CHARACTERISATION OF AGRICULTURAL SOILS IN CASCAPE INTERVENTION WOREDAS OF AMHARA REGION

ANNEX C: SOIL PROFILE DESCRIPTION, ANALYSES AND CLASSIFICATION

Dera woreda

Profile Description

Profile Number: ADJP001

Status: routine profile description

Date: 12/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, Jigna kebele

Coord: N11°50'52.965", 37°36'25.863"E

Soil climate: SU

Land Form: Plain (LP)

Position: BO- Bottom (flat)

Slope form: SV

Slope: 1-2%

Topography: 1-3% gen. undulating

LandUse: Rainfed arable cultivation(AA4)

Crops: Barley(CeBa), Wheat(CeWh)

Human Infl: Ploughing (Pl), surface compaction(Sc)

Vegetation: Ground water-fed bog peat(B)

Parent Materials: Alluvial deposit over colluvium

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: no evidence (N)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Watertable: >1m

Flooding: seasonal

WRB: Gleyic **Vertisols** (Pellic, Eutric) (FAO 2006)

Samples: A: 0-10 B: 10-25 C: 25-80 D: 80-120 E: 120-150 F: 150-200

Ap 0-10 cm. very dark gray (7.5 YR3/1) clay; few fine and medium prominent grayish brown (10YR 5/2) and yellowish red (5YR 5/7) mottles, moderate, fine to medium angular blocky structure; hard when dry; firm when moist; very sticky and plastic wet; very few thin broken clay pressure faces, few coarse pores; abundant fine and common roots; common fine inped continuous pores; non calcareous; clear and smooth boundary/transition.

ABg 10 – 25 cm. dark gray (10 YR4/1) moist; clay; many medium distinct dark yellowish brown(10YR4/4) mottles along pores; moderate coarse sub angular blocky to angular block structure; hard when dry; firm moist; very sticky plastic wet; few thin clay cutans; common very fine, fine and medium, common fine and medium continousinped pores; common medium roots; thickpressure faces along ped faces and wedge shape structure; non calcareous; gradual and smooth boundary.

Bg1 25 – 80cm. dark gray to gray (10 YR4.5/1) moist, clay; strong coarse angular blocky structure; very hard when dry; firm moist; very sticky plastic wet, common distinct yellowish brown(10 YR 5/4) mottles along pores; moderate medium wedge shape structure; very few very fine pores along roots; many fine interstitial pores; non calcareous; thick continuous pressure faces and slickensides along wedges; gradual and smooth boundary.

Bg2 80 – 120cm. greenish gray (5BG5/1) moist, clay; strong coarse angular blocky structure; very hard when dry; firm moist; very sticky plastic wet, few medium distinct yellowish brown(10 YR 4/4) mottles along pores; moderate medium wedge shape structure; very few very fine pores along roots; many fine interstitial pores; non calcareous; thick continuous pressure faces and slickensides along wedges; gradual and smooth boundary.

BCg 120 – 150cm. dark gray to gray (10 YR4.5/1) moist, clay; strong coarse angular blocky structure; very hard when dry; firm moist; very sticky plastic wet, few medium distinct yellowish brown to light yellowish brown(10 YR 6/5) mottles along pores; moderate medium wedge shape structure; very few very fine pores along roots; many fine interstitial pores; non calcareous; thick continuous pressure faces and slickensides along wedges; gradual and smooth boundary.

Cg 150 – 200cm. gray (N5/) moist, clay; strong coarse angular blocky structure; very hard when dry; firm moist; very sticky plastic wet, few medium distinct yellowish brown to light(10 YR 5/4)few medium distinct yellowish brown to light yellowish brown(10YR 6/5) mottles; very coarse strong wedge shape structure; very few very fine pores along roots; many fine interstitial pores; non calcareous; thick continuous pressure faces and slickensides along wedges; gradual and smooth boundary.

Table 1: Analytical data of Profile No: ADJP001, Jigna kebele, Deraworeda

Horizon	Ap	ABg	Bg1	Bg2	BCg	Cg
Depth (cm)	0-10	10-25	25-80	80-120	120-150	150-200
Sand %	22	6	9	8	18	15
Silt %	21	37	30	34	27	32
Clay %	57	57	61	57	55	54
Texture class	Clay	Clay	Clay	Clay	Clay	Clay
Bulk density	1.26	1.27	1.34	1.34	1.31	
pH-H2O (1:2.5)	5.18	5.38	5.66	6.84	7.81	7.39
pH-KCl	4.35	4.32	4.7	5.93	6.97	6.53
EC (dS/m)	0.14	0.05	0.05	0.1	0.13	0.12
Exch Ca ,,	21.12	27.28	26.64	29.38	31.64	38.18
Exch Mg ,,	7.04	8.8	8.86	9.04	9.04	13.3
Exch K ,,	0.18	0.08	0.03	0.06	0.06	0.02
Exch Na (cmol+/kg)	0.75	0.84	0.52	0.77	1.33	0.69
CEC ,,	51.17	57.39	59.36	43.23	54.53	60
BS %	57	64	61	91	77	87
OC %	1.7	0.96	0.87	0.75	0.56	0.46
Total N %	0.23	0.12	0.11	0.09	0.08	0.06
C/N	7.4	8	7.9	8.3	7	7.7
P Olsen (ppm)	29.3					
Av. S %	1.55					
Av Zn (mg/kg)	1.5					
Av Mn ,,	74.6					
Av Cu ,,	4.14					
Av Fe ,,	90.4					

Profile description

Profile Number: Profile No: ADJP002

Status: routine profile description

Date: 13/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, Jigna kebele

Coord: 11°49'53.806"N: 37°37'59.692"E

Soil climate: SU

Land Form: Plain (LP)

Position: BO- Bottom (flat)

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

LandUse: Rainfed arable cultivation(AA4) and comercial

Crops: Barley(CeBa), Wheat(CeWh)& rice(CeRi)

Human Infl: Ploughing (Pl), surface compaction(Sc)

Vegetation: eucalyptus

Parent Materials: Alluvial deposit over colluvium

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: water erosion or deposition (W)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: >5m

Flooding: seasonal

Moist Cond: dry 0-10, slightly moist 10-25, moist 25+

WRB: Haplic **Vertisols** (Eutric chromic) (FAO 2006)

Samples:A: 0-13 B: 13-33 C: 33-67 D: 67-130 E: 130-200

Ah 4 – 13 cm. Very dark grey (5YR3/1) moist; clay; very few fine prominent yellowish red (5YR4/6) mottles along pores; weak fine sub angular blocky; friable; many fine and very fine and abundant medium roots; many and very fine pores; non calcareous; gradual and smooth boundary.

A11 13 – 33 cm. Dark grey (5YR4/1) moist; clay; very few fine prominent yellowish red (5YR4/6) mottles along pores; weak fine crumb structure; very sticky; very plastic; friable; many fine and very fine and abundant medium roots; many and very fine pores; non calcareous; gradual and smooth boundary.

Bg 33 – 67 cm. dark gray (N4/) moist; clay; very few fine prominent yellowish red (5YR5/6) mottles along pores; weak fine crumb structure; very sticky; very plastic; friable; many fine and very fine and abundant medium roots; many and very fine pores; non calcareous; gradual and smooth boundary.

BCg 67 – 130 cm. very dark gray (N3/) moist; clay; very few fine prominent yellowish red (5YR4/6 and 5/8) mottles along pores; weak fine crumb structure; very sticky; very plastic; friable; many fine and very fine and abundant medium roots; many and very fine pores; non calcareous; gradual and smooth boundary.

Cg1 130 – 200 cm. gray (N5/) moist; clay; many fine and medium reddish brown (5YR5/4 and yellowish red (5YR5/8) mottles along pores; massive structure; very sticky; very plastic; friable; many fine and very fine and abundant medium roots; many and very fine pores; non calcareous; gradual and smooth boundary.

Photo of Vertisol Jigna kebele (ADJP001)

TABLE 2: ANALYTICAL DATA OF PROFILE NO: ADJP002, JIGNA KEBELE, DERA WOREDA

Horizon	Ap	B1	B2	BCg1	BCg2
Depth (cm)	0-13	13-33	33-67	67-130	130-200
Sand %	11	9	21	13	9
Silt %	40	40	28	31	32
Clay %	49	51	51	59	59
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.25	1.2	1.3	1.36	
pH-H2O (1:2.5)	5.6	5.6	6.3	6.4	6
pH-KCl	4.4	4.5	4.6	4.9	4.8
EC (dS/m)	0.4	0.5	0.28	0.3	0.25
Exch Ca ,,	20.5	21.8	24.5	25.2	19.2
Exch Mg ,,	10.9	11.5	12.2	11.6	10.6
Exch K ,,	0.9	0.4	0.3	0.2	0.3
Exch Na (cmol+/kg)	0.4	0.3	0.5	0.3	0.3
CEC ,,	43.1	43.3	48.5	45.9	38.9
BS %	76	75	77	82	78
OC %	2.62	1.39	0.93	1.18	0.77
Total N %	0.22	0.19	0.1	0.12	0.07
C/N	12	7.3	9.3	9.8	11
P Olsen (ppm)	5.5				
Av. S %	1.4				

Profile Number: Profile No: **ADQP001**

Status: routine profile description

Date: 14/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, **Korata Kebele**

Coord: N11°44'5.435", E: 37°27'0.309"

Soil climate: SU

Land Form: Plain (LP)

Position: **: middle slope(MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

LandUse: Rainfed arable cultivation(AA4) and comercial

Crops: Barley(CeBa), Wheat(CeWh)

Human Infl: Ploughing (Pl), surface compaction(Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: Alluvial deposit over colluvium

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: water erosion or deposition (W)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Watertable: >1m

Flooding: seasonal

Moist Cond: dry 0-10, slightly moist 10-25, moist 25+

WRB: Nitic Luvisols (Rhodic) (2006)

Samples:A: 0-13 B: 13-31 C: 31-60 D: 60-91 E: 91-121 F: 121-195

AP 0-13 Dark brown (7.5YR3/2), moist; clay; rapidly permeable; very hard dry, friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; many fine, common medium and very few coarse pores; common fine roots; non-calcareous; clear smooth boundary.

AB 13-31Dark reddish brown (2.5YR3/3), moist; clay; rapidly permeable; slightly hard dry, very friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; common distinct clay skins; many fine and common medium pores; few fine roots; non-calcareous; gradual smooth boundary.

Bt1 31-60 Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; slightly hard dry, very friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; many fine and common medium pores; few fine ferromanganese concretions; very few fine roots; non-calcareous; clear smooth boundary.

Bt2 60-91 Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct greyish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous.

Bt3 91-121Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct greyish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous.

C 121-195Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct greyish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous.

TABLE 3: ANALYTICAL DATA OF PROFILE NO: ADQP001, QORATA KEBELE, DERA WOREDA

Horizon	Ap	AB	Bt1	Bt2	Bt3	C
Depth (cm)	0-13	13-31	31-60	60-91	91-121	121-195
Sand %	17.14	20.34	8.94	6.66	3.66	2.17
Silt %	27.62	21.53	28.18	31.11	33.22	35.58
Clay %	55.24	58.13	62.87	62.23	63.12	62.26
silt/clay	0.5	0.4	0.4	0.5	0.5	0.6
Bulk density	1.24	1.16	1.19	1.21	1.21	1.25
pH-H2O (1:2.5)	4.95	4.97	5.09	5.06	5.01	4.75
pH-KCl	4.23	4.32	4.23	4.1	4.11	3.97
EC (dS/m)	0.06	0.03	0.03	0.02	0.04	0.04
Exch Ca ,,	24.59	18.83	25.92	22	19.36	19.36
Exch Mg ,,	9.32	6.85	8.64	7.92	7.04	6.16
Exch K ,,	0.26	0.22	0.25	0.11	0.1	0.18
Exch Na (cmol+/kg)	0.98	0.91	1.35	0.94	1.26	1.13
SUM	35.15	26.81	36.16	30.97	27.76	26.83
CEC ,,	48.39	41.87	48.83	43.52	38.28	36.35
CECclay	87.60	72.03	77.67	69.93	60.65	58.38
BS %	72.64	64.03	74.05	71.16	72.52	73.81
OC %	1.56	1.52	1.05	0.65	0.66	0.6
OM %	2.69	2.62	1.81	1.12	1.14	1.03
Total N %	0.21	0.19	0.14	0.09	0.08	0.08
C/N	7.4	8.0	7.5	7.2	8.3	7.5
P Olsen (ppm)	9.3					
Av. S %	0.78					
Av Zn (mg/kg)	0.87					
Av Mn ,,	76.4					
Av Cu ,,	1.68					
Av Fe ,,	19.2					

Profile Number: Profile No: **ADQP002**

Status: routine profile description

Date: 14/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, **Korata Kebele**

Coord**: N11**°49'53.806", E: 37°37'59.692"

Soil climate: SU

Land Form: **plateau**

Position: **: middle slope(MS)**

Slope form: SV

Slope: 5-10%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat(CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: Alluvial deposit over colluvium

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: water erosion or deposition (W)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Watertable: >1m

Flooding: seasonal

Moist Cond: dry 0-10, slightly moist 10-25, moist 25+

WRB: Haplic Luvisols (Manganiferric) (2006)

Samples: A: 0-19 B: 19-44 C: 44-79 D: 79-200

AP 0-19cm Dark reddish brown (5YR3/3), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; many fine, common

medium and common coarse pores; many fine and few medium roots; non-calcareous; clear smooth boundary.

