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M02/92/012 Report 1A

LAND RESOURCES APPRAILSAL REPORT

DISTRICT OF XAI-XAI

Volume 1
MAIN REPORT

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1995

Maputo, Moçambique

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GLOSSARY

ALES	Automated Land Evaluation Software
DINAGECA	National Directorate of Geography and Cadaster
DPA	Provincial Directorate of Agriculture
DTA	Department of Land and Water
GIS	Geographic Information System
INIA	National Agriculture Research Institute
NGO	Non Governemental Organization
SCS	Soil Conservation Service
SEHA	Service of Agriculture Hydraulics
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture

1. INTRODUCTION

The Ministry of Agriculture of Mozambique is preparing a national agricultural development programme, specifically addressed to the family sector which represents about 90% of the rural population. A Pre-programme phase, which started in April 1993, is elaborating and testing methodological approaches in a few pilot districts. Successful methodologies are to be incorporated in the full-scale agricultural development programme. Land use planning is one of the main components of the Pre-programme. It is hosted by the Land and Water Department (DTA) of the National Institute for Agronomic Research (INIA).

The purpose of this study is to develop and test, in the district of Xai-Xai, a low cost participatory land resources appraisal methodology that provides an information base which may serve for land use planning as well as for farming systems research and extension.

The study shows that informal investigation techniques when used <u>together</u> with conventional land resources appraisal procedures, allow to understand farmers' land use strategy and to take into account their experience and aspirations. Indeed, in the conditions of subsistence agriculture, farmers' lives depend on delicate land use systems that must be well understood to avoid introducing disturbing innovations.

The field work and the reporting were done by A. Souirji, L. Amós, J. Mafalacusser and V. Lefebvre. The soil analyses were made by the staff of the laboratory section of DTA, while map production, including GIS operations, was done by the cartography and GIS section. The staff of the DPA of Xai-Xai have also made valuable contributions to this study.

This report is comprised of two volumes:

- **Volume I**, which is titled "Main Report", includes all the information that may be useful for readers who are not soil specialists.

- **Volume II** is titled "Typical pedons" and includes a collection of descriptions of representative soils of the district.

2. METHODOLOGY

2.1 Introduction

The methodology was developed after careful examination of the existing studies and methodologies, especially of their adequacy for the family sector. Farmers' knowledge and participation were given a particular importance.

2.2 Available information

2.2.1 Available soil information

When this study was started in April 1994, the most recent soil maps of the district were those published by DTA in 1992-1993. They are compilations at scale 1:250,000 and 1:50,000 of all the available information that could be found, complemented by minimal field investigations wherever the difficult war situation permitted. The maps legend and the accompanying report cover the Maputo province and a major part of the Gaza province.

These maps provide useful information, have the merit of covering a large part of the south of the country, and seem adequate for regional planning. However, due to the fact that they rely largely on existing data, their accuracy depends essentially on the quality and the geographical coverage of available soil maps. Therefore the following shortcomings for district level land use planning in the specific area of Xai-Xai were noted:

- about 3/4 of the district do not include any field observations
- the alluvial levees and terraces are not sufficiently accurately delineated in part of the plain
- the wetlands are grouped as one unit and no differentiation is made between peat soils and humic clays.
- the red earthy sands, locally called Giho, having a more favourable moisture regime than other sandy soils are not identified in the maps
- Vertisols, which are the dominant soils in the plain are not identified as such.
- the legend is not sufficiently detailed in term of slope in the sandy area, probably because of the very large area covered by the legend
- analytical data, which is necessary for land evaluation, is scarce.

We have also managed to assemble a collection of maps which were produced by Russian teams working for DINAGECA and the SEHA during the early eighties. They cover most of the alluvial plain at scale 1:25,000. They have the following shortcomings:

- except for 2 of the studies, no reports were found.
- texture analysis and classification are according to Russian standards e.g. clay is <1 micron and sand <1 mm, hence difficulty in correlation.
- the various maps and legends do not match. For instance some recognise Vertisols where other identify Fluvisols.
- some of the legends have missing symbols or are in Russian.
- some of the limits are unreliable.
- a small part of the plain and all the Serra are not covered.

However, these maps proved very useful, especially to get information for some swampy areas that we could not access. The differentiation between clayey and peaty wetlands is clearly indicated in these maps.

Also available were two soil studies done by consulting firms which cover smaller areas. One is the "Estudo de viabilidade e anteprojectos do complexo agroindustrial do Lumane" done by Geotecnica in 1981 in the northern part of the plain and part of the western Serra, between the road to Maputo and rio Lumane. The other is that of the "Projecto de Recuperacao do Machongo de Chongoene (Longue) em Xai-Xai", done by the consulting firm SANAQUA (1982), which concerns essentially the depression of Chongoene and its' surroundings.

It must be noted that none of the above-mentioned soil studies, which were not oriented toward the family sector, provides specific information about the local land management and soil classification system.

2.2.2 Available land evaluation information

The above mentioned soil maps published by DTA in 1992-1993, include land capability assessment for rainfed arable farming, grazing and forestry according to the USDA-SCS system, and for irrigation according to the USBR system. However, these systems do not take into account animal traction and hand tools-based agriculture which are practised in Mozambique. The same short-coming exists with all the other existing studies as they were all oriented towards commercial agriculture. The land evaluation systems available in DTA in April 1994 were:

- AEZ, which is not directly useable at 1:50,000, since little variation in climate occurs at that scale over the study area.

- A comprehensive set of ALES semi-quantitative models for individual crop suitability estimation. Attainable yields may be estimated, including under animal traction or hand tools-based agricultural systems for some crops. These models require further validation and refinement, as shown by some testing done earlier by DTA. Also, they cannot be used easily for the zonation of the district into management units as required for land use planning.

- ALES land capability model based on the USDA-SCS system, which as said earlier is not adapted to Mozambique.

- ALES land capability model for irrigated agriculture based on the USBR system.

- guidelines for land evaluation in the crystalline part of Mozambique (Voortman) which are partly and extension of the AEZ methodology. They do not apply to Xai-Xai area.

2.2.3 Available base documents

The following base documents were available:

- full coverage of topographic maps at scale 1:50,000 and 1:250,000.

- panchromatic aerial photographs at scale 1:40,000 of 1989 for the western and central part of the district and of 1958 for the eastern part.
- full coverage of panchromatic SPOT satellite imagery at scale 1:50,000 and false colour MSS LandSat imagery at scale 1:250,000.
- full coverage of geologic maps at scale 1:250,000.

2.3 Adopted methodology

2.3.1 Soil survey

Given the small-scale and scattering of individual plots, a soil map that would provide farm-level information, would have to be done at a fairly large scale, the cost of which would be prohibitive. Also, in small-scale agriculture, most development work is done at community level. Communities generally know well their natural resources and their location. Therefore, in this situation, mapping detail is of lesser importance. It was therefore felt that to gather global soil information on the districts and to produce a zonation into land management units (i.e. landscape units having similar productive potential and constraints), an exploratory[1] soil survey at scale 1:50,000 is sufficient.

The soil survey followed the morpho-pedological approach in order to speed-up the execution while ensuring a good technical standard. The photo-interpretation was done on the SPOT satellite imagery and on the aerial photographs. The excellent newly acquired SPOT panchromatic satellite imagery proved very useful as levee soils, which have a thin surface structural sandy crust show much better than on the aerial photographs used by earlier studies, thanks to the higher albedo. The ground truthing was carried out by transecting, during which 400 observations were described, out of which 46 were sampled (214 soil samples analyzed in the laboratory, and more than 200 soil salinity measurements were done in the field).

Twelve detailed farmers interviews and more than 50 shorter ones were done and permitted to elicit the local soil classification system which was included in the map legend, together with the FAO system. The American Soil Taxonomy classification is also given for individual typical profiles.

One set of soil maps was draughted and digitized, using the GIS software ILWIS, at scale 1:50,000. A generalized soil map was also compiled and published at scale 1:250.000.

2.3.2 Water survey

Given the importance of lakes in the study area, 23 of them were sampled and farmers' interviews were conducted to find out what each one of them is used for by the population. A well was also sampled in the Baixa of Banhine.

1. Although scale 1:50,000 is normally a semi-detailed one, we use the term exploratory because of the low density of augerings and profiles, which is in the order of 1 per 400 ha.

2.3.3 Land evaluation

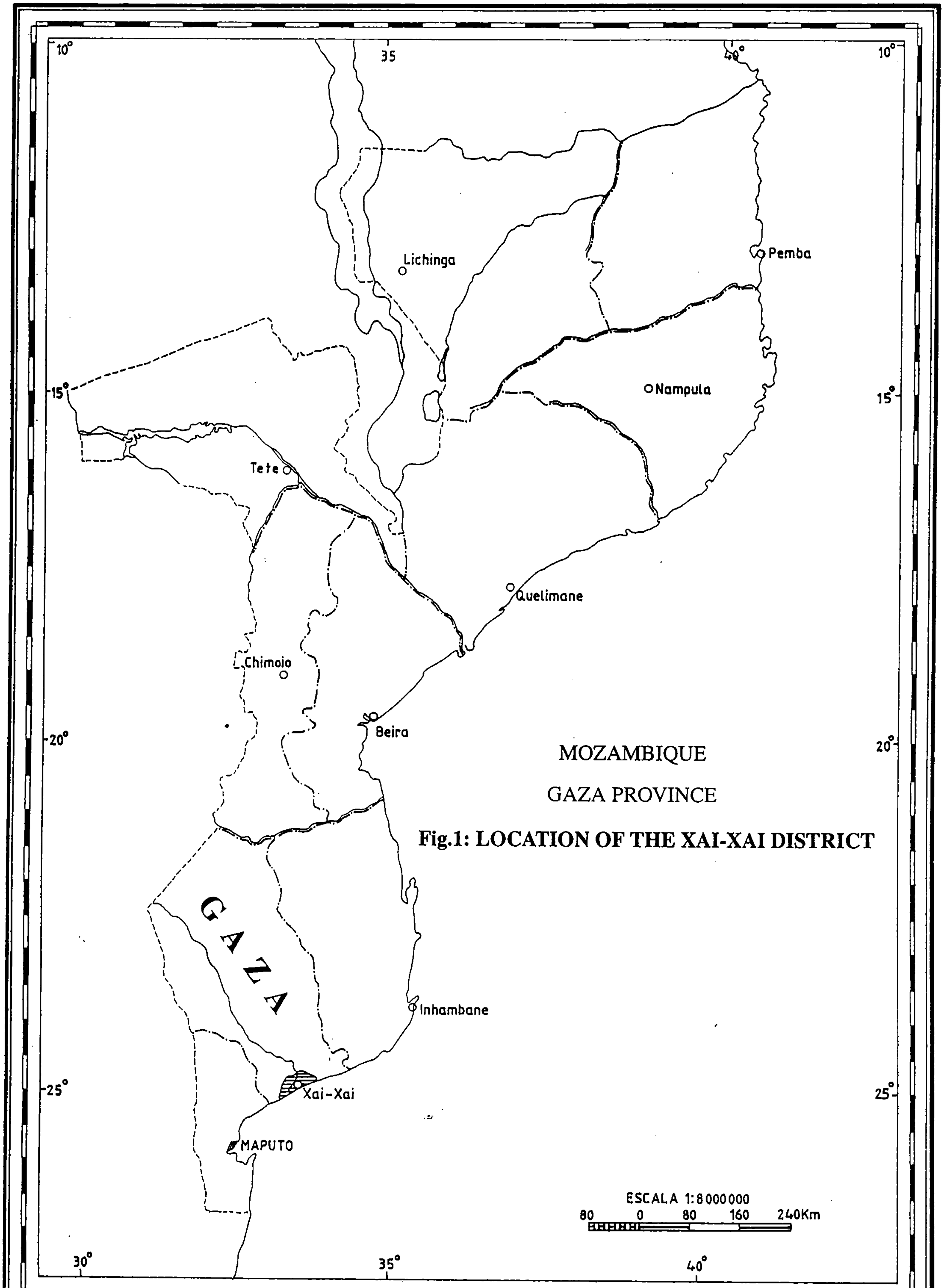
In the conditions of the family sector in Mozambique, farmers give priority to risk minimising and therefore potential crop yield estimation is not a high priority. Also, the refinement and validation of the existing land evaluation models would necessitate several years. However, the on-going development activities cannot await the conclusion of the validation process.

It was decided to build an ALES-based new land capability system which takes into account the conditions of the Mozambican family sector conditions and allows to produce a zonation of the district into management units having similar productive potential and constraints. The rules for these land capability procedures were elicited from farmers, observation of local crops behaviour and from available secondary information. Fourteen ALES models were built, 8 for the current situation and 6 for the potential one, i.e. after drainage and/or fertilization. The 14 resulting land evaluation maps were produced with ILWIS at scale 1:100,000. The global district zonation map was also produced with ILWIS at scale 1:100,000.

Farmers interviews were carried out in order to tap their knowledge and make them participate in the assessment of their land. These interviews yielded comprehensive information about the strategy of family sector small-scale farmers as well as farmer generated specific land evaluation information.

2.3.4 Dissemination of results

Besides the maps and the report, which are required to record and present soil information, practical training was organized for government and NGOs extensionists in order to enable them to recognize the main soil types of the district and to know their distribution, limitations and potential. For this purpose a 2 days seminar followed by 3 days field excursion was held in June 1995.



MOZAMBIQUE

GAZA PROVINCE

Fig.1: LOCATION OF THE XAI-XAI DISTRICT

3. ENVIRONMENTAL SETTING

3.1. Location of the Study Area

The district of Xai-xai is located in the south of the province of Gaza of which the city of Xai-Xai is the capital. It is roughly located between longitudes 33° 19' and 33° 45' east and latitudes 24° 48' and 25° 12' south.

3.2 Physiography and Geology

The study area extends over two major landforms which are the alluvial flood plain (known as **Vale**) of the Limpopo river and its' tributaries, and the surrounding sandy high plain (known as **Serra**), of mostly aeolian origin. The contact between the two landforms consists generally of quite steep slopes, though more gradual transitions do exist in certain locations, e.g. at aldeia Emilia Dausse. Both the Vale and the Serra include a variety of landscapes associated with specific local conditions.

3.2.1 The alluvial plain

The alluvial plain is relatively flat and its' altitude decreases from about 14 m a.m.s.l., at the level of aldeia Julius Nyerere, to 0 when the limpopo reaches the Indian ocean. The plain includes typical features associated with coastal flood plains i.e. abandoned meanders, alluvial levees, point bars, back-swamps and mangroves. The presence of peaty areas is associated with permanent high water table due to water seepage from the sandy plain.

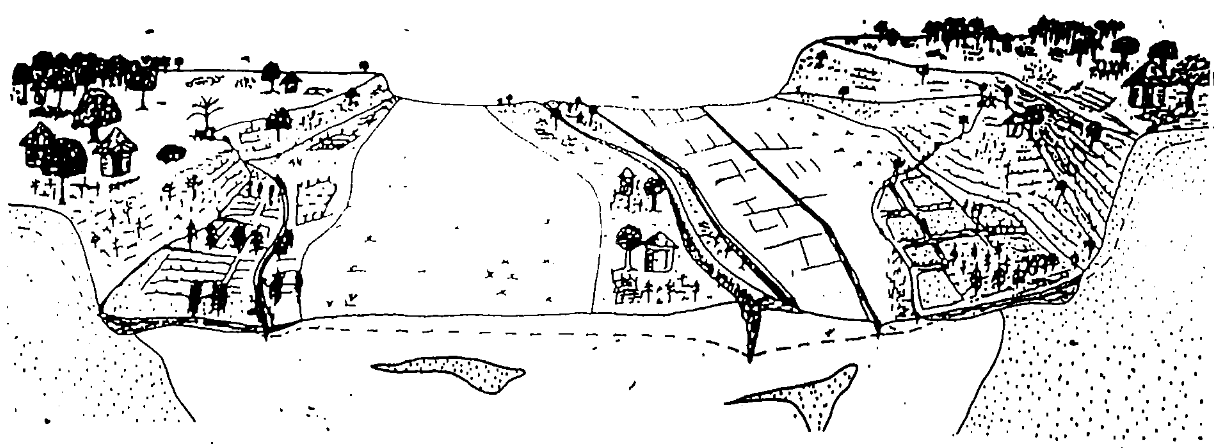
Abandoned meanders are found in various parts of the alluvial plain but they are more frequent at the level of aldeia Julius Nyerere, where the valley is narrower. They are associated with rapid changes in the course of the Limpopo during major floods, resulting in an irregular topography with an alternation of depressions and higher levees. Lakes formed in the largest abandoned meanders.

The levees are higher well drained alluvial lands, generally located on the outer bank at river bends, along active rivers and abandoned meanders. Point bars complexes are often found on the inner bank of river bends. The alluvium which constitutes the levees is of somewhat coarser texture than the rest of the alluvial plain.

The flood plain and the back-swamps are lower more poorly-drained and flat clayey areas situated behind the levees. Unless they are artificially drained, water stagnates in the back-swamps for protracted periods.

The more or less peaty areas, called **machongos** by the farmers, are found in areas of water seepage, at the foot-slopes of the scarps which form the transition between the serra and the valley. They may be at a lower, or higher, altitude than the levees depending on the slope of the sandy terrain. The machongos sometimes extend as narrow veins within the back-swamps.

Figure 2 Typical Landscape in the Study Area



Mangroves are densely vegetated swampy areas, influenced by sea-water during high tides. They are extremely saline.

After the 1:250,000 scale geological map of the region (sheets SUL-G-36/D and SUL-G-36/J), all the alluvial plain belongs to unit *QA1*, which corresponds to the recent quaternary period. Clays are the dominant deposits but lenses of sand occur frequently.

3.2.2 The serra

The serra can be divided in several landscapes according to the orientation of sand dunes, topography, presence of lakes and degree of mobility of sand formations.

Along the coast there is a narrow strip, less than 3 km wide, of relatively active sand dunes having a strongly undulated relief. They belong to the recent quaternary (*QDc* geological unit)

Following the active coastal sand dunes there is another inner strip of high and strongly undulated dunes, oriented perpendicular to the seashore, interspersed with sweet water lakes, some of them covering areas of several hundreds hectares.

More inland, in the south-western part of the serra (localidade of Zongoene), the dunes are oriented perpendicular to the sea and alternate with poorly drained elongated depressions.

The north-western part of the serra, between rio Lumane and rio Munhuana (localidades of Chirrindzene, Chicumbane, Novunguene and Muzingane), has a relatively flat or gently undulating relief and lower altitudes than the rest of the serra lands, generally between 30 and 60 m a.m.s.l.

The rest of the serra has an undulated topography and altitudes generally between 60 and 130 m a.m.s.l, except for the localidades of Banhine and Nhacutse which have a mixture of flat and undulated relief.

After the geological maps, apart from the coastal dunes, all the serra sands are of Pleistocene age (*QDi* unit). Aeolian sands are the dominant deposits.

3.3 Climate

3.3.1 Introduction

According to Köppen's classification, the climate of the district of Xai-Xai is subtropical (type **Aw**) with one wet season, during the hottest months, from October through April, and a drier season during the coolest months, from May through September. During the hot season, the study area is mostly influenced by continental tropical depressions coming from the southwest bringing heavy rains, while during the cool season, the Atlantic and Indian oceans anticyclones determine a dry climate.

Rainfall data is available for four weather stations which are Chilaulene, Chongoene, Maniquenique[2] and Xai-Xai. It must be noted that the data series vary in length, therefore comparisons between stations must be considered with some caution.

[2] The station of Maniquenique is located a few hundreds meters outside the extreme northern corner of the district.

Table 1 Coordinates of the Weather Stations

Name of station	Latitude (S)	Longitude (E)	Altitude (m)
Chilaulene (*)	25° 09'	33° 63	3
Xai-Xai (**)	25° 03	33° 38'	4
Chongoene (***)	25° 00'	33° 47'	67
Maniquenique (***)	24° 44'	33° 32'	13

(*) Source: DNA
(**) Source: INAM (in the SUIVI climatic database at DTA)
(***) Source: (FAO/MOZ/75/011; 1981)

3.3.2 Precipitation

As shown in table 2, the average annual rainfall ranges roughly between 850 and 1150 mm. Table 2 and figure 4 show that rainfall decreases in quantity from the littoral towards the interior and from the high sandy plain down to the valley. The minimum observed annual rainfall is in the order of 350 mm and the maximum varies between about 1400 and 1900 mm. Dependable[3] annual rainfall is everywhere higher than 700 mm.

The precipitation in the district of Xai-Xai is characterized by a high irregularity (see figure 5). The coefficient of variation ranges from 22 to 33 percent for annual rainfall and from 60 to 140 percent for monthly rainfall (see tables 2, 3 and 4). Most of the rainfall occurs during the hot season, mainly from November to April, with the peak being in January/February. August and September are the driest months in all four weather stations.

[3] Rainfall that is attained or exceeded 3 years out of 4.

Table 2 Annual Rainfall and Dependable Rainfall

Station	Number of years	Rainfall (mm)				
		Average	Coefficient of variation (%)	Minimum	Maximum	Dependable
Maniquenique	26	842	28	369	1398	712
Chilaulene	32	955	29	347	1625	777
Xai-Xai	33	1052	33	352	1904	802
Chongoene	11	1145	22	785	1542	972

Figure 3 Average and Dependable Rainfall

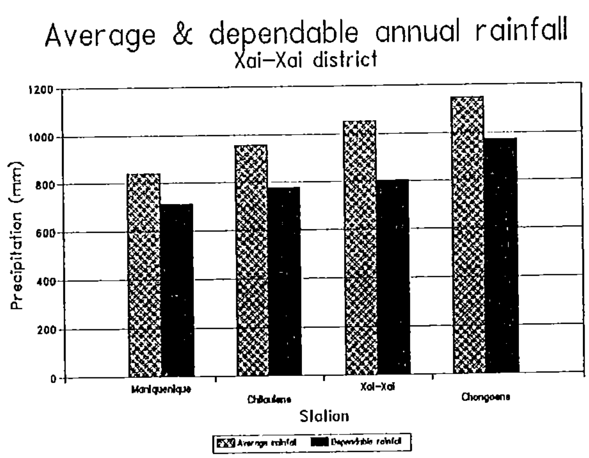


Figure 4 Rainfall Distribution in the District of Xai-Xai Modified from Geotecnica 1981.

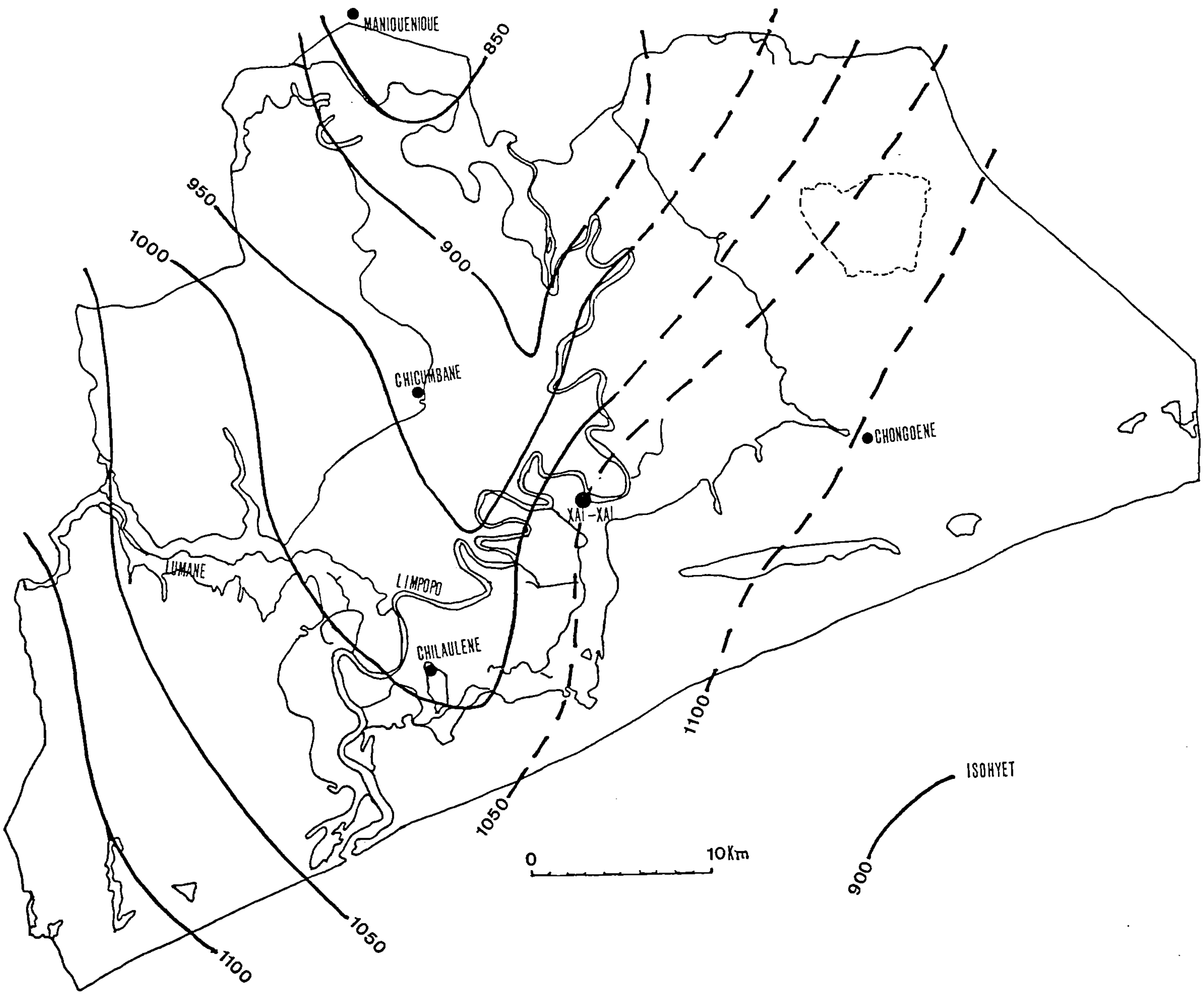
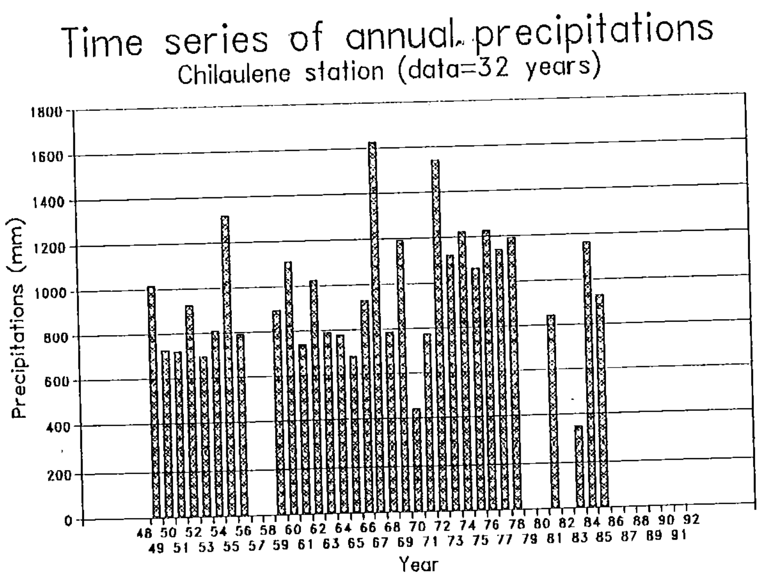


Figure 5 Examples of Inter-annual Rainfall Variation



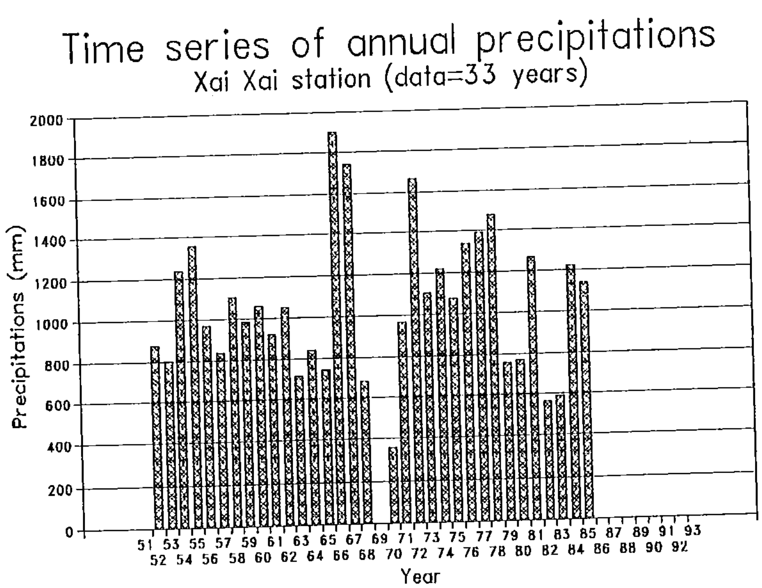


Table 3 Monthly Rainfall at Chilaulene and Chongoene

Month	Rainfall (mm)				
	Average	Coefficient of variation %	Minimum	Maximum	Dependable
Chilaulene					
OCT	55	82	0	181	22
NOV	74	85	4	253	35
DEC	107	64	0	306	62
JAN	122	75	11	394	52
FEB	111	89	4	527	46
MAR	96	74	10	284	49
APR	94	82	0	323	37
MAY	75	111	0	491	38
JUN	59	66	11	190	30
JUL	47	74	0	134	19
AUG	32	94	0	117	9
SEP	36	117	0	193	6
Chongoene					
OCT	53	62	9	113	23
NOV	103	74	0	261	59
DEC	145	71	29	354	49
JAN	113	95	17	414	66
FEB	245	75	13	683	102
MAR	110	53	12	209	74
APR	92	66	21	196	29
MAY	69	59	0	132	26
JUN	75	115	13	301	22
JUL	45	80	3	118	17
AUG	43	91	3	125	18
SEP	55	82	0	130	22

Table 4 Monthly Rainfall at Xai-Xai and Maniquenique

Month	Rainfall (mm)				
	Average	Coefficient of Variation %	Minimum	Maximum	Dependable
Xai-Xai					
OCT	58	67	5	178	30.7
NOV	85	78	10	253	33.1
DEC	125	68	23	339	63.6
JAN	125	77	16	386	51.2
FEB	188	107	23	1176	76.9
MAR	102	66	16	313	54.7
APR	94	84	2	385	49.1
MAY	89	109	0	529	27.5
JUN	61	66	0	169	30.3
JUL	45	80	3	162	16.9
AUG	33	88	1	104	8.1
SEP	39	138	1	300	8.1
Maniquenique					
OCT	43	77	3	128	22
NOV	72	81	19	277	29
DEC	104	66	31	285	50
JAN	134	78	15	329	51
FEB	147	71	9	423	68
MAR	107	64	15	255	61
APR	70	73	11	248	36
MAY	52	87	2	204	14
JUN	36	64	8	92	17
JUL	26	81	0	78	12
AUG	21	110	1	85	5
SEP	31	110	0	120	4

3.3.3 Temperature

Data is available for Chongoene, Xai-Xai and Maniquenique. Table 5 shows that:

- monthly average temperatures range from 18 to 27°C
- monthly maximum temperatures range from 24 to 34°C
- monthly minimum temperatures range from 11 to 22°C
- monthly thermic amplitude range from 9 to 15°C

December, January and February are the hottest months while June, July and August are the coolest. Maniquenique is hotter than Xai-Xai and Chongoene, due to its longer distance from the littoral. The thermic amplitude is bigger during the cool season in all station and is also bigger inland (maniquenique) than nearer to the coast.

Table 5 Temperatures at Chongoene, Xai-Xai and Maniquenique
Source: FAO/MOZ/75/011; 1981

Month	**Chongoene**				**Xai-Xai**				**Maniquenique**			
	Aver.	Max.	Min.	Ampl.	Aver.	Max.	Min.	Ampl.	Aver.	Max.	Min.	Ampl.
Oct	23.1	29.2	17.0	12.2	23.4	29.4	17.4	12.0	24.4	31.3	17.5	13.8
Nov	24.4	29.8	18.9	10.9	24.6	30.1	19.0	11.1	25.8	32.2	19.5	12.7
Dec	25.2	30.3	20.2	10.1	25.8	31.1	20.4	10.7	26.7	32.9	20.6	12.3
Jan	25.4	30.2	20.6	9.6	26.2	31.3	21.2	10.1	26.9	33.3	20.6	12.7
Feb	25.4	30.2	20.7	9.5	26.2	31.1	21.4	9.7	26.5	32.7	20.3	12.4
Mar	24.4	29.6	19.2	10.4	25.3	30.4	20.2	10.2	25.4	31.6	19.1	12.5
Apr	23.4	29.0	17.9	11.1	23.6	29.3	18.0	11.3	23.9	30.2	17.6	12.6
May	21.2	27.1	15.2	11.9	20.9	27.2	14.7	12.5	21.3	28.1	14.5	13.6
Jun	18.7	25.0	12.4	12.6	18.6	25.3	12.0	13.3	19.2	26.1	12.2	13.9
Jul	18.4	24.8	11.9	12.9	18.3	25.2	11.4	13.8	18.5	25.8	11.2	14.6
Aug	19.6	26.1	13.2	12.9	19.8	26.5	13.0	13.5	20.1	27.6	12.7	14.9
Sep	21.5	27.3	15.7	11.6	21.6	28.1	15.1	13.0	22.8	30.1	15.6	14.5
Year	22.6	28.2	16.9	11.3	22.2	28.8	17.0	11.8	23.5	30.2	16.8	13.4

3.3.4 Wind speed

Wind speed data is only available for Chongoene, Xai-Xai and Maniquenique. It appears from table 6 that wind speed is mostly controlled by the distance to from the littoral. Chongoene and Xai-Xai, which are at about the same distance from the ocean have nearly exactly the same wind speed pattern and intensities. Maniquenique which is the most inland station has much lower wind speeds, though the difference is clearly marked only from August to February. In all stations the windiest months are August/September through February, with the peak being in November/December.

Table 6 Average Wind Speed
Source: FAO/MOZ/75/011; 1981

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Chongoene	2.2	2.3	2.3	2.0	1.9	1.6	1.4	1.2	1.2	1.4	1.7	2.1	1.8
Xai-Xai	2.2	2.3	2.2	2.0	1.9	1.6	1.4	1.2	1.2	1.4	1.7	2.1	1.8
Maniquenique	1.5	1.7	1.8	1.5	1.5	1.3	1.4	1.1	1.1	1.3	1.3	1.6	1.4

3.3.5 Relative air humidity

Relative air humidity data is only available for Chongoene, Xai-Xai and Maniquenique. Table 7 shows that the relative air humidity varies between 65 and 85% in all three stations. Chongoene is the most humid, followed by Maniquenique and Xai-Xai. The fact that the Limpopo river is very close to Maniquenique may be the reason why the latter is more humid than Xai-Xai although it is located farther from the ocean.

During the cool season, from April to September, the wind blows mostly from the sea and dew forms early in the morning, hence the cool season is more humid that the hot season. June and July are the most humid months while October and November are the driest.

Table 7 Average Relative Air Humidity
Source: FAO/MOZ/75/011; 1981

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Chongoene	74	74	76	77	76	78	79	81	84	84	80	75	78
Xai-Xai	65	65	67	68	70	72	74	78	81	80	74	68	72
Maniquenique	70	69	71	71	73	73	76	78	81	80	77	71	74

3.3.6 Bright sunshine hours

Data is available[4] only for Xai-Xai and Maniquenique. Hours of bright sunshine are in the range of 50 to 70% for Xai-Xai and 60 to 80% for Maniquenique. As can be expected, the cool season, from May through September, is more sunny than the hot season during which cloudiness is more frequent. Xai-Xai being closer to the ocean and having a higher rainfall, has less sunshine than Maniquenique.

Table 8 Average Hours of Bright Sunshine (in percent)
Source: FAO/MOZ/75/011; 1981

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Xai-Xai	52	50	51	51	52	56	57	67	62	64	63	59	57
Maniquenique	63	61	61	70	64	60	65	78	72	71	68	72	67

Note: The hours of bright sunshine are expressed as a percentage of maximum possible sunshine hours.

3.3.7 Evapotranspiration

The evapotranspiration (ETP) was calculated, for the stations of Xai-Xai and Maniquenique, with CROPWAT, the specialized software developed by the FAO, using the climatic data stored in CLIMWAT. CROPWAT uses the new modification of the Penman formula proposed by Monteith.

Table 9 shows that for both stations the annual ETP is in the range of 1400 to 1450 mm and that the monthly ETP is highest in December/January and lowest in June July. Though ETP is only slightly higher in Maniquenique than in Xai-Xai, the moisture deficit is clearly bigger in the former. In Maniquenique, rainfall never exceeds the ETP on a monthly basis, but it does in Xai-Xai in February and May.

It should also be noted that in Xai-Xai, rainfall exceeds ETP during the period from February to June (P=534 mm; ETP=515 mm). This means that the cool season crops sown in April-May will generally have adequate moisture supply from the soils. We have indeed noticed during the soil survey that all the sandy soils of the district were moist at depth throughout the cool season. On the contrary, hot season crops sown in october to November find a soil with depleted from its deep water reserves, hence the impact of a drought is more damaging during the hot season than the cool one.

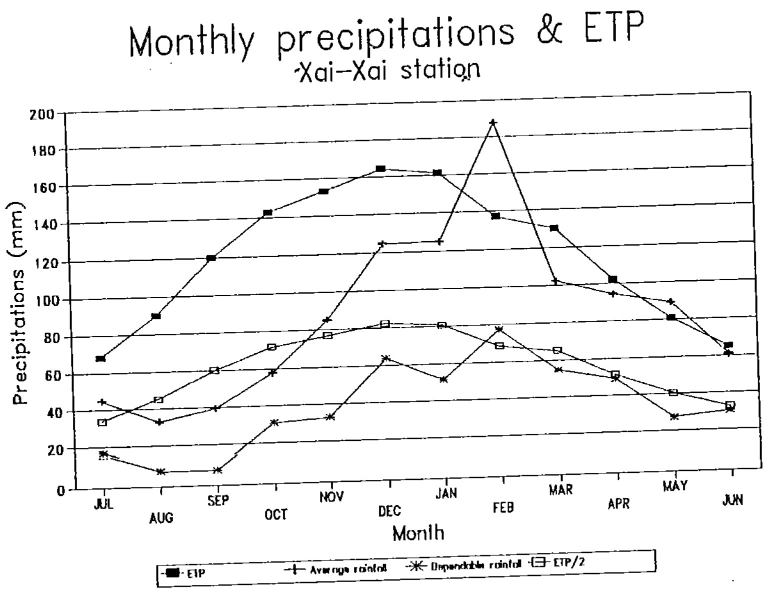
[4] Project FAO/MOZ/75/011 (1981) did mention sunshine data for Chongoene but actually these were those of Xai-Xai which were used because of the similarity of location.

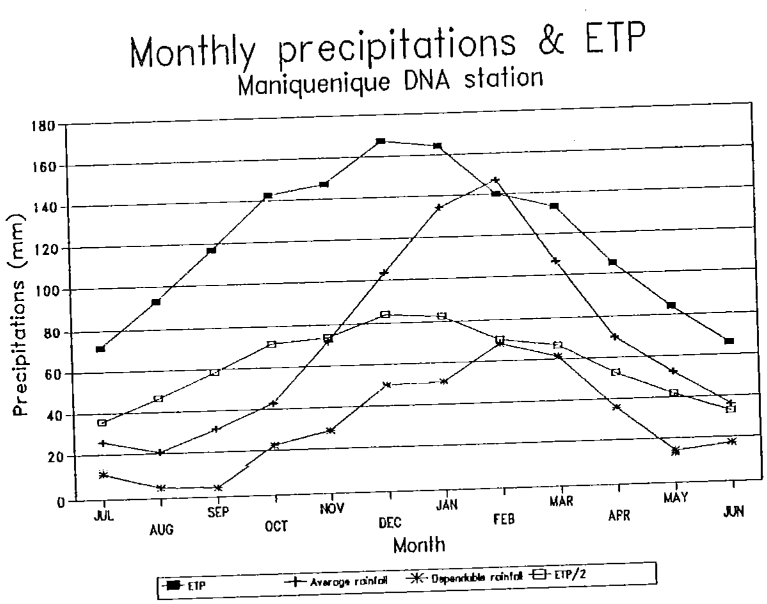
Table 9 Evapotranspiration in Xai-Xai and Maniquenique

Month	**Xai-Xai**			**Maniquenique**		
	P	ETP	P/ETP	P	ETP	P/ETP
OCT	58	142.6	41	43	142.6	30
NOV	85	153.0	56	72	147.0	49
DEC	125	164.3	76	104	167.4	62
JAN	125	161.2	78	134	164.3	82
FEB	188	137.2	137	147	150.0	98
MAR	102	130.2	78	107	133.3	80
APR	94	102.0	92	70	105.0	67
Hot season	777	990.5	78	677	1,009.6	67
MAY	89	80.6	110	52	83.7	62
JUN	61	65.1	94	36	66.0	55
JUL	45	68.2	66	26	71.3	36
AUG	33	89.9	37	21	93.0	23
SEP	39	120.0	33	31	117.0	27
Cool season	267	423.8	63	166	431.0	39
Year	1,044	1,414.3	74	843	1,440.6	59

(*) ETP calculated with the Penman formula as modified by Monteith

Figure 6 Evapotranspiration and Rainfall in Xai-Xai and Maniquenique





3.3.8 Length of growing period

The AEZ project, implemented by the FAO and INIA's department of land and water during the early 1980's, has calculated the growing periods for numerous stations throughout Mozambique including Chongoene, Xai-Xai and Maniquenique for which the results are shown in table 10 (FAO/MOZ/75/011; 1981). It appears that as for precipitation, the total length of growing period decreases from the littoral towards the interior and from the serra to the valley:

- **Chongoene**: On the average, there is at least one growing period of 170-318 days, followed by another one of 70 to 80 days, the occurrence of a third growing period of about 65 days has a probability of only 18 percent.

- **Xai-Xai**: On the average, there is at least one growing period of 127-307 days, followed by another one of 73 to 85 days, the occurrence of a third growing period of about 49 days has a probability of only 26 percent.

- **Maniquenique**: On the average, there is a 95 probability of having at least one growing period of 118-245 days, followed by another one of 46 to 65 days, the occurrence of a third growing period of about 58 days has a probability of only 19 percent.

A fourth growing period was very rarely observed at Xai-Xai and Maniquenique. Whatever the number of lengths of growing periods, two cropping seasons, the first of at least 185 days and the second of at least 70 days, are always possible at Chongoene and Xai-Xai.

The average starting date of the first growing period is usually October for Xai-Xai (the range is August-January) and November for Chongoene (the range is September-January) and Maniquenique (the range is October-January). The second growing period usually starts between March and June at Chongoene, February and June at Xai-Xai and April and June at Maniquenique.

It must be kept in mind that the calculated lengths of growing period are only rough estimates of the potential of the climate to supply moisture for plant growth. A number of simplistic assumptions are made in the AEZ methodology such as considering that rainfall infiltrates entirely and that the soils have all the same water holding capacity of 100 mm. These assumptions are necessary at very small scale (1:1,000,000 or smaller) but lead to erroneous results at more detailed levels. Indeed many Vertisols in the alluvial plain of Xai-Xai have a water holding capacity of more than 200 mm and receive runoff from the surrounding Serra's sandy soils which hardly reach 100 mm of water storage capacity.

Table 10 Length and frequency of growing periods
Source: FAO/MOZ/75/011; 1981

Number of growing periods	Chongoene		Xai-Xai		Maniquenique	
	LGP (days)	Frequency	LGP (days)	Frequency	LGP (days)	Frequency
1 Growing period	318 (12)	36	307 (9)	26	245 (11)	15
2 Growing periods	303 (3)	45	259 (26)	45	205 (26)	62
Length 1	233 (19)		185 (31)		140 (39)	
Length 2	70 (64)		73 (58)		65 (53)	
3 Growing periods	317 (11)	18	261 (9)	26	222 (21)	19
Length 1	170 (29)		127 (38)		118 (43)	
Length 2	83 (81)		85 (58)		46 (75)	
Length 3	65 (30)		49 (65)		58 (48)	
4 Growing periods	-	0	265 (*)	3	211 (*)	4
Length 1			51		75	
Length 2			133		39	
Length 3			6		58	
Length 4			75		39	

LGP = length of growing period

( ) coefficient of variation in percent.

(*) 4 growing periods occurred only once in Xai-Xai and Maniquenique during the period of observation, therefore no coefficient of variation is given.

3.4 Water resources

3.4.1 Surface hydrology

3.4.1.1 Rivers and streams

The Limpopo is the main permanent watercourse in the district of Xai-Xai. Its' watershed covers about 412,000 km^2, and extends over the Republic of South Africa, Zimbabwe, Botswana and Mozambique. Its' main tributaries in the district of Xai-Xai are Rio Chégua, R. Umbapi and R. Ingluxane on the left bank, and R. Munhuana, R. Lumane and R. Chaiane on the right bank.

The water discharge of the Limpopo varies between 8 and 7800 m^3/s. Big floods occur periodically however the city of Xai-Xai and part of the left bank are protected by man-made dikes. The water of the Limpopo in most of its' course in the study area is brackish during high tides when the river's water discharge is too low to counter the seawater influx.

R. Lumane has a permanent water discharge of 3 to 25 m^3/s. It has good quality except in its lower course where it is influenced by saline tide water. R. Chégua has also a permanent discharge of good quality water.

3.4.1.2 Lakes

Due to the high permeability and thickness of the aeolian sand deposits, to the presence of underlying impervious deposits, and to the relatively high rainfall in the area, sizeable aquifers occur in the serra. These aquifers surface in numerous lakes and springs as well as in the machongos. Lakes also occur in abandoned meanders in the Limpopo's valley. The largest permanent lakes in the district are the Lagoa Pave, L. Ualute and L. Sauce.
A campaign of sampling of lakes and depressions and interviews about their uses, was carried out during the last week of February 1995. The results are shown in tables 11 and 12. The water analyses results should be considered with care because their chemical characteristics are likely to fluctuate with the precipitation and evaporation regimes, especially for small lakes. The water of lakes Muzingane and Vumbe near the aldeia Julius Nyéréré, which are influenced by saline mananga deposits, are known to experience periods of high salinity. We have once measured and EC of 4.7 dS/m in lake Muzingane. However the data give a good idea of the chemical composition of the lakes of the Serra.

Except lake Sane, near Nhabanga village, all lakes have water that is suitable for human and cattle drinking, washing, irrigation and pisciculture. Lake Sane's water may only be used for cattle drinking and pisciculture. The interviews have shown that lakes are a vital source of water for domestic utilisation (drinking, cooking, washing etc.) , for small-scale irrigation, and a source of fish.

Table 11 Utilization of lakes and depressions

Source: farmers' interviews

Geomorphic unit	Name	Water Regime	Uses					Remarks
			Drink human	Drink animal	Wash.	Irrig.	Fish.	
Serra lakes and wet depressions	Xipete	P	R	Y	Y	Y	Y	Human drink only during extreme droughts
	Sane	P	N	N	N	N	Y	Too saline
	Leanuli	NP	N	Y	N	N	N	Distant from village and too small. Dry during extreme droughts
	Chiboene	P	N	Y	Y	N	Y	
	Sauce	P	N	Y	Y	N	Y	Distant from cultivated fields but could be used for irrigation
	Gire	P	R	Y	Y	Y	Y	Human drink only when there is a strong drought
	Chissura	P	N	Y	Y	N	Y	Distant from cultivated fields but could be used for irrigation
	Chance	P	Y	Y	Y	Y	Y	
	Sanzative	P	Y	Y	Y	Y	Y	
	Chevise	P	N	N	N	N	N	Full of reeds
	Nhambozi	NP	N	N	N	Y	N	Full of reeds. Dry during strong droughts
	Ualute	P	Y	Y	Y	Y	Y	
	Cué	P	N	Y	Y	Y	Y	Reeds at the periphery. Irrigated banana, Papaya and sugarcane
	Masseque	P	N	Y	Y	Y	Y	
	Rongote	P	N	Y	Y	Y	Y	Irrigated banana, Papaya and sugarcane
	Muié	P	Y	Y	Y	Y	Y	
	Chegua	P	-	Y	Y	Y	Y	Fishing little practised
Serra dry depressions	Banhine	VR	Y	Y	Y	N	Y	Exceptionally partly flooded. The mentioned uses are when flooded. Water sample from a well
Valley oxbow lakes	Vumbe	P	N	Y	Y	Y	Y	Water salinity increases substantially during dry periods
	Muzingane	P	N	Y	Y	Y	Y	

P= permanent; NP= not permanent; R= rare; VR= very rare; N= no; Y= yes

Table 12 Analyses of water samples

Geomorphic unit	Name	pH	CE (field)	K	Ca	Mg	Na	Cl	SAR
				ppm					
Serra lakes and wet depressions	Xipete	6.0	0.25	0.3	0.4	1.4	4.6	53	0.8
	Sane	6.6	6.25	0.2	0.1	0.6	2.1	18	0.6
	Leanuli	5.3	0.24	0.2	0.2	0.7	2.1	18	0.5
	Chiboene	5.6	0.17	1.0	2.0	9.4	21.4	320	1.4
	Sauce	5.5	0.14	0.2	0.1	0.5	1.8	18	0.5
	Gire	6.2	0.27	0.3	0.3	1.3	3.4	36	0.6
	Chissura	4.6	0.80	1.8	2.0	12.6	-	36	-
	Chance	8.4	2.05	0.2	0.2	1.2	4.4	36	0.8
	Sanzative	7.8	0.84	0.3	0.5	2.6	6.1	89	0.8
	Chevise	5.2	0.73	0.6	2.4	6.9	-	36	-
	Nhambozi	6.5	1.07	1.4	1.8	6.9	15.1	498	1.1
	Ualute	7.3	0.48	1.0	0.1	4.6	-	320	-
	Cué	6.3	0.30	0.4	0.5	2.5	7.4	54	1.0
	Masseque	6.4	0.45	0.5	0.3	1.7	5.4	53	0.8
	Malembué	6.6	0.37	-	-	-	-	-	-
	Làbué	7.5	0.72	0.4	0.4	2.0	5.2	71	0.8
	Rongote	6.9	0.37	0.4	0.5	2.6	5.2	107	0.7
	Saque	6.3	0.25	0.6	0.4	2.6	4.1	89	0.5
	Dâmbué	6.7	0.41	0.4	2.3	5.2	16.6	214	1.4
	Muié	6.9	0.57	0.5	0.4	2.1	6.8	89	1.0
	Chegua	6.6	0.98	0.4	0.8	1.5	8.9	125	1.3
Serra dry depressions	Banhine (*)	5.2	0.13	0.2	0.4	0.5	2.4	36	0.6
Valley	Vumbe	7.5	1.66	0.3	0.7	1.8	3.3	125	0.5
	Muzingane	5.6	0.46	0.4	0.5	2.1	6.2	18	0.9

EC= electrical conductivity; SAR= sodium absorption ratio
(*) This is a large dry baixa. The water sample was taken from a shallow well.

