

Reference soil Zimbabwe 11:

Description

(1) Natural vegetation consists predominantly of medium-sized open woodland of trees and shrubs. *Brachystegia spiciformis* and *Julbernardia globiflora* trees and shrubs dominate, but there are common *Terminalia sericea* and *Parinari curatellifolia* trees and shrubs. A detailed listing of natural vegetation types is available. (2) Only a few grasses and arable weeds were observed in the immediate vicinity of the pit. (3) The land has been cleared and stumped to accommodate the ICRAF Agroforestry Trials. The upper part of the Block where the pit is sited was cleared in 1990. Agroforestry shrubs were planted in December 1990. The land was ploughed at the time of establishment. At the time of planting, all agroforestry shrubs were watered every 2 weeks with 10 litres of water for a two-month period. Thereafter, no water beyond the annual rainfall was applied. During the 1990/91 season, 251 mms of rainfall were received, but during the 1991/92 season, only 151 mms were received. No pretreatments or fertilisations have taken place. In contrast to the ICRAF Trials at Domboshawa, each shrub was surrounded with a low depression well. Plantings occur about 5 metres from the pit. (4) A variety of agroforestry species have been planted in blocks. They include *Acacia augustisma*, *Calliandra calliothrus*, *Flemingia conjesta*, *Gliditsia triacant*, *Grincidia sepium*, *Sesbania sesban*, *Leucaena leucocephala*, *Cajanus cajan* and *Flemingia macrophila*. (5) Occasional, broad, round termite mounds occur within the Block, about 80-100 metres apart and up to 2 metres in height. These mounds would normally support tree and/or shrub growth, but this vegetation cover has been removed. (6) The location of the pit relative to the landscape is difficult to assess. It occupies a crestal, but midslope position on a long, gradually sloping (<2%), west-facing and convex spur of ground that lies between two drainage lines. The slope in the immediate vicinity of the pit is flat. (7) Lister (1986, p99) indicates that the dominant landform of the area consists of regularly jointed granite koppies with intermediate flat pediments. (8) This particular pit is very slightly higher (50 cms) in position than ZW12, but about 6 metres higher than ZW13. (9) The soil horizonation is very variable within the pit. On the sampled and described face, the dense gravel horizon occurs at about 100 cms from the surface, and is underlain by heavily mottled red/yellow plinthic material, which sets hard on exposure. On the other side of the pit, the dense gravel horizon tapers down to 200 cms from the surface, and above it is a moist, heavily mottled sand, which is not as strongly mottled as the plinthite. (10) Roots observed in the profile are mostly tree roots of varying dimensions. (11) Mottle concentrations vary from about 2% in the 2nd horizon, 5% in the 3rd to 10% in the 4th. The concentrations of mottles in the 5th and 6th horizons is difficult to determine. The 7th horizon is dominantly mottled. (12) Mottle colours in the 5th, 6th and 7th horizons also include 7.5YR hues ,

Classification

WRB 2006:

FAO-UNESCO-ISRIC 1988:

FAO-UNESCO 1974:

Site description

General information:

Names of person(s) : Spurway JKR
who described the
profile
General description of : Makoholi Research Station in
location of profile (e.g., ICRAF Agroforestry Trial Block
town, province)
Climate classification : Cw
according to Köppen
Date : June 1992
Latitude / Longitude : S -19.8° / E 31.75°

Physiography:

The altitude of the : 1220 m asl
soil profile relative
to mean sea level,
specified in meters
Regional landform : pediment
Topography of the : flat or almost flat
surrounding country
Physiographic Unit : long interfluvium
in the immediate
surrounding of the
site

The slope refers to : 0 %
the inclination of the
land immediately
surrounding the
site. The measured
or estimated slope
angle is specified to
the nearest per cent
The physiographic : crest
position of the site
where the profile is
located
Form of the slope : convex
surrounding the site
Slope Aspect of the : West
site

Parent material:

The main parent rock/ : coarse-grained acid igneous rock
material over which
the soil has been
formed (1st entry)
Mode of Accumulation : residual material
or deposition of parent
material (1st entry)
Texture of parent : sandy
material (1st entry)
Weathering status of : slightly
solid rock (1st entry)
Resistance against : high
weathering (solid rock)
(1st entry)
Depth1 of lithological : 97 cm
boundary
The main parent rock/ :
material over which
the soil has been
formed (2nd entry)
Resistance against :
weathering (solid rock)
(2nd entry)
Soil Depth; depth to : 97 cm
which roots can easily
penetrate throughout
the year
Remarks on Parent : granodiorite
Materials