B1 19-44cmDark reddish brown (5YR3/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; strong medium angular blocky structure; continuous clay skins; common fine, common medium and common coarse pores; few fine roots; non-calcareous; clear wavy boundary.

B2 44-79 Dark reddish brown (5YR3/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate medium sub-angular blocky structure; continuous clay skins; few fine, common medium and common coarse pores; very few fine roots; common fine ferromanganease concretions; non-calcareous; gradual smooth boundary.

C 79-200Reddish brown (5YR4/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; broken clay skins; common fine, common medium and common coarse pores; very few fine roots; common fine and medium ferromanganease concretions; non-calcareous.

Photograph

TABLE 4: ANALYTICAL DATA OF PROFILE NO: ADQP002, QORAT KEBELE, DERA WOREDA

Horizon	Ap	B1	B2	C
Depth (cm)	0-19	19-44	44-79	79-200
Sand %	9	3	3	5
Silt %	24	12	12	9
Clay %	68	85	85	76
silt/clay	0.4	0.1	0.1	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.2	1.2	1.2	1.11
pH-H2O (1:2.5)	5.1	5.4	5.3	5.2
pH-KCl	4	4.2	4.2	4.1
EC (dS/m)	0.3	0.1	0.1	0.1
Exch Ca ,,	27.1	21.9	18.2	18.2
Exch Mg ,,	12.2	11.9	9.1	11.9
Exch K ,,	3.1	1.1	0.3	0.5
Exch Na (cmol+/kg)	0.1	0.3	0.3	0.3
SUM	42.5	35.2	27.9	30.9
CEC ,,	45	44	36	36
CEC clay ,,	66.2	51.8	42.4	47.4
BS %	94.4	80.0	77.5	85.8
OC %	3.9	1.9	1.1	0.9
OM %	6.7	3.3	1.9	1.6
Total N %	0.35	0.17	0.12	0.1
C/N	11.1	11.2	9.2	9.0
P Olsen (ppm)	11.3			

Profile Number: Profile No: ADSP001

Status: routine profile description

Date: 15/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, **Shime Kebele**

Coord: N11°38'30.95"**, E:** 37°42'3.29"

Soil climate: SU

Land Form valley floor

Position: **middle slope(MS)**

Slope form: SV

Slope: 5-10%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat(CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

Moist Cond: dry 0-10, slightly moist 10-25, moist 25+

WRB: Nitic Luvisols (manganiferic) (2006)

Samples: A: 0-14 B: 14-36 C: 36-70 D: 70-99 E: 99-120 F: 120-185

AP 0-14 Reddish brown (5YR4/4), moist; clay; rapidly permeable; very hard dry, friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; many fine, common medium and very few coarse pores; common fine roots; non-calcareous; clear smooth boundary.

AB 14-36 Yellowish Red (5YR4/6), moist; clay; rapidly permeable; slightly hard dry, very friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; common distinct clay skins; many fine and common medium pores; few fine roots; non-calcareous; gradual smooth boundary.

Bt1 36-70 Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; slightly hard dry, very friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; many fine and common medium pores; few fine ferromanganese concretions; very few fine roots; non-calcareous; clear smooth boundary.

Bt2 70-99 Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct greyish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous.

Bt3 99-121Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct greyish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous.

C 120-185Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct greyish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous

TABLE 5:ANALYTICAL DATA OF PROFILE NO: ADSP001, SHIME MARIAM KEBELE, DERA WOREDA

Horizon	Ap	AB	Bt1	Bt2	Bt3	C
Depth (cm)	0-14	14-36	36-70	70-99	99-120	120-185
Sand %	23	23.12	4.39	0.55	0.95	1.9
Silt %	27.5	19.21	32.62	36.16	39.39	39.92
Clay %	49.5	57.64	62.99	63.29	59.65	58.17
silt/clay	0.56	0.33	0.52	0.57	0.66	0.69
Texture class	Clay	Clay	Clay	Clay	Clay	Clay
Bulk density(gm/cm3)	1.26	1.13	1.14	1.18	1.19	1.22
pH-H2O (1:2.5)	4.87	4.91	5.24	5.09	5.19	4.88
pH-KCl	4.04	4.08	4.28	4.2	4.48	4.12
EC (dS/m)	0.04	0.02	0.02	0.02	0.03	0.03
Exch Ca ,,	15.12	16.96	25.54	18.3	17.64	20.35
Exch Mg ,,	5.04	5.09	8.24	6.66	5.88	6.78
Exch K ,,	0.28	0.16	0.15	0.116	0.17	0.18
Exch Na (cmol+/kg)	1.24	1.53	1.36	1.61	1.72	1.7
SUM	21.68	23.74	35.29	26.73	25.41	29.02
CEC ,,	46.57	45.63	49.71	53.36	46.57	49.31
BS %	46.55	52.02	70.99	50.09	54.56	58.85
OC %	1.56	1.52	1.05	0.65	0.66	0.6
OM %	2.69	2.62	1.81	1.12	1.14	1.03
Total N %	0.21	0.19	0.14	0.09	0.08	0.08
C/N	7.4	8.0	7.5	7.2	8.3	7.5
P Olsen (ppm)	10.7					
Av. S %	1.6					
Av Zn (mg/kg)	0.87					
Av Mn ,,	76.4					
Av Cu ,,	1.68					
Av Fe ,,	19.2					

Profile Number: Profile No: ADSP002

Status: routine profile description

Date: 15/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, **Shime Kebele**

Coord: N 11°38'21.589", **E** 37°44'43.558"

Soil climate: SU

Land Form valley floor

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat (CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Luvisols (Rhodic)

Samples: A: 0-19 B: 19-44 C: 44-79 D: 79-200

AP 0-18cm brown (7.5YR4/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; many fine, common medium and common coarse pores; many fine and few medium roots; non-calcareous; clear smooth boundary.

B1 18-52cmDark reddish brown (5YR3/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; strong medium angular blocky structure; continuous clay skins; common fine, common medium and common coarse pores; few fine roots; non-calcareous; clear wavy boundary.

B2 52-90Dark reddish brown (5YR3/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate medium sub-angular blocky structure; continuous clay

skins; few fine, common medium and common coarse pores; very few fine roots; common fine ferromanganease concretions; non-calcareous; gradual smooth boundary.

B3 90-146 Reddish brown (5YR4/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; broken clay skins; common fine, common medium and common coarse pores; very few fine roots; common fine and medium ferromanganease concretions; non-calcareous.

C 146-200Reddish brown (5YR4/6), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; broken clay skins; common fine, common medium and common coarse pores; very few fine roots; common fine and medium ferromanganease concretions; non-calcareous.

TABLE 6: ANALYTICAL DATA OF PROFILE NO: ADSP002, SHIME MARIAM KEBELE, DERA

Horizon	Ap	B1	B2	B3	C
Depth (cm)	0-18	18-52	52-90	90-146	146-200
Sand %	26	25	20	6	4
Silt %	34	23	20	18	14
Clay %	40	52	60	76	82
silt/clay	0.9	0.4	0.3	0.2	0.2
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.16	1.17	1.14	1.14	1.31
pH-H2O (1:2.5)	5.6	5.1	5.4	5.6	5.9
pH-KCl	4.3	4.1	4.3	4.6	5.1
EC (dS/m)	0.2	0.21	0.1	0.11	0.39
Exch Ca ,,	4.4	5.8	6.3	6.3	7.5
Exch Mg ,,	3.1	3.5	3.52	3.7	2.8
Exch K ,,	1.4	1	0.8	0.5	0.4
Exch Na (cmol+/kg)	3	3	3	2.9	2.3
SUM	11.9	13.3	13.62	13.4	13
CEC ,,	29.8	36.7	33.4	29.2	26.3
CECclay ,,	74.5	70.6	55.7	38.4	32.1
BS %	39.9	36.2	40.8	45.9	49.4
OC %	2.3	1.68	1.26	1.17	0.53
OM %	3.97	2.90	2.17	2.02	0.91
Total N %	0.23	0.16	0.13	0.1	0.04
C/N	10.0	10.5	9.7	11.7	13.3
P Olsen (ppm)	9.3				
Av. S %	0.54				
Av Zn (mg/kg)	0.65				
Av Mn ,,	66.4				
Av Cu ,,	1.58				

Profile Number: Profile No: ADGP001

Status: routine profile description

Date: 16/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, **GelawdewosKebele**

Coord: N 11°38'5.418", E: 37°48'7.051"

Soil climate: SU

Land Form valley floor

Position: **middle slope(MS)**

Slope form: SV

Slope: 5-10%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat(CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Luvisols (Rhodic)

Samples: A: 0-15 B: 15-65 C: 65-120

AP 0-15cm brown (7.5YR4/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; many fine, common medium and

common coarse pores; many fine and few medium roots; non-calcareous; clear smooth boundary.

B1 15-65cmDark reddish brown (5YR3/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; strong medium angular blocky structure; continuous clay skins; common fine, common medium and common coarse pores; few fine roots; non-calcareous; clear wavy boundary.

C 65-120 Reddish brown (5YR4/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; broken clay skins; common fine, common medium and common coarse pores; very few fine roots; common fine and medium ferromanganease concretions; non-calcareous.

TABLE 7: ANALYTICAL DATA OF PROFILE NO: ADGP001, GELAWDEWOS KEBELE, DERA

Horizon	Ap	AB	Bt1
Depth (cm)	0-15	15-65	65-120
Sand %	20.85	14.04	2.45
Silt %	24.18	27.91	37.43
Clay %	54.96	58.05	60.12
silt/clay	0.44	0.48	0.62
Texture class	Clay	Clay	Clay
Bulk density	1.21	1.43	1.16
pH-H2O (1:2.5)	5.1	5.09	4.87
pH-KCl	4.23	4.2	4.29
EC (dS/m)	0.03	0.02	0.04
Exch Ca ,,	23.54	22.88	25.09
Exch Mg ,,	7.85	7.92	8.96
Exch K ,,	0.08	0.1	0.11
Exch Na (cmol+/kg)	0.95	1.28	1.64
SUM	32.42	32.18	35.8
CEC ,,	48.81	50.22	40.9
CECclay ,,	88.81	86.51	68.03
BS %	66.4	64.1	87.5
OC %	1.7	1.52	0.9
Total N %	0.23	0.18	0.13
C/N	7.4	8.4	6.9
P Olsen (ppm)	2.5		
Av. S %	0.51		
Av Zn (mg/kg)	0.71		
Av Mn ,,	42.03		
Av Cu ,,	1.29		
Av Fe ,,	18.9		

Profile Number: Profile No: ADGP002

Status: routine profile description

Date: 16/06/06EC

Author(s): Mekonnen Getahun

Location: Dera Woreda, **GelawdewosKebele**

Coord: N11°38'5.418", **E** 37°48'7.051"

Soil climate: SU

Land Form valley floor

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat (CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Luvisols (Manganiferric)

Samples: A: 0-12 B: 12-50 C: 50-95 D: 95-135

AP 0-12cm brown (7.5YR4/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; many fine, common medium and common coarse pores; many fine and few medium roots; non-calcareous; clear smooth boundary.

B1 12-50cmDark reddish brown (5YR3/4), moist; clay; rapid permeability; friable moist, very sticky and very plastic wet; strong medium angular blocky structure; continuous clay skins;

common fine, common medium and common coarse pores; few fine roots; non-calcareous; clear wavy boundary.

B2 50-95Dark reddish brown (5YR3/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate medium sub-angular blocky structure; continuous clay skins; few fine, common medium and common coarse pores; very few fine roots; common fine ferromanganease concretions; non-calcareous; gradual smooth boundary.

C 95-135 Reddish brown (5YR4/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; broken clay skins; common fine, common medium and common coarse pores; very few fine roots; common fine and medium ferromanganease concretions; non-calcareous.

