

Soil Mapping and Advisory Services

Botswana

**SOILS AND LAND SUITABILITY
FOR ARABLE FARMING OF
SOUTH-EAST CENTRAL DISTRICT**



FOOD & AGRICULTURE
ORGANIZATION OF THE
UNITED NATIONS



UNITED NATIONS
DEVELOPMENT
PROGRAMME



REPUBLIC OF
BOTSWANA

GABORONE, 1989

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Field Document 7
Annex 1

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FARMING OF SOUTHEAST CENTRAL DISTRICT

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Food and Agricultural Organization of the United Nations
United Nations Development Programme
Republic of Botswana

Gaborone, 1989

The conclusions given in this report are those considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages of this project.

The definitions employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Food and Agricultural Organization of the United Nations concerning the legal or constitutional status of any country, territory or sea area or concerning the delimitation of frontiers.

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1 METHODS

1.1 Soil Chemical Analysis

Methods of soil chemical analysis are fully described and discussed by Breitbart (1987). Short description of the methods used are as follows:

pH determination

Two pH values are determined, pH-H₂O and pH-CaCl₂. For the latter a 0.01N solution is used. Soil suspension ratio is 1:2.5. Values are determined electrometric with an "onion" Ag/AgCl electrode and a Zeiss 300 pH meter.

Electrical conductivity

EC is determined in a soil/water suspension of 1:5, only for samples with a pH>7. A Philips PW9506 conductivity meter is used.

Phosphorus

Extractable phosphorous is determined following the Bray and Kurtz (1945) method. The extracting solution is 0.03N NH₄F in 0.025N HCL. P concentration is determined colorimetrically with a modification of the molybdenum blue method of Diekmann and Bray (1940) at 660nm.

Oxidizable organic carbon (organic matter)

In order to obtain results with a better reproducibility, the original Walkley and Black (1934) method was modified. A solution of 3.4N sodium dichromate (Na₂Cr₂O₇) in 10N H₂SO₄ is added to the soil and heated for 1h to 150±5°C. The green colour of Cr³⁺ is determined colorimetrically at 570nm. A standard curve is prepared with glucose.

CEC by ammonium acetate method pH 7.0

This procedure is based on the method of Peech et al. (1947). It has been modified by the USDA National Soil Survey Laboratory for use with 24 place automatic extractors. Soil is leached with ammonium acetate to remove exchangeable cations and to saturate the exchange sites with the ammonium ion. The excess ammonium is removed by leaching with ethanol and the remaining exchangeable ammonium ion is removed by distillation and determined by titration.

Exchangeable cations

Na, K, Ca and Mg are determined with a Varian atomic absorption spectrometer.

Particle-size determination

Clay and silt fraction:For the particle-size distribution of the clay and silt fractions both the pipette method and the hydrometer method are used. The pipette method is more accurate than the hydrometer method, but the output is much higher with the latter. 24 analyses versus 6 are possible per day, for this reason the routine analyses is carried out with the hydrometer method.

Sand fraction:Particles coarser than 50µ are segregated by dry sieving. The sandfraction is divided into five subfractions, following the USDA system: 2000-1000µ, 1000-500µ, 500-250µ, 250-100µ, 100-50µ. Clay and silt are separated from the sand fraction by wet sieving through a 50µ sieve. The sand fraction is dried in an oven before sieving.

With the pipette method the clay and silt fraction is washed into sedimentation cylinders for determination. With the hydrometer method, clay and silt are determined within the complete sample. The sand fraction is separated after the determination, clay and silt are discarded.

Pretreatment and dispersion: Soils which contain considerable amounts of organic matter, soluble salts or gypsum, may not disperse adequately. These components are removed first by treating the soil with hydrogenperoxide to destroy the organic matter and, if applicable, filtration and washing with enough water to dissolve soluble salts and gypsum. For dispersion samples are shaken for more than 12 hours in a dilute alkaline solution of sodium hexametaphosphate. According to Tyner (1940) and Kilmer and Alexander (1949) mixtures of sodium hexametaphosphate and sodium carbonate have proved to disperse also calcareous soils without prior removal of alkaline earth carbonates.

Pipette method: This method was adopted in 1929 by the International Society of Soil Science (Intern. Soc. Sci, 1929). The pipette method for particle-size analyses is a sedimentation procedure which utilizes pipette sampling at controlled depths and times, calculated with Stokes' equation. The determination is performed in a constant temperature waterbath controlled to $\pm 0.5^{\circ}\text{C}$.

Hydrometer method: The hydrometer method is a sedimentation procedure for clay and silt, introduced by Bouycous (1926, 1927). The hydrometer method, like the pipette method, depends fundamentally upon Stokes' equation. The determination is performed in a constant temperature bath controlled to $\pm 0.5^{\circ}\text{C}$.

1.2 Soil physical analysis

Infiltration: The double ring infiltration method is used to measure the water intake characteristics of soils. Open ended cylinders of diameter 25-35 cms and height 30cms are driven into the soil to a depth of 15cms. Around each cylinder, another cylinder larger in diameter is driven concentrically into the soil to the same depth. The intake of water in the inner cylinder is measured for progressively increasing time intervals while keeping the space between the inner and outer cylinder always ponded with water. At each site three to five replicate measurements are made (for detailed procedures see reference No 1).

Bulk density: Bulk density is determined by obtaining an undisturbed soil sample of known volume (100cc) and dividing the oven dry soil mass by the field volume of the sample. Stainless steel cylinders of diameter 5cms and height 5 cms are driven into the soil by a heavy hammer to obtain the cylindrical undisturbed core samples. Five replicate measurements are made for each soil horizon. (for detailed procedure see reference No 1).

Soil moisture retention: Soil moisture characteristics (moisture retention) are done on undisturbed soil core samples for tensions between 0.03 bar and 1.0 bar and on 2mm sieved samples for tensions between 5 bars and 15bars. For tensions of 0.03 bar and 0.05 bar, hanging water column technique, using a sand table is used. For higher tensions, a pressure plate apparatus is used. Generally moisture contents are measured at 0.03, 0.05, 0.1, 0.3, 1.0, 3.0, 5.0 and 15. bar tensions in duplicate.

Structural stability index

The relative structural stability of soils to wetting is assessed by comparing the degree of collapse of samples of air dried soils when rapidly wetted as opposed to slow wetting under a tension. The degree of collapse is estimated by the relative change in pore-size distribution which in turn is determined from the moisture release characteristics.

Air dry sieved soil samples of 50cc volume and size range between 1mm and 2mm are placed in two sintered glass Buchner funnels connected to burettes by flexible tubing. One sample is wetted slowly at a tensions of 10cms of water for 24 hours. The second sample is wetted fast by raising the water level in burette to saturate the soil. After both samples have been equilibrated at zero tension, moisture release at different tensions are measured by lowering the burettes and noting the increase in volume of water in the burettes (for detailed procedures see reference No 2).

References

1. Methods of soil analyses. American Society of Agronomy Monograph 9 (1965)
2. Drainage testing, FAO Irrigation and Drainage paper No 28 (1976)

1.3 Survey Methods

The used procedures, methods, formats and organization of the survey are summarized in the following sections.

Mapping scale

The category of mapping chosen is reconnaissance mapping at a scale of 1:250.000. The maps are produced on a regular sheet by sheet basis, following the lay-out of the topographical maps at that scale. The topographical sheets 1:250.000 used are Serowe, Palapye, Lephepe and Mahalapye.

Aerial Photography

Air photos were available for almost the whole area, in large blocks of photos, mostly at scale 1:50.000, but also at 1:40.000 and 1:70.000. From the following blocks over a thousand photos were interpreted and used:

1971 Motloutse block, for the area north of 23°S

1975 SE block, for the area south of 23°S

(both the Motloutse and SE block were re flown in 1981/82 and used in the last phase of the survey)

1974 Eastern Kalahari block

1970 Shoshong-Mahalapye special block

Part of the block overlap. Especially the Motloutse and SE blocks were studied intensively, using a stereoscope. The interpretation alone enabled the determination of relevant physiographic units, including aspects of soils, geology and hydrology.

Satellite imagery

Landsat or other satellite imagery is extremely useful in semi-arid countries as Botswana, which have a relatively thin vegetation cover. Some of the advantages are:

- (1) synoptic view (comprehensive view of 185x185km per full image)
- (2) planimetric view (facilitates direct mapping on a reliable base map)
- (3) sequential coverage (repetition every 18 days). Images can be selected for the most appropriate seasons.

Landsat images proved indispensable in this reconnaissance soil survey. A large number of different frames and dates were used. Initially only black and white prints of various bands and standard color composites were available, but their usefulness was rather limited. Also the use of a colour additive viewer with 70mm 'chips' was disappointing. In a later stage systematically corrected and edge enhanced colour composites at scale 1:250.000 were used which strongly improved the interpretation.

Through the kind cooperation of the International Training Institute in Enschede, the Netherlands, the opportunity was given to try to establish automatic classification using a CCT from Botswana (Shoshong area). After the geometrical and image corrections and optronic stretch, the principal component transform method was started, but after the feature space plotting a high band similarity appeared and the procedure was stopped. Some useful results and enhanced images were obtained, but the classification itself was not promising enough to continue.

Interpretation of Landsat imagery and aerial photography

Stage 1 Preliminary interpretation .

Landsat is at the same scale as the final soil maps. The photos are more useful for precise location of the observation points in the field. The interpretation includes the use of geological maps and other data. The first field reconnaissance, mainly follows transects. The first aim is the identification of the main physiographic units and major soil groups, and the relation with the vegetation.

Stage 2 Reinterpretation, using the results of the first field trips. In the first survey areas this is the most important interpretation phase, but in the later stages of the survey there is more experience with the Landsat patterns and the first interpretation very often needs only little modification. This is the main field routine phase, with ground truth checking of as many of the soil mapping units as possible. Of course, not all of them can be checked, and selection depends of confidence in extrapolation and on accessibility, but also on time available.

Stage 3 Final interpretation and field check.

This may be necessary when soil patterns are very complex, or when the analytical results do not confirm the field data.

Stage 4 Finalization of the first draft map on a transparent overlay on the Landsat 1:250.000 image. This includes the final check of all mapping units and boundaries.

Stage 5 Final construction of the map legend and soil mapping units. Symbols are placed in all mapping units. This stage includes the matching of soil unit classification and analytical data.

Stage 6 Transfer of the draft soil map on Landsat to the 1:250.00 topographical base map, which has been amended by the surveyor for roads and other relevant topographical features. The final draft is now ready for production by the cartographer.

Routine soil description and storage

The method of describing soil profiles is according to the Botswana Soil Database - Guidelines for Soil Profile Description (Rommelzwaal and Van Waveren, 1988), which is based on the Guidelines for Soil Description (FAO, 1974). Colours were described using the Munsell Soil Color Charts (1975)

All data, including analytical results, are stored in the Botswana Soil Database.

Field Methods

The procedure in the 1:250.000 reconnaissance soil mapping is the free survey method, which is largely based on the recognition of physiographic patterns. The selection of observation points is to a great deal determined by accessibility. In the hardveld accessibility is generally fairly good, but in the sandveld relatively few tracks exist. However, the variety of soils in the sandveld is not great, and therefore less observations are needed. To a certain extent cross country traveling on transects was applied, but location becomes problematic when the vegetation is dense or when there are few recognizable features in the landscape.

Soil observations were done from pits that were dug, from existing exposures in borrow pits and gullies and from augerings or combinations of pits and augerings. During the extended dry periods in the previous drought years, it was often not possible to make augerings, due to the hardness and compaction of the soil.

The number of described and registered observations is about 1500, but the total number including the short observations, mainly for boundary checks and recorded only in the logbooks, is much higher. The density of observation is about 1 per 10km² but this varies strongly over the different regions, from no more than 1 observation per 100 km² in sandveld areas to 1 per km² in detailed surveyed areas.

When executing a soil survey, one should bear in mind the size of areas that can still be represented on the final soil map. Vink (1963) gives as the smallest reproducible mapping unit, the basic mapping unit of 5x5mm or 10x2.5mm (25mm²). He also indicates the number of observations per km² for various scales. Forbes, Rossiter and Van Wambeke (1982) suggest a minimum legible area on the map of 40mm², which is 2.5km² on a 1:250.000 map. The implication is that areas smaller than about 1.5 x 1.5km cannot be represented on the final map. Elongate mapping units have a maximum width of 500m. sometimes features important for location, such as hills or pans are included.

2 SOIL PROFILE DESCRIPTIONS AND ANALYTICAL RESULTS

2.1 Introduction

Following soil profiles have been selected as representative for the soil units occurring in the study area. A complete set of soil profiles for SE Central District is stored in the National Soil Database.

Soil Unit	Profile No	Soil Classification (FAO, 1974)
A1	SH-0901	Pellic Vertisol, sodic phase
A5b	SH-0014	Orthic Solonetz
A6	M-0330	Solodic Planosol
A9	MC-0065	Calcic Luvisol
A11	PS-0010	Ferric Luvisol
A11	MC-0010	Ferric Luvisol
A11a	MC-0058	Ferric Luvisol
A16	S-001	Eutric Nitosol
A22a	BS-0100	Cambic Arenosol
A36	TC-0004	Luvic Xerosol
B06	SH-0016	Eutric Nitosol
C01a	D-0041	Rendzina, shallow petrocalcic phase
D3	SH-0005	Ferric Acrisol
D5b	PS-0901	Ferric Luvisol
D7c	MC-0037	Ferric Acrisol, petroferric phase
G02	M-0201	Dystric Regosol, petroferric phase
G03d	M-0901	Ferric Luvisol, shallow petric phase
G03	M-0099	Albic Arenosol, petroferric phase
G04	SH-0006	Ferralic Acrisol, petroferric phase
G06	TS-0003	Arenic Ferric Luvisol
G06a	M-0224	Ferric Luvisol
G08	TS-0007	Chromic Luvisol
G09	M-0083	Chromic Luvisol
G11	M-0361	Plinthic Luvisol
G12	M-0362	Gleyic Luvisol
G13a	MC-0901	Calcic Luvisol, petrocalcic phase
G14	SH-0902	Eutric Nitosol
G15	M-0295	Solodic Planosol
(K)S3	DI-0901	Ferralic Arenosol
(K)S5	S-0010	Ferralic Arenosol
S5	S-0002	Ferralic Arenosol
S6	S-0013	Ferralic Arenosol
S7	S-0507	Arenic Ferric Luvisol
S9	S-0011	Arenic Ferric Luvisol
S11	S-0512	Arenic Eutric Nitisol
S17	S-0006	Eutric Arenosol

SOIL PROFILE DESCRIPTION				Profile: SH 0901	Unit: A01	Status: 1
SHEET : 2326B1 LOCATION : 16km SE of Shoshong, 2km E of Bonwapitse bridge. AUTHOR(S): A.B.Price M.D.Mays CLASSIFICATION FAO: Grumi-Pellic Vertisol(1988) Pellic Vertisol (1974) sodic phase ST : Typic Pellustert ; fine montmorillonitic hyperthermic LANDFORM : alluvial plain TOPOGRAPHY: flat SURF. CHAR: no sealing, cracks 2 cm wide, nil evidence of salt, LAND USE: traditional grazing SPECIES : Trees - Acacia tortilis subs. heterocantha (dom.) : Shrubs - Acacia mellifera (dom.) Acacia grandicornuta Acacia tenuispina Acacia nilotica : Grasses/forbs- PARENT MATERIAL: alluvium MOIST. COND: slightly moist 0 - 200 cm SURF. STONES: none EROSION : slight sheet erosion						
GRID : ME-618-420 COORD: 23-07-50-S 26-37-40-E DATE : 16/03/86 LAND ELEMENT : not applicable MICRO TOPOGRAPHY: low gilgai VEGETATION: savanna AGRO CLIM.ZONE: ID3 ELEVATION : 1025 m SMR: aquic to ustic POSITION: intermediate part SLOPE : 0 - 0.5% GRASSCOVER: 30 - 70 % GEOL.UNIT: DRAINAGE : imperfectly to poorly drained HUMAN INF: nil						
REMARKS: USDA Pedon no.1 with modifications A.Remmelzwaal. Excursions site FAO EASC meeting 3-4-87. Cracks 1cm wide to 57cm. Savanna alternates from open low shrub to dense with high - shrubs, few trees in general. Cmk horizon cemented but not indurated.						
SAMPLES:	A: 0 - 6	B: 6 - 20	C: 20 - 57	D: 57 - 90	E: 90 - 130	F: 131 - 160
					G: 160 - 188	H: 188 - 200
A1	0 - 6 cm	10YR 3/1 (moist) and 10YR 3.5/1 (dry), clay, moderate fine and medium granular structure, hard firm, very sticky very plastic, common very fine and fine pores, very few fine spherical hard calcareous white nodules, slightly calcareous, few very fine and fine roots, abrupt wavy boundary.				
A2	6 - 20 cm	10YR 3/1 (moist) and 10YR 3.5/1 (dry), clay, moderate medium prismatic falling apart into moderate medium subangular blocky structure, hard firm, very sticky very plastic, common very fine and fine pores, very few fine spherical hard calcareous white nodules, strongly calcareous, few very fine roots, clear wavy boundary.				
B1	20 - 57 cm	10YR 3/1 (moist) and 10YR 3.5/1 (dry), clay, moderate to strong coarse prismatic falling apart into moderate to strong coarse angular and subangular blocky structure, extremely hard very firm, very sticky very plastic, continuous partly intersecting slickensides on pedfaces, few medium pores, very few fine spherical hard calcareous white nodules, strongly calcareous, few fine and medium roots, diffuse wavy boundary.				
B2	57 - 90 cm	10YR 3/1 (moist) and 10YR 3.5/1 (dry), clay, weak to moderate coarse prismatic falling apart into moderate coarse wedge shaped angular blocky structure, extremely hard very firm, very sticky very plastic, continuous partly intersecting slickensides on pedfaces, few fine pores, very few fine spherical hard calcareous white nodules, strongly calcareous, few very fine and fine roots, diffuse wavy boundary.				
B3	90 - 160 cm	10YR 3/1 (moist) and 10YR 3.5/1 (dry), clay, moderate coarse and very coarse wedge shaped angular blocky structure, extremely hard very firm, very sticky very plastic, continuous intersecting slickensides on pedfaces, few fine pores, very few fine spherical hard calcareous white nodules, strongly calcareous, few very fine and fine roots, gradual irregular boundary.				
B4	160 - 188 cm	10YR 3/2 (moist) and 10YR 3.5/2 (dry), clay, weak to moderate medium and coarse angular and subangular blocky structure, extremely hard firm, very sticky very plastic, patchy slickensides on pedfaces, few fine pores, frequent fine spherical soft calcareous white nodules, strongly calcareous, very few very fine and fine roots, abrupt wavy boundary.				
Cmk	188 - 200 cm	10YR 8/1 (moist) and 10YR 8/2 (dry), strongly coherent massive structure, extremely hard extremely firm, cemented, extremely calcareous, very few very fine roots,				

STANDARD SOIL ANALYSIS RESULTS

PROFILE: SH 0901

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)						CECclay	MEH	PRETR
		H2O CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	
A	0	8.3	7.6	3	0.9	41.0	38.1	10.4	1.5	0.3	>100	8	9	4	7	9	1	8	54	
B	6	8.1	7.6	2	0.9	46.8	44.9	13.0	0.9	0.6	>100	11	9	3	6	8	5	6	52	
C	20	8.4	7.8	1	0.7	54.3	50.6	18.1	0.7	2.2	>100	11	8	3	4	6	2	5	60	
D	57	8.1	7.8	1	0.7	58.8	46.5	25.4	1.0	4.3	>100	8	8	3	4	6	2	7	62	
E	90	7.8	7.6	1	0.7	63.0	52.1	26.9	1.1	6.0	>100	5	6	3	4	5	3	4	70	
F	131	7.7	7.7	1	0.5	59.8	72.8	27.7	1.3	6.7	>100	7	5	2	3	5	1	8	70	
G	160	7.9	7.7	1	0.3	57.7	46.2	29.5	1.2	7.4	>100	4	4	2	3	5	4	0	78	
H	188	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	

Soil Survey of Botswana FAO/BOT/85/011

Print date: 25/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PHYSICAL PROPERTIES

PROFILE: SH 0901

INFILTRATION

No. Basic (cm/hr) a n

1	0.0	0.00	0.00
2	0.0	0.00	0.00
3	0.0	0.00	0.00

METHODS.

Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F = at^n$ where F = cumulative infiltration (cm) and t = elapsed time (min)

Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core

Moisture Retention: Tension ≤ 1 bar on core or clods; Tension > 1 bar on < 2 mm crushed samples

Structural Stability Index: on > 1 mm sieved samples < 2 mm of surface soil, relative collapse larger pores on slow & fast wetting

SURFACE STRUCTURE STABILITY INDEX: 0.00

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)				
			0.03bar	0.05bar	0.1bar	0.3bar	1.0bar 3.0bar 5.0bar 15.0bar
B	6 20	1.20	CL	40.10	36.90		21.1
C	20 57	1.25	CL	39.70	36.30		22.7
D	57 90	1.21	CL	43.10	39.30		25.4
E	90 131	1.14	CL	44.40	40.10		32.7
F	131 160	1.09	CL	53.60	47.70		35.8
G	160 188	1.00	CL	60.20	53.90		36.7
H	188 200	0.00					7.9

REMARKS: used clods for moisture retention

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Print date: 26/01/89

SOIL PROFILE DESCRIPTION

Profile: SH 0014 Unit: A05b Status: 1

SHEET : 2326A2
LOCATION : 8km SW of Shoshong (Palamaokwe).
AUTHOR(S): A. Remmelzwaal
CLASSIFICATION FAO: Calcic Solonetz(1988) Orthic Solonetz (1974)
ST : Aquic Natrustalf
LANDFORM : plain
TOPOGRAPHY: flat
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: traditional dryland farming
SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-
PARENT MATERIAL: alluvium
MOIST. COND: dry 0 - 55 , slightly moist 55 - 120 cm
SURF. STONES: none
EROSION : nil

GRID : ME-481-499
COORD: 23-03-36-S 26-26-36-E
DATE : 20/11/80
LAND ELEMENT : depression
MICRO TOPOGRAPHY: even
VEGETATION:
GRASSCOVER:
POSITION: intermediate part
SLOPE : 0 - %
SMR: ustic
AGRO CLIM.ZONE: 1D3
ELEVATION : 1095 m

ROCK TYPE:
ROCK OUTCROP: none
GEOL. UNIT:
DRAINAGE : imperfectly drained
HUMAN INF: ploughing

11

REMARKS:

SAMPLES: A: 0 - 15 B: 25 - 40 C: 55 - 65 D: 90 - 110

Ap 0 - 15 cm 10YR 3/2 (moist) and 10YR 4/2 (dry), sandy clay, moderate fine to coarse subangular blocky structure, hard friable, many very fine and fine pores, strongly calcareous, few roots, clear smooth boundary.

Btkn 15 - 50 cm 10YR 3/2 and 10YR 4/3 mottled (moist), clay, strong very coarse prismatic falling apart into moderate to strong very coarse angular and subangular blocky structure, very hard, continuous thick clay cutans on pedfaces, common very fine and fine pores, frequent coarse irregular soft calcareous white nodules, strongly calcareous, very few roots, clear smooth boundary.

Btn 50 - 75 cm 10YR 4/3 (moist) and 10YR 5/3 (dry), clay, moderate very coarse prismatic falling apart into moderate very coarse angular and subangular blocky structure, very hard, continuous thick clay cutans on pedfaces, common very fine and fine pores, few coarse irregular soft calcareous white nodules, strongly calcareous, very few roots, clear smooth boundary.

BCckn 75 - 120 cm 10YR 6/2 and 10YR 4/6 mottled (moist), sandy clay, massive structure, hard firm, few fine pores, frequent coarse irregular hard calcareous white nodules, strongly calcareous, no roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: SH 0014

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)						CECclay	METH	PRETR			
												weight %	-----	-----	-----	-----	-----				-----	-----	-----
		H2O	CaCl2	mS/cm	ppm	weight %	----- <td>meq/100gr</td> <td>soil</td> <td>-----<td>%</td><td>vcS</td><td>cS</td><td>mS</td><td>fS</td><td>vfs</td><td>cSi</td><td>fSi</td><td>Clay</td><td>meq/100gr</td><td></td><td></td></td>	meq/100gr	soil	----- <td>%</td> <td>vcS</td> <td>cS</td> <td>mS</td> <td>fS</td> <td>vfs</td> <td>cSi</td> <td>fSi</td> <td>Clay</td> <td>meq/100gr</td> <td></td> <td></td>	%	vcS	cS	mS	fS	vfs	cSi	fSi	Clay	meq/100gr			
A	0 15	8.6	7.7	0.2	4	0.6	26.4	17.6	8.0	1.1	1.4	100	4	20	16	11	7	1	2	40	60	H	A
B	25 40	9.3	8.4	0.3	1	0.4	26.1	23.4	11.9	0.6	7.7	100	4	14	10	8	6	1	6	51	48	H	A
C	55 65	9.1	8.6	0.5	2	0.3	30.0	20.0	12.3	0.9	10.9	100	1	9	12	10	3	4	1	59	49	P	A
D	90 110	0.1	8.6	0.5	2	0.1	23.8	17.2	11.3	0.8	9.6	100	2	12	16	14	7	9	3	37	63	P	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION		Profile: M 0330	Unit: A06	Status: 2
SHEET : 2226D1 LOCATION : Mokgware Plain; 6km NE of Mokgware hills. AUTHOR(S) : A.Remmelzwaal B.G.Moganane CLASSIFICATION FAO: Albi-Abrupti--Stagnic Solonetz(1988) Solodic Planosol (1974) ST : Typic Natrustalf				
LANDFORM : escarpment TOPOGRAPHY: undulating SURF. CHAR: no cracks, nil evidence of salt, LAND USE: traditional grazing SPECIES : Trees - Acacia nigrescens (dom.) Combretum apiculatum : Shrubs - Euclea undulata (dom.) Dichrostachys cinerea : Grasses/forbs-				
PARENT MATERIAL: colluvium over in situ weathered MOIST. COND: dry 0 - 165 cm SURF. STONES: none EROSION : moderate gully erosion and moderate sheet erosion				
REMARKS: Profile eroded. Natric horizon marginal. On top of Bt1 horizon 2cm white layer sand/silt and interfingering of albic material 2-10mm thick in cracks down to base of Bt1, also uncoated sandy silt on vertical pedfaces in upper part Bt1 horizon.				
SAMPLES: B: 15 - 35 A: 15 - 35 C: 95 - 115 D: 135 - 155 E: 0 - 0				
E	0 - 35 cm	10YR 5/3 (moist) and 10YR 7/2 (dry), loamy sand, weakly coherent massive structure, slightly hard very friable, common fine pores, very few fine quartz rock fragments, strongly calcareous, common roots, abrupt smooth boundary.		
Bt1	35 - 90 cm	10YR 4/3 (moist) and 10YR 5/3 (dry), sandy clay, weak very coarse columnar weak coarse subangular blocky structure, very hard, continuous thick clay cutans on pedfaces, common very fine and fine pores, few fine quartz rock fragments, strongly calcareous, few roots, gradual smooth boundary.		
Bt2	90 - 125 cm	10YR 4/3 (moist) and 10YR 5/3 (dry), sandy clay to clay, weak coarse and very coarse subangular blocky structure, broken thick clay cutans, few fine and medium pores, frequent fine quartz rock fragments, very few fine spherical hard manganiferous bluish-black concretions, moderately calcareous, very few roots, clear smooth boundary.		
2Cro	125 - 165 cm	2.5YR 5/2 (moist) and 2.5YR 5/2 (dry), hard friable, very frequent fine and medium granite rock fragments, frequent fine spherical hard manganiferous bluish-black concretions, slightly calcareous, no roots, abrupt wavy boundary.		
2R	165 cm +			
AGRO CLIM.ZONE: 1D3 ELEVATION : 224 m SMR: ustic POSITION: middle slope SLOPE : 3 - 4 % GRASSCOVER: GEOL.UNIT: Mahalapye migmatite DRAINAGE : imperfectly drained HUMAN INF: nil				

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0330

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR						
			mS/cm	ppm	weight %	-----	meq/100gr soil	-----	-----	-----	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr					
B	15	35	8.7	7.9	0.0	0.0	1	0.2	20.4	34.6	4.8	1.4	2.8	100	0	1	10	29	9	8	12	31	46	H	A
A	15	35	8.6	8.1	0.0	0.0	1	0.2	1.9	32.0	2.6	0.2	0.1	100	0	2	19	58	4	2	2	14	9	H	A
C	95	115	7.8	7.6	0.0	0.0	1	0.1	23.4	26.5	4.1	1.3	3.7	100	0	2	5	15	6	10	16	46	50	H	A
D	135	155	6.4	5.9	0.0	0.0	6	0.3	6.3	4.8	0.6	0.7	0.1	98	11	15	18	14	19	7	5	12	42	H	A
E	0	0	6.4	5.9	0.0	0.0	6	0.3	6.3	4.8	0.6	0.7	0.1	98	11	15	18	14	19	7	5	12	44	H	A

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PART SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: MC 0065 Unit: A09 Status: 2

SHEET : 2327B1
 LOCATION : Sefhare village.
 AUTHOR(S): A.Remmelzwaal G.M.Segonetso
 CLASSIFICATION FAO: Calcic Luvisol(1988) Calcic Luvisol (1974)
 ST : Typic Haplustalf
 LANDFORM : alluvial plain
 TOPOGRAPHY: almost flat
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE: disturbed vegetation
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 130 cm
 SURF.STONES: none
 EROSION : nil

GRID : NE-542-537
 COORD: 23-01-33-S 27-31-40-E
 DATE : 29/08/80
 LAND ELEMENT : valley floor
 MICRO TOPOGRAPHY: even
 VEGETATION:
 GRASSCOVER:
 SMR: ustic to aridic
 POSITION: higher part
 SLOPE : 0 - 1 %
 AGRO CLIM.ZONE: 2D3
 ELEVATION : 892 m

ROCK TYPE:
 ROCK OUTCROP: none
 GEOL.UNIT:
 DRAINAGE : moderately well to imperfectly drained
 HUMAN INF: borrow pit

REMARKS: Analytical clay low compared to field estimate, photo. B2 horizon very coarse mottled.

SAMPLES: A: 0 - 20 B: 30 - 50 C: 65 - 85 D: 100 - 120

A 0 - 20 cm 2.5YR 4/2 (moist) and 2.5YR 5/2 (dry), coarse sandy loam, weak medium subangular blocky structure, hard, common very fine and fine pores, slightly calcareous, very few roots, abrupt smooth boundary.

Btk1 20 - 60 cm 2.5YR 4/2 (moist) and 2.5YR 5/2 (dry), sandy clay, moderate very coarse prismatic falling apart into strong very coarse subangular and angular blocky structure, very hard, broken moderately thick clay cutans, common fine pores, very few fine rock fragments, moderately calcareous, very few roots, gradual irregular boundary.

Btk2 60 - 90 cm 2.5YR 5/3 and 2.5YR 4/2 mottled (moist), sandy clay to clay, moderate very coarse prismatic falling apart into weak to moderate very coarse subangular and angular blocky structure, very hard, broken moderately thick clay cutans, few fine pores, very few fine rock fragments, few fine soft calcareous white nodules, moderately calcareous, very few roots, clear wavy boundary.

Btck 90 - 130 cm 2.5YR 5/2 (moist) and 2.5YR 6/2 (dry), sandy clay to clay, weak medium and coarse subangular blocky structure, very hard, patchy moderately thick clay cutans, few fine pores, very few fine rock fragments, frequent medium soft calcareous white nodules, strongly calcareous, no roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: MC 0065

SAMPLE	DEPTH	pH	EC	P	C	weight %	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)										CECclay	METH	PRETR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
													H2O	CaCl2	mS/cm	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil				meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr 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soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr 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Print date: 25/01/89

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: PS 0010 Unit: All Status: 2

SHEET : 2227C1
LOCATION : 4.5km SW of Letseng, along Sherwood road..

AUTHOR(S): G.J.Rhebergen A.Remmelzwaal
CLASSIFICATION **FAO:** Harlic Lixisol(1988) Terric Luvisol (1974)

ST : Kanhaplic Haplustalf

LANDFORM : alluvial plain
TOPOGRAPHY: flat

TOPOGRAPHY: flat
SURF. CHAR: no sealing, no cracks, nil evidence of salt,

TOPOGRAPHY: flat
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing

LAND USE: traditional grazing
SPECIES : Trees - Colophospermum mopane (dom.)

SPECIES : Trees - *Colophospermum mopane* (dom.)
: Shrubs -

- : Shrubs ~
- : Grasses/forbs-

PARENT MATERIAL: alluvium
: Grasses/forbs-

GLASSES/100DS
PARENT MATERIAL: alluvium
MOIST. COND: dry 0 - 100 cm

PARENT MATERIAL: ALLUVIUM
MOIST. COND: dry 0 - 100 cm
SURF STONES: none

SURF. STONES: none
EROSION : nil

SOIL EROSION : nil

REMARKS:

SAMPLES: A: 0 - 20 B: 25 - 45 C: 80 -

A 0 - 20 cm 7.5YR 3/4 (moist) and 7.5YR 4/4 (dry)
common fine and medium roots, clear

Bt1 20 - 50 cm 6YR 3/6 (moist) and 6YR 4/6 (dry), s
clay cutans, common fine and medium

Bt2 50 ~ 100 cm 5YR 3.5/6 (moist) and 5YR 4.5/6 (dry)
clay cutans, common fine and medium

print date: 25/01/85

STANDARD SOIL ANALYSIS RESULTS

PROFILE: PS 0010

SAMPLE	DEPTH	pH	EC	P	C	weight %	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)										CECclay	METH	PRETR
													vcS	cS	mS	fS	vfS	cSi	fSi	Clay					
A	0	7.1	6.4	0.0	2	0.5	6.3	3.4	1.4	0.7	0.0	87	4	12	19	27	19	4	4	18	25	P	A		
B	25	45.9	6.2	0.0	1	0.4	8.3	3.2	2.1	1.1	0.0	77	4	9	16	24	13	2	3	29	23	P	A		
C	80	6.2	5.5	0.0	1	0.2	9.2	3.2	2.3	0.8	0.0	68	3	8	13	21	11	4	1	38	22	P	A		

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Print date: 25/01/89

PART SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: MC 0059 Unit: All Status: 2

SHEET : 2327B1
LOCATION : 1km SE of Sefhare, along Chadibe road.
AUTHOR(S) : A. Remmelzwaal G.J. Rhebergen B.G. Moganane T.D. Mafoko
CLASSIFICATION FAO: Rhodi-Ferric Lixisol (1988) Ferric Lixisol (1974)
ST : Kandic Rhodustalf

LANDFORM : hill
TOPOGRAPHY: undulating
SURF. CHAR: no cracks, nil evidence of salt,
LAND USE: traditional dryland farming
SPECIES : Trees - Combretum apiculatum (dom.) Sclerocarya caffra Acacia erubescens Albizia harveyi
: Shrubs - Grewia flava Grewia bicolor Grewia flavescens
: Grasses/forbs-

PARENT MATERIAL: colluvium

MOIST. COND: dry 0 - 140 cm

SURF. STONES: few stones

EROSION : slight gully erosion and slight sheet erosion

REMARKS: Analytical clay % Bt2 low compared to field estimate (CEC low). photo

SAMPLES: A: 0 - 20 B: 50 - 70 C: 90 - 130

A 0 cm + 2.5YR 3/4 (moist) and 2.5YR 3.5/4 (dry), loamy sand to sandy loam, weak coarse subangular blocky structure, slightly hard, few fine pores, non calcareous, few termite/ant activity, few fine roots, gradual smooth boundary.

Bt1 0 - 35 cm 2.5YR 3/4 (moist) and 2.5YR 3.5/4 (dry), loamy sand to sandy loam, weak coarse subangular blocky structure, slightly hard, few fine pores, non calcareous, few termite/ant activity, few fine roots, gradual smooth boundary.

Bt2 35 - 80 cm 2.5YR 3/8 (moist) and 2.5YR 4/8 (dry), sandy clay loam (25% clay), very weak medium and coarse subangular blocky structure, hard, broken moderately thick clay cutans, few fine pores, few fine rounded slightly weathered quartz rock fragments, non calcareous, abrupt smooth boundary.

C 140 cm + dominant coarse rounded slightly weathered quartzite rock fragments, non calcareous,

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STANDARD SOIL ANALYSIS RESULTS

PROFILE: MC 0059

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
		H2O	CaCL2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
A	0 20	6.3	5.6	0.0	2	0.3	3.4	1.9	0.2	0.3	0.0	71	4	7	18	37	16	8	2	8	27	P	A
B	50 70	6.6	6.1	0.0	2	0.2	3.6	1.7	1.0	0.2	0.1	83	2	6	23	39	12	4	1	13	21	P	A
C	90 130	6.5	5.9	0.0	1	0.2	4.3	1.6	1.4	0.1	0.1	74	3	7	26	33	10	4	1	18	20	P	A

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Print date: 25/01/89

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: MC 0058

Unit: Alla

Status: 2

SHEET : 2227D3

LOCATION : Mokobeng (school compound).

AUTHOR(S) : A.Remmelzwaal G.J.Rhebergen B.G.Moganane T.D.Mafoko

CLASSIFICATION : FAO: Rhodi-Ferric Lixisol(1988) Ferric Luvisol (1974) petroferric phase

ST : Petroferric Rhodustalf

GRID : NE-683-563

COORD: 22-59-56-S 27-40-00-E

DATE : 28/04/82

LANDFORM : plain

TOPOGRAPHY: almost flat

SURF. CHAR: no cracks, nil evidence of salt,

LAND USE: disturbed vegetation

SPECIES : Trees - Combretum imberbe Combretum apiculatum Acacia nigrescens Boscia albitrunca

: Shrubs -

: Grasses/forbs-

PARENT MATERIAL: alluvium over in situ weathered

MOIST. COND: dry 0 - 250 cm

SURF.STONES: none

EROSION : slight sheet erosion

AGRO CLIM.ZONE: 2D3

ELEVATION : 837 m

SMR: ustic to aridic

POSITION: intermediate part

SLOPE : 1 - 2 %

GRASSCOVER:

GEOL.UNIT: Basement complex

DRAINAGE : moderately well drained

HUMAN INF: surface compaction

LAND ELEMENT :

MICRO TOPOGRAPHY: even

VEGETATION: savanna

ROCK TYPE: gneiss

ROCK OUTCROP: none

REMARKS: In Cmo horizon minor patches moderately cemented where sample taken from. Stones in Cmo horizon include sandstone. CEC and Org C seems high (old analysis), Analytical clay content low due to cementation by iron.

SAMPLES: A: 0 - 20 B: 30 - 50 C: 90 - 110 D: 130 - 150

A 0 - 20 cm 5YR 3/3 (moist) and 5YR 4/5 (dry), coarse sandy loam to sandy clay loam, very weak med'um subangular blocky structure, slightly hard, common fine pores, few coarse rounded gneiss rock fragments, non calcareous, few roots, clear smooth boundary.

Bt 20 - 70 cm 3YR 2.5/6 (moist) and 3YR 4/5 (dry), sandy clay loam, weak medium and coarse subangular blocky structure, hard, broken moderately thick clay cutans, common fine pores, few medium and coarse rounded gneiss and few medium rounded quartz rock fragments, non calcareous, few roots, abrupt wavy boundary.

Cmo 70 - 130 cm 2.5YR 2.5/6 (moist) and 2.5YR 4/6 (dry), many coarse prominent sharp black mottles, sandy clay loam to sandy clay, strongly coherent massive structure, extremely hard, cemented, few fine pores, frequent medium and coarse rounded gneiss and frequent medium quartz rock fragments, frequent medium irregular hard ferruginous reddish-brown concretions, non calcareous, no roots, clear irregular boundary.

