205.0	206.5	1810.6
1992	357.3	356.8	128.2	87.5	104.3	0.0	0.0	0.0	29.2	143.2	252.4	386.0	1844.9
1993	144.3	209.6	123.4	92.1	42.2	0.0	0.0	15.0	125.5	58.3	122.2	207.8	1140.4
1994	317.3	292.4	263.6	181.8	11.2	4.1	3.2	0.0					
1995													
Max.	529.8	377.3	341.3	239.8	140.8	17.0	5.4	38.5	125.5	266.2	342.7	676.9	2128.7
Aver.	296.0	232.2	222.8	143.0	46.7	3.5	0.9	6.7	36.6	155.2	201.1	275.6	1653.5
Min.	144.3	136.2	123.4	67.5	0.6	0.0	0.0	0.0	3.7	58.2	58.4	155.7	1140.4
Med	318.7	216.1	236.5	138.4	36.7	0.0	0.0	0.6	22.2	148.1	206.6	245.8	1551.4
Stdes	122.5	75.1	71.4	50.9	43.5	5.5	1.8	11.0	34.6	64.9	98.1	140.6	338.1

Station: GUARAI Local: ABELARDO LUZ

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
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1964													
1965													
1966													
1967													
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978										201.3	276.0	223.4	
1979	412.7	336.1	321.1	209.7	13.0	0.0	0.0	43.0	69.8	122.9	132.3	252.5	1913.1
1980	441.7	604.5	134.8	119.6	0.0	0.0	0.0	0.0	107.9	138.2	267.0		
1981	344.7	104.4	271.5	12.0	6.3	56.4	0.0	0.0	0.0	212.4	332.9	148.5	1489.1
1982		212.0	263.9	258.4	9.3	0.0	0.0	0.0	135.2	96.2	210.2	345.5	
1983	374.8	149.6	274.2	24.2	5.8	0.0	0.0	1.8	126.6	158.0	259.8	311.8	1686.6
1984	105.2	285.6	305.4	202.0	6.1	0.0	0.0	11.2	39.4	251.2	86.6	362.6	1655.3
1985	405.0	324.5	211.8	302.3	76.5	3.2	1.0	5.2	77.6	206.5	283.8	591.8	2489.2
1986	486.8	447.4	390.2	179.0	3.2	0.0	0.3	25.6	54.8	311.1	57.9	204.7	2161.0
1987	277.2	508.4	413.4	198.1	57.8	3.2	0.0	14.2	87.2	41.6	369.2		
1988	243.8	164.0	232.2	218.3	0.1	13.6	0.0	0.0	7.3	190.5	233.8	263.6	1567.2
1989	420.6	216.6	248.4	212.9	118.6	2.6	11.6	13.6	140.5	86.4	187.2		
1990			131.0	50.2	90.8	0.0	31.4	4.2	108.2	269.8	141.2	163.8	
1991	483.2	110.8	358.5	135.8	39.2	0.0	0.0	0.0	25.0	23.2	221.5	243.1	1640.3
1992	315.4											302.4	
1993	61.6	263.8	304.5	79.0	4.6	0.0	0.0	4.8	130.4	250.8	200.0	225.2	1524.7
1994	298.2	423.2	250.5	136.7	24.1	64.2	0.0	0.0	0.0	205.2			
1995													
Max.	486.8	604.5	413.4	302.3	118.6	64.2	31.4	43.0	140.5	311.1	369.2	591.8	2489.2
Aver.	333.6	296.5	274.1	155.9	30.4	9.5	3.0	8.2	74.0	172.8	217.3	279.9	1791.8
Min.	61.6	104.4	131.0	12.0	0.0	0.0	0.0	0.0	0.0	23.2	57.9	148.5	1489.1
Med.	359.8	274.7	271.5	179.0	9.3	0.0	0.0	4.2	77.6	195.9	221.5	252.5	1655.3
Stdes	129.3	153.5	80.6	86.0	38.0	21.0	8.4	12.2	50.7	82.7	86.9	113.6	336.1

Station: FAZ. SANTA RITA Local: LUPERCIO

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
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1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983													
1984			325.2	41.1	17.3	0.0	0.0	0.8	0.0	167.4	116.2	144.7	
1985	439.8	188.1	91.6	68.4	48.8	0.0	0.0	0.0	11.1	175.6	109.7	549.8	1682.9
1986	459.4	196.9	144.4	35.9	0.0	0.0	0.0	0.0	6.4	89.8	127.6	139.0	1199.4
1987	70.6	71.9	95.7	15.2	1.8	0.0	0.0	0.0	0.0	14.3	110.9	273.3	653.7
1988	147.6	177.0	331.0	0.0	0.0	0.0	0.0	0.0	0.0				
1989													
1990													
1991						0.0	0.0	0.0	41.4	39.3	77.1	153.5	
1992	373.1	174.1	34.4	15.6	0.0	0.0	0.0	0.0	23.0	110.1	235.8	361.4	1327.5
1993	60.7	164.0	73.0	21.1	44.5	0.0	0.0	0.0	42.0	134.5	198.0	274.2	1012.0
1994	184.8	182.7	334.3	35.4	0.0	0.0	0.0						
1995													
Max.	459.4	196.9	334.3	68.4	48.8	0.0	0.0	0.8	42.0	175.6	235.8	549.8	1682.9
Aver.	248.0	165.0	178.7	29.1	14.1	0.0	0.0	0.1	15.5	104.4	139.3	270.8	1175.1
Min.	60.7	71.9	34.4	0.0	0.0	0.0	0.0	0.0	0.0	14.3	77.1	139.0	653.7
Med.	184.8	177.0	120.1	28.3	0.9	0.0	0.0	0.0	8.8	110.1	116.2	273.3	1199.4
Stdes	172.1	42.3	129.0	20.9	21.0	0.0	0.0	0.3	17.9	61.3	56.2	148.9	380.8

Station: CONCEICAO Local: S. FRANCISCO DO SUL

	Monthly Rainfall (mm)												Total
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anual
1949													
1950													
1951													
1952													
1953													
1954													
1955													
1956													
1957													
1958													
1959													
1960													
1961													
1962													
1963													
1964													
1965													
1966													
1967													
1968													
1969													
1970													
1971													
1972													
1973						15.9	60.6	8.2	42.5	302.2	245.3	200.1	
1974	256.4	211.0	290.4	240.0	145.4	3.6	0.0	23.6	54.4	198.0	213.7	209.4	1845.9
1975	331.0	336.0		45.6	34.2	11.7	0.0	0.0	3.4	76.9	28.3	64.8	
1976	62.5	76.3	73.3	71.4				5.4	21.2	55.0			
1977													
1978													
1979													
1980													
1981													
1982													
1983													
1984													
1985													
1986													
1987													
1988													
1989													
1990													
1991													
1992													
1993													
1994													
1995													
Max.	331.0	336.0	290.4	240.0	145.4	15.9	60.6	23.6	54.4	302.2	245.3	209.4	1845.9
Aver.	216.6	207.8	181.9	119.0	89.8	10.4	20.2	9.3	30.4	158.0	162.4	158.1	1845.9
Min.	62.5	76.3	73.3	45.6	34.2	3.6	0.0	0.0	3.4	55.0	28.3	64.8	1845.9
Med.	256.4	211.0	181.9	71.4	89.8	11.7	0.0	6.8	31.9	137.5	213.7	200.1	1845.9
Stdes	138.6	129.9	153.5	105.6	78.6	6.3	35.0	10.1	22.6	114.9	117.2	80.9	