TABLE 8: ANALYTICAL DATA OF PROFILE NO: ADGP002, GELAWDEWOS KEBELE, DERA

Horizon	Ap	AB	Bt1	Bt2
Depth (cm)	0-12	12-50	50-95	95-135
Sand %	26.12	14.16	6.3	11.01
Silt %	23.9	27.51	34.58	27.81
Clay %	49.98	58.33	59.12	61.18
silt/clay	0.48	0.47	0.58	0.45
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.18	1.18	1.18	1.21
pH-H2O (1:2.5)	4.97	4.78	4.81	4.98
pH-KCl	4.09	4.01	4.06	4.18
EC (dS/m)	0.03	0.02	0.03	0.02
Exch Ca ,,	17.47	15.66	14.98	16.8
Exch Mg ,,	5.82	5.77	5.82	5.88
Exch K ,,	0.12	0.13	0.15	0.16
Exch Na (cmol+/kg)	1.72	1.54	1.61	1.52
SUM	25.13	23.09	22.56	24.
CEC ,,	50.19	43.89	51.55	53.87
BS %	50.06	52.61	43.76	44.55
OC %	1.99	1.92	1.92	1.53
OM %	3.4	3.3	3.3	2.6
Total N %	0.21	0.2	0.2	0.2
C/N	9.5	9.6	9.6	7.7
P Olsen (ppm)	3.3			
Av. S %	0.75			
Av Zn (mg/kg)	0.66			
Av Mn ,,	27.26			
Av Cu ,,	1.25			
Av Fe ,,	24.8			

MECHA WOREDA

Soil profile Descriptions with Analytical Data

Profile Number: Profile No: **AMIP001**

Status: routine profile description

Date: 11/03/06EC

Author(s): Mekonnen Getahun

Location: Mecha Woreda, Inguti Kebele

Coord: N11°25'55.253", **E37**°7'51.825"

Soil climate: SU

Land Form: valley floor

Position: middle slope (MS)

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat (CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: mollic **Nitisols** (Rhodic,humic)

Samples: A: 0 – 20 B: 20 – 42 C: 42 – 69 D 69 – 99 E 99 – 130 F 130-185

Ap 0 - 20cm Dusky red (5YR ¾) (dry) and 2.5YR 3/4 (moist); clay; moderate fine angular blocky structure; slightly hard (dry), friable (moist), slightly sticky (wet), non plastic (wet), many fine-medium pores, common fine roots; non calcareous; gradual smooth boundary.

Bt1 20 - 42 cm dusky red(2.5YR ¾) dry, 10R3/4, moist); clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), slightly plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

Bt2 42-69 cm dark red(2.5YR 3/6 dry; clay; weak fine and medium sub prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous;

Bt3 69-99 cm dark red(2.5YR 3/6) (moist); clay; weak fine and medium sub prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous;

BC 99-130 cm dark red(2.5YR 3/6) (moist); clay; weak fine and medium sub prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous;

C 130-185 cm dark red(2.5YR 3/6) (moist); clay; weak fine and medium sub prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous;

TABLE 9: ANALYTICAL DATA OF PROFILE NO: AMIP001, INGUTI KEBELE, MECHA WOREDA

Horizon	Ap	Bt1	Bt2	Bt3	BC	C
Depth (cm)	0-20	20-42	42-69	69-99	99-130	130-185
Sand %	3.47	18.52	5.02	6.94	4.54	7.13
Silt %	33.25	26.8	32.38	33.54	32.54	30.24
Clay %	63.28	54.67	62.6	59.51	62.92	62.63
silt/clay	0.5	0.5	0.5	0.6	0.5	0.5
Texture class	Clay	Clay	Clay	Clay	Clay	Clay
Bulk density	1.18	1.15	1.14	1.12	1.13	1.19
pH-H2O (1:2.5)	4.87	4.63	5.24	5	5.17	4.97
pH-KCl	4.12	4.09	4.31	4.29	4.34	4.23
EC (dS/m)	0.04	0.02	0.02	0.02	0.02	0.03
Exch Ca ,,	18.48	16.64	16.80	12.48	12.6	14.28
Exch Mg ,,	5.04	4.99	5.88	4.16	4.2	4.2
Exch K ,,	0.38	0.27	0.17	0.17	0.16	0.15
Exch Na (cmol+/kg)	1.66	1.36	1.44	1.45	1.55	1.35
SUM	25.56	23.26	24.29	18.26	18.51	19.98
CEC ,,	45.2	42.05	48.85	30.30	32.41	42.91
BS %	56.54	55.31	49.72	60.26	57.11	46.56
OC %	1.56	1.43	1.31	1.18	1.12	0.97

Total N %	0.18	0.16	0.15	0.14	0.12	0.11
C/N	8.7	8.9	8.7	8.4	9.3	8.8
P Olsen (ppm)	7.4					
Av. S %	1.54					
Av Zn (mg/kg)	0.31					
Av Mn ,,	49.6					
Av Cu ,,	1.15					
Av Fe ,,	18					

Profile description

Profile Number: AMAMP001

Status: routine profile description

Date: 10/05/06EC

Author(s): Mekonnen Getahun

LocationMecha Woreda, Ambo Mesk Kebele

GPS N 11°24'26.593"N 37°3'36.276"E

Soil climate: SU

Land Form: valley floor

Position: middle slope (MS)

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: Barley (CeBa), Wheat (CeWh)

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic **Nitisols** (Rhodic)

Samples: A: 0 – 12 B: 12 – 40 C: 40 – 80 D: 80 – 170 E: 170 – 200

AP 0 - 12 cm dark brown(7.5YR 3/4), silt clay loam, moderate medium sub-angular blocky structure; hard (dry), friable (moist), slightly sticky (wet), plastic (wet), many fine-medium pores, common fine roots; non calcareous; gradual smooth boundary.

AB 12 - 40cm dark reddish brown(5YR 3/3), (moist); clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), thin clay coatings on ped faces, plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

Bt1 40- 80cm dark reddish brown to yellowish red (5YR 3/5), (moist); clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

Bt2 80 - 170cm dark reddish brown (2.5YR 3/3), (moist); clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

C 170-200 cm dark reddish brown to dark red (2.5YR 3/5), (moist); clay; weak fine and medium sub prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous.

TABLE 10: ANALYTICAL DATA OF PROFILE NO: AMAMP001, AMBOMESK KEBELE, MECHA WOREDA

Horizon	Ap	AB	Bt1	Bt2	C
Depth (cm)	0-12	12-40	40-80	80-170	170-200
Sand %	16.39	12.8	11.26	17.16	15.69
Silt %	23.1	24.6	25.03	25.4	29.62
Clay %	60.51	62.61	63.71	57.43	54.69
silt/clay	0.4	0.4	0.4	0.4	0.5
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16	1.17
pH-H2O (1:2.5)	4.78	5.76	5.78	5.11	5.08
pH-KCl	4.04	4.9	4.94	4.38	4.32
EC (dS/m)	0.05	0.06	0.11	0.01	0.01
Exch Ca ,,	17.47	19.32	15.96	14.96	17.64
Exch Mg ,,	5.82	5.04	5.88	5.82	5.88
Exch K ,,	0.36	0.30	0.16	0.10	0.09
Exch Na (cmol+/kg)	1.54	1.61	1.66	1.61	1.55
SUM	25.2	26.27	23.66	22.51	25.16
CEC ,,	48.38	42.91	40.17	34.82	46.57
BS %	52.09	61.22	58.89	64.64	54.03
OC %	1.49	1.34	1.23	0.7	0.57

Total N %	0.18	0.17	0.14	0.08	0.06
C/N	8.3	7.9	8.8	8.8	9.5
P Olsen (ppm)	5.5				
Av. S %	1.1				
Av Zn (mg/kg)	0.25				
Av Mn ,,	12.2				
Av Cu ,,	0.62				
Av Fe ,,	8.2				

Profile description

Profile Number: AMAMP002

Status: routine profile description

Date: 10/05/06EC

Author(s): Mekonnen Getahun

Location: Mecha Woreda, Ambo Mesk Kebele

Coord: N 11°23'5.426", E37°3'43.458"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **Maize,teff, tomato Potato**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Nitisols (2006)

Samples: A: 0 – 16 B: 16 – 57 C: 57 – 100 D: 100 – 200

AP0 - 16 cm dark brown to brown (10YR 3.5/3), silt clay loam to silty clay, moderate medium sub-angular blocky structure; hard (dry), friable (moist), slightly sticky (wet), plastic (wet), many fine-medium pores, common fine roots; non calcareous; gradual smooth boundary.

B21 16 - 57cm dark reddish brown(7.5YR 3.5/3), (moist); clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), thin clay coatings on ped faces, plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

B22 57- 100cm dark yellowish brown (10YR 4/4), (moist); clay; weak fine and medium angular blocky structure; friable (moist), sticky (wet), plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

C 100 - 200cm dark yellowish brown to yellowish brown (10YR 4.5/4), (moist); clay; moderate fine and medium angular blocky structure; friable (moist), sticky (wet), plastic (wet), common medium-coarse pores, few fine roots; non calcareous; gradual smooth boundary.

TABLE 11: ANALYTICAL DATA OF PROFILE NO: AMAMP002, AMBO MESK KEBELE, MECHA WOREDA

Horizon	Ap	AB	Bt1	C
Depth (cm)	0-16	16-57	57-100	100-200
Sand %	12	3	3	5
Silt %	34	10	19	20
Clay %	54	87	78	75
silt/clay	0.6	0.1	0.2	0.3
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.3	5.1	5.3	6
pH-KCl	4	3.8	4.8	5
EC (dS/m)	0.1	0.1	0.1	0.1
Exch Ca ,,	23.5	22.6	18.1	16.3
Exch Mg ,,	12.7	13.6	19	9
Exch K ,,	1.2	0.7	0.6	0.6
Exch Na (cmol+/kg)	0.5	0.5	0.4	0.5
SUM	37.9	37.4	38.1	26.4
CEC ,,	40	39	39	32
CECclay	74.07	44.83	50.00	42.67
BS %	94.75	95.90	97.69	82.50
OC %	3.7	1.3	0.8	0.7

Total N %	0.22	0.14	0.11	0.08
C/N	16.8	9.3	7.3	8.8
P Olsen (ppm)	8.1			
Av. S %	1.2			
Av Zn (mg/kg)	0.25			
Av Mn ,,	12.2			
Av Cu ,,	0.62			
Av Fe ,,	8.2			

Profile description

Profile Number: AMTWP001

Status: routine profile description

Date: 05/05/06EC

Author(s): Mekonnen Getahun

Location: Mecha Woreda, Tagel Wodefit

Coord: N11°25'47.064", E 37°4'59.105"

Soil climate: SU

Land Form: upland

Position: middle slope (MS)

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **Maize,teff, tomato Potato**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Luvisols (Rhodic)

Samples: A: 0 – 21 B: 21 – 53 C: 53 – 98 D: 98 – 200

Ap 0 - 21 cm Very dark brown (7.5YR2.5/2), moist; clay; very hard dry, friable moist, very sticky and very plastic wet; weak coarse sub-angular blocky structure; common faint clay skin; common fine, many medium and few coarse pores; few fine and very few medium roots; few animal borrow; non-calcareous; clear smooth boundary.

B 21 - 53 cmDark reddish brown (2.5YR3/4), moist; clay; friable moist, very sticky and very plastic wet; moderate very coarse sub-angular blocky structure; common distinct clay skin; many fine, common medium and few coarse pores; very few fine, very few medium and very few coarse roots; non-calcareous; clear smooth boundary.

Bt1 53-98 cmDark reddish brown (2.5YR3/4), moist; light clay; very friable moist, sticky and plastic wet; moderate coarse angular blocky structure; common distinct clay skin; many fine, common medium and few coarse pores; very few medium roots; non-calcareous; gradual smooth boundary.

Bt2 98-200cm Dark reddish brown (2.5YR3/4), moist; clay loam; very friable moist, sticky and slightly plastic wet; weak coarse sub-angular blocky structure; common distinct clay skin; common distinct pressure face; many fine, common medium and few coarse pores; very few fine, common medium and common coarse roots; non-calcareous.

TABLE 12: ANALYTICAL DATA OF PROFILE NO: AMTWP001, TAGEL WODEFIT KEBELE, MECHA

Horizon	Ap	AB	Bt1	Bt2
Depth (cm)	0-21	21-53	53-98	98-200
Sand %	5	1	1	1
Silt %	23	11	10	10
Clay %	71	88	89	89
silt/clay	0.3	0.1	0.1	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.2	4.7	5.1	5.7
pH-KCl	4.3	4.1	4.3	4.7
EC (dS/m)	0.05	0.06	0.11	0.01
Exch Ca ,,	18.2	8.1	8.1	7.2
Exch Mg ,,	8.2	5.4	4.5	5.4
Exch K ,,	0.4	0.2	0.19	0.13
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.1
SUM	26.9	13.8	12.89	12.83
CEC ,,	46	32	48	28
CECclay	64.79	36.36	53.93	31.46
BS %	58.48	43.13	26.85	45.82
OC %	2.4	1.2	1.1	1.5

Total N %	0.15	0.08	0.06	0.08
C/N	16.0	15.0	18.3	18.8
P Olsen (ppm)	7.4			
Av. S %	1.1			
Av Zn (mg/kg)	0.25			
Av Mn ,,	12.2			
Av Cu ,,	0.62			
Av Fe ,,	8.2			

PROFILE DECRIPTION

Profile Number: AMTWP002

Status: routine profile description

Date: 05/05/06EC

Author(s): Mekonnen Getahun

LocationMecha Woreda, Tagel Wodefit

Coord: N 11°26'15.106", **E37°**3'2.08"

Soil climate: SU

Land Form: upland

Position: middle slope (MS)

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **Maize,teff, tomato Potato**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Luvic Nitisol (Rhodic) (2006)

Samples: A: 0 – 14 B: 14 – 55 C: 55 – 126 D: 126 – 200

Ap 0 - 14cmVery dark brown (7.5YR2.5/2), moist; clay; hard dry, very friable moist, very sticky and very plastic wet; moderate coarse sub angular blocky structure; common fine, many medium and common coarse pores; common fine roots; non calcareous; clear smooth boundary.