Lakes are also refuges for wild animals such as birds. Drinking water is usually taken from shallow dug wells located on the margins of lakes and wet depressions.

3.4.2 Groundwater

There are two types of aquifers in the study area, those of the fluvio-marine sediments of the Limpopo's valley and those of the eolian sand dunes formations.

The aquifers of the valley are shallow, mostly between 0.2 and 1.5 m, but may reach 5 m in some of the alluvial levees and in the north of the plain. These aquifers are recharged by rainwater, floods and water seepage from the surrounding high sandy plain. Water is saline and contains up to 30 g/l of mostly sodium chloride.

The aquifers of the eolian sand formations are sweet and contain less than 1 g/l. They are recharged by the infiltration of atmospheric precipitation.

4. THE SOILS OF THE STUDY AREA

4.1 Soil formation

Due to the highly pervious nature of the aolian sands and to the relatively high rainfall, there is active clay illuviation in upland Serra soils which show prominent deep lamellae of clay and sesquioxides, generally at a depth of 130 to 200 cm.

Rubefaction is also widespread among Serra sands, but seems to be associated with the oldest deposits. On footslopes and margins of depressions there are generally grayish to whitish sandy soils, due to deep leaching of sesquioxides.

In the valley soil formation is controlled by the moisture regime and the geomorphic position. Stratified young alluvial soils form on the well drained alluvial levees and terraces, while swelling montmorillonitic clays form in the flood plains and backswamps, hence the wide occurrence of Vertisols. Gleyification due to water stagnation and high watertables is also wide spread.

In areas not reached by the Limpopo's flood waters and where there is a high watertable, peat soils through the accumulation of organic material which cannot decompose in anaerobic. Hydromorphic and relatively organic soils of the lower course of the Limpopo often show some jarosite mottles.

4.2 Soil classification

4.2.1 Scientific soil classification

The soils were classified according to the FAO legend (FAO, 1990; 1993) and to Soil Taxonomy (Soil Survey Staff, 1994). The reader is referred to the literature for details on these classification systems.

4.2.2 Farmers' soil classification

The interviews showed that the farmers of the area have a well defined soil classification system. The most important diagnostic criteria are the moisture regime, topsoil texture and topsoil colour. The following soils are identified by the farmers:

- Bila (Bilene): Cracking compact clayey valley soils, black to brownish. Remain wet and sticky after a rainy episode for at least a week, if there is no stagnation of water. After a rainy episode, it takes about a week before they are dry enough to allow ploughing and remain ploughable only about 2-3 weeks before becoming too hard. They have a good water holding capacity and a good fertility.

- Giho: Red (dark reddish brown or brown topsoil and reddish brown to dark red subsoil) earthy sandy soils which has a better moisture retention than other upland sandy soils of the Serra. Farmers describe Giho as follows: "When you sit on Giho and rise your clothes get the soils' colour". "During the hot season, cars driving on Giho provoke such a red dust that the face of a person can change (of colour)".

- Mananga (Manangene): Fine textured Soils that contain sand in the topsoil (sandy clay loam to loamy sand) above finer (marine?) material, generally clay loam or sandy clay. They are typically covered with scattered large termites mounds that contain saline material brought up from the substratum. These soils are only extensive on a high terrace in the northwest of the district. They are associated with large patches of Bila soils to which they intergrade in depressions . They can be ploughed during or shortly after rainy episodes, and have a saline water table at about 3 meters depth. Most tall tree species remain stunted.

There is also a small area of Mananga soils in the Serra north of the aldeia Agostinho Neto. They have a sandy or loamy sand topsoil above finer material, generally sandy clay loam. They are also typically covered with scattered large termites mounds that contain saline material brought from the substratum.

- N'Tlava (N'Tlavene): Other upland sandy soils having low moisture retention. N'Tlavene is also used in Shangana to refer globally to land outside urban areas ("the country side").

- N'Tlangua (N'Tlangoene): Blackish to brownish soil, relatively organic and of sandy clay loam to sandy loam texture in the topsoil, with often a sandy subsoil. Very similar to XiN'Tlavane but occur in narrow drainage ways inside the serra instead of at the footslopes of the scarps. The water table is within 150 cm but stagnation is only occasional. This name is mostly used in the localidade de Chilaulene and is not well known in other areas.

- Puwa (Upwene): Yellowish to whitish loose sandy soil of coastal shifting dunes.

- T'Lavate (T'Lavatene): Somewhat droughty medium-textured soil with surface crusting and segregation of whitish fine sand which occurs on the alluvial levees and high terraces. Dries out quickly after rainy episodes and water does not stagnate. It can be ploughed moist.

In the Serra the name T'Lavate is used for whitish washed sand in the margins of lakes and depressions. Relatively similar to Xixefo from which it differs by somewhat whiter colour and the nearby presence of water. The name T'Lavate is not used consistently in the Serra and sometimes the farmers use it as synonymous with XiN'TLavane or N'Tlangoene which are rather earthy sands. The T'Lavate usually has a water table at relatively shallow depth (1 to 5 m).

- T'Sovo: Black generally peaty or mucky soils, which contain some clay, that have a permanent water table (seepage from the serra) within rooting depth, and that suffer from stagnation for protracted periods. The subsoil maybe peat, sand or clay. Animal traction cannot normally be used for ploughing because the animals sink, unless the organic layer is thin or the soil dries out thoroughly, which happens very rarely. The word T'Sogoene is sometimes used to designate T'Sovo but it actually means swampy area (physiographic unit), where T'Sovo soils occur.

- Xiboa, T'Seve-T'Seve, Xitseve, Ximucunhe (synonims): Peat soils with permanently stagnating seepage water. The difference with T'Sovo is not always made by the farmers.

- Ximunhuanine (syn. Xivumbane). From the Shangana word munhu meaning salt. Saline, generally clayey, soils where crops do not grow. Often with temporary salt crusts.

- XiN'TLavane (XiN'Tlavanene): Transition soil between the N'Tlava of the footslopes of the Serra and the T'Sovo of the adjoining wetlands. The topsoil is a grayish to brownish mixture of sand with black earthy and organic material of the wet depressions. The water table is usually within 150 cm but there is no stagnation.

- Xiruka: Actually this term is used for finer-textured subsoil layers which are rich enough in fines that they can be used as plaster (kutsula in Shangana). It is also sometimes used to designate a brownish to reddish brown sandy soil wich has loamy sand to (rarely) sandy loam layers in the subsoil. It is normally less red than Giho.

- Xixefo: Grayish sandy soils of dry depressions and toeslopes. This term is mostly used near Banhine. Little or not used in other areas.

4.3 Soil map units description

The soil map units components descriptions were generated with the ALES software in a tabular and coded form. The legend of the codes is shown in table 13, part 1 and 2. Tables 14 Parts 1,2 and 3 show the coded map units descriptions, while tables 15 and 16 give the aereal coverage of each map unit, respectively in hectares and in percent. Table 17 (parts 1,2,3,4,5,6,7 and 8) show the legend of the soil map. Map units which have a component that makes 80 percent or more are considered nearly pure and the inclusions are not mentioned.

Table 13 Legend of the codes used in the map units description (Part 1)

Slope gradient

A (Level) [0-1 percent]
B (Nearly level) [1-2 percent]
C (Very gently sloping) [2-4 percent]
D (Gently sloping) [4-8 percent]
E (Strongly sloping) [8-16 percent]
F (Moderately steep) [16-30 percent]
G (Steep) [30-50 percent]
H (Very steep) [50-100 percent]

Microtopography

N (None or very slight)
SL (Slight)
M (Moderate)
S (Strong)

Frequency of damaging floods with strong current

N (None)
R (Rare (once in 10 yrs or less))
I (Infrequent (once in 6-10 yrs))
F (Frequent (once in 3-5 yrs))
VF (Very Frequent (every 1-2 yrs))

Ponding frequency

VF (Very frequent) [0-2 years]
F (Frequent) [2-5 years]
I (Infrequent) [5-10 years]
N (None or very rare) [10-100 years]

Ponding duration

S (Short) [0-2 weeks]
M (Moderately long) [2-6 weeks]
L (Long) [6-10 weeks]
VL (Very long) [10-52 weeks]

Global drainage class

VP (Very poorly drained)
P (Poorly drained)
I (Imperfectly drained)
MW (Moderately well drained)
W (Well drained)
SE (Somewhat excessively drained)
E (Excessively drained)

Surface drainage class

P (Ponded)
S (Slow run-off)
M (Moderately rapid run-off)
R (Rapid run-off)

Infiltration rate class

VS (Very slow) [0-.2 cm/hr]
S (Slow) [.2-.6 cm/hr]
MS (Moderately slow) [.6-2 cm/hr]
M (Moderate) [2-6 cm/hr]
MR (Moderately rapid) [6-12 cm/hr]
R (Rapid) [12-20 cm/hr]
VR (Very rapid) [20-1000 cm/hr]

Permeability of most limiting layer within 120 cm

ES (Extremely slow) [0-.06 cm/h]
VS (Very slow) [.06-.2 cm/h]
S (Slow) [.2-.6 cm/h]
MS (Moderately slow) [.6-2 cm/h]
MR (Moderately rapid) [2-6 cm/h]
R (Rapid) [6-12 cm/h]
VR (Very rapid) [12-20 cm/h]
ER (Extremely rapid) [20-100 cm/h]

Depth to water table

ES (Extremely shallow) [0-25 cm]
VS (Very shallow) [25-50 cm]
S (Shallow) [50-75 cm]
MS (Moderately shallow) [75-100 cm]
MD (Moderately deep) [100-125 cm]
D (Deep) [125-150 cm]
VD (Very deep) [150-200 cm]
ED (Extremely deep) [200-300 cm]
VED (Very extremely deep) [300-1000 cm]

Salinity of water table

L (Low) [0-1.5 dS/m]
M (Medium) [1.5-4 dS/m]
H (High) [4-50 dS/m]

Local classification soil type

GIH (Giho)
XIR (Xiruka)
PUW (Puwa)
NTL (N'Tlava)
MAp (Mananga of plain)
MAs (Mananga of serra)
XIX (Xixefo)
TLp (T'Lavate of plain)
TLs (T'Lavate of serra)
XIN (XiN'Tlavane)
NTG (N'Tlangua)
TSO (T'Sovo)
BIL (Bila)
XIM (Ximunhuanine, Xivumbane)
XIB (Xiboa, T'seve T'seve)

Current concentrated water erosion

N (None or slight)
M (Moderate)
S (Severe)
VS (Very severe)

Current sheet erosion

N (None or slight)
M (Moderate)
S (Severe)
VS (Very severe)

Current wind erosion

N (None)
SL (Slight)
M (Moderate)
S (Severe)
VS (Very severe)

Available water holding capacity of the whole soil

VL (Very low) [0-7.5 cm/150 cm]
L (Low) [7.5-15 cm/150 cm]
M (Moderate) [15-22.5 cm/150 cm]
H (High) [22.5-30 cm/150 cm]
VH (Very high) [30-100 cm/150 cm]

Type of surface horizon

M (Mineral)
H (Histic)

Particle-size class of 0-125 cm

S/C (Sandy over clayey)
S/L (Sandy over loamy)
L/S (Loamy over sandy)
CoL/S (Coarse loamy over sandy)
S (Sandy)
CoL (Coarse loamy)
FL (Fine loamy)
CoSi (Coarse silty)
FSi (Fine silty)
FC (Fine clay (<60%))
VFC (Very fine clay (>60%))
Peat (Peat)
C/L (Clayey over loamy)
C/S (Clayey over sandy)
FL/C (Fine loamy over clayey)
FL/S (Fine loamy over sandy)

Note: peat is not a particle-size but was included here for convenience

Texture of topsoil

C (Clay)
L (Loam)
CL (Clay loam)
SiC (Silty clay)
SiCL (Silty clay loam)
SiL (Silt loam)
SC (Sandy clay)
SCL (Sandy clay loam)
SL (Sandy loam)
FSL (Fine sandy loam)
CSL (Coarse sandy loam)
LS (Loamy sand)
LFS (Loamy fine sand)
LCS (Loamy coarse sand)
FS (Fine sand)
CS (Coarse sand)

Topsoil clay content

L (Low) [0-18 percent]
M (Moderate) [18-35 percent]
H (High) [35-60 percent]
VH (Very high) [60-100 percent]

Presence of cracking clays

N (Not present)
P (Present)

Table 13 Legend of the codes used in the map units description (Part 2)

Topsoil consistence dry

LO (Loose)
SO (Soft)
SHA (Slightly Hard)
HA (Hard)
VHA (Very hard)
EHA (Extremely Hard)

Topsoil stickiness

NST (Non sticky)
SST (Slightly sticky)
ST (Sticky)
VST (Very sticky)

Topsoil plasticity

NPL (Non plastic)
SPL (Slightly plastic)
PL (Plastic)
VPL (Very plastic)

Topsoil calcium carbonate content

Vl (Very low) [0-2 percent]
L (Low) [2-5 percent]
M (Moderate) [5-15 percent]
H (High) [15-40 percent]
VH (Very high) [40-80 percent]
EH (Extremely high) [80-100 percent]

Topsoil salinity

N (Non) [0-2 dS/m]
SL (Slightly) [2-4 dS/m]
M (Moderately) [4-8 dS/m]
S (Strongly) [8-16 dS/m]
VS (Very strongly) [16-32 dS/m]
E (Extremely) [32-500 dS/m]

Subsoil salinity

N (Non or slightly) [0-4 dS/m]
SL (Slightly) [4-8 dS/m]
M (Moderately) [8-16 dS/m]
S (Strongly) [16-32 dS/m]
VS (Very strongly) [32-64 dS/m]
E (Extremely) [64-500 dS/m]

pH of topsoil

ULTAC (Ultra acid) [0-3.4 units]
EXTAC (Extremely acid) [3.4-4.4 units]
VSTAC (Very strongly acid) [4.4-5 units]
STRAC (Strongly acid) [5-5.5 units]
MODAC (Moderately acid) [5.5-6 units]
SLIAC (Slightly acid) [6-6.5 units]
NEUTR (Neutral) [6.5-7.3 units]
MILAC (Mildly alkaline) [7.3-7.8 units]
MOALK (Moderately alkaline) [7.8-8.4 units]
STALK (Strongly alkaline) [8.4-9 units]
VSALK (Very strongly alkaline) [9-14 units]

Topsoil content in phosphorus (Olsen)

VL (Very low) [0-5 ppm]
L (Low) [5-9 ppm]
M (Moderate) [9-17 ppm]
H (High) [17-25 ppm]
VH (Very high) [25-500 ppm]

Topsoil content of nitrogen

VL (Very low) [0-.04 percent]
L (Low) [.04-.08 percent]
M (Moderate) [.08-.15 percent]
H (High) [.15-100 percent]

Potassium content in topsoil

VL (Very low) [0-.1 meq/100g]
L (Low) [.1-.15 meq/100g]
M (Moderate) [.15-.2 meq/100g]
H (High) [.2-.4 meq/100g]
VH (Very High) [.4-.75 meq/100g]
EH (Extremely high) [.75-10 meq/100g]

Cation exchange capacity of topsoil

EL (Extremely low) [0-3 meq/100g]
VL (Very low) [3-6 meq/100g]
L (Low) [6-10 meq/100g]
M (Moderate) [10-20 meq/100g]
H (High) [20-500 meq/100g]

Exchangeable sodium percentage of topsoil

N (Non sodic) [0-6 percent]
SL (Slightly sodic) [6-15 percent]
M (Moderately sodic) [15-30 percent]
S (Strongly sodic) [30-50 percent]
VS (Very strongly sodic) [50-70 percent]
E (Extremely sodic) [70-100 percent]

Exchangeable sodium percentage of subsoil

N (Non sodic) [0-6 percent]
SL (Slightly sodic) [6-15 percent]
M (Moderately sodic) [15-30 percent]
S (Strongly sodic) [30-50 percent]
VS (Very strongly sodic) [50-70 percent]
E (Extremely sodic) [70-100 percent]

Vegetation cover density

H (High)
M (Medium)
L (Low)

Table 14 Tabular Map Units Description (part 1)

MAP UNITS	DEC1	DEC2	DEC3	DEC4	DEC5	DEC6	DEC7	DUC1	DUC2	DUC3	DUC4	DUC5	DUC6	DUC7	DUI1	DUI2
Slope gradient	B	C	D	E	E	F	D	F	D	F	E	F	F	D	C	D
Microtopography	M	SL	M	M	M	S	S	S	S	S	SL	S	SL	S	M	M
Flooding frequency	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Ponding frequency	I	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Ponding duration	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Drainage class	I	I	SE	SE	E	E	I	E	E	E	E	E	E	E	SE	SE
Infiltration rate	MS	VR	VR	R	VR	VR	VR	VR	VR	VR	VR	VR	VR	VR	VR	VR
Permeability	MS	ER	ER	R	ER	ER	S	ER	ER	ER	ER	ER	ER	ER	ER	ER
Surface drainage	S	S	S	M	M	R	S	R	M	R	M	R	R	M	S	S
Depth of water table	S	MS	VED	VED	VED	VED	VED	VED	VED	VED	VED	VED	VED	VED	VED	VED
Salinity of water table	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L
Local classification	XIN	NTL	NTL	GIH	NTL	NTL	MAs	PUW	NTL	NTL	NTL	NTL	NTL	NTL	NTL	NTL
Concentrated water erosion	N	N	M	M	M	M	M	N	N	M	N	M	N	N	N	N
Sheet water erosion	N	N	M	M	M	M	M	M	N	M	M	M	M	N	N	N
Wind erosion	SL	SL	SL	SL	SL	SL	SL	VS	M	M	M	S	M	M	SL	SL
Water holding capacity	H	VL	VL	L	VL	VL	L	VL	VL	VL	VL	VL	VL	VL	VL	VL
Type of surface horizon	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Particle-size	FL	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Topsoil texture	SCL	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
Topsoil clay percent	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Cracking clay	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Topsoil consistency dry	SO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO
Topsoil stickiness	SST	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST
Topsoil plasticity	SPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL
Topsoil CaCO3	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Topsoil salinity	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Subsoil salinity	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Topsoil pH	MODAC	MODAC	STRAC	SLIAC	SLIAC	SLIAC	STRAC	MODAC	MODAC	MODAC	SLIAC	MODAC	SLIAC	SLIAC	SLIAC	SLIAC
Topsoil phosphorus	M	L	VH	L	VL	VL	L	VL	VL	VL	VL	VL	VL	VL	VL	VL
Topsoil nitrogen	M	L	VL	M	VL	VL	L	VL	VL	VL	VL	VL	VL	VL	L	L
Topsoil potassium	H	M	VL	H	VL	VL	VL	VL	VL	VL	VL	VL	VL	VL	VL	VL
Topsoil CEC	H	VL	EL	VL	VL	VL	VL	EL	EL	EL	VL	EL	VL	VL	VL	VL
Topsoil ESP	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Subsoil ESP	N	N	N	N	N	N	M	SL	N	N	N	N	N	N	N	N
Vegetation density	H	M	M	H	M	M	M	L	H	H	L	L	M	H	M	M

MAP UNITS	DUI3	DUI4	DUI5	DUI6	DUI7	DUI8	DUI9	DUI10	DUI11	DUI12	DEH1-1	DEH1-2	DEH2	DEM	DES
Slope gradient	E	E	F	D	D	C	D	E	C	C	A	B	A	C	B
Microtopography	M	M	M	M	M	M	M	M	SL	SL	M	M	M	M	M
Flooding frequency	N	N	N	N	N	N	N	N	N	N	R	N	N	N	N
Ponding frequency	N	N	N	N	N	N	N	N	N	N	F	I	VF	I	I
Ponding duration	S	S	S	S	S	S	S	S	S	S	L	S	VL	M	S
Drainage class	E	E	E	E	SE	SE	SE	SE	SE	SE	P	I	VP	SE	SE
Infiltration rate	VR	R	VR	VR	VR	R	R	R	VR	VR	R	R	MR	R	R
Permeability	ER	ER	ER	ER	ER	R	R	R	ER	ER	R	R	MR	ER	R
Surface drainage	M	M	R	M	S	S	S	M	S	S	P	S	P	S	S
Depth of water table	VED	VED	VED	VED	VED	VED	VED	VED	VED	VED	S	MS	ES	VD	VED
Salinity of water table	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Local classification	NTL	NTL	NTL	NTL	NTL	GIH	GIH	GIH	NTL	NTL	TSO	XIX	TSO	TLs	XIX
Concentrated water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sheet water erosion	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N
Wind erosion	SL	N	M	M	SL	SL	SL	SL	SL	SL	N	SL	N	SL	SL
Water holding capacity	VL	VL	VL	VL	VL	L	L	L	VL	VL	L	VL	L	VL	L
Type of surface horizon	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Particle-size	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Topsoil texture	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	LCS	CS	CS	CS	CS
Topsoil clay percent	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Cracking clay	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Topsoil consistency dry	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	SO	SO	SO	LO	LO
Topsoil stickiness	NST	NST	NST	NST	NST	NST	NST	NST	NST	NST	SST	NST	SST	NST	NST
Topsoil plasticity	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	NPL	SPL	NPL	SPL	NPL	NPL
Topsoil CaCO3	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Topsoil salinity	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Subsoil salinity	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Topsoil pH	SLIAC	SLIAC	SLIAC	MODAC	MODAC	SLIAC	SLIAC	SLIAC	STRAC	SLIAC	SLIAC	MODAC	SLIAC	MODAC	MODAC
Topsoil phosphorus	VL	VL	VL	L	L	L	L	L	L	L	H	VL	H	VL	L
Topsoil nitrogen	L	VL	VL	L	L	M	M	M	L	L	H	M	H	VL	L
Topsoil potassium	VL	VL	VL	VL	VL	H	H	H	L	H	M	VL	M	VL	VL
Topsoil CEC	VL	VL	VL	EL	EL	VL	VL	VL	VL	EL	M	VL	M	EL	EL
Topsoil ESP	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Subsoil ESP	N	N	N	N	N	N	N	N	N	N	N	N	N	SL	N
Vegetation density	H	H	M	M	H	M	M	H	H	H	H	H	H	M	M

Table 14 Tabular Map Units Description (part 2)

MAP UNITS	PLA-1	PLA-2	COM1	COM2-1	COM2-2	COM3-1	COM3-2	COM4	PBC1-1	PBC1-2	PBC2-1	PBC2-2	PBC3-1	PBC3-2	PBC4-1	PBC4-2
Slope gradient	B	B	B	B	B	B	B	B	B	A	A	A	C	A	C	B
Microtopography	M	M	S	S	S	S	M	S	S	M	M	M	S	M	S	M
Flooding frequency	N	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ponding frequency	N	F	I	I	I	I	I	I	I	F	I	F	I	F	I	F
Ponding duration	S	S	S	S	S	S	M	S	S	M	S	M	S	L	S	L
Drainage class	SE	I	W	W	MW	MW	MW	W	MW	P	MW	P	MW	VP	I	VP
Infiltration rate	R	MS	M	M	MS	MS	S	MR	MS	S	S	S	S	S	S	S
Permeability	R	MS	MS	MS	MS	MS	VS	MR	MS	VS	VS	VS	VS	VS	VS	VS
Surface drainage	S	S	S	S	S	S	S	S	S	P	S	P	M	P	M	P
Depth of water table	VD	MS	VED	VED	VED	VED	ED	VED	VED	MS	ED	MS	D	S	MD	S
Salinity of water table	L	L	M	M	M	M	H	M	M	H	H	H	H	H	H	H
Local classification	XIX	NTG	TLp	TLp	TLp	TLp	BIL	TLp	TLp	BIL	BIL	BIL	TLp	BIL	BIL	BIL
Concentrated water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sheet water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Wind erosion	SL	SL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Water holding capacity	VL	M	H	H	VH	VH	VH	M	VH	VH	VH	VH	VH	VH	VH	VH
Type of surface horizon	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Particle-size	S	FL	FL	FL	FC	FC	VFC	CoL	FC	VFC	VFC	VFC	FC	VFC	FC	VFC
Topsoil texture	CS	SCL	L	L	CL	CL	C	FSL	CL	C	C	C	CL	C	CL	C
Topsoil clay percent	L	M	M	M	H	H	H	L	H	VH	VH	VH	H	VH	H	VH
Cracking clay	N	N	N	N	N	N	P	N	N	P	P	P	N	P	N	P
Topsoil consistency dry	LO	SO	HA	HA	HA	HA	VHA	SHA	HA	VHA	VHA	VHA	HA	VHA	HA	VHA
Topsoil stickiness	NST	SST	SST	SST	ST	ST	ST	SST	ST	ST	ST	ST	ST	ST	ST	ST
Topsoil plasticity	NPL	SPL	SPL	SPL	PL	PL	PL	SPL	PL	PL	PL	PL	PL	PL	PL	PL
Topsoil CaCO3	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Topsoil salinity	N	N	N	N	N	N	N	N	N	M	N	M	N	M	SL	S
Subsoil salinity	N	N	N	N	N	N	SL	N	N	M	SL	M	SL	M	SL	M
Topsoil pH	MODAC	MODAC	NEUTR	NEUTR	SLIAC	SLIAC	NEUTR	SLIAC	SLIAC	NEUTR	NEUTR	NEUTR	NEUTR	NEUTR	SLIAC	SLIAC
Topsoil phosphorus	L	M	VH	VH	VH	VH	VH	M	VH	VH	VH	VH	VH	VH	L	L
Topsoil nitrogen	L	M	L	L	M	M	M	L	M	M	M	M	M	M	H	H
Topsoil potassium	M	H	EH	EH	EH	EH	EH	EH	EH	EH	EH	EH	EH	EH	EH	EH
Topsoil CEC	L	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H
Topsoil ESP	N	N	N	N	N	N	N	N	N	SL	N	SL	SL	SL	SL	SL
Subsoil ESP	N	N	N	N	N	N	SL	N	N	M	SL	M	SL	M	SL	M
Vegetation density	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

MAP UNITS	RIH	RIS1	RIS2	TE1-1	TE1-2	TE2	TE3	TE4	TE5	TE6	TE7	TE8	TEA1	TEA2	TEM
Slope gradient	A	B	B	B	B	A	B	A	A	A	A	A	C	B	A
Microtopography	M	M	M	M	S	SL	M	SL	M	SL	SL	SL	M	SL	M
Flooding frequency	R	R	R	R	R	R	R	R	F	I	F	VF	N	N	R
Ponding frequency	VF	F	F	I	I	I	I	F	I	I	F	VF	N	N	I
Ponding duration	VL	M	L	M	S	S	S	M	S	S	L	VL	S	S	S
Drainage class	VP	I	P	MW	MW	I	MW	I	I	I	P	VP	E	I	MW
Infiltration rate	VS	S	VS	S	MS	R	MS	MS	MR	MS	S	S	R	R	MS
Permeability	VS	VS	S	VS	MS	S	MS	MS	MR	MS	S	S	R	R	VS
Surface drainage	P	S	P	S	S	S	S	P	S	S	P	P	M	M	S
Depth of water table	ES	MD	S	ED	VED	VED	ED	ED	D	MD	S	VS	ED	MD	ED
Salinity of water table	M	M	M	H	M	M	M	M	H	H	H	H	L	L	H
Local classification	TSO	BIL	TSO	BIL	TLp	TLp	TLp	BIL	TLp	TLp	BIL	BIL	NTL	NTL	MAp
Concentrated water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sheet water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Wind erosion	N	N	N	N	N	N	N	N	N	N	N	N	SL	SL	N
Water holding capacity	VH	VH	VH	VH	VH	H	H	VH	H	VH	VH	VH	VL	L	VH
Type of surface horizon	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Particle-size	VFC	VFC	VFC	VFC	FC	S/C	C/S	FC	FL/S	FC	C/L	VFC	S	S	FC
Topsoil texture	C	C	C	C	CL	LS	SiC	SiC	L	SiC	SiC	C	CS	CS	SCL
Topsoil clay percent	VH	VH	VH	H	H	L	H	H	L	H	H	VH	L	L	H
Cracking clay	P	P	P	P	N	N	N	P	N	N	P	P	N	N	P
Topsoil consistency dry	HA	HA	HA	VHA	HA	SHA	HA	HA	SHA	HA	HA	VHA	LO	LO	HA
Topsoil stickiness	ST	ST	ST	ST	ST	NST	ST	ST	SST	ST	ST	ST	NST	NST	ST
Topsoil plasticity	PL	PL	PL	PL	PL	NPL	PL	PL	SPL	PL	PL	PL	NPL	NPL	PL
Topsoil CaCO3	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Topsoil salinity	M	N	SL	N	N	N	N	N	SL	SL	S	E	N	N	N
Subsoil salinity	M	SL	SL	SL	N	N	N	N	SL	M	M	S	N	N	N
Topsoil pH	SLIAC	SLIAC	SLIAC	NEUTR	SLIAC	SLIAC	NEUTR	SLIAC	NEUTR	NEUTR	NEUTR	NEUTR	STRAC	STRAC	SLIAC
Topsoil phosphorus	M	M	M	VH	VH	M	VH	VH	M	M	M	M	H	H	VH
Topsoil nitrogen	H	H	H	M	M	VL	L	M	L	M	M	M	VL	VL	M
Topsoil potassium	EH	EH	EH	H	EH	M	EH	EH	H	EH	EH	EH	M	M	EH
Topsoil CEC	H	H	H	H	H	L	H	H	M	H	H	H	EL	EL	H
Topsoil ESP	SL	N	N	N	N	N	N	N	N	SL	M	VS	N	N	M
Subsoil ESP	M	SL	SL	SL	N	N	N	N	SL	M	M	VS	N	N	M
Vegetation density	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M

Table 14 Tabular Map Units Description (part 3)

MAP UNITS	VAL1-1	VAL1-2	VAL2-1	VAL2-2	VAL2-3	PLI1	PLI2	PLI3	PLI4-1	PLI4-2	PLI5	PLI6	PLI7	PLI8-1	PLI8-2	PLI9	PLI10-1	PLI10-2
Slope gradient	A	B	B	B	B	A	A	B	B	B	A	A	A	A	A	A	A	A
Microtopography	M	M	M	M	M	SL	SL	M	M	S	SL	SL	SL	SL	M	M	SL	SL
Flooding frequency	R	N	I	I	N	R	R	R	R	R	R	R	R	R	R	R	R	R
Ponding frequency	F	I	F	F	I	I	F	I	I	I	F	F	F	F	F	F	F	F
Ponding duration	M	S	L	M	S	S	M	M	M	S	M	M	M	M	M	M	M	M
Drainage class	P	I	VP	P	I	MW	MW	MW	MW	MW	I	I	I	I	I	I	I	I
Infiltration rate	R	R	MR	MS	R	S	S	S	S	MS	S	S	S	MS	S	S	S	S
Permeability	R	R	MR	MS	R	VS	VS	VS	VS	MS	VS	VS	VS	MS	VS	VS	S	S
Surface drainage	P	S	P	P	S	S	S	S	S	S	S	P	P	S	S	P	S	P
Depth of water table	MS	MS	S	S	MS	VED	ED	ED	ED	VED	VD	MD	MD	MS	MD	MS	MS	MS
Salinity of water table	L	L	L	L	L	M	H	H	H	M	M	H	H	L	L	L	L	L
Local classification	TSO	XIX	XIB	TSO	XIX	BIL	BIL	BIL	BIL	TLp	BIL	BIL	BIL	TSO	BIL	BIL	BIL	BIL
Concentrated water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sheet water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Wind erosion	N	SL	N	N	SL	N	N	N	N	N	N	N	N	N	N	N	N	N
Water holding capacity	L	VL	H	H	VL	VH	VH	VH	VH	VH	VH	VH	VH	H	VH	VH	M	H
Type of surface horizon	M	M	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Particle-size	S	S	Peat	FL	S	VFC	VFC	VFC	VFC	FC	VFC	VFC	VFC	C/L	VFC	VFC	C/S	C/S
Topsoil texture	LCS	CS	LS	L	CS	C	C	C	C	CL	C	C	C	C	C	C	C	C
Topsoil clay percent	L	L	L	M	L	H	H	H	H	H	H	H	H	H	VH	VH	VH	VH
Cracking clay	N	N	N	N	N	P	P	P	P	N	P	P	P	N	P	P	P	P
Topsoil consistency dry	SO	SO	SO	SHA	SO	VHA	VHA	VHA	VHA	HA	VHA	VHA	VHA	SHA	HA	HA	HA	HA
Topsoil stickiness	SST	NST	SST	SST	NST	ST	ST	ST	ST	ST	ST	ST	ST	ST	ST	ST	ST	ST
Topsoil plasticity	SPL	NPL	SPL	SPL	NPL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL
Topsoil CaCO3	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Topsoil salinity	N	N	N	N	N	N	SL	N	N	N	SL	SL	S	N	N	N	N	M
Subsoil salinity	N	N	SL	N	N	N	SL	SL	SL	N	SL	M	S	N	SL	N	SL	M
Topsoil pH	SLIAC	MODAC	STRAC	MODAC	MODAC	NEUTR	NEUTR	NEUTR	NEUTR	SLIAC	NEUTR	SLIAC	SLIAC	MODAC	MODAC	SLIAC	NEUTR	NEUTR
Topsoil phosphorus	H	VL	VL	H	VL	VH	VH	VH	VH	VH	M	M	M	M	L	L	VL	VL
Topsoil nitrogen	H	M	H	H	M	M	M	M	M	M	M	H	H	H	H	H	H	H
Topsoil potassium	M	VL	VL	EH	VL	EH	EH	EH	H	EH	H	H	H	H	EH	EH	EH	EH
Topsoil CEC	M	VL	H	H	VL	H	H	H	H	H	H	H	H	H	H	H	H	H
Topsoil ESP	N	N	N	N	N	N	N	N	N	N	N	SL	SL	N	SL	SL	SL	SL
Subsoil ESP	N	N	N	SL	N	N	SL	SL	SL	N	SL	M	M	N	M	SL	M	M
Vegetation density	H	H	H	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M

MAP UNITS	PLI11	PLI12	BAD1	BAD2	BAD3	BAD4	BAD5-1	BAD5-2	BAD6	BAD7	BAD8	BAD9-1	BAD9-2	BAD10	MAC1	MAC2	MAC3-1	MAC3-2	MAN
Slope gradient	A	B	A	A	A	A	A	A	A	A	A	A	A	A	B	B	A	A	A
Microtopography	SL	M	N	N	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	M	M	M	SL	SL
Flooding frequency	R	R	VF	R	R	R	R	R	R	R	R	R	R	R	R	R	VF	VF	VF
Ponding frequency	F	F	VF	VF	F	F	F	F	F	F	F	F	F	F	VF	F	VF	VF	VF
Ponding duration	M	M	VL	VL	VL	L	M	S	L	L	M	L	L	L	VL	L	VL	VL	VL
Drainage class	I	MW	VP	VP	VP	P	I	I	VP	I	I	I	I	I	VP	P	VP	VP	VP
Infiltration rate	S	MR	VS	VS	S	MS	MS	S	M	S	S	S	S	S	MR	MR	MR	S	VS
Permeability	S	MR	VS	VS	VS	MS	MS	VS	MR	VS	VS	VS	VS	VS	R	R	R	VS	VS
Surface drainage	P	S	P	P	P	P	S	S	P	P	P	P	P	P	P	P	P	P	P
Depth of water table	MS	D	ES	ES	VS	S	MS	MD	ES	MS	MS	MD	MS	MS	ES	VS	ES	ES	ES
Salinity of water table	M	L	H	H	L	L	L	L	L	H	M	H	H	M	L	L	L	M	H
Local classification	BIL	TLp	XIM	XIM	BIL	TSO	TSO	BIL	TSO	BIL	BIL	BIL	BIL	BIL	XIB	XIB	XIB	BIL	XIM
Concentrated water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sheet water erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Wind erosion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Water holding capacity	H	M	VH	VH	VH	H	H	VH	M	VH	VH	VH	VH	VH	M	M	M	VH	VH
Type of surface horizon	M	M	M	M	M	M	M	M	M	M	M	M	M	M	H	H	H	M	M
Particle-size	C/S	FL/S	VFC	VFC	VFC	FC	C/L	VFC	FL/S	VFC	VFC	VFC	VFC	VFC	Peat	Peat	Peat	VFC	VFC
Topsoil texture	C	FSL	C	C	C	CL	C	C	SCL	C	C	C	C	C	LS	LS	LS	C	C
Topsoil clay percent	VH	L	VH	VH	VH	M	H	VH	M	VH	VH	VH	VH	VH	L	L	L	VH	VH
Cracking clay	P	N	P	P	P	N	N	P	N	P	P	P	P	P	N	N	N	P	P
Topsoil consistency dry	HA	SHA	VHA	VHA	VHA	SHA	SHA	VHA	SHA	VHA	VHA	VHA	VHA	VHA	SO	SO	SO	VHA	VHA
Topsoil stickiness	ST	SST	ST	ST	ST	ST	ST	ST	SST	ST	ST	ST	ST	ST	NST	SST	NST	ST	ST
Topsoil plasticity	PL	SPL	PL	PL	PL	PL	PL	PL	SPL	PL	PL	PL	PL	PL	SPL	PL	SPL	PL	PL
Topsoil CaCO3	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Topsoil salinity	S	N	VS	VS	M	N	N	N	N	SL	N	SL	S	M	SL	N	SL	S	VS
Subsoil salinity	M	N	S	VS	N	N	N	N	SL	M	M	M	S	M	SL	SL	SL	M	E
Topsoil pH	NEUTR	SLIAC	NEUTR	VSTAC	MODAC	MODAC	MODAC	MODAC	MODAC	VSTAC	NEUTR	NEUTR	NEUTR	VSTAC	MODAC	VSTAC	VSTAC	VSTAC	MILAC
Topsoil phosphorus	VL	M	M	M	M	M	M	L	VL	L	H	H	H	L	M	M	L	L	VH
Topsoil nitrogen	H	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Topsoil potassium	EH	H	H	H	EH	H	H	EH	H	EH	EH	EH	EH	EH	VH	EH	VH	EH	EH
Topsoil CEC	H	M	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H	H	H
Topsoil ESP	SL	N	M	M	SL	N	N	N	SL	SL	SL	SL	SL	SL	SL	N	SL	SL	E
Subsoil ESP	M	N	M	M	N	SL	N	N	M	M	M	M	M	M	SL	N	SL	M	E
Vegetation density	M	M	L	L	M	M	M	M	M	M	M	M	M	H	H	H	H	H	H

Table 15 Extent of Map Units (in hectare)

Map Unit	Localidades													District
	Banhine	Chicumbane	Chilaulene	Chirrindzene	Chongoene	Maciene	Muzingane	Nhacutse	Nhamavila	Novunguene	Siaia	Xai-Xai	Zongoene	
BAD1		41					345	87						473
BAD2			119											119
BAD3			328	339	431			1,480			2,996	1,416	703	7,693
BAD4		786		96						586			3	1,471
BAD5		47	44									159	1,408	1,658
BAD6			21										185	206
BAD7		11					392						204	607
BAD8		418	2,299				431	1,093		39	1,359	1,334		6,973
BAD9		2,475					79			2,101			141	4,796
BAD10													265	265
COM1		63	118				1,194	241		280		229		2,125
COM2		512	274				1,258	481		435	362	781	232	4,335
COM3							172	42		229		256		699
COM4												38		38
DEC1		73						75						148
DEC2							18			37	48		29	132
DEC3		240					110	36		282				668
DEC4					206			1,665			1,500			3,371
DEC5								165						165
DEC6												28		28
DEC7							46							46
DEH1			123		105							190	130	548
DEH2		60	91		753	52		22	3			275	148	1,404
DEL			37	65		154		32	255				1,075	1,618
DEM			5			14			145				268	432
DES	2,057							307			666		480	3,510
DUC1			474		146	642			576			75	942	2,855
DUC2			239										302	541
DUC3			3,681		196	205			184			328	2,195	6,789
DUC4			1,417		94							290	1,124	2,925
DUC5					719	146						113		978
DUC6			1,146		1,032	1,055			1,320			442		4,995
DUC7			939		154							67		1,160
DUI1					353								208	561
DUI2	3,678		371		6,870	3,992		33	10,326		2,374	2,714	1,947	32,305
DUI3									83				8,570	8,653
DUI4													1,670	1,670
DUI5					899							988	1,095	2,982
DUI6													8,244	8,244
DUI7	3,136							1,377						4,513
DUI8		509											1,066	1,575
DUI9					640			6,799			3,914			11,353
DUI10													2,429	2,429
DUI11		4,831		10,496			956			5,785				22,068
DUI12							2,285			282				2,567
MAC1					245			373		72	825			1,515
MAC2													509	509
MAC3		6		768									569	1,343
MAN			148										251	399
PBC1							467							467
PBC2							517							517
PBC3							97							97
PBC4													376	376
PLA			654											654
PLI1							148							148
PLI2		393					2,573			586		1,397		4,949
PLI3		558	251				100	411		431				1,751
PLI4							835			3				838
PLI5			2,411				63	1,486		629	2,356	655		7,600
PLI6		3,104	300							1,339		267		5,010
PLI7		695					85			1,100				1,880
PLI8													671	671
PLI9			162											162
PLI10			473											473
PLI11			78											78
PLI12			19										24	43
Q		6												6
RIH							84	124		33	71	37		349
RIL							160	32						192
RIO		229	444	14			93	192		143	109	419	406	2,049
RIS1										112				112
RIS2							215	24		105				344
TE1							788			30				818
TE2							72							72
TE3		72	68				26	86		84	49	223		608
TE4							15			22				37
TE5		43	36											79
TE6			114											114
TE7			172										25	197
TE8			371										276	647
TEA1		41					23	164						228
TEA2			97				44	8			44		11	204
TEM			17				811			668		4		1,500
VAL1													89	89
VAL2		27		194			25	55		60			77	438
Totals	8,871	15,240	17,541	11,972	12,843	6,260	14,527	16,890	12,892	15,473	16,673	12,726	38,347	200,254

Table 16 Extent of Map Units (in percent)

Map Unit	Localidades													District
	Banhine	Chicumbane	Chilaulene	Chirrindzene	Chongoene	Maciene	Muzingane	Nhacutse	Nhamavila	Novenguene	Siaia	Xai-Xai	Zongoene	
BAD1		0.27					2.37	0.52						0.24
BAD2			0.68											0.06
BAD3			1.87	2.83	3.36			8.76			17.97	11.13	1.83	3.84
BAD4		5.16		0.80						3.79			0.01	0.73
BAD5		0.31	0.25									1.25	3.67	0.83
BAD6			0.12										0.48	0.10
BAD7		0.07					2.70						0.53	0.30
BAD8		2.74	13.11				2.97	6.47		0.25	8.15	10.48		3.48
BAD9		16.24					0.54			13.58			0.37	2.39
BAD10													0.69	0.13
COM1		0.41	0.67				8.22	1.43		1.81		1.80		1.06
COM2		3.36	1.56				8.66	2.85		2.81	2.17	6.14	0.61	2.16
COM3							1.18	0.25		1.48		2.01		0.35
COM4												0.30		0.02
DEC1		0.48						0.44						0.07
DEC2							0.12			0.24	0.29		0.08	0.07
DEC3		1.57					0.76	0.21		1.82				0.33
DEC4					1.60			9.86			9.00			1.68
DEC5								0.98						0.08
DEC6												0.22		0.01
DEC7							0.32							0.02
DEH1			0.70		0.82							1.49	0.34	0.27
DEH2		0.39	0.52		5.86	0.83		0.13	0.02			2.16	0.39	0.70
DEL			0.21	0.54		2.46		0.19	1.98				2.80	0.81
DEM			0.03			0.22			1.12				0.70	0.22
DES	23.19							1.82			3.99		1.25	1.75
DUC1			2.70		1.14	10.26			4.47			0.59	2.46	1.43
DUC2			1.36										0.79	0.27
DUC3			20.99		1.53	3.27			1.43			2.58	5.72	3.39
DUC4			8.08		0.73							2.28	2.93	1.46
DUC5					5.60	2.33						0.89		0.49
DUC6			6.53		8.04	16.85			10.24			3.47		2.49
DUC7			5.35		1.20							0.53		0.58
DUI1					2.75								0.54	0.28
DUI2	41.46		2.12		53.49	63.77		0.20	80.10		14.24	21.33	5.08	16.13
DUI3									0.64				22.35	4.32
DUI4													4.35	0.83
DUI5					7.00							7.76	2.86	1.49
DUI6													21.50	4.12
DUI7	35.35							8.15						2.25
DUI8		3.34											2.78	0.79
DUI9					4.98			40.25			23.48			5.67
DUI10													6.33	1.21
DUI11		31.70		87.67			6.58			37.39				11.02
DUI12							15.73			1.82				1.28
MAC1					1.91			2.21		0.47	4.95			0.76
MAC2													1.33	0.25
MAC3		0.04		6.41									1.48	0.67
MAN			0.84										0.65	0.20
PBC1							3.21							0.23
PBC2							3.56							0.26
PBC3							0.67							0.05
PBC4													0.98	0.19
PLA			3.73											0.33
PLI1							1.02							0.07
PLI2		2.58					17.71			3.79		10.98		2.47
PLI3		3.66	1.43				0.69	2.43		2.79				0.87
PLI4							5.75			0.02				0.42
PLI5			13.74				0.43	8.80		4.07	14.13	5.15		3.80
PLI6		20.37	1.71							8.65		2.10		2.50
PLI7		4.56					0.59			7.11				0.94
PLI8													1.75	0.34
PLI9			0.92											0.08
PLI10			2.70											0.24
PLI11			0.44											0.04
PLI12			0.11										0.06	0.02
Q		0.04												0.00
RIH							0.58	0.73		0.21	0.43	0.29		0.17
RIL							1.10	0.19						0.10
RIO		1.50	2.53	0.12			0.64	1.14		0.92	0.65	3.29	1.06	1.02
RIS1										0.72				0.06
RIS2							1.48	0.14		0.68				0.17
TE1							5.42			0.19				0.41
TE2							0.50							0.04
TE3		0.47	0.39				0.18	0.51		0.54	0.29	1.75		0.30
TE4							0.10			0.14				0.02
TE5		0.28	0.21											0.04
TE6			0.65											0.06
TE7			0.98										0.07	0.10
TE8			2.12										0.72	0.32
TEA1		0.27					0.16	0.97						0.11
TEA2			0.55				0.30	0.05			0.26		0.03	0.10
TEM			0.10				5.58			4.32		0.03		0.75
VAL1													0.23	0.04
VAL2		0.18		1.62			0.17	0.33		0.39			0.20	0.22
Totals	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Legend of the soil maps (part 1)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent.				FAO	LOCAL	
SOILS OF COASTAL DUNES								
Shifting aeolian sands	ARhd1	80	Hilly sand dunes, dominantly parallel to the coast, with inclusion of a narrow strip of beach sands.	16-30	Yellowish to whitish aeolian sands with inclusion of marine sands.	Dystri-Haplic Arenosols	Puwa	Mostly bare of vegetation. Includes locally cultivated fields on deforested lands.
Gently undulating wooded coastal aeolian sands	ARhd2	80	Gently undulating wooded sand dunes, dominantly parallel to the coast.	4-8	Yellowish aeolian sands.	Dystri-Haplic Arenosols	N'Tlava	Mostly natural woodland and Casuarina plantations.
Hilly wooded coastal aeolian sands	ARhd3	80	Hilly wooded sand dunes, dominantly parallel to the coast.	8-30		Dystri-Haplic Arenosols	N'Tlava	
Strongly undulating orange coastal sands	ARo1	80	Strongly undulating sand dunes, dominantly parallel to the coast.	8-16	Reddish aeolian sands.	Dystri- Ferralic Arenosols	N'Tlava	Upland crops, with some remnants of natural vegetation (palmeiras, imbis).
Hilly orange coastal sands, partly eroded	ARod2	80	Hilly sand dunes, dominantly parallel to the coast.	8-30		Dystri-Ferralic Arenosols	N'Tlava	Mostly extensive grazing, locally cultivated.
Hilly orange aeolian sand ridges	ARod3	80	Sand ridges dominantly oriented perpendicular to the coast.	8-30		Dystri-Ferralic Arenosols	N'Tlava	
Low coastal dunes cordons	ARhd4	80	Narrow elongated low dunes cordons, irregular in shape but dominantly oriented perpendicular to the coast.	4-8	Yellowish aeolian sands.	Dystri-Haplic Arenosols	N'Tlava	Mostly natural bushland, locally cultivated.