2Cr 130 - 160 cm many coarse prominent sharp black mottles, sandy clay loam to sandy clay, strongly coherent massive structure, very hard, very frequent medium and coarse angular gneiss rock fragments, non calcareous, no roots, gradual irregular boundary.

2R 160 - 250 cm

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STANDARD SOIL ANALYSIS RESULTS

PROFILE: MC 0058

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)										CECclay	METH	PRETR
		H2O CaCl2	mS/cm	ppm	weight %	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil
A	0 20	6.5	6.0	0.0	8	0.6	6.4	3.6	0.7	1.2	0.1	88	6	10	18	29	12	7	3	16	25	?		
B	30 50	6.0	5.4	0.0	6	0.4	8.1	4.2	1.0	0.5	0.2	73	6	10	17	23	9	5	1	28	23	?		
C	90 110	6.4	5.8	0.0	4	0.2	11.5	6.2	1.3	0.6	0.3	73	6	10	17	17	9	8	5	28	36	?		
D	130 150	6.5	6.0	0.0	3	0.1	11.0	7.0	1.9	0.8	0.4	90	21	13	11	11	6	4	4	30	35	?		

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PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: S 0001 Unit: A16 Status: 1

SHEET : 2226B4

LOCATION : 18km SE of Serowe, along old Palapye road.

AUTHOR(S): A. Rummelzwaal

CLASSIFICATION FAO: Rhodi-Pale-Chromic Luvisol (1988) Eutric Nitosol (1974)

ST : Rhodic Paleustalf

LANDFORM : alluvial plain

TOPOGRAPHY: almost flat

SURF. CHAR: no sealing, no cracks, nil evidence of salt,

LAND USE: traditional dryland farming

SPECIES : Trees -

: Shrubs - Colophospermum mopane (dom.)

: Grasses/forbs-

PARENT MATERIAL: alluvium

MOIST. COND: dry 0 - 160 cm

SURF. STONES: none

EROSION : slight gully erosion

REMARKS: Nearby arable land with few *Boscia albitrunca*.

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SAMPLES: A: 0 - 20 B: 30 - 50 C: 60 - 80 D: 100 - 120 E: 130 - 150

A 0 - 30 cm 7.5YR 3/4 (moist) and 7.5YR 3.5/4 (dry), fine sandy loam, weak medium and coarse subangular blocky structure, slightly hard, many very fine and fine and few medium pores, non calcareous, abundant roots, gradual smooth boundary.

Bt1 30 - 50 cm 5YR 3/5 (moist) and 5YR 3.5/5 (dry), few fine distinct clear bluish-black mottles, fine sandy loam, weak to moderate coarse and very coarse subangular blocky structure, hard, patchy thin cutans, many very fine and fine and few medium pores, non calcareous, no roots, gradual smooth boundary.

Bt2 50 - 130 cm 2.5YR 3/6 (moist) and 2.5YR 4/6 (dry), sandy clay loam, weak to moderate very coarse subangular blocky structure, hard, continuous moderately thick cutans, many very fine and fine and few medium pores, non calcareous, common roots, gradual smooth boundary.

Bt3 130 - 160 cm 2.5YR 3/4 (moist) and 2.5YR 4/4 (dry), few medium distinct clear bluish-black and common coarse distinct diffuse yellowish-red mottles, sandy clay loam to sandy clay, weak very coarse subangular blocky structure, very hard, continuous moderately thick cutans, many very fine and fine and few medium pores, non calcareous, few roots,

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PROFILE: S 0001

SAMPLE	DEPTH	pH	EC	P	C	weight %	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR			
													ms/cm	ppm	q-----	meq/100gr soil	-----				%	vcS	cS
H2O CaCl2																							
A	0	7.4	6.7	0.0	2	0.4	6.4	5.3	1.4	0.6	0.1	>100	0	0	10	57	14	2	2	15	32	H	A
B	30	7.1	6.5	0.0	2	0.3	8.9	5.0	2.3	0.3	0.1	87	0	0	10	54	13	3	2	19	42	H	A
C	60	6.5	5.5	0.0	0	0.3	13.5	6.1	2.8	0.4	0.1	70	0	0	8	44	12	2	2	32	39	H	A
D	100	6.6	5.7	0.0	1	0.2	13.4	7.0	2.6	0.4	0.2	76	0	0	10	45	11	3	2	29	44	H	A
E	130	7.2	6.0	0.0	0	0.2	18.8	13.0	3.1	0.5	0.1	89	0	0	7	41	11	3	3	34	54	H	A

Soil Survey of Botswana FAO/BOT/85/011

PART. SIZE DETERMINATION

PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Print date: 25/01/89

SOIL PROFILE DESCRIPTION		Profile: BS 0100	Unit: A22a	Status: 2
SHEET : 2228A2 LOCATION : 100m N of Thune river sandbed. AUTHOR(S): G.J.Rhebergen T.D.Mafoko CLASSIFICATION FAO: Luvic Arenosol(1988) Cambic Arenosol (1974) ST : Ustic Torripsamment LANDFORM : valley TOPOGRAPHY: gently undulating SURE. CHAR: no sealing, no cracks, nil evidence of salt, LAND USE: traditional dryland farming SPECIES : Trees - Combretum imberbe (dom.) : Shrubs - Acacia tortilis subs. heterocantha (dom.) : Grasses/forbs- PARENT MATERIAL: alluvium over in situ weathered MOIST. COND: dry 0 - 110 cm SURF.STONES: none EROSION : nil REMARKS: GRID : PF-452-523 COORD: 22-07-55-S 28-24-30-E DATE : 09/03/83 LAND ELEMENT : levee MICRO TOPOGRAPHY: even VEGETATION: savanna ROCK TYPE: gneiss-granite ROCK OUTCROP: none AGRO CLIM.ZONE: 4B3 ELEVATION : 730 m SMR: aridic to ustic POSITION: intermediate part SLOPE : 1 - 2 % straight GRASSCOVER: GEOLOG.UNIT: Basement complex DRAINAGE : somewhat excessively drained HUMAN INF: nil				
SAMPLES: A: 0 - 20 B: 40 - 60 C: 90 - 110				
A 0 - 20 cm 10YR 3/3 (moist) and 10YR 4/3 (dry), coarse sand, very weak medium subangular blocky structure, soft, common fine pores, non calcareous, common fine roots, clear smooth boundary.				
B 20 - 110 cm 7.5YR 3.5/4 (moist) and 7.5YR 4/4 (dry), loamy coarse sand, weakly coherent massive structure, loose, common fine pores, non calcareous, common fine roots,				
Soil Survey of Botswana FAO/BOT/85/011 print date: 25/01/89				

STANDARD SOIL ANALYSIS RESULTS

PROFILE: BS 0100

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)							CECclay	METH	PRETR		
		H2O	CaCl2	mS/cm	ppm	weight %	meq/100gr soil					%	vcS	cS	mS	fS	vfs	cSi	fSi	Clay	meq/100gr		
A	0 20	8.2	7.1	0.0	10	0.5	7.3	5.8	0.6	0.9	0.4	100	6	29	28	21	7	2	2	7	79	H	A
B	40 60	0.1	6.7	0.0	9	0.3	7.0	4.5	0.8	0.6	0.1	86	6	28	29	19	6	1	1	9	68	H	A
C	90 110	7.7	7.0	0.0	7	0.3	7.3	4.2	1.2	0.5	0.1	82	10	41	25	11	3	1	1	8	79	H	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 25/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION Profile: TC 0004 Unit: A36 Status: 1

SHEET : 2227D4
 LOCATION : Seleka farm, near Limpopo (400m from farmhouse).
 AUTHOR(S): A. Remmelzwaal
 CLASSIFICATION: FAO: Rhodi-Pale-Chromic Luvisol (1988) Luvisol Xerosol (1974)
 LANDFORM : valley
 TOPOGRAPHY: gently undulating
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE: crops: fruits
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs -
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 70 , slightly moist 70 - 200 cm
 SURF. STONES: none
 EROSION : nil

GRID : NE-998-622
 COORD: 22-56-50-S 27-58-30-E
 DATE : 28/08/80
 LAND ELEMENT : levee
 MICRO TOPOGRAPHY: even
 VEGETATION:
 SMR: aridic to ustic
 POSITION: crest
 SLOPE : 0 - 2 %
 GRASSCOVER:
 ROCK TYPE:
 ROCK OUTCROP: none
 GEOL. UNIT:
 DRAINAGE : well drained
 HUMAN INF: nil

REMARKS: Natural levee of Limpopo with flat top 6m higher than low backswamp area. Land prepared for extension cultivation of oranges. Augering from 170cm. Foto. Marginal argillic transitional to Haplic Xerosol/Cambic Arenosol.

SAMPLES: A: 0 - 20 B: 30 - 50 C: 90 - 110 D: 150 - 170 E: 200 - 230

Ap 0 - 20 cm 5YR 4/6 (moist) and 5YR 5/6 (dry), loamy fine sand, weak coarse and very coarse subangular blocky structure, hard friable, many very fine and fine pores, non calcareous, many roots,

Bt1 20 - 70 cm 4YR 4/8 (moist) and 4YR 5/8 (dry), fine sandy loam, very weak coarse and very coarse subangular blocky structure, hard friable, broken thin cutans, many very fine and fine pores, very few medium and coarse rounded strongly weathered rock fragments, non calcareous, few roots, gradual smooth boundary.

Bt2 70 - 130 cm 2.5YR 4/6 (moist) and 2.5YR 4.5/7 (dry), fine sandy loam, very weak coarse subangular blocky structure, hard friable, continuous moderately thick cutans on vertical pedfaces, many very fine and fine pores, very few medium and coarse rounded rock fragments, non calcareous, few roots, gradual smooth boundary.

Bt3 130 - 170 cm 4YR 4/6 (moist) and 4YR 5/6 (dry), fine sandy loam, massive structure, hard friable, broken thin cutans, many very fine and fine pores, very few medium and coarse rounded rock fragments, non calcareous, few roots, gradual smooth boundary.

BC 170 - 230 cm 5YR 5/6 (moist) and 5YR 6.5/7 (dry), fine sandy loam to loamy fine sand, friable,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: TC 0004

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR					
			mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr				
A	0	20	6.8	5.4	0.0	3	0.1	7.9	3.2	1.5	0.2	0.2	65	0	3	14	39	22	11	4	7	106	H	A
B	30	50	6.5	5.1	0.0	1	0.1	7.0	3.7	2.1	0.2	0.2	89	0	3	17	38	19	9	3	11	61	H	A
C	90	110	0.0	6.1	0.0	1	0.1	8.1	4.5	2.6	0.2	0.2	93	0	4	20	40	14	7	3	12	63	H	A
D	150	170	7.5	6.5	0.0	1	0.0	9.1	5.4	2.7	0.2	0.4	96	0	3	15	40	17	10	3	11	87	H	A
E	200	230	8.3	6.7	0.0	1	0.0	9.2	4.5	2.4	0.1	1.0	87	0	4	16	40	17	10	4	9	108	H	A

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Print date: 25/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION		Profile: S 0005	Unit: B06	Status: 2
SHEET : 2226B4 LOCATION : Swaneng, 8km SE of Serowe (old Palapye road). AUTHOR(S): A.Remmelzwaal CLASSIFICATION FAO: Calcic Luvisol(1988) Calcic Luvisol (1974) petric (skeletal) phase ST : Typic Haplustalf				
LANDFORM : plain TOPOGRAPHY: undulating SURF. CHAR: no sealing, no cracks, nil evidence of salt, LAND USE: disturbed vegetation SPECIES : Trees - Acacia tortilis subs. heterocantha (dom.) Acacia nigrescens : Shrubs - Acacia tortilis subs. heterocantha (dom.) Acacia nigrescens : Grasses/forbs-				
PARENT MATERIAL: in situ weathered MOIST. COND: slightly moist 0 - 140 cm SURF.STONES: very few stones EROSION : slight gully erosion and moderate sheet erosion				
REMARKS: Older analytical data.				
SAMPLES: A: 0 - 20 B: 30 - 50 C: 65 - 80 D: 90 - 105				
A 0 - 25 cm 5YR 3/3 (moist) and 5YR 3.5/3 (dry), sandy loam, weak medium and coarse subangular blocky structure, hard firm, many fine pores, very few fine weathered basalt rock fragments, non calcareous, many fine roots, gradual smooth boundary.				
Bt1 25 - 55 cm 5YR 3/4 (moist) and 5YR 3.5/4 (dry), sandy clay loam, weak to moderate medium and coarse subangular blocky structure, hard, broken moderately thick clay cutans, many fine pores, very few fine weathered basalt rock fragments, slightly calcareous, many fine roots, gradual smooth boundary.				
Bt2 55 - 85 cm 7.5YR 4/4 (moist) and 7.5YR 4.5/4 (dry), sandy clay loam, very weak medium and coarse subangular blocky structure, slightly hard, patchy thin cutans, many fine pores, frequent fine angular weathered basalt rock fragments, slightly calcareous, common fine roots, clear wavy boundary.				
Ckr 85 - 140 cm 10YR 5/4 (moist) and 10YR 6/4 (dry), common yellow and common greenish mottles, sandy loam to loamy coarse sand, massive structure, hard to very hard, dominant fine and medium angular weathered basalt rock fragments, few fine hard calcareous white nodules, moderately calcareous, no roots, clear irregular boundary.				
R 140 cm + extremely hard, non calcareous,				
Soil Survey of Botswana FAO/BOT/85/011				
print date: 24/01/89				

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0005

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	MEH	PRETR			
		H2O	CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0 20	0.0	6.0	0.0	5	0.5	23.2	16.8	4.9	0.1	0.2	95	2	2	5	40	12	10	18	118	H	
B	30 50	0.0	6.6	0.0	5	0.5	24.0	23.2	6.3	0.1	0.2	100	2	2	4	36	11	10	26	85	H A	
C	65 80	0.0	7.0	0.0	6	0.4	18.8	32.0	9.4	0.1	0.2	100	10	7	7	26	10	10	9	21	82	H A
D	90 105	0.0	7.0	0.0	4	0.2	10.6	59.2	15.0	0.1	0.3	100	17	14	15	20	8	6	8	122	H A	

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Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: SH 0016 Unit: B07 Status: 2

SHEET : 2326A2
 LOCATION : Ikongwe, 12km SW of Shoshong.
 AUTHOR(S): A.Remmelzwaal
 CLASSIFICATION FAO: Rhodi-Pale-Chromic Luvisol (1988) Eutric Nitrosol (1974)
 ST : Rhodic Paleustalf
 LANDFORM : hill
 TOPOGRAPHY: hilly
 SURF. CHAR: moderate sealing, no cracks, nil evidence of salt,
 LAND USE: no apparent management system
 SPECIES : Trees -
 : Shrubs - *Acacia erubescens* (dom.)
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 200 cm
 SURF. STONES: very few stones
 EROSION : moderate sheet erosion

REMARKS: Transitional to Petrocalcic Paleustalf.

SAMPLES: A: 0 - 20 B: 80 - 100 C: 140 - 155

A 0 - 20 cm 5YR 2.5/3 (moist) and 5YR 3.5/4 (dry), sandy loam to sandy clay loam, weak very coarse subangular blocky structure, very hard, common very fine and fine pores, non calcareous, few roots, gradual smooth boundary.

Bt1 30 - 60 cm 3.5YR 3/5 (moist) and 3.5YR 3.5/5 (dry), sandy clay loam, weak to moderate very coarse subangular blocky structure, very hard, broken moderately thick cutans, common very fine and fine pores, very few coarse weathered dolerite rock fragments, non calcareous, few roots, diffuse smooth boundary.

Bt2 60 - 120 cm 2.5YR 3/5 (moist) and 2.5YR 3.5/5 (dry), sandy clay loam, moderate very coarse subangular blocky structure, very hard, continuous thin cutans, common very fine and fine pores, few coarse weathered dolerite rock fragments, slightly calcareous, few roots, diffuse smooth boundary.

Btk 120 - 160 cm 2.5YR 3/6 (moist) and 2.5YR 4/6 (dry), sandy clay loam to sandy clay, weak very coarse subangular blocky structure, very hard, patchy thin cutans, common very fine and fine pores, frequent extremely coarse weathered dolerite rock fragments, strongly calcareous, abrupt wavy boundary.

Cmk 160 - 200 cm strongly coherent massive structure, extremely hard, cemented, frequent extremely coarse weathered dolerite rock fragments, extremely calcareous,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: SH 0016

SAMPLE	DEPTH	pH	H2O	CaCl2	EC	P	C	weight %	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)										CECclay	METH	PRETR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: D 0041 Unit: C01a Status: 2

SHEET : 2326B3
 LOCATION : Serurume valley; 8km S of Dinokwe, along main road..
 AUTHOR(S): A. Remmelzwaal B.G. Moganane
 CLASSIFICATION FAO: Rendzic Leptosol (1988) Rendzinas (1974) shallow petrocalcic phase
 ST : Petrocalcic Calcicustoll
 LANDFORM : valley
 TOPOGRAPHY: flat
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE: disturbed vegetation
 SPECIES : Trees - Acacia luederitzii var. luederitzii
 : Shrubs - Acacia tortilis subs. heterocantha
 : Grasses/forbs-
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 200 cm
 SURF. STONES: none
 EROSION : slight wind erosion/deposition
 REMARKS: In complex with slightly lower situated Calcic Cambisols (see D42 at 300m N and D40 (Petrocalcic Arenosols). Cmk1 horizon indurated, Cmk2 includes partly cemented nodular zones. Photo.

SAMPLES: A: 0 - 20

A 0 - 20 cm 10YR 3.5/3 (moist) and 10YR 4.5/3 (dry), loamy fine sand, weak fine and medium subangular blocky structure, soft, many very fine and fine pores, moderately calcareous, common roots, abrupt wavy boundary.

Cmk1 20 - 40 cm strongly coherent massive structure, extremely hard, cemented, extremely calcareous, clear wavy boundary.

Cmk2 40 - 200 cm strongly coherent massive structure, very hard, partly cemented, extremely calcareous,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: D 0041

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: SH 0005 Unit: D03 Status: 1

SHEET : 2326A2
 LOCATION : 11.3km WSW of Shoshong.
 AUTHOR(S): A.Remmelzwaal
 CLASSIFICATION FAO: Pale-Ferric Acrisol(1988) Ferric Acrisol (1974)
 ST : kandic Paleustult
 LANDFORM : plain
 TOPOGRAPHY: flat
 SURF. CHAR: slight sealing, no cracks, nil evidence of salt, bleached sand on surface
 LAND USE: traditional grazing
 SPECIES : Trees -
 : Shrubs - Terminalia sericea (dom.) Grewia sp. Boscia albitrunca Acacia tortilis subs. heterocantha
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 170 cm
 SURF.STONES: none
 EROSION : nil

GRID : ME-379-512
 COORD: 23-02-50-S 26-23-37-E
 DATE : 19/09/80

AGRO CLIM.ZONE: 1D3
 ELEVATION : 1105 m
 SMR: ustic

LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even
 VEGETATION: shrub savanna

POSITION: intermediate part
 SLOPE : 0 - 1 %

GRASSCOVER:

GEOL..UNIT: Waterberg Shoshong frm
 DRAINAGE : moderately well to well drained
 HUMAN INF: nil

REMARKS: Parent material quartzite or feldspathic grit (Pgg)

SAMPLES: A: 0 - 20 B: 40 - 55 C: 70 - 90 D: 100 - 120 E: 140 - 150

A 0 - 33 cm 7.5YR 3.5/4 (moist) and 7.5YR 4.5/4 (dry), loamy coarse sand, very weak coarse and very coarse subangular blocky structure, slightly hard, common fine pores, non calcareous, few open burrows, common roots, clear smooth boundary.