B 14 - 55 cmDark reddish brown (2.5YR3/3), moist; clay; hard dry, friable moist, very sticky and very plastic wet; strong fine to medium angular blocky structure; distinct shiny faces; few fine, common medium and common coarse pores; few fine roots; few animal burrows; non calcareous; gradual smooth boundary.

Bt1 55-126 cmDark red (2.5YR3/6), moist; clay; very friable moist, very sticky and very plastic wet; strong medium to coarse angular blocky structure; distinct shiny faces; common fine, many medium and common coarse pores; very few fine roots; few animal burrows; few medium ferromanganese concretions; non calcareous; diffuse smooth boundary.

Bt2 126- 200cm Dark red (2.5YR3/6), moist; clay; very friable moist, very sticky and plastic wet; moderate fine to medium angular blocky structure; distinct shiny faces; common fine, many medium and few coarse pores; common medium ferromanganese segregations and concretions; non calcareous.

TABLE 13: ANALYTICAL DATA OF PROFILE NO: AMTWP002, TAGEL WODEFIT KEBELE, MECHA

Horizon	Ap	AB	Bt1	Bt2
Depth (cm)	0-14	14-55	55-126	126-200
Sand %	7	1	2	3
Silt %	31	13	18	16
Clay %	62	86	81	81
silt/clay	0.5	0.2	0.2	0.2
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.5	5.1	5.1	5.11
pH-KCl	4.7	4.1	4.4	4.38
EC (dS/m)	0.05	0.06	0.11	0.01
Exch Ca ,,	12.5	10.8	6.3	21.02
Exch Mg ,,	10.8	10.8	7.2	7.01
Exch K ,,	0.5	0.12	0.19	0.13
Exch Na (cmol+/kg)	0.1	0.2	0.2	0.3
SUM	23.9	21.92	13.89	28.46
CEC ,,	46	33	35	33.33
CECclay	74.19	38.37	43.21	41.15

BS %	51.96	66.42	39.69	85.39
OC %	3.8	1.3	0.9	0.7
Total N %	0.18	0.12	0.06	0.08
C/N	21.1	10.8	15.0	8.8
P Olsen (ppm)	9.7			
Av. S %	0.8			
Av Zn (mg/kg)	0.15			
Av Mn ,,	105			
Av Cu ,,	0.48			
Av Fe ,,	6.7			

Profile description

Profile Number: AMAP001

Status: routine profile description

Date: 05/05/06EC

Author(s): Mekonnen Getahun

LocationMecha Woreda, Amarite Kebele

Coord: N 11°28'23.944", **E**37°5'58.762"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **Maize,teff, tomato Potato**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Nitic Luvisols (Rhodic)

Samples: A: 0 – 32 B: 32 – 70 C: 70 – 130 D: 130 – 160 E: 160 – 200

Ap 0 - 32 cm Dark reddish brown (5YR3/2), moist; clay; rapid permeability; hard dry, friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; many fine, common medium and common coarse pores; common fine and few medium roots; non-calcareous; clear smooth boundary.

B 32 - 70 cm Dark reddish brown (2.5YR3/1), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; distinct broken clay skins; common fine, common medium and common coarse pores; few fine roots; non-calcareous; gradual smooth boundary.

Bt1 70-130 cm Reddish brown (2.5YR4/4), moist; light clay; moderate permeability; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct broken clay skins; common fine, common medium and common coarse pores; very few fine, common medium and few coarse roots; non-calcareous; gradual smooth boundary.

Bt2 130-160 Dark reddish brown (2.5YR3/4), moist; light clay; moderate permeability; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct patchy clay skins; common fine, common medium and few coarse pores; very few fine and common medium roots; non-calcareous; clear smooth boundary.

Bt3 160-200cm Dark reddish brown (2.5YR3/4), moist; clay; moderate permeability; friable moist, very sticky and very plastic wet; moderate medium sub-angular blocky structure; common fine, common medium and common coarse pores; common fine ferromanganease concretion; non-calcareous.

TABLE 14: ANALYTICAL DATA OF PROFILE NO: AMAP001, AMARIT KEBELE, MECHA

Horizon	Ap	AB	Bt1	Bt2	Bt3
Depth (cm)	0-32	32-70	70-130	130-160	160-200
Sand %	2	2	2		
Silt %	17	10	14		
Clay %	81	88	84		
silt/clay	0.2	0.1	0.2		
Texture class	Clay	Clay	Clay		
Bulk density	1.13	1.05	1.02	1.13	1.12
pH-H2O (1:2.5)	5.4	5.4	5.5	5.11	5.08
pH-KCl	4.3	4.6	4.9	4.38	4.32
EC (dS/m)	0.1	0.1	0.1	0.1	0.1
Exch Ca ,,	14.2	9.9	9		

Exch Mg ,,	20.4	17	17.9	7.01	7.18
Exch K ,,	0.1	0.1	0.1	0.1	0.14
Exch Na (cmol+/kg)	0.2	0.2	0.2	0.2	0.2
SUM	34.9	27.2	27.2	7.31	7.52
CEC ,,	39	37	34	33.33	36.59
CECclay	48.15	42.05	40.48	#DIV/0!	#DIV/0!
BS %	89.49	73.51	80.00	21.93	20.55
OC %	3.1	1	0.8	0.7	0.57
Total N %	0.15	0.11	0.05	0.08	0.06
C/N	20.7	9.1	16.0	8.8	9.5
P Olsen (ppm)	5.5				
Av. S %	1.5				
Av Zn (mg/kg)	0.35				
Av Mn ,,	13.1				
Av Cu ,,	0.72				
Av Fe ,,	9.1				

Profile description

Profile Number: AMAP002

Status: routine profile description

Date: 08/05/06EC

Author(s): Mekonnen Getahun

LocationMecha Woreda, Amarite Kebele

Coord: N 11°32'14.774", **E**37°6'5.745"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **Maize,teff, tomato Potato**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Luvic Nitisol (Rhodic) (2006)

Samples: A: 0 – 16 B: 16 – 75 C: 75 – 110 D: 110 – 200

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0 -16 cm Very dark brown (7.5YR2.5/2), moist; clay; hard dry, very friable moist, sticky and plastic wet; moderate coarse sub-angular blocky structure; common distinct clay skin; many fine, many medium and common coarse pores; few fine roots; non-calcareous; clear smooth boundary.

16 - 75 cm Dark reddish brown (2.5YR2.5/3), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; very few fine roots; animal borrow; non-calcareous; diffuse smooth boundary.

75-110 cm Dark reddish brown (2.5YR2.5/3), moist; clay; friable moist, sticky and plastic wet; moderate very coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; very few fine roots; animal borrow; non-calcareous; gradual smooth boundary.

110-200 Dark reddish brown (2.5YR3/4), moist; clay; very friable moist, very sticky and plastic wet; moderate very coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and few coarse pores; very few coarse roots; animal borrow; non-calcareous.

TABLE 15: ANALYTICAL DATA OF PROFILE NO: AMAP002, AMARIT KEBELE, MECHA

Horizon	Ap	AB	Bt1	Bt2
Depth (cm)	0-16	16-75	75-110	110-200
Sand %	7	3	1	4
Silt %	43	20	18	16
Clay %	49	77	81	80
silt/clay	0.9	0.3	0.2	0.2
Texture class	Sily Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.8	5.1	5.2	5.11

pH-KCl	4.8	4	4.6	4.38
EC (dS/m)	0.05	0.06	0.11	0.01
Exch Ca ,,	17	8.1	13.4	21.02
Exch Mg ,,	11.6	5.4	2.7	7.01
Exch K ,,	1.4	0.9	0.1	0.13
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.1
SUM	30.1	14.5	16.3	28.26
CEC ,,	56	36	30	33.33
CECclay	114.29	46.75	37.04	41.66
BS %	53.75	40.28	54.33	84.79
OC %	4.8	1.7	0.9	0.7
OM %				
Total N %	0.22	0.12	0.11	0.08
C/N	21.8	14.2	8.2	8.8
P Olsen (ppm)	10			
Av. S %	1.0			
Av Zn (mg/kg)	0.35			
Av Mn ,,	14.2			
Av Cu ,,	0.56			
Av Fe ,,	9.2			

Profile description

Profile Number: AMKP001

Status: routine profile description

Date: 08/05/06EC

Author(s): Mekonnen Getahun

Location: Mecha Woreda, **Andnet Kebele(Kolela)**

Coord: N 11°27'33.306", **E37°**7'29.326"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize, tomato, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Haplic Luvisols (Manganiferric)

Samples: A: 0 – 20 B: 20 – 57 C: 57 – 98 D: 98 – 130 D: 130 – 200

Ap 0 - 20 cmDark reddish brown (5YR2.5/2), moist; clay; very hard dry, friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; common distinct clay skin; many fine, many medium and common coarse pores; common fine and very few medium roots; animal borrow; non-calcareous; diffuse smooth boundary.

AB 20 - 57 cmDark reddish brown (2.5YR3/4), moist; clay; friable moist, very sticky and very plastic wet; moderate very coarse sub-angular blocky structure; common distinct clay skin; many fine, common medium and few coarse pores; very few fine, very few medium and very few coarse roots; non-calcareous; clear smooth boundary.

Bt1 57-98 cmDark reddish brown (2.5YR3/3), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; few fine roots; animal borrow; non-calcareous.

Bt298-130 cmDark reddish brown (2.5YR3/6), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; few fine roots; animal borrow; non-calcareous.

Bt3130-200 cmDark reddish brown (2.5YR3/6), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; few fine roots; animal borrow; non-calcareous.

TABLE 16: ANALYTICAL DATA OF PROFILE NO: AMKP001, KOLELA KEBELE, MECHA

Horizon	Ap	AB	Bt1	Bt2	Bt3
Depth (cm)	0-20	20-57	57-98	98-130	130-200
Sand %	20.5	3.94	6.72	9.31	1.79
Silt %	23.63	35.62	30.37	28.8	34.16
Clay %	55.84	60.44	62.91	61.88	64.05
silt/clay	0.4	0.6	0.5	0.5	0.5
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.14	1.13	1.11	1.12	1.13
pH-H2O (1:2.5)	6	4.77	4.88	5.21	4.97
pH-KCl	5.06	4	4.11	4.36	4.22
EC (dS/m)	0.06	0.07	0.02	0.08	0.04
Exch Ca ,,	22.23	22.32	22.42	21.26	14.46
Exch Mg ,,	7.69	7.72	8.62	7.65	5.1
Exch K ,,	1.85	1.01	0.57	0.19	0.15
Exch Na (cmol+/kg)	2.06	2.26	2.31	3.01	3.07
SUM	33.83	33.31	33.92	32.11	22.78
CEC ,,	37.7	34.52	38.43	38.82	29.58
CECclay	67.51	57.11	61.09	62.73	46.18
BS %	89.73	96.49	88.26	82.72	77.01
OC %	1.47	1.33	1.14	1.05	0.88
Total N %	0.16	0.14	0.12	0.1	0.1
C/N	9.2	9.5	9.5	10.5	8.8
P Olsen (ppm)	6.4				
Av. S %	1.23				
Av Zn (mg/kg)	0.67				
Av Mn ,,	53.2				
Av Cu ,,	1.6				
Av Fe ,,	16				

Profile description

Profile Number: AMKP002

Status: routine profile description

Date: 08/05/06EC

Author(s): Mekonnen Getahun

Location: Mecha Woreda, Andnet Kebele(Kolela)

Coord: N 11°30'49.602", **E37°**10'29.726"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 1-3% gen. undulating

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize, tomato, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Haplic Luvisols (Manganiferric)

Samples: A: 0 – 20 B: 20 – 57 C: 57 – 98 D: 98 – 130 D: 130 – 200

Ap 0 - 15 cmDark reddish brown (5YR2.5/2), moist; clay; very hard dry, friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; common distinct clay skin; many fine, many medium and common coarse pores; common fine and very few medium roots; animal borrow; non-calcareous; diffuse smooth boundary.

AB 15 - 49 cmDark reddish brown (2.5YR3/4), moist; clay; friable moist, very sticky and very plastic wet; moderate very coarse sub-angular blocky structure; common distinct clay

skin; many fine, common medium and few coarse pores; very few fine, very few medium and very few coarse roots; non-calcareous; clear smooth boundary.

Bt1 49-101 cmDark reddish brown (2.5YR3/3), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; few fine roots; animal borrow; non-calcareous.

Bt2101-155 cmDark reddish brown (2.5YR3/6), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; few fine roots; animal borrow; non-calcareous.

Bt3155-200 cmDark reddish brown (2.5YR3/6), moist; clay; friable moist, very sticky and plastic wet; moderate coarse sub-angular blocky structure; distinct shiny faces; many fine, many medium and common coarse pores; few fine roots; animal borrow; non-calcareous.