Legend of the soil maps (part 2)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent				FAO	LOCAL	
SOILS OF THE SERRA								
Low interior reddish sands	ARod4	80	Very gently undulated low dunes and interdunal flats.	2-4	Reddish aeolian sands	Dystri-Ferralic Arenosols	N'Tlava	Upland annual crops between moderately dense tree plantations and remnants of original woodland
Reddish interior sand ridges	ARlf1	80	Gently undulating sand ridges	4-8	Reddish aeolian sands	Ferrali-Luvic Arenosols	N'Tlava/ Xiruka	
Strongly undulating brownish interior sand ridges and grayish sands association	ARod5	75	Strongly undulating sand ridges	8-16	Brownish aeolian sands	Dystri-Ferralic Arenosols	N'Tlava	Sparse upland annual crops between moderately dense remnants of woodland and sparse tree plantations
	ARad1	25	Lower slopes and interdunal flats	0-8	Grayish reworked aeolian sands	Dystri-Albic Arenosols	N'Tlava/ Xixefo	Sparse upland annual crops and/or grazing
Strongly undulating brownish interior sand ridges	ARod5	80	Undulating sand ridges	8-16	Brownish aeolian sands	Dystri-Ferralic Arenosols	N'Tlava	Upland annual crops between moderately dense tree plantations and remnants of woodland
Hilly brownish interior sand ridges	ARod6	80	Hilly sand ridges	8-30	Brownish aeolian sands	Dystri-Ferralic Arenosols	N'Tlava	Mostly grazing and limited upland crops. Includes locally moderately dense caju plantations.
Gently undulating grayish sand ridges	ARbd1	80	Gently undulating sand ridges	4-8	Brownish aeolian sands	Dystri-Cambic Arenosols	N'Tlava	Mostly extensive grazing with scattered remnants of original woodland
Gently undulating brownish interior sand ridges and grayish sands association	ARod7	65	Gently undulating sand ridges	4-8	Brownish aeolian sands	Dystri-Ferralic Arenosols	N'Tlava	Upland annual crops between moderately dense tree plantations and remnants of woodland
	ARad1	35	Lower slopes and interdunal depressions	0-8	Grayish reworked aeolian sands	Dystri-Albic Arenosols	Xixefo	
Very gently undulating red interior sandy plateau	ARlf2	80	Very gently undulating to level sandy plateau	2-4	Red (reworked ?) aeolian sands	Ferrali-Luvic Arenosols	Giho	Upland annual crops between moderately dense to dense tree plantations and remnants of woodland
Gently undulating red interior sandy plateau	ARlf3	80	Gently undulating sandy plateau	4-8	Red (reworked ?) aeolian sands	Ferrali-Luvic Arenosols	Giho	
Strongly undulating red interior sand ridges	ARlf4	80	Strongly undulating sand ridges	8-16	Red (reworked ?) aeolian sands	Ferrali-Luvic Arenosols	Giho	Sparse upland annual crops between moderately dense remnants of woodland and sparse tree plantations
Very gently undulating brownish and reddish interior sands	ARbd2	80	Very gently undulating to level sandy plateau	2-4	Brownish aeolian sands	Dystri-Cambic Arenosols	N'Tlava	Upland annual crops between moderately dense to dense tree plantations and remnants of original woodland
	ARod4	20	Very gently undulating to level sandy plateau	2-4	Reddish aeolian sands	Dystri-Ferralic Arenosols	N'Tlava	
Very gently undulating brownish and grayish interior sands	ARbd2	80	Very gently undulating to level sandy plateau	2-4	Brownish aeolian sands	Dystri-Cambic Arenosols	N'Tlava	
	ARad2	20	Very gently undulating to level sandy plateau	2-4	Grayish (reworked ?) aeolian sands	Dystri-Albic Arenosols	N'Tlava	

Legend of the soil maps (part 3)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent				FAO	LOCAL	
				SOILS OF THE RISERS OF THE SERRA				
Imperfectly drained loams of toeslopes	FLmg1	80	Nearly level toeslopes (transition Serra-Vale).	1-2	Fine-loamy over sandy alluvium	Gleyi-Mollic Fluvisols	XiN'Tlavane	Mostly sugarcane, banana, sweet potato, maize, papaya.
Imperfectly drained greyish sands of footslopes	RGug1	80	Very gentle footslopes.	2-4	Sandy colluvium.	Gleyi-Umbric Regosols	N'Tlava	Most common upland crops, sugarcane and sparse cashew and mango trees.
Gently sloping brownish and reddish sands	ARho5	65	Gentle slopes	4-8	Sandy colluvium	Orthi-Haplic Arenosols	N'Tlava	Most common upland crops, cashew, mango and other fruit trees.
	ARod8	35	Gentle slopes.	4-8	Sandy colluvium.	Dystri-Ferralic Arenosols	N'Tlava	
Strongly sloping red sands	ARlf5	80	Strong slopes.	8-16	Sandy colluvium	Ferrali-Luvic Arenosols	Giho	
Strongly sloping reddish sands	ARod9	80	Strong slopes.	8-16	Sandy colluvium	Dystri-Ferralic Arenosols	N'Tlava	
Moderately steep reddish sands	ARod10	80	Moderately steep slopes, with strong microrelief due to natural vegetation.	16-30	Sandy colluvium	Dystri-Ferralic Arenosols	N'Tlava	Mostly under natural woody vegetation
Gently sloping sandy mananga soils	LVho1	80	Gentle slopes, with strong microrelief due to dense and high termites mounds.	4-8	Mananga colluvium.	Orthi-Haplic Luvisols	Mananga of Serra	Most common upland crops, cashew, mango and other fruit trees.
				SOILS OF CLOSED DEPRESSIONS OF THE SERRA				
Poorly drained sandy soils of closed depressions	PHga1	80	Better drained parts of depressions	0-1	Sandy alluvium/colluvium	Areni-Gleyic Phaeozems	TSovo	Wetland crops
	ARge1	20	Nearly level toeslopes	1-2	Sandy colluvium	Eutri-Gleyic Arenosols	Xixefo	Mostly sugarcane, banana, sweet potato, maize, papaya.
Very poorly drained sandy soils of closed depressions	PHga2	80	Bottom of depressions	0-1	Sandy alluvium/colluvium	Areni-Gleyic Phaeozems	TSovo	Reeds, grazing or cropping in exceptionally dry years.
Soils of the margins of lakes and closed wet depressions	ARad3	80	Margins of lakes and of wet closed depressions	2-4	Reworked grayish aeolian sands	Dystri-Albic Arenosols	TLavate of Serra	Mostly grazing but also locally cultivated
Soils of dry closed depressions	ARal4	80	Dry closed depressions	1-2	Reworked grayish aeolian sands	Lamelli-Albic Arenosols	Xixefo	

Legend of the soil maps (part 4)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent				FAO	LOCAL	
SOILS OF ALLUVIAL LEVEES AND POINT BAR COMPLEXES								
Well drained fine-loamy alluvial soils	FLeo1	80	Alluvial levees and well drained terraces	1-2	Stratified alluvium	Orthi-Eutric Fluvisols	TLavate of plain	Most upland annual crops and fruit trees, including cassava. Cashew very rare. Gardens crops because population in the valley is concentrated in these lands.
Well drained fine-loamy and moderately well drained clayey alluvial soils association	FLeo1	65		1-2	Stratified alluvium	Orthi-Eutric Fluvisols		
	FLev1	35		1-2	Stratified alluvium	Verti-Eutric Fluvisols		
Moderately well drained clayey alluvial soils association	FLev1	60		1-2	Stratified alluvium	Verti-Eutric Fluvisols		
	VRep1	40	Lower areas within alluvial levees and well drained terraces	1-2	Clayey alluvium	Pelli-Eutric Vertisols	Bila	Mostly maize and beans. Nearly no trees.
Well drained sandy alluvial soils	FLeo2	80	Alluvial levees and well drained terraces	1-2	Stratified sandy alluvium	Orthi-Eutric Fluvisols	TLavate of plain	Same as COM1 and COM2
Moderately well drained clayey and poorly drained moderately saline heavy clay soils association	FLev1	65	Higher parts of point bar complexes	1-2	Stratified alluvium	Verti-Eutric Fluvisols	TLavate of plain	Mostly maize and beans. Few trees.
	VReg1	35	Lower parts of point bar complexes	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly maize and beans when dry. No trees.
Moderately well drained and poorly drained moderately saline heavy clay soils association	VRep2	65	Higher parts of point bar complexes	0-1	Clayey alluvium	Pelli-Eutric Vertisols	Bila	Mostly maize and beans. Nearly no trees.
	VReg1	35	Lower parts of point bar complexes	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly maize and beans when dry. No trees.
Moderately well and very poorly drained moderately saline heavy clay soils association	FLev2	65	Higher parts of point bar complexes	2-4	Stratified alluvium	Verti-Eutric Fluvisols	TLavate of plain	Mostly maize and beans. Some fruit trees groves.
	VReg2	35	Lower parts of point bar complexes	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly grazing when dry.
Imperfectly drained slightly saline clayey and very poorly drained moderately saline and sodic heavy clay soils association	FLev3	65	Higher parts of point bar complexes	2-4	Clayey alluvium	Verti-Eutric Fluvisols	Bila	Mostly maize and beans. Some fruit trees groves.
	VReg3	35	Lower parts of point bar complexes	1-2	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly grazing when dry.

Legend of the soil maps (part 5)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent				FAO	LOCAL	
SOILS OF THE VALLEY TERRACES								
Clayey soils association of the Munhuana lower terraces	VRep1	65	Lower terraces of rio Munhuana	1-2	Clayey alluvium	Pelli-Eutric Vertisols	Bila	Mostly maize and beans. Few fruit trees groves.
	FLev1	35		1-2	Stratified alluvium	Verti-Eutric Fluvisols	T'Lavate of plain	Mostly maize and beans. Few scattered trees.
Overwashed clay soils of the Munhuana higher terrace	VRep3	80	High terrace of rio Munhuana	0-1	Stratified alluvium	Pelli-Eutric Verrtisols	T'Lavate of plain	Mostly maize and beans and Scattered fruit trees.
Moderately well drained stratified soils of the Limpopo's lower terraces	FLev4	80	Lower terraces of rio Limpopo	1-2	Stratified alluvium	Verti-Eutric Fluvisols	T'Lavate of plain	
Imperfectly drained clayey soils of the Limpopo's lower terraces	FLev5	80	Depressions within lower terraces of rio Limpopo	0-1	Stratified alluvium	Verti-Eutric Fluvisols	Bila	
Imperfectly drained periodically flooded soils of the Limpopo's lower terraces	Fleg1	80	Lower terraces of rio Limpopo	0-1	Stratified alluvium	Gleyi-Eutric Fluvisols	T'Lavate of plain	Mostly bush. Extensive grazing and some upland crops.
Imperfectly drained periodically flooded moderately saline soils	FLeg2	80	Lower terraces	0-1	Stratified alluvium	Gleyi-Eutric Fluvisols	T'Lavate of plain	Mostly maize and beans and Scattered fruit trees.
Poorly drained periodically flooded moderately saline soils	FLeg3	80	Lower terraces	0-1	Stratified alluvium	Gleyi-Eutric Fluvisols	Bila	Extensive grazing.
Very poorly drained periodically flooded extremely saline soils	FLsg1	80	Lower terraces and streams bed	0-1	Stratified alluvium	Gleyi-Salic Fluvisols	Bila	Episodic extensive grazing only when dry.
Excessively drained sandy soils of high terraces	FLea1	80	High terraces	2-4	Alluvial and reworked aeolian sands	Areni-Eutric Fluvisols	N'Tlava	The same upland crops than the serra, cashew and some other fruit trees.
Imperfectly drained sandy soils of high terraces	ARbg	80	High terraces	1-2	Alluvial and reworked aeolian sands	Bathigleyi-Cambic Arenosols	N'Tlava	The same upland crops than the serra and some fruit trees. Cashew rare.
Mananga terraces soils	CMvn	80	High terraces	0-1	Mananga deposits	Hyposodi-Vertic Cambisols	Mananga	Maize and beans. Large areas with grasses and thorny woodland used for grazing.

Legend of the soil maps (part 6)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent.				FAO	LOCAL	
SOILS OF THE FLOOD PLAIN								
Reworked aeolian sands association	FLea2	65	Higher parts of the sandy flood plain	1-2	Stratified sandy alluvium	Areni-Eutric Fluvisols	Xixefo	Mostly grazing or sandy upland crops.
	FLeg4	35	Lower parts of the sandy flood plain	1-2	Stratified alluvium	Gleyi-Eutric Fluvisols	N'Tlangoene	Mostly maize, beans, sweet potato
Moderately well drained heavy clay soils	VRep4	80	Flood plain	0-1	Clayey alluvium	Pelli-Eutric Vertisols	Bila	Mostly maize, beans and squash. Rarely cotton. very few trees.
Moderately well drained slightly saline heavy clay soils	VRep5	80	Flood plain	0-1	Clayey alluvium	Pelli-Eutric Vertisols	Bila	
Moderately well drained heavy clay soils with moderate microrelief	VRep1	80	Flood plain with moderate microrelief due to former meanders	1-2	Clayey alluvium	Pelli-Eutric Vertisols	Bila	
Moderately well drained heavy clay and clay soils association	VRepi	65	Flood plain with moderate microrelief due to former meanders	1-2	Clayey alluvium	Pelli-Eutric Vertisols	Bila	
	FLev1	35	Higher parts of flood plain	1-2	Stratified alluvium	Verti-Eutric Fluvisols	T'Lavate of plain	Most upland crops including cassava. Fruit trees present.
Imperfectly drained slightly saline heavy clay soils	VReg4	80	Flood plain	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Now mostly grazing but normally irrigated rice dominant.
Imperfectly drained moderately saline heavy clay soils	VReg5	80	Flood plain	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly maize and beans. Locally grazing.
Imperfectly drained strongly saline heavy clay soils	VReg6	80	Flood plain	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Now mostly grazing but normally irrigated rice dominant.
Imperfectly drained fine-textured soils with sulfidic material and slightly saline clayey soils association	FLtg1	50	Flood plain	0-1	Stratified alluvium	Gleyi-Thionic Fluvisols	T'Sovo	Maize, banana, beans.
	VReg7	50	Flood plain	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Maize, beans.
Poorly drained heavy clay soils	VReg8	80	Flood plain	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly wetland crops.
Imperfectly drained clayey over sandy soils association	FLeg4	65	Flood plain	0-1	Stratified alluvium	Gleyi-Eutric Fluvisols	Bila	Mostly grazing.
	VReg9	35	Flood plain	0-1	Stratified alluvium	Gleyi-Eutric Vertisols	Bila	
Imperfectly drained moderately saline clayey over sandy soils	VReg10	80	Flood plain	0-1	Stratified alluvium	Gleyi-Eutric Vertisols	Bila	
Imperfectly drained fine-loamy over sandy soils	FLeo3	80	Flood plain	1-2	Stratified alluvium	Orthi-Eutric Fluvisols	T'Lavate of plain	Maize, beans, sweet potato, cassava and fruit trees.

Legend of the soil maps (part 7)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent				FAO	LOCAL	
SOILS OF THE VALLEY BACK SWAMPS, FLOODED SMALL VALLEYS AND CLOSED DEPRESSIONS								
Flooded clayey and saline soils	FLsg2	80	Flooded depressions	0-1	Clayey alluvium	Gleyi-Salic Fluvisols	Ximunhuanine	Reeds. Extensive grazing on exceptionally dry years.
Flooded clayey and saline soils with sulfidic material	FLtg2	80	Flooded depressions	0-1	Clayey alluvium	Gleyi-Thionic Fluvisols	Ximunhanine	
Very poorly drained moderately saline heavy clay soils	VReg11	80	Back swamps	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Now largely grazing, but normally irrigated rice or dryland maize and beans dominant
Poorly drained humic clay soils	FLmg2	80	Back swamps	0-1	Clayey alluvium	Gleyi-Mollic Fluvisols	TSovo	Mostly wetland crops.
Imperfectly drained fine-textured soils with sulfidic material and heavy clay soils association	FLtg1	65	Back swamps	0-1	Stratified alluvium	Gleyi-Thionic Fluvisols	TSovo	
	VReg4	35	Back swamps	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	
Very poorly drained sandy soils	FLtg3	80	Flooded small valley	0-1	Stratified alluvium	Gleyi-Thionic Fluvisols	TSovo	Reeds and wetlands crops in better drained areas.
Imperfectly drained slightly over moderately saline heavy clay soils with sulfidic material	VRet1	80	Back swamps	0-1	Clayey alluvium	Protothioni-Eutric Vertisols	Bila	Grazing and maize and beans.
Poorly drained moderately saline heavy clay soils	VReg12	80	Back swamps	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Now largely grazing, but normally irrigated rice or maize and beans dominant.
Imperfectly drained moderately to strongly saline heavy clay soils	VReg13	65	Back swamps	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly extensive grazing, locally maize and beans.
	VReg14	35	Back swamps	0-1	Clayey alluvium	Sali-Eutric Vertisols	Bila	Extensive grazing.
Imperfectly drained moderately saline heavy clay soils with sulfidic material	VRet2	80	Back swamps	0-1	Clayey alluvium	Protothioni-Eutric Vertisols	Bila	Grazing or maize and beans.
Imperfectly drained heavy clay soils of abandoned meanders	VReg15	80	Abandoned meanders	1-2	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Mostly maize and beans.
Poorly drained heavy clay soils of abandoned meanders	VReg16	80	Abandoned meanders	1-2	Clayey alluvium	Gleyi-Eutric Vertisols	Bila	Wetland crops or grazing.
Very poorly drained heavy clay soils of abandoned meanders	VReg17	80	Abandoned meanders	0-1	Clayey alluvium	Gleyi-Eutric Vertisols	TSovo	Mostly reeds. Grazing on exceptionally dry years.

Legend of the soil maps (part 8)

MAP UNIT NAME	COMPONENT		PHYSIOGRAPHY	DOMINANT SLOPE GRADIENT	PARENT MATERIAL	SOIL CLASSIFICATION		PRESENT LAND USE
	Symbol	Percent				FAO	LOCAL	
PEAT AND HUMIC SANDY SOILS FORMED IN ALLUVIAL PLAINS AND SMALL VALLEYS								
Very poorly drained peat soils	HSfe	80	Swamps at the foot of the risers of the Serra	1-2	Moderately acid peat	Eutri-Fibric Histosols	Xiboa	Wetland crops when artificially drained, otherwise only reeds
Poorly drained peat soils	HSfd1	80	Swamps at the foot of the risers of the Serra	1-2	Very strongly acid peat	Dystri-Fibric Histosols	Xiboa	Wetland crops when artificially drained, otherwise only reeds
Lumane valley floor complex	HSfd2	65	Swampy valley floor of the rio Lumane	0-1	Very strongly acid peat	Dystri-Fibric Histosols	Xiboa	Permanently submerged. Only reeds.
	VRet3	35			Heavy clay alluvium	Protothioni-Eutric Vertisols	Bila	
Narrow valleys humic sandy soils association	PHge3	65	Swampy valley floor of small streams	0-1	Sandy alluvium	Eutri-Gleyic Phaeozems	TSovo	Most upland crops and few fruit trees.
	ARgel	35	Toeslopes of bordering sandy plateau	1-2	Sandy colluvium	Eutri-Gleyic Arenosols	Xixefo	Sugarcane, banana, papaya, maize, sweet potato
Poorly drained narrow valleys soils complex	HSfd3	45	Swampy valley floor of small streams	1-2	Strongly acid peat	Dystri-Fibric Histosols	Xiboa	Wetland crops when artificially drained, otherwise only reeds Sugarcane, banana, papaya, maize, sweet potato
	FLmg4	35		1-2	Fine-textured alluvium	Gleyi-Mollic Fluvisols	TSovo	
	ARgel	20	Toeslopes of bordering sandy plateau	1-2	Sandy colluvium	Eutri-Gleyic Arenosols	XiXefo	
Mangrove soils	FLsg3	100	Tidal flats	0-1	Clayey alluvium	Gleyi-Salic Fluvisols	Ximunhuanine	Mangrove woodland
MISCELLANEOUS MAP UNITS								
Lake formed between sand dunes								
Lake formed in abandoned meanders								
Quarry for the extraction of red earthy sand								

5. LAND EVALUATION

5.1 Introduction

We have used simultaneously formal land evaluation methods and indigenous knowledge.

5.2 Formal land suitability evaluation

5.2.1 Methodology

The objective in this case is to identify the land suitability for broad land use types. We have built 14 different computer (ALES) models to determine the suitability for the following land utilization types:

- mechanized (surface) irrigation farming (current and potential)
- mechanized irrigated rice production (current and potential)
- mechanized rainfed farming (current and potential)
- animal traction-based rainfed farming (current and potential)
- hand tools-based rainfed farming (current and potential)
- traditional wetland farming (current and potential)
- extensive grazing (only current)
- forestry (only current)

The ALES programme was used to build expert systems (the above mentioned models) which consist of decision trees based on rules elicited from farmers, from the observation of local crops behaviour and from available secondary information. The models together constitute a land capability system.

The ALES land evaluation computer software follows the FAO Framework for Land Evaluation (FAO, 1976) which defines the following suitability categories:

- **suitability orders** reflecting kinds of suitability, namely **S** which is suitable, and **N** which is unsuitable.

- **suitability classes**, reflecting degree of suitability within orders. Usually but not necessarily 4 which are S1, S2, S3 and N[5].

- **suitability subclasses** reflecting kinds of limitation, or main kinds of improvement measures required, within classes. For example in S2**d**, d means require drainage.

- **land suitability units** reflecting minor differences in required management within subclasses (not used in Xai-Xai).

In order to determine the land suitability for a particular LUT, we first computed the suitability rating of each land quality, then combined the ratings of all the relevant land qualities, using the maximum limitation method. For details, the reader is invited to consult the models which are available in digital form in DTA.

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[5] Here we do not distinguish between N1 and N2 as no economic evaluation is contemplated. at this stage

5.2.2 Results

Table 18 (parts 1 and 2) shows the suitability evaluation for the current situation whereas table 19 (parts 1 and 2) shows the suitability after drainage and fertilization, wherever relevant.

5.3 Farmers generated land suitability evaluation

5.3.1 Methodology

Semi-structured interviews and ranking techniques were used to elicit farmers knowledge. We asked farmers to rank the soils of their area according to their productivity for various local crops.

Land suitability as predicted by farmers is extremely valuable because it is the result of the accumulated experience of many generations. However, it covers only locally known crops, grown with the techniques that are locally known. Therefore it must be seen as a complement to conventional land evaluation techniques. It can also be used to fine-tune conventional land evaluation expert systems.

5.3.2 Results

Table 20 shows farmers generated land suitability evaluation for the main local crops. Table 21 (parts 1, 2 and 3) shows the detailed suitability rating in each individual interview, by type of crops and by season.

Table 18 Current Land Suitability (part 1)

Map Unit	Forestry	Grazing	Mechanized Irrigated Agriculture	Mechanized Irrigated Rice	Mechanized Rainfed Agriculture	Traditional Agriculture Animal traction	Traditional Agriculture Hand Tools	Traditional Agriculture Wetland
BAD1	4w	4w	4W/f/w/z	4f/z	4f/w/z	4f/w/z	4f/w/z	4W/f/w/z
BAD2	4w/z	4w	4W/w/z	4z	4w/z	4w/z	4w/z	4W/w/z
BAD3	4w	3w	4W/w	3q	4w	4w	4w	4w
BAD4	3w	2w	4W/w	3q	4w	4w	4w	3w
BAD5	2w & 3r	1	3w	2W/n/t & 2W/n/q/t	2e/n/w & 2e/n/q/w	2n/w & 2k/n/w	2n/w & 3k	2W/n/w & 3W/k
BAD6	4w	2n/w	4W/w	3n/q	4w	4w	4w	3W/n/w
BAD7	3r	2x	4W	3n/x/z	3n/w/x/z	3n/w/x/z	3k/n/w/x/z	4W/z
BAD8	3r	1	3W/w/z	3z	3z	3z	3k/z	3W/k/z
BAD9	3r & 3r/z	1 & 2z	4W & 4W/z	3z & 4z	3w/z & 4z	3w/z & 4z	3k/w/z & 4z	4W/z
BAD10	3r	2x	3W/n/w/x/z	3n/x/z	3n/w/x/z	3n/w/x/z	3k/n/w/x/z	4z
COM1	1	1	4t	4W/t	2n	2n	2n	4W/m
COM2	1	1	4t	4W/t	2n & 1	2n & 1	2n & 1	4W/m
COM3	1 & 3r	1	4t & 3t	4W/t & 3W/t	1 & 2e/n/q/w	1 & 2k/n/w	1 & 3k	4W/m
COM4	1	1	4t	4W/t	2e/n	2n	2n	4W/m
DEC1	2w	1	4W	3W/t	2n/w	2n/w	2n/w	2n
DEC2	2m	2m	4W/e/m	4W/m	4e/m	2m/n	2m/n	3W/m
DEC3	2m	3n	4W/e/m/n	4W/m/n	4e/m/n	3n	3n	4W/m
DEC4	2a	3e	4e/t	4W/t	4e	3e	3e	4W/m
DEC5	2a/m	3m	4W/e/m/t	4W/m/t	4e/m	3m/n	3m/n	4W/m
DEC6	3m	3e/m	4W/e/m/q/t	4W/m/q/t	4e/m/q	4k/m	4m	4W/m
DEC7	2w/z	2e/n	4W/e/t	4W/t	4e	2e/m/n/w/x/z	2e/m/n/w/x/z	4W/m
DEH1	3w & 2m/w	2w & 2m/n	4W/w & 4e/m	4W & 4W/m	4w & 4e/m	4w & 3n	4w & 3n	3W/w & 3W/m/n
DEH2	4w	4w	4W/e/w	4W	4e/w	4w	4w	4w
DEL	?	?	?	?	?	?	?	?
DEM	2m	3n	4e/m/n	4W/m/n	4e/m/n	3n	3n	4W/m
DES	1	3n	4e/n	4W/n	4e/n	3n	3n	4W/m
DUC1	3m	4e	4W/e/m/n/q/t	4W/m/n/q/t	4e/m/n/q	4e/k/m	4e/m	4W/m
DUC2	2m	3m/n	4W/e/m/n/t	4W/m/n/t	4e/m/n	3m/n	3m/n	4W/m
DUC3	3m	3e/m/n	4W/e/m/n/q/t	4W/m/n/q/t	4e/m/n/q	4k/m	4m	4W/m
DUC4	2a/m	3e/m	4W/e/m/t	4W/m/t	4e/m	4e	4e	4W/m
DUC5	3m	3e/m/n	4W/e/m/n/q/t	4W/m/n/q/t	4e/m/n/q	4e/k/m	4e/m	4W/m
DUC6	3m	3e/m	4W/e/m/q/t	4W/m/q/t	4e/m/q	4k/m	4m	4W/m
DUC7	2m	3m	4W/e/m/t	4W/m/t	4e/m	3m/n	3m/n	4W/m
DUI1	2m	2m/n	4W/e/m	4W/m	4e/m	3n	3n	4W/m
DUI2	2m	2m/n	4W/e/m	4W/m	4e/m	3n	3n	4W/m
DUI3	2a/m	3m	4W/e/m/t	4W/m/t	4e/m	3m/n	3m/n	4W/m
DUI4	2a/m	3m	4e/m/t	4W/m/t	4e/m	3m/n	3m/n	4W/m
DUI5	3m	3e/m	4W/e/m/q/t	4W/m/q/t	4e/m/q	4k/m	4m	4W/m
DUI6	2m	3m/n	4W/e/m/n	4W/m/n	4e/m/n	3m/n	3m/n	4W/m
DUI7	2m	3n	4W/e/m/n	4W/m/n	4e/m/n	3n	3n	4W/m
DUI8	1	1	4e	4W	4e	2m/n	2m/n	4W/m
DUI9	1	2e	4e	4W	4e	2e/m/n	2e/m/n	4W/m

Table 18 Current Land Suitability (part 2)

Map Unit	Forestry	Grazing	Mechanized Irrigated Agriculture	Mechanized Irrigated Rice	Mechanized Rainfed Agriculture	Traditional Agriculture Animal traction	Traditional Agriculture Hand Tools	Traditional Agriculture Wetland
DUI10	2a	3e	4e/t	4W/t	4e	3e	3e	4W/m
DUI11	2m	2m	4W/e/m	4W/m	4e/m	2m/n/x	2m/n/x	4W/m
DUI12	2m	3n	4W/e/m/n	4W/m/n	4e/m/n	3n	3n	4W/m
MAC1	4w	4a/w	4W/q/w	4W/q	4q/w	4k/w	4w	4w
MAC2	3w	4a	4W/q/w	4W/q	4q/w	4k/w	4w	3n/w/x
MAC3	4w	4a/w & 4w	4W/f/q/w & 4W/f/w	4W/f/q & 4f	4f/q/w & 4f/w	4f/k/w & 4f/w	4f/w	4f/w & 4f/w/z
MAN	4w/z	4w/z	4W/f/w/z	4f/z	4f/w/z	4f/w/z	4f/w/z	4W/f/w/z
PBC1	1 & 3r/w	1 & 2w	4t & 4W/w	4W/t & 3W/q/t/z	1 & 4w	1 & 4w	1 & 4w	4W/m & 4W/z
PBC2	3r & 3r/w	1 & 2w	3t & 4W/w	3W/t & 3W/q/t/z	2e/q & 4w	2k & 4w	3k & 4w	4W/m & 4W/z
PBC3	1 & 4w	1 & 2w	4t & 4W/w	4W/t & 3W/q/t/z	3m & 4w	2m/z & 4w	2m/z & 4w	4W/m & 4W/z
PBC4	2w & 4w	1 & 2w/z	4W/t & 4W/w	4W/t & 3W/q/t/z	3m & 4w	2m/n/w/z & 4w	2m/n/w/z & 4w	4W & 4W/z
PLA	2m & 2w	2m & 1	4e/m/n & 3t/w	4W/m/n & 3W/t	4e/m/n & 2n/w	3n & 2n/w	3n & 2n/w	4W/m & 2W/n
PLI1	3r	1	2W/e/n/q/t/w	2W/n/q/t	2e/n/q	2k/n	3k	4W/m
PLI2	3r	1	2W/e/n/q/t/w	2W/n/q/t	2e/n/q/w	2k/n/w	3k	4W/m
PLI3	3r	1	3t	3W/t	2e/n/q/w	2k/n/w	3k	4W/m
PLI4	3r & 1	1	3t & 4t	3W/t & 4W/t	2e/n/q/w & 1	2k/n/w & 1	3k & 1	4W/m
PLI5	3r	1	3w	2W/n/q/t	2e/n/q/w	2k/n/w	3k	4W/m
PLI6	3r	1	4W	3z	3z	3z	3k/z	4W/z
PLI7	3r/z	2z	4W/z	4z	4z	4z	4z	4W/z
PLI8	2w & 3r	1	3t/w & 3w	2W/n/t & 3W/t	2e/n/w & 2e/n/w/z	2n/w & 2n/w/z	2n/w & 2n/w/z	2W/n/w & 3W
PLI9	3r	1	3t/w	3W/t	2e/n/w/z	2n/w/z	2n/w/z	2W/n/w/z
PLI10	3r	2n	3n/w & 3n/w/z	3n & 3n/z	3n & 3n/z	3n & 3n/z	3n & 3n/z	3n & 4z
PLI11	3r	2n/z	3W/n/w/z	3n/z	3n/z	3n/z	3n/z	4z
PLI12	1	1	3t	3W/t	2e/w	2w	2w	4m
RIH	4w	4w	4W/w	3W/q/t/z	4w	4w	4w	4w/z
RIL	?	?	?	?	?	?	?	?
RIS1	3r	1	3W/t/w	3W/t	2e/w	2w	2w	3W
RIS2	3r/w	2w	4W/w	3W/q/t	4w	4w	4w	3W/w/z
TE1	3r & 1	1	3t & 4t	3W/t & 4W/t	2e/n/q/w & 1	2k/n/w & 1	3k & 1	4W/m
TE2	2w	2n	4n	4W/n	4n	3n	3n	4W/m
TE3	1	1	3t	3W/t	2e/n	2n	2n	4W/m
TE4	3r	1	3w	2W/t	2e/w	2w	2w	4W/m
TE5	3f	2f	3W/f/t/w	3W/f/t	3f	3f	3f	4W/m
TE6	2f/w/z	1	4W	3z	3z	3z	3z	4W/z
TE7	3f/r/w	2f/w/z	4W/w	3f/q/z	4w	4w	4w	4W/z
TE8	4w	4w/z	4W/f/w/z	4f/z	4f/w/z	4f/w/z	4f/w/z	4W/f/w/z
TEA1	2m	3m/n	4e/m/n	4W/m/n	4e/m/n	3m/n	3m/n	4W/m
TEA2	2w	3n	4e/n	4W/n	4e/n	3n	3n	4W
TEM	3r	2z	3g/t/z	3W/t/z	3g/z	3g/z	3g/z	4W/m
VAL1	3w & 2m/w	2w & 2m/n	4w & 4e/m	4W & 4W/m	4w & 4e/m	4w & 3n	4w & 3n	3W & 3W/m/n
VAL2	3w & 4w & 2m/w	2w & 4a & 2m/n	4W/w & 4W/q/w & 4e/m	3W/q/t & 4W/q & 4W/m	4w & 4q/w & 4e/m	4w & 4k/w & 3n	4w & 3n	2f/w & 3n/w & 3W/m/n

Table 19 Potential Land Suitability (part 1)

Map Unit	Drainability	Fertilisers Relevance	Land Utilization Types: Mechanized General Irrigated Agriculture	Mechanized Irrigated Rice cultivation	Mechanized Rainfed Agriculture	Traditonal Agriculture Animal Traction	Traditonal Agriculture Wetland
BAD1	D	NR	4W/f/w/z	4f/z	4f/w/z	4f/w/z	4W/f/w/z
BAD2	N	NR	4W/w/z	4z	4w/z	4w/z	4W/w/z
BAD3	Y	Y	2W/e/z	2z	2e/k	2k	3W/k
BAD4	Y	Y	2W	1	2w	2w	1
BAD5	Y	Y	2W/e	1	2e/w & 2e/k	2w & 2k	2W & 3W/k
BAD6	Y	Y	2m/z	2W/m/z	2w/z	2w/z	2z
BAD7	Y	Y	3W	2n/x/z	2e/k/n/x/z	2k/n/x/z	4W
BAD8	Y	Y	2W/e/z	2z	2e/k/z	2k/z	3W/k
BAD9	Y	Y	3W & 3W/z	2z & 3z	2e/k/z & 3z	2k/z & 3z	4W
BAD10	Y	Y	3z	3z	2e/k/n/x/z	2k/n/x/z	3W/k/z
COM1	NR	Y	4t	4W/t	1	1	4W/m
COM2	NR	Y	4t	4W/t	1	1	4W/m
COM3	Y	Y	4t & 2W/e/t/z	4W/t & 2W/t/z	1 & 2e/k/w	1 & 2k/w	4W/m
COM4	NR	Y	4t	4W/t	2e	1	4W/m
DEC1	Y	Y	2W/t	2W/t	2w	2w	1
DEC2	NR	Y	4W/e/m	4W/m	4e/m	2m	3W/m
DEC3	NR	D	4W/e/m/n	4W/m/n	4e/m/n	3n	4W/m
DEC4	NR	D	4e/t	4W/t	4e	3e	4W/m
DEC5	NR	D	4W/e/m/t	4W/m/t	4e/m	3m/n	4W/m
DEC6	NR	D	4W/e/m/q/t	4W/m/q/t	4e/k/m/q	4k/m	4W/m
DEC7	NR	D	4W/e/t	4W/t	4e	2e/m/n/x/z	4W/m
DEH1	N	Y	4W/w & 4e/m	4W & 4W/m	4w & 4e/m	4w & 2m/w	3W/w & 3W/m
DEH2	N	N	4W/e/w	4W	4e/w	4w	4w
DEL	N	NR					
DEM	NR	D	4e/m/n	4W/m/n	4e/m/n	3n	4W/m
DES	NR	D	4e/n	4W/n	4e/n	3n	4W/m
DUC1	NR	N	4W/e/m/n/q/t	4W/m/n/q/t	4e/k/m/n/q	4e/k/m	4W/m
DUC2	NR	D	4W/e/m/n/t	4W/m/n/t	4e/m/n	3m/n	4W/m
DUC3	NR	D	4W/e/m/n/q/t	4W/m/n/q/t	4e/k/m/n/q	4k/m	4W/m
DUC4	NR	D	4W/e/m/t	4W/m/t	4e/m	4e	4W/m
DUC5	NR	D	4W/e/m/n/q/t	4W/m/n/q/t	4e/k/m/n/q	4e/k/m	4W/m
DUC6	NR	D	4W/e/m/q/t	4W/m/q/t	4e/k/m/q	4k/m	4W/m
DUC7	NR	D	4W/e/m/t	4W/m/t	4e/m	3m/n	4W/m
DUI1	NR	D	4W/e/m	4W/m	4e/m	3n	4W/m
DUI2	NR	D	4W/e/m	4W/m	4e/m	3n	4W/m
DUI3	NR	D	4W/e/m/t	4W/m/t	4e/m	3m/n	4W/m
DUI4	NR	D	4e/m/t	4W/m/t	4e/m	3m/n	4W/m
DUI5	NR	D	4W/e/m/q/t	4W/m/q/t	4e/k/m/q	4k/m	4W/m
DUI6	NR	D	4W/e/m/n	4W/m/n	4e/m/n	3m/n	4W/m
DUI7	NR	D	4W/e/m/n	4W/m/n	4e/m/n	3n	4W/m
DUI8	NR	D	4e	4W	4e	2m/n	4W/m
DUI9	NR	D	4e	4W	4e	2e/m/n	4W/m
DUI10	NR	D	4e/t	4W/t	4e	3e	4W/m
DUI11	NR	D	4W/e/m	4W/m	4e/m	2m/n/x	4W/m
DUI12	NR	D	4W/e/m/n	4W/m/n	4e/m/n	3n	4W/m

NR= not relevant; Y= yes; D= doubtful

Table 19 Potential Land Suitability (part 2)

Map Unit	Drainability	Fertilisers Relevance	Land Utilization Types: Mechanized General Irrigated Agriculture	Mechanized Irrigated Rice cultivation	Mechanized Rainfed Agriculture	Traditonal Agriculture Animal Traction	Traditonal Agriculture Wetland
MAC1	Y	Y	4q	4W/q	4q	2k/n/w	1
MAC2	Y	Y	4q	4W/q	4q	2k/n/w/x	2x
MAC3	Y	Y	4q & 3z	4W/q & 3z	4q & 2e/k/n/x/z	2k/n/w/x & 2k/n/x/z	2x & 3W/k/z
MAN	N	NR	4W/f/w/z	4f/z	4f/w/z	4f/w/z	4W/f/w/z
PBC1	D	Y	4t & 4W/w	4W/t & 3W/q/t/z	1 & 4w	1 & 4w	4W/m & 4W/z
PBC2	D	Y	3t & 4W/w	3W/t & 3W/q/t/z	2e/k/q & 4w	2k & 4w	4W/m & 4W/z
PBC3	D	Y	4t & 4W/w	4W/t & 3W/q/t/z	3m & 4w	2m/z & 4w	4W/m & 4W/z
PBC4	D	Y	4W/t & 4W/w	4W/t & 3W/q/t/z	3m & 4w	2m/w/z & 4w	4W & 4W/z
PLA	Y	Y	4e/m & 2W/m/t	4W/m & 2W/m/t	4e/m & 2w	2m & 2w	4W/m & 2W
PLI1	Y	Y	2W/e	1	2e/k	2k	4W/m
PLI2	Y	Y	2W/e/z	2z	2e/k	2k	4W/m
PLI3	Y	Y	2W/e/t/z	2W/t/z	2e/k/w	2k/w	4W/m
PLI4	Y	Y	2W/e/t/z & 4t	2W/t/z & 4W/t	2e/k/w & 1	2k/w & 1	4W/m
PLI5	Y	Y	2W/e/z	2z	2e/k	2k	4W/m
PLI6	Y	Y	3W	2z	2e/k/z	2k/z	4W
PLI7	Y	Y	3W/z	3z	3z	3z	4W
PLI8	Y	Y	2W/e & 2W/e/t/z	1 & 2W/t/z	2e/w & 2e/z	2w & 2z	2W & 3W
PLI9	Y	Y	2W/e/t	2W/t	2e/w	2w	2W
PLI10	Y	Y	2W/e/m/z & 3z	2m/z & 3z	2e/z & 2z	2z	3W & 3z
PLI11	Y	Y	3z	3z	2e/z	2z	3W/z
PLI12	Y	Y	2W/e/m/t	3W	2e	1	4m
RIH	N	N	4W/w	3W/q/t/z	4w	4w	4w/z
RIL	N	NR					
RIS1	N	Y	3W/t/w	3W/t	2e/w	2w	3W
RIS2	N	Y	4W/w	3W/q/t	4w	4w	3W/w/z
TE1	NR	Y	3t & 4t	3W/t & 4W/t	2e/k/q/w & 1	2k/w & 1	4W/m
TE2	NR	Y	3W/e/w	4W	3e	2w	4W/m
TE3	NR	Y	3t	3W/t	2e	1	4W/m
TE4	D	Y	3w	2W/t	2e/w	2w	4W/m
TE5	D	Y	3W/f/t/w	3W/f/t	3f	3f	4W/m
TE6	D	Y	4W	3z	3z	3z	4W/z
TE7	D	D	4W/w	3f/q/z	4w	4w	4W/z
TE8	D	D	4W/f/w/z	4f/z	4f/w/z	4f/w/z	4W/f/w/z
TEA1	NR	D	4e/m/n	4W/m/n	4e/m/n	3m/n	4W/m
TEA2	NR	Y	4e/n	4W/n	4e/n	2m/w/x	4W
TEM	NR	Y	3g/t/z	3W/t/z	3g/z	3g/z	4W/m
VAL1	Y	Y	3W/e/m & 4e/m	4W & 4W/m	3e/m & 4e/m	2w & 2m/w	3W & 3W/m/n
VAL2	Y	Y	2W/t & 4q & 4e/m	3W & 4W/q & 4W/m	2w & 4q & 4e/m	2w & 2k/n/w & 2m/w	1 & 3W/m/n

NR= not relevant; Y= yes; D= doubtful

Table 20 Farmers Generated Land Suitability For the Main Crops

CROPS	SEASON	SOILS						
		N'tlava	Xin'Tlavane	T'sovo Normal	T'sovo Well drained	T'sovo Poorly drained	Bila	T'lavate (of plain)
Cassava	NR	2	3	0	3	0	1	3
Cocoyam	NR	0	1	3	3	0	0	
Pigeon pea	NR	3			2		1	3
Rice	NR	0	0	3	2	3	3	1
Sugar cane	NR	1	2	3	3		1	
Pineapple	NR	3	1		0	0		
Banana	NR	0	2	3	3	0	0	
Papaya	NR	3	2	1	2	0	1	
Sweet potato	C	2	2	1	3	0	1	3
	H	1	2	3	3	0	2	3
Groundnut	C	3	2	0	1	0	0	
	H	3	2	0	1	0	0	
Cowpea	H	3	2	1	1	0	1	3
Beans (F. mantelga)	C	0	0		3	0	1	3
Maize	C	2	2	1	2	0	2	3
	H	1	2	1	3	0	2	3
Pumpkin	C	2	2	3	3	0	3	3
	H	2			3		3	3
Vegetables	C	1	2	3	3	0	2	3

0= unsuitable; 1= marginally suitable; 2= moderately suitable; 3= highly suitabldRice in T'Lavate only if irrigated
C=cool season H=hot season
For sweet potato in the T'sovo (normal) if rain is scarce a moderate yield may be achieved

Table 21 Detailed Farmers Generated Land Suitability (part 1)

CROPS	INTERVIEWS	SOILS						
		N'tlava	Xin'Tlavane	T'sovo Normal	T'sovo Well drained	T'sovo Poorly drained	Bila	T'lavate (of plain)
Cassava	**Average**	**2**	**3**	**0**	**3**	**0**	**1**	**3**
	#2	2			3			
	#3						0	3
	#4	2	3		3	0		
	#5	3	2	0			1	
Cocoyam	**Average**	**0**	**1**	**3**	**3**	**0**	**0**	
	#4	0	2		3	0		
	#5	0	0	3			0	
Pigeon pea	**Average**	**3**			**2**		**1**	**3**
	#2	3			2			
	#3						1	3
Rice	**Average**	**0**	**0**	**3**	**2**	**3**	**3**	**1**
	#3						3	1
	#4	0	0		2	3		
	#5	0	0	3			2	
Sugar cane	**Average**	**1**	**2**	**3**	**3**		**1**	
	#1	0	2	3				
	#2	1			3			
	#4	1	2		3			
	#5	1	3	2			1	
Pineapple	**Average**	**3**	**1**		**0**	**0**		
	#4	3	1		0	0		
Banana	**Average**	**0**	**2**	**3**	**3**	**0**	**0**	
	#1	0	2	3				
	#2	1			3			
	#4	0	2		3	0		
	#5	0	3	3			0	
Papaya	**Average**	**3**	**2**	**1**	**2**	**0**	**1**	
	#4	3	2		2	0		
	#5	3	2	1			1	

0= unsuitable; 1= marginally suitable; 2= moderately suitable; 3= highly suitable
Rice in T'lavate only if irrigated
Cocoyam and rice are included with perennial crops because they grow during more than one season

Table 21 Detailed Farmers Generated Land Suitability (part 2)

Cool season

CROPS	INTERVIEWS	SOILS						
		N'tlava	Xin'Tlavane	T'sovo Normal	T'sovo Well drained	T'sovo Poorly drained	Bila	T'lavate (of plain)
Sweet potato	**Average**	**2**	**2**	**1**	**3**	**0**	**1**	**3**
	#1	1	3	1				
	#2	2			3			
	#3						1	3
	#4	1	2		3	0		
	#5	2	2	0			0	
Groundnut	**Average**	**3**	**2**	**0**	**1**	**0**	**0**	
	#1	3	2	0				
	#2	3			1			
	#4	3	1		0	0		
	#5	3	3	0			0	
Beans (F. manteiga)	**Average**	**0**	**0**		**3**	**0**	**1**	**3**
	#3						1	3
	#4	0	0		3	0		
Maize	**Average**	**2**	**2**	**1**	**2**	**0**	**2**	**3**
	#1	2	2	1				
	#3						3	3
	#4	3	3		2	0		
	#5	2	2	0			3	
Pumpkin	**Average**	**2**	**2**	**3**	**3**	**0**	**3**	**3**
	#2	2			3			
	#3						3	3
	#4	2	2		3	0		
	#5	2	2	3			2	
Vegetables	**Average**	**1**	**2**	**3**	**3**	**0**	**2**	**3**
	#2	0			3			
	#3						-	3
	#4	1	2		3	0		
	#5	2	2	3			2	

0= unsuitable; 1= marginally suitable; 2= moderately suitable; 3= highly suitable

For sweet potato in the T'sovo (normal) if rain is scarce a moderate yield may be achieved

Table 21 Detailed Farmers Generated Land Suitability (part 3)

Hot season

CROPS	INTERVIEWS	SOILS						
		N'tlava	Xin'Tlavane	T'sovo Normal	T'sovo Well drained	T'sovo Poorly drained	Bila	T'lavate (of plain)
Sweet potato	**Average**	**1**	**2**	**3**	**3**	**0**	**2**	**3**
	#1	1	2	3				
	#2	2			3			
	#3						1	3
	#4	0	2		3	0		
	#5	1	2	3			2	
Groundnut	**Average**	**3**	**2**	**0**	**1**	**0**	**0**	
	#1	2	3	0				
	#2	3			1			
	#4	3	1		0	0		
	#5	2	2	0			0	
Cowpea	**Average**	**3**	**2**	**1**	**1**	**0**	**1**	**3**
	#1	3	2	0				
	#2	3			2			
	#3						1	3
	#4	3	2		0	0		
	#5	3	2	1			1	
Maize	**Average**	**1**	**2**	**1**	**3**	**0**	**2**	**3**
	#1	1	3	2				
	#3						3	3
	#4	1	2		3	0		
	#5	1	2	3			2	
Pumpkin	**Average**	**2**	**2**		**3**	**0**	**3**	**3**
	#2	2			3			
	#3						3	3
	#4	1	2		3	0		

0= unsuitable; 1= marginally suitable; 2= moderately suitable; 3= highly suitable
For sweet potato in the T'sovo (normal) if rain is scarce a moderate yield may be achieved

5.4 Crop selection

5.4.1 Methodology

In order to recommend crops that may be grown in the area, we have used FAO's **ECOCOCROP1** computer crop database. ECOCROP1 gives climatic and soil requirements as well as potential uses for 1200 plants, including crops, fruit trees, forage species, timber and fuelwood tree species etc. Once the programme user enters land information, a list of suitable crops is automatically generated upon request. We have also used various crop monographs which include information on crop land requirements.