Bt1 33 - 65 cm 5YR 4/6 (moist) and 5YR 5/6 (dry), sandy loam, very weak coarse and very coarse subangular blocky structure, slightly hard, patchy thin clay cutans, common fine pores, non calcareous, few open burrows, common roots, gradual smooth boundary.

Bt2 65 - 95 cm 5YR 4.5/8 (moist) and 5YR 5/8 (dry), common distinct brownish mottles, sandy loam, very weak very coarse subangular blocky structure, slightly hard to hard, patchy thin clay cutans, common fine pores, non calcareous, common roots, gradual smooth boundary.

Bt3 95 - 125 cm 3.5YR 4.5/7 and 10YR 6.5/3 mottled (moist), sandy loam, massive structure, hard, common fine pores, non calcareous, few roots, abrupt irregular boundary.

BCo 125 - 170 cm 10YR 6.5/3 (moist) and 10YR 7.5/3 (dry), many medium prominent sharp yellowish-red mottles, sandy loam to loamy sand, weakly coherent massive structure, slightly hard, common fine pores, non calcareous, few roots, abrupt irregular boundary.

Cmo 170 cm + strongly coherent massive structure, extremely hard, cemented, frequent quartz rock fragments, very frequent iron-manganese nodules, non calcareous, no roots,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: SH 0005

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
		H2O	CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay				
A	0	4.9	4.5	0.0	3	0.2	4.1	0.8	0.5	0.3	0.0	39	5	19	17	26	15	6	1	12	28	P	A
B	40	4.7	3.8	0.0	2	0.3	4.6	0.5	0.8	0.3	0.1	37	4	15	19	26	13	7	1	16	21	P	A
C	70	4.4	3.7	0.0	1	0.2	5.4	0.3	0.9	0.3	0.1	30	4	14	17	26	15	6	1	18	25	P	A
D	100	4.5	3.7	0.0	1	0.4	5.4	0.5	0.9	0.3	0.2	35	4	15	18	26	13	6	1	17	22	P	A
E	140	4.7	3.9	0.0	1	0.3	5.8	0.3	1.2	0.3	0.2	34	6	16	21	22	11	9	0	15	31	P	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: PS 0901 Unit: D05b Status: 1

SHEET : 2227C1
LOCATION : 2km W of Makoro.
AUTHOR(S): A.B.Price M.D.Mays A.Rommelzwaal
CLASSIFICATION FAO: Pale-Haplic Lixisol(1988) Ferric Luvisol (1974)
ST : kandic Paleustalf
LANDFORM : plain
TOPOGRAPHY: almost flat
SURF. CHAR: slight sealing, no cracks, nil evidence of salt, bleached sand on surface
LAND USE: improved trad. dryland farming, crops: sorghum
SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: moist 0 - 40 , dry 40 - 177 cm
SURF.STONES: none
EROSION : moderate sheet erosion
GRID : NE-014-845
COORD: 22-44-56-S 27-00-53-E
DATE : 18/03/86
LAND ELEMENT :
MICRO TOPOGRAPHY: termite mounds
VEGETATION:
ROCK TYPE: feldspatic sandstone
ROCK OUTCROP: none
GEOL.UNIT: Waterberg Tswapong fm
DRAINAGE : well drained
HUMAN INT: ploughing
AGRO CLIM.ZONE: 2D3
ELEVATION : 1020 m
SMR: ustic to aridic
POSITION: upper slope
SLOPE : 1 - 2 %
GRASSCOVER:

REMARKS: USDA Pedon no.4 (Aridic Oxlic Paleustalf) with minor modifications. Excursion site FAO EASC meeting 3-4-87.

SAMPLES: A: 0 - 15 B: 15 - 39 C: 40 - 80 D: 82 - 107 E: 110 - 130 F: 135 - 175

Ap 0 - 15 cm 7.5YR 3/3 (moist) and 7.5YR 4/3 (dry), loamy sand to sandy loam (12% clay), very weak medium and coarse subangular blocky structure, soft very friable, non sticky non plastic, few very fine pores, non calcareous, few very fine roots, abrupt smooth boundary.

AB 15 - 39 cm 7.5YR 3.5/4 (moist) and 7.5YR 4.5/4 (dry), sandy loam (19% clay), very weak medium and coarse subangular blocky structure, slightly hard friable, slightly sticky non plastic, common very fine pores, non calcareous, few fine and medium roots, gradual wavy boundary.

Bt1 39 - 82 cm 6.5YR 3.5/5 (moist) and 6.5YR 5/6 (dry), sandy clay loam (29% clay), very weak coarse and very coarse subangular blocky structure, hard friable, sticky slightly plastic, patchy thin clay cutans on pores, common very fine and fine pores, non calcareous, few fine and medium and very few coarse roots, gradual wavy boundary.

Bt2 82 - 133 cm 6YR 4/6 (moist) and 5YR 5/8 (dry), sandy clay loam (30% clay), massive structure, hard friable, sticky slightly plastic, patchy thin clay cutans on pores, common fine pores, non calcareous, few fine and medium roots, gradual irregular boundary.

Bt3 133 - 177 cm 6YR 5/8 (moist) and 6YR 6.5/8 (dry), few fine prominent sharp red mottles, sandy clay loam (28% clay), massive structure, hard friable, sticky slightly plastic, patchy thin clay cutans on pores, few very fine pores, non calcareous, few fine and medium roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: PS 0901

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	MEIH	PRETR		
		H2O	CaCL2	mS/cm	ppm	weight %	µ-----	meq/100gr soil	-----µ	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0 15	4.1	3.8	1.3	14	0.5	5.0	1.6	0.6	0.6	0.2	60	4	19	20	25	13	3	1	15	20
B	15 39	5.9	5.0	0.4	2	0.4	5.9	2.5	1.2	0.7	0.1	76	4	16	17	24	14	4	2	20	22
C	40 80	5.6	4.7	0.6	2	0.2	7.4	1.8	1.9	0.6	0.1	59	7	17	16	19	11	3	1	27	24
D	82 107	5.3	4.6	0.7	2	0.2	7.9	1.9	1.9	0.6	0.2	58	6	14	14	21	12	3	1	29	24
E	110 130	5.3	4.5	0.6	2	0.2	6.7	1.7	1.6	0.4	0.2	58	3	12	14	21	14	3	2	31	19
F	135 175	5.6	4.5	0.6	0	0.3	6.8	1.6	1.5	0.3	0.2	53	8	16	16	18	10	3	2	27	21

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PHYSICAL PROPERTIES

PROFILE: PS 0901

INFILTRATION			
No.	Basic (cm/hr)	a	n
1	0.0	0.00	0.00
2	0.0	0.00	0.00
3	0.0	0.00	0.00

METHODS. Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F = at$ where F = cumulative infiltration (cm) and t=elapsed time (min)
 Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core
 Moisture Retention: Tension $\leq$ 1bar on core or clods; Tension > 1bar on <2mm crushed samples
 Structural Stability Index: on >1mm sieved samples <2mm of surface soil, relative collapse larger pores on slow & fast wetting

SURFACE STRUCTURE STABILITY INDEX: 0.00

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)			
			0.03bar 0.05bar 0.1bar 1.0bar 3.0bar 5.0bar 15.0bar			
A	0 150	1.62	CL	11.60	7.90	3.2
B	15 39	1.55	CL	13.70	10.30	4.7
C	39 82	1.60	CL	13.50	10.80	7.2
D	82 107	1.55	CL	15.70	11.20	6.8
E	107 133	1.55	CL	15.50	11.90	7.1
F	133 177	1.53	CL	16.30	12.90	7.5

REMARKS: used clods for moisture retention

Soil Survey of Botswana FAO/BOT/85/011

Print date: 26/01/89

SOIL PROFILE DESCRIPTION

Profile: MC 0037 Unit: D07c Status: 2

SHEET : 2327A3
 LOCATION : 9km W of Khudumetse.
 AUTHOR(S): A. Remmelzwaal B.G.Moganane
 CLASSIFICATION FAO: Ferric Acrisol (1988) Ferric Acrisol (1974) petroferic phase
 ST : Petroferic Haplustult
 LANDFORM : plain
 TOPOGRAPHY: flat
 SURF. CHAR: moderate sealing, no cracks, nil evidence of salt,
 LAND USE: traditional grazing
 SPECIES : Trees - Combretum apiculatum (dom.) Acacia nigrescens
 : Shrubs -
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 140 cm
 SURF. STONES: none
 EROSION : nil

GRID : NE-058-114
 COORD: 23-24-42-S 27-04-25-E
 DATE : 24/02/81
 LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY:
 VEGETATION: woodland
 GRASSCOVER: 10 - 30 %
 POSITION: intermediate part
 SLOPE : 0 - 1 %
 SMR: ustic to aridic

AGRO CLIM.ZONE: 2D3
 ELEVATION : 877 m

ROCK TYPE: conglomerate
 ROCK OUTCROP: none
 GEOL.UNIT: Karoo Ecga gtp
 DRAINAGE : well to moderately well drained
 HUMAN INF: nil

REMARKS: Transitional to shrubland (small trees only, almost exclusively Combretum apiculatum). Geology Kg grit/conglomerate. Transitional to Kanhaplustult.

SAMPLES: A: 0 - 20 B: 50 - 70

A 0 - 30 cm 9YR 3/3 (moist) and 9YR 4.5/4 (dry), loamy coarse sand to coarse sandy loam, massive structure, slightly hard, few fine pores, non calcareous, few roots, clear smooth boundary.

Bt 30 - 80 cm 5YR 5/6 (moist) and 5YR 5.5/6 (dry), sandy clay loam, massive structure, slightly hard, patchy thin clay cutans, few fine pores, non calcareous, few roots, abrupt wavy boundary.

Cmc 80 - 140 cm extremely hard, cemented, very few fine and medium quartz rock fragments, dominant coarse hard iron-manganese reddish-brown nodules, non calcareous, no roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: MC 0037

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)							CECclay	METH	PRETR			
		H2O	CaCl2	ms/cm	ppm	weight %	µ-----	meq/100gr soil	-----µ	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr					
A	0	20	5.8	5.0	0.0	3	0.3	3.0	1.1	0.4	0.2	0.1	60	14	19	16	24	12	4	2	10	18	P	A
B	50	70	5.1	4.3	0.0	2	0.2	4.3	0.6	0.6	0.3	0.1	37	27	20	14	15	7	4	3	22	16	P	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: M 0201 Unit: C02 Status: 2

GRID : ME-867-431

GRID : ME-867-431

ELEVATION : 925

ELEVATION : 925 m

ELEVATION : 925 m

ELEVATION : 925 m

ELEVATION : 925 m

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ELEVATION : 925 m

ELEVATION : 925 m

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0201

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR		
		H2O CaCl2	ms/cm	ppm	weight %	u-----u	u-----u	meq/100gr soil	u-----u	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0 20	6.9 5.3	0.0	2	0.2	3.1	0.9	0.3	0.2	0.0	45	6	22	18	23	16	7	1	7	32	
B	40 60	6.1 4.1	0.0	2	0.1	2.4	0.5	0.1	0.1	0.0	29	11	22	16	20	13	7	2	10	20	
Soil Survey of Botswana FAO/BOT/85/011																					

Print date: 24/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION										Profile: M 0901	Unit: G02d	Status: 1		
SHEET : 2326B2										AGRO CLIM.ZONE: ID3				
LOCATION : 6km NE of Mahalapye.										ELEVATION : 1030 m				
AUTHOR(S) : A.B.Price M.D.Mays														
CLASSIFICATION FAO: Ferric Lixisol(1988)														
ST : Kanhaplic Haplustalf										SMR: ustic				
LANDFORM : plain										POSITION:				
TOPOGRAPHY: almost flat										SLOPE : 0 - 1 %				
SURF. CHAR: no cracks, nil evidence of salt,										GRASSCOVER:				
LAND USE: partly mechan. dryland farming, crops: sorghum, cowpea														
SPECIES : Trees -														
: Shrubs -														
PARENT MATERIAL: in situ weathered										GEOL.UNIT: Mahalapye migmatite				
MOIST. COND: dry 0 - 150 cm										DRAINAGE : well drained				
SURF.STONES: none														
EROSION : moderate sheet erosion										HUMAN INF: ploughing				
REMARKS: USDA Pedon no.13 (Typic Haplargid), with minor modifications. Argillic horizon 23-40cm very marginal. CEC clay irregular.														
SAMPLES:	A:	0 - 10	B:	10 - 23	C:	23 - 40	D:	40 - 65	E:	65 - 97	F:	97 - 124	G:	124 - 150
Ap	0 - 10 cm	7.5YR 3/3 (moist) and 7.5YR 4/4 (dry), loamy coarse sand (7% clay), weak medium subangular blocky structure, soft very friable, non sticky non plastic, common very fine pores, very few medium weathered granite rock fragments, non calcareous, common fine and medium roots, abrupt wavy boundary.												
AB	10 - 23 cm	7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), loamy coarse sand (10% clay), weak medium and coarse subangular blocky structure, slightly hard very friable, non sticky non plastic, patchy thin clay cutans, few very fine pores, very few medium weathered granite rock fragments, non calcareous, common very fine and fine roots, gradual wavy boundary.												
Bt	23 - 40 cm	7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), coarse sandy loam (12% clay), weak medium and coarse subangular blocky structure, slightly hard very friable, non sticky non plastic, patchy thin clay cutans random, few very fine pores, few medium weathered granite rock fragments, non calcareous, few very fine roots, clear wavy boundary.												
C	40 - 65 cm	7.5YR 4/4 (moist) and 7.5YR 4.5/6 (dry), coarse sandy loam (12% clay), weakly coherent massive structure, slightly hard very friable, non sticky non plastic, few very fine pores, very frequent fine and medium weathered granite rock fragments, non calcareous, few very fine roots, gradual wavy boundary.												
Cco1	65 - 97 cm	7.5YR 4/5 (moist) and 7.5YR 5/6 (dry), many coarse prominent diffuse yellowish-red mottles, coarse sandy loam (11% clay), weakly coherent massive structure, slightly hard very friable, non sticky non plastic, few very fine pores, very frequent fine and medium weathered granite rock fragments, frequent coarse spherical hard iron-manganese yellowish-red concretions, non calcareous, very few fine roots, gradual wavy boundary.												
Cco2	97 - 124 cm	7.5YR 4/6 (moist) and 10YR 6/5 (dry), many coarse prominent diffuse yellowish-red mottles, coarse sandy loam, weakly coherent massive structure, slightly hard very friable, non sticky non plastic, common fine and medium pores, very frequent fine and medium weathered granite rock fragments, frequent coarse spherical hard iron-manganese yellowish-red concretions, non calcareous, very few fine roots, diffuse smooth boundary.												
Cco3	124 - 150 cm	7.5YR 5/6 (moist) and 10YR 6/5 (dry), many coarse prominent diffuse yellowish-red mottles, coarse sandy loam, weakly coherent massive structure, slightly hard very friable, non sticky non plastic, common fine and medium pores, frequent fine and medium weathered granite rock fragments, frequent coarse spherical hard iron-manganese yellowish-red concretions, non calcareous, very few fine roots,												

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0901

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR			
		H2O	CaCl2	ms/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0	10	8.3	7.3	0.1	3	0.4	4.3	4.7	0.3	0.4	0.0	>100	37	32	10	7	4	1	3	6	45
B	10	23	8.1	7.1	0.1	3	0.3	3.5	3.4	0.3	0.3	0.0	>100	51	26	6	5	3	1	1	7	33
C	23	40	7.6	6.8	0.1	3	0.3	3.1	2.3	0.7	0.3	0.0	>100	47	27	8	5	3	0	3	7	27
D	40	65	6.1	4.8	0.0	2	0.3	3.1	1.0	0.8	0.6	0.0	77	24	25	20	11	5	2	3	11	17
E	65	97	5.7	4.6	0.0	2	0.2	4.5	1.2	1.0	0.4	0.0	58	29	27	21	7	3	1	3	11	34
F	97	124	5.4	4.5	0.0	1	0.1	4.0	1.3	1.0	0.3	0.0	65	61	20	5	2	1	1	2	9	40
G	124	150	5.7	4.7	0.0	1	0.1	3.8	1.9	0.8	0.3	0.0	79	29	27	13	5	4	6	3	13	26

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

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SOIL PHYSICAL PROPERTIES

PROFILE: M 0901

METHODS. Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F=at$ where F = cumulative infiltration (cm) and t =elapsed time (min)
 Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core
 Moisture Retention: Tension <=1bar on core or clods; Tension > 1bar on <2mm crushed samples
 Structural Stability Index: on >1mm sieved samples <2mm of surface soil, relative collapse larger pores on slow & fast wetting

SURFACE STRUCTURE STABILITY INDEX: 0.00

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)	
A	0 10	1.82 CL	8.40 5.20	2.2
B	10 23	1.71 CL	7.70 5.30	2.8
C	23 40	1.66 CL	6.80 4.80	3.1
D	65 97	1.51 CL	18.00 16.10	4.3
E	97 124	1.21 CL	26.30 23.20	5.6

REMARKS:used clods for moisture retention

Soil Survey of Botswana FAO/BOT/85/011

Print date: 26/01/89

SOIL PROFILE DESCRIPTION			Profile: M 0099	Unit: G03	Status: 2
SHEET : 2326B2	GRID : ME-890-493	AGRO CLIM.ZONE: 1D3			
LOCATION : 8km NE of Mahalapye.	COORD: 23-05-58-S 26-53-30-E	ELEVATION : 1025 m			
AUTHOR(S): A.Rommelzwaal G.M.Segonetso	DATE : 27/03/80	SMR: ustic			
CLASSIFICATION FAO: Albic Arenosol(1988)		POSITION:			
ST : Typic Ustipsamment		SLOPE : 0 - 1 %			
LANDFORM : plain	LAND ELEMENT :	GRASSCOVER:			
TOPOGRAPHY: almost flat	MICRO TOPOGRAPHY: even				
LAND USE: traditional grazing	VEGETATION: savanna				
SPECIES : Trees - Acacia nigrescens Combretum apiculatum Terminalia sericea					
: Shrubs - Terminalia sericea Acacia tortilis subs. heterocantha Acacia erubescens					
: Grasses/forbs-					
PARENT MATERIAL: in situ weathered	ROCK TYPE: granite	GEOL.UNIT: Mahalapye migmatite			
MOIST. COND: dry 0 - 240 cm	ROCK OUTCROP: none	DRAINAGE : moderately well drained			
SURF.STONES: very few		HUMAN INF: nil			
EROSION : nil					
REMARKS: In places ironstone as shallow as 30cm. Cmo horizon contains partly cemented zones. Could also be Quartzipsamment.					
SAMPLES: A: 0 - 20	B: 60 - 80	D: 200 - 210			
A 0 - 30 cm	10YR 3/3 (moist) and 10YR 5/2.5 (dry), loamy coarse sand, massive structure, hard friable, common very fine and fine pores, very few fine quartz rock fragments, non calcareous, common roots, diffuse smooth boundary.				
E 30 - 90 cm	10YR 6/2 (moist) and 10YR 8/2 (dry), many coarse distinct clear red mottles, loamy coarse sand, massive structure, hard friable, common very fine and fine pores, few fine quartz rock fragments, non calcareous, few roots, clear irregular boundary.				
Cmo 90 - 200 cm	strongly coherent massive structure, extremely hard, cemented, very frequent medium and coarse quartz rock fragments, very frequent hard iron-manganese concretions, non calcareous, no roots, abrupt irregular boundary.				
C 200 - 240 cm	10YR 7/2 (moist) and 10YR 8/1 (dry), coarse sand, single grain structure, loose, few fine and medium pores, few nodules, non calcareous, no roots,				
Soil Survey of Botswana			print date: 24/01/89		