TABLE 17: ANALYTICAL DATA OF PROFILE NO: AMKP002, KOLELA KEBELE, MECHA

Horizon	Ap	AB	Bt1	Bt2	Bt3
Depth (cm)	0-15	15-49	49-101	101-155	155-200
Sand %	26	22	13	6	2
Silt %	34	26	17	12	13
Clay %	40	52	70	82	85
silt/clay	0.9	0.5	0.2	0.1	0.2
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16	1.17
pH-H2O (1:2.5)	5.3	5	5.3	5.4	5.7
pH-KCl	4.2	3.8	4.1	4.7	5
EC (dS/m)	0.06	0.07	0.02	0.08	0.04
Exch Ca ,,	5.9	4.8	4.6	4.4	3.8
Exch Mg ,,	4.2	2.3	3.1	3.4	4
Exch K ,,	0.6	0.3	0.3	0.3	0.3
Exch Na (cmol+/kg)	3	2.8	3	2.8	2.8
SUM	13.7	10.2	11	10.9	10.9
CEC ,,	34.9	30.6	31.4	26.7	22.9
CECclay	87.25	58.85	44.86	32.56	26.94
BS %	39.26	33.33	35.03	40.82	47.60
OC %	2.62	1.77	1.09	0.77	0.62
Total N %	0.3	0.19	0.15	0.1	0.08
C/N	8.7	9.3	7.3	7.7	7.8
P Olsen (ppm)	5.5				
Av. S %	2.1				
Av Zn (mg/kg)	0.15				
Av Mn ,,	10.2				

Av Cu ,,	0.32
Av Fe ,,	6.0

South Achefer woreda

Soil Profile description and Analytical data

Soil profile description

Profile Number: ASAAP001

Status: routine profile description

Date: 01/10/2013

Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Abchikli Kebele

Coord: N 11°21'49.326" E36°57'8.624"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Luvic **Nitisols** (Rhodic)

Samples: A: 0-20 B: 20-60 C: 60-101 D: 101-133 E: 133-200

Ap 0 – 20 cm 7.5YR 4/3 (moist); clay; moderate medium sub angular blocky structure; friable (moist), slightly sticky (wet), slightly plastic (wet), common fine-medium pores, common fine-medium roots; non calcareous; clear smooth boundary.

AB 20-60 cm 7.5YR 3/3 (moist); clay; moderate medium sub angular blocky structure; friable to firm (moist), sticky (wet), plastic (wet), common fine medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

Bt1 60-101 cm 7.5YR 3/6 (moist); clay; moderate to strong medium sub angular blocky structure; firm (moist), sticky (wet), plastic (wet), common fine-medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

BC 101-133 cm 7.5YR 3/6 (moist); clay; moderate to strong medium sub angular blocky structure; firm (moist), sticky (wet), plastic (wet), common fine-medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

C 133- 200 cm 7.5YR 2.5/2 (moist); clay; moderate to strong medium and coarse sub angular and angular blocky structure; firm (moist), sticky (wet), plastic (wet), few fine pores, common distinct clay; few fine rounded hard manganiferous nodules; non calcareous;

TABLE 18: Analytical data of Profile No: ASAAP001, Abchikli kebele, South Achefer

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-20	20-60	60-101	101-133	133-200
Sand %	23.06	13.67	11.4	12.42	11.03
Silt %	19.23	23.74	25.93	25.63	27.54
Clay %	57.7	62.59	62.67	61.95	61.43
silt/clay	0.3	0.4	0.4	0.4	0.4
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.22	1.18	1.17	1.18	1.12
pH-H2O (1:2.5)	5.05	5.12	4.97	5	5.16
pH-KCl	4.38	4.29	4.17	4.11	4.33
EC (dS/m)	0.07	0.02	0.05	0.06	0.06
Exch Ca ,,	18.73	15.45	20.62	19.58	16.9
Exch Mg ,,	5.96	6.87	7.73	6.81	5.07
Exch K ,,	0.22	0.24	0.19	0.12	0.14
Exch Na (cmol+/kg)	1.2	1.19	1.14	1.15	1.4
SUM	26.11	23.75	29.68	27.66	23.51

CEC ,,	41.17	35.46	36.89	37	33.52
CECclay	71.35	56.65	58.86	59.73	54.57
BS %	63.42	66.98	80.46	74.76	70.14
OC %	3.07	1.55	1.43	1.29	1.23
OM %					
Total N %	0.28	0.18	0.15	0.13	0.12
C/N	11.0	8.6	9.5	9.9	10.3
P Olsen (ppm)	11.9				
Av. S %	0.51				
Av Zn (mg/kg)	0.8				
Av Mn ,,	62.7				
Av Cu ,,	1.3				
Av Fe ,,	29				

Profile Number: ASAAP002

Status: routine profile description

Date: 01/10/2013

Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Abchikli Kebele

Coord:N11°20'21.373",E36°55'52.203"

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Nitisols (Rhodic)

Samples: A: 0-20 B: 20-60 C: 60-101 D: 101-133 E: 133-200

Ap 0 – 19 cm Very dark brown (7.5YR2.5/2), moist; clay; very hard dry, friable moist, very sticky and very plastic wet; weak coarse sub-angular blocky structure; common fine, many medium and common coarse pores; common fine roots; non-calcareous; clear smooth boundary.

AB 19-44 cm Dark reddish brown (2.5YR2.5/3), moist; clay; very hard dry, very friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; common distinct clay skins; common fine, common medium and common coarse pores; common fine and very few medium roots; non-calcareous; diffuse smooth boundary.

Bt1 44-79 cm Dark reddish brown (2.5YR3/4), moist; clay; very friable moist, very sticky and plastic wet; moderate medium and coarse sub-angular blocky structure; few distinct clay skins; common fine, common medium and few coarse pores; few fine roots; non-calcareous; gradual smooth boundary.

BC 79-200 cm Dark reddish brown (2.5YR3/4), moist; light clay; very friable moist, sticky and plastic wet; moderate very coarse angular blocky structure; common distinct clay skins; common fine, many medium and common coarse pores; very few coarse roots; non-calcareous.

TABLE 19: Analytical data of Profile No: ASAAP002, Abchikli kebele, South Achefer

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-19	19-44	44-79	79-200
Sand %	6	2	1	1
Silt %	26	13	32	10
Clay %	69	85	67	89
silt/clay	0.4	0.2	0.5	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.1	5.1	5	5.2
pH-KCl	4.4	4	4.5	4.6
EC (dS/m)	0.1	0.02	0.05	0.06

Exch Ca ,,	16.1	9	10.9	8.2
Exch Mg ,,	10.8	9	7.3	5.5
Exch K ,,	0.6	0.2	0.1	0.1
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.2
SUM	27.6	18.3	18.4	14
CEC ,,	44	32	30	27
CECclay	63.77	37.65	44.78	30.34
BS %	62.73	57.19	61.33	51.85
OC %	2.1	1.7	1	0.8
OM %				
Total N %	0.2	0.09	0.08	0.05
C/N	10.5	18.9	12.5	16.0
P Olsen (ppm)	5.5			
Av. S %	0.49			
Av Zn (mg/kg)	0.25			
Av Mn ,,	52.0			
Av Cu ,,	0.92			
Av Fe ,,	26.5			

Profile description

Profile Number: ASAAKP001

Status: routine profile description

Date: 12/5/2013

Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Ahuri-Keltafa Kebele

Coord: N11°24'58.697", E 36°56'43.325" Elevation: 1984 m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: mollic **Nitisols** (Rhodic,humic)

Samples: A: 0-12 B: 12-40 C: 40-95 D: 95-110 E: 110-190

Ap 0 – 12 cm 10YR5/3 (dry) and 10YR 3/2 (moist); clay; strong medium and coarse subangular blocky structure; hard (dry), friable (moist), sticky (wet), plastic (wet), common fine and very fine pores, common fine-medium roots; non calcareous; clear wavy boundary.

AB 12 – 40 cm 7.5YR 4/3 (moist); clay; moderate fine and medium subangular blocky structure; friable (moist), sticky (wet), plastic (wet), few fine and very fine pores, very few faint clay no specific location very few fine irregular soft manganiferous soft segregation; few fine roots; non calcareous; clear wavy boundary.

Bt1 40-95 cm 7.5YR 4/4 (moist); clay; weak fine subangular blocky structure; friable (moist), sticky (wet), plastic (wet), very few very fine pores, few faint clay no specific locations; common medium irregular soft manganiferous soft segregation; non calcareous; gradual wavy boundary.

Bt2 95-110 cm 7.5YR 4/4 (moist); clay; weak fine subangular blocky structure; friable (moist), sticky (wet), plastic (wet), very few very fine pores, few faint clay no specific locations; common medium irregular soft manganiferous soft segregation; non calcareous; gradual wavy boundary.

Bt3 110-190 cm 7.5 YR 4/6 (moist); clay; weak fine subangular blocky structure; friable (moist), sticky (wet), plastic (wet), very few very fine pores, few distinct clay no specific locations; many coarse irregular soft manganiferous soft segregation; non calcareous;

TABLE 20: Analytical data of Profile No: ASAAKP001, Ahuri Keltafa kebele, South Achefer

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-12	12-40	40-95	95-110	110-190

Sand %	23.01	12.84	13.5	10.08	8.03
Silt %	19.25	25.06	24.87	27.83	28.04
Clay %	57.75	62.1	61.63	62.09	63.93
silt/clay	0.3	0.4	0.4	0.4	0.4
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.22	1.17	1.15	1.12	1.13
pH-H2O (1:2.5)	5.02	4.94	5.23	5.19	5.44
pH-KCl	4.15	4.07	4.46	4.16	4.64
EC (dS/m)	0.02	0.02	0.02	0.02	0.02
Exch Ca ,,	15.34	13.85	20.64	22.17	22.16
Exch Mg ,,	5.96	4.33	6.88	7.68	7.98
Exch K ,,	0.36	0.31	0.25	0.14	0.13
Exch Na (cmol+/kg)	1.65	1.59	1.55	1.71	1.85
SUM	23.31	20.08	29.32	31.7	32.12
CEC ,,	44.91	34.81	32.25	33.83	38.54
CECclay	77.77	56.05	52.33	54.49	60.28
BS %	51.90	57.68	90.91	93.70	83.34
OC %	2.12	1.89	1.69	1.52	1.24
Total N %	0.24	0.19	0.18	0.16	0.14
C/N	8.8	9.9	9.4	9.5	8.9
P Olsen (ppm)	8.7				
Av. S %	0.83				
Av Zn (mg/kg)	0.56				
Av Mn ,,	80.98				
Av Cu ,,	1.3				
Av Fe ,,	33				

Soil profile description

Profile Number: ASAAKP002

Status: routine profile description

Date:20/03/2006EC

Author(s): Mekonnen Getahun

Location: South Achefer Woreda, **Ahuri-Keltafa** Kebele

Coord: N11°25'45.166",E 36°56'37.752"

Elevation: 1946M

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Gleyic **Vertisols** (Eutric,Chromic)

Samples: A: 0-12 B: 12-35 C: 35-100 D: 100-185

Ap 0 – 12 cm 10YR 3/2 (moist); common fine distinct mottles; clay; weak to moderate fine and medium subangular blocky structure; friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, many fine and very fine roots; non calcareous; clear smooth boundary.

Bw1 12-35 cm 10YR 3/1.5 (moist); few fine distinct mottles; clay; weak to moderate medium angular blocky and weak to moderate medium subangular blocky structure; firm (moist), very sticky (wet), very plastic (wet), few fine pores, very few faint slickensides on pedfaces; very few fine rounded hard and soft manganiferous nodules; many fine roots; non calcareous; clear smooth boundary.

Bw2 35-100 cm 10YR 3.5/1 (moist); V. few faint mottles; clay; moderate medium angular blocky and moderate medium subangular blocky structure; firm (moist), very sticky (wet), very plastic (wet), few fine pores, common prominent slickensides on pedfaces; few fine rounded hard and soft manganiferous nodules; few fine roots; non calcareous; clear smooth boundary.

Bw3 100-185 cm 10YR 4/2 (moist); common fine distinct mottles; clay; moderate medium subangular blocky structure; firm (moist), very sticky (wet), very plastic (wet),

very plastic (wet), few fine pores, common prominent slickensides on pedfaces; common fine rounded hard and soft manganiferous nodules; few fine roots; non calcareous; abrupt smooth boundary.