5.4.2 Results

Table 23 (part 1, 2, 3 and 4) give the list of selected crops for each soil grouping, as defined in table 22. Table 23 gives in sequence: the scientific name, the common english name, type of crop (I= industrial crop; f= food crop; g= grass; t= tree), presence of the plant in Mozambique indicated by M, comments, references and soil groupings in which the plant would normally grow.

Table 25 (part 1,2 and 3) shows the uses that can be made of each plant. The legend of uses is given in table 24.

Table 22 Soil Groupings for Crop Selection

Grouping number	Definition	Map unit components
Soils of the Serra		
1	Somewhat excessively to excessively drained sandy soils	DEC3; DEC4; DEC5; DEC7; DUI1; DUI2; DUI3; DUI4; DUI7; DUI8; DUI9; DUI10; DUI11; DUI12; DEM; DES; PLA-1; TEA1
2	Imperfectly drained sandy soils having a high water table	DEC2; DEH1-2; PLA-2; TEA2; VAL1-2, VAL2-3
3	Seasonally waterlogged humic sandy soils	DEH1-1; VAL1-1
4	Very erodible sandy soils	DUC4; DUC5; DUC6; DUI5; DUI6
5	Extremely erodible sandy soils	DEC6; DUC1; DUC2; DUC3; DUC7
Soils of the Valley		
6	Well drained medium to fine textured soils	COM1; COM2-1; COM4; TE2 (*)
7	Medium to fine textured soils of seasonnally flooded wetlands	BAD4; BAD5; BAD6; DEC1; PLI8-1; PLI9; RIS2; VAL2-2
8	Wetland peat soils (after drainage)	MAC1; MAC2; MAC3-1; VAL2-1
9	Moderately well drained, not or slightly saline medium and fine textured soils	COM2-2; COM3; PBC1-1; PBC2-1; PBC3-1; PLI1; PLI2; PLI3; PLI4; PLI12; TE1; TE3; TEM (**)
10	Imperfectly drained, not or slightly saline medium and fine textured soils	PBC4-1; PLA-2; PLI5; PLI8-2; PLI10-1; RIS1; TE4; TE5
11	Imperfectly to poorly drained, moderately saline fine textured soils	BAD7; BAD8; BAD9-1; BAD10; PBC1-2; PBC2-2; PLI6; PLI10-2; TE6
12	Imperfectly to poorly drained, very saline fine textured soils	BAD9-2; PLI7; PLI11; TE7
13	Very poorly drained moderately to strongly saline fine textured soils	BAD3; MAC3-2 (both drainable); BAD1; BAD2; PBC3-2; PBC4-2; TE8 (not drainable)
14	Mangrove soils periodically flooded by seawater	MAN

(*) TE2 is included in this grouping because it is located in high alluvial terraces, has a coarse textured topsoil and the internal drainage limitation is only due to textural discontinuity.

(**) TEM is included although it differs in having a moderate exchangeable sodium percentage.

Table 23 List of Crops by Soil Groupings (part 1)

Common name	Scientific name	Type	Moz.	Additional notes	References	Soil Groupings													
						1	2	3	4	5	6	7	8	9	10	11	12	13	14
African ebony	Diospyros mespiliformis	t	M		TFP246, DM629, EMAMC51	X			X	X	X								
African mahogani	Khaya senegalensis	t		fire susceptibility	MF351/382/526						X			X					
African oak	Chlorophora excelsa	t			MF350/369, DM196						X								
African star grass	Cynodon nlemfuensis	g			TG316						X								
Alyce clover	Alysicarpus vaginalis	g		nematode susceptibility; will not grow on wetlands	TFL216	X			X		X			X					
Amaranth	Amaranthus dubius L.	f			TFP71						X								
Amaranthus	Amaranthus spp.	f			MA 846, TFP71	X					X								
American joint veld	Aeschynomene americana	g			TFL205		X	X											
Ampupu	Eucalyptus urophylla	t		coastal plantation	EFP503, FFID10/31, MF353/416	X			X	X									
Angleton bluestem	Dichanthium aristatum	g		very good flooding tolerance; highly salt resistant; may become a weed	TG333		X	X				X							
Asparagus	Asparagus officinalis	f				X	X							X					
Australian bluestem	Bothriochloa bladhii	g		tolerates short-term flooding	TG217						X	X		X	X				
Avaram	Cassia auriculata	t			TFP155	X			X	X	X								
Avocado	Persea americana	t	M		MA799	X			X	X									
Axle-wood tree	Anogeissus latifolia	t			FC112, MF35[illegible]/362	X			X	X	X			X					
Bahia grass	Paspalum notatum	g		may become a weed	TG571		X	X											
Bambara groundnut	Voandzeia (Vigna) subterranea	f	M		MA863, TFP5[illegible], TL47	X													
Banana	Musa spp	f			MA804		X				X		X	X					
Barley six-rowed	Hordeum vulgare	f	M		MM284						X								
Barley two-rowed	Hordeum distichon	f	M		MM283						X								
Basam	Grewia bicolor	t	M		DM517, TFP306						X			X					
Basella	Basella alba	f		no salinity tolerance	MA847, TFP100						X		X	X					
Bermuda grass	Cynodon dactylon v dactylon	g		very drought resistant; survives annual flooding	MM239, TG310		X	X			X	X		X	X	X	X		
Bimbe	Garcinia livingstonei	t	M		DM539	X			X	X									
Birdwood grass	Cenchrus setigerus	g		on sandy dunes: very tolerant of drought and flooding	TG279	X			X										
Boer love grass	Eragrostis chloromelas	g	M	adapted to semi-desert conditions & very drought resistant	TG413	X			X		X								
Bottle gourd	Lagenaria siceraria (M) St.	f			TFP343						X		X	X					
Brachiaria dura	Brachiaria dura	g		extremely drought resistant	TG243	X			X										
Brazilian lucerne	Stylosanthes guianensis var. guianensis	g		tolerates temporary waterlogging, drought resistant	TFL394	X	X		X		X			X	X				
Brazilian lucerne	Stylosanthes guianensis var. intermedia	g		no flooding	TFL407	X			X		X								
Brown beetle grass	Diplachne fusca	g		extremely tolerant to salt	MM261, TG358							X			X	X	X	X	
Buffel grass	Cenchrus ciliaris	g		salinity up to 80meq. Na Cl/l; very drought resistant; no flooding for more than a week	MM214, TG266	X	X		X		X								
Bullock's heart	Annona senegalensis	t	M		TFP84	X			X	X	X								
Bungoma grass	Entolasia imbricata	g		withstands flooding	TG410		X	X				X			X				
Butterfly pea	Clitoria ternatea	g		somewhat tolerant to salt and drought-tolerant: no flooding	TFL258, TL3	X	X		X		X			X					
Butterfly tree	Colophospermum mopane	t	M		DM250, FC122						X			X	X	X			
Cabbage	Brassica oleracea L.v capi.	f	M	during cold season (with irrigation in 1,6,9 and 10)	MA848	X	X				X	X	X	X	X				
Cacana	Momordica basalmina	f	M		EMAMC50	X			X										
Camba	Acacia xanthophloea	t	M	in the interior	DM231						X								
Carribean pine	Pinus caribaea v. hondurensis	t	M	coastal plantation	FFID10/32, MF353/424	X			X	X	X								
Carribean stylo	Stylosanthes hamata	g		some varieties/forms more drought & flood tolerant than others	MA1113/1117, TFL414		X	X				X			X	X			
Carrot	Daucus carota	f	M	during cold season (with irrigation in 1,6,9 and 10)	MA839/842	X	X				X	X	X	X	X				
Cashew	Anacardium occidentale	t	M		MA782, MF352/405	X			X	X									
Cassava	Manihot esculenta	f	M		MA665	X	X				X		X						
Castor	Ricinus communis	I			MA913						X			X					
Centurion	Centrosema pascuorum	g		susceptible to nematodes: very tolerant to drought & flooding	TFL238	X	X	X	X		X	X		X	X				
Chamfuta	Afzelia quanzensis	t	M		DM256	X			X	X									
Channel millet	Echinochloa turneriana	g		no drought tolerance; seeds germinate if flooded; will not grow in permanent water	TG391							X			X				
Chelingamacho	Spirostachy africanus	t	M		DM488	X			X	X									
Chickpea	Cicer arietinum	f		drought tolerant; no waterlogging	TFP175						X			X					
Chicocotzi	Combretum gueinzii	t	M		DM604						X								
Chinese amarath	Amaranthus tricolor L.	f			TFP75	X							X						
Chiquiche	Combretum zeyheri	t	M		DM605						X			X					

Table 23 List of Crops by Soil Groupings (part 2)

Common name	Scientific name	Type	Moz.	Additional notes	References	Soil Groupings													
						1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cimbirre	Androstachys johnsonii	t	M		DM477	X			X	X	X			X					
Citron	Citrus medica	t			MA767/769, TFP192	X			X	X	X								
Citrus	Citrus spp	t	M		MA767/ 769, TFP192	X			X	X	X								
Coast sheoak	Casuarina equisetifolia	t	M		FC38,MF353/410, DM187, FFID10	X	X		X	X	X								
Coconut	Cocos nucifera	t	M		MA882	X			X	X	X								
Coloured Guinea grass	Panicum coloratum	g	M		MM167, TG515						X			X	X	X			
Common russet grass	Loudetia simplex	g		not drought tolerant; on seasonally flooded plains	TG501		X	X				X			X				
Conola	Terminalaria sericea	t	M		DM610	X			X	X									
Corchorus	Corchorus tridens	f		needs regular rainfall; 80-90% rel. humidity	TFP218						X		X						
Cotton	Gossypium hirsutum	I	M		MA1017						X			X	X	X			
Cowpea	Vigna unguiculata unguicu.	f	M	no flooding; very drought tolerant	MA851, TFL477, TFP518	X	X		X		X		X						
Crowfoot grass	Dactyloctenium aegyptium	g	M	extremely drought resistant	TG322, MM248	X			X		X								
Diaz bluestem	Dichanthium annulatum	g		tolerant to short term flooding	TG328						X	X		X	X				
Diospyros	Diospyros spp.	t	M		EMAMC52	X			X	X									
Doum palm	Hyphaene thebaica	t	M	moderately tolerant of saline soils	DM179, TFP333	X			X	X	X			X					
Dubi grass	Urochloa oligotricha	g	M	highly drought resistant	TG740	X			X		X								
East Indian walnut	Albizia lebbeck	t		tolerates salt spray	MF154/352/404, FC110, TL177	X			X	X	X								
Eddoe	Colocasia esculenta v. ant.	f	M	tolerant of flooding; not tolerant to drought			X	X				X	X						
Edible canna	Canna edulis	f			MA642		X												
Eggplant	Solanum melongena	f	M	with irrigation	MA846, TFP461		X				X		X	X					
Elephant grass	Pennisetum purpureum	g	M	mean rainfall: 1500mm; no flooding	MM216, TG621						X								
Elephant orange (Masala)	Strychnos spinosa	t	M		DM641, TFP476	X			X	X									
Feather finger grass	Chloris virgata	g	M	not drought or flood tolerant	TG293, MM243	X			X		X			X					
Finger millet	Eleusine coracana	f	M	no flooding; extremely drought resistant	MA646, TFP264, TG397	X			X		X			X					
Flooded gum	Eucalyptus grandis	t	M	coastal plantation; weedings necessary at early stage	FC84, FFID10/30/31, MF353/418		X				X			X	X				
Forest red gum	Eucalyptus tereticornis	t	M		FFID10/314, MF353/415/525		X				X			X					
Gamba grass	Andropogon gayanus	g		very drought & flood tolerant	TG185, MA1115	X	X	X	X		X	X		X	X				
Garlic	Allium sativum	f	M								X		X	X					
Giant button grass	Dactyloctenium giganteum	g	M	no flooding; very short growing season	MM251, TG325	X			X										
Golden timothy	Setaria sphacelata	g	M	some cultivars drought tolerant; tolerates short-term waterlogging	MA1118, MM210, TG662		X												
Grapefruit	Citrus paradisi	t	M		MA767, TFP192	X			X	X	X								
Grewia	Grewia spp.	t	M		DM115/516517, TFP301	X	X		X	X									
Groundnut	Arachis hypogaea L.	f			MA867	X			X		X								
Guava	Psidium guajava	t	M		TFP415	X			X	X	X			X					
Guinea grass	Panicum maximum	g	M	no waterlogging; poor drought tolerance	MA1112/1116, MM172, TG522	X			X		X			X					
Gympie messmate	Eucalyptus cloeziana	t		coastal plantation	FFID10/30, MF353/416	X			X	X									
Horse bean tree	Parkinsonia aculeata	t	M	weed aroud watering places	TFL578, FC140	X	X		X	X	X			X	X	X			
Inca wheat	Amaranthus caudatus L.	f			TFP71	X							X						
Indian fig	Opuntia ficus-indica	t	M	spineless varieties more useful; extremely drought tolerant; no resistance to salt & waterlogg	TFP374	X			X	X	X								
Indian jujube	Ziziphus mauritianus	t	M	coastal plantation;	DM513, FC160, TFP531	X	X		X	X	X			X	X				
Inhala	Hyphaene critina	t	M		EMAMC48	X			X	X	X								
Italian millet	Setaria italica	g		escapes drought through early maturity; no waterlogging	MA646, MM208, TG655						X								
Janeiro	Eriochloa punctata	g	M	withstands flooding; little drought tolerance; on fertile soil	MM193, TG436		X	X							X				
Japanese millet	Echinochloa frumentacea	g	M	escapes drought through early maturity	MM194, TG376		X					X							
Jaragua grass	Hyparrhenia rufa	g	M	no permanent flooding	MM142, TG460							X		X	X				
Job's tears	Coix lacryma-jobi	g	M	no drought; tolerant to flooding	MA646, MM118, TG300						X	X		X	X				
Kodo millet	Paspalum scrobiculatum	g	M	poorly drought resistant; tolerates flooding	MA646, MM160, TG585							X			X				
Lablab bean	Lablab purpureus	f		drought tolerant when established; no waterlogging	TFL311, TFP337, TL59	X					X			X					
Lehmann love grass	Eragrostis lehmanniana	g	M	drought tolerant	MM276, TG422	X			X										
Leichhardt biflorus (horse gram)	Macrotyloma uniflorum	g		very good drought tolerance; no flooding allowed	TFL349	X			X		X			X					
Lemon sented gum	Eucalyptus citriodora	t	M		FC128, FFID10/30, MF353/415	X			X	X	X			X					
Lentil	Lens culinaris	f		during cold season with irrigation	TFP350						X			X					
Lettuce	Lactuca sativa	f	M		MA850		X				X	X	X	X					
Leucaena	Leucaena leucocephala	t	M	persists with drought but will defoliate; no flooding	FC50, MF353/421, TFL566, TL131	X	X		X	X	X			X					

Table 23 List of Crops by Soil Groupings (part 3)

Common name	Scientific name	Type	Moz.	Additional notes	References	Soil Groupings 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lima bean	Phaseolus lunatus	f		roots in contact with water-table	MA858, TL97						X			X	X				
Lime	Citrus aurantifolia	t			MA767, TFP192	X			X	X	X			X					
Little millet	Panicum sumatrense	g		tolerates drought & waterlogging	TG546	X	X		X										
Liverseed grass	Urochloa panicoides	g		no drought & flooding tolerance	TG743									X					
Long-fruited jute	Corchorus olitorius	f			TFP218						X		X						
Love grass	Chrysopogon aciculatus	g		drought tolerant	TG296	X	X		X		X								
Macuacua	Strychnos innocua	t	M		TFP476	X			X	X									
Mafureira	Trichlea emetica	t	M		DM313	X			X	X	X								
Maize	Zea mays s. mays	f	M		MA1083, TG752	X	X				X		X	X	X				
Mandarin	Citrus reticulata	t	M		MA767, TFP192	X			X	X	X			X					
Mango	Mangifera indica	t	M		MA816, TFP359	X			X	X	X								
Mangrove	Avicenna spp.	t			FC52														X
Mangrove	Brugueira spp.	t			FC52														X
Mangrove	Rhizophora spp.	t			FC52														X
Masai love grass	Eragrostis superba	g	M	good drought tolerance; highly salt resistant	SB42FAO74, MM278, TG425	X			X		X			X					
Massundo	Phoenix reclinata	t	M		EMAMC48	X	X		X	X	X								
Mat grass	Axonopus affinis	g	M	no flooding	TG206, MM163		X												
Milanje grass	Digitaria milanjiana	g		extremely drought resistant; severely affected by fire	TG360	X			X		X			X					
Millet Common	Panicum miliaceum	g	M		MA343/646, TFP378, TG538	X			X		X								
Mission grass	Pennisetum polystachion	g	M	drought & flooding resistant	MM216, TG616	X	X	X	X		X	X		X	X				
Molasses grass	Melinis minutiflora	g	M	fire susceptibility; drought resistant; not flooding & salinity tolerance	MA1116, MM158, TG504	X			X		X								
Mondzo	Combretum imberbe	t	M		DM606	X			X	X	X								
Morula (Canhueiro)	Sclerocarya caffra	t	M		TFP437, DM494	X			X	X									
Moth bean	Vigna aconitifolia	f		no waterlogging; regular rainfall; no heavy rainfall	TL75, TFP402	X					X								
Multhlu	Syzygium cordatum	t	M		DM612	X			X	X	X								
Mung bean	Vigna radiata	f		adapted cultivar for salinity & photo-insensitivity	TFP503	X					X			X					
Natal-palm	Carissa macrocarpa	t	M	good drought resistance; adapted to dunes	TFP143	X			X	X	X								
Neem	Azadirachta indica	t	M	watertable above 18m; ecotypes resistant to drought	FC114, MF352 406/526, TFP88	X			X	X	X			X					
Nulo	Balanites maughamii	t	M		DM299						X								
Okra Lady fingers	Hibiscus esculentus	f	M		MA849, TFP320						X			X					
Onion	Allium cepa	f	M		MA854	X	X				X		X	X					
Oyster nut	Telfaira pedata	f	M		TFP486						X								
Palmyra palm	Borassus flabellifer	t	M		MA1043, TFP109	X			X	X									
Pangola grass	Digitaria decumbens	g	M	withstands temporary flooding; not drought resistant	MA1116, MM189, TG351		X	X			X	X		X	X				
Parkia	Parkia filicoidea	f			TFP391						X			X					
Pea	Pisum sativa	f	M								X		X						
Pearl millet	Pennisetum glaucum	f		drought tolerant; no flooding	MM217, TFP394, TG596	X					X			X					
Perrenial soybean	Glycine wightii	g		adapted varieties to salty soil	TFL357						X			X					
Pigeon Pea	Cajanus cajan (L.) Hunt	f	M		FC118, MA1118, TFL539, TFP130	X					X			X					
Pineapple	Ananas comosus	f	M		MA789	X					X			X					
Plicatulum	Paspalum plicatulum	g		good drought tolerance; highly flood resistant	TG579	X	X	X	X		X	X							
Potato	Solanum tuberosum L.	f	M	regular rainfall	MA684/843		X				X		X						
Princess feather	Amaranthus hypochondriacus	f			TFP71	X					X								
Pummelo	Citrus grandis	t			MA767, TFP192	X			X	X	X			X					
Pumpkin	Cucurbita moschata (Duch.)	f	M	good drought tolerance	TFP232	X					X			X					
Rat's tail grass	Sehima nervosum	g			TG652		X	X			X	X		X	X				
Red oat grass	Themeda triandra	g	M	inland grass; no flooding; adapted varieties	MM150, TG721		X				X			X					
Rhodes grass	Chloris gayana	g	M	seed germinate in 0.4M NaCl; tolerates seasonal waterlogging	MM240, TG283						X			X	X	X			
Rhynchosia	Rhynchosia minima	g		tolerates 1.6 meq salt /100g soil	TFL386									X					
Riba	Dialium schlechteri	t	M	on dunes	DM258	X			X	X									
Rice	Oryza sativa	f	M		MA687, TG508			X				X	X		X	X			
River red gum (NP)	Eucalyptus camaldulensis NP	t	M	inland plantation; salt & waterlogging tolerance depending on seed origin	EFP369, FC126, MF353/414 525		X				X			X	X	X			
Roselle	Hibiscus sabdariffa	f		no waterlogging	MA1044, TFP328						X			X					

Table 23 List of Crops by Soil Groupings (part 4)

Common name	Scientific name	Type	Moz.	Additional notes	References	Soil Groupings 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Roundleaf cassia	Cassia rotundifolia	t		poor resistance to flooding	TFL232	X			X	X	X								
Sabi grass	Urochloa mosambicensis	g	M	resistant to drought; no flooding	MM198, TG735						X								
Sapodilla	Manilkara achras	t	M			X	X				X								
Seragoon grass	Digitaria didactyla	g		supports temporary flooding	TG357						X	X							
Sesame	Sesamum indicum	f		intolerant of flooding & waterlogging	MA919, TFP445						X			X					
Shrubby stylo	Stylosanthes scabra	g		poorly tolerant to salt	TFL436	X			X		X								
Signal grass	Brachiaria brizantha	g		good drought tolerance; no flooding	MA1115, MM182, TG235	X			X		X			X					
Siratro	Macroptilium atropurpureum	g			TFL328	X			X		X								
Sisal	Agave sisalana	I	M		MA1045	X					X								
Sissoo	Dalbergia sissoo	t			MF353/412, TL199	X	X		X	X	X								
Smooth luffa	Luffa cylindrica (L.) M.J.R	g		excessive rainfall during flowering & fruiting decreases yield	TFP355						X		X						
Sorghum	Sorghum bicolor	f	M	no flooding; supports temporary waterlogging	MA718, TFP470, TG677	X	X				X			X					
Sour orange	Citrus aurantium	t			MA767, TFP192	X			X	X	X			X					
Soursop	Annona muricata	t			UTP80														
Soybean	Glycine max	I			MA840/921						X			X					
Spanish greens	Amaranthus cruentus L.	f			TFP71	X					X								
Sprouting broccoli	Brassica oleracea L.v ital.	f			MA848						X			X					
Squash gourd	Cucurbita maxima Duch ex L.	f			TFP232	X					X			X					
Stylo	Stylosanthes fruticosa	g	M	some strains extremely susceptible to anthracnose	TFL392	X			X										
Sugar cane	Saccharum officinarum	I	M		MA938, TG640		X				X		X	X	X				
Sunflower	Helianthus annuus v macro.	I	M		MA928						X			X					
Swamp couch	Hemarthria altissima	g	M	tolerates flooding & only short drought; not resistant to fire	MM125, TG443		X	X				X			X				
Swamp rice grass	Leersia hexandra	g		in permanently flooded places	MM220, TG494			X				X							
Sweet orange	Citrus sinensis	t	M		MA767, TFP192	X			X	X	X			X					
Sweet peper	Capsicum frutescens	f	M	during cold season (with irrigation in 1,6,9 and 10)	MA858	X	X				X	X	X	X	X				
Sweet potato	Ipomoea batatas (L.) Lam.	f	M		MA680	X	X	X			X	X	X	X					
Tamarind	Tamarindus indica	t	M	not in stagnant water	DM263, TFP479, TL117	X			X	X	X								
Tambookie grass	Hyparrhenia hirta	g		some clones moderately tolerant to salinity; extremely drought resistant	TG457	X			X										
Teak	Tectona grandis	t	M		MF353/427	X			X	X									
Teff	Eragrostis tef	f	M	no surface crusting; tolerates waterlogging	TFP274, TG428	X	X				X			X	X				
Terapy bean	Phaseolus acutifolius	f			TL92	X					X								
Tomato	Lycopersicon esculentum	f	M		MA861	X	X				X		X	X					
Tondue	Cordyla africana	t	M		DM276						X								
Townsville lucerne	Stylosanthes humilis	g		drought resistant	TFL419	X	X		X		X			X					
Tsondzo	Brachystigia spiciformis	t	M		DM268	X			X	X	X			X					
Urd bean	Vigna mungo	f		drought resistant; cultivated after paddy rice	TFP498						X			X					
Vegetable marrow	Cucurbita pepo L.	f			TFP232	X					X			X					
Velvet bean	Mucuna pruriens	g			TFL353	X			X		X			X					
Vetiver grass	Vetiveria zizanioides	g	M	tolerates flooding	MA935, TG747	X	X		X										
Virginian centro	Centosema virginiatum	g		drought resistant; poorly tolerant of waterlogged soils	TFL255						X								
Watermelon	Citrullus lanatus (T) Mansf	f	M		MA840, TFP186	X					X		X	X					
Weeping love grass	Eragrostis curvula	g	M	drought & salt resistant; does not tolerate waterlogging & flooding	MM271, TG417						X			X					
Wheat	Triticum vulgare	f	M		MM282						X			X	X	X			
White jute	Corchorus capsularis	t			TFP218		X				X		X						
Winter thorn	Acacia albida	t	M	no direct seedling	MA585, MF350/355/551, TFL503, TL1	X	X		X	X	X								
Wooly finger grass	Digitaria pentzii	g	M	good drought tolerance	MM190, TG363	X			X		X			X					
Cocoyam	Colocasia spp	f	M	tolerant of flooding; not tolerant to drought			X	X				X	X						
Yellow cassia	Cassia siamea	t	M	in dry depression	FC120, FFID10, MF352/409/526, TFP1	X			X	X	X								

Table 24 Legend of Plant Uses

Uses	Symbol	Uses	Symbol	Uses	Symbol
Food	F	Energy (fuel)	Ef	Control	C
-cereal	Fc	Industrial	I	-erosion	Ce
-vegetables & melon	Fv	-oil	Io	-shade and shelter	Cs
-pulses	Fp	-fiber	If	-windbreak	Cw
-root crops	Fr	-timber	It	-dune stabilization	Cd
-tubers	Ft	Fodder	O	-firebreak	Cf
-fruit	Ff	-pasture	Oa	-living fence	Cl
-nuts	Fn	-fodder and feed grain	Of		

Table 25 Plant Uses (part 1)

Common name	Scientific name	Uses																			
		Fc	Fn	Fp	Fv	Fr	Ft	Ff	Ef	Io	If	Is	It	Oa	Of	Ce	Cw	Cd	Cf	Cl	Cs
African ebony	Diospyros mespiliformis					Fr		Ff	Ef				It								
African mahogani	Khaya senegalensis								Ef				It		Of						Cs
African oak	Chlorophora excelsa												It								
African star grass	Cynodon nlemfuensis													Oa	Of	Ce					
Alyce clover	Alysicarpus vaginalis													Oa	Of	Ce					
Amaranth	Amaranthus dubius L.				Fv																
Amaranthus	Amaranthus spp.	Fc			Fv						If										
American joint veld	Aeschynomene americana													Oa							
Ampupu	Eucalyptus urophylla								Ef				It								
Angleton bluestem	Dichanthium aristatum													Oa	Of						
Asparagus	Asparagus officinalis				Fv																
Australian bluestem	Bothriochloa bladhii													Oa	Of	Ce					
Avaram	Cassia auriculata				Fv									Oa		C	C	C	C	C	C
Avocado	Persea americana							Ff		Io											
Axle-wood tree	Anogeissus latifolia								Ef				It		Of						
Bahia grass	Paspalum notatum													Oa	Of	Ce					
Bambara groundnut	Voandzeia (Vigna) subterranea		Fn	Fp	Fv																
Banana	Musa spp				Fv			Ff							Of						Cs
Barley six-rowed	Hordeum vulgare	Fc													Of						
Barley two-rowed	Hordeum distichon	Fc													Of						
Basam	Grewia bicolor				Fv			Ff	Ef				It								
Basella	Basella alba				Fv																
Bermuda grass	Cynodon dactylon v dactylon													Oa	Of	Ce					
Bimbe	Garcinia livingstanei							Ff													
Birdwood grass	Cenchrus setigerus													Oa	Of						
Boer love grass	Eragrostis chloromelas													Oa	Of	Ce					
Bottle gourd	Lagenaria siceraria (M) St.				Fv																
Brachiaria dura	Brachiaria dura													Oa							
Brazilian lucerne	Stylosanthes guianensis var. guianensis													Oa	Of						
Brazilian lucerne	Stylosanthes guianensis var. intermedia													Oa	Of						
Brown beetle grass	Diplachne fusca													Oa							
Buffel grass	Cenchrus ciliaris													Oa	Of	Ce					
Bullock's heart	Annona senegalensis							Ff													
Bungoma grass	Entolasia imbricata														Of						
Butterfly pea	Clitoria ternatea				Fv										Of						
Butterfly tree	Colophospermum mopane								Ef				It		Of	Ce		Cd			
Cabbage	Brassica oleracea L.v capi.				Fv										Of						
Cacana	Momordica basalmina				Fv			Ff													
Camba	Acacia xanthophloea												It								
Carribean pine	Pinus caribaea v. hondurensis								Ef				It								
Carribean stylo	Stylosanthes hamata													Oa	Of						
Carrot	Daucus carota				Fv	Fr															
Cashew	Anacardium occidentale		Fn					Ff		Io							Cw				
Cassava	Manihot esculenta	Fc					Ft		E						Of						
Castor	Ricinus communis									Io	If				Of						
Centurion	Centrosema pascuorum													Oa							
Chamfuta	Afzelia quanzensis												It								
Channel millet	Echinochloa turneriana	Fc												Oa	Of						
Chelingamacho	Spirostachy africanus												It								
Chickpea	Cicer arietinum				Fv									Oa							
Chicocotzi	Combretum gueinzii												It								
Chinese amarath	Amaranthus tricolor L.				Fv																
Chiquiche	Combretum zeyheri												It								
Cimbirre	Androstachys johnsonii												It								
Citron	Citrus medica							Ff													
Citrus	Citrus spp							Ff													
Coast sheoak	Casuarina equisetifolia								Ef				It				Cw	Cd			Cs
Coconut	Cocos nucifera							Ff		Io			It		Of						
Cocoyam	Colocosia spp.						Ft								Of						
Coloured Guinea grass	Panicum coloratum													Oa	Of	Ce					
Common russet grass	Loudetia simplex													Oa							
Conola	Terminalaria sericea												It								
Corchorus	Corchorus tridens				Fv			Ff			If				Of						
Cotton	Gossypium hirsutum									Io	If				Of						
Cowpea	Vigna unguiculata unguicu.	Fc		Fp							If				Of	C		C			
Crowfoot grass	Dactyloctenium aegyptium	Fc												Oa	Of						
Diaz bluestem	Dichanthium annulatum													Oa	Of	Ce					
Diospyros	Diospyros spp.							Ff													
Doum palm	Hyphaene thebaica							Ff			If		It								
Dubi grass	Urochloa oligotricha													Oa	Of						
East Indian walnut	Albizia lebbeck								Ef				It		Of	C	C	C		C	C
Eddoe	Colocasia esculenta v. ant.						Ft														

Table 25 Plant Uses (part 2)

Common name	Scientific name	Uses																			
		Fc	Fn	Fp	Fv	Fr	Ft	Ff	Ef	Io	If	Is	It	Oa	Of	Ce	Cw	Cd	Cf	Cl	Cs
Edible canna	Canna edulis				Fv										Of						
Eggplant	Solanum melongena				Fv																
Elephant grass	Pennisetum purpureum										If			Oa	Of	Ce					
Elephant orange (Masala)	Strychnos spinosa	Fc						Ff	Ef												
Feather finger grass	Chloris virgata															Ce					
Finger millet	Eleusine coracana	Fc																			
Flooded gum	Eucalyptus grandis								Ef				It								
Forest red gum	Eucalyptus tereticornis								Ef	Io			It					Cd			
Gamba grass	Andropogon gayanus													Oa		Ce					
Garlic	Allium sativum				Fv					Io											
Giant button grass	Dactyloctenium giganteum														Of						
Golden timothy	Setaria sphacelata													Oa	Of	Ce					
Grapefruit	Citrus paradisi							Ff		Io											
Grewia	Grewia spp.							Ff	Ef		If										
Groundnut	Arachis hypogaea L.		Fn							Io	If				Of						
Guava	Psidium guajava							Ff	Ef												
Guinea grass	Panicum maximum													Oa	Of						
Gympie messmate	Eucalyptus cloeziana								Ef				It								
Horse bean tree	Parkinsonia aculeata								Ef						Of	Ce	Cw				
Inca wheat	Amaranthus caudatus L.	Fc			Fv										Of						
Indian fig	Opuntia ficus-indica							Ff						Oa	Of	Ce					
Indian jujube	Ziziphus mauritianus							Ff	Ef				It		Of						
Inhala	Hyphaene crinita							Ff													
Italian millet	Setaria italica	Fc												Oa	Of						
Janeiro	Eriochloa punctata													Oa	Of						
Japanese millet	Echinochloa frumentacea	Fc												Oa	Of	Ce					
Jaragua grass	Hyparrhenia rufa													Oa	Of						
Job's tears	Coix lacryma-jobi	Fc												Oa	Of						
Kodo millet	Paspalum scrobiculatum	Fc												Oa	Of						
Lablab bean	Lablab purpureus	Fc			Fv										Of	Ce					
Lehmann love grass	Eragrostis lehmanniana															Ce					
Leichhardt biflorus (horse gram)	Macrotyloma uniflorum														Of						
Lemon sented gum	Eucalyptus citriodora								Ef	Io			It								
Lentil	Lens culinaris	Fc			Fv																
Lettuce	Lactuca sativa				Fv																
Leucaena	Leucaena leucocephala				Fv				Ef					Oa	Of		Cw				Cs
Lima bean	Phaseolus lunatus			Fp	Fv											Ce					
Lime	Citrus aurantifolia							Ff		Io											
Little millet	Panicum sumatrense	Fc												Oa	Of						
Liverseed grass	Urochloa panicoides													Oa	Of						
Long-fruited jute	Corchorus olitorius				Fv			Ff			If				Of						
Love grass	Chrysopogon aciculatus													Oa		Ce					
Macuacua	Strychnos innocua	Fc						Ff	Ef												
Mafureira	Trichilea emetica							Ff		Io											
Maize	Zea mays s. mays	Fc			Fv					Io				Oa	Of						
Mandarin	Citrus reticulata							Ff													
Mango	Mangifera indica							Ff					It								
Mangrove	Avicenna spp.								Ef												
Mangrove	Bruguiera spp.								Ef												
Mangrove	Rhizophora spp.								Ef												
Masni love grass	Eragrostis superba													Oa							
Massundo	Phoenix reclinata							Ff													
Mat grass	Axonopus affinis													Oa		Ce					
Milanje grass	Digitaria milanjiana														Of						
Millet Common	Panicum miliaceum	Fc												Oa	Of						
Mission grass	Pennisetum polystachion													Oa	Of	Ce					
Molasses grass	Melinis minutiflora									Io				Oa	Of	Ce					
Mondzo	Combretum imberbe												It								
Morula (Canhueiro)	Sclerocarya caffra		Fn					Ff													
Moth bean	Vigna aconitifolia	Fc			Fv									Oa	Of	Ce					
Multhlu	Syzygium cordatum							Ff					It								
Mung bean	Vigna radiata	Fc			Fv									Oa	Of						
Natal-palm	Carissa macrocarpa							Ff													
Neem	Azadirachta indica								Ef				It		Of		Cw				Cs
Nulo	Balanites maughamii												It								
Okra Lady fingers	Hibiscus esculentus				Fv					Io	If										
Onion	Allium cepa				Fv																
Oyster nut	Telfaira pedata									Io											
Palmyra palm	Borassus flabellifer				Fv						If		It								
Pangola grass	Digitaria decumbens													Oa	Of	Ce					
Parkia	Parkia filicoidea							Ff							Of						
Pea	Pisum sativa				Fv																
Pearl millet	Pennisetum glaucum	Fc							Ef					Oa	Of						
Perrenial soybean	Glycine wightii													Oa	Of						
Pigeon Pea	Cajanus cajan (L.) Hunt				Fv				Ef					Oa	Of	Ce					
Pineapple	Ananas comosus							Ff			If										

Table 25 Plant Uses (part 3)

Common name	Scientific name	Uses																			
		Fc	Fn	Fp	Fv	Fr	Ft	Ff	Ef	Io	If	Is	It	Oa	Of	Ce	Cw	Cd	Cf	Cl	Cs
Plicatulum	Paspalum plicatulum													Oa	Of						
Potato	Solanum tuberosum L.						Ft								Of						
Princess feather	Amaranthus hypochondriacus	Fc																			
Pummelo	Citrus grandis							Ff													
Pumpkin	Cucurbita moschata (Duch.)				Fv					Io											
Rat's tail grass	Sehima nervosum													Oa	Of						
Red oat grass	Themeda triandra													Oa	Of						
Rhodes grass	Chloris gayana													Oa	Of						
Rhynchosia	Rhynchosia minima													Oa	Of						
Riba	Dialium schlechteri												It								
Rice	Oryza sativa	Fc													Of						
River red gum (NP)	Eucalyptus camaldulensis NP								Ef				It				Cw				Cs
Roselle	Hibiscus sabdariffa	Fc			Fv			Ff			If										
Roundleaf cassia	Cassia rotundifolia																				
Sabi grass	Urochloa mosambicensis													Oa	Of	Ce					
Sapodilla	Manilkara achras							Ff					It								
Serragoon grass	Digitaria didactyla													Oa	Of	Ce					
Sesame	Sesamum indicum	Fc								Io											
Shrubby stylo	Stylosanthes scabra													Oa	Of						
Signal grass	Brachiaria brizantha													Oa	Of	Ce					
Siratro	Macroptilium atropurpureum													Oa							
Sisal	Agave sisalana										If										
Sissoo	Dalbergia sissoo								Ef				It		Of	Ce		Cd			
Smooth luffa	Luffa cylindrica (L.) M.J.R				Fv			Ff		Io											
Sorghum	Sorghum bicolor	Fc												Oa	Of						
Sour orange	Citrus aurantium							Ff		Io											
Soursop	Annona muricata							Ff													
Soybean	Glycine max			Fp	Fv					Io				Oa	Of						
Spanish greens	Amaranthus cruentus L.	Fc																			
Sprouting broccoli	Brassica oleracea L.v ital.				Fv																
Squash gourd	Cucurbita maxima Duch ex L.				Fv					Io											
Stylo	Stylosanthes fruticosa													Oa	Of						
Sugar cane	Saccharum officinarum											Is			Of						
Sunflower	Helianthus annuus v macro.									Io	If			Oa	Of						
Swamp couch	Hemarthria altissima													Oa	Of						
Swamp rice grass	Leersia hexandra													Oa							
Sweet orange	Citrus sinensis							Ff		Io											
Sweet peper	Capsicum frutescens						Ff														
Sweet potato	Ipomoea batatas (L.) Lam.						Ft								Of						
Tamarind	Tamarindus indica								Ef				It				Cw				Cs
Tambookie grass	Hyparrhenia hirta													Oa	Of	Ce					
Teak	Tectona grandis								Ef				It								
Teff	Eragrostis tef													Oa	Of						
Terapy bean	Phaseolus acutifolius			Fp	Fv										Of	Ce					
Tomato	Lycopersicon esculentum				Fv					Io					Of						
Tondue	Cordyla africana												It								
Townsville lucerne	Stylosanthos humilis													Oa	Of						
Tsondzo	Brachystigia spiciformis										If		It								
Urd bean	Vigna mungo			Fp	Fv									Oa	Of						
Vegetable marrow	Cucurbita pepo L.		Fn		Fv					Io											
Velvet bean	Mucuna pruriens			Fp	Fv									Oa	Of	Ce					
Vetiver grass	Vetiveria zizanioides									Io				Oa		Ce		Cd			
Virginian centro	Centosema virginiatum													Oa							
Watermelon	Citrullus lanatus (T) Mansf							Ff		Io											
Weeping love grass	Eragrostis curvula													Oa	Of	Ce					
Wheat	Triticum vulgare	Fc													Of						
White jute	Corchorus capsularis				Fv			Ff			If				Of						
Winter thorn	Acacia albida								Ef				It		Of	Ce					Cs
Wooly finger grass	Digitaria pentzii													Oa	Of	Ce					
Yellow cassia	Cassia siamea								Ef				It		Of		Cw				

6. LAND MANAGEMENT

In the following sections we will examine first the main physical limitations to agriculture, see what farmers do about them and then see what else can be done to improve agriculture production. The last section describes each land management unit and gives specific recommendations for them.

6.1 Main soil and climate limitations to crop production

We have identified the following major soil aspects that are limiting crop production:

- inadequate soil moisture regime
- low soil fertility
- high soil salinity and sodicity
- low soil workability
- active soil erosion

6.1.1 Soil moisture regime

The availability of moisture to plants is the most important factor controlling their growth. Although some plants can make use of atmospheric moisture, most of the water consumed by plants is usually provided by the soil. Figure 7 gives a schematic representation of the soil water balance in the study area.

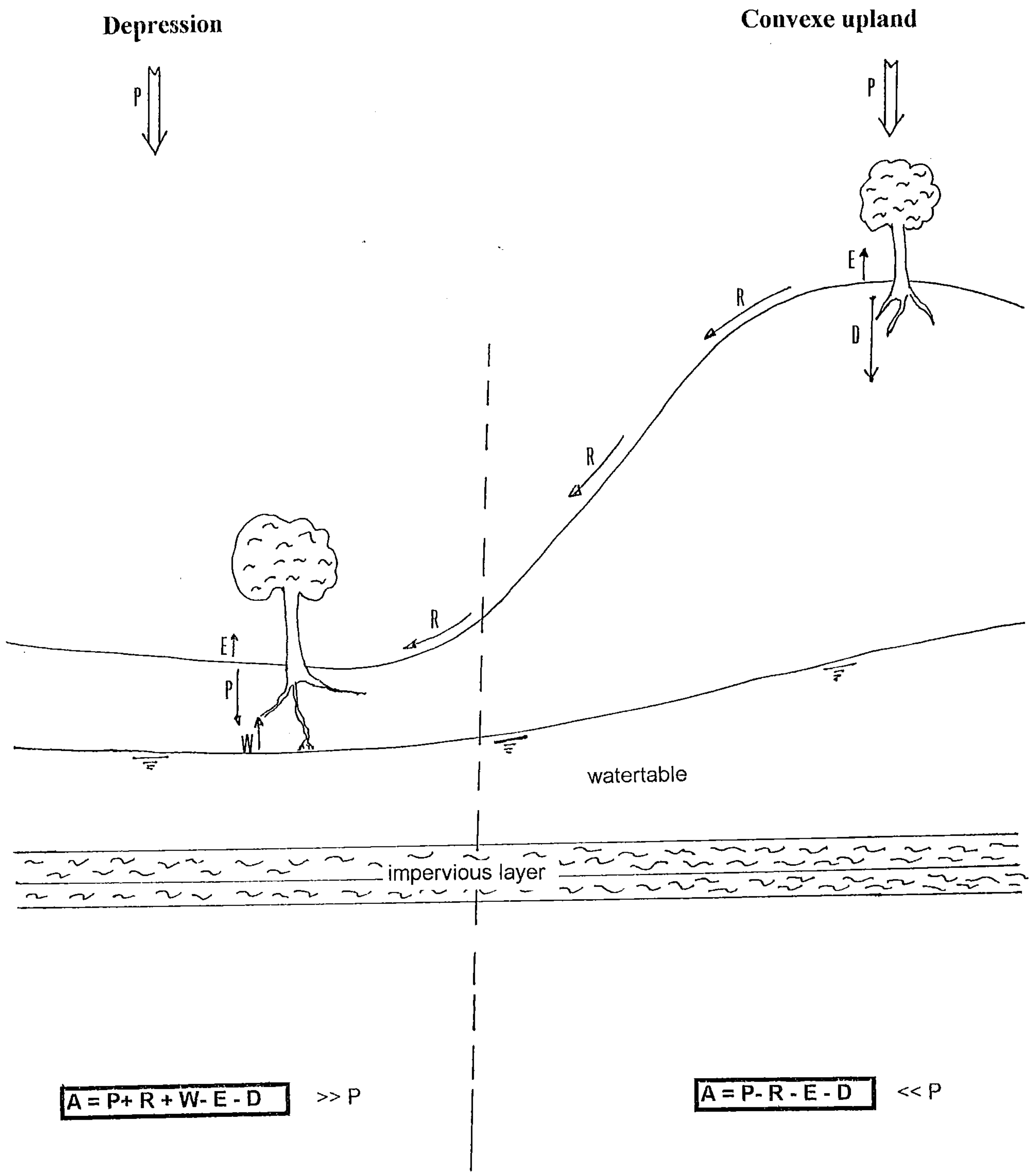
The water supply of upland soils is only comprised of the atmospheric precipitation minus the water that runs off, evaporates and percolates deeply. The water supply of lowland soils, and of those of concave slopes, is comprised of the atmospheric precipitation plus the water that runs off the uplands minus water lost through evaporation and deep percolation. This means that lowland soils not only do not loose water through runoff, but also that they gain the runoff water lost by the uplands. When a water table occurs at shallow depth, as is the case in the machongos, it further increases the water supply of lowland soils.

It is clear from the above that there is a tendency for upland soils to be droughty and for those of the lowlands to be too wet. However, the soil's permeability, slope and water holding capacity may improve or worsen it's moisture regime. A high permeability or a steep slope decrease the water supply, whereas a low water holding capacity reduces the moisture storage.

In the Serra uplands, sandy soils having a high permeability and low water holding capacity, dominate. They are droughty and only have an adequate moisture regime during the rare years when there is a good rainfall distribution over the growing period.

In the valley, fine-textured slowly-permeable soils having a high water holding capacity, and often a shallow water table, are dominant. These soils are excessively wet during rainy years, but have adequate moisture during normal and moderately dry years. Among the soils of the valley those of the alluvial levees are better drained and generally have a good moisture regime, but may be droughty during moderately dry years.

Figure 7 Schematic soils water balance



A = moisture available to plants
P = precipitation
R = runoff
D = deep percolation
E= evaporation
W= moisture contributed by the water table

The high seasonal and interannual variability of the atmospheric precipitation further aggravates the negative impact of the above mentioned soils' characteristics on the moisture supply to plants.

6.1.2 Soil fertility

The fertility problem exists mostly in the Serra and in the machongos.

The sandy soils of the Serra have a low reserve of weatherable minerals which are usually the main source of calcium, magnesium and potassium. They also have a low organic matter content and a low nutrients retention capacity. Their high permeability allows the rain water to percolate and leach nutrients below the rootzone. The natural low fertility of the Serra is further aggravated by the short duration of the fallow, or often even its' absence, and by the cultivation of maize repeatedly, season after season for several years. Maize is a crop which is known for rapidly depleting the soil's nutrients.

The organic soils of the Machongos are very acid (pH of 4.2-5.5), therefore the exchange complex is mostly saturated by H^+ and Al^{+++}, hence little calcium and potassium is held in the exchange sites. The exchangeable aluminum is also toxic for many crops and causes empty panicles in rice. The subsistence farmers of the area do not use chemical fertilisers, and only manure is sometimes used for vegetables or maize in the wetlands.

6.1.3 Soil salinity and sodicity

Salinity affects to various levels most valley soils with the exception of those of the levees and high terraces. This situation is due to the following reasons:

- the influence of the ocean which floods regularly the mangroves, invades the lower course of the Limpopo and its' lower tributaries such as the rio Lumane, and infiltrates its' saline waters into the water table of much of the plain which has altitudes that are mostly less than 2 m.

- the occurrence of saline and sodic parent material, namely the Mananga deposits, where sodicity induces strong soil dispersion and the formation of thick structural crusts that reduce germination.

- irrigation with brackish water pumped from rivers during high tides at a time when their discharge is low.

6.1.4 Soil workability

Most valley soils are Vertisols which are heavy swelling clays. When these soils are dry they are very hard and compact, hence difficult to work by hand tools and even with animal traction. During rainy periods they quickly become too wet and too sticky to be ploughed and necessitate much time to dry out. In these conditions very little time is available for land preparation.

6.1.5 Soil erosion

Three types of erosion were observed in the district of Xai-Xai, namely erosion caused by water, by wind and by creep.

6.1.5.1 Water erosion

Water erosion is active on most sloping Serra soils. This situation is due to:

- lack of vegetative cover because of the destruction of the natural vegetation and the sparse cultivation of crops.

- soil compaction, due to animal and human traffic on the numerous tracks that go from the villages, that are on the edge of the Serra, down to the footslopes where are located many wells. This compaction reduces water infiltration, hence increasing runoff and erosion.

- the ditches evacuating the drainage water of asphalt roads are often ill protected and are sometimes transformed into enormous gullies during big storms (see figure 8).

- the villagers, mostly the women, make shallow excavations in roads and steep lands to extract clayey sandy material to be used as plaster on the walls of their houses. These excavations very often turn into gullies during intense rainfall occurrences.

- in certain areas such as along the road from the city of Xai-Xai to its beach, land has been distributed in hilly terrain according to geometrical patterns. It was observed that rainfall water concentrates along the parcels limits that are perpendicular to the contours.

Water erosion is also active on the concave banks of the main rivers, especially of the Limpopo.