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0099

SAMPLE	DEPTH	pH	H2O CaCL2	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)						CECclay	METH	PRETR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr 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 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION		Profile: SH 0006		Unit: G04	Status: 1
SHEET : 2326A2 LOCATION : 1km SW from Bonwapitse river at Shoshong.. AUTHOR(S): A.Remmelzwaal CLASSIFICATION FAO: Ferralic Arenosol(1988) Ferralic Arenosol (1974) ST : Typic Ustipsamment LANDFORM : plain TOPOGRAPHY: almost flat SURF. CHAR: no sealing, no cracks, nil evidence of salt, bleached sand on surface LAND USE: traditional grazing SPECIES : Trees - : Shrubs - Acacia erubescens (dom.) Terminalia sericea Acacia fleckii Boscia albitrunca Peltoporum africanum Euclea undulata : Grasses/forbs- PARENT MATERIAL: in situ weathered MOIST. COND: dry 0 - 210 cm SURF. STONES: none EROSION : slight sheet erosion					
GRID : ME-474-520 COORD: 23-03-00-S 26-29-13-E DATE : 16/05/79 LAND ELEMENT : not applicable MICRO TOPOGRAPHY: even VEGETATION: shrub savanna POSITION: intermediate part SLOPE : - 1 % straight GRASSCOVER: AGRO CLIM.ZONE: 1D3 ELEVATION : 1076 m SMR: ustic GEOL.UNIT: Mahalapye migmatite DRAINAGE : somewhat excessively drained HUMAN INF: borrow pit					
REMARKS: Resampled 11-03-83. Photos. Other shrubs: Grewia flavescens, Ximenia Caffra, Combretum apiculatum. In nearby pit ironstone at 150cm depth.					
SAMPLES: A: 0 - 20 B: 40 - 60 C: 70 - 90 D: 130 - 150					
A	0 - 30 cm	7.5YR 4/4 (moist) and 7.5YR 5/4 (dry), coarse sand, very weak medium subangular blocky structure, slightly hard, common very fine and fine pores, very few fine angular slightly weathered quartz rock fragments, non calcareous, many fine roots, gradual smooth boundary.			
B1	30 - 60 cm	6YR 4/6 (moist) and 6YR 5.5/6 (dry), coarse sand, weakly coherent massive structure, slightly hard, common very fine and fine pores, very few fine angular slightly weathered quartz rock fragments, non calcareous, common fine roots, diffuse smooth boundary.			
B2	60 - 105 cm	6YR 4.5/7 (moist) and 6YR 5.5/7 (dry), coarse sand to loamy coarse sand, weakly coherent massive structure, slightly hard, common very fine and fine pores, few fine angular slightly weathered quartz rock fragments, non calcareous, few very fine and few coarse roots, diffuse smooth boundary.			
B3	105 - 175 cm	6YR 4.5/7 (moist) and 6YR 5.5/7 (dry), coarse sand to loamy coarse sand, weakly coherent massive structure, soft, common very fine and fine pores, few fine angular slightly weathered quartz rock fragments, non calcareous, few coarse roots, diffuse smooth boundary.			
B4	175 - 210 cm	7.5YR 5/6 (moist) and 7.5YR 6/6 (dry), coarse sand to loamy coarse sand, weakly coherent massive structure, soft, common very fine and fine pores, few fine angular slightly weathered quartz rock fragments, non calcareous, few coarse roots, abrupt wavy boundary.			
Cmo	210 cm +	strongly coherent massive structure, extremely hard, cemented, dominant medium and coarse angular slightly weathered quartz rock fragments, few medium hard iron-manganese red concretions, non calcareous,			

STANDARD SOIL ANALYSIS RESULTS

PROFILE: SH 0006

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)								CECclay	METH	PRETR	
		H2O	CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
A	0 20	6.3	5.6	0.0	2	0.3	2.8	0.8	0.4	0.3	0.1	57	11	22	16	25	14	4	2	5	31	H	A
B	40 60	4.7	3.9	0.0	1	0.2	2.3	0.0	0.1	0.2	0.1	17	15	25	16	22	12	4	2	5	33	H	A
C	70 90	90.8	3.8	0.0	1	0.1	2.9	0.0	0.3	0.1	0.0	14	23	26	15	17	9	2	2	8	33	H	A
D	130 150	4.7	3.7	0.0	1	0.1	2.6	0.1	0.5	0.1	0.1	31	25	26	15	15	8	4	1	7	32	H	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/85

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: TS 0005 Unit: G05 Status: 2

SHEET : 2327B2
 LOCATION : APRU Seleka demonstration ranch.
 AUTHOR(S) : A.Remmelzwaal
 CLASSIFICATION FAO: Ferric Acrisol (1988) Ferric Acrisol (1974) petroferic phase
 ST : Petroferic Rhodustult
 LANDFORM : plain
 TOPOGRAPHY: undulating
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE: commercial grazing
 SPECIES : Trees - Combretum apiculatum (dom.) Acacia nigrescens
 : Shrubs - Combretum apiculatum (dom.) Acacia nigrescens
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 100 cm
 SURF.STONES: none
 EROSION : nil

GRID : NE-792-527
 COORD: 23-02-02-S 27-46-25-E
 DATE : 28/08/80
 AGRO CLIM.ZONE: 2D3
 ELEVATION : 820 m
 SMR: ustic to aridic

LAND ELEMENT : interfluv
 MICRO TOPOGRAPHY: termite mounds
 VEGETATION: dense savanna
 POSITION: upper slope
 SLOPE : 1 - 2 %
 GRASSCOVER: 30 - 70 %

ROCK TYPE: gneiss
 ROCK OUTCROP: none
 GEOL.UNIT: Basement complex
 DRAINAGE : well drained
 HUMAN INF: nil

REMARKS: 100m side road N. Catena with TS6 and TS7. Small trees only. Ironstone partly cemented in upper 10cm. Analytical clay low compared to field estimate.

SAMPLES: A: 0 - 20 B: 40 - 60 C: 80 - 100

A 0 - 20 cm 7.5YR 3/3 (moist) and 7.5YR 4/6 (dry), loamy sand, very weak medium subangular blocky structure, hard, common fine pores, few fine quartz rock fragments, non calcareous, common roots, clear smooth boundary.
 Bt 20 - 80 cm 2.5YR 3/6 (moist) and 2.5YR 3.5/6 (dry), sandy loam to sandy clay loam, very weak coarse and very coarse subangular blocky structure, hard to very hard, broken thin cutans, common fine pores, frequent fine quartz rock fragments, non calcareous, few roots, clear wavy boundary.
 Cmc 80 - 100 cm 2.5YR 3/6 (moist) and 2.5YR 3.5/6 (dry), sandy loam to sandy clay loam, strongly coherent massive structure, extremely hard, cemented, few fine pores, frequent medium and coarse quartz rock fragments, very frequent coarse spherical hard iron-manganese bluish-black nodules, non calcareous, very few roots,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: TS 0005

SAMPLE	DEPTH	pH	CaCl2	EC	P	C	weight %	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)										CECclay	METH	PRETR
				mS/cm	ppm			µ-----à					%	vcS	cs	mS	fS	vfS	csI	fSI	Clay	meq/100gr				
A	0	20	6.2	5.2	0.0	2	0.2	4.6	1.0	0.4	0.5	0.0	41	2	15	21	29	12	9	3	9	41	H	A		
B	40	60	5.5	4.7	0.0	1	0.2	4.8	1.0	0.6	0.3	0.0	40	3	15	22	26	10	7	3	15	27	H	A		
C	80	100	5.5	5.0	0.0	1	0.2	5.2	1.0	0.8	0.2	0.0	38	4	12	27	22	10	8	2	16	27	H	A		

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: TS 0003 Unit: G06 Status: 2

SHEET : 2327B1
LOCATION : Sunnyside farm (middle of field at back road).
AUTHOR(S): A.Remmelzwaal B.C.Moganane
CLASSIFICATION FAO: Rhodi-Areni-Haplic Lixisol(1988) Arenic Ferric Luvisol (1974)
ST : Arenic kandic Rhodustalf
LANDFORM : plain
TOPOGRAPHY: almost flat
SURF. CHAR: no cracks, nil evidence of salt,
LAND USE: commercial dryland farming
SPECIES : Trees - Combretum apiculatum (dom.)
 : Shrubs -
 : Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: slightly moist 0 - 100 cm
SURF.STONES: none
EROSION : nil

GRID : NE-755-539
COORD: 23-01-39-S 27-44-06-E
DATE : 29/07/82
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: savanna
SMR: ustic to aridic
POSITION: lower part
SLOPE : 0 - 1 %
GRASSCOVER:
ROCK TYPE: gneiss
ROCK OUTCROP: none
GEOL.UNIT: Basement complex
DRAINAGE : well to moderately well drained
HUMAN INF: ploughing

REMARKS: Depth of ground water table fairly shallow (approx. 3m)

SAMPLES: A: 0 - 20 B: 40 - 60 C: 80 - 100

Ap 0 - 35 cm 7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), coarse sand to loamy coarse sand, massive structure, hard, common very fine and fine pores, non calcareous, few roots, abrupt wavy boundary.
Bt1 35 - 65 cm 3.5YR 4/6 (moist) and 3.5YR 5/6 (dry), loamy coarse sand, weakly coherent massive structure, friable, patchy thin clay cutans, common very fine and fine pores, non calcareous, few roots, gradual smooth boundary.
Bt2 65 - 100 cm 2.5YR 5/6 (moist) and 2.5YR 5/6 (dry), coarse sandy loam, weakly coherent massive structure, friable, patchy thin clay cutans, few fine and medium pores, non calcareous, abrupt wavy boundary.
C 100 cm + dominant fine and medium rounded quartz and very few coarse rounded gneiss rock fragments, frequent medium spherical soft manganiferous bluish-black nodules, non calcareous,

Soil Survey of Botswana FAO/BOT/85/011 print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: TS 0003

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR	

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: M 0224 Unit: G06a Status: 2

SHEET : 2326B1
 LOCATION : 10km W. of Mahalapye, along Shoshong road.
 AUTHOR(S): A. Remmalzwaal G.M. Segonetsa
 CLASSIFICATION FAO: Pale-Haplic Lixisol(1988) Ferric Luvisol (1974)
 ST : kandic Paleustalf
 LANDFORM : plain
 TOPOGRAPHY: gently undulating
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE: traditional dryland farming, crops: sorghum
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 30 , moist 30 - 160 cm
 SURF. STONES: none
 EROSION : nil

REMARKS: Sampled for micromorphology.

SAMPLES: A: 0 - 20 B: 35 - 50 C: 90 - 110 D: 140 - 150

A 0 - 25 cm 10YR 3/2 (moist) and 10YR 5/2 (dry), sandy loam, strongly coherent massive structure, very hard, many fine and medium pores, non calcareous, common roots, gradual smooth boundary.

Bt1 25 - 50 cm 5YR 4/4 (moist), sandy clay loam to sandy clay, very weak coarse subangular blocky structure, very hard firm to very firm, broken moderately thick clay cutans, many fine pores, non calcareous, few roots, gradual smooth boundary.

Bt2 50 - 140 cm 4YR 4/4 (moist), sandy clay loam to sandy clay, very weak coarse subangular blocky structure, very hard firm to very firm, broken moderately thick clay cutans, many fine pores, non calcareous, few roots, clear smooth boundary.

Bt3 140 - 150 cm 5YR 5.5/6 (moist), common medium prominent clear yellowish-red and common medium distinct clear yellow mottles, sandy clay loam to sandy clay, very weak coarse subangular blocky structure, very hard firm to very firm, broken moderately thick clay cutans, common fine pores, non calcareous, no roots, clear smooth boundary.

Bt4 150 - 160 cm 7.5YR 5/5 (moist) and 7.5YR 7/5 (dry), common coarse prominent sharp yellowish-red mottles, sandy clay loam to sandy clay, very weak coarse subangular blocky structure, very hard very friable, patchy thin cutans, common fine pores, non calcareous, no roots,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0224

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	MEH	PRETR				
		H2O	CaCl2	mS/cm	ppm	weight %	-----	meq/100gr soil	-----	-----	%	vcS	cS	mS	fS	vFS	cSi	fSi	Clay	meq/100gr			
A	0 20	6.7	6.1	0.0	13	0.6	7.6	3.6	1.5	0.8	0.0	78	8	21	19	16	6	8	7	16	33	P A	
B	35 50	6.2	5.1	0.0	4	0.5	8.6	2.5	1.2	0.9	0.1	54	7	17	15	12	5	5	6	33	20	P A	
C	90 110	5.3	4.9	0.0	2	0.3	9.9	2.8	1.5	1.0	0.0	54	8	15	13	12	7	4	6	36	25	P A	
D	140 150	5.7	5.1	0.0	2	0.3	9.1	3.2	1.7	0.7	0.0	62	10	18	14	10	7	7	1	34	23	P A	
Soil Survey of Botswana EAO/BOT/85/011																					Print date: 24/01/89		

PART SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SHEET : 2327B2
 LOCATION : APRU Seleka demonstration farm.
 AUTHOR(S) : A. Remmelzwaal
 CLASSIFICATION FAO: Rhodi-Chromic Luvisol (1988) Chromic Luvisol (1974) petric (skeletal) phase
 ST : Typic Rhodustalf
 LANDFORM : plain
 TOPOGRAPHY: undulating
 SURF. CHAR: no sealing, no cracks, nil evidence of salt,
 LAND USE: commercial grazing
 SPECIES : Trees - Acacia nigrescens (dom.)
 : Shrubs - Acacia nigrescens (dom.) Acacia mellifera Acacia tortilis subs. heterocantha Grewia flava
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 90 cm
 SURF. STONES: none
 EROSION : nil

GRID : NE-813-532
 COORD: 23-01-37-S 27-46-46-E
 DATE : 28/08/80
 AGRO CLIM. ZONE: 2D3
 ELEVATION : 811 m
 SMR: ustic to aridic
 POSITION: lower slope
 SLOPE : 2 - 3 %
 GRASSCOVER: 30 - 70 %
 GEOL. UNIT: Basement complex
 DRAINAGE : well drained
 HUMAN INF: nil

REMARKS: 1050m Side road N. Catena with TS5 and TS6 (upslope), 100m down Calcic Luvisols and calcrete, 300m down in valley 200m wide strip of Pellic Vertisols.

SAMPLES: A: 0 - 20 B: 45 - 55 C: 80 - 90

- A 0 - 22 cm 5YR 3/4 (moist) and 5YR 4/5 (dry), coarse sandy loam, very weak subangular blocky structure, very hard, many fine pores, very few medium quartz rock fragments, non calcareous, common roots, clear smooth boundary.
- Bt 22 - 75 cm 1YR 2.5/6 (moist) and 1YR 3/6 (dry), sandy clay loam, very weak subangular blocky structure, very hard, broken thin cutans, many fine pores, few medium quartz rock fragments, non calcareous, common roots, clear wavy boundary.
- C 75 - 90 cm 1YR 2.5/6 (moist) and 1YR 3/6 (dry), sandy clay loam, strongly coherent massive structure, very hard, weakly cemented, very frequent medium and coarse quartz rock fragments, non calcareous, few roots,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: TS 0007

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
		H2O	CaCL2	ppm	weight %	à-----	meq/100gr soil	-----	ù	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr				
A	0 20	6.7	5.9	0.0	3	0.2	8.0	5.5	0.7	0.5	0.2	86	9	23	18	19	8	6	6	11	63	H	A
B	45 55	7.0	6.3	0.0	1	0.1	9.0	6.8	1.0	0.1	0.2	90	8	20	18	19	8	5	5	17	52	H	A
C	80 90	7.3	6.7	0.0	1	0.2	9.8	4.4	0.8	0.1	0.2	56	12	20	21	15	6	5	5	15	59	H	A

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Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: M 0083 Unit: G09 Status: 2

SHEET : 2326B1
LOCATION : 500m S. of Morale hills.
AUTHOR(S): A.Remmelzwaal G.M.Segonetso
CLASSIFICATION FAO: Chromic Luvisol(1988) Chromic Luvisol (1974)
LANDFORM : pediment
TOPOGRAPHY: gently undulating
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing
SPECIES : Trees - Acacia nigrescens (dom.) Acacia nilotica Combretum apiculatum
: Shrubs - Acacia tortilis subs. heterocantha Dichrostachys cinerea
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 140 cm
SURF.STONES: none
EROSION : slight gully erosion

GRID : ME-712-383
COORD: 23-09-58-S 26-43-02-E
DATE : 26/03/80

AGRO CLIM.ZONE: 1D3
ELEVATION : 1052 m
SMR: ustic

LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: savanna

POSITION: upper slope
SLOPE : 3 - 4 %
GRASSCOVER:

ROCK TYPE: gneiss
ROCK OUTCROP: none

GEOLOGICAL UNIT: Basement complex
DRAINAGE : well drained
HUMAN INT: nil

REMARKS: Samples for micromorphology taken at 10-20, 40-50, 70-80 and 110-120cm. Transitional to Ferric Luvisol G6a, also to Eutric Nitosol G14.

SAMPLES: B: 40 - 50 A: 0 - 20 B: 40 - 50 C: 70 - 80 D: 110 - 120

A 0 - 30 cm 7.5YR 4/3 (moist) and 7.5YR 5/3 (dry), coarse sandy loam, very weak medium and coarse subangular blocky structure, hard, common very fine and fine pores, very few fine quartz rock fragments, non calcareous, common roots, gradual smooth boundary.
Bt1 30 - 70 cm 7.5YR 4/6 (moist) and 7.5YR 5/6 (dry), coarse sandy loam, very weak coarse and very coarse subangular blocky structure, hard, broken thin clay cutans, common very fine and fine pores, very few fine quartz rock fragments, non calcareous, few roots, gradual smooth boundary.
BC 70 - 140 cm 5YR 4/6 (moist) and 5YR 4.5/6 (dry), sandy clay loam, very weak very coarse subangular blocky structure, hard, continuous moderately thick clay cutans, common very fine and fine pores, very few fine quartz rock fragments, non calcareous, clear wavy boundary.
BC 140 cm + 5YR 4/6 (moist) and 5YR 4.5/6 (dry), sandy clay loam, massive structure, hard, very frequent medium quartz rock fragments,

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print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0083

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
		H2O	CaCl2	mS/cm	ppm	weight %	-----	meq/100gr	soil	-----	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
B	40	50	6.2	5.6	0.0	0.3	5.7	2.5	0.9	0.3	0.1	67	13	26	18	16	8	4	3	12	37	H	A
A	0	20	6.0	5.2	0.0	0.7	7.0	3.5	1.0	0.4	0.0	70	8	24	17	17	7	7	7	13	32	H	A
B	40	50	6.2	5.6	0.0	0.3	5.7	2.5	0.9	0.3	0.1	67	13	26	18	16	8	4	3	12	37	H	A
C	70	80	6.2	5.6	0.0	1	6.6	3.2	1.1	0.3	0.1	71	14	22	17	13	5	8	3	19	31	P	A
D	110	120	5.8	5.2	0.0	1	8.8	3.8	1.8	0.3	0.1	68	10	19	15	13	7	4	3	29	26	H	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: M 0361 Unit: G11 Status: 2

SHEET : 2326B1
LOCATION : 8km W of Mahalapye.
AUTHOR(S): A. Remmelzwaal B.G. Moganane
CLASSIFICATION FAO: Albic Plinthosol(1988) Plinthic Luvisol (1974)
ST : Albic Plinthustalf
LANDFORM : plain
TOPOGRAPHY: gently undulating
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: partly mechan. dryland farming, crops: sorghum
SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs -
PARENT MATERIAL: in situ weathered
MOIST. COND: moist 0 - 95 cm
SURF. STONES: very few stones
EROSION :
GRID : ME-744-452
COORD: 23-06-20-S 26-44-57-E
DATE : 20/10/82
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: termite mounds
VEGETATION:
AGRO CLIM. ZONE: ID3
ELEVATION : 1027 m
SMR: ustic
POSITION: intermediate part
SLOPE : 1 - 2 %
GRASSCOVER:
ROCK TYPE: granite
ROCK OUTCROP: none
GEOLOG. UNIT: Mahalapye migmatite
DRAINAGE : moderately well drained
HUMAN INT: ploughing

REMARKS: Trial plot Agric. Research (dry land farming). Mottling pattern in B horizon coarse prominent sharp grey and red, red mottles very firm and moderately cemented. B horizon interpreted as plinthite. Transitional to Plinthic Acrisol/Plinthustult.