Land use / vegetation:

Current land use at : agro-forestry
the site
Major crops : crops (unspecified)
Main type of irrigation : no irrigation
Rotation scheme : crop rotation scheme not relevant
Vegetation Type;The : deciduous woodland
natural vegetation at
the site
Status of vegetation : primary
Remarks on Land : LANDUSE: The land has been
Use / Vegetation : cleared and stumped to
accomodate agro-forestry trials.
Species p;lanted: Acacia
augustisma, Calliandra calliothrus,

Hydrology and drainage:

Depth of : cm
groundwater table
Groundwater Top : cm
Groundwater Bottom : cm
Kind of groundwater : no groundwater table observed
table
Top Stagnating : 97 cm
Layer
Bottom Stagnating : 162 cm
Layer
Runoff : very slow
Flooding frequency : never
Estimated : slow
permeability (class)
of least permeable
part of the profile
Drainage Class : excessive
To Drainage Class :
Moisture conditions : 0-162 cm
of the profile: dry
from -to
Moisture conditions : 162-228 cm
of the profile: moist
from -to
Wet From - To : cm

Erosion and aggredation:

Soil erosion type (1st: sheet
entry)
Intensity of the soil : slight
erosion type (1st
entry)
Occurrence of soil : not apparent
aggradation
Slope Stability : stable

Flemingia conjesta, Gliditsia triacant, Grincidia sepium, Sesbania seban, leucaena leucocephala, Cajanus cajan and Flemingia macrophila.

VEGETATION: Natural vegetation consists predominantly of medium-sized open woodland of trees and shrubs. Brachystegia spiciformis and Julbernardia globiflora trees and shrubs dominate, but there are common Terminalia sericea and Parinari curatellifolia trees and shrubs. Only a few grasses and arable weeds were observed in the immediate vicinity.

Surface characteristics:

Microrelief type: small-scale : termite/ant mounds
differences in relief in the direct vicinity of the site

Microrelief Pattern : isolated

Microrelief Height : 250

Rockiness : none

Stoniness : none

Average size of stones :

Shape of stones (on average) :

Cracks : no cracks observed

Slaking of aggregates by tillage, rainfall or frost : no surface slaking/crusting observed

Evidence of salt : non-saline

Evidence of alkali : non-alkaline

Nearest climate station:

Station : Makoholi

Country : Zimbabwe

WMO Code : 67.889

Distance : 10 km S (good)

Latitude / Longitude : S 19°50 / E 30°47

Climate data*:

data	Type	(Station)	:	nrecord	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation	(mm)	(Makoholi)	:	30	144	128	68	26	6	5	1	2	5	23	88	154	650
Number of rain	days	(Makoholi)	:	35	11	11	7	6	2	2	1	1	2	4	9	12	68
Mean temperature	(°C)	(Makoholi)	:	12	21.8	21	20.2	18.4	15.7	13.2	13.4	16	19.1	21.2	21.3	21.5	18.6
Maximum temperature	(°C)	(Makoholi)	:	12	27.9	27	26.4	25.1	23.2	20.8	21.1	23.9	27.2	28.6	27.9	27.6	25.6
Minimum temperature	(°C)	(Makoholi)	:	12	16.8	16.1	15	12.8	9.3	6.6	6.2	8.4	10.9	14.2	15.5	16.6	12.4
Relative humidity	(%)	(Makoholi)	:	22	69	73	70	66	61	59	57	50	46	51	59	68	60.8
Pot. evapotranspiration	(mm)	(Makoholi)	:	12	18.2	18.3	16.7	14.1	11	8.9	8.6	9.1	9.5	12.3	14.9	17.1	13.2
Epot. - Frere, Popov	(mm)	(Makoholi)	:	-	138	113	115	93	75	62	71	106	151	168	143	136	1371
Act. evaporation - Class A	pan (mm)	(Makoholi)	:	22	182	147	157	134	120	96	113	155	200	223	194	174	1895
Bright sunshine	(%)	(Makoholi)	:	12	62	60	64	68	77	76	79	80	82	71	58	53	69.2
Bright sunshine	(hours/day)	(Makoholi)	:	22	8.2	7.6	7.8	8.2	8.7	8.4	8.6	9.3	9.4	8.7	7.7	7.2	8.3
Estimated global radiation	(MJ/m ²)	(Makoholi)	:	-	22.1	20.8	19.7	17.5	16	14.4	15.3	17.7	21.1	21.8	21	20.6	19
Windspeed (m/s, at 2m	height)	(Makoholi)	:	12	1.8	1.8	1.9	1.8	1.6	1.6	1.7	2	2.3	2.5	2.2	1.9	1.9