6.1.5.2 Wind erosion

Due to their loose topsoil, the sandy soils of the Serra are strongly affected by wind erosion wherever the vegetative cover is reduced by destruction or replacement with sparse crops (see photographs next page). Wind erosion is especially severe in the coastal zone where winds are stronger.

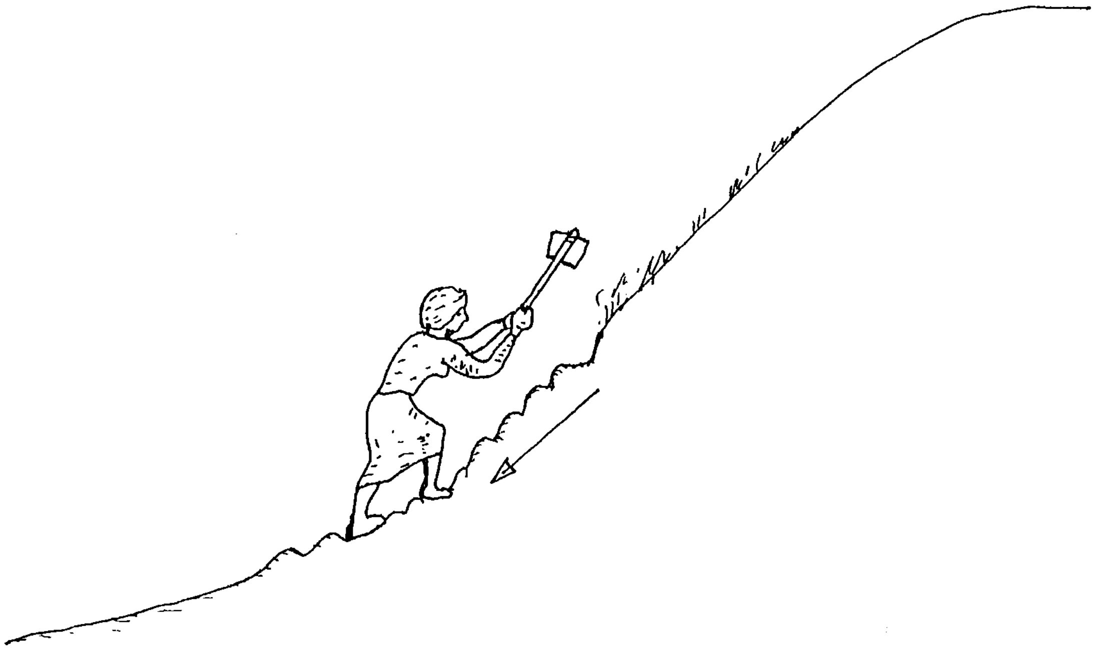
6.1.5.3 Creep

This type of erosion is caused by land preparation with hand tools. This type of land preparation is done from the footslope up to the top of the hills. Hence, the hoe moves the soil downslope, each time a little bit lower see (figure 8). It is however difficult to see the effect of creep in the fields because the fluidity of sands allows all excavations to be levelled quickly.

Photograph showing wind erosion in a maize field in sandy soils

Photograph showing wind erosion in a maize field in sandy soils

Figure 8 Erosion by creep due to land preparation with a hoe



6.2 Farmers' strategy to overcome the soil and climate limitations

Subsistence farmers try to ensure that food is available to them at all times. Indeed their storage capacity is very low, both physically (low cellars capacity and destruction of stored produce by pests and diseases) and financially since they sell very little (they do not store excess production in the form of money which could be used the bad years to buy food). Therefore, excess production of the good years cannot be used substantially to compensate the deficit during the bad years. This explains why minimizing production risks is the main objective of subsistence farmers who deploy an efficient strategy to achieve food security. The pillars of this strategy are:

- genetic diversity: farmers grow a variety of herbaceous and tree crops. If a given crop does not produce under given environmental conditions, another one will.

- environmental diversity: whenever possible farmers cultivate fields having complementary edaphic conditions. They often cultivate uplands and lowlands, hence if the weather is too wet, the uplands will produce and vice-versa in case of drought. The "Xin'tlavane", which is a narrow strip of land in the footslopes of the Serra, is particularly liked by farmers because it is too high to be flooded but low enough to benefit from moisture provided by the relatively shallow water table (see figure 9)

- temporal diversity: farmers prefer to grow 2 crops during both the cold and the hot seasons rather than a single crop which extends across both seasons, hence if weather conditions are not favourable during one season, they may be better during the next and the chances of getting a harvest are thus increased.

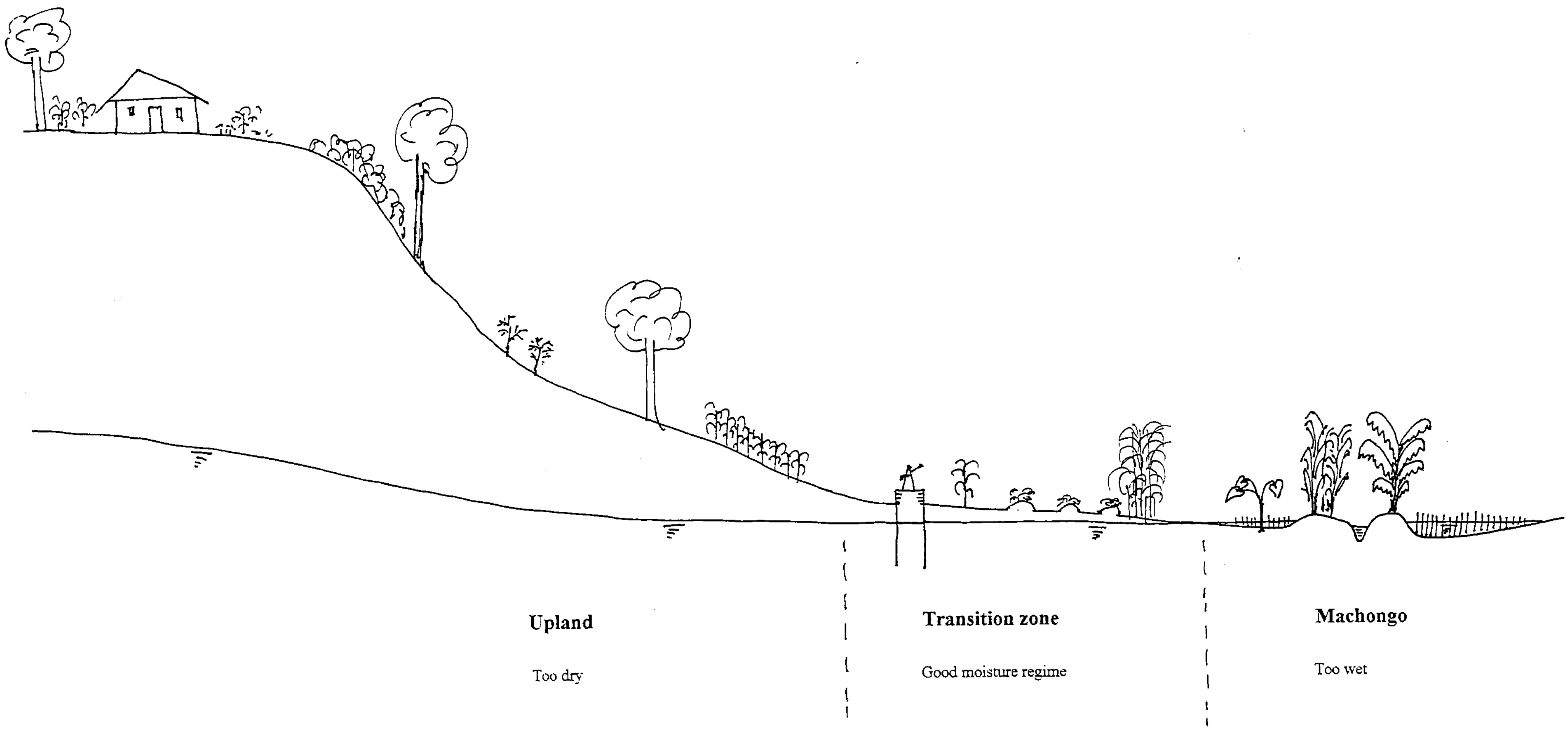
- high mobility: Farmers shift their cropping activities to the most appropriate locations according to the prevailing weather. If there is a protracted drought, they would concentrate their cropping activities in the wetlands. If there is excessive precipitation they would on the contrary concentrate on the uplands. This is only possible with fast growing crops such as **sweet potato** which once transplanted allows to start eating the leaves within 2 weeks and tubers after a few months. This emphasises the role of sweet potato in food security.

- utilization of adapted crops: Drought resistant crops in the Serra, such as pigeonpea, groundnut, cowpea, and flood resistant crops in the wetlands, such as rice and yams.

- land use diversity: Farmers diversify their activities and may practice simultaneously crop production, animal husbandry, fishing, fabrication of alcoholic drinks, collection of reeds in the swamps, firewood etc... Thus if they face difficulties with one activity another may compensate.

- adapted nutritional habits: The large place occupied by leaves in the diet is an important food security measure. Indeed, in case of drought, crops such as cowpea, sweet potato or squash give no or little fruit/tuber, but their leaves will be eaten.

Figure 9 Ecological diversity in the district of Xai-Xai



- adapted management practices: Farmers cultivate several crops on raised beds in the wetlands, in spite of the hard labour involved. Burning the bush and weeds is a measure by which farmers make available to crops, from the ashes, calcium, potassium and phosphorus, and control weeds, pests and diseases.

This food security strategy is very labour-intensive, thus the availability of labour becomes often a major constraint.

6.3 Proposed measures to overcome the soil and climate limitations

To be accepted by farmers all action proposals at their level must increase directly the food availability, therefore the proposals which reduce the cultivated area are unlikely to be accepted by them. They must also be little demanding in labour because, as we have seen, farmers have many labour intensive activities.

6.3.1 Measures to remedy the inadequate soil moisture regime

6.3.1.1 Irrigation development

The most efficient way to prevent the destructive effects of periodic droughts is to irrigate all the lands that are suitable.

- In the valley

The main physical obstacle to the expansion of irrigation in the Limpopo valley is the lack of sufficient water and its' episodically high salinity.

The volume of available water can be increased by building the long-planned Mapai dam, and use existing untapped or little tapped water resources such as those of Rio Lumane and Rio Chégua. Feasibility studies for such use are already available in the Ministry of agriculture.

Water quality in the Limpopo and the Lumane can be improved by building a dam in the lower course of the Limpopo in order to prevent the intrusion of saline ocean water.

Also, since most irrigation is done by gravity, land levelling would improve the efficiency of irrigation hence saving water.

- In the Serra

The many lakes existing in the coastal strip of the Serra constitute an appreciable good quality water resource that can be used for irrigation. However, the terrain around the lakes is hilly and the available relatively flat land consist generally of narrow strips on their margins. There is often enough room to accommodate small irrigated fields for the production of vegetables. The depression of Banhine has large expanses of land suitable for overhead or drip irrigation and irrigation by hand-carried watering-cans. However, it is necessary to know the yield capacity of the aquifer.

Note: Given the importance of the wetlands for the food security strategy of the family sector, it is necessary to declare these as "key resources" protected by law against acquisition by external persons or institutions.

6.3.1.2 Drainage development

The majority of valley lands suffer from poor drainage, and this fact has been recognized and dealt with since the early 1950s. There are several drainage schemes in the plain, with or without irrigation.

The existing drainage networks suffer from a number of deficiencies, probably because they were constructed hastily with minimal technical and financial means. The main problem is that they aim at lowering the water table and do not answer the important problem of the bad surface drainage. Indeed the evacuation of stagnating rain water is prevented by the lack of land forming (levelling but keeping a slight slope toward surface drains) and by the frequent existence of dikes on both sides of the drains. It is not clear whether these were done during the construction or are the result of the cleaning of the drains, the moved earth being piled in-situ. The existence in certain areas of above ground level earthen irrigation canals also prevent the circulation of runoff water. The near absence of bridges for the cattle and farmers to cross the canals and collectors, force these to walk across them, hence causing damage than often result in their complete obstruction.

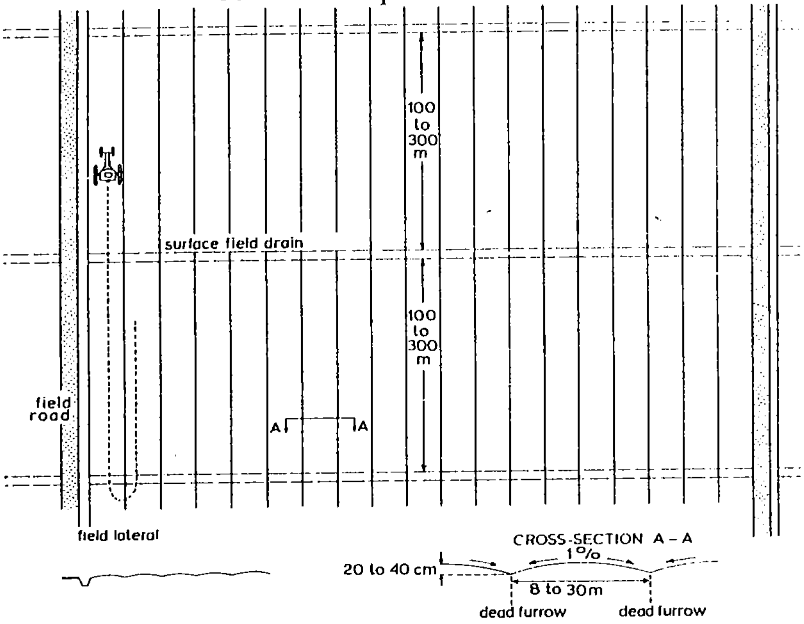
Due to war and to the lack of financial resources, maintenance has been neglected during several years. The problem of deciding who should pay the maintenance is still to be resolved.

It is recommended to carry out a general drainage (and irrigation) study of all the plain taking into account surface drainage requirements. A detailed topographic map at scale 1:5000 or larger must be prepared beforehand. As shown in figure 10, there are various open drainage systems that can be used (based on ILRI publication No. 16):

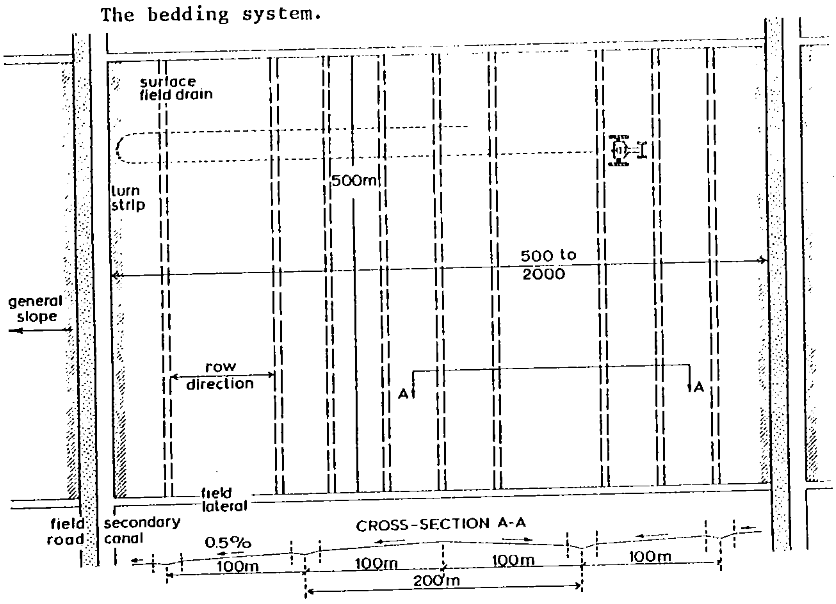
- Parallel open ditch system: Preferable in areas where it is necessary and possible to lower substantially the water table (down to 125-150 cm for mineral soils and 50-75 cm for organic soils). Ditches are at least 60 to 100 cm deep and have steep side slopes, usually 1:1 or 1.5:1 depending on soil stability. The distance between ditches is usually between 60 and 200 m. As the ditches cannot be crossed by machinery, all farm operations have to be made parallel to them. The parallel open drain system is both a surface and a deep drainage system.

- Parallel field drain system: This method as well as the bedding system described below are strictly surface drainage systems, to be used when deep drainage is not necessary or not possible. The parallel field drainage system is recommended in flat poorly drained areas with many irregularities. This system requires precise land forming to give a proper slope to the rows to allow them to discharge runoff water into the parallel field drains

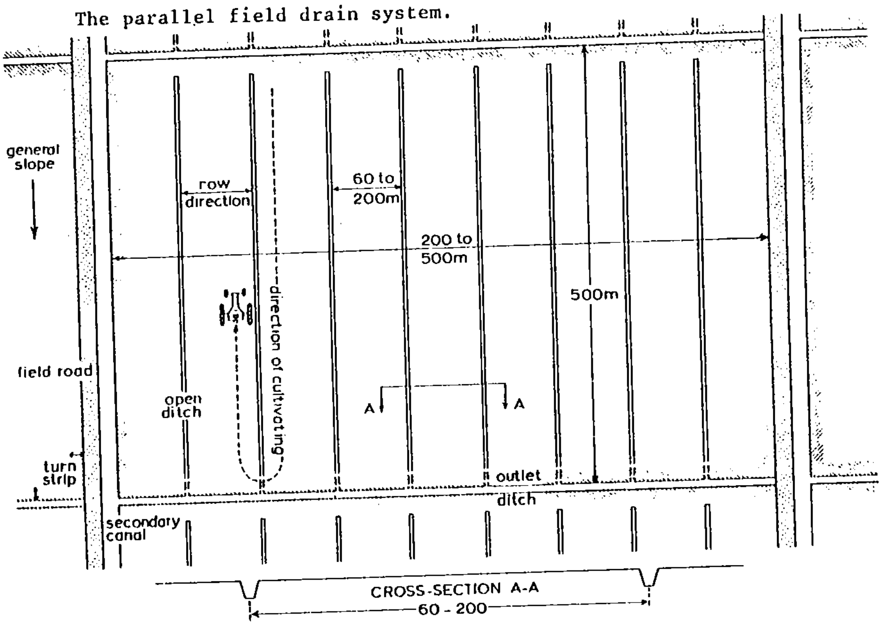
Figure 10 Three types of open drainage systems
Source: ILRI publication No. 16



The bedding system.



The parallel field drain system.



The parallel open ditch system.

which are perpendicular to row direction. The field drains are shallow channels that can be crossed by machinery and which have a minimum depth of 25 cm, side slopes of 8:1 to 10:1 and a cross- sectional area of 0.5 m^2 and a grade of 0.1 to 0.3 percent.

- Bedding system: This system is used on flat poorly drained land with low permeability. The land is shaped by ploughing several consecutive years into beds separated by dead furrows which run in the direction of the prevailing slope. Ploughing must always be done parallel to the furrows, whereas sowing and other farm operation can be done either parallel or perpendicular to them. Bedding is possible on lands with up to 1.5 percent slope. For the soil of the Xai-Xai plain the recommended bed width is 10 to 20 m and the bed length 100 to 300 m. The height difference between the top of the beds and the bottom of the furrow is about 20 cm for arable lands and 40 cm for pastures. This bed height can be obtained either by repeated ploughing with the furrow remaining always in the same place, or by using earth moving machinery.

The water from the dead furrows is collected into a field drain which is constructed at the lower end of the field in direction perpendicular to that of the furrows. The field drains discharge their water into field laterals which in turn discharge their water to the main drains. The field drains have a depth of about 25 cm, side slopes of 6:1 to 10:1 and a grade of 0.1 percent or more.

When crops have to be sown parallel to the field drains, the bedding system will function only in case the beds surface is left smooth. This is often a serious limitation for mechanized arable farming, but not for pasture or traditional agriculture where sowing is done by hand.

Note: In the peaty areas it recommended to avoid lowering the water table below 50-75 cm, and to design the drainage as a surface drainage one. Indeed the real problem in the machongos is the flooding and not the high water table which is rather an asset for the types of crops that are grown and allows to dispose of soil moisture during dry periods. It is less costly and more productive to grow adapted crops such as yams, rice and vegetables rather than spend money on deep drainage.

6.3.1.3 Rainfed agriculture in sandy areas

It is necessary to test mulching techniques to help conserve soil moisture. Some farmers already use these techniques but some of them spoke of problems with termites.

The best way to cope with drought is to cultivate drought resistant crops. Among these, deep rooting plants such as fruit trees and ligneous legumes (e.g. pigeonpea), are particularly indicated. It would be necessary to develop local food processing, to prepare jams (techniques completely ignored by the villagers as shown by our interviews) and dry fruits.

6.3.2 Measures to remedy the high soil salinity and sodicity

The implementation of an efficient land drainage system will induce a rapid diminution of soil salinity. It is also recommended to avoid irrigating with brackish water and grow crops that are relatively resistant to salinity such as cotton, wheat, soya, rice and tomato. In case of irrigation it is better to alternate crops that require basin irrigation (e.g. rice) with those that require furrow irrigation (e.g. cotton). When there is a good drainage, basin irrigation ensures a more efficient salt leaching.

The soils affected by high sodicity could be treated with gypsum to substitute exchangeable sodium with calcium. However, this costly operation is probably not economically justified in Xai-Xai.

6.3.3 Measures to remedy the low soil fertility

Fertility recommendations are different for the Serra, the mineral valley soils and the machongos.

6.3.3.1 Serra

Given the fact that mineral fertilizers are unlikely to be presently economical for subsistence farming, fertility must be improved by adequate management rather than by using inputs external to the household. We will examine successively the various possible measures in the next sections:

- Incorporation of crop residues: Some farmers incorporate crop residues during land preparation, after letting them decompose at the soil surface after the harvest. However, the majority gather the dry crop residues with weeds in heaps and burn them, then incorporate the ashes. Although there is much criticism of the practice of burning it has great advantages in that the ashes:

  * provide several nutrients, including calcium and potassium, in a form that is readily available to crops.

  * raise the soil pH, hence improving the general chemical environment of the rootzone. This is important since many Serra soils have pHs between 5 and 5.5.

The burning also helps control weeds, pests and diseases and is less labour intensive than incorporation.

Considering the low yield levels achieved in subsistence agriculture due to reasons other than fertility, and the important share of leguminous crops in the cropping pattern, the above mentioned benefits of burning outweigh the loss of an important part of nitrogen and sulphur with the burning.

Therefore it is unwise to advise farmers to abandon this practice unless an alternative is found which provides all the benefits of burning and not only the fertility aspects. Some research should be done to explore ways to carry out the burning more efficiently by ensuring a better distribution of the ashes in the fields and preventing the fire from extending to nearby fields and/or natural vegetation, thus causing important destructions. It is also likely that fire damages the cashew and other trees that are nearly always present in the fields.

- Animal manure: The first obstacle to wide application of manure in the fields is that little of it is available due to:

  * small cattle population due to war and stealing.

  * dispersion due to the fact that cattle spends most of the daytime grazing, mostly in communal lands.

* bad quality of the manure produced in the corrals because the animal dropping fall directly in sand and the urine infiltrates deeply into the soil, wasting many nutrients.

Besides its' rarity, manuring is labour intensive and requires transportation means that are often unavailable. This is why the use of manure is reserved for intensive crops such as vegetables.

Increased use of manure will depend on the increase of the cattle population, development of animal traction for transportation and on the introduction of types of corrals that produce a better manure.

- Composts: Besides being labour intensive and requiring transportation means, composting cannot be done efficiently without application of water in droughty sandy soils. Water being scarce in the Serra, there is very little scope for developing the use of composts.

- Green manure: The main obstacles to this practice are that it is labour and inputs intensive (seeds, land preparation). Therefore there is little scope for developing the use of green manure (the case of green manure from trees will be discussed under agroforestry) .

- Agroforestry: It consists of adding trees or bushes to annual or perennial crops and/or grasses to foster their overall productivity. In the conditions of the study area the ideal agroforestry species should:

* not compete with crops for nutrients and water. This means that a vertical rooting system is better.

* not shade crops too much. This means small or sparse canopy or leaves falling during the crops growing season.

* render multiple services and not only improve soil fertility, such as providing fruit, drinks, fodder, pollen for bees, firewood, windbreak, firebreak, shade etc.

A number of agroforestry species were mentioned as suitable for the study area (see section 5.4.2). We can however mention Acacia albida and Albizzia lebbeck for the sandy depressions such as that of Banhine, and canhu and papaya for use in Serra uplands. However, the best solution in the Serra is by far to introduce rotations including pigeonpea.

Pigeonpea is a bushy crop which is drought resistant, has a deep rooting system with a central taproot which can fetch nutrients and water from deep soil substratums. Besides fixing nitrogen it also produces protein-rich food and the leaves can be used as fodder. It is well-known by farmers and productive varieties are available in Mozambique. A suitable rotation could be:

* pure stand of pigeonpea. 2 years (regrowth of the shoots the 2nd year).
* maize consociation (with cowpea or groundnut etc.) followed by pure maize during the cool season. 1 year.
* maize-cassava-cowpea (or groundnut) during the hot season, the cassava continuing alone during the cool season. 2 years.

It must be noted that such rotations with pure stands of pigeonpea cover extensive areas in Zambezia, especially in the district of Mocuba. There are also isolated cases in the district of Xai-Xai, near the aldeia "3 de Fevereiro".

- Fallow: Given the high population density, fallow is very short or non existent. However, the rare farmers who have enough land could benefit from 2 years of grazed fallow.

- Dispersion of the population: Dispersed habitat prevents a high concentration of the population thus helping to increase fallow duration.

Note: Introducing new high-yielding crop varieties may lead to accelerated depletion of soil fertility because they export more nutrients, unless adequate accompanying measures are taken.

6.3.3.2 Valley mineral soils

All the valley mineral soils have adequate available potassium but there are phosphorus deficiencies in the south of the district and of nitrogen in the north. These deficiencies could be easily corrected with the application of chemical fertilisers. Phosphorus could be incorporated during land preparation but only a small fraction of nitrogen should be applied this way, leaving the rest of it to be applied at suitable crop physiological stages, whenever there is enough soil moisture (in rainfed agriculture). We have noticed that the fertilization of rice is not properly done. Indeed nitrogen must be incorporated at 7-10 cm below the soil surface before flooding otherwise it is mostly lost. It is however unlikely that the application of chemical fertilisers would be economical, except for irrigated crops.

6.3.3.3 Machongo soils

Machongo soils have guarantied moisture, therefore the application of chemical is probably economically justified. It is recommended to use NPK fertilisers and to apply CaO to raise the pH to reduce aluminum toxicity.

6.3.4 Measures to remedy soil erosion

The following measures are proposed:

- maintain or restore the prevailing mixture of tree (mostly cashew) and herbaceous crops. According to several interviewed farmers, a distance of 20 to 25 m between trees is optimal for the associated crops.

- plant a network of windbreaks in the coastal strip of the Serra (see details in section 6.4.2.1).

- total afforestation of active coastal sand dunes with Casuarina equisetifolia which can establish itself even where there are strong winds.

- define a protection zone along the coast and around the lakes where the natural vegetation should be left to grow. These areas could be considered as natural parks.

- protect the paths in sloping areas, in particular by avoiding straight lines.

- reserve specific areas in the main villages for the extraction of plastering material.

- plant trees on the external banks in river bends to limit fluvial erosion. These areas can help reduce the problem of firewood in the plain.

6.3.5 Measures to remedy soil workability problems

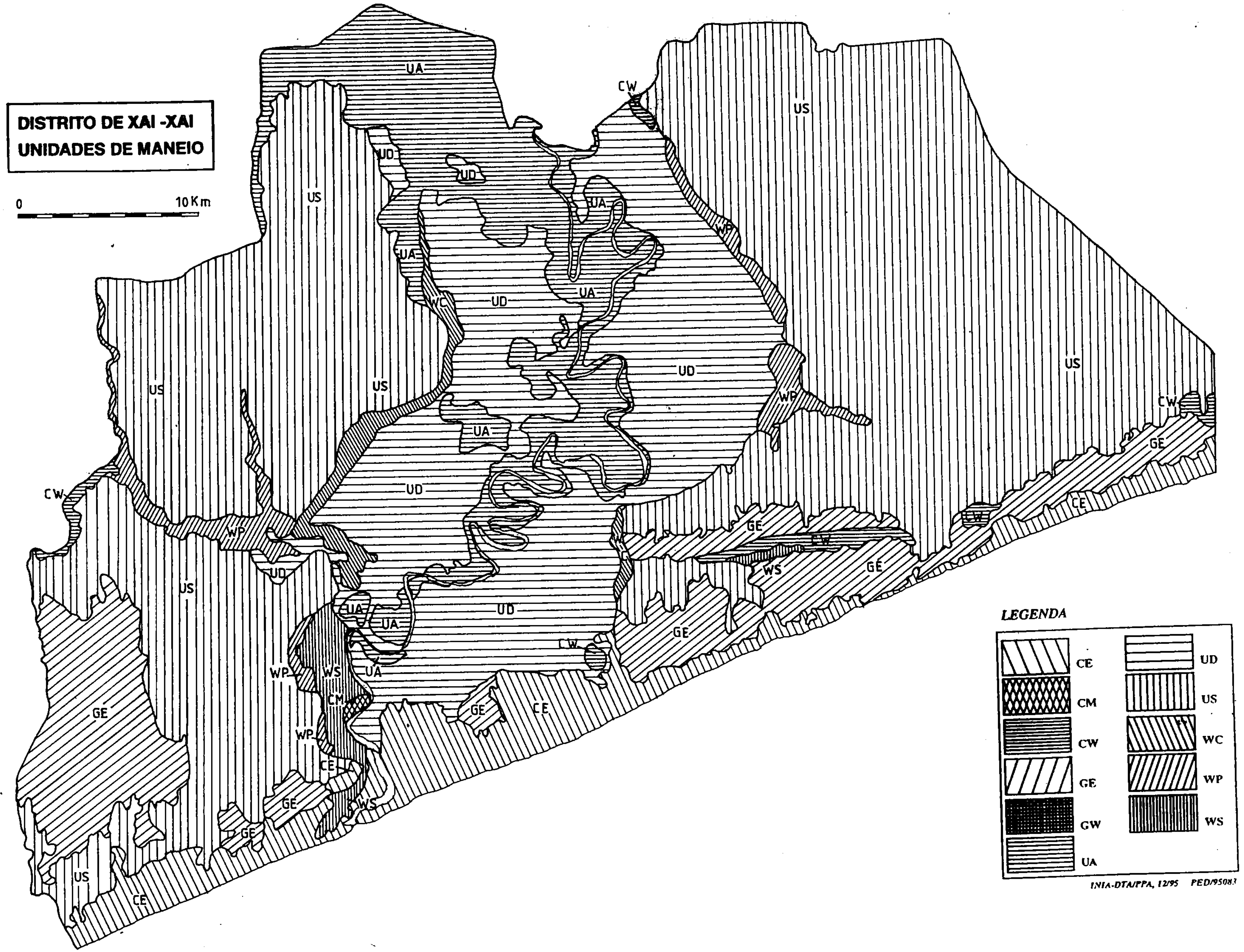
Motorized mechanical means are the best way to fully exploit the heavy clay soils in the valley because the growing season is often lost because of late land preparation. Therefore, tractors should be made available for rent to small farmers. If the operation does not prove economically viable, at least animal traction should be made available.

6.4 Description of the management units

This section is meant to give a broad idea on the characteristics of each land management unit. Land management units are lands that have similar potential uses and require similar management. Table 26 shows to which management unit belongs each map unit. Figure 11 is a generalized zonation map of the district of Xai-Xai into management units.

Table 26 Map units and management units

Map unit	Management unit	Map unit	Management unit	Map unit	Management unit	Map unit	Management unit
BAD1	CW2	**DUC1**	CE1	**PBC4**	UA3	**TEA1**	US2
BAD2	CW2	**DUC2**	CE2	**PLA**	US7	**TEA2**	US8
BAD3	UD2	**DUC3**	CE2	**PLI1**	UA4	**TEM**	UA5
BAD4	WC1	**DUC4**	GE	**PLI2**	UA4	**VAL1**	WS1
BAD5	WC1	**DUC5**	GE	**PLI3**	UA4	**VAL2**	WP3
BAD6	WS2	**DUC6**	GE	**PLI4**	UA4		
BAD7	UD2	**DUC7**	CE2	**PLI5**	UD2		
BAD8	UD2	**DUI1**	US3	**PLI6**	UD2		
BAD9	UD3	**DUI2**	US3	**PLI7**	UD3		
BAD10	UD3	**DUI3**	US2	**PLI8**	WC1		
COM1	UA1	**DUI4**	US2	**PLI9**	WC1		
COM2	UA1	**DUI5**	GE	**PLI10**	UD1		
COM3	UA1	**DUI6**	GE	**PLI11**	UD2		
COM4	UA1	**DUI7**	US3	**PLI12**	UA1		
DEC1	WC1	**DUI8**	US6	**RIH**	CW2		
DEC2	US8	**DUI9**	US6	**RIL**	CW1		
DEC3	US3	**DUI10**	US1	**RIS1**	UA2-1		
DEC4	US1	**DUI11**	US5	**RIS2**	WC2		
DEC5	US2	**DUI12**	US3	**TE1**	UA4		
DEC6	DEC6	**MAC1**	WP	**TE2**	UA2-2		
DEC7	US5	**MAC2**	WP	**TE3**	UA1		
DEH1	WS3	**MAC3**	WP2	**TE4**	UA2-1		
DEH2	CW2	**MAN**	CM	**TE5**	UA6		
DEL	CW1	**PBC1**	UA3	**TE6**	UA6		
DEM	US4	**PBC2**	UA3	**TE7**	GW		
DES	US4	**PBC3**	UA3	**TE8**	CW2		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WS
INIA-DTA/PPA, 12/95 PED/95083

Figure 11 Generalized zonation map of the district of Xai-Xai

6.4.1 Conservation areas (**C**)

6.4.1.1 Areas of strict erosion control (**CE**)

Strict erosion control is compatible with partial use for wildlife, recreation and tourism.

- Areas requiring total reforestation (**CE1**)

This is mostly map unit **DUC1** which consists largely of coastal shifting aeolian sands, threatening inner arable and grazing lands and lakes. Total reforestation is the best way to fix these sands and prevent further damage.

- Areas requiring protection of the existing woody vegetation and partial reforestation (**CE2**)

These are mainly map units **DUC2**, **DUC3**, **DUC7**, which are fixed coastal aeolian sand dunes which, given their exposure to the strong winds blowing from the sea, will start drifting if the natural vegetation is destroyed.

Steep risers linking the Serra to the valley require similar management. Map unit **DEC6** is the only steep riser shown on the map because, given the very narrow width of these land units, they are not mappable at 1:50,000.

6.4.1.2 Areas of mangrove conservation (**CM**)

Mangroves represent a special ecosystem which requires protection of it's flora and fauna. If properly controlled, a partial use for fuelwood supply may be allowed. The map unit concerned is **MAN**.

6.4.1.3 Areas of inland water bodies (**CW**)

- Permanent lakes (**CW1**)

These are map units **DEL** and **RIL**. A campaign of sampling of lakes and depressions and interviews about their uses, was carried out during the last week of February 1995.

Except lake Sane, near Nhabanga village, all lakes have water that is suitable for human and cattle drinking, washing, irrigation and pisciculture. Lake Sane's water may only be used for cattle drinking and pisciculture.

The investigations have shown that lakes are a vital source of water for domestic utilization (drinking, cooking, washing etc...), for small-scale irrigation with hand-carried watering-cans, and a source of fish. They are also refuges for wild animals such as birds.

These areas require protection from sand deposition (the surrounding areas must be vegetated, preferably wooded), from pollution and adequate management of the fish resources. This may include a comprehensive pisciculture programme and/or regulation and control of fishing activities as fishermen are presently using nets with too small mesh-size. Forbidding fishing with nets may improve the situation, but a preferable solution may be to organize and train the fishermen to implement a sustainable fish exploitation.

Permanent lakes, especially those of the Serra, have also a definite value for recreation and tourism. The lack of good access, due to the lack or the bad condition of roads, is a major limitation for the development of these activities.

- Temporary lakes and very humid closed depressions (**CW2**)

These are map units **BAD1**, **BAD2**, **DEH2** (examples of DEH2 are lakes Chevise and Nhambozi), **RIH** and **TE8**. They represent also an interesting source of water for small-scale irrigation, and less so, for domestic utilization (drinking, cooking, washing etc). An additional interesting feature is the frequent presence of reeds. These serve as building material and, when sold, as a source of cash. During droughts, these areas may be grazed or even partly cultivated. The reeds are also refuges for wild animals such as birds.

Only protection from excessive reeds exploitation is required.

6.4.2 Areas only suited for forestry and/or grazing (**G**)

6.4.2.1 Excessively drained sparsely vegetated sloping sands (**GE**)

These are map units **DUC4**, **DUC5**, **DUC6**, **DUI5** and **DUI6**. They consist of excessively drained sloping infertile sands having a low water holding capacity and little woody vegetation. Both wind and water erosion are active in these soils. Destructive uncontrolled fires are often provoked by hunters and/or honey collectors. They are mostly used as grazing lands though arable farming is locally practised.

These soils may be used for extensive grazing or for forestry. However, in conformity with the current land use, it is recommended to reserve these lands for silvopastoral use (grazing and exploitation of trees). Partial afforestation with adequate tree mixes may provide the following advantages:

- serve as wind breaks hence reducing wind erosion. For this purpose the hedges should be relatively permeable, oriented perpendicular to the dominant winds and spaced at not more than 120 meters (about 12 times tree height).

- if planted on contours, the trees would also limit water erosion.

- serve as firebreaks.

- increase available soil moisture through increased infiltration, reduced evapotranspiration due to the reduction of wind speed, and retention of night dew.

- improve soil fertility through foliage residues scattered by wind.

- provide additional fodder, especially during droughty years.

- provide extra revenue through the production of honey (apiculture), poles and fuelwood.

- facilitate a rational rotation of cattle grazing in the various blocks delimited by the hedges.

- provide shade to cattle during the hot hours.

The above mentioned advantages will largely outweigh the loss of grazing space due to the presence of hedges.

Marginal traditional farming, with intensive soil fertility and water conservation measures, may be authorized in favourable sites such as footslopes and toeslopes.

6.4.2.2 Wet flooded and saline clays (**GW**)

This is map unit **TE7**. It has a poor drainage, a high water table, strong salinity and is subject to frequent flooding. These lands are presently used for extensive grazing. They are moderately suitable for grazing and marginally suitable for forestry. It is suggested to maintain their present use for grazing.

Simple land forming (raised beds) through adequate mechanical ploughing may improve durably the drainage and salinity situation, hence improving the nutritive quality of the grass.

6.4.3 Areas suited for upland farming, grazing and forestry (**U**)

6.4.3.1 Alluvial lands not requiring deep drainage (**UA**)

- <u>Well to moderately well drained lands</u> (**UA1**)

These are map units **COM1**, **COM2**, **COM3**, **COM4**, **PLI12** and **TE3**. These soils are well to moderately well drained, have a moderate to high water holding capacity and a good natural fertility status. They are rich in potassium and phosphorus and poor to moderately rich in nitrogen, which makes them highly suitable for leguminous and tuber crops.

They are mostly used by the family sector for intensive traditional dryland farming, generally with annual crops intercropped with fruit trees. Many smallholders have dwellings in this management unit, especially in map units COM1, COM2 and COM4, where flood waters do not stagnate, hence the presence of many homesteads gardens.

These map units are highly to moderately suitable for all types of rainfed agriculture and highly suitable for grazing and forestry. Except for the heaviest component of map unit COM3 (COM3-2), hand tools cultivation is feasible in all other map units of this management unit. However, since farmers often also own lands in the neighbouring heavy clay soils, animal traction, owned or hired, is widely used.

Map units PLI12, TE3 and part of COM3 are also moderately to marginally suitable for surface irrigation while the other map units are unsuitable mainly due to unfavourable microtopography. No deep drainage is required and only map unit PLI12 and the heavy clay component of COM3 (COM3-2), require surface drainage. Cultivation on raised beds, as a measure to improve surface drainage, is largely practised in map unit PLI12.

Given the good P and K status of these soils, only nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen. Given the availability of water from the river or from shallow wells, and the presence of homesteads, use can also be made of compost of crop residues and domestic waste.

- <u>Imperfectly drained lands</u> (**UA2**)

* Drainage impeded by unfavourable topography and heavy texture (**UA2-1**)

These are map units **RIS1** and **TE4**. The soils of map unit RIS1 formed in shallow abandoned meanders while those of map unit TE4 formed in depressions within the Limpopo's lower terraces.

The restricted drainage of the soils of both map units represents an advantage during frequent droughty years and makes them important resources for the family sector.

These soils have good fertility and water holding capacity. Given their good P and K status, only nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen. Wherever water is available, use can be made of compost of crop residues and domestic waste.

Drainage is not feasible or only at a very high cost. These units are moderately suitable for all types of rainfed farming, moderately to marginally suitable for irrigated agriculture, highly suitable for grazing and marginally suitable for forestry.

* Drainage impeded by textural heterogeneity (**UA2-2**)

This is map unit **TE2**. The subsoil is clayey but the topsoil is sandy, hence the formation of a temporary perched water table during heavy rainy episodes. In moderately dry years this soil will benefit from its' impeded drainage. However, during very dry years, the sandy nature of its' topsoil will be a disadvantage.

This soil is moderately rich in P and K but very poor in nitrogen. Nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen. Since water is available in the neighbouring Munhuana river, use can be made of compost of crop residues.

Drainage will not solve the problem of the perched water table. Only repeated deep ploughing may improve the situation by mixing the upper soil. However this operation is not feasible wherever the sandy topsoil is thicker than 30 cm, because special ploughing equipment, unlikely to be available, is required.

This unit is moderately suitable for traditional rainfed farming, grazing and forestry, marginally suitable for general irrigated agriculture and mechanized rainfed farming. The sandy topsoil permits growing groundnuts.

- <u>Complexes of moderately well and imperfectly to poorly drained lands</u> (**UA3**)

These are map units **PBC1**, **PBC2**, **PBC3**, **PBC4**. These soils formed in point bar complexes that have a moderate to strong microtopography. The better drained components are on convex terrain and the poorly drained ones in depressions. They all have a very high water holding capacity and a good natural fertility status. They are rich in potassium and phosphorus (except PBC4 which is poor in phosphorus) and rich to moderately rich in nitrogen.

Convex components: (PBC1-1, PBC2-1, PBC3-1 and PBC4-1) They are mostly used by the family sector for traditional dryland farming, generally maize, beans and pumpkins. Some smallholders have dwellings in these lands. They consist of moderately well to imperfectly drained non to slightly saline soils.

These map unit components are highly suitable for grazing, highly to moderately suitable for animal traction-based rainfed agriculture, highly to marginally suitable for hand tools-based and mechanised rainfed agriculture and forestry, and marginally suitable to unsuitable for irrigated agriculture.

Given the good P and K status of these soils, only nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen. Given the availability of water from the river or from shallow wells, and the presence of homesteads, use can also be made of compost of crop residues and domestic waste. PBC4-1 however will benefit from a basal application of phosphorus.

Depressions components: (PBC1-2, PBC2-2, PBC3-2 and PBC4-2) They are mostly used for grazing. They are poorly to very poorly drained moderately to strongly saline soils. They are not drainable due to their topography.

These map unit components are moderately suitable for grazing, marginally suitable for irrigated rice production, marginally suitable to unsuitable for forestry and unsuitable for all other uses.

- <u>Moderately well drained heavy clay soils</u> (**UA4**)

These are map units **PLI1**, **PLI2**, **PLI3**, **PLI4** and **TE1**. These soils formed in level to nearly level flood plains and generally have a slight to moderate microrelief. They all have a very high water holding capacity and a good natural fertility status. They are rich to very rich in potassium and phosphorus and moderately rich in nitrogen. They are not or only slightly saline.

They are mostly used by the family sector for traditional dryland farming, generally maize, beans and pumpkins.

These map units would benefit from surface drainage. They are highly suitable for grazing, moderately suitable for animal traction-based and mechanised rainfed agriculture, moderately to marginally suitable for irrigated agriculture, marginally suitable for hand tools-based rainfed agriculture and forestry, and unsuitable for wetland agriculture.

Given the good P and K status of these soils, only nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen.

- <u>Mananga of high terraces</u> (**UA5**)

This is map unit **TEM**. It consists of moderately well drained and moderately sodic lands which formed on high alluvial terraces and have a moderate microrelief due to the presence of high but sparse termites mounds. They have a very high water holding capacity and a good natural fertility status. They are rich to very rich in potassium and phosphorus and moderately rich in nitrogen.

They are not saline but have a strong tendency to crust hence causing acute germination problems.

They are mostly used by the family sector for grazing but are also locally cultivated generally with maize, beans and pumpkins.

This map unit would benefit from surface drainage. It is moderately suitable for grazing, unsuitable for wetland farming, and marginally suitable for all other uses.

Given the good P and K status of these soils, only nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen. Gypsum could be applied to reduce crusting but it is unlikely that it would be economically justified.

- Imperfectly drained and periodically flooded alluvial lands (**UA6**)

These are map units **TE5** and **TE6**. These soils formed in level terraces of the lower course of the Limpopo and generally have a slight to moderate microrelief. They all have a high to very high water holding capacity and a moderate natural fertility status. They are rich to very rich in potassium, moderately rich in phosphorus and poor to moderately rich in nitrogen. They are slightly saline in the topsoil and slightly to moderately saline in the subsoil.

They are mostly used by the family sector for traditional dryland farming, generally maize, beans and pumpkins, and for grazing.

These map units would benefit from surface drainage. They are highly suitable to moderately suitable for grazing, moderately to marginally suitable for forestry, marginally suitable for all types of dryland farming and irrigated rice farming, marginally suitable to unsuitable for general irrigated farming and unsuitable for wetland agriculture.

Given the good P and K status of these soils, only nitrogen fertilizers may prove economical on non-leguminous crops such as maize. It is therefore recommended to use N fertilizers during the growing season as top-dressings provided sufficient rainfall has fallen.

6.4.3.2 Alluvial upland farming areas that require deep drainage and salinity control (**UD**)

- Imperfectly drained, slightly to strongly saline, clayey over sandy soils (**UD1**)

These are map units **PLI10** and **PLI11**. These soils formed in clayey alluvium overlying aeolian (?) sands. They are imperfectly drained and generally have a water table at about 75-100 cm. They have a moderate to high water holding capacity, are very rich in potassium, rich in nitrogen and very poor in phosphorus.

These soils are presently mostly used for grazing. Once deep drainage is implemented, these soils would be moderately to marginally suitable for irrigated agriculture, marginally suitable for wetland farming, and moderately suitable for animal traction-based rainfed traditional and mechanized farming. In their present state they are moderately suitable for grazing and marginally suitable for hand tools based-farming and forestry.

- Imperfectly to very poorly drained, not to moderately saline heavy clay soils (**UD2**)

These are map units **BAD3**, **BAD7**, **BAD8**, **PLI5** and **PLI6**. These soils formed in heavy swelling clays. The are imperfectly drained and generally have a water table at about 75-100 cm. They have a very high water holding capacity, are very rich in potassium and moderately rich to rich in nitrogen and phosphorus.

These soils are presently mostly used for grazing or, if drainage permits, maize and beans. They used to be largely irrigated before the collapse of the drainage system. Once deep drainage is implemented, these soils would be moderately suitable for irrigated rice farming, animal traction-based and mechanised rainfed agriculture. They would be also moderately to marginally suitable for general irrigated farming and marginally suitable to unsuitable for wetland farming. In their present state they are highly to marginally suitable for grazing and marginally to unsuitable for forestry.

- Imperfectly drained strongly saline heavy clay soils (**UD3**)

These are map units **BAD9**, **BAD10** and **PLI7**. These soils formed in heavy swelling clays. The are imperfectly drained and generally have a water table at about 25-50 cm. They have a very high water holding capacity, are very rich in potassium, rich in nitrogen and poor to rich in phosphorus.

These soils are presently mostly used for grazing or, if drainage permits, maize and beans. They used, especially PLI7, to be largely irrigated before the collapse of the drainage system. Once deep drainage is implemented, these soils would be moderately to marginally suitable for irrigated rice farming, animal traction-based and mechanised rainfed agriculture. They would be also marginally suitable for general irrigated farming and marginally suitable to unsuitable for wetland farming. In their present state they are highly to moderately suitable for grazing and marginally suitable for forestry.

6.4.3.3 Sandy upland areas (**US**)

They are suitable for both animal traction and hand tools-based agriculture. They all require erosion control and fertility improvement.

- Somewhat excessively drained, strongly sloping moderately fertile red earthy sands (**US1**)

These are map units **DEC4** and **DUI10**. These soils have a low water holding capacity, are slightly acid (pH 6 to 6.5), moderately rich in nitrogen, poor in phosphorus and rich in potassium. Their moderate fertility status is mostly due to the dense tree cover and, less so, to their higher clay content.

Due to their tendency to compact (higher clay content) these soils may undergo severe water erosion and therefore require intensive soil conservation measures, which may consist primarily in conserving the existing tree cover. Moderate fertility and moisture conservation measures are also required.

The soils of this management unit are marginally suitable for traditional upland arable farming and grazing and moderately suitable for forestry.

- <u>Excessively drained, strongly to gently sloping poor sands</u> (**US2**)

These are map units **DEC5**, **DUI3**, **DUI4** and **TEA1**. These soils have a very low water holding capacity compounded by excessive runoff. They are slightly to strongly acid (pH 5 to 6.5) and have a very low fertility status.