SAMPLES: A: 0 - 20 B: 25 - 40 C: 60 - 80

Ap 0 - 20 cm 10YR 3/2.5 (moist), loamy sand to loamy coarse sand, weakly coherent massive structure, friable, common very fine and fine pores, very few fine quartz rock fragments, non calcareous, abrupt wavy boundary.
E 20 - 40 cm 7.5YR 4/2 (moist), coarse sandy loam, friable, common very fine and fine pores, frequent fine and medium quartz rock fragments, non calcareous, few roots, clear smooth boundary.
Bt 40 - 95 cm 7.5YR 5/3 and 10R 3/8 mottled (moist), sandy clay loam, weakly coherent massive structure, friable, patchy thin clay cutans random, partly cemented, few very fine and fine pores, very frequent coarse quartz rock fragments, frequent medium spherical hard and soft iron-manganese red concretions, non calcareous, very few roots,

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STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0361

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR			
		H2O CaCL2	mS/cm	ppm	weight %	%	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	csi	fSi	Clay	meq/100gr		
A	0 20	5.3 4.8	0.0	5	0.5	4.3	2.0	0.7	0.4	0.0	72	8	16	19	23	14	8	3	10	24	P	A
B	25 40	5.7 5.2	0.0	3	0.3	5.8	1.9	0.8	0.3	0.1	53	18	22	17	14	8	1	3	18	26	P	A
C	60 80	4.9 4.2	0.0	1	0.2	7.9	1.7	2.0	0.3	0.1	52	14	21	15	8	7	4	4	28	25	P	A
Soil Survey of Botswana FAO/BOT/85/011																						
Print date: 24/01/89																						

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SHEET : 2326B1
 LOCATION : 8km W of Mahalapye.
 AUTHOR(S): A. Remmelzwaal B.G.Moganane
 CLASSIFICATION FAO: Calci-Stagnic Luvisol(1988) Gleyic Luvisol (1974)
 ST : Aeric Ochraqualf
 LANDFORM : plain
 TOPOGRAPHY: almost flat
 SURF. CHAR: moderate sealing, no cracks, nil evidence of salt,
 LAND USE: partly mechan. dryland farming, crops: sorghum
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs -
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 130 cm
 SURF. STONES: none
 EROSION : nil

GRID : ME-744-452
 COORD: 23-06-20-S 26-44-57-E
 DATE : 11/03/83

AGRO CLIM.ZONE: 1D3
 ELEVATION : 1026 m
 SMR: aquic to ustic

LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even

VEGETATION:
 ROCK TYPE: granite
 ROCK OUTCROP: none

GEOL.UNIT: Mahalapye migmatite
 DRAINAGE : imperfectly drained
 HUMAN INF: ploughing

REMARKS: Trial plot Agric.Research (dryland farming). 100m downslope from M361. Sorghum survived severe drought at M361, less at M362. Hydromorphic properties marginal. Organic C see-
 ms too high.

SAMPLES: A: 0 - 20 B: 25 - 45 C: 55 - 75 D: 90 - 110

Ap 0 - 25 cm 10YR 3/2 (moist) and 10YR 4/2 (dry), sandy clay loam, strongly coherent massive structure, very hard, very few fine quartz rock fragments, non calcareous, clear irregular boundary.

Btg1 25 - 45 cm 10YR 3/2 and 7.5YR 4.5/5 (dry), sandy clay, very weak very coarse prismatic structure, very hard, broken moderately thick clay cutans, very few fine quartz rock fragments, non calcareous, very few roots, clear irregular boundary.

Btg2 45 - 80 cm 10YR 4/2 (moist) and 10YR 5/2 (dry), common medium faint diffuse brownish mottles, sandy clay, weak to moderate very coarse prismatic structure, very hard, broken moderately thick clay cutans, very few fine quartz rock fragments, slightly calcareous, very few roots, clear irregular boundary.

Ck 80 - 110 cm 10YR 4.5/2.5 (moist) and 10YR 6/2.5 (dry), common medium faint diffuse brownish mottles, sandy clay, massive structure, hard, very few fine quartz rock fragments, strongly calcareous, clear wavy boundary.

Cck 110 - 130 cm 4YR 6/3 (moist) and 4YR 7/3 (dry), massive structure, hard, weakly cemented, frequent fine and medium quartz rock fragments, dominant medium hard and soft calcareous white nodules, extremely calcareous, no roots,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0362

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)							CECclay	METH	PRETR			
		H2O	CaCl2	mS/cm	ppm	weight %	-----	meq/100gr soil	-----	-----	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr				
A	0	20	5.9	5.3	0.0	2	0.9	15.7	9.1	2.2	0.6	0.0	76	9	15	15	14	9	8	4	27	46	P	A
B	25	45	6.3	5.8	0.0	1	0.5	21.6	13.8	3.4	0.3	0.1	81	13	15	9	9	8	4	3	40	49	P	A
C	55	75	7.5	7.1	0.0	1	0.3	22.3	17.9	4.0	0.3	0.1	100	10	12	10	11	8	6	5	39	54	P	A
D	90	110	8.1	7.5	0.0	1	0.3	21.4	35.8	3.9	0.4	0.2	100	5	10	11	12	10	6	8	39	52	P	A

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PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: MC 0901 Unit: G13a Status: 1

SHEET : 2327A4
 LOCATION : 2km W of Makwate.
 AUTHOR(S): A.B.Price M.D.Mays
 CLASSIFICATION FAO: Petri-Calcic Luvisol(1988) Calcic Luvisol (1974) petrocalcic phase
 ST : Petrocalcic Paleustalf

LANDFORM : plain
 TOPOGRAPHY: almost flat
 SURF. CHAR: moderate sealing, no cracks, nil evidence of salt,
 LAND USE: traditional dryland farming, crops: sorghum
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-

PARENT MATERIAL: in situ weathered
 MOIST. COND: slightly moist 0 - 85 cm
 SURF.STONES: none
 EROSION : moderate sheet erosion

REMARKS: USDA Pedon no.2 (Ustolic Paleargid), with minor modifications. Soil material partly colluviated. US coordinates not correct. Site is before village S of road.

SAMPLES: A: 0 - 0 B: 0 - 0 C: 0 - 0 D: 0 - 0

Ap1 0 - 5 cm 5YR 3/2 (moist) and 5YR 3/4 (dry), sandy loam (11% clay), moderate coarse platy falling apart into moderate medium granular structure, soft very friable, non sticky non plastic, common very fine pores, few infilled burrows, common very fine roots, abrupt wavy boundary.

Ap2 5 - 16 cm 5YR 3/3 (moist) and 5YR 3/4 (dry), sandy loam (14% clay), weak medium subangular blocky structure, soft very friable, slightly sticky non plastic, common very fine pores, non calcareous, few infilled burrows, common very fine roots, clear wavy boundary.

Bt1 16 - 30 cm 4YR 3/3 (moist) and 4YR 3/4 (dry), sandy loam (19% clay), weak coarse prismatic falling apart into weak subangular and angular blocky structure, slightly hard friable, sticky slightly plastic, patchy thin clay cutans, non calcareous, few infilled burrows, few very fine roots, clear wavy boundary.

Bt2 30 - 61 cm 3.5YR 3/4 (moist) and 3.5YR 3/6 (dry), sandy clay (28% clay), moderate coarse prismatic falling apart into weak coarse subangular and angular blocky structure, slightly hard to hard friable, sticky plastic, patchy thin clay cutans, non calcareous, few very fine roots, abrupt irregular boundary.

Cmk 61 - 85 cm 7.5YR 7/4 (moist) and 7.5YR 8/4 (dry), strongly coherent massive structure, extremely hard extremely firm, non sticky non plastic, cemented, extremely calcareous, no roots,

Soil Survey of Botswana FAO/BCOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: MC 0901

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)							CECclay	METH	PRETR	
		H2O	CaCl2	mS/cm	ppm	weight %	-----	meq/100gr soil	-----	-----	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0	0	6.9	5.9	0.5	3	0.6	8.5	3.8	1.3	0.6	0.1	68	12	27	19	17	8	4	2	12	51
B	0	0	6.7	5.3	0.2	4	0.7	8.0	3.7	1.2	0.6	0.1	70	11	20	18	20	10	5	3	14	37
C	0	0	6.5	5.4	0.2	2	0.5	8.5	4.4	1.5	0.4	0.1	75	22	23	15	13	6	2	3	15	43
D	0	0	6.7	5.8	0.7	2	0.4	9.8	5.2	1.5	0.3	0.1	72	10	19	16	18	10	4	2	22	37

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PART-SIZE DETERMINATION PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PHYSICAL PROPERTIES

PROFILE: MC 0901

INFILTRATION

No.	Basic (cm/hr)	a	n
1	0.0	0.00	0.00
2	0.0	0.00	0.00
3	0.0	0.00	0.00

METHODS.

Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F = at^n$ where
 F = cumulative infiltration (cm) and t = elapsed time (min)
 Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core
 Moisture Retention: Tension <= 1 bar on core or clods; Tension > 1 bar on <2mm crushed samples
 Structural Stability Index: on >1mm sieved samples <2mm of surface soil, relative collapse larger pores on slow & fast wetting

SURFACE STRUCTURE STABILITY INDEX: 0.00

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)			
A	0 5	1.70 CL	0.03bar 0.05bar 0.1bar 0.3bar 1.0bar 3.0bar 5.0bar 15.0bar	14.10	9.10	3.5
B	0 0	1.70 CL		12.40	9.20	3.5
C	16 30	1.63 CL		11.70	9.20	5.4
D	30 61	1.59 CL		13.30	10.60	5.5

REMARKS: used clods for moisture retention

Soil Survey of Botswana FAO/BOT/85/011

Print date: 26/01/89

SOIL PROFILE DESCRIPTION

Profile: SH 0902 Unit: G14 Status: 1

SHEET : 2326B1
LOCATION : 9km SE of Shoshong(Marutwe).
AUTHOR(S): A.B.Price M.D.Mays A.Rommelzwaal
CLASSIFICATION FAO: Rhodi-Pale-Chromic Luvisol(1988) Eutric Nitosol (1974)

ST : Typic Paleustalf ; fine loamy mixed hyperthermic

LANDFORM : pediment

TOPOGRAPHY : gently undulating

SURF. CHAR: slight sealing, no cracks, nil evidence of salt,

LAND USE: partly mechan. dryland farming, crops: sorghum

SPECIES : Trees -

: Shrubs -

: Grasses/forbs-

PARENT MATERIAL: in situ weathered

MOIST. COND: moist 0 - 30 , dry 30 - 158 cm

SURF.STONES: none

EROSION : moderate sheet erosion

GRID : ME-550-447

COORD: 23-06-40-S 26-33-40-E

DATE : 18/03/86

AGRO CLIM.ZONE: ID3

ELEVATION : 1055 m

SMR: ustic

LAND ELEMENT : not applicable

MICRO TOPOGRAPHY: even

POSITION: middle slope

SLOPE : 1 - 2 % straight

VEGETATION:

GRASSCOVER:

ROCK TYPE: granite

GEOLOG UNIT: Mahalapye migmatite

DRAINAGE : well drained

ROCK OUTCROP: none

HUMAN INF: ploughing

REMARKS: USDA Pedon no.3 (Aridic Paleustalf) with minor modifications. Excursion site FAO EASC meeting 3-4-87. Soil material alluvial reworked.

SAMPLES: A: 0 - 18 B: 18 - 34 C: 34 - 68 D: 68 - 99 E: 99 - 129 F: 129 - 158

Ap 0 - 18 cm 5YR 3/3 (moist) and 7.5YR 4/4 (dry), loamy coarse sand (10% clay), weak medium subangular blocky structure, soft very friable, non sticky slightly plastic, common very fine and fine pores, very few fine angular quartz rock fragments, non calcareous, few very fine roots, clear wavy boundary.

Bt1 18 - 34 cm 5YR 3/4 (moist) and 5YR 4/4 (dry), sandy clay loam (30% clay), weak coarse subangular blocky structure, hard friable, sticky slightly plastic, patchy thin clay cutans on pores, common very fine and few coarse pores, very few fine angular quartz rock fragments, non calcareous, few very fine roots, gradual wavy boundary.

Bt2 34 - 68 cm 5YR 3.5/4 (moist) and 5YR 4/4 (dry), sandy clay loam (30% clay), weak coarse and very coarse subangular blocky structure, hard friable, sticky plastic, broken moderately thick clay cutans on pedfaces and moderately thick clay cutans on pores, common very fine and few coarse pores, very few fine angular quartz rock fragments, non calcareous, few very fine roots, diffuse wavy boundary.

Bt3 68 - 99 cm 5YR 4/4 (moist) and 5YR 4/4 (dry), sandy clay loam (30% clay), weak coarse and very coarse subangular blocky structure, hard friable, sticky plastic, broken moderately thick clay cutans on pedfaces and moderately thick clay cutans on pores, common very fine and few coarse pores, very few fine angular quartz rock fragments, non calcareous, very few very fine roots, gradual wavy boundary.

Bt4 99 - 129 cm 5YR 4/4 (moist) and 5YR 4.5/4 (dry), common medium prominent clear red mottles, sandy clay loam to sandy clay (33% clay), weak coarse and very coarse subangular blocky structure, hard friable, sticky plastic, broken moderately thick clay cutans on pedfaces and moderately thick clay cutans on pores, common very fine and few coarse pores, few fine and medium angular quartz rock fragments, non calcareous, clear wavy boundary.

BCco 129 - 158 cm 7.5YR 4/4 (moist) and 7.5YR 4+ /4 (dry), sandy clay loam to sandy clay (33% clay), massive structure, hard friable, sticky plastic, frequent fine and medium angular quartz and few angular weathered granite rock fragments, few medium spherical hard iron-manganese bluish-black concretions, non calcareous,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: SH 0902

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR			
		H2O	CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0	18	5.4	4.5	0.0	6	0.3	3.6	1.0	0.4	0.5	0.2	58	14	37	15	12	9	2	3	8	30
B	18	34	5.6	5.3	0.0	10	0.5	6.5	2.9	1.3	0.6	0.1	75	15	30	15	12	7	2	2	17	26
C	34	68	6.7	5.7	0.0	2	0.2	7.4	3.5	1.6	0.5	0.1	77	13	29	14	12	7	2	2	21	31
D	68	99	6.3	5.7	0.0	4	0.3	7.4	3.7	1.8	0.5	0.2	84	15	30	13	10	6	1	3	22	28
E	99	129	7.3	6.4	0.0	1	0.2	7.8	4.2	1.8	0.6	0.1	86	11	23	14	14	9	2	3	24	29
F	129	158	7.7	6.6	0.0	1	0.3	12.1	6.6	2.7	0.5	0.2	83	11	21	12	11	9	2	2	32	34

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PART.SIZE DETERMINATION
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PHYSICAL PROPERTIES

PROFILE: SH 0902

INFILTRATION

No.	Basic (cm/hr)	a	n
1	0.0	0.00	0.00
2	0.0	0.00	0.00
3	0.0	0.00	0.00

METHODS. Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F=at^n$ where F = cumulative infiltration (cm) and t =elapsed time (min)
 Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core
 Moisture Retention: Tension <=1bar on core or clods; Tension > 1bar on <2mm crushed samples
 Structural Stability Index: on >1mm sieved samples <2mm of surface soil, relative collapse larger pores on slow & fast wetting

SURFACE STRUCTURE STABILITY INDEX: 0.00

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)				
A	18 34	1.57 CL	13.70 10.90	0.03bar 0.05bar 0.1bar 0.3bar 1.0bar 3.0bar 5.0bar 15.0bar			
B	34 68	1.59 CL	13.80 11.40				6.5
C	68 99	1.55 CL	16.20 13.70				6.5
D	99 129	1.53 CL	17.00 13.80				8.2
E	129 158	1.43 CL	22.90 21.00				8.2
							9.3

REMARKS:Used clods for moisture retention

Soil Survey of Botswana FAO/BOT/85/011

Print date: 26/01/89

SOIL PROFILE DESCRIPTION		Profile: M 0295	Unit: G15	Status: 3
SHEET : 2226D3 LOCATION : 7km NW of Kalamare. AUTHOR(S): A.Remmelzwaal B.C.Moganane CLASSIFICATION FAO: Abrupti-Stagnic Solonetz(1988) Solodic Planosol (1974) ST : Typic Natrustalf LANDFORM : plain TOPOGRAPHY: rolling SURF. CHAR: no cracks, nil evidence of salt, LAND USE: traditional grazing SPECIES : Trees - Acacia karroo (dom.) Acacia tortilis subs. heterocantha Boscia albitrunca : Shrubs - Dichrostachys cinerea Euclea undulata : Grasses/forbs- PARENT MATERIAL: in situ weathered MOIST. COND: dry 0 - 110 cm SURF.STONES: none EROSION : strong gully erosion and strong sheet erosion REMARKS: Coluviated material. Topsoil eroded. SAMPLES: A: 30 - 40 B: 40 - 50 C: 80 - 100				
GRID : ME-513-706 COORD: 22-52-37-S 26-31-31-E DATE : 18/11/81 LAND ELEMENT : not applicable MICRO TOPOGRAPHY: even VEGETATION: savanna ROCK TYPE: granite ROCK OUTCROP: none AGRO CLIM.ZONE: 1D3 ELEVATION : 1230 m SMR: ustic POSITION: lower part SLOPE : 2 - 3 % GRASSCOVER: GEOL.UNIT: Mahalapye migmatite DRAINAGE : imperfectly drained HUMAN INF: nil				
AE 0 - 40 cm 9YR 4/3 (moist) and 9YR 5.5/3 (dry), loamy coarse sand, weakly coherent massive structure, slightly hard, few fine pores, few fine quartz rock fragments, non calcareous, no roots, abrupt smooth boundary. Bt1 40 - 80 cm 10YR 4/4 (moist) and 10YR 5/4 (dry), sandy clay loam, weak very coarse columnar to strongly coherent massive structure, extremely hard, continuous thick clay cutans, few fine quartz rock fragments, abrupt irregular boundary. Bt2 80 - 110 cm 10YR 5/4 (moist) and 10YR 6/4 (dry), common coarse distinct sharp yellow mottles, sandy clay loam, strongly coherent massive structure, extremely hard, broken thick clay cutans, few fine quartz rock fragments, slightly calcareous,				
Soil Survey of Botswana FAO/BOT/85/011 print date: 24/01/89				

STANDARD SOIL ANALYSIS RESULTS

PROFILE: M 0295

SAMPLE	DEPTH	pH	CaCl2	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
				mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
A	30	40	6.1	5.3	0.0	1	0.2	4.9	1.9	1.1	0.1	0.2	67	24	28	17	12	5	2	2	10	41	H	A
B	40	50	6.8	5.9	0.0	1	0.3	10.0	3.9	2.1	0.3	2.1	84	20	19	13	10	6	4	3	25	35	H	A
C	80	100	7.7	6.7	0.0	1	0.2	10.7	3.9	2.5	0.3	2.8	89	26	18	11	8	5	3	3	27	36	H	A

Soil Survey of Botswana FAO/BOT/85/011

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Print date: 24/01/89

SOIL PROFILE DESCRIPTION

Profile: DI 0901 Unit: KS03 Status: 1

SHEET : 2326C2
LOCATION : Dibete, 1.2km N along Francistown road.
AUTHOR(S): A.Rommelzwaal
CLASSIFICATION FAO: Ferralic Arenosol(1988) Ferralic Arenosol (1974)
ST : Ustic Quartzipsamment ; siliceous hyperthermic
LANDFORM : sand plain
TOPOGRAPHY: almost flat
SURF. CHAR: no sealing, no cracks, nil evidence of salt, bleached sand on surface
LAND USE: traditional grazing
SPECIES : Trees - Combretum apiculatum (dom.) Terminalia sericea Peltophorum africanum
: Shrubs - Grewia flava (dom.) Terminalia sericea Dichrostachys cinerea
: Grasses/forbs-
PARENT MATERIAL: aeolian sand
MOIST. COND: dry 0 - 170 cm
SURF. STONES: none
EROSION : nil

GRID : MO-467-755
COORD: 23-44-30-S 26-28-40-E
DATE : 24/06/86
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: savanna
SMR: ustic to aridic
POSITION: higher part
SLOPE : 0 - 1 % straight
GRASSCOVER: 30 - 70 %

GEOL.UNIT:
DRAINAGE : somewhat excessively drained
HUMAN INF: borrow pit

ROCK TYPE:
ROCK OUTCROP: none

REMARKS: USDA Pedon no.17 (Typic Torripsament) with minor modifications. Excursion site FAO EASC meeting (3-4-87).