*Data are considered representative for site

Profile description:

- Ah 0-27 cm : very pale brown (10YR 7/3, dry) brown (10YR 5/3, moist), coarse sand, single grain, soft non sticky non plastic, no cutans, few very fine discontinuous expd interstitial random pores highly porous (>60 vol%), many fine and common coarse roots, no inclusions, no fragments, no, non-calcareous, clear smooth boundary to,
- E1 27-52 cm : very pale brown (10YR 8/3, dry) (2.5Y 6/3, moist), coarse sand, single grain, soft non sticky non plastic, fine faint clear 10YR5/6 (yellowish brown) mottles and few (2-5%) fine faint clear mottles 10YR5/8 (yellowish brown), no cutans, common very fine discontinuous expd interstitial random pores, common fine and common coarse roots, no inclusions, no fragments, no, non-calcareous, clear smooth boundary to,
- E2 52-71 cm : (2.5Y 8/3, dry) (2.5Y 6/3, moist), coarse sand, weakly coherent massive, soft slightly sticky non plastic, few (2-5%) fine faint clear mottles, 10YR5/6 (yellowish brown) and 10YR5/8 (yellowish brown), no cutans, common very fine discontinuous expd interstitial random pores, few fine few and coarse roots, no inclusions, no fragments, no, non-calcareous, non-calcareous, gradual smooth boundary to,
- Bt 71-97 cm : (2.5Y 7/3, dry) light yellowish brown (2.5Y 6/4, moist), coarse sand, moderately coherent massive, slightly hard slightly sticky slightly plastic, common fine distinct clear mottles (10YR 5/6) and common fine distinct mottles (10YR 5/8), broken moderately thick clay cutans between sand grains, many very fine discontinuous expd interstitial random pores and common very fine discontinuous expd tubular random pores moderately porous (40-60 vo, few fine and few coarse roots, no inclusions, few fine gravel weathered quartz fragments, no, non-calcareous, abrupt wavy boundary to,
- Btv 97-162 cm : white (2.5Y 8/2, dry) (2.5Y 7/3, moist), coarse sand gravel, strongly coherent massive, many (15-40%) medium prominent sharp mottles, 10YR5/6 (yellowish brown) and 7.5YR5/8 (strong brown), broken thick clay cutans between sand grains, few fine roots, dominant medium and large spherical hard ferruginous concretions, many medium and coarse gravel weathered quartz fragments, no, discontinuous nodular strongly cemented plinthite pans, non-calcareous, gradual irregular boundary to,
- BC 162-199 cm : white (2.5Y 8/2, dry) (2.5Y 7/3, moist), very gravelly coarse sand, moderately coherent massive, many (15-40%) medium distinct clear mottles, 10YR5/6 (yellowish brown) and 7.5YR5/8 (strong brown), no cutans, few fine roots, few medium spherical hard ferruginous concretions, dominant fine gravel weathered quartz fragments, no, non-calcareous, gradual irregular boundary to,
- Cg 199-228 cm : light grey (10YR 7/1, moist), coarse sandy loam stony, moderately coherent massive, friable slightly sticky slightly plastic, many (15-40%) medium prominent sharp mottles 10YR5/6 (yellowish brown) and many (15-40%) coarse prominent sharp 7.5YR5/8 (strong brown) mottles, no cutans, few fine roots, few medium spherical ferruginous soft segregations, few fine gravel weathered quartz fragments, no, non-calcareous,

Physical

Particle size distribution:

Depth (cm)	Gravel (%)	Very Coarse Sand (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Very Fine Sand (%)	Total Sand (%)	Coarse Silt (%)	Fine Silt (%)	Total Silt (%)	Clay (%)
0-27	: 2	9.0	20.4	20.6	21.9	11.9	83.8	8.4	2.7	11.1	5.2
27-52	: 2	9.5	18.8	21.0	23.1	9.7	82.1	7.8	2.9	10.7	7.2
52-71	: 2	4.6	12.5	18.3	18.9	10.1	64.4	25.3	3.7	29	6.6
71-97	: 5	10.0	19.3	20.9	18.6	7.8	76.6	8.1	2.1	10.2	13.2
97-162	: -	-	-	-	-	-	-	-	-	-	-
162-199	: -	-	-	-	-	-	-	-	-	-	-
199-220	: 20	10.4	20.0	15.9	11.6	12.0	69.9	6.4	8.7	15.1	15.0

Other physical data

Depth (cm)	Bulk Density (kg/dm ³)	Spec. Surf. Area (m ² /g)	COLE (cm/cm)	Water Disp. Clay (%)	Clay (%)
0-27	:	-	-	1.9	5.2
27-52	:	-	-	1.4	7.2
52-71	:	-	-	4.6	6.6
71-97	:	-	-	2.5	13.2
97-162	:	-	-	-	-
162-199	:	-	-	-	-
199-220	:	-	-	5.6	15.0

Chemical characteristics:

Depth (cm)	pH H ₂ O	pH KCl	EC 1 : 2.5 (mS/cm)	CaCO ₃ (%)	Org. C (%)	Org. N (%)	C / N	Exch. Acid (cmol/kg)	Exch. Al (cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)	K (cmol/kg)	Na (cmol/kg)	Sum Cations (cmol/kg)
0-27	: 4.7	4.1	0.08	-	0.44	0.03	15	0.4	0.0	0.6	0.0	0.1	0.0	0.7
27-52	: 4.2	4.1	0.18	-	0.14	0.01	14	0.5	0.2	0.2	0.3	0.1	0.2	0.8
52-71	: 4.2	3.9	0.11	-	0.12	0.01	12	0.6	0.2	0.0	0.3	0.1	0.2	0.6
71-97	: 4.1	3.8	0.12	-	0.05	0.03	2	1.0	0.4	0.0	0.3	0.1	0.2	0.6
97-162	: -	-	-	-	-	-	-	-	-	-	-	-	-	-
162-199	: -	-	-	-	-	-	-	-	-	-	-	-	-	-
199-220	: 4.6	4.0	0.03	-	0.06	0.01	6	0.8	0.5	0.2	0.3	0.1	0.4	1

Depth (cm)	CEC Soil (cmol/kg)	CEC Clay (cmol/kg)	CEC Org (cmol/kg)	ECEC (cmol/kg)	Base sat. (%)	Al sat. (%)	ESP (%)
0-27	: 1.9	37	1.5	-	37	0	0
27-52	: 1.2	17	0.5	-	67	17	17
52-71	: 1.9	29	0.4	-	32	11	11
71-97	: 1.9	14	0.2	-	32	21	11
97-162	: -	-	-	-	-	-	-
162-199	: -	-	-	-	-	-	-
199-220	: 2.1	14	0.2	-	48	24	19

Clay mineralogy:

Depth (cm)	Kaolinite	Mica / illite	Vermiculite	Chlorite	Sme c	Halloysite	Mixed layer	Quartz	Feldspar	Gibbsite	Goethite	Hematite
0-27	: strong to very strong	weak	-	-	-	-	-	very weak	very weak	-	-	-
27-52	: strong to very strong	weak	-	-	-	-	-	very weak	very weak	-	-	-
52-71	: very strong	weak	-	-	-	-	-	very weak	very weak	-	-	-
71-97	: very strong	weak	-	-	-	-	-	-	very weak	-	-	-
97-162	: -	-	-	-	-	-	-	-	-	-	-	-
162-199	: -	-	-	-	-	-	-	-	-	-	-	-
199-220	: very strong	weak	-	-	-	-	-	-	very weak	-	-	-

Source of analyzing procedures:

Laboratory Attribute	Description	Proc. ref
ISRIC Al sat.	Calculation; Exchangeable Al / (exchangeable bases+Al+H) or Al / CEC	11.1.4-1.4.3
ISRIC Base sat.	Calculation; Sum of Exchangeable Cations (Na, K, Ca, Mg) / CEC soil	labmanual
ISRIC C / N	Calculation; Organic Carbon / Organic Nitrogen	labmanual
ISRIC Ca	Exchangeable bases with 1 M ammonium acetate at pH 7; Ca by atomic absorption spectrometry	9-4 and 9-5.3