These soils require intensive soil, fertility and water conservation measures.

The soils of this management unit are marginally suitable for traditional upland arable farming and grazing and moderately suitable for forestry.

- <u>Somewhat excessively drained, very gently to gently sloping poor brownish sands</u> (**US3**)

These are map units **DEC3**, **DUI1**, **DUI2**, **DUI7** and **DUI12**. These soils have a very low water holding capacity, are slightly to strongly acid (pH 5 to 6.5) and have a very low fertility status.

These soils require intensive fertility and moderate soil and water conservation measures.

The soils of this management unit are marginally suitable for traditional upland farming, marginally to moderately suitable for grazing and moderately suitable for forestry.

- <u>Somewhat excessively drained poor greyish sands of margins of lakes and dry depressions</u> (**US4**)

These are map units **DEM** and **DES**. These soils have a low to very low water holding capacity, are moderately acid (pH 5.5 to 6) and have a very low fertility status. They have a sweet water table at depths varying between 3 and 15 m.

These soils require intensive fertility and moderate soil and water conservation measures. Acacia albida is particularly interesting in this unit.

The soils of this management unit are marginally suitable for traditional upland farming and grazing and highly to moderately suitable for forestry. Small-scale "manual" irrigation is often possible from the neighbouring lakes or shallow dug wells.

- <u>Somewhat excessively drained, strongly acid very gently to gently sloping sandy soils</u> (**US5**)

These are map units **DEC7** and **DUI11**. These soils have a low to very low water holding capacity, are strongly acid (pH 5 to 5.5) and have a low fertility status.

These soil require moderate fertility, soil and water conservation measures.

The soils of this management unit are moderately suitable for traditional upland farming, grazing and forestry.

- <u>Somewhat excessively drained, very gently to gently sloping red earthy sands</u> (**US6**)

These are map units **DUI8** and **DUI9**. These soils have a low water holding capacity, are slightly acid (pH 6 to 6.5), moderately rich in nitrogen, poor in phosphorus and rich in potassium.

These soils require moderate fertility, soil and water conservation measures.

The soils of this management unit are moderately suitable for traditional upland farming, highly suitable for forestry and highly to moderately suitable for grazing.

- Sandy plain soil association (**US7**)

This is map unit **PLA**. It is heterogenous and includes somewhat excessively nearly level to very gently undulated upland sands and fine-loamy soils that have a seasonally high water table in narrow depressions.

* **PLA-1**. These soils are somewhat excessively drained, have a very low water holding capacity, are moderately acid (pH 5.5-6), poor in phosphorus and nitrogen and rich in potassium.

These soil require moderate fertility, soil and water conservation measures. The water table being within 3-15 m, Acacia albida may assist in restoring and maintaining fertility.

The soils of this management subunit are moderately suitable for traditional upland farming, grazing and forestry.

* **PLA-2**. These soils are imperfectly drained, have a moderate water holding capacity, are moderately acid (pH 5.5-6), moderately rich in phosphorus and nitrogen and rich in potassium.

These soil require moderate fertility, soil and water conservation measures and some surface drainage. Wherever water is available, they can be irrigated.

The soils of this management subunit are moderately suitable for upland, wetland and irrigated farming and forestry, and highly suitable for grazing.

- Sandy soils that have a seasonally high water table (**US8**)

These are map units **DEC2** and **TEA2**. These soils are imperfectly drained, have a low water holding capacity and a sweet water table at 75-125 cm, are moderately to strongly acid (pH 5-6), moderately rich in potassium, poor in nitrogen and poor to rich in phosphorus.

These soil require moderate fertility, soil and water conservation measures and some surface drainage. Wherever water is available, they can be irrigated.

The soils of this management unit are moderately suitable for traditional upland farming and forestry, and moderately to marginally suitable for grazing.

6.4.4 Wetland farming areas (**W**)

6.4.4.1 Clayey wetlands (**WC**)

- Drainable imperfectly to poorly drained fine-textured soils (**WC1**)

These are map units **BAD4**, **BAD5**, **DEC1**, **PLI8** and **PLI9**. These soils have a high water holding capacity and a sweet water table at 50-125 cm, are moderately to slightly acid (pH 5.5-

6.5), poor to moderately rich in phosphorus, rich to moderately rich in nitrogen and rich to very rich in potassium.

These soils require drainage and P fertilizer.

Once drained the soils of this management unit are suitable for all types of rainfed, wetland and irrigated farming. In their present state they are also highly suitable for grazing and moderately to marginally suitable for forestry.

- Non drainable poorly drained fine-textured soils (**WC2**)

This is map unit **RIS2**. These soils formed in poorly drained abandoned oxbows. They have a high water holding capacity and a moderately saline water table at 50-75 cm, are slightly acid (pH 6-6.5), moderately rich in phosphorus and rich in nitrogen and potassium.

These soils require drainage but are not drainable at a reasonable cost. They may respond to P fertilizer.

The soils of this management unit are marginally suitable for wetland farming and forestry, and moderately suitable for grazing.

6.4.4.2 Peaty wetlands (**WP**)

- Peat wetlands (**WP1**)

These are map units **MAC1** and **MAC2**. These soils are poorly to very poorly drained, have a very low fertility, particularly map unit MAC2 which is very strongly acid (pH 4.4 to 5).

These soils require drainage to lower the water table to a depth of 50-75 cm. Deeper drainage would cause rapid mineralization and subsidence of the peat. NPK fertilization is also recommended, especially PK. Map unit MAC2 would benefit from lime application to increase the pH.

Once drained, the soils of this management unit are suitable for wetland farming and traditional upland farming. However, it is better to reserve it for wetland farming as it is more productive.

- Clayey and peaty wetlands soils association (**WP2**)

This is map unit **MAC3** which is heterogenous and is composed of peat soils similar to those of map unit **MAC2** and of saline heavy clay soils. These soils are presently permanently flooded by the waters of rio Lumane.

* **MAC3-1** The peat soils are very poorly drained, very strongly acid (pH 4.4 to 5) and have a very low fertility.

These soils require drainage to lower the water table to a depth of 50-75 cm. Deeper drainage would cause rapid mineralization and subsidence of the peat. NPK fertilization is also recommended, especially PK. Lime application would help increase the pH.

Once drained, these soils are moderately suitable for wetland farming and traditional upland farming. However, it is better to reserve it for wetland farming as it is more productive.

* **MAC3-2** The heavy clay soils are very poorly drained, very strongly acid (pH 4.4 to 5), moderately saline, and have a moderate fertility status.

These soils require drainage, leaching of salts and P fertilization. Lime application would help increase the pH.

Once drained, these soils are moderately suitable for traditional animal traction-based upland and mechanized rainfed farming. They are also moderately suitable for wetland, hand tools-based agriculture and all types of irrigated agriculture.

- Clayey, peaty and sandy wetlands soils association (**WP3**)

This is map unit **VAL2** which is heterogenous and includes a very poorly drained peat soil and a poorly drained humic fine-loamy soil in the valley floor, and an imperfectly drained grey sandy soil on the toeslopes of the surrounding reliefs.

* **VAL2-1** The peat soil component is very strongly acid (pH 4.4-5) and has a very low fertility.

These soils require drainage to lower the water table to a depth of 50-75 cm. Deeper drainage would cause rapid mineralization and subsidence of the peat. NPK fertilization is also recommended, especially PK. Lime application would help raise the pH.

Once drained, these peat soils are highly suitable for wetland farming and moderately suitable for traditional upland farming. However, it is better to reserve them for wetland farming as it is more productive.

* **VAL2-2** The fine-loamy soil component is moderately acid (pH 5.5-6) and has a good fertility status.

These soils require drainage and moderate PK fertilization to sustain high yields.

Once drained, these soils are highly suitable for wetland farming and moderately suitable for all types of upland farming, mechanized general irrigation and marginally suitable for mechanized irrigated rice production. However, it is better to reserve them for wetland farming as it is more productive. In their present situation, these soils are moderately suitable for grazing.

* **VAL2-3** The imperfectly drained grey sandy soils of the toeslopes are moderately acid (pH 5.5-6) and have a low fertility status.

These soils do not require drainage but NPK fertilization is necessary to sustain high yields.

These soils are moderately suitable for traditional upland farming, grazing and forestry, marginally suitable for wetland farming.

6.4.4.3 Sandy wetlands (**WS**)

- Drainable sandy wetlands of narrow valleys (**WS1**)

This is map unit **VAL1** which is heterogenous and includes a poorly humic sandy soil in the valley floor, and an imperfectly drained grey sandy soil on the toeslopes of the surrounding reliefs.

* **VAL1-1** The poorly drained humic sandy soils are slightly acid (pH 6-6.5) and have a moderately high fertility status. They have a sweet water table at 75-100 cm.

These soils require moderate drainage and minimal NPK fertilization to sustain high yields.

Once drained, these soils are moderately suitable for traditional upland farming and marginally suitable for wetland farming, mechanized rainfed and general irrigated agriculture. In their present situation they are moderately suitable for grazing and marginally suitable for forestry.

* **VAL1-2** The imperfectly drained grey sandy soil of the toeslopes are moderately acid (pH 5.5-6) and have a low fertility status. They have a sweet water table at 75-100 cm.

These soils do not require drainage but NPK fertilization is necessary to sustain high yields.

These soils are moderately suitable for traditional upland farming, grazing and forestry and marginally suitable for wetland farming.

- Drainable sandy wetlands (**WS2**)

This is map unit **BAD6**. They are moderately acid (pH 5.5-6) and have a moderate fertility status. They have a sweet water table within 25 cm.

These soils require drainage and P fertilization to sustain high yields.

Once drained, these soils are moderately suitable for all types of farming. In their present situation they are moderately suitable for grazing.

- Non drainable sandy wetlands (**WS3**)

This is map unit **DEH1** which is heterogenous and includes a poorly humic sandy soil in the bottom of the depressions, and an imperfectly drained grey sandy soil on the toeslopes of the surrounding reliefs.

* **DEH1-1** The poorly drained humic sandy soils are slightly acid (pH 6-6.5) and have a moderately high fertility status. They have a sweet water table at 50-75 cm.

These soils are not drainable and NPK fertilization is unlikely to be economical.

They are marginally suitable for wetland farming and forestry and moderately suitable for grazing.

* **DEH1-2** The imperfectly drained grey sandy soil of the toeslopes are moderately acid (pH 5.5-6) and have a low fertility status. They have a sweet water table at 75-100 cm.

These soils do not require drainage but NPK fertilization is necessary to sustain high yields.

These soils are moderately suitable for traditional upland farming, grazing and forestry and marginally suitable for wetland farming.

R.M. Westerink

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LAND RESOURCES APPRAISAL REPORT DISTRICT OF XAI-XAI

Volume II

TYPICAL PEDONS

Souirji, A.

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1995

Maputo, Moçambique

ISN 27039

Project MOZ/92/012 Report 1b

NATIONAL FAMILY SECTOR AGRICULTURAL DEVELOPMENT PROGRAMME

PRE-PROGRAMME

MOZAMBIQUE

LAND RESOURCES APPRAISAL REPORT

District of Xai-Xai

Volume II. Typical Pedons

by

A. Souirji

MINISTRY OF AGRICULTURE AND FISHERIES (MAP)

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)

December 1995

Maputo, Mozambique

INTRODUCTION

The profiles were described on SDB (Soil Database) formats, as adapted by the Department of Land and Water. The terms used are largely compatible with those of the Guidelines for Soil Profile Description (FAO, 1990).

The soil classification is given in three systems:

- FAO system, according to the "Revised Legend of the Soil Map of the World" (FAO, 1990)

- Soil Taxonomy system, according to "Keys to Soil Taxonomy" (Soil Survey Staff, SCS-USDA, 1994)

- Local soil classification, as elicited from farmers through interviews. The system is presented in section 4.2.2, page 27 of volume I of this report.

The attention of the reader is drawn on the fact that due to the lack of mineralogical information, it was not possible to ascertain if for Soil Taxonomy, the sandy soils of the study area are Ustipsamments or Quartzipsamments. Therefore both possibilities are included.

Thionic properties are assumed in some profiles in accordance with field evidence, in the absence of relevant laboratory data.

The profiles were described in 1994 by:

- J. Mafalacusser
- L. Amós
- A. Souirji

<u>Publications in this study:</u>

This report is the first in a serie of two volumes:

Vol. I: Souirji, A. et al, 1995 - Land resources appraisal report district of Xai Xai. Volume I: Main report. Project MOZ/92/012 report 1a.

Vol II: Souirji, A. 1995 - Land resources appraisal report district of Xai Xai. Volume II: Typical pedons. Project MOZ/92/012 report 1b.

See also: Souirji, A. et al, 1995 - Methodology for participatory soil survey and land evaluation. Project MOZ/92/012 report 3.

PROFILE: GX0066 **UNIT: DUI12** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (600).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 51 33 S ; 33 30 01 E
Elevation: 29 m
Date : 21/04/94

Classification: - FAO : Ferrali-Luvic Arenosol
- ST : Argic Ustipsamment/Argic Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : nearly level
Element/Pos.: interfluve, edge of plateau
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. : borrow pit
Vegetation : herbaceous (fallow)
Species : gramineae

Land Form: sandy plateau
Slope : 0 - 2% , straight
Crops: cashew
Grass cover: 40-80%

Parent Material: (reworked?) aeolian sand

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive;
External drainage: rapid
Flooding : none
Moist. Conditions: all dry

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks: This profile was dug in a quarry of sand used for rural roads. The profile was probably disturbed above the depth of 46 cm.

Samples: all horizons. Lamellas, from horizon 177-218 cm, were also sampled separately.

A1 0 - 19 cm; dark greyish brown (10YR 4/2) dry and very dark greyish brown (10YR 3/2) moist; sand; massive; slightly hard (dry), friable (moist), not sticky (wet), not plastic (wet); few very fine pores; common fine and very fine roots; few charcoal pieces; not calcareous; clear wavy boundary.

A2 19 - 46 cm; very dark greyish brown (10YR 3/2) dry and very dark brown (10YR 2/2) moist; sand; massive; slightly hard (dry), friable (moist), slightly sticky (wet), not plastic (wet); common very fine pores; common fine and very fine roots; few charcoal pieces; not calcareous; clear straight boundary.

Bt1 46 - 80 cm; dark greyish brown (10YR 4/2) dry and very dark greyish brown (10YR 3/2) moist; sand; massive; slightly hard (dry), loose (moist), slightly sticky (wet), not plastic (wet); common very fine pores; few distinct clay and sesquioxides in lamellas; common fine and very fine roots; few charcoal pieces; not calcareous; gradual wavy boundary.

Bt2 80 - 96 cm; pale brown (10YR 6/3) dry and dark brown (10YR 4/3) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common very fine pores; common distinct clay and sesquioxides in lamellas; few fine and very fine roots; not calcareous; gradual wavy boundary.

Bt3 96 - 132 cm; light yellowish brown (10YR 6/4) dry and dark yellowish brown (10YR 4/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); few fine pores; very few fine and very fine roots; not calcareous; diffuse wavy boundary.

Bt4 132 - 177 cm; yellowish brown (10YR 5/4) dry and dark brown (7.5YR 4/4) moist; sand; massive; slightly hard (dry), friable (moist), not sticky (wet), not plastic (wet); few fine pores; common prominent clay and sesquioxides in lamellas; very few fine and very fine roots; not calcareous; diffuse wavy boundary.

Bt5 177 - 218 cm; yellowish brown (10YR 5/6) dry and dark brown (7.5YR 4/4) moist; sand; massive; slightly hard (dry), friable (moist), slightly sticky (wet), not plastic (wet); few fine pores; common prominent clay and sesquioxides in lamellas; fine and very fine roots; not calcareous.

PROFILE: GX0065 **UNIT: BAD8** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (601).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 28 S ; 33 31 17 E
Elevation: 10 m
Date : 21/04/94

Classification: - FAO : Gleyi-Eutric Vertisol
- ST : Sodic Haplustert
- Local : Bila

Soil Climate: ustic

Topography : flat
Element/Pos.: backswamp, intermediate part
Micro Top. : irregular low
Land Use : irrigated agriculture
Human Infl. : medium-scale flood irrigation
Vegetation :
Species :

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops: rice
Grass cover:

Parent Material: alluvial deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : poor
External drainage: ponded
Flooding : rare
Moist. Conditions: dry 0-43, fresh 43-130 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : not observed
Catchment: Limpopo

Remarks: 3-4 cm polygonal cracks at the surface.

Samples: all horizons.

A 0 - 15 cm; very dark grey (2,5Y 3/0) dry and black (2.5Y 2/0) moist; common fine distinct sharp brownish mottles; clay; moderate to strong very coarse prismatic structure party to angular blocky; extremely hard (dry), friable (moist), sticky (wet), very plastic (wet); few fine pores; few prominent sesquioxides coatings in the pores; common fine and medium roots; not calcareous; clear wavy boundary.

Bg1 15 - 43 cm; black (2,5Y 2/0) dry and moist; common fine prominent evident reddish mottles; clay; strong very coarse prismatic structure party to wedge-shaped angular blocky; very hard (dry), friable (moist), sticky (wet), very plastic (wet); few fine pores; common fine irregular soft ferruginous red soft segregations; few fine and medium roots; not calcareous; gradual wavy boundary.

Bg2 43 - 85 cm; black (2.5Y 2/0) moist; common fine prominent sharp reddish mottles; clay; moderate to strong very coarse wedge-shaped angular blocky structure; very hard (dry), friable (moist), sticky (wet), very plastic (wet); few very fine and fine pores; many prominent intersecting slickensides on peds faces; few fine irregular ferruginous red soft segregations, and few fine spheroidal soft ferro-manganic red nodules; few fine and medium roots; not calcareous; gradual wavy boundary.

Bg3 85 - 105 cm; black (2.5Y 2/0) moist; clay; moderate very coarse wedge-shaped angular blocky structure; very hard (dry), friable (moist), sticky (wet), very plastic (wet); few fine and very fine pores; common prominent partly intersecting slickensides on peds faces; very few very fine roots; not calcareous; clear wavy boundary.

Bg4 105 - 130 cm; very dark grey (2,5Y 3/0) moist; many medium distinct sharp brownish mottles; clay; weak coarse angular blocky structure; very hard (dry), friable (moist), sticky (wet), very plastic (wet); very fine pores; common prominent partly intersecting slickensides on peds faces; very few very fine roots; not calcareous;

PROFILE: GX0113 **UNIT: TEM** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (602).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 37 S ; 33 32 12 E
Elevation: 11 m

Date : 22/04/94

Classification: - FAO : Sodi-Vertic Cambisol
- ST : Sodic Haplustert
- Local : Mananga (of plain)

Soil Climate: ustic

Topography : flat
Element/Pos.: terrace, high part
Micro Top. : flat, termites mounds 1-2 m high, 100-200 m apart
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous
Species : gramineae

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops: fallow
Grass cover: 40-80%

Parent Material: mananga deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : medium hard crust
Drainage class : moderately well
External drainage: slow
Flooding : nil
Moist. Conditions: dry 0-64, slightly moist 64-120 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : observed at 4 m in a well
Catchment: Limpopo

Remarks: few thin polygonal cracks and fine sand and very fine gravel individualization at the surface.

Samples: all horizons.

AE 0 - 8 cm; dark brown (10YR 3/3) dry and very dark brown (10YR 2/2) moist; sandy clay loam; weak coarse prismatic structure parting to subangular blocky; very hard (dry), very friable (moist), slightly sticky (wet), slightly plastic (wet); few very fine pores; common fine and very fine roots; clear wavy boundary.

Btn 8 - 45 cm; black (10YR 2/1) dry and moist; sandy clay loam; moderate coarse prismatic structure parting to parallelepipeds; very hard (dry), very friable (moist), sticky (wet), plastic (wet); few very fine pores; common distinct pressure faces on peds; many fine and very fine roots; few infilled burrows; gradual wavy boundary.

Btng1 45 - 65 cm; very dark grey (10YR 3/1) dry and black (5Y 2.5/1) moist; few fine distinct yellowish brown mottles; sandy clay loam; moderate coarse wedge-shaped angular blocky structure; very hard (dry), very friable (moist), sticky (wet), plastic (wet), very few fine pores, common distinct partly intersecting slickensides on peds faces; very few fine spheroidal hard calcareous white nodules and very few irregular soft ferro-manganic black concretions; common fine and very fine roots; common infilled burrows; locally strongly calcareous; diffuse wavy boundary.

Btng2 65 - 100 cm; very dark greyish brown (10YR 3/2) dry and very dark grey (5Y 3/1) moist; common fine distinct yellowish brown mottles; clay; moderate to strong very coarse wedge-shaped angular blocky structure; very hard (dry), very friable (moist), sticky (wet), plastic (wet); very few fine pores, common prominent partly intersecting slickensides on peds; few fine spheroidal hard calcareous white nodules and few fine irregular soft and hard ferro-manganic black concretions; few very fine roots; few infilled burrows; locally strongly calcareous; diffuse wavy boundary.

Btng3 100 - 120 cm; dark olive grey (5Y 3/2) dry and moist; many fine distinct sharp yellowish brown mottles; clay; moderate to strong very coarse wedge-shaped angular blocky structure; very hard friable (moist), sticky (wet), plastic (wet); very few very fine pores; common prominent partly intersecting slickensides on peds; common medium spheroidal hard calcareous white modules and common fine irregular soft and hard ferro-manganic black concretions; very few very fine roots; locally strongly calcareous.

PROFILE: GX0114 **UNIT: DUI12** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (603).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 31 S ; 33 30 54 E
Elevation: 28 m

Date : 22/04/94

Classification: - FAO : Dystri-Cambic Arenosol
- ST : Argic Ustipsamment/Argic Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : flat
Element/Pos.: interfluve, near edge of plateau
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation :
Species :

Land Form: sandy plateau
Slope : 0 - 1% , straight

Crops: cashew, mango, maize

Grass cover:

Parent Material: (reworked?) aeolian sand

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive;
External drainage: slow
Flooding : none
Moist. Conditions: all dry

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment: Limpopo

Remarks: pieces of pottery in second and third horizons. The lamellas in the fourth and fifth horizons are very long and intersecting. Their thickness is 2-5 and 2-10 mm, respectively.

Samples: all horizons.

A 0 - 15 cm; dark brown (10YR 4/3) dry and (5YR 4/2) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common fine and very fine roots; few charcoal pieces; not calcareous; clear wavy boundary.

AB 15 - 80 cm; dark brown (10YR 4/3) dry and (7.5YR 3/2) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common very fine pores; common fine and very fine and few coarse roots; common infilled burrows and few charcoal pieces; not calcareous; gradual wavy boundary.

Bw 80 - 135 cm; pale brown 10YR 6/3 (dry) and dark yellowish brown (10YR 4/4) moist; sand; massive; soft (dry), loose (moist), not sticky, not plastic (wet); common very fine and fine pores; few fine and medium roots; few infilled burrows and few charcoal pieces; not calcareous; clear wavy boundary.

Bt1 135 - 145 cm; yellowish brown (10YR 5/6) dry and dark brown (7.5YR 4/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common very fine and fine pores; few prominent clay and sesquioxides in lamellas; few fine and medium roots; not calcareous; gradual wavy boundary.

Bt2 145 - 185 cm; yellowish brown (10YR 5/6) dry and dark brown (7.5YR 4/4) moist; sand; massive; hard (dry), loose (moist), not sticky (wet), not plastic (wet); common very fine and fine pores; common prominent clay and sesquioxides in lamellas; very few fine and medium roots; not calcareous.

PROFILE: GX0115 **UNIT: DEC3** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (604).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 35 S ; 33 31 07 E
Elevation: 18 m

Date : 22/04/94

Classification:
- FAO : Dystri-Haplic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : undulating
Element/Pos.: riser, middle slope
Micro Top. : none
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous (fallow)
Species : gramineae

Land Form: sandy plateau
Slope : 4 - 8% , straight
Crops: cashew, mango, mafurra, canhu
Grass cover: 15-40%

Parent Material: colluvium derived from aeolian sands

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive;
External drainage: moderately rapid
Flooding : none
Moist. Conditions: dry 0-135, slightly moist 135-200 cm

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks:

Samples: all horizons

A	0 - 24 cm; dark greyish brown (10YR 4/2) dry and very dark greyish brown (10YR 3/2) moist; sand; massive; soft (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and very fine roots; few infilled burrows; not calcareous; gradual wavy boundary.
AC	24 - 80 cm; greyish brown (10YR 5/2) dry and very dark greyish brown (10YR 3/2) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; few coarse and common fine and medium roots; common infilled and open burrows and insect channels and charcoal pieces; not calcareous; gradual wavy boundary.
C1	80 - 135 cm; pale brown (10YR 6/3) dry and dark brown (10YR 4/3) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); few fine pores; few coarse and few fine and medium roots; common charcoal pieces; not calcareous; diffuse wavy boundary.
C2	135 - 165 cm; light yellowish brown (10YR 6/4) dry and dark yellowish brown (10YR 4/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet), few fine pores, few fine-medium roots; common charcoal pieces; not calcareous; gradual wavy boundary.
C3	165 - 200 cm; yellowish brown (10YR 5/4) dry and dark yellowish brown (10YR 4/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic; few fine and medium roots; not calcareous.

PROFILE: GX0116 **UNIT: DEC7** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (605).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 50 33 S ; 33 28 14 E
Elevation: 13 m

Date : 27/04/94

Classification: - FAO : Hyposodi-Haplic Luvisol
- ST : Typic Haplustalf
- Local : Mananga (of Serra)

Soil Climate: ustic

Topography : undulating
Element/Pos.: riser, middle slope
Micro Top. : termites mounds (up to 3 m high)
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : palmeiras and herbaceous (fallow)
Species : phoenix reclinata and gramineae

Land Form: sandy plateau
Slope : 4 - 8% , straight

Crops: young cashew, canhu

Grass cover: 15-40%

Parent Material: mananga deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : imperfect
External drainage: slow
Flooding : none
Moist. Conditions: slightly moist 0-14, dry 14-130 cm

Rock Outcrops : nil
Erosion : nil

Permeability: slow
Watertable : not observed

Catchment: Limpopo

Remarks: the thickness of the sandy layer above the argillic horizon is only 45 cm, instead of the 50 cm required for Arenic subgroups, therefore this pedon is classified as Typic Haplustalf. Roots are along ped faces in the horizon 28-45 cm.

Samples: all horizons

A1 0 - 14 cm; dark greyish brown (10YR 4/2) (dry) and very dark greyish brown (10YR 3/2) moist; loamy sand; moderate fine to medium subangular blocky structure; loose (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and medium roots; not calcareous; gradual wavy boundary.

A2 14 - 28 cm; brown (10YR 5/3) dry and very dark brown (10YR 2/2) moist; loamy sand; massive; slightly hard (dry), very friable (moist), not sticky (wet), slightly plastic (wet); common fine pores; common fine and medium roots; few infilled burrows; not calcareous; gradual wavy boundary.

Eg 28 - 45 cm; brown (10YR 5/3) dry and dark brown (10YR 4/3) moist; common medium faint diffuse brownish mottles; loamy sand; massive; slightly hard (dry), very friable (moist), not sticky (wet), not plastic (wet); common fine pores; common fine and very fine roots; not calcareous; gradual wavy boundary.

Btng1 45 - 67 cm; dark brown (10YR 4/3) dry and dark brown (10YR 4/3) moist; medium faint diffuse brownish mottles; sandy clay loam; moderate coarse prismatic structure; very hard (dry), very friable (moist), sticky (wet), plastic (wet); common fine pores; common fine and very fine roots; few infilled burrows; not calcareous; gradual wavy boundary.

Btng2 67 - 85 cm; brown (10YR 5/3) dry and dark greyish brown (10YR 4/2) moist; medium distinct evident brownish mottles; sandy clay loam; moderate coarse prismatic structure; very hard (dry), friable (moist), sticky (wet), plastic (wet); few fine pores; common faint not intersecting slickensides on peds faces; few fine and very fine roots; not calcareous; gradual wavy boundary.

Btng3 85 - 130 cm; light grey (10YR 7/1) dry and grey (10YR 6/1) moist; many fine distinct sharp brownish and many fine distinct sharp reddish mottles; sandy clay loam; weak coarse prismatic structure; very hard (dry), firm (moist), slightly sticky (wet), plastic (wet); few fine pores; common distinct clay and humus coatings on peds faces and very few faint pressure faces; common fine irregular hard and soft manganiferous black concretions; few fine and very fine roots; not calcareous.

PROFILE: GX0117 **UNIT: DEC7** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (606).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 50 34 S ; 33 28 17 E
Elevation: 17 m

Date : 27/04/94

Classification: - FAO : Areni-Haplic Alisol
- ST : Arenic Haplustalf
- Local : Mananga (of Serra)

Soil Climate: ustic

Topography : undulating
Element/Pos.: riser, upper slope
Micro Top. : termites mounds
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : palmeiras and herbaceous (fallow)
Species : phoenix reclinata and gramineae

Land Form: sandy plateau
Slope : 2 - 4% , straight

Crops: cashew, canhu

Grass cover: 15-40%

Parent Material: mananga deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : imperfect
External drainage: slow
Flooding : none
Moist. Conditions: dry 0-140 cm

Rock Outcrops : nil
Erosion : nil

Permeability: slow
Watertable : not observed

Catchment: Limpopo

Remarks: the horizon 20-48 cm has very reduced gley colours (seasonal perched watertable.

Samples: all horizons

A 0 - 20 cm; brown (7.5YR 5/2) dry and dark brown (7.5YR 3/2) moist; sand; weak medium subangular blocky structure; loose (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; many fine, very fine and medium roots; few open burrows; not calcareous; clear wavy boundary.

Eg1 20 - 48 cm; pinkish grey (7.5YR 6/2) dry and dark brown (7.5YR 3/2) moist; common fine distinct diffuse reddish mottles; sand; massive; loose (dry), loose (moist), not sticky (wet), not plastic (wet); few fine and medium pores; common very fine, fine and medium roots; few insect channels; not calcareous; gradual wavy boundary.

Eg2 48 - 65 cm; brown (7.5YR 5/2) dry and dark brown (7.5YR 3/2) moist; common fine distinct evident reddish mottles; sand; massive; slightly hard (dry), very friable (moist), not sticky (wet), not plastic; common fine and very fine pores; common fine and medium roots; few open burrows; not calcareous; gradual wavy boundary.

Btng1 65 - 97 cm; dark reddish grey (5YR 4/2) dry and dark reddish brown (5YR 3/2) moist; few distinct evident reddish mottles; sand clay loam; massive; hard (dry), very friable (moist), not sticky (wet), not plastic (wet); many fine and medium pores; common fine and medium roots; common open burrows; not calcareous; gradual wavy boundary.

Btng2 97 - 140 cm; dusky red (2.5YR 3/2) dry and dark reddish brown (5YR 3/2) moist; many fine distinct evident reddish mottles; sandy loam; massive; hard (dry), very friable (moist), sightly sticky (wet), plastic (wet); many fine and medium pores; few fine irregular soft and hard manganiferous black concretions; few fine and medium roots; not calcareous.

PROFILE: GX0067 **UNIT: DUI12** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (607).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 33 S ; 33 27 22 E
Elevation: 19 m
Date : 28/04/94

Classification: - FAO : Dystri-Albic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : gently undulating
Element/Pos.: upper slope
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous and bush (fallow)
Species : gramineae and few bushes

Land Form: sandy plateau
Slope : 4 - 8% , straight
Crops: cashew, masala
Grass cover: 15-40%

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-10 moist, 10-150 cm dry

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks: there are clear signs of former hydromorphic conditions revealed by the presence of reddish ferruginous mottles below 44 cm. The fine-textured mananga deposits probably underline the sandy parent material at a shallow depth.

Samples: all horizons

A 0 - 10 cm; greyish brown (10YR 5/2) dry and dark greyish brown (10YR 4/2) moist; sand; weak fine to medium subangular blocky structure; loose (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and medium roots; few charcoal pieces; not calcareous; gradual wavy boundary.

AE 10 - 44 cm; greyish brown (10YR 5/2) dry and very dark greyish brown (10YR 3/2) moist; sand; massive; loose (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and medium roots; few charcoal pieces; not calcareous; gradual wavy boundary.

E1 44 - 78 cm; light brownish grey (10YR 6/2) dry and dark greyish brown (10YR 4/2) moist; common medium distinct evident reddish mottles; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), plastic (wet); common fine and very fine pores; common fine and medium and few coarse roots; not calcareous; diffuse wavy boundary.

E2 78 - 127 cm; white (7.5YR 8/0) dry and light brownish grey (10YR 6/2) moist; common medium distinct evident reddish mottles; sand; massive; loose (dry), loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; common fine and medium roots; not calcareous; gradual wavy boundary.

E3 127 - 150 cm; white (7.5YR 8/0) dry and light brownish grey (10YR 6/2) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few fine and medium roots; not calcareous;

PROFILE: GX0068 **UNIT: DEC2** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (608).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 32 S ; 33 27 17 E
Elevation: 16 m

Date : 28/04/94

Classification: - FAO : Gleyi-Umbric Regosol
- ST : Aquic Ustipsamment/Aquic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : gently undulating
Element/Pos.: middle slope
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. : ploughed
Vegetation :
Species :

Land Form: sandy plateau
Slope : 4 - 8% , straight

Crops: mafurra, canhu

Grass cover:

Parent Material: colluvium derived from aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : imperfect
External drainage: slow
Flooding : none
Moist. Conditions: 0-68 dry, 68-150 cm moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : observed at 115 cm

Catchment: Limpopo

Remarks: the reddish and black ferro-manganiferous mottles below 20 cm are dominantly vertically oriented.

Samples: all horizons

A1 0 - 20 cm; dark reddish brown (5YR 3.5/1) dry and black (5YR 2.5/1) moist; sand; weak fine granular structure; soft (dry), very friable (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and very fine roots; few charcoal pieces; not calcareous; gradual wavy boundary.

A2 20 - 45 cm; very dark grey (5YR 3/1) dry and black (5YR 2.5/1) moist; few fine distinct sharp reddish mottles; sand; moderate fine to medium granular structure; slightly hard (dry), very friable (moist), not sticky (wet), not plastic (wet); common fine pores; common fine and very fine roots; common open burrows and few charcoal pieces; not calcareous; clear straight boundary.

Cg1 45 - 68 cm; dark grey (10YR 4/1) dry and black (10YR 2/1) moist; few fine faint diffuse reddish mottles; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; few fine and very fine roots; not calcareous; gradual wavy boundary.

Cg2 68 - 90 cm; dark greyish brown (10YR 4/2) moist; many coarse distinct evident reddish and common medium distinct evident black mottles; sand; massive; loose (moist); not sticky (wet), not plastic (wet); common fine pores; fine and very fine roots; not calcareous; gradual wavy boundary.

Cg3 90 - 115 cm; dark greyish brown (10YR 4/2) moist; common coarse distinct evident reddish and common medium distinct evident black mottles; sand; massive; loose (moist), not sticky (wet), not plastic (wet); common fine pores, fine and very fine roots; not calcareous; gradual wavy boundary.

Cr 115 - 150 cm; very dark greyish brown (10YR 3/2) moist; common coarse distinct evident reddish and common medium distinct evident black mottles; sand; massive; loose (moist), not sticky (wet), not plastic (wet); common fine pores, not calcareous.

PROFILE: GX0069 **UNIT: VAL2** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (609).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 52 33 S ; 33 27 13 E
Elevation: 12 m
Date : 28/04/94

Classification: - FAO : Gleyi-Mollic Fluvisol
- ST : Aquic Haplustoll
- Local : T'Sovo

Soil Climate: aquic

Topography : gently undulating
Element/Pos.: narrow valley floor, middle part
Micro Top. : irregular medium
Land Use :
Human Infl. : drained
Vegetation : reeds and grasses (abandoned)
Species : Phragmites sp. and gramineae

Land Form: sandy plateau
Slope : 0 - 1% , straight
Crops:
Grass cover:

Parent Material: alluvial deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : poor
External drainage: slow
Flooding : rare
Moist. Conditions: 0-130 moist

Rock Outcrops : nil
Erosion : nil
Permeability: moderately slow
Watertable : observed at 110 cm
Catchment: Limpopo

Remarks: non decomposed organic debris in second and third horizons.

Samples: all horizons

A1 0 - 16 cm; black (5YR 2.5/1) moist; loam; moderate medium granular structure; very friable (moist), slightly sticky (wet), slightly plastic (wet); many fine and medium pores; many fine-medium roots; not calcareous; gradual straight boundary.

A2 16 - 41 cm; black (5YR 2,5/1) moist; coarse distinct evident brownish mottles; clay loam; strong medium granular structure; very friable (moist), slightly sticky (wet), plastic (wet); many fine and medium pores; many fine and medium and few coarse roots; not calcareous; clear straight boundary.

Cg 41 - 77 cm; black (7.5YR 2/0) moist; sandy clay loam; massive; very friable (moist), slightly sticky (wet), plastic (wet); few fine pores; few distinct clay and sesquioxides coatings along root channels; many fine and medium and common coarse roots; not calcareous; clear straight boundary.

Cr1 77 - 110 cm; very dark grey (5YR 3/1) moist; sandy clay loam; very friable (moist), slightly sticky (wet), plastic (wet); few fine pores; common distinct clay and sesquioxides coatings along root channels; few fine and medium roots; not calcareous; gradual straight boundary .

Cr2 110 - 130 cm; black (5YR 2.5/1) moist; sandy loam; very friable (moist), slightly sticky (wet), plastic (wet); no pores; very few fine roots; not calcareous;

PROFILE: GX0070 **UNIT: DUI8** **STATUS: 1**

Sheet/Grid : 1161
Location : Chicumbane (610).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 59 20 S ; 33 33 01 E
Elevation: 41 m
Date : 29/04/94

Classification:
- FAO : Ferrali-Luvic Arenosol
- ST : Argic Ustipsamment/Argic Ustic Quartzipsamment
- Local : Giho

Soil Climate: ustic

Topography : nearly level
Element/Pos.: interfluve, near edge of plateau
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation :
Species :

Land Form: sandy plateau
Slope : 0 - 1% , straight
Crops: coconut, cassava, pigeon pea
Grass cover:

Parent Material: (reworked?) aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-22 moist, 22-160 cm dry

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks: there are dry residues of a groundnut crop.

Samples: all horizons

A1 0 - 22 cm; dark reddish brown (5YR 3/2) moist; sand; weak medium granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine and medium roots; few charcoal pieces and pottery debris; not calcareous; clear wavy boundary.

A2 22 - 50 cm; dark brown (7.5YR 3/2) dry and black (5YR 2.5/1) moist; sand; massive; slightly hard (dry); loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; common fine and very fine roots; few charcoal pieces and pottery debris and common infilled burrows; not calcareous; gradual straight boundary.

Bw 50 - 102 cm; reddish brown (5YR 4/4) dry and dark reddish brown (5YR 3/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; few fine and medium roots; few charcoal pieces and pottery debris and common infilled burrows; not calcareous; gradual straight boundary.

Bt1 102 - 130 cm; yellowish red (5YR 4/6) dry and dark reddish brown (5YR 3/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; common distinct clay and sesquioxides lamellas; few fine and medium roots; not calcareous; gradual straight boundary.

Bt2 130 - 145 cm; red (2.5YR 4/6) dry and dark reddish brown (2.5YR 3/4) moist; loamy sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many distinct clay and sesquioxides lamellas and few distinct clay and sesquioxides coatings on sand particles; few fine and medium roots; not calcareous; gradual straight boundary.

Bt3 145 - 160 cm; dark red (2.5YR 3/6) dry and dark reddish brown (2.5YR 3/4) moist; loamy sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many distinct clay and sesquioxides lamellas and common distinct clay and sesquioxides coatings on sand particles; few fine and medium roots; not calcareous;

PROFILE: GX0071 **UNIT: DUI11** **STATUS: 1**

Sheet/Grid : 1160
Location : Chicumbane (611).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 59 43 S ; 33 29 41 E
Elevation: 38 m

Date : 29/04/94

Classification:
- FAO : Dystri-Ferralic Arenosol
- ST : Argic Ustipsamment/Argic Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : nearly level
Element/Pos.: interfluve, middle part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : fallow
Species : gramineae

Land Form: sandy plateau
Slope : 0 - 1% , straight

Crops: citrus, coconut, bullocks' heart

Grass cover: 0-15%

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-150 moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment: Limpopo

Remarks: the soil is too humid to observe the pores. There are pottery debris in the second horizon.

Samples: all horizons

A1 0 - 15 cm; dark reddish brown (5YR 3/2) moist; sand; weak fine to medium granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and medium roots; few infilled burrows and few charcoal pieces; not calcareous; gradual straight boundary.

A2 15 - 50 cm; dark brown (7.5YR 4/2) moist; sand; massive; very friable (moist), not sticky (wet), not plastic (wet); many fine and medium roots; few infilled burrows and few charcoal pieces; not calcareous; gradual straight boundary.

Bw 50 - 104 cm; dark brown (7.5YR 4/4) moist; sand; massive; very friable (moist), not sticky (wet), not plastic (wet); few fine and medium roots; common infilled burrows and few charcoal pieces; not calcareous; diffuse straight boundary.

C1 104 - 140 cm; light brown (7.5YR 6/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); few fine and medium roots; not calcareous; clear straight boundary.

C2 140 - 150 cm; brown (7.5YR 5/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common distinct clay and sesquioxides lamellas; few fine and medium roots; not calcareous;

PROFILE: GX0072 **UNIT: DUI11** **STATUS: 1**

Sheet/Grid : 1160
Location : Novunguene (612).
Survey Area: Xai-Xai district
Author(s) : J. Mafalacusser

Coord. : 24 56 43 S ; 33 26 12 E
Elevation: 49 m
Date : 29/04/94

Classification: - FAO : Dystri-Cambic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : nearly level
Element/Pos.: interfluve, middle part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : long term bushy fallow
Species : unspecified native trees

Land Form: sandy plateau
Slope : 0 - 1% , straight
Crops: cashew, canhu
Grass cover:

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-16 moist, 16-130 dry, 130-150 cm moist

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks:

Samples: all horizons

A1 0 - 16 cm; very dark brown (10YR 2/2) moist; sand; weak fine to medium granular structure; very friable (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and medium roots; few charcoal pieces; not calcareous; gradual straight boundary.

A2 16 - 33 cm; dark greyish brown (10YR 4/2) dry and very dark brown (10YR 2/2) moist; sand; moderate fine to medium granular structure; slightly hard (dry), very friable (moist), not sticky (wet), not plastic (wet); common fine pores; many fine and medium roots; few charcoal pieces; not calcareous; gradual straight boundary.

Bw 33 - 85 cm; dark yellowish brown (10YR 4/4) dry and moist (10YR 3/4); sand; massive; slightly hard (dry), very friable (moist), not sticky (wet), not plastic (wet); common fine pores; common fine and medium roots; few charcoal pieces and common infilled burrows; not calcareous; diffuse straight boundary.

C1 85 - 130 cm; light yellowish brown (10YR 6/4) dry and yellowish brown (10YR 5/4) moist; sand; massive; slightly hard (dry), loose (moist), not sticky (wet), not plastic (wet); common fine pores; common fine and medium roots; few charcoal pieces; not calcareous; diffuse straight boundary.

C2 130 - 150 cm; light brown (7,5YR 6/4) moist; sand; massive; loose (moist), not sticky (wet), not plastic (wet); common fine pores; very few fine roots; not calcareous;

PROFILE: GX0074 **UNIT: DUI10** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T13).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 11 34 S ;33 26 30 E
Elevation: 50 m

Date : 06/07/94

Classification: - FAO : Ferrali-Luvic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : Giho

Soil Climate: ustic

Topography : rolling
Element/Pos.: slope, lower part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 2 - 4%, concave

Crops: fallow

Grass cover: 40-80%

Parent Material: aeolian sand deposits, partly reworked as colluvium

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-160 cm moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks:

Samples: all horizons

A 0 - 27 cm; dark brown (7.5YR 3/2) moist; sand: weak fine and very fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); many very fine pores; many fine and very fine and many medium roots; few charcoal pieces; not calcareous; abrupt straight boundary.

Bw1 27 - 50 cm; dark reddish brown (5YR 3/3) moist; sand; very weak fine and very fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); many very fine pores; many fine and very fine and few medium roots; not calcareous; clear straight boundary.

Bw2 50 - 79 cm; dark brown (7.5YR 3/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine pores; many fine and very fine and many medium roots; not calcareous; clear straight boundary.

Bt1 79 - 109 cm; dark brown (7.5YR 3/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine pores; common fine and very fine roots; not calcareous; gradual straight boundary.

Bt2 109 - 160 cm; dark reddish brown (5YR 3/3) moist; loamy sand; massive; very friable (moist), not sticky (wet), not plastic (wet); common very fine pores; few fine and very fine roots; not calcareous;

PROFILE: GX0075 **UNIT: DUI10** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T14).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 11 30 S ; 33 26 30 E
Elevation: 54 m

Date : 06/07/94

Classification: - FAO : Ferrali-Luvic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : Giho

Soil Climate: ustic

Topography : rolling
Element/Pos.: slope, medium part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 8 - 16%, concave

Crops: fallow

Grass cover: 40-80%

Parent Material: aeolian sand deposits, partly reworked as colluvium

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: moderate
Flooding : none
Moist. Conditions: 0-146 cm moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks:

Samples: all horizons

A1 0 - 27 cm; very dark greyish brown (10YR 3/2) moist; sand; very weak very fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); common very fine pores; many very fine and few medium roots; few open burrows; not calcareous; abrupt wavy boundary.

Bw 27 - 52 cm; dark reddish brown (5YR 3/3) moist; sand; single grain; loose (moist), not sticky (wet); not plastic (wet); common very fine pores; many very fine and few fine roots; few open burrows; not calcareous; clear straight boundary.

Bt1 52 - 76 cm; dark reddish brown (5YR 3/3) moist; loamy sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine pores; common very fine roots; few open burrows; not calcareous; diffuse straight boundary.

Bt2 76 - 99 cm; dark red (2.5YR 3/6) moist; loamy sand; friable (moist), not sticky (wet), not plastic (wet); common very fine pores; few very fine roots; few open burrows; not calcareous; diffuse straight boundary.

Bt3 99 - 146 cm; red (2.5YR 4/6) moist; loamy sand; friable (moist), not sticky (wet), common very fine pores; few very fine roots; few open burrows; not calcareous;

PROFILE: GX0076 **UNIT: DUI10** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T15).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 11 28 S ; 33 26 28 E
Elevation: 58 m
Date : 06/07/94

Classification: - FAO : Areni-Haplic Lixisol
- ST : Arenic Kandiustalf
- Local : Giho

Soil Climate: ustic

Topography : rolling
Element/Pos.: ridge summit, higher part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 2 - 4%, convex
Crops: fallow
Grass cover: 40-80%

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: moderately rapid
Flooding : none
Moist. Conditions: 0-146 cm moist

Rock Outcrops : nil
Erosion : nil
Permeability: moderately rapid
Watertable : not observed
Catchment:

Remarks:

Samples: all horizons

A1 0 - 16 cm; dark brown (7.5YR 3/4) moist; sand; very weak very fine and fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); common very fine pores; many fine and few medium roots; few charcoal pieces; not calcareous; abrupt straight boundary.

Bw 16 - 30 cm; dark brown (7.5YR 4/4) moist; sand; very weak very fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); common very fine pores; many very fine and few coarse roots; few charcoal pieces; not calcareous; abrupt straight boundary.

Bt1 30 - 70 cm; yellowish red (5YR 4/6) moist; loamy sand; single grain; loose (moist), not sticky (wet), slightly plastic (wet); common very fine pores; common very fine and common medium roots; few infilled burrows; not calcareous; gradual straight boundary.

Bt2 70 - 107 cm; yellowish red (5YR 4/6) moist; sandy loam; massive; friable (moist), not sticky (wet), slightly plastic (wet); common very fine pores; common fine and very fine and few medium roots; not calcareous; diffuse straight boundary.

Bt3 107 - 160 cm; yellowish red (5YR 4/6) moist; sandy loam; friable (moist), not sticky (wet), slightly plastic (wet); common fine pores and common very fine pores. few medium and few fine roots; not calcareous.

PROFILE: GX0077 **UNIT: DUI6** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T16).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 09 37 S ;33 21 48 E
Elevation: 55 m

Date : 07/07/94

Classification: - FAO : Dystri-Cambic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : rolling
Element/Pos.: ridge summit, higher part
Micro Top. : irregular low
Land Use : grazing
Human Infl. : burning
Vegetation : herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 2 - 4%, convex

Crops:

Grass cover: 40-80%

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: moderately rapid
Flooding : none
Moist. Conditions: 0-170 cm moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks: deep fire penetration along root channels. Charcoal pieces are actually burned roots.

Samples: all horizons

A1 0 - 9 cm; very dark greyish brown (10YR 3/2) moist; sand; very weak fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine roots; common infilled burrows and common charcoal pieces; not calcareous; abrupt straight boundary.

Bw1 9 - 48 cm; dark brown (10YR 4/3) moist; sand; very weak fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and few coarse roots; common infilled burrows and common charcoal pieces; not calcareous; diffuse straight boundary.

Bw2 48 - 88 cm; dark brown (7.5YR 4/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine and few coarse roots; common infilled burrows and common charcoal pieces; not calcareous; diffuse straight boundary.