TABLE 21: Analytical data of Profile No: ASAAKP002, Ahuri Keltafa kebele, South Achefer

Horizon	**Ap**	**Bw1**	**Bw2**	**Bw3**
Depth (cm)	0-12	12-35	35-100	100-185
Sand %	20.84	17.77	29.17	23.66
Silt %	23.09	24.45	15.49	17.96
Clay %	56.07	57.78	55.34	58.38
silt/clay	0.4	0.4	0.3	0.3
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.25	1.2	1.3	1.36
pH-H2O (1:2.5)	5.64	5.49	5.68	5.86
pH-KCl	4.77	4.76	4.92	5.09
EC (dS/m)	0.06	0.06	0.09	0.13
Exch Ca ,,	29.65	21.12	32.44	35.49
Exch Mg ,,	9.59	7.92	11.4	11.53
Exch K ,,	0.28	0.2	0.11	0.11
Exch Na (cmol+/kg)	1.99	1.79	1.54	1.5
SUM	41.51	31.03	45.49	48.63
CEC ,,	43.13	40.65	49.08	59.31
CECclay	76.92	70.35	88.69	101.59
BS %	96.24	76.33	92.69	81.99
OC %	2.46	2.09	1.93	1.52
Total N %	0.29	0.23	0.21	0.14
C/N	8.5	9.1	9.2	10.9
P Olsen (ppm)	5.5			
Av. S %	1.02			
Av Zn (mg/kg)	0.25			
Av Mn ,,	12.2			
Av Cu ,,	0.62			
Av Fe ,,	8.2			

Soil profile description

Profile Number: ASAKGP001

Status: routine profile description

Date:20/03/2006EC

Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Ker Gurach Kebele

Coord: N11°24'28.362", E 37°0'8.538"

Elevation: 1955 m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**,** potato, cabbage

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Luvisols (Rhodic)

Samples: A: 0-13 B: 13-36 C: 36-85 D: 85-180

Ap 0 – 13 cm 7.5YR 4/3 (moist); clay; moderate medium sub angular blocky structure; friable (moist), slightly sticky (wet), slightly plastic (wet), common fine-medium pores, common fine-medium roots; non calcareous; clear smooth boundary.

A/AB 13-36 cm 7.5YR 3/3 (moist); clay; moderate medium sub angular blocky structure; friable to firm (moist), sticky (wet), plastic (wet), common fine medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

Bt1 36-85 cm 7.5YR 3/6 (moist); clay; moderate to strong medium sub angular blocky structure; firm (moist), sticky (wet), plastic (wet), common fine-medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

Bt2 85- 180 cm 7.5YR 2.5/2 (moist); clay; moderate to strong medium and coarse sub angular and angular blocky structure; firm (moist), sticky (wet), plastic (wet), few fine pores, common distinct clay; few fine rounded hard manganiferous nodules; non calcareous;

TABLE 22: Analytical data of Profile No: ASAKGP001Ker Gurach kebele, South Achefer

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-13	13-36	36-85	85-180
Sand %	18.15	19.92	17.14	8.58
Silt %	20.99	21.07	23.37	29.76
Clay %	60.86	59	59.49	61.65
silt/clay	0.3	0.4	0.4	0.5
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.2	1.17	1.18	1.24
pH-H2O (1:2.5)	4.97	4.78	4.75	4.82
pH-KCl	4.24	4.13	4.06	4.34
EC (dS/m)	0.04	0.03	0.02	0.02
Exch Ca ,,	17.47	15.26	18.13	21.00
Exch Mg ,,	4.16	5.94	4.94	7.56
Exch K ,,	0.37	0.28	0.21	0.22
Exch Na (cmol+/kg)	1.65	1.53	1.54	1.52
SUM	23.65	23.01	24.82	30.29
CEC ,,	57.43	49.77	56.87	57.52
BS %	41.18	46.23	43.64	52.66
OC %	2.06	1.97	1.72	1.55
Total N %	0.22	0.19	0.18	0.16
C/N	9.4	10.4	9.6	9.7
P Olsen (ppm)	6			
Av. S %	0.67			
Av Zn (mg/kg)	0.8			
Av Mn ,,	76.6			
Av Cu ,,	1.2			
Av Fe ,,	30			

Soil profile description

Profile Number: ASAKGP002

Status: routine profile description

Date: 01/04/2006EC

Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Ker Gurach Kebele

Coord: N11°22'43.502", **E**36°59'15.866"

Elevation: 1955 m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic **Nitisols** (Rhodic)

Samples: A: 0-21 B: 21-55 C: 55-85 D: 85-180

Ap 0 – 21 cm Very dark brown (7.5YR2.5/2), moist; clay; very hard dry, friable moist, very sticky and very plastic wet; weak coarse sub-angular blocky structure; common faint clay skin; common fine, many medium and few coarse pores; few fine and very few medium roots; few animal borrow; non-calcareous; clear smooth boundary.

A/AB 21-55 cm Dark reddish brown (2.5YR3/4), moist; clay; friable moist, very sticky and very plastic wet; moderate very coarse sub-angular blocky structure; common distinct clay skin; many fine, common medium and few coarse pores; very few fine, very few medium and very few coarse roots; non-calcareous; clear smooth boundary.

Bt1 55-85 cm Dark reddish brown (2.5YR3/4), moist; light clay; very friable moist, sticky and plastic wet; moderate coarse angular blocky structure; common distinct clay skin;

many fine, common medium and few coarse pores; very few medium roots; non-calcareous; gradual smooth boundary.

Bt2 85- 200 cm 7 Dark reddish brown (2.5YR3/4), moist; clay loam; very friable moist, sticky and slightly plastic wet; weak coarse sub-angular blocky structure; common distinct clay skin; common distinct pressure face; many fine, common medium and few coarse pores; very few fine, common medium and common coarse roots; non-calcareous.

TABLE 23: Analytical data of Profile No: ASAKGP002Ker Gurach kebele, South Achefer

Horizon	**Ap**	**B**	**Bt1**	**Bt2**
Depth (cm)	0-21	21-55	55-85	85-200
Sand %	5	1	1	1
Silt %	23	11	10	10
Clay %	71	88	89	89
silt/clay	0.3	0.1	0.1	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.2	4.7	5.1	5.7
pH-KCl	4.3	4.1	4.3	4.7
EC (dS/m)	0.05	0.06	0.11	0.01
Exch Ca ,,	18.2	8.1	8.1	7.2
Exch Mg ,,	8.2	5.4	4.5	5.4
Exch K ,,	0.4	0.2	0.1	0.1
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.1
SUM	26.9	13.8	12.8	12.8
CEC ,,	46	32	48	28
BS %	58.48	43.13	26.67	45.71
OC %	2.4	1.2	1.1	1.5
Total N %	0.15	0.08	0.06	0.08
C/N	16.0	15.0	18.3	18.8
P Olsen (ppm)	7.4			
Av. S %	1.0			
Av Zn (mg/kg)	0.28			
Av Mn ,,	11.2			
Av Cu ,,	0.53			
Av Fe ,,	10.2			

Soil profile description

Profile Number: ASALP001

Status: routine profile description

Date: 02/04/2006EC
Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Lalibela Kebele

Coord: N11°31'15.005",E 36°56'54.789"

Elevation: 2880 m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification:): Nitic Luvisols (Rhodic)

Samples: A: 0-30 B: 30-95 C: 95-150 D: 150-200

Ap 0 – 14 cm 7.5YR 4/3 (moist); clay; moderate medium sub angular blocky structure; friable (moist), slightly sticky (wet), slightly plastic (wet), common fine-medium pores, common fine-medium roots; non calcareous; clear smooth boundary.

AB 14-34 cm 7.5YR 3/3 (moist); clay; moderate medium sub angular blocky structure; friable to firm (moist), sticky (wet), plastic (wet), common fine medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

Bt134-59 cm 7.5YR 3/6 (moist); clay; moderate to strong medium sub angular blocky structure; firm (moist), sticky (wet), plastic (wet), common fine-medium pores, very few faint clay; common fine roots; non calcareous; clear smooth boundary.

Bt2 59- 100 cm 7.5YR 2.5/2 (moist); clay; moderate to strong medium and coarse sub angular and angular blocky structure; firm (moist), sticky (wet), plastic (wet), few fine pores, common distinct clay; few fine rounded hard manganiferous nodules; non calcareous;

Bt2 100- 120 cm 7.5YR 2.5/2 (moist); clay; moderate to strong medium and coarse sub angular and angular blocky structure; firm (moist), sticky (wet), plastic (wet), few fine pores, common distinct clay; few fine rounded hard manganiferous nodules; non calcareous;

Bt2 120- 190 cm 7.5YR 2.5/2 (moist); clay; moderate to strong medium and coarse sub angular and angular blocky structure; firm (moist), sticky (wet), plastic (wet), few fine pores, common distinct clay; few fine rounded hard manganiferous nodules; non calcareous;

TABLE 24: Analytical data of Profile No: ASALP001Lalibela kebele, South Achefer

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**	**C**
Depth (cm)	0-14	14-34	34-59	59-100	100-120	120-190
Sand %	10.76	9.34	15.98	12.68	13.5	12.72
Silt %	38.25	32.38	23.7	26.2	28.11	28.37
Clay %	51	58.28	60.33	61.12	58.39	58.91
silt/clay	0.8	0.6	0.4	0.4	0.5	
Texture class	Clay	Clay	Clay	Clay	Clay	
Bulk density	1.21	1.17	1.1	1.13	1.12	1.23
pH-H2O (1:2.5)	5.08	5	5.17	5.11	4.86	5.79
pH-KCl	4.18	4.2	4.29	4.09	4.02	5
EC (dS/m)	0.03	0.03	0.03	0.03	0.04	0.02
Exch Ca ,,	18.3	23.07	19.32	17.47	15.12	15.81
Exch Mg ,,	6.66	7.42	6.72	5.82	5.04	8.82
Exch K ,,	0.32	0.22	0.18	0.16	0.18	0.29
Exch Na (cmol+/kg)	1.72	1.72	1.55	1.57	2.26	1.57
SUM	27.00	32.43	27.78	25.03	21.6	23.49
CEC ,,	46.12	36.72	42.91	44.31	32.87	46.12

BS %	58.54	88.3	64.74	56.49	65.71	50.93
OC %	3.02	1.81	0.94	0.74	0.72	0.47
Total N %	0.31	0.23	0.11	0.09	0.07	0.06
C/N	9.7	7.9	8.5	8.2	10.3	
P Olsen (ppm)	6.7					
Av. S %	0.57					
Av Zn (mg/kg)	0.71					
Av Mn ,,	77.19					
Av Cu ,,	1.35					
Av Fe ,,	24.8					

Soil profile description

Profile Number: ASALP002

Status: routine profile description

Date: 03/04/2006EC
Author(s): Mekonnen Getahun

Location: South Achefer Woreda, Lalibela Kebele

Coord:N 11°33'7.287", **E**36°55'22.554"

Elevation: 2880 m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Nitic Luvisols (manganiferic)

Samples: A: 0-13 B: 13-41 C: 41-91 D: 91-200

Ap 0 – 13 cm Very dark greyish brown (10YR3/2), moist; rapidly permeable; clay; friable moist, very sticky and very plastic wet; strong medium sub-angular blocky structure; common fine and few medium pores; many fine roots; non-calcareous; clear smooth boundary.

A/AB 13-41 cm Dark reddish brown (2.5YR3/3), moist; clay; moderately permeable; friable moist, very sticky and plastic wet; strong medium sub-angular blocky structure; common distinct clay skins; common fine and very few medium pores; common fine roots; non-calcareous; gradual smooth boundary.

Bt141-91 cm Dark reddish brown (2.5YR3/4), moist; clay; moderately permeable; friable moist, very sticky and plastic wet; weak medium sub-angular blocky structure; broken distinct clay skins; common fine and very few medium pores; few fine and very few coarse roots; non-calcareous; gradual smooth boundary.

Bt2 91- 200Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; friable moist, sticky and plastic wet; weak medium sub-angular blocky structure; many fine and very few medium pores; very few fine and very few coarse roots; non-calcareous

TABLE 25: Analytical data of Profile No: ASALP002Lalibela kebele, South Achefer

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-13	13-41	41-91	91-200
Sand %	7	5	2	5
Silt %	34	21	18	12
Clay %	58	74	81	83
silt/clay	0.6	0.3	0.2	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	4.7	4.9	4.5	4.7
pH-KCl	3.7	3.5	3.4	3.7
EC (dS/m)	0.4	0.1	0.5	0.1
Exch Ca ,,	19.7	25.1	31.4	9
Exch Mg ,,	16.1	20.6	18.8	12.7
Exch K ,,	0.2	0.1	0.1	0.1
Exch Na (cmol+/kg)	0.4	0.4	0.5	0.4
SUM	36.4	46.2	50.8	22.2

CEC ,,	41	49	54	28
CECclay	70.69	66.22	66.67	33.73
BS %	88.78	94.29	94.07	79.29
OC %	3.6	2	1.1	0.7
Total N %	0.17	0.09	0.05	0.03
C/N	21.2	22.2	22.0	23.3
P Olsen (ppm)	8.1			
Av. S %	0.63			
Av Zn (mg/kg)	0.55			
Av Mn ,,	69.7			
Av Cu ,,	1.62			
Av Fe ,,	18.1			

Burie woreda

Soil profile Descriptions with Analytical data

Profile Number: **ABWAP001**

Status: routine profile description

Date: 12/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, Woinma Ambaye Kebele

Coord: 10°43'13.637"N; 37°6'35.932"E

Elevation: 2116m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Mollic **Nitisols** (Rhodic,humic)

Samples: A: 0-11 B: 11-26 C: 26-80 D: 80-100 E: 100-131 F: 131-190

Ap 0-11 cm 10YR 5/4 (dry) and 7.5YR 3.5/3 (moist); clay; weak to moderate fine and medium subangular blocky structure; hard (dry), friable (moist), very sticky (wet), very plastic (wet), common fine pores, many fine-medium roots; non calcareous; clear smooth boundary.

AB 11-26 cm 7.5YR 3/2 (moist); common fine distinct mottles; clay; weak to moderate fine and medium subangular blocky structure; friable to firm (moist), very sticky (wet), very plastic (wet), many fine-medium pores, common distinct clay; common fine roots; non calcareous; clear smooth boundary.