SAMPLES: A: 0 - 25 B: 25 - 45 C: 50 - 75 D: 85 - 115 E: 125 - 170

A1 0 - 25 cm 10YR 4/4 (moist) and 10YR 5/4 (dry), fine sand (3% clay), very weak medium and coarse subangular blocky structure, soft loose, non sticky non plastic, common very fine and fine pores, non calcareous, many infilled burrows, many very fine and fine roots, gradual smooth boundary.

A2 25 - 46 cm 10YR 4.5/4.5 (moist) and 10YR 5/4 (dry), fine sand (3% clay), very weak medium to very coarse subangular blocky structure, soft loose, non sticky non plastic, common very fine and fine pores, non calcareous, many very fine and fine roots, gradual smooth boundary.

B1 80 - 120 cm 9YR 5/8 (moist) and 9YR 5.5/6 (dry), fine sand (3% clay), very weak medium to very coarse subangular blocky structure, soft loose, non sticky non plastic, few very fine and fine pores, non calcareous, common infilled burrows, common very fine and fine and few medium and coarse roots, diffuse smooth boundary.

B2 80 - 120 cm 9YR 5/8 (moist) and 9YR 6/8 (dry), fine sand (3% clay), very weak very coarse subangular blocky structure, slightly hard loose, non sticky non plastic, few very fine and fine pores, non calcareous, few infilled burrows, common very fine and fine and few medium and coarse roots, diffuse smooth boundary.

B3 120 - 170 cm 7.5YR 5/7 (moist) and 7.5YR 6/7 (dry), fine sand (3% clay), weakly coherent massive structure, slightly hard loose, non sticky non plastic, few very fine and fine pores, non calcareous, few very fine and fine and few medium and coarse roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: DI 0901

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR		
		H2O	CaCL2	mS/cm	ppm	weight %	-----	meq/100gr soil	-----	-----	%	vcS	cS	mS	fS	vfs	cSi	fSi	Clay	meq/100gr	
A	0 25	5.2	4.3	0.0	3	0.2	1.1	0.5	0.1	0.1	0.0	64	0	4	32	48	11	0	1	3	10
B	25 45	4.9	4.0	0.0	3	0.1	1.2	0.3	0.1	0.1	0.0	42	0	3	25	51	15	1	1	4	20
C	50 75	4.6	3.8	0.0	3	0.1	1.0	0.3	0.0	0.1	0.0	40	0	5	37	44	8	1	1	3	20
D	85 115	4.7	3.9	0.0	2	0.0	1.1	0.4	0.1	0.1	0.0	55	0	5	32	46	11	1	2	4	28
	125 170	5.0	4.0	0.0	2	0.0	1.0	0.4	0.1	0.1	0.0	60	0	5	34	46	9	0	1	5	20

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PHYSICAL PROPERTIES

PROFILE: DI 0901

INFILTRATION			
No.	Basic (cm/hr)	a	n
1	0.0	0.00	0.00
2	0.0	0.00	0.00
3	0.0	0.00	0.00

METHODS. Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F = at^n$ where F = cumulative infiltration (cm) and t=elapsed time (min)
 Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core
 Moisture Retention: Tension <=1bar on core or clods; Tension > 1bar on <2mm crushed samples
 Structural Stability Index: on >1mm sieved samples <2mm of surface soil, relative collapse larger pores on slow & fast wetting

SURFACE STRUCTURE STABILITY INDEX: 0.00

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)	
A	0 25	1.57 CL	0.03bar 0.05bar 0.1bar 0.3bar 1.0bar 3.0bar 5.0bar 15.0bar	1.2
B	25 46	1.63 CL		1.2
C	120 170	1.77 CL		1.2

REMARKS: used clods for moisture retention

Soil Survey of Botswana FAO/BOT/85/011

Print date: 26/01/89

SOIL PROFILE DESCRIPTION		Profile: S 0010 Unit: KS05 Status: 2	
SHEET : 2226B3 LOCATION : 10km W of Serowe. AUTHOR(S): A.Remmelzwaal CLASSIFICATION FAO: Rhodi-Luvic Arenosol(1988) Ferralic Arenosol (1974) ST : Ustic Quartzipsamment LANDFORM : plateau TOPOGRAPHY: undulating SURF. CHAR: no sealing, no cracks, nil evidence of salt, bleached sand on surface LAND USE: traditional grazing SPECIES : Trees - Terminalia sericea (dom.) Ochra pulchra Combretum apiculatum Peitophorum africanum Acacia nigrescens : Shrubs - Croton gratusimus (dom.) Terminalia sericea Combretum apiculatum Acacia fleckii Grewia flava Dichrostachys cinerea : Grasses/forbs- PARENT MATERIAL: aeolian sand MOIST. COND: moist 0 - 20 , dry 20 - 220 cm SURF.STONES: none EROSION : slight wind erosion/deposition and slight sheet erosion		GRID : MF-598-249 COORD: 22-22-57-S 26-36-32-E DATE : 10/12/79 LAND ELEMENT : MICRO TOPOGRAPHY: even VEGETATION: dense savanna AGRO CLIM.ZONE: ID3 ELEVATION : 1210 m SMR: ustic POSITION: lower part SLOPE : 2 - 4 % GRASSCOVER: 30 - 70 % GEOL.UNIT: DRAINAGE : somewhat excessively drained HUMAN INF: nil	
ROCK TYPE: ROCK OUTCROP: none			
REMARKS: Revisited and resampled 16-3-83. At escarpment edge of plateau. Previous analysis indicated transition to Arenic Ferric Luvisol-KS7			
SAMPLES: A: 0 - 20 B: 50 - 65 X: 0 - 0 Y: 0 - 0			
A 0 - 40 cm 5YR 3/5 (moist) and 5YR 4/4 (dry), fine sand (5% clay), weak medium and coarse subangular blocky structure, hard very friable, non sticky non plastic, common fine and medium pores, non calcareous, common roots, diffuse smooth boundary.			
B1 40 - 75 cm 3.5Y 3/6 (moist) and 3.5Y 4/6 (dry), fine sand (7% clay), very weak coarse subangular blocky structure, hard friable, non sticky non plastic, few fine and medium pores, non calcareous, few roots, diffuse smooth boundary.			
Bt1 75 - 150 cm 2.5YR 3/6 (moist) and 2.5YR 4/6 (dry), fine sand to loamy fine sand (10% clay), very weak very coarse subangular blocky structure, hard friable, non sticky non plastic, patchy thin clay cutans on pedfaces, many fine pores, non calcareous, few coarse roots, diffuse smooth boundary.			
Bt2 150 - 220 cm 2.5YR 3/6 (moist) and 2.5YR 4/6 (dry), loamy fine sand (12% clay), massive structure, hard friable, non sticky non plastic, patchy thin clay cutans, many fine pores, non calcareous, very few roots,			
Soil Survey of Botswana FAO/BOT/85/011		print date: 24/01/89	

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0010

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
		H2O	CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
A	0 20	6.5	5.8	0.0	4	0.4	4.3	2.0	0.7	0.1	0.0	65	0	2	14	60	18	2	1	4	66	H	A
B	50 65	6.3	5.7	0.0	2	0.2	3.7	1.0	1.0	0.1	0.1	59	0	2	13	62	16	2	2	5	58	H	A
X	0 0	5.4	4.8	0.0	1	0.1	3.8	0.7	1.3	0.1	0.0	55	0	2	18	59	13	1	2	6	59	H	A
Y	0 0	5.9	5.4	0.0	1	0.1	4.3	0.8	1.4	0.1	0.0	53	0	2	15	58	13	1	1	8	47	H	A
Soil Survey of Botswana FAO/BOT/85/011																				Print date: 24/01/89			

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: S 0002 Unit: S05 Status: 1

SHEET : 2226B4
LOCATION : 13km ESE of Serowe just N of Palapye road.
AUTHOR(S): A.Remmelzwaal
CLASSIFICATION FAO: Rhodi-Luvic Arenosol(1988) Ferralic Arenosol (1974)
ST : Ustic Quartzipsamment

LANDFORM : plain
TOPOGRAPHY: undulating
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing
SPECIES : Trees - Combretum apiculatum (dom.) Acacia erioloba Dombeya rotundifolia Sclerocarya caffra Pappea capensis Kirkia acuminata
: Shrubs - Terminalia sericea (dom.) Acacia tortilis subs. heterocantha Acacia gerrardii Grewia bicolor Euclea divinorum Colophospermum mopane
: Grasses/forbs-

PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 260 cm
SURF.STONES: none
EROSION : slight sheet erosion and slight gully erosion

GRID : MF-820-195
COORD: 22-25-57-S 26-49-30-E
DATE : 14/08/79

AGRO CLIM.ZONE: ID3
ELEVATION : 1088 m
SMR: ustic to aridic
POSITION: middle slope
SLOPE : 3 - 4 % straight
GRASSCOVER: 30 - 70 %

VEGETATION: savanna
MICRO TOPOGRAPHY: termite mounds
LAND ELEMENT : interfluv

ROCK TYPE: quartzitic sandstone
ROCK OUTCROP: very few rocky

GEOLOGICAL UNIT: Karoo Ntane fm
DRAINAGE : well to somewhat excessively drained
HUMAN INF: nil

REMARKS: Near large outcrop, thin red/black Fe/Mn bands in C horizon. CEC slightly high for ferralic.

SAMPLES: A: 0 - 20 B: 30 - 50 C: 90 - 110 D: 140 - 160 E: 170 - 190 F: 190 - 210

A 0 - 25 cm 5YR 3/4 (moist) and 5YR 4/4 (dry), fine sand, very weak coarse subangular blocky structure, slightly hard, many very fine and fine pores, non calcareous, common termite/ant activity, common fine and medium roots, gradual smooth boundary.

Bt1 25 - 55 cm 2.5YR 3.5/5 (moist) and 2.5YR 4.5/5 (dry), fine sand, very weak very coarse subangular blocky structure, hard, patchy thin clay cutans on pedfaces, many very fine and fine pores, non calcareous, common termite/ant activity, common fine and medium roots, diffuse smooth boundary.

Bt2 55 - 170 cm 2.5YR 4/7 (moist) and 2.5YR 4.5/7 (dry), loamy fine sand, very weak very coarse subangular blocky structure, hard, broken moderately thick clay cutans on pedfaces, many very fine and fine pores, non calcareous, common termite/ant activity, few fine and medium roots, clear irregular boundary.

Bt3 170 - 190 cm 2.5YR 4/7 (moist) and 2.5YR 4.5/7 (dry), few medium faint diffuse reddish mottles, loamy fine sand, very weak very coarse subangular blocky structure, hard, broken moderately thick clay cutans on pedfaces, many very fine and fine pores, non calcareous, no roots, clear irregular boundary.

Cr 190 - 240 cm 5YR 5/6 (moist) and 5YR 6/7 (dry), loamy fine sand, strongly coherent massive structure, extremely hard, patchy cutans, non calcareous, no roots, diffuse irregular boundary.

R 240 cm + 2.5YR 7/2 (dry), extremely hard,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0002

SAMPLE	DEPTH	pH	EC	P	C	weight %	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)						CECclay	METH	PRETR			
													H2O	CaCl2	mS/cm	ppm	-----	-----				-----	-----	vcS
A	0	20	7.2	6.1	0.0	1	0.2	4.9	2.4	0.8	0.4	0.0	73	0	0	11	69	9	1	2	8	51	H	A
B	30	50	7.3	6.5	0.0	1	0.1	4.1	2.0	1.0	0.1	0.0	76	0	0	11	69	9	1	1	9	43	H	A
C	90	110	7.3	6.0	0.0	1	0.1	4.4	1.5	1.2	0.1	0.0	64	0	0	10	68	9	1	1	11	36	H	A
D	140	160	7.3	6.1	0.0	0	0.1	4.6	1.8	1.3	0.1	0.0	70	0	0	10	67	9	2	1	10	41	H	A
E	170	190	7.2	6.1	0.0	0	0.0	4.6	2.4	1.4	0.1	0.0	85	0	0	11	71	6	3	1	9	54	H	A
F	190	210	6.8	6.0	0.0	1	0.0	4.3	2.2	1.7	0.1	0.1	95	0	0	12	75	4	2	1	6	67	H	A

Soil Survey of Botswana FAO/BOT/85/011

PART SIZE DETERMINATION

METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known

PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Print date: 24/01/89

SOIL PROFILE DESCRIPTION

Profile: S 0013 Unit: S06 Status: 2

SHEET : 2226B3

LOCATION : NE of Serowe, 2.7km on road to Paje.

AUTHOR(S): A.Rummelzwaal

CLASSIFICATION FAO: Ferralic Arenosol(1988) Ferralic Arenosol (1974)

ST : Ustic Quartzipsamment

LANDFORM : hill

TOPOGRAPHY: undulating

SURF. CHAR: no sealing, no cracks, nil evidence of salt,

LAND USE: traditional grazing

SPECIES : Trees - *Peltophorum africanum* *Securidaca longi-pedunculata* *Terminalia sericea*

: Shrubs - *Acacia fleckii* (dcm.) *Croton gratissimus* *Combretum zeyheri* *Ziziphus mucronata*

: Grasses/forbs-

PARENT MATERIAL: aeolian sand over in situ weathered

MOIST. COND: dry 0 - 180 cm

SURF. STONES: none

EROSION : nil

GRID : MF-718-269

COORD: 22-21-57-S 26-43-36-E

DATE : 31/07/80

LAND ELEMENT : not applicable

MICRO TOPOGRAPHY: even

VEGETATION: savanna

ROCK TYPE: sandstone

ROCK OUTCROP: none

AGRO CLIM.ZONE: 2D3

ELEVATION : 1121 m

SMR: ustic to aridic

POSITION: upper slope

SLOPE : 3 - 4 %

GRASSCOVER:

GEOL.UNIT: Karoo Ntane fm

DRAINAGE : somewhat excessively drained

HUMAN INF: nil

REMARKS: Catena with S11 (middle slope) and S6 (bottom). Irregular clay lamellae 7.5yr4/6m , 3-6mm thick at 135, 150cm and 160cm (too deep to be diagnostic).

SAMPLES: A: 0 - 20 B: 50 - 70 C: 100 - 120 D: 145 - 165

A 0 - 45 cm 10YR 4.5/3.5 (moist) and 10YR 5.5/3.5 (dry), common medium distinct sharp white mottles, fine sand, very weak very coarse subangular blocky structure, slightly hard to hard, many very fine and fine and few medium pores, non calcareous, many roots, diffuse smooth boundary.

B1 45 - 85 cm 9YR 5/4 (moist) and 9YR 6/4 (dry), common medium distinct sharp white mottles, fine sand, massive structure, slightly hard to hard, many very fine and fine and few medium pores, non calcareous, few roots, diffuse smooth boundary.

B2 85 - 135 cm 8.5YR 5/5 (moist) and 8.5YR 6/5 (dry), few medium distinct sharp white mottles, fine sand, massive structure, hard, many very fine and fine pores, non calcareous, few roots, clear smooth boundary.

Bt 135 - 180 cm 7.5YR 6/6 (moist) and 7.5YR 7/6 (dry), few medium distinct sharp white mottles, fine sand, massive structure, hard, patchy thin clay cutans and continuous moderately thick clay lamellae, many fine and few fine and medium pores, non calcareous, very few roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0013

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)						CECclay	METH	PRETR				
		H2O	CaCl2	mS/cm	ppm	weight %	-----	meq/100gr soil	-----	-----	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr				
A	0 20	4.9	4.0	0.0	2	0.3	2.9	0.7	0.5	0.1	0.0	45	0	1	9	53	27	4	0	6	29	H A		
B	50 70	4.8	4.1	0.0	1	0.1	2.6	0.3	0.2	0.1	0.0	23	1	1	8	52	28	4	0	5	42	H A		
C	100 120	4.9	3.9	0.0	1	0.1	2.3	0.4	0.3	0.1	0.0	35	0	1	10	53	27	3	0	6	34	H A		
D	145 165	4.5	3.8	0.0	1	0.0	2.2	0.3	0.4	0.1	0.0	36	0	1	12	54	24	2	1	5	43	H A		
Soil Survey of Botswana																							FAO/BOT/85/011	Print date: 24/01/89

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART-SIZE DETERMINATION

METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known

PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: S 0507 Unit: S07 Status: 2

GRID : MF-828-363

COORD: 22-26-58-S 26-49-58-E
ELEVATION : 1110 m

DATE : 15/07/82

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EXHIBIT: NATIONAL OPEN SOURCE

Journal of Management Education

TELESTATICS LIMITED

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many faint diffuse red

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0507

SAMPLE	DEPTH	pH	CaCl2	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
				mS/cm	ppm	weight %	µ-----	meq/100gr soil	-----	-----	-----	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
A	0	20	6.1	5.4	0.0	1	0.3	4.2	1.2	0.7	0.6	0.1	62	0	0	8	63	18	3	1	8	39	H	A
B	50	70	5.8	5.3	0.0	1	0.1	2.7	0.6	0.8	0.1	0.2	63	0	0	10	62	17	3	1	6	38	H	A
C	100	120	6.1	5.7	0.0	1	0.1	3.9	1.1	0.9	0.1	0.2	59	0	0	9	60	16	4	1	11	33	H	A
D	135	155	6.7	6.3	0.0	1	0.1	3.7	0.9	0.9	0.2	0.1	57	0	0	10	60	16	3	2	10	33	H	A
E	190	210	7.4	7.1	0.0	0	0.1	5.7	2.6	1.2	0.1	0.4	75	1	1	8	53	17	6	1	15	35	H	A
F	230	250	7.7	7.2	0.8	0	0.1	5.0	2.7	0.9	0.1	0.2	78	0	0	8	55	19	5	1	11	41	H	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION		Profile: S 0011	Unit: S09	Status: 2
SHEET : 2226B3 LOCATION : NE of Serowe, 2.4km on road to Paje. AUTHOR(S) : A.Remmelzwaal CLASSIFICATION : FAO: Dystric-Arqi-Luvic Arenosol(1988) Arenic Ferric Acrisol (1974) ST : Arenic Paleustult				
GRID : ME-723-273 COORD : 22-21-40-S 26-43-50-E DATE : 25/04/80				
AGRO CLIM.ZONE: 2D3 ELEVATION : 1117 m SMR: ustic to aridic				
POSITION: middle slope SLOPE : 2 - 3 % straight GRASSCOVER: 30 - 70 %				
LANDFORM : hill TOPOGRAPHY: undulating SURF.CHAR: no sealing, no cracks, nil evidence of salt, bleached sand on surface LAND USE: traditional grazing SPECIES : Trees - Terminalia sericea (dom.) Combretum apiculatum Acacia erioloba Peltophorum africanum : Shrubs - Acacia fleckii (dom.) Dichrostachys cinerea Securidaca longi-pedunculata Grewia bicolor : Grasses/forbes-				
VEGETATION: savanna ROCK TYPE: sandstone ROCK OUTCROP: none				
PARENT MATERIAL: aeolian sand over in situ weathered MOIST. COND: dry 0 - 180, moist 180 - 200 cm SURF.STONES: none EROSION : slight wind erosion				
REMARKS: Marginal argillic hor from 90cm. Catena with S13 (top) and S6 (bottom). Distinct, subhorizontal, hard, partly interconnected 5-10mm thick 7.5YR 5/6 m clay bands at 60, 70, 90, 1-10, 125, 140 and faint at 170 and 185cm depth. Argic horizon not within 150cm.				
SAMPLES: A: 0 - 20 B: 80 - 90 C: 90 - 125 D: 160 - 180				
A 0 - 40 cm 10YR 4/3 (moist) and 10YR 6/3.5 (dry), fine sand, very weak medium and coarse subangular blocky structure, slightly hard friable, many fine and few medium and coarse pores, non calcareous, common roots, gradual smooth boundary.				
Bt1 40 - 90 cm 7.5YR 5.5/5 (moist) and 7.5YR 6.5/5 (dry), common medium faint sharp greyish mottles, fine sand, weakly coherent massive structure, slightly hard friable, patchy thin clay cutans and patchy moderately thick clay lamellae, many fine and few medium and coarse pores, non calcareous, common roots, diffuse smooth boundary.				
Bt2 90 - 150 cm 7.5YR 5.5/5 (moist) and 7.5YR 6.5/5 (dry), weakly coherent massive structure, slightly hard friable, patchy thin clay cutans and continuous thick clay lamellae, many fine and few medium and coarse pores, non calcareous, common roots, diffuse wavy boundary.				
Bt3 150 - 200 cm 7.5YR 5/ 7 and 7.5YR 6/ 7 (dry), many coarse distinct diffuse reddish mottles, loamy fine sand to fine sandy loam, weakly coherent massive structure, slightly hard friable, patchy thin clay cutans and patchy thin clay lamellae, many fine and few medium and coarse pores, non calcareous, few roots,				
Soil Survey of Botswana FAO/BOT/85/011				
print date: 24/01/89				