Bw3 88 - 117 cm; brown (7.5YR 5/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); few fine and very fine roots; common infilled burrows and common charcoal pieces; not calcareous;

PROFILE: GX0078 **UNIT: DUI6** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T17).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 09 40 S ;33 21 45 E
Elevation: 50 m

Date : 07/07/94

Classification: - FAO : Dystri-Luvic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : rolling
Element/Pos.: slope, medium part
Micro Top. : irregular low
Land Use : grazing
Human Infl. : burning
Vegetation : herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 2 - 4%, convex

Crops:

Grass cover: 40-80%

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: moderately rapid
Flooding : none
Moist. Conditions: 0-160 cm moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks: deep fire penetration along root channels. Charcoal pieces are actually burned roots.

Samples: all horizons

A1 0 - 8 cm; very dark brown (10YR 2/2) moist; sand; very weak very fine and fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and few medium roots; common charcoal pieces and few open burrows; not calcareous; abrupt straight boundary.

Bw1 8 - 37 cm: dark brown (10YR 4/3) moist; sand; very weak very fine and fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and few medium and coarse roots; common charcoal pieces and few open burrows; not calcareous; diffuse straight boundary.

Bw2 37 - 78 cm; dark brown (7.5YR 4/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and few medium roots; common charcoal pieces; not calcareous; gradual straight boundary.

Bw3 78 - 99 cm; dark brown (7.5YR 4/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine roots; common charcoal pieces; not calcareous; gradual straight boundary.

Bt1 99 - 160 cm; strong brown (7.5YR 5/6) moist; sand; single grain; loose (moist), not sticky (wet); common fine and few medium roots; few charcoal pieces; not calcareous;

PROFILE: GX0079 **UNIT: DUI6** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T18).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 09 43 S ;33 21 43 E
Elevation: 44 m

Date : 07/07/94

Classification: - FAO : Dystri-Cambic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : rolling
Element/Pos.: slope, lower part
Micro Top. : irregular low
Land Use : grazing
Human Infl. : burning
Vegetation : herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 1 - 2%, convex

Crops:

Grass cover: 40-80%

Parent Material: aeolian sand deposits, partly reworked as colluvium

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-160 cm moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks: deep fire penetration along root channels. Charcoal pieces are actually burned roots.

Samples: all horizons

A1 0 - 8 cm; very dark greyish brown (10YR 3/2) moist; sand; weak very fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine roots; many charcoal pieces; not calcareous, abrupt straight boundary.

Bw1 8 - 18 cm; dark brown (10YR 4/3) moist; sand; very weak very fine granular structure; loose (moist), not sticky), not plastic (wet); many fine and very fine roots; common infilled burrows, many charcoal pieces; not calcareous; clear straight boundary.

Bw2 18 - 44 cm; yellowish brown (10YR 5/4) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and few medium roots; common infilled burrows and common charcoal pieces; not calcareous; diffuse straight boundary.

Bw3 44 - 75 cm; dark yellowish brown (10YR 3/6) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine and few medium and coarse roots; common infilled burrows and common charcoal pieces; not calcareous; gradual straight boundary.

Bw4 75 - 160 cm; strong brown (7.5YR 5/8) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); few medium and common fine and very fine roots; common infilled burrows and common charcoal pieces; not calcareous;

PROFILE: GX0080 **UNIT: DEM** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T19).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 09 22 S ;33 21 44 E
Elevation: 29 m
Date : 07/07/94

Classification:
- FAO : Dystri-Albic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : T'lavate (of Serra)/Xixefo

Soil Climate: ustic

Topography : rolling
Element/Pos.: temporary lake margin, higher part
Micro Top. : irregular low
Land Use : grazing
Human Infl. : burning
Vegetation : herbaceous
Species : gramineae e cyperaceae

Land Form: sandy plateau
Slope : 1 - 2%, concave
Crops:
Grass cover: 15-40%

Parent Material: aeolian sand deposits, partly reworked as colluvium

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : imperfect
External drainage: slow
Flooding : rare
Moist. Conditions: 0-155 cm moist

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment:

Remarks: The charcoal pieces are actually burned roots. There are many interstitial pores throughout the profile.

Samples: all horizons

A1 0 - 8 cm; dark reddish brown (5YR 2.5/2) moist; sand; weak very fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and few medium and coarse roots; many charcoal pieces; not calcareous, clear straight boundary.

AE 8 - 30 cm; very dark grey (5YR 3/1) moist; sand; very weak very fine granular structure; loose (moist), not sticky), not plastic (wet); many fine and very fine and few medium and coarse roots; common charcoal pieces; not calcareous; clear straight boundary.

E1 30 - 59 cm; dark grey (4/1) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine roots; not calcareous; gradual straight boundary.

E2 59 - 95 cm; reddish grey (5YR 5/2) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine roots; not calcareous; gradual straight boundary.

E3 95 - 155 cm; dark reddish grey (5YR 4/2) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); few fine and very fine roots; not calcareous.

PROFILE: GX0081 **UNIT: VAL2** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T20).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 05 26 S ;33 21 01 E
Elevation: 12 m
Date : 19/07/94

Classification: - FAO : Dystri-fibric Histosol, overwash phase
- ST : Typic Tropofibrists
- Local : T'Sovo

Soil Climate: aquic (artificially drained)

Topography : rolling
Element/Pos.: valley bottom, lower part
Micro Top. : irregular low
Land Use : traditional, wetland cropping
Human Infl. : drainage
Vegetation :
Species :

Land Form: sandy plateau
Slope : 0 - 1%, concave
Crops: sweet potato, cassava, sugar cane and banana
Grass cover:

Parent Material: peat over reworked aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : imperfect
External drainage: slow
Flooding : rare
Moist. Conditions: 0-143 cm moist, wet 143-170 cm

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : 143 cm
Catchment: Limpopo

Remarks:

Samples: all horizons

C1 0 - 18 cm; dark brown (7.5YR 3/2) moist; sand; very weak very fine and fine granular structure; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; common fine and very fine and few medium roots; common charcoal pieces; not calcareous; abrupt straight boundary.

H1 18 - 43 cm; black (7.5YR 2/0) moist; loamy sand; moderate fine and medium subangular blocky structure; friable (moist), slightly sticky (wet), slightly plastic (wet); many fine and very fine and few medium roots; few open burrows; not calcareous; clear straight boundary.

H2 43 - 67 cm; black (5YR 2.5/1) moist; peat; friable (moist), slightly sticky (wet), slightly plastic (wet); few fine and very fine pores; many fine and very fine and few medium roots; few open burrows, not calcareous; gradual straight boundary.

H3 67 - 143 cm; dark reddish brown (5YR 3/3) moist; peat; friable (moist), slightly sticky (wet), slightly plastic (wet); few fine and very fine pores; common fine and very fine roots; not calcareous; abrupt straight boundary.

2C 143 - 170 cm; dark brown (7.5YR 3/2) moist; sand; very friable (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few very fine roots; not calcareous;

PROFILE: GX0082 **UNIT: DUI4** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T21).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 05 27 S; 33 21 06 E
Elevation: 38 m

Date : 19/07/94

Classification:
- FAO : Dystri-Luvic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : rolling
Element/Pos.: ridge, crest
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. : burning
Vegetation :
Species :

Land Form: sandy plateau
Slope : 2 - 4%, convex

Crops: maize, cashew, mango

Grass cover:

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : excessive
External drainage: rapid
Flooding : none
Moist. Conditions: 0-11 cm dry, 11-160 moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment: Limpopo

Remarks: deep fire penetration along root channels. Charcoal pieces are actually burned roots.

Samples: all horizons

A 0 - 11 cm; brown (10YR 5/3) dry and dark brown (10YR 3/3) moist; fine sand; moderate to strong single grains structure; loose (dry), loose (moist), not calcareous; gradual straight boundary.

AB 11 - 30 cm; dark brown (10YR 4/3) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine pores; many fine and very fine and few coarse roots; common; not calcareous; gradual straight boundary.

Bw1 30 - 64 cm; dark yellowish brown (10YR 4/4) moist; fine sand; single grain; loose (moist); not sticky (wet), not plastic (wet); common very fine pores fine and very fine and common medium-coarse roots; common; not calcareous; gradual straight boundary.

Bt1 64 - 111 cm; yellowish brown (10YR 5/8) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine pores; common fine and very fine roots; common; not calcareous; diffuse straight boundary.

Bt2 111 - 160 cm; brownish yellow (10YR 6/8) moist; fine sand; single grain; loose (moist), not sticky (wet), common very fine pores; common fine and very fine and few medium roots; few; not calcareous;

PROFILE: GX0083 **UNIT: DUC4** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T22).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 11 09 S; 33 28 12 E
Elevation: 53 m
Date : 20/07/94

Classification:
- FAO : Dystri-Ferralic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : N'Tlava

Soil Climate: ustic

Topography : rolling
Element/Pos.: ridge, crest
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : herbaceous fallow
Species : gramineae

Land Form: sandy plateau
Slope : 2 - 4%, convex
Crops: cashew, mafurra
Grass cover: 15-40%

Parent Material: aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : excessive
External drainage: rapid
Flooding : none
Moist. Conditions: 0-120 moist

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks: The mottles are around hollow channels associated with ants activity and roots. The interior of the channels is bleached (7.5 YR 8/2) and iron accumulates around them (5 YR 4/6). The dominant crop in the area is maize associated with sweet potato, cowpea, squash and cassava.

Samples: all horizons

A 0 - 15 cm; dark yellowish brown (10YR 4/4) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; many fine and very fine roots; common; not calcareous; clear straight boundary.

Bw1 15 - 67 cm; dark yellowish brown (10YR 4/6) moist; few fine distinct clear reddish mottles; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine and few medium roots; few; not calcareous; gradual straight boundary.

Bw2 67 - 112 cm; yellowish brown (10YR 5/6) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); few fine and fine pores; few fine and fine roots; few; not calcareous; diffuse straight boundary.

C 112 - 160 cm; brownish yellow (10YR 6/6) moist; fine sand; single grain; (moist), not sticky (wet), not plastic (wet); few fine and very fine pores; few fine and very fine roots; few; not calcareous;

PROFILE: GX0084 UNIT: DEM STATUS: 1

Sheet/Grid : 1171
Location : Zongoene (T23).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 12 56 S; 33 22 28 E
Elevation: 15 m
Date : 20/07/94

Classification: - FAO : Dystri-Albic Arenosol
- ST : Typic Ustipsamment/Ustic Quartzipsamment
- Local : T'lavate (of Serra)/Xixefo

Soil Climate: ustic

Topography : undulated
Land Form: sandy plateau
Element/Pos.: gently sloping lake margin, lower part
Slope : 2 - 4%, convex
Micro Top. : flat
Land Use : none
Crops: none
Human Infl. :
Vegetation : herbaceous
Grass cover: 0-15%
Species : unidentified

Parent Material: lacustrine sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : excessive
External drainage: rapid
Flooding : rare
Moist. Conditions: 0-150 moist

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : not observed
Catchment: Limpopo

Remarks: The charcoal pieces are in within sedimentary stratifications. All pores are interstitial.

Samples: all horizons

AE 0 - 10 cm; light brownish grey (10YR 6/2) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; common fine and very fine roots; few charcoal pieces; not calcareous; clear straight boundary.

E1 10 - 71 cm; pale brown (10YR 6/3) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few fine and few medium roots; few charcoal pieces; not calcareous; clear straight boundary.

E2 71 - 104 cm; very pale brown (10YR 7/3) moist; sand; single grain; loose (moist), not sticky (wet); not plastic (wet); common fine and very fine pores; few fine roots; not calcareous; gradual wavy boundary.

E3 104 - 122 cm; light grey (10YR 7/2) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few fine roots; few charcoal pieces; not calcareous; gradual wavy boundary.

E4 122 - 150 cm; light grey (10YR 7/2) moist; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; no roots; many charcoal pieces; not calcareous;

PROFILE: GX0086 **UNIT: DES** **STATUS: 1**

Sheet/Grid : 1162
Location : Banhine (T30).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 54 36 S; 33 46 51 E
Elevation: 53 m

Date : 10/08/94

Classification: - FAO : Lamelli-Albic Arenosol
- ST : Argic Ustipsamment/Argic Ustic Quartzipsamment
- Local : Xixefo/T'Lavate (of Serra)

Soil Climate: ustic

Topography : flat
Element/Pos.: large dry depression, higher part
Micro Top. : flat
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation :
Species :

Land Form: sandy plateau
Slope : 0 - 1%, straight

Crops: citrus, mango and mafurra

Grass cover:

Parent Material: lacustrine (?) sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-150 moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks: the leaves of the citrus (tangerines) show evidence of probable micro-nutrients deficiencies.

Samples: all horizons

A1 0 - 11 cm; very dark greyish brown (10YR 3/2) moist; sand; very weak very fine granular structure; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; many fine and very fine roots; not calcareous; clear straight boundary.

A2 11 - 29 cm; very dark gray (10YR 3/1) moist; sand; weak very fine and fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; many fine and very fine roots; few open burrows; not calcareous; gradual straight boundary.

AE 29 - 72 cm; very dark greyish brown (10YR 3/2) moist; sand; weak fine to medium subangular blocky structure; friable (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; many fine and very fine and few medium roots; few open burrows; not calcareous; clear wavy boundary.

E1 72 - 120 cm; dark greyish brown (10YR 4/2) moist; sand; massive; friable (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few prominent clay and humus lamellas; few fine and very fine and coarse roots; few open burrows; not calcareous; gradual wavy boundary.

E2 120 - 150 cm; greyish brown (10YR 5/2) moist; loamy sand; massive; friable (moist), not sticky (wet), not plastic; common prominent clay and humus lamellas; few fine and very fine roots; few open burrows; not calcareous;

PROFILE: GX0087 **UNIT: DUI9** **STATUS: 1**

Sheet/Grid : 1162
Location : Siaia (T31).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 55 27 S; 33 46 18 E
Elevation: 88 m

Date : 10/08/94

Classification: - FAO : Feralli-Luvic Arenosol
- ST : Argic Ustipsamment/Argic Ustic Quartzipsamment
- Local : Giho

Soil Climate: ustic

Topography : nearly level
Element/Pos.: interfluve, higher part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : fallow, herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 0 - 1%, straight

Crops: cassava, pigeon pea, cashew

Grass cover: 0-15%

Parent Material: eolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : slightly excessive
External drainage: slow
Flooding : none
Moist. Conditions: 0-150 moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks:

Samples: all horizons

A1 0 - 14 cm; dark reddish brown (5YR 3/2) moist; sand; very weak very fine and fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine roots; few charcoal pieces; not calcareous; clear straight boundary.

AB 14 - 34 cm; dusky red (2.5YR 3/3) moist; loamy sand; very weak very fine and fine granular structure; very friable (moist), not sticky (wet), not plastic (wet); many fine and very fine roots; few charcoal pieces; not calcareous; gradual straight boundary.

Bt1 34 - 64 cm; dark reddish brown (2.5YR 3/4) moist; loamy sand; massive; very friable (moist), common fine and very fine pores; common fine and very fine roots; few charcoal pieces; not calcareous; gradual straight boundary.

Bt2 64 - 102 cm; dark reddish brown (2.5YR 3/4) moist; loamy sand; massive; friable (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few fine and very roots; common charcoal pieces; not calcareous; diffuse straight boundary.

Bt3 102 - 170 cm; reddish brown (2.5YR 4/4) moist; loamy sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few fine and very fine roots; few charcoal pieces; not calcareous;

PROFILE: GX0088 **UNIT: TEA2** **STATUS: 1**

Sheet/Grid : 1161
Location : Siaia (T32).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 58 25 S; 33 44 43 E
Elevation: 10 m
Date : 10/08/94

Classification: - FAO : Dystri-Gleyic Arenosol
- ST : Aquic Ustipsamment/Aquic Quartzipsamment
- Local : N'Tlava

Soil Climate: aquic

Topography : nearly level
Element/Pos.: terrace, higher part
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
human Infl. :
Vegetation : fallow, herbaceous
Species : gramineae

Land Form: sandy plateau
Slope : 1 - 2%, convex
Crops: (nearby) maize
Grass cover: 15-40%

Parent Material: (reworked?) eolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : Imperfect
External drainage: slow
Flooding : none
Moist. Conditions: 0-131 cm moist, 131-150 wet

Rock Outcrops : nil
Erosion : nil
Permeability: moderately rapid
Watertable : at 131 cm
Catchment:

Remarks: the land unit may be considered as a footslope which was partly separated from the sandy plateau.

Samples: all horizons

A1 0 - 12 cm; dark brown (7.5YR 4/2) moist; sand; weak granular structure; very friable (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine roots; few charcoal pieces; not calcareous; clear straight boundary.

A2 12 - 31 cm; dark reddish brown (5YR 3/2) moist; weak fine to medium granular structure; very friable (moist), not plastic (wet); many fine and very fine pores; many fine and very fine roots; few charcoal pieces and few infilled burrows; not calcareous; gradual straight boundary.

Bw 31 - 63 cm; dark brown (7.5YR 3/2) moist; sand; massive; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; common fine and very fine roots; few charcoal pieces; not calcareous; clear wavy boundary.

Br1 63 - 104 cm; dark reddish gray (5YR 4/2) moist; medium distinct evident reddish yellow and coarse distinct evident reddish yellow mottles; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; common medium irregular hard ferro-manganic black concretions; few charcoal pieces; few fine and very fine roots; not calcareous; abrupt wavy boundary.

Br2 104 - 132 cm; dark gray (5YR 4/1) moist; common medium faint evident mottles; sand; single grain; loose (moist), not sticky (wet), not plastic (wet); few fine and very fine pores; fine and very fine roots; not calcareous; clear straight boundary.

Br3 132 -150 cm; very dark gray (5YR 3/1) moist; common medium distinct sharp mottles; sandy loam; massive; friable (moist), slightly sticky (wet), slightly plastic (wet); few fine and very fine pores; very few medium irregular hard ferro-manganic black concretions; fine and very fine roots; not calcareous;

PROFILE: GX0089 **UNIT: DUC3** **STATUS: 1**

Sheet/Grid : 1172
Location : Xai-Xai (T33).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 06 33 S; 33 43 41 E
Elevation: 56 m

Date : 11/08/94

Classification:
- FAO : Dystri-Haplic Arenosol
- ST : Typic Utipsamment/Ustic Quartzipsamment
- Local : N'Tlava/Puwa

Soil Climate: ustic

Topography : rolling
Element/Pos.: mid-slope
Micro Top. : irregular low
Land Use : none
Human Infl. :
Vegetation : shrub
Species : Shina, palmeira and gramineae

Land Form: fixed coastal sand dunes
Slope : 8 - 16%, convex

Crops:

Grass cover: 15-40%

Parent Material: recent aeolian sand deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : excessive
External drainage: rapid
Flooding : none
Moist. Conditions: 0-160 moist

Rock Outcrops : nil
Erosion : nil

Permeability: rapid
Watertable : not observed

Catchment:

Remarks:

Samples: all horizons

A 0 - 22 cm; dark yellowish brown (10YR 3/4) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine and common medium and coarse roots; few charcoal pieces; not calcareous; clear straight boundary.

AC 22 - 62 cm; dark yellowish brown (10YR 4/4) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine and common medium and coarse roots; few charcoal pieces; not calcareous; gradual straight boundary.

C1 62 - 91 cm; dark yellowish brown (10YR 4/6) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; common fine and medium roots; not calcareous; diffuse straight boundary.

C2 91 - 160 cm; yellowish brown (10YR 5/6) moist; fine sand; single grain; loose (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; few fine and medium roots; not calcareous;

PROFILE: GX0099 **UNIT: DEH1** **STATUS: 1**

Sheet/Grid : 1172
Location : Xai-Xai (T34).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 04 23 S; 33 41 59 E
Elevation: 7 m
Date : 11/08/94

Classification:
- FAO : Eutri-Gleyic Arenosol
- ST : Aquic Ustipsamment/Aquic Quartzipsamment
- Local : T'lavate (of Serra)/Xixefo

Soil Climate: aquic

Topography : Undulated
Element/Pos.: footslope, margin of depression
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
human Infl. :
Vegetation :
Species :

Land Form: sandy plateau
Slope : 4 - 8%, convex
Crops: maize, squash, tomato, sugar cane, papaya
Grass cover:

Parent Material: aeolian sand deposits reworked as colluvium

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : imperfect
External drainage: moderate
Flooding : none
Moist. Conditions: 0-139 cm moist, 139-150 wet

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : at 139 cm
Catchment:

Remarks: the profile is located at the side of the baixa of Chongoene.

Samples: all horizons

A1 0 - 10 cm; very dark gray (10YR 3/1) moist; medium sand; very weak granular structure; very friable (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine roots; not calcareous; abrupt straight boundary.

A2 10 - 23 cm; brown (7.5YR 5/2) moist; many black (7.5 YR 2/0) mottles; medium sand; weak to moderate medium to coarse granular structure; friable (moist), not sticky (wet), not plastic (wet); not plastic (wet); many fine and very fine pores; common fine and very fine and few medium roots; not calcareous; abrupt wavy boundary.

Eg 23 - 50 cm; brown (7.5YR 5/2) moist; medium sand; massive; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few fine irregular soft ferro-manganic segregations; few fine and medium roots; not calcareous; gradual straight boundary.

Er1 50 - 80 cm; gray (10YR 5/1) moist; medium sand; single grain; loose (moist), not sticky (wet), not plastic (wet); common very fine pores; few medium soft ferro-manganic segregations; few fine roots; diffuse straight boundary.

Er2 80 - 139 cm; gray (10YR 6/1) moist; medium sand; single grain; loose (moist); not sticky (wet), not plastic (wet); many very fine and few fine pores; few distinct clay and sesquioxides coatings in the pores; not calcareous.

PROFILE: GX0100 **UNIT: DEH1** **STATUS: 1**

Sheet/Grid : 1172
Location : Xai-Xai (T35).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 04 26 S; 33 42 02 E
Elevation: 5 m
Date : 11/08/94

Classification:
- FAO : Areni-Gleyic Phaeozem
- ST : Mollic Psammaquents
- Local : T'Sovo

Soil Climate: aquic

Topography : Undulated
Element/Pos.: bottom of depression
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
human Infl. :
Vegetation : many reeds
Species : Phragmites spp.

Land Form: sandy plateau
Slope : 1 - 2%, concave
Crops: maize, sugar cane, tomato
Grass cover:

Parent Material: eolian sand deposits reworked as colluvium

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : poor
External drainage: slow
Flooding : irregular
Moist. Conditions: 0-40 cm moist, 40+ wet

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : at 40 cm
Catchment:

Remarks: the profile is located in the baixa of Chongoene.

Samples: all horizons

A 0 - 26 cm; black (7.5YR 2/0) moist; loamy sand; weak fine to medium subangular blocky structure; friable (moist), slightly sticky (wet), slightly plastic (wet); common fine and very fine pores; many fine and very fine roots; few open burrows; not calcareous; abrupt wavy boundary.

ACr 26 - 40 cm; very dark gray (5YR 3/1) moist; medium sand; loose (moist), not sticky (wet), not plastic (wet); common fine and very fine pores; few distinct clay and sesquioxides coatings in the pores; common fine and very fine roots; few open burrows; not calcareous.

PROFILE: GX0101 **UNIT: COM1** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (T36).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 48 19 S ; 33 31 07 E
Elevation: 14 m
Date : 10/09/94

Classification:
- FAO : Orthi-Eutric Fluvisol
- ST : Typic Ustifluvent
- Local : T'Lavate (of plain)

Soil Climate: ustic

Topography : flat
Element/Pos.: alluvial levee, intermediate part
Micro Top. : ploughed
Land Use : traditional rainfed agriculture
Human Infl. : ploughed
Vegetation :
Species :

Land Form: alluvial plain
Slope : 1 - 2% , convex
Crops: Mafurra, canhu
Grass cover:

Parent Material: alluvial deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : moderate
External drainage: slow
Flooding : rare
Moist. Conditions: dry 0-20, slightly moist 20-140, dry 140-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: moderately slow
Watertable : not observed

Catchment: Limpopo

Remarks: in horizon 45-68 cm, there are strata and pockets of black (vertic) material. This soil is stratified.

Samples: all horizons.

A1 0 - 20 cm; dark brown (10YR 4/3) dry; loam; moderate very coarse subangular blocky structure; hard (dry), friable (moist), slightly sticky (wet), slightly plastic (wet); common fine and very fine and few coarse pores; many distinct pressure faces; many fine and very fine roots; not calcareous; clear straight boundary.

A2 20 - 45 cm; dark yellowish brown (10YR 3/4) moist; loam; moderate very coarse subangular blocky structure; hard (dry), friable (moist); slightly sticky (wet), slightly plastic (wet); common fine and very fine and few medium pores; many fine and very fine roots; many infilled burrows; not calcareous; clear straight boundary.

C1 45 - 68 cm; dark yellowish brown (10YR 4/4) moist; sandy loam; massive; slightly hard (dry), friable (moist), slightly sticky (wet), slightly plastic (wet); many fine and very fine and few medium pores; common fine and very fine roots; many infilled burrows; not calcareous; clear straight boundary.

C2 68 - 90 cm; dark yellowish brown (10YR 3/4) moist; sandy clay loam; massive; slightly hard (dry), friable (moist), slightly sticky (wet), slightly plastic (wet); many fine and very fine and few medium pores; not calcareous; clear straight boundary.

C3 90 - 115 cm; yellowish brown (10YR 5/4) moist; sandy loam; massive; hard (dry), firm (moist), slightly sticky (wet), slightly plastic (wet); many fine and few medium pores; not calcareous; clear straight boundary.

C4 115 - 140 cm; very dark gray (10YR 3/1) moist; clay loam; strong very coarse angular blocky structure; very hard (dry), friable (moist), sticky (wet), plastic; few fine and medium pores; not calcareous; clear straight boundary.

140 - 150 cm; dark yellowish brown (10YR 3/4) dry and dark brown (7.5YR 4/4) moist; clay loam; strong medium angular blocky structure; hard (dry), friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; many distinct pressure faces; not calcareous.

PROFILE: GX0102 **UNIT: LPI1** **STATUS: 1**

Sheet/Grid : 1161
Location : Muzingane (T37).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 48 50 S ; 33 30 00 E
Elevation: 13 m
Date : 10/09/94

Classification:
- FAO : Pelli-Eutric Vertisol
- ST : Typic Haplustert
- Local : Bila

Soil Climate: ustic

Topography : flat
Land Form: alluvial plain
Element/Pos.: flood plain, intermediate part
Slope : 0 - 1% , straight
Micro Top. :
Land Use : traditional rainfed agriculture
Crops: fallow
Human Infl. :
Vegetation :
Grass cover:
Species :

Parent Material: alluvial deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : none
Drainage class : Moderately well
External drainage: slow
Flooding : rare
Moist. Conditions: slightly moist 0-20, moist 20-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : not observed
Catchment: Limpopo

Remarks: surface desiccation cracks 2-3 cm wide. Horizon 20-43 cm includes some pockets of brown to dark greyish brown (10YR 4/3) material and some weakly expressed slickensides.

Samples: all horizons, except horizon 90-150 cm

A — 0 - 20 cm; very dark gray (10YR 5/2) moist; silty clay; weak coarse to very coarse subangular blocky structure; slightly hard (dry), friable (moist), slightly sticky (wet), plastic (wet); few fine and very fine pores; many fine and very fine roots; not calcareous; clear straight boundary.

Bw1 — 20 - 43 cm; very dark gray (10YR 5/2) moist with pockets of dark brown material (10YR 4/3) moist; silty clay; weak coarse subangular blocky structure; slightly hard (dry), friable (moist), slightly sticky (wet), plastic (wet); few fine and very fine pores; common fine and very fine roots; not calcareous; gradual wavy boundary.

Bw2 — 43 - 90 cm; black (10YR 2/1) moist; clay; weak coarse wedge-shaped angular blocky structure; hard (dry), firm (moist), sticky (wet), plastic (wet); few fine and very fine pores; common distinct slickensides on peds faces; few fine and very fine roots; not calcareous; gradual straight boundary.

Bw3 — 90 - 150 cm; black (10YR 2/1) moist; clay; strong coarse wedge-shaped angular blocky structure; hard (dry), firm (moist), sticky (wet), plastic (wet); few fine and few very fine pores; distinct slickensides on peds faces; few fine and very fine roots; not calcareous;

PROFILE: GX0103 **UNIT: TE2** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (T38).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 49 28 S ; 33 27 47 E
Elevation: 13 m
Date : 10/09/94

Classification:
- FAO : Pelli-Eutric Vertisol, overwashed phase
- ST : Typic Haplustert, overwashed phase
- Local : T'Lavate (of plain)

Soil Climate: ustic

Topography : flat
Element/Pos.: alluvial terrace of rio Munhuana
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. : ploughed
Vegetation : a few native trees
Species : the native trees are called "ugunda" in shangana.

Land Form: alluvial plain
Slope : 0 - 1% , convex
Crops: mafurra
Grass cover:

Parent Material: alluvial deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : thin silt crust with whitish fine sand segregation
Drainage class : Imperfectly drained
External drainage: slow
Flooding : rare
Moist. Conditions: moist 0-117, slightly moist 117-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: moderately slow
Watertable : not observed
Catchment: Limpopo

Remarks: yellowish sand individualization at the surface of peds in horizon 21-37 cm which has a temporary perched watertable during heavy rains. Few vertical cracks in horizon 37-73 cm.

Samples: all horizons,

C 0 - 21 cm; dark greyish brown (10YR 3/4) moist; loamy sand; weak fine subangular blocky structure; very friable (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine roots; not calcareous; clear straight boundary.

Cg 21 - 37 cm; very dark gray (10YR 3/1) moist, common fine distinct evident brownish mottles; loamy sand; weak fine to medium subangular blocky structure; friable (moist), not sticky (wet), not plastic (wet); many fine and very fine pores; many fine and very fine roots; common open burrows; not calcareous; clear wavy boundary.

2A 37 - 73 cm; black (10YR 2/1) moist; clay; moderate medium to coarse angular blocky structure; friable (moist), slightly sticky (wet), plastic (wet); many fine and very fine pores; many distinct intersecting slickensides on peds faces; many fine and very fine roots; not calcareous; gradual wavy boundary.

2Bw 73 - 117 cm; black (10YR 2/1) moist; clay; moderate to strong coarse to very coarse wedge-shaped angular blocky structure; firm (moist), sticky (wet), plastic (wet); many fine and very fine pores; abundant prominent intersecting slickensides on peds faces; few very fine roots; not calcareous; gradual wavy boundary.

2Bg 117 - 150 cm; very dark gray (10YR 3/1) moist; common fine faint evident yellowish brown mottles; clay loam; moderate coarse to very coarse wedge-shaped angular blocky structure; firm (moist), very sticky (wet), very plastic (wet); few fine and very fine pores; abundant distinct partly intersecting slickensides on peds faces; few very fine roots; not calcareous.

PROFILE: GX0104 **UNIT: PLI2** **STATUS: 1**

Sheet/Grid : 1160
Location : Muzingane (T39).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 49 47 S ; 33 27 52 E
Elevation: 12 m
Date : 10/09/94

Classification: - FAO : Sodi-Eutric Vertisol
- ST : Sodic Haplustert
- Local : Bila

Soil Climate: ustic

Topography : nearly level
Element/Pos.: flood plain, intermediate position
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation : a few native trees and grasses
Species : gramineae, "ugunda" trees (shangana name) and Parkinsonia sp.

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops: fallow
Grass cover: 40-80%

Parent Material: alluvial deposits

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : Moderately well
External drainage: slow
Flooding : rare
Moist. Conditions: slightly moist 0-20, moist 20-160 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : not observed
Catchment: Limpopo

Remarks:

Samples: all horizons,

A — 0 - 20 cm; very dark gray (10YR 3/1) moist; clay; strong very coarse prismatic structure parting to strong medium to coarse angular blocky; hard (dry), friable (moist), very sticky (wet), very plastic (wet); few fine and very fine pores; many fine and very fine roots; not calcareous; clear straight boundary.

Bw1 — 20 - 90 cm; black (10YR 2/1) moist; few distinct sharp reddish brown mottles; clay; strong very coarse prismatic structure parting to moderate to strong very coarse wedge-shaped angular blocky; very hard (dry), friable (moist), very sticky (wet), very plastic (wet); common fine and very fine pores; abundant distinct slickensides on peds faces; common fine and very fine roots; not calcareous; gradual straight boundary.

Bw2 — 90 - 160 cm; very dark gray (10YR 3/1) moist; clay; very strong very coarse wedge-shaped angular blocky structure; very hard (dry), friable (moist), very sticky (wet), very plastic (wet); common fine and very fine pores; dominant prominent intersecting slickensides on peds faces; common fine and very fine roots; not calcareous;

PROFILE: GX0105 **UNIT: PLI6** **STATUS: 1**

Sheet/Grid : 1161
Location : Novunguene (T40).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 58 50 S ; 33 34 45 E
Elevation: 3 m
Date : 10/09/94

Classification:
- FAO : Gleyi-Eutric Vertisol
- ST : Sodic Haplustert
- Local : Bila

Soil Climate: ustic

Topography : flat
Element/Pos.: flood plain, intermediate position
Micro Top. : irregular moderate
Land Use : extensive grazing
Human Infl. : burning
Vegetation : grasses
Species : gramineae

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops:
Grass cover: 40-80%

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : imperfect
External drainage: ponded
Flooding : rare
Moist. Conditions: moist 0-115, wet 115-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : at 115 cm, saline (EC 15.4 dS/cm)
Catchment: Limpopo

Remarks: gley below 75 cm.

Samples: all horizons.

A 0 - 10 cm; dark reddish brown (5YR 2.5/2) moist; few fine prominent evident reddish brown mottles; clay; strong fine to coarse subangular blocky structure; friable (moist), slightly sticky (wet), plastic (wet); common fine and very fine pores; many fine and very fine roots; not calcareous; clear straight boundary.

Bg1 10 - 45 cm; black (10YR 2/1) moist; common fine prominent evident reddish brown mottles; clay; strong coarse to very coarse prismatic structure parting to moderate to strong medium to very coarse wedge-shaped angular blocky; friable (moist), slightly sticky (wet), plastic (wet); few fine and very fine pores; many distinct intersecting slickensides on peds faces; common fine and very fine roots; not calcareous; gradual wavy boundary.

Bg2 45 - 75 cm; black (10YR 2/1) moist; many fine distinct evident reddish brown mottles; clay; strong medium to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; prominent intersecting slickensides on peds faces; common fine and very fine roots; not calcareous; gradual irregular boundary.

Bg 75 - 150 cm; dark gray (10YR 4/1) moist; fine distinct evident reddish brown mottles; clay; very strong very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and very fine pores and few medium pores; prominent intersecting slickensides on peds faces; few fine and very fine roots; not calcareous.

PROFILE: GX0106 **UNIT: MAC1** **STATUS: 3**

Sheet/Grid : 1161
Location : Nhacutse (T41).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 53 59 S ; 33 41 24 E
Elevation: 3 m
Date : 11/09/94

Classification:
- FAO : Eutri-Fibric Histosol
- ST : Fibric Tropohemists
- Local : Xiboa, T'Seve-T'Seve

Soil Climate: aquic

Topography : nearly level
Element/Pos.: swampy area
Micro Top. : irregular moderate
Land Use : none
Human Infl. :
Vegetation : reeds and herbaceous
Species : Phragmites spp. and aquatic weeds

Land Form: alluvial plain
Slope : 1 - 2% , concave
Crops:
Grass cover: 40-80%

Parent Material: peat

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : very poor
External drainage: ponded
Flooding : rare
Moist. Conditions: moist 0-5, wet 5-100 cm

Rock Outcrops : nil
Erosion : nil
Permeability: rapid
Watertable : at 5 cm, sweet
Catchment: Limpopo

Remarks: the description was made on an augering (special peat auger).

Samples: all horizons,

H1 0 - 20 cm; black (10YR 2/1) moist; moderate fine to coarse subangular blocky structure; friable (moist), not sticky (wet), slightly plastic (wet); not calcareous.

H2 20 - 50 cm; black (10YR 2/1) moist; friable (moist), not sticky (wet), slightly plastic (wet). Plastic mass of horizontally piled little decomposed leaves.

H3 50 - 80 cm; very dark gray (10YR 3/1) moist; friable (moist), slightly sticky (wet), plastic (wet); decomposed peat with good porosity.

H4 80 - 100 cm; black (7.5YR 2.5/0) moist, slightly sticky (wet), plastic (wet); very decomposed peat with little porosity.

PROFILE: GX0107 **UNIT: BAD3** **STATUS: 1**

Sheet/Grid : 1161
Location : Nhacutse (T42).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 54 13 S ; 33 41 12 E
Elevation: 3 m
Date : 11/09/94

Classification: - FAO : Gleyi-Eutric Vertisol
- ST : Ustic Epiaquert
- Local : Bila

Soil Climate: ustic

Topography : flat
Element/Pos.: backswamp, lower position
Micro Top. : irregular low
Land Use : extensive grazing
Human Infl. : drainage
Vegetation : short grasses
Species : gramineae

Land Form: alluvial plain
Slope : 0 - 1% , concave
Crops:
Grass cover: >80%

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : poor
External drainage: ponded
Flooding : rare
Moist. Conditions: moist 0-115, wet 115-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : at 115 cm, not saline (EC 1.09 Ds/cm)
Catchment: Limpopo

Remarks: gley below 30 cm.

Samples: all horizons,

A 0 - 10 cm; black (5YR 2.5/1) moist; common distinct sharp reddish brown mottles; clay; friable (moist), sticky (wet), plastic (wet); common fine and medium pores; common fine and medium roots; not calcareous; clear straight boundary.

AB 10 - 30 cm; black (7.5YR 2.5/0) moist; few fine distinct evident reddish brown mottles; clay; moderate to strong medium to coarse angular blocky structure; friable (moist), sticky wet), plastic (wet); few fine and very fine pores; many distinct pressure faces on ped faces; common fine and very fine roots; not calcareous; clear straight boundary.

Br1 30 - 77 cm; very dark gray (7.5YR 3/0) moist; coarse prominent sharp reddish mottles; clay; moderate medium to very coarse wedge-shaped blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and medium pores; abundant prominent intersecting slickensides on ped faces and prominent sesquioxides coatings in the pores; common fine and very fine roots; not calcareous; clear wavy boundary.

Br2 77 - 115 cm; dark gray (7.5YR 4/0) moist; many coarse prominent sharp reddish mottles; clay; strong coarse to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and medium pores; abundant prominent intersecting slickensides on ped faces and common prominent sesquioxides coatings in the pores; common fine and very fine roots; not calcareous;

PROFILE: GX090 **UNIT: BAD8** **STATUS: 1**

Sheet/Grid : 1161
Location : Nhacutse (T43).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 54 49 S ; 33 40 39 E
Elevation: 3 m
Date : 11/09/94

Classification:
- FAO : Gleyi-Eutric Vertisol
- ST : Ustic Epiaquert
- Local : Bila

Soil Climate: ustic

Topography : flat
Element/Pos.: backswamp, intermediate position
Micro Top. : irregular low
Land Use : extensive grazing
Human Infl. : drainage
Vegetation : short grasses
Species : gramineae

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops:
Grass cover: >80%

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : poor
External drainage: slow
Flooding : rare
Moist. Conditions: moist 0-115, wet 115-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : not observed
Catchment: Limpopo

Remarks: non-active gley below 45 cm.

Samples: all horizons.

A 0 - 33 cm; very dark gray (7.5YR 3/0) moist; few medium distinct evident mottles; clay; moderate coarse to very coarse prismatic structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; many fine and very fine and few medium roots; not calcareous; gradual wavy boundary.

AB 33 - 45 cm; very dark gray (7.5YR 3/0) moist; few medium distinct evident mottles; clay; moderate medium to coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); many fine and very fine pores; distinct intersecting slickensides on ped faces; common fine and very fine roots; not calcareous; gradual wavy boundary.

Br1 45 - 100 cm; very dark gray (7.5YR 3/0) moist; coarse distinct evident mottles; clay; moderate to strong coarse to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and very fine pores and few medium pores; prominent intersecting slickensides on ped faces; common fine and very fine roots; not calcareous; gradual irregular boundary.

Br2 100 - 160 cm; very dark gray (7.5YR 3/0) moist; few coarse distinct evident mottles; clay; moderate to strong coarse to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and very fine pores and few pores; prominent intersecting slickensides on ped faces; few fine and very fine roots; not calcareous;

PROFILE: GX0091 **UNIT: COM2** **STATUS: 1**

Sheet/Grid : 1161
Location : Nhacutse (T44).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 24 55 03 S ; 33 39 34 E
Elevation: 6 m
Date : 11/09/94

Classification: - FAO : Verti-Eutric Fluvisol
- ST : Vertic Ustifluvent
- Local : Bila

Soil Climate: ustic

Topography : nearly level
Element/Pos.: alluvial levee, intermediate position
Micro Top. : irregular low
Land Use : traditional rainfed agriculture
Human Infl. :
Vegetation :
Species :

Land Form: alluvial plain
Slope : 1 - 2% , complex
Crops: maize, beans, sweet potato, a few sugar cane and mafurra
Grass cover:

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : moderate
External drainage: moderate
Flooding : rare
Moist. Conditions: moist 0-150 cm

Rock Outcrops : nil
Erosion : nil
Permeability: slow
Watertable : not observed
Catchment: Limpopo

Remarks: The fourth and fifth layers are stratified and include each other's material. The fifth layer contains many mica flakes.

Samples: all horizons,

A 0 - 20 cm; very dark greyish brown (10YR 3/2) moist; clay loam; moderate medium coarse subangular blocky structure; friable (moist), sticky (wet), plastic (wet); many fine pores and many fine and very fine and few coarse roots; not calcareous; clear straight boundary.

Bw1 20 - 50 cm; black (10YR 2/1) moist; clay; moderate to strong medium to coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine and few medium pores; distinct intersecting slickensides on ped faces; common fine and very fine roots; few open burrows; not calcareous; clear wavy boundary.

Bw2 50 - 70 cm; very dark brown (10YR 2/2) moist; silty clay; strong medium to coarse angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and very fine pores; distinct pressure faces on peds; few fine and very fine and few medium roots; not calcareous; clear wavy boundary.

C1 70 - 95 cm; dark yellowish brown (10YR 3/4) moist; clay loam; very friable (moist), slightly sticky (wet), plastic (wet); many fine and very fine and few medium pores; very few fine roots; few termite channels; not calcareous; abrupt straight boundary.

C2 95 - 150 cm; dark brown (7.5YR 4/4) moist; sandy clay loam; very friable (moist), slightly sticky (wet), plastic (wet); many fine and very fine and few medium pores; very few fine roots; not calcareous.

PROFILE: GX0092 UNIT: PLI10 STATUS: 1

Sheet/Grid : 1172
Location : Chilaulene (T45).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 06 54 S ; 33 37 55 E
Elevation: 3 m
Date : 12/09/94

Classification: - FAO : Gleyi-Eutric Vertisol
- ST : Sodic Epiaquert, clayey over sandy
- Local : Bila

Soil Climate: aquic

Topography : flat
Element/Pos.: backswamp, intermediate position
Micro Top. : irregular low
Land Use : grazing
Human Infl. : drainage
Vegetation : short grass
Species : gramineae

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops:
Grass cover: 40-80%

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : poor
External drainage: ponding
Flooding : rare
Moist. Conditions: moist 0-85 cm, wet below

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : at 95 cm (EC 1.76 dS/m)
Catchment: Limpopo

Remarks: The layer 64-85 cm shows yellow mottles that are apparently jarosite. However, the analyses give pH however is 7.1 which is not what is expected in such a layer.

Samples: all horizons,

A 0 - 18 cm; black (7.5YR 2.5/0) moist; clay; moderate to strong medium to coarse angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; many fine and very fine and few medium roots; not calcareous; clear straight boundary.

Bw 18 - 44 cm; black (7.5YR 2.5/0) moist; few faint clear mottles; clay; moderate medium to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; many distinct intersecting slickensides on ped faces; many fine and very fine roots; not calcareous; gradual straight boundary.

Br1 44 - 64 cm; very dark gray (10YR 3/1) moist; common fine distinct evident yellowish mottles; clay; moderate to strong medium to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; distinct intersecting slickensides on ped faces; common fine and very fine roots; not calcareous; gradual straight boundary.

Br2 64 - 85 cm; very dark gray (10YR 3/1) moist; coarse prominent sharp yellowish mottles; clay; strong medium to very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and very fine pores; dominant intersecting slickensides on ped faces; common fine and very fine roots; not calcareous; abrupt straight boundary.

2Cr 85 - 120 cm; very dark gray (10YR 3/1) moist; few fine distinct evident mottles; medium sand; loose (moist), not sticky (wet), not plastic (wet); no pores; few fine and very fine roots; not calcareous;

PROFILE: GX0093 **UNIT: BAD10** **STATUS: 1**

Sheet/Grid : 1171
Location : Zongoene (T46).
Survey Area: Xai-Xai district
Author(s) : L. Amós
Coord. : 25 04 03 S ; 33 29 11 E
Elevation: 2 m
Date : 12/09/94

Classification: - FAO : Gleyi-Eutric Vertisol
- ST : Sodic Epiaquert
- Local : Bila

Soil Climate: aquic

Topography : flat
Element/Pos.: backswamp, intermediate position
Micro Top. : irregular low
Land Use : grazing
Human Infl. : drainage
Vegetation : short grass
Species : gramineae and some cyperaceae
Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops:
Grass cover: 40-80%

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : poor
External drainage: ponding
Flooding : rare
Moist. Conditions: moist 0-63 cm, wet below
Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : at 74 cm (EC 2.2 dS/m)
Catchment: (Lumane) Limpopo

Remarks: The layer 63-90 cm shows yellow mottles that are apparently jarosite. This is compatible with the pH of 4.8 given by the analyses.

Samples: all horizons,

A 0 - 10 cm; black (10YR 2/1) moist; clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; many fine and very fine and few medium roots; not calcareous; clear straight boundary.

AB 10 - 25 cm; black (7.5YR 2/0) moist; few very fine distinct sharp reddish brown mottles; clay; moderate to strong fine and coarse angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; many distinct pressure faces on peds; many fine and very fine roots; not calcareous; gradual straight boundary.

Bw 25 - 45 cm; black (7.5YR 2/0) moist; few fine distinct diffuse yellowish brown mottles; clay; moderate medium and coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; distinct intersecting slickensides on ped faces; common fine and very fine roots; not calcareous; gradual wavy boundary.

Bg1 45 - 63 cm; black (7.5YR 2/0) moist; common fine distinct diffuse yellowish brown mottles; clay; moderate medium and coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); few fine and very fine pores; abundant intersecting slickensides on ped faces; common fine and very fine roots; not calcareous; clear wavy boundary.