ISRIC	CEC Clay	Calculation; ((CEC soil - CEC org.m.) / clay %) * 100	9-6.3
ISRIC	CEC Org	CEC organic matter; expert estimate for charge per unit C	9-6.3
ISRIC	CEC Soil	CEC; with index cation in buffered solution pH7	9-4 and 9-5.3.3
ISRIC	Clay; < 0.002 mm	Fraction by Pipette analysis; after removal CaCO ₃ and organic matter, dispersion and sedimentation	3-4.7
ISRIC	EC 1 : 2.5	Electro Conductivity of a soil / water (1:2.5) suspension	4-1.4 and 13-4
ISRIC	ESP	Calculation; (Exchangeable Na / CEC soil) * 100	9-6.3
ISRIC	Exch. Acid	Extraction by 1 M KCl; titration with NaOH	11.1.4-1.4.2
ISRIC	Exch. Al	Extraction by 1 M KCl; Al by atomic absorption spectrometry	11.1.4-1.4.3
ISRIC	Feldspar	Feldspar; relative abundance scale 0 - 7	16-1
ISRIC	K	Exchangeable bases with 1 M ammonium acetate at pH 7; K by flame atomic emission spectrometry	9-6.1
ISRIC	Kaolinite	Kaolinite; relative abundance scale 0 - 7	16-1
ISRIC	Mg	Exchangeable bases with 1 M ammonium acetate at pH 7; Mg by atomic absorption spectrometry	9-4 and 9-5.3
ISRIC	Mica / Illite	Mica / illite; relative abundance scale 0 - 7	16-1
ISRIC	Na	Exchangeable bases with 1 M ammonium acetate at pH 7; Na by flame atomic emission spectrometry	9-4 and 9-5.3
ISRIC	Organic Carbon	Wet combustion of organic matter by potassium dichromate and sulphuric acid at about 125 degrees Celcius. Residual dichromate is back titrated against ferrous sulphate. To compensate for incomplete destruction an empirical correction factor of 1.3 is applied	5
ISRIC	Organic Nitrogen	Organic Matter is digested in sulphuric acid (and hydrogen peroxide) with selenium as catalyst. Nitrogen is converted to ammonium sulphate. The solution is made alkaline and ammonia is distilled off. The evolved ammonia is trapped in boric acid and titrated with standardized acid solution	6
ISRIC	pH H ₂ O	pH electrode; in supernatant suspension	4-1
ISRIC	pH KCl	In supernatant suspension; potentiometrically	4-1
ISRIC	Quartz	Quartz; relative abundance scale 0 - 7	16-1
ISRIC	Sand; 0.10 - 0.05 mm	Fraction by sieving; after removal CaCO ₃ and organic matter	3-4.6
ISRIC	Sand; 0.25 - 0.10 mm	Fraction by sieving; after removal CaCO ₃ and organic matter	3-4.6
ISRIC	Sand; 0.5 - 0.25 mm	Fraction by sieving; after removal CaCO ₃ and organic matter	3-4.6
ISRIC	Sand; 1.0 - 0.5 mm	Fraction by sieving; after removal CaCO ₃ and organic matter	3-4.6
ISRIC	Sand; 2.0 - 0.05 mm	Total sand fractions by sieving; after removal CaCO ₃ and organic matter	3-5
ISRIC	Sand; 2.0 - 1.0 mm	Fraction by sieving; after removal CaCO ₃ and organic matter	3-4.6
ISRIC	Silt; 0.02 - 0.002 mm	Fraction by Pipette analysis ; after removal CaCO ₃ and organic matter, dispersion and sedimentation	3-4.7
ISRIC	Silt; 0.05 - 0.002 mm	Calculation; Sum fractions Silt 0.05 - 0.02 mm	3-4.7
ISRIC	Silt; 0.05 - 0.02 mm	Fraction by Pipette analysis ; after removal CaCO ₃ and organic matter, dispersion and sedimentation	3-4.7
ISRIC	Sum cations Water	Sum of Exchangeable Cations (Ca, Mg, Na, K) with 1 M ammonium acetate at pH 7	9-
ISRIC	Dispersable Clay	Fraction by Pipette analysis; without any pretreatment	3-8
CSRI	Gravel	Fraction from field sample, after drying, crushing, sieving	*ref

*ref: no labmanual available, link to presumable used analytical methode

Other classification

USDA-NRCS (1999) :
 USDA-SCS (1975) :
 Classification (other) :