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0011

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	METH	PRETR				
		H2O	CaCL2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr			
A	0 20	5.4	4.8	0.0	3	0.2	3.4	0.7	0.7	0.3	0.0	50	0	1	6	51	32	5	1	5	51	H	A
B	80 90	4.8	4.1	0.0	2	0.1	3.1	0.7	0.7	0.1	0.0	48	0	1	8	51	29	5	1	7	42	H	A
C	90 125	5.0	4.1	0.0	2	0.1	4.6	0.8	1.1	0.2	0.1	48	0	1	9	49	26	5	1	11	38	H	A
D	160 180	5.0	3.9	0.0	2	0.1	5.1	0.8	1.1	0.1	0.1	41	0	2	20	17	45	6	1	12	39	H	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART.SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: S 0512 Unit: S11 Status: 2

SHEET : 2226B4
LOCATION : 1.7km W of Palamaokowe hill.
AUTHOR(S) : A.Rommelzwaal G.J.Rhebergen T.D.Mafoko
CLASSIFICATION FAO: Pale-Arenic-Chromic Luvisol(1988) Arenic Eutric Nitrosol (1974)
ST : Psaumaqueutic Paleustalf
LANDFORM : plain
TOPOGRAPHY: almost flat
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing
SPECIES : Trees - Terminalia sericea (dom.)
: Shrubs -
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 210 cm
SURF.STONES: none
EROSION : nil

GRID : MF-873-285
COORD: 22-21-31-S 26-52-36-E
DATE : 16/07/82
LAND ELEMENT :
MICRO TOPOGRAPHY: even
VEGETATION: savanna
ROCK TYPE: siltstone
ROCK OUTCROP: none
GEOL.UNIT: Waterberg Lotsane fm
DRAINAGE : well drained
HUMAN INF: nil

AGRO CLIM.ZONE: 2D3
ELEVATION : 1041 m
SMR: ustic to aridic
POSITION: intermediate part
SLOPE : 0 - 1 %
GRASSCOVER:

REMARKS: Along pipeline. Parent rock siltstone or sandy shale. Clay increase marginal for argillic and argic horizon. (at about 120cm). Too sandy for D unit, but transitional to D10. -
Organic C of A horizon high.

SAMPLES: A: 0 - 20 B: 55 - 75 C: 140 - 160 D: 180 - 200

A 0 - 30 cm 7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), fine sand to loamy fine sand, weak medium and coarse subangular blocky structure, loose, many very fine and fine pores, non calcareous, many roots, gradual smooth boundary.

Bt1 30 - 100 cm 7.5YR 4/5 (moist) and 7.5YR 5/5 (dry), loamy fine sand, very weak very coarse subangular blocky structure, hard, patchy thin clay cutans on pedfaces, common very fine and fine pores, non calcareous, common roots, diffuse smooth boundary.

Bt2 100 - 170 cm 5YR 4/6 (moist) and 5YR 5/6 (dry), fine sandy loam, very weak very coarse subangular blocky structure, hard, broken moderately thick clay cutans on pedfaces, common very fine and fine pores, few strongly weathered siltstone rock fragments, non calcareous, few roots, abrupt wavy boundary.

C 170 - 210 cm 9YR 5/4 (moist) and 9YR 6/4 (dry), common faint diffuse yellowish-brown mottles, sandy clay loam, strongly coherent massive structure, very hard, broken moderately thick clay cutans on pedfaces, few very fine and fine pores, few siltstone rock fragments, moderately calcareous, very few roots, abrupt wavy boundary.

R 210 cm + strongly calcareous,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0512

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)					CECclay	MEH	PRETR					
		H2O	CaCL2	mS/cm	ppm	weight %	u-----	meq/100gr soil	-----u	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr					
A	0	20	7.5	7.0	0.1	2	0.8	7.6	6.4	0.9	0.5	0.1	100	0	1	10	56	19	3	2	10	44	H	A
B	55	75	6.7	5.8	0.0	1	0.2	7.0	2.9	1.1	0.3	0.1	63	0	1	11	54	17	5	1	11	56	H	A
C	140	160	6.3	5.8	0.0	0	0.1	8.7	5.9	0.9	0.2	0.1	82	0	1	8	51	19	3	2	17	50	H	A
D	180	200	8.3	7.8	0.3	0	0.1	12.0	45.9	1.2	0.4	3.1	100	1	1	8	44	18	4	3	21	54	H	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: S 0006 Unit: S17 Status: 2

SHEET : 2226B3
LOCATION : 3.8km NE of Serowe, along Paje road.

AUTHOR(S) : A. Remmelzwaal

CLASSIFICATION FAO: Haplic Arenosol(1988) Eutric Arenosol (1974)

ST : Ustic Quartzipsamment

LANDFORM : plain

TOPOGRAPHY: undulating

SURF. CHAR: no sealing, no cracks, nil evidence of salt, bleached sand on surface

LAND USE: traditional grazing

SPECIES : Trees - Combretum apiculatum Burkea africana Terminalia sericea

: Shrubs - Terminalia sericea (dom.) Acacia fleckii Dichrostachys cinerea Grewia bicolor

: Grasses/forbs-

PARENT MATERIAL: in situ weathered

MOIST. COND: dry 0 - 220 cm

SURF. STONES: none

EROSION : slight wind erosion/deposition

REMARKS: Revisited and resampled 16-3-83. Small trees only. Aeolian sand probably alluvial reworked in dry valley.

SAMPLES: A: 0 - 20 B: 70 - 90 C: 180 - 200

A1 0 - 35 cm 10YR 4/3 (moist) and 10YR 5.5/3 (dry), fine sand, very weak medium and coarse subangular blocky structure, slightly hard, many fine and medium pores, non calcareous, common roots, diffuse smooth boundary.

A2 35 - 55 cm 10YR 5/4 (moist) and 10YR 6/4 (dry), fine sand, very weak medium and coarse subangular blocky structure, slightly hard, many fine and medium pores, non calcareous, common roots, gradual smooth boundary.

B 55 - 110 cm 10YR 5.5/4.5 (moist) and 10YR 7/4.5 (dry), fine sand, weakly coherent massive structure, slightly hard, many fine pores, non calcareous, few roots, gradual smooth boundary.

C 110 - 150 cm 10YR 7.5/3 (moist) and 10YR 8/1.5 (dry), fine sand, weakly coherent massive structure, slightly hard, common fine pores, non calcareous, no roots, clear smooth boundary.

Cg 150 - 220 cm 10YR 7.5/2 (moist) and 10YR 8/1 (dry), common medium distinct clear reddish-yellow mottles, fine sand, weakly coherent massive structure, slightly hard, common fine pores, non calcareous, no roots,

Soil Survey of Botswana FAO/BOT/85/011

print date: 24/01/89

STANDARD SOIL ANALYSIS RESULTS

PROFILE: S 0006

SAMPLE	DEPTH	pH	EC	P	C	CEC	Ca	Mg	K	Na	PBS	Particle size (weight %)						CECclay	MEH	PRETR		
		H2O CaCl2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	vcS	cS	mS	fS	vfS	cSl	fSl	Clay	meq/100gr		
A	0 20	5.4 4.7	0.0	0	0.3	3.8	1.3	0.7	0.2	0.0	58	0	0	8	61	23	4	1	4	67	P	A
B	70 90	5.4 4.6	0.0	1	0.1	2.3	0.7	0.5	0.1	0.0	57	0	0	9	61	21	5	0	4	50	P	A
C	180 200	6.3 5.9	0.0	0	0.0	1.4	0.4	0.4	0.1	0.0	64	0	0	9	63	22	5	0	1	127	P	A

Soil Survey of Botswana FAO/BOT/85/011

Print date: 24/01/89

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

3 LAND QUALITY RATINGS AND SUITABILITY CLASSES FOR IMPROVED TRADITIONAL DRYLAND FARMING OF SORGHUM AND MAIZE

3.1 Introduction

Land quality ratings and suitability of classes of land units for improved dryland farming of sorghum and maize have been determined with the methodology proposed by Rhebergen (1988).

Results are presented for the main soil units in combination with the four agro climatic zones occurring in the area.

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: SORGHUM

Agro Climatic Zone: 1D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
A1	S	S4m	S1 1	-	S3 3	S2 2	S4 4	S1 2	S2-S3 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	S2 2	-	-	-
			Remarks: Less than 60% clay.																		
A1	N	N2m	S1 1	-	S3 3	S2 2	N2 5	S1 2	S2-S3 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	S2 2	-	-	-
			Remarks: Less than 60% clay.																		
A1	N		-	-	-	0	N2 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A1	S		-	-	-	0	N2 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A10	N	S3m	S1 1	-	S1 1	S1 1	S3 3	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For SCL and SL textures.																		
A11	N	S3m	S1 1	-	S1 1	S1 1	S3 3	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
A12	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For LS textures.																		
A12	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For SL texture.																		
A13	N	S3m	S1 1	-	S1 1	S1 1	S3 3	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For SL and SCL textures.																		
G2C	W	N2m	S1 1	-	S1 1	S2 2	N2 5	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
G2D	W	N2m	S1 1	-	S1 1	S2 2	N2 5	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
G6	N	S4m	S1 1	-	S1 1	S2 2	S4 4	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For LS texture.																		

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: SORGHUM

Agro Climatic Zone: ID3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
G6	W	N2m	S1 1	-	S1 1	S2 2	N2 5	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For LS texture.																					
G8	N	S4m	S1 1	-	S1 1	S2 2	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
G9	N	S3m	S1 1	-	S1 1	S2 2	S3 3	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S2 2	-	-	-
S3	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S5	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
Remarks: For fine - medium sand.																					
S5	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
Remarks: For loamy fine sand.																					
S7	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S7	W	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S10	N	S3me	S1 1	-	S1 1	S1 1	S3 3	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: MAIZE

Agro Climatic Zone: 1D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (s)	Sodic (t)	CaCO3 (u)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
A1	S	N2m	S1 1	-	S3 3	S2 2	N2 4	S2 2	S4 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	-	2	-	-
			Remarks: Less than 60% clay.																		
A1	N	N2m	S1 1	-	S3 3	S2 2	N2 5	S2 2	S4 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	-	2	-	-
			Remarks: Less than 60% clay.																		
A1	N		-	-	-	0	N2 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A1	S		-	-	-	0	N2 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A10	N	S4m	S1 1	-	S1 1	S1 1	S4 3	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	S1 1	-	-
			Remarks: For SCL and SL textures.																		
A11	N	S4m	S1 1	-	S1 1	S1 1	S4 3	S3 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	S1 1	-	-
A12	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For LS textures.																		
A12	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For SL texture.																		
A13	N	S4m	S1 1	-	S1 1	S1 1	S4 3	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	S1 1	-	-
			Remarks: For SL and SCL textures.																		
G2C	W	N2m	S1 1	-	S1 1	S2 2	N2 5	S3 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	-	S2 2	-	-
G2D	W	N2m	S1 1	-	S1 1	S2 2	N2 5	S3 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	-	S2 2	-	-
G6	N	N2m	S1 1	-	S1 1	S2 2	N2 4	S3 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	S1 1	-	-
			Remarks: For LS texture.																		

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: MAIZE

Agro Climatic Zone: 1D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
G6	W	N2m	S1 1	-	S1 1	S2 2	N2 5	S3 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For LS texture.																					
G8	N	N2m	S1 1	-	S1 1	S2 2	N2 4	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
G9	N	S4m	S1 1	-	S1 1	S2 2	S4 3	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S2 2	-	-	-
S3	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S7	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S7	W	N2m	S1 1	-	S1 1	S1 1	N2 5	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S10	N	S4m	S1 1	-	S1 1	S1 1	S4 3	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: SORGHUM

Agro Climatic Zone: 2D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
A1	S	S4m	S1 1	-	S3 3	S2 2	S4 4	S1 2	S2-S3 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	S2 2	-	-	-
			Remarks: Less than 60% clay.																		
A1	N	N2m	S1 1	-	S3 3	S2 2	N2 6	S1 2	S2-S3 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	S2 2	-	-	-
			Remarks: Less than 60% clay.																		
A1	S		-	-	-	0	N2 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A1	N		-	-	-	0	N2 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A10	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For SCL and SC textures.																		
A11	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For SL texture.																		
A12	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For SL texture.																		
A12	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For LS texture.																		
A13	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For SL and SCL textures.																		
G2C	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
			Remarks: For SL and SCL textures.																		
G2D	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
			Remarks: For SL and SCL textures.																		
G2E	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
			Remarks: For SL and SCL textures.																		

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: SORGHUM

Agro Climatic Zone: 2D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
G6	N	N2m	S1 1	-	S1 1	S2 2	N2 5	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For LS texture.																		
G6	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For LS texture.																		
G8	N	S4m	S1 1	-	S1 1	S2 2	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
G9	N	S4m	S1 1	-	S1 1	S2 2	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S2 2	-	-	-
S3	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S5	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
			Remarks: For loamy fine sand.																		
S5	N		-	-	-	0	N2 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: For fine and fine - medium sand.																		
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
			Remarks: For fine - medium sand.																		
S5	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
			Remarks: For loamy fine sand.																		
S7	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
			Remarks: For fine and fine - medium sand.																		
S7	W	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
			Remarks: For fine - medium sand.																		
S10	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: MAIZE

Agro Climatic Zone: 2D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (s)	Sodic (t)	CaCO3 (u)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
A1	S	N2m	S1 1	-	S3 3	S2 2	N2 4	S2 2	S4 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	S2 2	-	-	-
			Remarks: Less than 60% clay.																		
A1	N	N2m	S1 1	-	S3 3	S2 2	N2 6	S2 2	S4 3	-	S1 1	S1 1	S1 1	S1 1	S1 1	S1 1	-	S2 2	-	-	-
			Remarks: Less than 60% clay.																		
A1	S		-	-	-	0	N2 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A1	N		-	-	-	0	N2 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Remarks: More than 60% clay.																		
A10	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For SCL and SC textures.																		
A11	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For SL texture.																		
A12	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For SL texture.																		
A12	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	-	-	-	-
			Remarks: For LS texture.																		
A13	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For SL and SCL textures.																		
G2C	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S3 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
			Remarks: For SL and SCL textures.																		
G2D	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S3 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
			Remarks: For SL and SCL textures.																		
G6	N	N2m	S1 1	-	S1 1	S2 2	N2 5	S3 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
			Remarks: For LS texture.																		

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: MAIZE

Agro Climatic Zone: 2D3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
G6	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S3 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For LS texture.																					
G8	N	N2m	S1 1	-	S1 1	S2 2	N2 4	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
G9	N	N2m	S1 1	-	S1 1	S2 2	N2 4	S2 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S2 2	-	-	-
S3	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
Remarks: For loamy fine sand.																					
S5	N		-	-	-	0	N2 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Remarks: For fine and fine - medium sand.																					
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
Remarks: For fine - medium sand.																					
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
Remarks: For loamy fine sand.																					
S7	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S7	W	N2m	S1 1	-	S1 1	S1 1	N2 5	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
S10	N	N2m	S1 1	-	S1 1	S1 1	N2 4	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: SORGHUM

Agro Climatic Zone: 3B4

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
A10	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For SCL and SC textures.																					
A13	N	S4m	S1 1	-	S1 1	S1 1	S4 4	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For SL and SCL textures.																					
G2D	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
G2E	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
G6	N	N2m	S1 1	-	S1 1	S2 2	N2 5	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For LS texture.																					
G6	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
Remarks: For LS texture.																					
G8	N	N2m	S1 1	-	S1 1	S2 2	N2 5	S1 2	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	-	S1 1	-	-	-
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-
Remarks: For loamy fine sand; fine and fine - medium sand.																					

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: MAIZE

Agro Climatic Zone: 3B4

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
A10	N	N2m	S1 1	- 1	S1 1	S1 1	N2 4	S2 2	S1 1	- -	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	- -	S1 1	- -	- -	- -
Remarks: For SCL and SC textures.																					
A13	N	N2m	S1 1	- 1	S1 1	S1 1	N2 4	S2 2	S1 1	- -	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	- -	S1 1	- -	- -	- -
Remarks: For SL and SCL textures.																					
G2D	W	N2m	S1 1	- 1	S1 1	S2 2	N2 6	S3 3	S1 1	- -	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	- -	S2 2	- -	- -	- -
G2E	W	N2m	S1 1	- 1	S1 1	S2 2	N2 6	S3 3	S1 1	- -	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	- -	S2 2	- -	- -	- -
G6	N	N2m	S1 1	- 1	S1 1	S2 2	N2 5	S3 3	S1 1	- -	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	- -	S1 1	- -	- -	- -
Remarks: For LS texture.																					
G6	W	N2m	S1 1	- 1	S1 1	S2 2	N2 6	S3 3	S1 1	- -	S1 2	S1 1	S1 1	S1 1	S1 1	S2 2	- -	S1 1	- -	- -	- -
Remarks: For LS texture.																					
G8	N	N2m	S1 1	- 1	S1 1	S2 2	N2 5	S2 2	S1 1	- -	S1 1	S1 1	S1 1	S1 1	S1 1	S2 2	- -	S1 1	- -	- -	- -
S5	N	N2m	S1 1	- 1	S1 1	S1 1	N2 5	S3 3	S1 1	- -	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	- -	S1 1	- -	- -	- -
Remarks: For loamy fine sand; fine and fine - medium sand.																					

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: SORGHUM
 Agro Climatic Zone: 4B3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
G2E	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S2 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S2 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-

Remarks: For loamy fine sand; fine and fine - medium sand.

Land Quality Ratings and Suitability Classes For: Improved Traditional Dryland Farming Main Crop: MAIZE

Agro Climatic Zone: 4B3

UNIT	SITE	SUIT. CLASS	Temp (c)	Drain (d)	Floods (f)	Germ (g)	Moist (m)	Nutr (n)	Oxygen (o)	Water (q)	Roots (r)	Salin (t)	Sodic (t)	CaCO3 (t)	Access (a)	Erosion (e)	Pests (p)	Work (w)	Topo (x)	Flood (y)	Drain (z)
G2E	W	N2m	S1 1	-	S1 1	S2 2	N2 6	S3 3	S1 1	-	S2 3	S1 1	S1 1	S1 1	S1 1	S3 3	-	S2 2	-	-	-
S5	N	N2m	S1 1	-	S1 1	S1 1	N2 5	S3 3	S1 1	-	S1 1	S1 1	S1 1	S1 1	S1 1	S3 3	-	S1 1	-	-	-

Remarks: For loamy fine sand; fine and fine - medium sand.

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