Br 63 - 90 cm; dark gray (7.5YR 4/0) moist; abundant coarse prominent sharp yellowish mottles; clay loam; strong coarse and very coarse wedge-shaped angular blocky structure; friable (moist), sticky (wet), plastic (wet); common fine and medium pores; abundant intersecting slickensides on ped faces; common fine and very fine roots; not calcareous;

PROFILE: GX0094 **UNIT: TE8** **STATUS: 3**

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Sheet/Grid : 1172                              Coord.    : 25 08 46 S ; 33 32 08 E
Location   : Chilaulene (T47).                           Elevation: 1 m
Survey Area: Xai-Xai district
Author(s)  : L. Amós                           Date      : 30/08/94

Classification:          - FAO   : Gleyi-Salic Fluvisol
                         - ST    : Typic Aquisalids
                         - Local : Ximunhuanine/Xivumbane
Soil Climate: aquic

Topography   : flat                            Land Form: alluvial plain
Element/Pos.: alluvial terrace, lower position Slope    : 0 - 1% , straight
Micro Top.   : irregular low
Land Use     : grazing                         Crops:
Human Infl. :
Vegetation   : short grass                     Grass cover: 40-80%
Species      : gramineae and some cyperaceae

Parent Material: estuarine deposits, derived from sedimentary rocks

Eff. Soil Depth   : > 150 cm                   Rock Outcrops  : nil
Surface Stones    : nil                        Erosion        : nil
Sealing/Crusting : nil
Drainage class    : very poor                  Permeability: very slow
External drainage: ponding                     Watertable   : at 40 cm (EC >20 Ds/m)
Flooding          : frequent
Moist. Conditions: moist 0-40 cm, wet below    Catchment: Limpopo

Remarks: The description was made on an augering.
```

Samples: at 0-10, 40-50 and 100-120 cm.

Arz 0 - 10 cm; very dark gray (10YR 3/1) moist; abundant fine prominent diffuse reddish brown mottles; clay;

Crz 10 -100 cm; very dark gray (10YR 3/1) moist; many coarse distinct diffuse yellowish brown mottles; clay;

PROFILE: GX0095 **UNIT: BAD6** **STATUS: 3**

Sheet/Grid : 1171
Location : Zongoene (T48).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 10 36 S ; 33 29 45 E
Elevation: 2 m
Date : 01/09/94

Classification: - FAO : Gleyi-Thionic Fluvisol
- ST : Mollic Psammaquents
- Local : T'Sovo

Soil Climate: aquic

Topography : flat
Element/Pos.: small valley floor
Micro Top. : irregular medium
Land Use : fallow
Human Infl. :
Vegetation : reeds and aquatic weeds
Species : Phragmites spp.

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops:
Grass cover:

Parent Material: estuarine deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : very poor
External drainage: ponding
Flooding : frequent
Moist. Conditions: 0+ wet

Rock Outcrops : nil
Erosion : nil
Permeability: moderate
Watertable : at 0 cm (EC 1.74 dS/m)
Catchment: Limpopo

Remarks: The description was made on an augering. Strong H_2S smell below 50 cm.

Samples: at 0-25, 35-50 and 50-100 cm.

A 0 - 25 cm; black (10YR 2/1) moist; sandy clay loam;

C 25 - 50 cm; very dark brown (10YR 2/2) moist; loamy fine sand;

Cr 50 - 100 cm; very dark gray (10YR 3/1) moist; medium sand ;

PROFILE: GX0096 **UNIT: MAN** **STATUS: 3**

Sheet/Grid : 1172
Location : Zongoene (T49).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 08 57 S ; 33 30 05 E
Elevation: 0.5 m
Date : 1/09/94

Classification:
- FAO : Gleyi-Salic Fluvisol
- ST : Typic Aquisalids
- Local : Ximunhuanine/Xivumbane

Soil Climate: aquic

Topography : flat
Element/Pos.: Inundable lower terrace
Micro Top. : irregular low
Land Use : firewood collection
Human Infl. :
Vegetation : mangrove
Species : Avicennia spp.

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops:
Grass cover:

Parent Material: alluvial deposits, derived from sedimentary rocks

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : patchy salt crust
Drainage class : very poor
External drainage: ponding
Flooding : very frequent
Moist. Conditions: 0-20 cm moist, 20-120 cm wet

Rock Outcrops : nil
Erosion : nil
Permeability: very slow
Watertable : at 20 cm (EC > 20 dS/m)
Catchment: Limpopo

Remarks: The description was made on an augering. Dry parts of the soil surface have a salt crust.

Samples: at 0-13, 13-38 and 50-120 cm.

A 0 - 13 cm; dark brown (7.5YR 3/2) moist; abundant coarse distinct diffuse yellowish brown mottles; clay;

Cr1 13 - 38 cm; very dark gray (7.5YR 3/0) moist; many coarse distinct diffuse yellowish brown mottles; clay;

Cr2 38 - 50 cm; dark gray (7.5YR 4/0) moist; many coarse prominent sharp reddish mottles; clay;

Cr3 50 - 150 cm; very dark gray (5YR 3/1) moist; common coarse distinct diffuse yellowish brown mottles; clay;

PROFILE: GX0097 **UNIT: MAC2** **STATUS: 3**

Sheet/Grid : 1171
Location : Zongoene (T50).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 05 10 S ; 33 28 07 E
Elevation: 6 m
Date : 12/09/94

Classification:
- FAO : Dystri-Terric Histosols
- ST : Typic Troposaprists
- Local : T'Sovo

Soil Climate: aquic

Topography : nearly level
Element/Pos.: swampy area
Micro Top. : irregular moderate
Land Use : traditional wetland agriculture
Human Infl. : drainage and burning
Vegetation : burned reeds and herbaceous
Species : Phragmites spp.

Land Form: alluvial plain
Slope : 1 - 2% , straight
Crops:
Grass cover:

Parent Material: peat

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : poor
External drainage: slow
Flooding : rare
Moist. Conditions: moist 0-30, wet 300-120 cm

Rock Outcrops : nil
Erosion : nil
Permeability: moderate
Watertable : at 35 cm, sweet (EC 0.32 dS/m)
Catchment: (Lumane) Limpopo

Remarks: the description was made on an augering (special peat auger).

Samples: 0-30, 30-60, 60-100 cm

H1 0 - 30 cm; black (10YR 2/1) moist; well decomposed peat; strong fine to medium crumb structure; friable (moist), slightly sticky (wet), plastic (wet); not calcareous;

H2 30 - 60 cm; dark reddish brown (5YR 2.5/2) moist; well decomposed peat; not calcareous;

H3 60 - 100 cm; dark reddish brown (5YR 2.5/2) moist; well decomposed peat; not calcareous;

\- 100 - 120 cm; water with little peat material.

PROFILE: GX0098 **UNIT: MAC2** **STATUS: 3**

Sheet/Grid : 1171
Location : Zongoene (T51).
Survey Area: Xai-Xai district
Author(s) : L. Amós

Coord. : 25 05 08 S ; 33 28 05 E
Elevation: 4 m
Date : 12/09/94

Classification:
- FAO : Dystri-Fibric Histosol
- ST : Hemic Tropofibrists
- Local : Xiboa, T'Seve-T'Seve

Soil Climate: aquic

Topography : Nearly level
Element/Pos.: swampy area
Micro Top. : irregular moderate
Land Use : traditional wetland agriculture
Human Infl. : burning
Vegetation : burned reeds and aquatic weeds
Species : Phragmites spp.

Land Form: alluvial plain
Slope : 0 - 1% , straight
Crops: banana
Grass cover:

Parent Material: peat

Eff. Soil Depth : > 150 cm
Surface Stones : nil
Sealing/Crusting : nil
Drainage class : very poor
External drainage: ponding
Flooding : frequent
Moist. Conditions: 0-120 cm wet

Rock Outcrops : nil
Erosion : nil
Permeability: moderate
Watertable : at + 5 cm (EC 0.32 dS/m)
Catchment: (Lumane) Limpopo

Remarks: the description was made on an augering (special peat auger).

Samples: 0-30, 30-64, 64-94 cm

H1 0 - 30 cm; black (10YR 2/1) moist; fibrous peat;

H2 30 - 64 cm; black (10YR 2/1) moist; semi-fibrous peat (hemic)

H3 64 - 94 cm; very dark brown (10YR 2/2) moist; fibrous peat.

TABELAS

	Depth cm	Coarse sand (Co)	Fine sand (F)	Silt	Clay	Textur Class	Sand ratio F/F&Co	CE (1:2.5) dS/m	pH H2O	pH KCl	O.M %	N total %	C/N	P. Olse ppm	Ca	Mg	Na	K	CEC pH 7	H+Al pH 7	B.S %	Na/CEC
															<—	meq/100g			—>			
GX0066	0-19	71.6	19.2	0.0	9.2	S	21	0.05	4.7	3.6	0.1	0.02	2.9	18.3	0.6	0.0	<0.1	0.1	1.3		54	
	19-46	69.0	22.7	0.8	7.5	S	25	0.02	5.6	3.9	0.2	0.01	11.6	14.8	0.5	0.0	<0.1	0.1	1.6		38	
	46-80	72.6	21.4	0.5	5.5	S	23	0.02	6.1	4.6	0.1	0.01	5.8	10.0	0.3	0.0	<0.1	0.1	0.3		133	
	80-96	67.7	26.3	1.5	4.5	S	28	0.02	5.9	4.6	0.2	0.02	5.8	8.9	0.4	0.1	<0.1	<0.1	1.3		38	
	96-132	68.5	25.9	0.6	5.0	S	27	0.03	6.1	4.9	0.3	0.02	8.7	7.7	1.2	0.1	<0.1	<0.1	2.0		65	
	132-177	69.6	22.6	2.4	5.4	S	25	0.03	5.9	4.9	0.4	0.03	7.7	9.7	1.8	0.0	<0.1	0.1	3.0		63	
	177-218	69.4	23.5	3.8	3.3	S	25	0.04	5.5	4.5	0.5	0.03	9.7	12.7	1.1	0.0	<0.1	0.1	1.3		92	
	Lamelas	58.5	24.8	0.5	16.2	SL	30	0.03	5.2	3.5	0.3	0.04	4.4	45.2	0.9	0.4	<0.1	0.2	3.3		45	
GX0065	0-15	9.1	5.2	19.0	66.7	C	36	0.38	5.6	4.1	2.9	0.17	9.9	11.2	10.0	12.0	2.0	1.5	35.1		73	5.7
	15-43	3.5	3.3	19.6	73.6	C	49	0.41	6.5	4.9	2.0	0.13	8.9	4.1	13.0	14.5	3.6	1.6	45.3		72	7.9
	43-85	5.4	6.3	19.8	68.5	C	54	0.07	7.3	5.3	1.2	0.08	8.7	2.7	7.5	10.0	4.4	0.9	38.1		60	11.5
	85-105	3.8	6.4	20.4	69.4	C	63	0.66	7.5	5.5	1.1	0.07	9.1	1.8	11.5	15.0	6.8	0.8	38.8		88	17.5
	105-130	20.6	15.7	15.8	47.9	C	43	0.51	8.1	6.0	0.4	0.03	7.7	1.2	7.2	5.2	4.1	0.5	20.4		83	20.1
GX0113	0-8	14.8	38.0	19.0	28.2	SCL	72	0.05	6.0	5.1	2.1	0.11	11.1	58.5	9.7	7.3	3.7	1.3	20.2		109	18.3
	8-45	15.6	28.7	15.7	40.0	CL/C	65	0.40	6.6	5.4	2.0	0.11	10.5	15.1	11.8	10.2	4.6	1.1	23.5		118	19.6
	45-65	13.5	30.3	16.2	40.0	CL/C	69	0.49	8.0	6.6	1.0	0.07	8.3	2.7	7.8	9.2	3.9	0.9	20.1		108	19.4
	65-100	13.3	31.8	11.5	43.4	C	71	0.75	8.7	7.0	0.5	0.05	5.8	1.8	6.7	10.0	1.6	0.8	19.5		98	8.2
	100-120	13.1	30.1	16.2	40.6	C	70	0.23	8.9	7.2	0.4	0.04	5.8	1.8	1.0	1.9	6.5	0.8	22.8		45	28.5
GX0114	0-15	69.1	23.1	2.2	5.6	S	25	0.03	5.1	3.7	0.5	0.03	9.7	22.4	1.4	0.1	<0.1	0.1	0.3		533	
	15-80	68.9	21.8	3.7	5.6	S	24	0.02	4.9	3.5	0.3	0.02	8.7	6.2	0.2	0.1	<0.1	<0.1	1.0		30	
	80-135	72.3	22.6	2.1	3.0	S	24	0.01	5.0	3.6	0.1	0.01	5.8	10.6	0.0	0.3	<0.1	<0.1	0.3		100	
	135-145	71.2	21.2	2.8	4.8	S	23	0.01	5.0	3.5	0.1	0.02	2.9	19.5	1.4	0.3	<0.1	<0.1	0.6		283	
	145-185	74.5	17.8	1.0	6.7	S	19	0.02	4.9	3.5	0.1	0.02	2.9	29.2	0.3	0.2	<0.1	<0.1	0.6		83	
GX0115	0-24	77.0	19.8	1.4	1.8	S	20	0.04	5.2	3.7	0.4	0.04	5.8	28.9	0.4	0.1	<0.1	<0.1	0.8		63	
	24-80	70.8	24.2	2.2	2.8	S	25	0.06	4.5	3.6	0.4	0.04	5.8	11.8	0.1	0.1	<0.1	<0.1	0.9		22	
	80-135	73.9	20.7	1.4	4.0	S	22	0.03	4.8	3.5	0.1	0.02	2.9	19.8	0.2	0.3	<0.1	<0.1	0.0			
	135-165	75.6	19.2	0.9	4.3	S	20	0.02	4.9	3.4	0.1	0.01	5.8	27.2	0.2	0.4	<0.1	<0.1	0.4		150	
	165-200	72.6	21.3	2.9	3.2	S	23	0.01	5.0	3.4	0.1	0.02	2.9	22.4	0.5	0.3	<0.1	<0.1	0.8		100	
GX0116	0-14	51.8	35.9	3.1	9.2	LS	41	0.11	4.9	4.3	1.0	0.06	9.7	3.5	1.1	1.4	<0.1	0.3	4.3		65	
	14-28	54.4	33.3	2.8	9.5	LS	38	0.08	5.8	4.3	0.6	0.06	5.8	2.1	1.3	1.9	0.2	0.2	4.9		73	4.1
	28-45	58.3	32.2	2.1	7.4	S	36	0.07	6.0	4.2	0.3	0.03	5.8	1.8	0.8	1.4	0.2	0.2	5.3		49	3.8
	45-67	51.1	26.0	1.3	21.6	SCL	34	0.07	5.9	4.0	0.5	0.05	5.8	1.2	1.5	3.4	0.6	0.3	9.1		64	6.6
	67-85	37.7	23.3	4.8	34.2	SCL	38	0.11	5.8	4.0	0.5	0.06	4.8	0.9	2.0	6.7	1.6	0.5	15.8		68	10.1
	85-135	49.8	26.4	3.4	20.4	SCL	35	0.25	6.2	4.8	0.2	0.01	11.6	1.5	1.0	5.7	1.9	0.3	10.4		86	18.3
GX0117	0-20	62.6	34.0	0.6	2.8	S	35	0.09	5.6	4.6	0.4	0.03	7.7	9.2	0.5	0.3	<0.1	0.3	1.6		69	
	20-48	68.0	27.1	0.6	4.3	S	28	0.06	5.5	4.2	0.3	0.02	8.7	4.4	0.6	0.5	<0.1	0.3	2.9		48	
	48-65	63.2	29.6	0.8	6.4	S	32	0.06	5.3	3.9	0.3	0.03	5.8	3.0	0.5	0.8	<0.1	0.3	2.6		62	
	65-97	48.7	25.1	0.8	25.4	SCL	34	0.07	5.7	3.8	0.4	0.05	4.6	2.1	0.7	1.6	0.2	0.3	7.3		38	2.7
	97-140	57.0	29.1	0.8	13.1	SL	34	0.09	5.6	3.8	0.4	0.07	3.3	6.2	0.8	2.5	0.6	0.3	9.0		47	6.7

	Depth cm	Coarse sand (Co)	Fine sand (F)	Silt	Clay	Textur Class	Sand ratio F/F&Co	CE (1:2.5) dS/m	pH H2O	pH KCl	O.M %	N total %	C/N	P. Olse ppm	Ca (meq/100g)	Mg (meq/100g)	Na (meq/100g)	K (meq/100g)	CEC pH 7 (meq/100g)	H+Al pH 7	B.S %	Na/CEC
GX0067	0-10	75.2	21.2	1.1	2.5	S	22	0.07	5.8	4.8	0.7	0.04	10.2	5.0	0.8	0.3	<0.1	0.2	2.2		59	
	10-44	77.3	19.3	0.9	2.5	S	20	0.05	5.4	4.2	0.4	0.03	7.7	3.3	2.4	0.1	<0.1	0.1	1.7		153	
	44-78	68.1	27.4	1.5	3.0	S	29	0.06	4.9	4.1	0.2	0.02	5.8	1.8	0.5	0.1	<0.1	0.1	1.9		37	
	78-127	71.6	25.5	1.1	1.8	S	26	0.06	5.0	4.2	0.1	0.01	5.8	2.1	1.0	0.0	<0.1	0.1	0.9		122	
	127-150	66.3	30.8	0.9	1.0	S	32	0.05	5.2	4.3	0.0	0.01	0.0	1.5	0.2	1.4	<0.1	<0.1	0.5		320	
GX0068	0-20	71.4	18.5	5.1	5.0	S	21	0.13	5.6	4.7	1.7	0.08	12.3	5.9	1.8	0.2	0.2	0.3	5.3		47	3.8
	20-45	71.7	18.6	3.5	6.2	S	21	0.11	5.3	4.2	1.6	0.06	15.5	3.5	0.3	0.3	<0.1	<0.1	6.4		9	
	45-68	70.8	24.8	1.9	2.5	S	26	0.07	5.4	4.2	0.2	0.01	11.6	1.2	0.7	0.3	<0.1	0.2	1.9		63	
	68-90	72.4	23.5	4.1	1.0	S	25	0.06	5.7	4.4	0.1	0.00	ERR	1.5	0.3	0.3	<0.1	0.2	1.5		53	
	90-115	70.2	24.0	1.8	4.0	S	25	0.08	5.8	4.7	0.1	0.00	ERR	1.8	0.3	0.3	0.1	0.1	3.6		22	2.8
	115-150	70.0	22.5	2.7	4.8	S	24	0.10	6.3	5.2	0.1	0.01	5.8	5.3	0.5	0.6	0.1	0.2	3.2		44	3.1
GX0069	0-16	28.3	20.0	28.5	23.2	L	41	0.55	5.8	4.8	19.1	0.56	19.8	19.5	5.7	9.5	1.4	1.6	31.0		59	4.5
	16-41	33.5	14.8	28.0	23.7	L/SCL	31	0.44	5.9	4.6	8.5	0.44	11.2	15.4	4.6	7.3	2.2	1.4	26.6		58	8.3
	41-77	41.4	24.4	6.9	27.3	SCL	37	0.17	5.7	4.3	3.6	0.11	19.0	2.4	2.9	3.7	1.2	0.7	13.1		65	9.2
	77-110	52.0	15.3	3.9	28.8	SCL	23	0.14	5.8	4.3	0.5	0.04	7.3	6.8	2.4	5.5	1.9	1.0	13.4		81	14.2
	110-130	57.1	21.1	2.7	19.1	SL	27	0.13	6.3	4.6	0.2	0.02	5.8	5.9	1.3	2.6	1.2	0.5	6.6		85	18.2
GX0070	0-22	73.8	18.2	1.5	6.5	S	20	0.08	6.1	5.3	0.8	0.04	11.6	24.2	1.2	0.5	<0.1	0.3	3.9		51	
	22-50	77.4	13.8	1.8	7.0	S	15	0.07	5.2	4.0	0.5	0.03	9.7	49.6	0.2	0.3	<0.1	0.2	1.9		37	
	50-102	73.9	18.3	0.6	7.2	S	20	0.06	5.5	4.2	0.2	0.01	11.6	31.6	0.3	0.1	<0.1	0.2	0.9		67	
	102-130	71.6	18.4	1.0	9.0	S	20	0.08	5.1	4.2	0.1	0.01	5.8	39.0	0.5	0.2	<0.1	0.2	2.2		41	
	130-145	76.0	12.1	2.9	9.0	LS	14	0.06	5.3	4.2	0.1	0.03	1.9	31.6	0.4	0.1	<0.1	0.2	1.2		58	
	145-160	71.2	14.0	2.0	12.8	LS	16	0.06	5.0	4.1	0.1	0.02	2.9	40.2	0.7	0.3	<0.1	0.2	3.9		31	
GX0071	0-15	70.0	22.7	2.2	5.1	S	24	0.09	6.3	5.7	0.8	0.05	9.3	14.8	1.4	0.3	<0.1	0.3	3.7		54	
	15-50	68.2	22.8	2.6	6.4	S	25	0.07	6.1	5.2	0.3	0.03	5.8	10.9	0.9	0.3	<0.1	0.3	0.9		167	
	50-104	66.7	24.4	2.1	6.8	S	27	0.06	6.3	5.3	0.1	0.02	2.9	11.5	0.6	0.3	<0.1	0.2	2.2		50	
	104-140	67.7	25.4	1.5	5.4	S	27	0.05	6.4	5.4	0.0	0.00	ERR	7.4	0.3	0.1	<0.1	0.1	0.7		71	
	140-150	67.0	25.6	2.7	4.7	S	28	0.06	6.3	5.4	0.1	0.01	5.8	7.1	0.4	0.0	<0.1	0.2	1.3		46	
GX0072	0-16	75.8	18.0	0.6	5.6	S	19	0.08	6.7	6.2	1.3	0.05	15.1	5.3	3.4	0.9	0.1	0.3	4.6		102	2.2
	16-33	66.5	23.8	5.3	4.4	S	26	0.07	6.6	6.1	0.7	0.04	10.2	2.4	3.0	0.7	0.1	0.3	3.0		137	3.3
	33-85	67.6	24.8	2.6	5.0	S	27	0.06	6.6	6.0	0.2	0.01	11.6	1.8	2.2	0.4	<0.1	0.2	3.0		93	
	85-130	64.8	30.4	0.6	4.2	S	32	0.06	6.7	5.8	0.1	0.01	5.8	2.4	0.6	0.2	<0.1	0.2	2.2		45	
	130-150	77.8	17.1	0.8	4.3	S	18	0.06	6.8	5.6	0.1	0.01	5.8	2.7	0.8	0.2	<0.1	0.2	2.8		43	
GX0074	0-27	69.6	21.4	3.2	5.8	S	24	0.05	5.8		1.4	0.10	8.1	43.8	2.8	1.1	<0.1	0.3	4.7		89	
	27-50	76.0	16.1	1.0	6.9	S	17	0.02	5.9		0.5	0.05	5.8	7.3	1.9	0.7	<0.1	<0.1	3.4		76	
	50-79	80.1	11.2	1.3	7.4	S	12	0.01	6.0		0.2	0.04	2.9	11.0	0.8	0.5	<0.1	<0.1	1.2		108	
	79-109	73.4	16.2	1.9	8.5	S	18	0.02	6.0		0.1	0.03	1.9	19.5	0.8	0.4	<0.1	<0.1	1.0		120	
	109-160	69.5	17.3	1.8	11.4	LS	20	0.03	5.8		0.1	0.03	1.9	34.1	0.8	0.5	<0.1	<0.1	1.7		76	
GX0075	0-27	71.5	20.8	1.5	6.2	S	23	0.05	6.2		1	0.11	5.3	7.3	3.5	0.7	<0.1	0.3	4.3		105	
	27-52	71.2	20.9	2.1	5.8	S	23	0.02	6.6		0.3	0.04	4.4	3.7	1.2	0.3	<0.1	0.1	1.1		145	
	52-76	69.9	19.1	2.8	8.2	LS	21	0.02	6.8		0.4	0.04	5.8	2.4	1.4	0.5	<0.1	<0.1	2.1		90	
	76-99	67.4	17.6	4.2	10.8	LS	21	0.03	6.8		0.1	0.03	1.9	3.7	0.9	0.6	<0.1	<0.1	1.8		83	
	99-146	66.5	17.4	2.3	13.8	LS	21	0.03	5.2		0.1	0.03	1.9	4.9	0.4	0.9	<0.1	<0.1	1.5		87	

Profile	Depth cm	Coarse sand (Co)	Fine sand (F)	Silt	Clay	Textur Class	Sand ratio F/F&Co	CE (1:2.5) dS/m	pH H2O	pH KCl	O.M %	N total %	C/N	P. Olse ppm	Ca	Mg	Na	K	CEC pH 7	H+Al pH 7	B.S %	Na/CEC
															<----	meq/100g			---->			
GX0076	0-16	64.0	26.1	3.4	6.5	S	29	0.05	6.2		1.1	0.10	6.4	6.1	2.2	1.1	<0.1	0.4	3.9		95	
	16-30	69.4	21.1	2.2	7.3	S	23	0.04	6.4		0.4	0.06	3.9	2.4	1.6	0.7	<0.1	0.2	1.8		139	
	30-70	61.0	21.6	5.0	12.4	LS	26	0.02	6.1		0.3	0.04	4.4	2.4	0.6	1.0	<0.1	0.2	1.9		95	
	70-107	50.3	25.2	6.3	18.2	SL	33	0.03	5.5		0.3	0.03	5.8	9.7	0.5	1.1	<0.1	0.1	1.8		94	
	107-160	56.8	23.7	4.3	15.2	SL	29	0.04	5.5		0	0.03	0.0	1.2	0.6	0.9	<0.1	<0.1	1.8		83	
GX0077	0-9	76.3	18.5	2.1	3.1	S	20	0.03	5.6		1.3	0.07	10.8	7.3	1.1	0.3	<0.1	<0.1	1.2		117	
	9-48	74.4	21.1	2.7	1.8	S	22	0.02	5.4		0.6	0.04	8.7	3.7	0.4	0.2	<0.1	<0.1	1.2		50	
	48-88	67.2	26.0	4.0	2.8	S	28	0.01	5.3		0.6	0.02	17.4	3.7	0.6	0.2	<0.1	<0.1	0.9		89	
	88-117	72.3	22.5	1.2	4.0	S	24	0.02	5.2		0.2	0.03	3.9	1.2	0.1	0.0	<0.1	<0.1	1.8		6	
GX0078	0-8	72.4	20.8	3.7	3.1	S	22	0.05	5.7		0.9	0.07	7.5	4.9	1.0	0.3	<0.1	<0.1	1.8		72	
	8-37	75.9	21.4	2.0	0.7	S	22	0.02	5.2		0.5	0.05	5.8	2.4	0.3	0.0	<0.1	<0.1	0.8		38	
	37-78	72.8	22.6	3.3	1.3	S	24	0.01	5.2		0.4	0.04	5.8	1.2	0.2	0.2	<0.1	<0.1	0.6		67	
	78-99	74.5	21.9	0.3	3.3	S	23	0.02	5.3		0.2	0.03	3.9	1.2	0.2	0.1	<0.1	<0.1	0.6		50	
	99-160	72.5	22.3	1.5	3.7	S	24	0.02	5.4		0.1	0.02	2.9	0.0	0.2	0.0	<0.1	0.1	0.5		60	
GX0079	0-8	85.6	9.7	1.7	3.0	S	10	0.04	5.6		0.9	0.05	10.4	7.3	1.2	0.3	<0.1	0.1	1.2		133	
	8-18	82.6	12.5	3.2	1.7	S	13	0.03	5.6		0.6	0.05	7.0	7.3	0.9	0.2	<0.1	<0.1	1.5		73	
	18-44	82.4	13.5	3.4	0.7	S	14	0.02	5.7		0.6	0.04	8.7	2.4	0.4	0.2	<0.1	<0.1	0.5		120	
	44-75	78.7	16.6	1.7	3.0	S	17	0.01	5.7		0.4	0.04	5.8	3.7	0.2	0.2	<0.1	<0.1	1.7		24	
	75-160	73.7	21.3	2.5	2.5	S	22	0.01	5.2		0.1	0.03	1.9	0.0	0.4	0.0	<0.1	<0.1	0.8		50	
GX0080	0-8	85.9	11.1	1.3	1.7	S	11	0.04	5.6		1.7	0.09	11.0	7.3	1.1	0.9	<0.1	<0.1	1.5		133	
	8-30	82.4	12.5	3.2	1.9	S	13	0.02	5.1		0.8	0.07	6.6	3.7	0.2	0.5	<0.1	<0.1	0.6		117	
	30-59	76.9	19.6	2.5	1.0	S	20	0.03	5.2		0.3	0.03	5.8	4.9	0.0	0.1	<0.1	<0.1	0.5		20	
	59-95	74.6	20.8	3.3	1.3	S	22	0.02	5.2		0.3	0.02	8.7	2.4	0.1	0.0	<0.1	<0.1	0.0			
	95-155	74.1	20.9	2.7	2.3	S	22	0.03	5.2		0.3	0.03	5.8	3.7	0.1	0.0	<0.1	<0.1	0.6		17	
GX0081	0-18	73.8	17.6	4.8	3.8	S	19	0.13	5.4	4.4	3.2	0.20	9.3	3.5	1.2	0.4	0.2	0.1	4.6		41	4.3
	18-43	66.7	15.3	10.0	8.0	LS	19	0.56	4.5	4.3	15.8	0.35	26.2	1.8	0.1	0.0	0.7	0.1	19.8	18.2	5	3.5
	43-67	78.8	13.5	6.5	1.2	S	15	0.72	4.6	4.4	44.2	1.15	22.3	2.9	0.1	0.3	2.0	0.1	51.3	38.0	5	3.9
	67-143	79.4	13.5	5.0	2.1	S	15	0.04	4.8	4.5	48.9	1.20	23.6	2.4	0.1	0.3	1.3	<0.1	46.1	35.5	4	2.8
	143-170	77.5	16.0	2.8	3.7	S	17	0.07	5.2	4.5	2.4	0.07	19.9	2.4	0.1	0.0	0.1	<0.1	4.3		5	2.3
GX0082	0-11	70.9	24.8	2.8	1.5	S	26	0.03	6.3	5.8	1	0.05	11.6	1.8	1.0	0.3	<0.1	<0.1	2.9		45	
	11-30	62.9	32.6	2.5	2.0	S	34	0.66	4.8	4.3	0.6	0.03	11.6	1.5	0.1	0.0	<0.1	0.1	1.1		18	
	30-64	65.2	30.8	2.5	1.5	S	32	0.05	4.7	4.2	0.4	0.03	7.7	1.2	0.3	0.0	<0.1	<0.1	3.8		8	
	64-111	59.0	36.4	1.3	3.3	S	38	0.01	4.9	4.4	0.3	0.02	8.7	0.6	0.0	0.0	<0.1	<0.1	2.4			
	111-160	61.8	31.3	1.0	5.9	S	34	0.02	4.8	4.4	0.2	0.02	5.8	0.9	0.0	0.0	<0.1	<0.1	1.3			
GX0083	0-15	73.3	21.3	1.0	4.4	S	23	0.42	6.2	6.0	0.6	0.04	8.7	0.0	1.4	0.3	<0.1	<0.1	3.9		44	
	15-67	72.8	23.2	1.8	2.2	S	24	0.01	6.4	5.7	0.2	0.02	5.8	0.6	0.3	0.0	<0.1	0.1	0.8		50	
	67-112	72.6	22.9	0.6	3.9	S	24	0.51	5.0	4.6	0.2	0.02	5.8	1.5	0.0	0.0	<0.1	<0.1	1.3			
	112-160	78.0	17.2	1.4	3.4	S	18	0.01	5.8	4.7	0	0.01	0.0	1.5	0.1	0.0	<0.1	<0.1	1.8		6	

	Depth cm	Coarse sand (Co)	Fine sand (F)	Silt	Clay	Textur Class	Sand ratio F/F&Co	CE (1:2.5) dS/m	pH H2O	pH KCl	O.M %	N total %	C/N	P. Olse ppm	Ca	Mg	Na	K	CEC pH 7	H+Al pH 7	B.S %	Na/CEC
															<— meq/100g				—>			
GX0084	0-10	86.5	9.8	1.5	2.2	S	10	0.01	5.7	4.9	0.1	0.01	5.8	0.9	0.0	0.0	<0.1	<0.1	1.7			
	10-71	90.5	7.0	0.5	2.0	S	7	0.12	5.2	4.8	0.1	0.02	2.9	0.6	0.2	0.0	<0.1	<0.1	3.2			
	71-104	84.0	13.2	1.3	1.5	S	14	0.02	5.8	5.0	0	0.01	0.0	1.2	0.0	0.0	<0.1	<0.1	2.4		6	
	104-122	73.2	24.2	2.1	0.5	S	25	0.11	5.4	4.9	0	0.01	0.0	1.2	0.0	0.1	<0.1	<0.1	2.0		5	
	122-150	96.0	3.5	0.5	0.0	S	4	0.01	6.0	5.1	0	0.00		0.6	0.0	0.1	<0.1	<0.1	2.2		5	
GX0086	0-11	78.0	12.8	8.2	1.0	S	14	0.07	5.4	4.5	0.8	0.02	23.2	4.3	0.5	0.4	<0.1	0.0	1.0		93	
	11-29	73.8	14.8	10.4	1.0	S	17	0.1	5.6	4.9	0.6	0.02	17.4	1.9	0.7	0.4	<0.1	0.0	1.1		96	
	29-72	73.3	15.5	9.5	1.7	S	17	0.11	5.5	4.8	0.3	0.01	17.4	0.9	0.3	0.2	<0.1	0.0	1.8		27	
	72-120	72.8	16.3	9.4	1.5	S	18	0.08	5.8	5.1	0.1	0.01	5.8	1.5	0.0	0.2	<0.1	0.0	0.3		108	
	120-150	69.3	15.3	9.6	5.8	LS	18	0.09	5.9	5.0	0.1	0.01	5.8	2.8	0.0	0.3	<0.1	0.1	0.1		310	
GX0087	0-14	81.4	8.2	9.2	1.2	S	9	0.11	5.3	4.5	0.9	0.03	17.4	2.8	0.6	0.3	<0.1	0.1	1.5		65	
	14-34	65.7	22.0	7.9	4.4	LS	25	0.10	5.1	4.3	0.6	0.03	11.6	0.3	0.2	0.0	<0.1	0.1	2.0		15	
	34-64	65.1	20.9	8.0	6.0	LS	24	0.07	5.0	4.3	0.3	0.01	17.4	0.4	0.1	0.2	<0.1	0.1	1.4		25	
	64-102	66.4	18.1	6.8	8.7	LS	21	0.08	4.8	4.2	0.3	0.01	17.4	1.3	0.1	0.0	<0.1	0.0	0.7		17	
	102-170	68.7	15.4	6.5	9.4	LS	18	0.06	4.9	4.2	0.2	0.01	11.6	2.0	0.3	0.1	<0.1	0.0	2.1		21	
GX0088	0-12	69.2	21.6	6.8	2.4	S	24	0.11	5.3	4.4	0.6	0.04	8.7	19.0	0.9	0.4	0.2	0.2	2.3		75	8.0
	12-31	67.2	22.6	8.6	1.6	S	25	0.10	5.3	4.3	0.6	0.02	17.4	7.3	0.8	0.2	0.1	0.2	1.9		67	5.4
	31-63	66.7	24.0	6.9	2.4	S	26	0.11	5.0	4.2	0.3	0.02	8.7	5.9	0.3	0.2	<0.1	0.1	1.6		37	
	63-104	72.0	20.8	6.2	1.0	S	22	0.10	4.9	4.2	0.1	0.01	5.8	14.0	0.1	0.1	<0.1	0.1	1.6		16	
	104-132	69.8	21.6	6.4	2.2	S	24	0.09	5.0	4.2	0.1	0.01	5.8	6.0	0.3	0.4	<0.1	0.1	1.4		56	
	132-150	64.3	17.8	5.3	12.6	SL	22	0.05	5.3	3.7	0.2	0.01	11.6	1.1	1.0	1.7	0.3	0.2	4.8		67	6.7
GX0089	0-22	94.5	3.8	0.4	1.3	S	4	0.04	5.9	5.3	0.5	0.04	7.3	1.1	0.7	0.5	<0.1	0.1	1.6		82	
	22-62	87.4	7.2	4.0	1.4	S	8	0.05	5.9	5.2	0.2	0.02	5.8	0.0	0.4	0.2	<0.1	0.0	1.6		35	
	62-91	89.4	6.3	3.5	0.8	S	7	1.11	5.8	5.1	0.0	0.01	0.0	0.7	0.3	0.3	0.1	0.0	1.2		57	8.5
	91-160	86.8	8.2	4.2	0.8	S	9	0.05	6.3	5.1	0.0	0.00		1.3	0.5	0.2	<0.1	0.0	2.0		33	
GX0099	0-10	78.5	14.1	4.2	3.2	S	15	0.04	5.8	5.1	1.7	0.12	8.2	3.5	1.2	1.6	<0.1	0.0	3.6		77	
	10-23	79.4	12.8	4.2	3.6	S	14	0.09	5.7	5.0	1.1	0.06	10.6	0.4	1.5	1.4	<0.1	0.1	3.7		82	
	23-50	63.3	29.4	6.3	1.0	S	32	0.03	5.9	5.1	0.2	0.03	3.9	8.3	0.5	0.6	<0.1	0.0	1.7		65	
	50-80	61.5	31.1	6.7	0.5	S	34	0.02	6.1	5.2	0.1	0.01	5.8	0.0	0.6	0.5	<0.1	0.0	1.1		93	
	80-139	60.5	31.1	5.0	3.4	S	34	0.03	6.2	5.2	0.1	0.01	5.8	0.0	1.0	0.4	<0.1	0.1	0.8		195	
GX0100	0-26	63.4	24.2	9.0	3.4	LS	28	0.24	6.2	5.2	6.7	0.31	12.5	20.6	3.0	4.4	1.0	0.2	14.0		61	7.2
	26-40	56.2	36.0	7.1	0.7	S	39	0.10	6.6	6.0	0.3	0.01	17.4	0.0	0.4	0.6	0.3	0.1	2.0		65	12.9
GX0101	0-20	2.4	42.2	32.7	22.7	L	95	0.14	6.9	6.0	2.1	0.08	15.2	47.9	7.8	4.6	0.8	0.8	21.8	0.8	64	3.7
	20-45	1.1	42.9	31.4	24.6	L	98	0.5	6.9	6.0	1.1	0.04	16.0	9.3	9.8	7.0	0.6	0.4	23.4	0.6	76	2.6
	45-68	3.1	59.1	18.7	19.1	SL	95	0.16	7.1	5.8	0.5	0.03	9.7	4.7	5.6	4.6	0.4	0.2	15.5	0.5	70	2.6
	68-90	8.7	48.0	22.4	20.9	SCL	85	0.12	7.3	5.9	0.5	0.02	14.5	4.2	8.7	6.6	0.5	0.3	18.8	0.4	86	2.6
	90-115	1.5	55.5	23.4	19.8	SL	97	0.1	7.4	5.9	0.5	0.02	14.5	4.1	10.5	7.9	0.6	0.4	17.5	0.4	110	3.1
	115-140	0.9	4.8	46.8	47.5	SiC	84	0.22	7.3	5.8	1.7	0.07	14.1	17.4	24.0	18.0	1.1	0.9	31.2	1.1	141	3.6
	140-150	1.1	7.4	51.0	40.5	SiC	87	0.2	7.3	5.8	1.5	0.06	14.5	7.7	19.3	14.4	1.0	0.6	37.6	0.9	94	2.5

	Depth cm	Coarse sand (Co)	Fine sand (F)	Silt	Clay	Textur Class	Sand ratio F/F&Co	CE (1:2.5) dS/m	pH H2O	pH KCl	O.M %	N total %	C/N	P. Olse ppm	Ca meq/100g	Mg meq/100g	Na meq/100g	K meq/100g	CEC pH 7 meq/100g	H+Al pH 7	B.S %	Na/CEC
GX0102	0-20	1.7	6.5	46.4	45.4	SiC	79	0.13	6.8	5.3	2.9	0.11	15.3	100.5	19.1	14.4	1.1	1.2	39.5	2.9	91	2.8
	20-43	0.9	6.7	42.4	50.0	SiC	88	0.12	7.0	5.4	1.5	0.09	9.7	43.5	17.3	17.3	1.1	0.9	38.3	1.9	96	3.0
	43-90	1.8	2.8	33.6	61.8	C	61	0.4	7.5	5.9	2.4	0.05	27.8	15.9	26.9	16.0	3.3	0.8	51.0	0.6	92	6.4
GX0103	0-21	61.2	25.4	5.2	8.2	LS	29	0.05	6.3	5.2	0.5	0.02	14.5	15.4	1.4	1.0	0.1	0.3	2.8	0.7	104	5.0
	21-37	64.9	22.4	5.2	7.5	LS	26	0.05	6.5	5.1	0.4	0.01	23.2	18.4	1.4	1.2	0.1	0.1	3.7	0.8	76	3.5
	37-73	2.6	24.8	29.5	43.1	C	91	0.11	6.8	5.2	1.7	0.06	16.4	12.3	18.9	14.8	1.0	0.4	37.7	1.8	93	2.7
	73-117	2.7	17.7	31.4	48.2	C	87	0.14	6.9	5.4	2.2	0.10	12.8	11.6	22.5	16.8	1.2	0.6	39.2	1.9	105	3.0
	117-150	1.6	37.6	26.7	34.1	CL	96	0.18	7.2	5.7	0.9	0.02	26.1	18.2	12.4	12.3	1.2	0.6	26.8	0.8	99	4.5
GX0104	0-20	2.4	6.8	35.7	55.1	C	74	0.14	6.5	4.8	2.7	0.11	14.2	58.9	17.5	18.5	2.0	1.0	42.6	3.5	92	4.6
	20-90	3.6	5.1	32.6	58.7	C	59	1.84	6.6	5.4	2.1	0.06	20.3	19.0	7.9	8.3	7.8	0.3	48.0	2.1	51	16.2
	90-160	1.0	1.9	32.5	64.6	C	66	2.82	7.5	6.3	1.2	0.03	23.2	2.4	17.8	22.7	7.6	0.4	38.3	0.2	127	19.9
GX0105	0-10	15.3	2.2	22.2	60.3	C	13	0.43	5.6	4.4	6.6	0.36	10.6	11.3	18.2	20.8	1.9	1.0	48.9	10.3	86	4.0
	10-45	0.9	1.8	17.9	79.4	C	67	0.96	6.6	5.4	2.6	0.11	13.7	1.9	23.2	24.5	4.6	0.6	48.7	2.5	108	9.4
	45-75	0.5	0.6	13.6	85.3	C	55	2.44	7.7	6.5	1.8	0.06	17.4	1.4	24.6	26.8	8.9	0.6	47.5	0.3	128	18.8
	75-150	0.5	0.5	11.9	87.1	C	50	4.62	7.5	6.5	1.0	0.02	29.0	3.8	23.6	27.4	11.7	0.6	46.8	19.7	135	25.1
GX0106	0-20	76.0	6.0	14.7	3.3	LS	7	2.00	5.6	4.9	59.2	0.84	40.9	9.5	32.8	31.7	8.2	0.6	93.6	25.6	78	8.7
	20-50	71.3	2.0	14.1	12.6	SL	3	2.16	5.1	4.5	47.6	0.83	33.3	4.7	21.2	27.0	6.7	0.9	81.5	20.2	68	8.2
	50-80	55.4	7.5	18.8	18.3	SL	12	2.07	5.4	4.8	45.9	0.82	32.5	6.9	30.2	33.1	6.8	1.0	24.3	19.9	293	28.0
	80-100	33.0	2.9	22.8	41.3	C	8	1.83	5.7	5.1	34.4	0.82	24.3	8.5	28.4	31.8	5.2	1.3	72.0	13.3	93	7.3
GX0107	0-10	7.6	2.4	11.4	78.6	C	24	3.12	5.6	4.8	6.2	0.29	12.4	13.0	25.1	27.9	8.1	2.5	61.8	8.1	103	13.1
	10-30	0.4	2.4	7.1	90.1	C	86	2.25	5.4	4.5	2.3	0.09	14.8	26.6	23.6	23.9	5.5	1.6	60.9	6.8	90	9.0
	30-77	0.2	2.9	15.8	81.1	C	94	1.14	5.4	4.3	1.0	0.02	29.0	18.4	19.3	19.6	1.9	1.3	46.9	5.1	90	3.9
GX0090	0-33	5.6	0.7	21.1	72.6	C	11	0.53	7.1	5.8	5.0	0.24	12.1	19.0	23.1	24.3	4.6	1.5	57.4	2.3	93	8.0
	33-45	0.5	0.7	13.6	85.2	C	58	1.40	7.7	6.2	3.1	0.14	12.8	3.2	21.4	25.3	8.9	1.1	52.2	0.6	109	17.1
	45-100	0.2	0.5	16.1	83.2	C	71	4.13	7.5	6.4	1.5	0.04	21.8	3.9	17.0	21.9	12.6	0.9	49.5	0.1	106	25.4
	100-160	0.2	0.4	17.7	81.7	C	67	6.07	7.4	6.5	1.6	0.06	15.5	5.4	16.8	20.8	14.0	0.9	52.1	0.1	101	26.9
GX0091	0-20	1.7	27.5	33.5	37.3	CL	94	0.19	6.3	5.1	2.9	0.13	12.9	58.3	13.4	11.7	0.1	1.7	28.9	2.6	93	0.3
	20-50	1.4	9.8	36.2	52.6	C	88	0.16	6.5	5.0	2.0	0.09	12.9	18.0	19.7	17.3	0.2	0.9	38.0	2.5	100	0.5
	50-70	0.7	10.3	41.5	47.5	SiC	94	0.18	6.8	5.3	1.2	0.06	11.6	4.5	17.9	17.2	0.2	0.7	33.4	1.4	108	0.4
	70-95	0.9	43.4	25.6	30.1	CL	98	0.13	7.1	5.4	0.6	0.02	17.4	3.1	12.7	12.1	0.1	0.2	27.0	0.8	93	0.5
	95-150	0.4	50.2	26.0	23.4	SCL	99	0.15	7.2	5.6	0.5	0.03	9.7	5.7	11.3	10.0	0.1	0.3	24.4	1.2	89	0.4
GX0092	0-18	16.7	0.6	14.1	68.6	C	3	1.50	6.6	5.8	4.6	0.33	8.1	3.5	21.4	26.7	6.5	1.9	57.2	3.0	99	11.4
	18-44	7.2	0.8	17.3	74.7	C	10	2.27	7.0	6.0	3.8	0.23	9.6	2.4	19.8	26.4	9.9	1.5	55.8	1.9	103	17.7
	44-64	1.6	0.8	14.2	83.4	C	33	3.39	7.0	5.9	2.5	0.10	14.5	1.0	17.6	24.0	12.2	1.5	46.9	0.3	118	26.1
	64-85	2.0	1.0	10.5	86.5	C	33	2.49	7.0	5.9	2.0	0.06	19.3	2.4	15.7	23.4	4.5	1.4	48.7	2.9	92	9.3
	85-120	78.9	16.8	0.9	3.4	S	18	0.21	7.5	6.4	0.1	0.01	5.8	0.7	1.6	1.7	0.4	0.1	2.0	0.9	183	20.1
GX0093	0-10	42.8	1.7	22.4	33.1	SCL	4	2.65	4.5	3.8	26.9	0.46	33.9	6.8	12.4	17.0	6.0	1.5	45.4	20.6	81	13.3
	10-25	24.5	4.1	23.2	48.2	C	14	2.87	4.4	3.7	5.8	0.36	9.3	3.5	12.5	16.9	6.3	0.7	45.2	18.1	81	13.9
	25-45	0.9	1.7	14.6	82.8	C	65	3.08	4.3	3.6	3.3	0.12	16.0	1.0	14.0	20.3	7.5	0.6	46.5	13.4	91	16.1
	45-63	1.7	2.4	17.2	78.7	C	59	2.80	4.8	4.1	2.5	0.08	18.1	1.0	16.9	18.8	6.5	0.6	46.6	9.3		14.0
	63-90	32.8	8.4	20.6	38.2	CL	20	1.34	4.8	3.9	0.8	0.03	15.5	0.8	10.2	8.2	2.3	0.6	21.9	4.7	97	10.3

	Depth cm	Coarse sand (Co)	Fine sand (F)	Silt	Clay	Textur Class	Sand ratio F/F&Co	CE (1:2.5) dS/m	pH H2O	pH KCl	O.M %	N total %	C/N	P. Olse ppm	Ca meq/100g	Mg meq/100g	Na meq/100g	K meq/100g	CEC pH 7 meq/100g	H+Al pH 7	B.S %	Na/CEC
GX0094	0-10	8.3	3.7	25.4	62.6	C	31	16.31	7.4	7.0	3.7	0.15	14.3	13.3	10.5	31.1	47.3	3.5	43.3	0.3	214	109.3
	40-50	1.1	2.8	26.5	69.6	C	72	11.83	7.2	6.5	1.8	0.07	14.9	17.0	9.1	27.6	36.7	2.8	41.7	1.1	183	88.1
	100-120	2.3	1.8	34.0	61.9	C	44	10.70	7.3	6.7	4.4	0.13	19.6	9.3	9.3	25.7	31.7	3.3	33.5	0.1	208	94.5
GX0095	0-25	31.0	28.0	15.1	25.9	SCL	47	0.46	5.7	4.6	4.4	0.17	15.0	3.5	9.3	5.7	1.2	0.6	17.3	5.1	96	6.9
	25-50	49.4	35.4	7.0	8.2	LS	42	0.47	5.0	4.3	4.5	0.09	29.0	2.6	5.0	2.3	0.6	0.2	8.7	4.8	93	7.0
	50-100	91.8	6.2	0.8	1.2	S	6	1.66	3.4	3.3	2.2	0.04	31.9	0.5	0.7	0.7	0.3	0.1	1.7	3.4	103	16.5
GX0096	0-13	7.9	1.6	25.8	64.7	C	17	15.50	7.3	6.9	4.2	0.19	12.8	32.6	9.9	30.5	48.0	5.0	44.8	0.1	209	107.3
	13-38	6.3	1.1	25.6	67.0	C	15	17.40	7.4	7.0	4.5	0.16	16.3	25.1	12.3	32.2	79.3	5.4	48.2	0.2	268	164.4
	50-120	10.5	0.7	27.0	61.8	C	6	18.90	7.4	7.0	4.8	0.15	18.6	24.1	11.3	31.8	82.9	5.9	44.0	0.1	300	188.4
GX0097	0-30	70.9	8.0	17.1	4.0	LS	10	0.50	4.3	3.4	55.5	1.17	27.5	16.0	2.3	2.9	1.5	1.3	66.7	46.5	12	2.2
	30-60	81.8	8.2	8.9	1.1	S	9	1.10	4.2	3.4	69.1	1.04	38.5	9.0	4.2	6.6	1.6	0.7	78.5	49.6	17	2.1
	60-100	78.3	12.6	8.9	0.2	S	14		4.3	3.5	75.4	1.11	39.4	7.2	7.1	14.5	1.9	0.5	75.7	36.8	32	2.6
GX0098	0-30	55.8	13.4	26.1	4.7	SL	19	0.44	4.9	3.8	50.0	1.27	22.8	12.7	5.1	5.2	1.3	0.7	65.7	44.2	19	2.0
	30-64	65.2	15.9	17.9	1.0	LS	20	1.24	4.2	3.5	67.0	1.12	34.7	7.2	8.6	10.3	1.8	0.4	80.9	49.5	26	2.2
	64-94	62.5	16.7	16.6	4.2	LS	21	3.22	4.1	3.6	67.7	1.04	37.8	4.6	16.9	19.5	2.2	0.6	90.7	66.8	43	2.4