B 26-80 cm 10YR 4.5/2 (moist); v. few faint mottles; clay; moderate coarse sub prismatic structure; firm (moist), very sticky (wet), very plastic (wet), common fine pores, many distinct clay-sesquioxides cutans on pedfaces; few fine rounded soft manganiferous nodules; very few fine roots; non calcareous; gradual smooth boundary.

Bt1 80-100 cm 7.5YR 4/3 (moist); clay; weak medium sub prismatic structure; friable (moist), very sticky (wet), very plastic (wet), common fine pores, abundant distinct clay on pedfaces; few fine rounded soft manganiferous nodules; non calcareous; gradual smooth boundary.

Bt2 100-132 cm 7.5YR 3.5/3 (moist); clay; very weak fine sub prismatic structure; very friable (moist), very sticky (wet), very plastic (wet), common fine pores, abundant distinct clay on pedfaces; few fine rounded soft manganiferous nodules; non calcareous;Bt3 132-190 cm 7.5YR 3.5/3 (moist); clay; very weak fine sub prismatic structure; very friable (moist), very sticky (wet), very plastic (wet), common fine pores, abundant distinct clay on pedfaces; few fine rounded soft manganiferous nodules; non calcareous;

TABLE 26: Analytical data of Profile No: ABWAP001Woynima Ambaye kebele, Burie

Horizon	**Ap**	**AB**	**B**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-11	11-26	26-80	80-100	100-132	132-190
Sand %	22.6	28.9	11.9	11.1	6.9	12.8
Silt %	19.4	21.6	25	26	30.7	26.2
Clay %	58.1	49.6	63.1	62.9	62.4	61.1
silt/clay	0.4	0.5	0.4	0.5	0.4	
Texture class	Clay	Clay	Clay	Clay	Clay	
Bulk density	1.2	1.19	1.12	1.14	1.17	1.11
pH-H2O (1:2.5)	5.14	5.36	5.57	5.64	5.81	5.65
pH-KCl	4.32	4.53	4.67	4.78	5.16	4.58
EC (dS/m)	0.03	0.04	0.04	0.03	0.03	0.05
Exch Ca ,,	15.4	15.4	22.5	16.4	10.5	9.5
Exch Mg ,,	5.1	6	6.9	6.1	4.4	3.5
Exch K ,,	0.2	0.1	0.1	0.1	0.1	0.1
Exch Na (cmol+/kg)	1.69	0.76	1.1	1.18	0.93	0.77
SUM	22.39	22.26	30.6	23.78	15.93	
CEC ,,	42.8	43.27	45.55	38.03	29.38	30.05

CECclay	73.67	87.24	72.19	60.46	47.08	
BS %	52.31	51.44	67.18	62.53	54.22	
OC %	1.9	1.85	1.82	1.47	1.26	1.11
Total N %	0.21	0.18	0.17	0.14	0.12	0.11
C/N	9.0	10.3	10.7	10.5	10.5	
P Olsen (ppm)	16.8					
Av. S %	0.51					
Av Zn (mg/kg)	1.18					
Av Mn ,,	76.9					
Av Cu ,,	2.88					
Av Fe ,,	42.7					

1

<u>Profile Number</u>: **<u>ABWAP002</u>**

Status: routine profile description

Date: 12/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, Woinma Ambaye Kebele

Coord: 10°44'18.689"N, 37°6'40.385"E

Elevation: 2116m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Mollic **Nitisols** (Rhodic,humic)

Samples: A: 0-12 B: 12-36 C: 36-76 D: 76-120

Ap 0-12cm. Very dark grayish brown (10YR3/2, moist) sandy clay loam, weak angular blocky, common fine to coarse pores, many fine and medium roots, soft wheat moist, slightly and slightly plastic when wet, no mottling, nodules or concretions.

AB12-36cm. Dark grayish brown (10YR4/2, dry) sandy clay loam; weak angular blocky; common fine and medium pores; common fine and medium roots; slightly hard when dry, slightly sticky and slightly plastic when wet, no mottling, nodules or concretion.

Bt1 36-76cm. Dark grayish brown (10YR4/2, dry) sandy clay loam to clay loam, including thin lenses of coarse sandy loam, moderate angular blocky, few faint clay skins, common fine pores, few fine and medium roots, slightly hard when dry, sticky and slightly plastic when wet, no mottling, nodules or concretion.

Bt2 76-120cm Dark grayish brown (10YR/2,dry) clay loam, moderate angular blocky, common fine thin clay skin, fine to medium pores, very few fine roots, hard when, sticky and plastic when wet, abundant fine and medium rust brown mottling along root channels, in the top 5cm of the horizon many fine Ca CO_3concretion.

TABLE 27: Analytical data of Profile No: ABWAP002Woynima Ambaye kebele, Burie

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-12	12-36	36-76	76-120
Sand %	25.4	7.7	14.2	21
Silt %	11.7	30.1	25	26.3
Clay %	62.9	62.3	60.8	52.7
silt/clay	0.2	0.5	0.4	0.5
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.29	1.16	1.15	1.12
pH-H2O (1:2.5)	5.43	5.37	5.46	5.58
pH-KCl	4.78	4.22	4.56	4.53
EC (dS/m)	0.03	0.03	0.03	0.04
Exch Ca ,,	15.3	18.8	17.3	11.3
Exch Mg ,,	5.94	6.85	6.04	3.48
Exch K ,,	0.08	0.08	0.07	0.03
Exch Na (cmol+/kg)	1.05	0.95	1.12	0.64

SUM	22.37	26.68	24.53	15.45
CEC ,,	39.17	34.89	38.47	35.48
CECclay	62.27	56.00	63.27	67.32
BS %	57.11	76.47	63.76	43.55
OC %	1.56	1.37	1.23	1.2
Total N %	0.19	0.15	0.14	0.12
C/N	8.2	9.1	8.8	10.0
P Olsen (ppm)	24.8			
Av. S %	1.93			
Av Zn (mg/kg)	1.18			
Av Mn ,,	85.4			
Av Cu ,,	1.47			
Av Fe ,,	26.6			

SOIL PROFILE DESCRIPTION

Profile Number: **ABWGP001**

Status: routine profile description

Date: 14/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, **Wadra Gindaba** Kebele

Coord: 10°39'6.426"N, 37°3'42.851"E

Elevation: 2046m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat, potato, cabbage

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic **Nitisols** (Rhodic)

Samples: A: 0-12 B: 12-40 C: 40-60 D: 60-90 E: 90-110 F: 110-180

AP 0-12 cm 10YR 5/4 (dry) and 7.5YR 3.5/3 (moist); clay; weak to moderate fine and medium subangular blocky structure; hard (dry), friable (moist), very sticky (wet), very plastic (wet), common fine pores, many fine-medium roots; non calcareous; clear smooth boundary.

A/AB 12-40 cm 7.5YR 3/2 (moist); common fine distinct mottles; clay; weak to moderate fine and medium subangular blocky structure; friable to firm (moist), very sticky (wet), very plastic (wet), many fine-medium pores, common distinct clay; common fine roots; non calcareous; clear smooth boundary.

Bt1 40-60 cm 10YR 4.5/2 (moist); v. few faint mottles; clay; moderate coarse sub prismatic structure; firm (moist), very sticky (wet), very plastic (wet), common fine pores, many distinct clay-sesquioxides cutans on pedfaces; few fine rounded soft manganiferous nodules; very few fine roots; non calcareous; gradual smooth boundary.

Bt2 60-90 cm 7.5YR 4/3 (moist); clay; weak medium sub prismatic structure; friable (moist), very sticky (wet), very plastic (wet), common fine pores, abundant distinct clay on pedfaces; few fine rounded soft manganiferous nodules; non calcareous; gradual smooth boundary.

BC 90-110 cm 7.5YR 3.5/3 (moist); clay; very weak fine sub prismatic structure; very friable (moist), very sticky (wet), very plastic (wet), common fine pores, abundant distinct clay on pedfaces; few fine rounded soft manganiferous nodules; non calcareous;

C 110-180 cm 7.5 YR 4/6 (moist); clay; weak fine subangular blocky structure; friable (moist), sticky (wet), plastic (wet), very few very fine pores, few distinct clay no specific locations; many coarse irregular soft manganiferous soft segregation; non calcareous;

TABLE 28: Analytical data of Profile No: ABWGP001Wadra Gendiba kebele, Burie

Horizon	Ap	AB	Bt1	Bt2	BC	C
Depth (cm)	0-12	12-40	40-60	60-90	90-110	110-180
Sand %	19.6	12.6	16.5	12	9.9	9.6
Silt %	26.5	26.6	22.5	28.6	30.8	28.7
Clay %	54	60.7	61.1	59.4	59.4	61.7
silt/clay	0.5	0.4	0.4	0.5	0.5	
Texture class	Clay	Clay	Clay	Clay	Clay	
Bulk density	1.21	1.17	1.19	1.15	1.14	1.15
pH-H2O (1:2.5)	5.07	5.03	4.92	5.21	5.33	5.27
pH-KCl	4.46	4.41	4.26	4.49	4.38	4.57
EC (dS/m)	0.06	0.03	0.03	0.03	0.04	0.04
Exch Ca ,,	18.7	15.3	13.7	18.7	19.5	10.2
Exch Mg ,,	5.94	5.94	4.28	6.78	6.78	4.24
Exch K ,,	0.36	0.3	0.14	0.12	0.13	0.13
Exch Na (cmol+/kg)	0.99	1.12	0.99	0.99	1.16	1.12
SUM	25.99	22.66	19.11	26.59	27.57	
CEC ,,	38.25	39.64	35.82	32.72	35.03	34.1
CECclay	70.83	65.30	58.63	55.08	58.97	
BS %	67.95	57.16	53.35	81.27	78.70	
OC %	2.49	1.75	1.53	1.44	1.19	1.15
Total N %	0.22	0.18	0.16	0.16	0.15	0.13
C/N	11.3	9.7	9.6	9.0	7.9	
P Olsen (ppm)	10.6					
Av. S %	0.43					
Av Zn (mg/kg)	1.35					
Av Mn ,,	81					
Av Cu ,,	2.63					
Av Fe ,,	41.9					

SOIL PROFILE DESCRIPTION

Profile Number: **ABWGP002**

Status: routine profile description

Date: 15/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, **Wadra Gindaba** Kebele

Coord: 10°44'10.213"N, 37°9'20.429"E

Elevation: 2790m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Gleyic **Vertisols** (Pellic, Eutric)

Samples: A: 0-30 B: 30-50 C: 50-100 D: 100-180

AP 0 – 30 cm Very dark grey (10YR3/1), moist; heavy clay; common fine distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong coarse angular blocky structure; many distinct pressure faces; 60 mm crack width; common fine and few medium pores; common fine and few medium roots; common fine ferromanganese concretion; non-calcareous; clear smooth boundary.

A1 30-50 cm Black (10YR2/1), moist; heavy clay; very hard dry, very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; abundant prominent pressure faces; 30 mm crack width; common fine and few medium pores; common fine, few medium and few coarse roots; few fine ferromanganese concretion; non-calcareous; gradual smooth boundary.

AC 50-100 cm Black (10YR2/1), moist; heavy clay; firm moist, very sticky and very plastic wet; strong coarse angular blocky structure; abundant prominent pressure faces; common fine and very few medium pores; few fine roots; few fine ferromanganese concretion; non-calcareous; gradual smooth boundary.

C 100-180 cm Black (10Y2/1), moist; heavy clay; firm moist, very sticky and very plastic wet; strong coarse angular blocky structure; abundant prominent pressure faces; common fine and very few medium pores; few fine ferromanganese concretion; non-calcareous.

TABLE 29: Analytical data of Profile No: ABWGP002Wadra Gendiba kebele, Burie

Horizon	**Ap**	**A**	**AC**	**C**
Depth (cm)	0-30	30-50	50-100	100-180
Sand %	15.5	21.6	20.4	14.4
Silt %	24.5	17.9	15.9	24.8
Clay %	60.1	60.5	63.7	60.8
silt/clay	0.4	0.3	0.2	0.4
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.24	1.14	1.19	1.31
pH-H2O (1:2.5)	5.44	4.88	5.49	6.34
pH-KCl	4.39	3.86	4.43	5.24
EC (dS/m)	0.06	0.05	0.06	0.1
Exch Ca ,,	35.1	32.9	34.1	33.3
Exch Mg ,,	12.3	10.7	11.7	10.2
Exch K ,,	0.09	0.09	0.06	0.06
Exch Na (cmol+/kg)	0.86	0.89	0.82	0.43
SUM	48.35	44.58	46.68	43.99
CEC ,,	52.13	54.06	57.95	57.4
CECclay	86.74	89.36	90.97	94.41
BS %	92.75	82.46	80.55	76.64
OC %	2.77	2.27	2.23	1.47
Total N %	0.32	0.29	0.24	0.17
C/N	8.7	7.8	9.3	8.6
P Olsen (ppm)	7.6			
Av. S %	0.89			
Av Zn (mg/kg)	0.8			
Av Mn ,,	65.2			
Av Cu ,,	4.45			
Av Fe ,,	64			

SOIL PROFILE DESCRIPTION

Profile Number: **ABAP001**

Status: routine profile description

Date: 16/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, Arbisi Kebele Kebele

Coord: 10°44'38.191"N, 37°8'48.715"E

Elevation: 2790m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize,** barley, wheat**, potato, cabbage**

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic Nitisol (Rhodic) (2006)

Samples: A: 0-22 B: 22-74 C: 74-157 D: 157-200

AP 0-22 cm Dark reddish brown (5YR3/3), moist; clay; hard dry, very friable moist, very sticky and plastic wet; moderate very coarse sub-angular blocky structure; common fine, common medium and common coarse pores; common fine roots; non calcareous; clear smooth boundary.

A/AB 22-74 cm Dark red (2.5YR3/6), moist; clay; very friable moist, very sticky and plastic wet; strong fine and medium angular blocky structure; distinct shiny faces; common fine, common medium and common coarse pores; few fine roots; non-calcareous; gradual smooth boundary.

Bt1 74-157 cm Dark red (2.5YR3/6), moist; clay; very friable moist, very sticky and plastic wet; moderate medium angular blocky structure; distinct shiny faces; common fine, common medium and few coarse pores; very few fine roots; very few fine ferromanganese concretion; non-calcareous; diffuse smooth boundary.

Bt2 157-200 cm Dark reddish brown (5YR3/4), moist; clay; very friable moist, very sticky and plastic wet; strong medium angular blocky structure; distinct shiny faces; common fine, common medium and very few coarse pores; few medium ferromanganese concretion; non-calcareous.

TABLE 30: Analytical data of Profile No: ABAP001Arbisi kebele, Burie

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-22	22-74	74-157	157-200
Sand %	3	1	1	3
Silt %	20	10	12	11
Clay %	77	89	87	86
silt/clay	0.3	0.1	0.1	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.23	1.18	1.14	1.12
pH-H2O (1:2.5)	5.2	5	4.9	5.11
pH-KCl	4.1	3.9	4.2	4.38
EC (dS/m)	0.05	0.06	0.11	0.01
Exch Ca ,,	13.6	9	9.9	
Exch Mg ,,	5.24	5.31	4.48	
Exch K ,,	0.1	0.1	0.1	
Exch Na (cmol+/kg)	0.1	0.1	0.1	
SUM	19.04	14.51	14.58	
CEC ,,	47	37	37	
CECclay	61.04	41.57	42.53	
BS %	40.51	39.22	39.41	
OC %	3.2	1.1	1	0.7
Total N %	0.18	0.12	0.05	0.08
C/N	17.8	9.2	20.0	8.8
P Olsen (ppm)	8.1			
Av. S %	1.1			
Av Zn (mg/kg)	1.17			
Av Mn ,,	70.9			

Av Cu ,,	2.62
Av Fe ,,	40.3

SOIL PROFILE DESCRIPTION

Profile Number: **ABAP002**

Status: routine profile description

Date: 16/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, Arbisi Kebele Kebele

Coord: 10°44'10.213"N, 37°9'20.429"E

Elevation: 2790m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: teff, maize**,** barley, wheat**,** potato, cabbage

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic Nitisol (Rhodic) (2006)

Samples: A: 0-26 B: 26-77 C: 77-130 D: 130-200

AP 0-26 cm Very dark brown (7.5YR2.5/2), moist; clay; hard dry, very friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; common fine, common medium and common coarse pores; few fine roots; non calcareous; clear smooth boundary.

A/AB 26-77 cm Dark reddish brown (5YR3/4), moist; clay; very friable moist, very sticky and very plastic wet; strong coarse angular blocky structure; distinct shiny faces; common fine, common medium and common coarse pores; few fine roots; very few animal borrows; very few fine ferromanganese concretion; non-calcareous; gradual smooth boundary.

Bt1 77-130 Dark reddish brown (5YR3/4), moist; clay; localized stones; iron staining; very friable moist, very sticky and plastic wet; moderate fine and medium angular blocky structure; distinct shiny faces; common fine, common medium and common coarse pores; very few fine roots; few fine and medium ferromanganese concretion; non-calcareous; diffuse smooth boundary.

Bt2 130-200 cm Brown (7.5YR4/3), moist; clay; friable moist, very sticky and very plastic wet; strong coarse angular blocky structure; prominent shiny faces; common fine, common medium and few coarse pores; many medium ferromanganese concretion; non-calcareous.

TABLE 31: Analytical data of Profile No: ABAP002 Arbisi kebele, Burie

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-26	26-77	77-130	130-200
Sand %	7	5	6	4
Silt %	33	26	20	11
Clay %	60	69	74	85
silt/clay	0.6	0.4	0.3	0.1
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.2	1.11	1.14	1.12
pH-H2O (1:2.5)	5.2	4.8	4.8	4.7
pH-KCl	4.1	3.6	3.6	3.4
EC (dS/m)	0.03	0.03	0.03	0.03
Exch Ca ,,	16.3	10.8	11.8	
Exch Mg ,,	16.3	11.8	6.3	
Exch K ,,	0.3	0.1	0.1	
Exch Na (cmol+/kg)	0.1	0.1	0.1	
SUM	33	22.8	18.3	
CEC ,,	53	48	48	
CECclay	88.33	69.57	64.86	
BS %	62.26	47.50	38.13	

OC %	3	1.1	0.9	0.7
Total N %	0.2	0.08	0.09	0.08
C/N	15.0	13.8	10.0	8.8
P Olsen (ppm)	18.2			
Av. S %	0.88			
Av Zn (mg/kg)	1.25			
Av Mn ,,	65.1			
Av Cu ,,	1.62			
Av Fe ,,	38.1			

SOIL PROFILE DESCRIPTION

Profile Number: **ABZAP001**

Status: routine profile description

Date: 17/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, Zalma Kebele

Coord: 10°31'8.245"N, 37°1'4.583"E

Elevation: 2790m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: teff, maize**,** barley, wheat**,** potato, cabbage

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic Nitisol (Rhodic) (2006)

Samples: A: 0-18 B: 18-86 C: 86-162 D: 162-200 E: 200-220

AP 0-18 cm Dark reddish brown (5YR3/4), moist; clay; hard dry, very friable moist, very sticky and very plastic wet; moderate medium and coarse angular blocky structure; common fine, common medium and few coarse pores; common fine roots; non calcareous; gradual smooth boundary.

AB 18-86 cm Dark red (2.5YR3/6), moist; clay; hard dry, very friable moist, very sticky and very plastic wet; strong fine and medium angular blocky structure; distinct shiny faces; common fine, common medium and few coarse pores; few fine roots; very few fine ferromanganese concretion; non-calcareous; diffuse smooth boundary.

Bt1 86-162 Dark red (2.5YR3/6), moist; clay; very friable moist, very sticky and plastic wet; strong medium and coarse angular blocky structure; distinct shiny faces; few fine, common medium and common coarse pores; very few fine and very few medium roots; few fine ferromanganese concretion; non-calcareous; diffuse smooth boundary.

Bt2 162-200 cm Dark reddish brown (5YR3/4), moist; clay; common iron staining mottles; very friable moist, very sticky and plastic wet; strong medium angular blocky structure; prominent shiny faces; few fine, common medium and few coarse pores; common medium ferromanganese concretion; non-calcareous.

Bt3 200-220 cm Dark reddish brown (5YR3/4), moist; clay; many iron staining mottles; common medium ferromanganese concretion and segregation; non-calcareous.

TABLE 32: Analytical data of Profile No: ABZAP001Zalma kebele, Burie

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-18	18-86	86-162	162-200	200-220
Sand %	3	1	2		
Silt %	15	13	13		
Clay %	82	86	85		
silt/clay	0.2	0.2	0.2		
Texture class	Clay	Clay	Clay		
Bulk density	1.14	1.07	1.02	1.16	1.17
pH-H2O (1:2.5)	5.2	5	5.1	5.11	5.08
pH-KCl	3.9	3.9	4.6	4.38	4.32
EC (dS/m)	0.05	0.06	0.11	0.01	0.01
Exch Ca ,,	11.6	9	12.5		
Exch Mg ,,	5.24	5.31	4.48	7.01	7.18

Exch K ,,	0.17	0.12	0.19	0.13	0.14
Exch Na (cmol+/kg)	2.03	1.82	3.18	3.16	3.34
SUM	19.04	16.25	20.35	10.3	10.66
CEC ,,	41	43	36	26	
CECclay	50.00	50.00	42.35		
BS %	46.44	37.79	56.53	39.62	
OC %	2.9	1.2	0.7	0.8	0.57
Total N %	0.18	0.09	0.03	0.06	0.06
C/N	16.1	13.3	23.3	13.3	9.5
P Olsen (ppm)	5.5				
Av. S %	0.35				
Av Zn (mg/kg)	1.25				
Av Mn ,,	76.1				
Av Cu ,,	2.62				
Av Fe ,,	39.7				

SOIL PROFILE DESCRIPTION

Profile Number: **ABZAP002**

Status: routine profile description

Date: 18/06/2013

Author(s): Mekonnen Getahun

Location: Burie Woreda, Zalma Kebele

Coord: 10°32'57.378"N, 37°1'50.281"E

Elevation: 2790m

Soil climate: SU

Land Form: upland

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: teff, maize**,** barley, wheat**,** potato, cabbage

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Gleyic **Vertisols** **(Chromic, eutric)**

Samples: A: 0-21 B: 21-50 C: 50-122 D: 122-160 E: 160-200

AP 0-21 cm Black (10YR2/1), moist; heavy clay; few fine distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; common distinct pressure faces; 40 mm crack width; common fine and few medium pores; common fine and few medium roots; few fine ferromanganese concretion; non-calcareous; gradual smooth boundary..

A/AB 21-50 Black (2.5Y2.5/1), moist; heavy clay; common fine distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; abundant prominent pressure faces; 35 mm crack width; common fine, few medium and few coarse pores; common fine roots; few fine ferromanganese concretion; non-calcareous; gradual smooth boundary..

Bt1 50-122 Very dark grey (2.5Y3/1), moist; heavy clay; common medium distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; abundant prominent pressure faces; common fine and very few medium pores; few fine roots; few fine ferromanganese concretion; non-calcareous; clear smooth boundary

Bt2 122-160 cm Black (2.5Y3/1), moist; clay; common fine gravels and coarse sand; few fine distinct reddish mottles; firm moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; common distinct clay skins; common fine and common medium pores; very few medium calcium carbonate concretion and few fine ferromanganese concretion; strongly calcareous.

Bt3160-200 Black (2.5Y3/1), moist; clay; common fine gravels and coarse sand; few fine distinct reddish mottles; firm moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; common distinct clay skins; common fine and common medium pores; very few medium calcium carbonate concretion and few fine ferromanganese concretion; strongly calcareous.

TABLE 33: Analytical data of Profile No: ABZAP002 Zalma kebele, Burie

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-21	21-50	50-122	122-160	160-200
Sand %	5	2	1	3	

Silt %	25	10	15	22
Clay %	70	89	84	55
silt/clay	0.4	0.1	0.2	0.4
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.25	1.27	1.19	1.31
pH-H2O (1:2.5)	5.8	6	6.7	7.8
pH-KCl	5	5.1	5.8	6.2
EC (dS/m)	0.05	0.06	0.11	0.01
Exch Ca ,,	28.7	25.1	35.8	22.6
Exch Mg ,,	11.6	28.7	19.7	20.8
Exch K ,,	0.3	0.2	0.2	0.2
Exch Na (cmol+/kg)	0.5	0.5	0.8	1.2
SUM	41.1	54.5	56.5	44.8
CEC ,,	44	56	58	52
CECclay	62.86	62.92	69.05	94.55
BS %	93.41	97.32	97.41	86.15
OC %	3.5	1.4	0.8	0.7
Total N %	0.23	0.12	0.06	0.05
C/N	15.2	11.7	13.3	14.0
P Olsen (ppm)	5.5			
Av. S %	1.1			
Av Zn (mg/kg)	0.75			
Av Mn ,,	52.9			
Av Cu ,,	3.62			
Av Fe ,,	58.2			

Jabi Tehnan woreda

Soil Profile Description and Analytical data

SOIL PROFILE DESCRIPTION

Profile Number: **AJJP001**

Status: routine profile description

Date: 09/04/06EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, Jiga Kebele

Coord: 10°41'9.653"N, 37°21'32.142"E

Elevation: 2790m

Soil climate: SU

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: teff, maize**,** barley, wheat**,** potato, cabbage

Human Infl: Ploughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic **Nitisols** (Rhodic)

Samples: A: 0-20 B: 20-70 C: 70-110 D: 110-200

Ap 0- 20 cm Dark brown (7.5YR3/2), moist; clay; rapidly permeable; very hard dry, friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; many fine, common medium and very few coarse pores; common fine roots; non-calcareous; clear smooth boundary.

AB 20 – 70 cm Dark reddish brown (2.5YR3/3), moist; clay; rapidly permeable; slightly hard dry, very friable moist, very sticky and very plastic wet; strong coarse sub-angular blocky structure; common distinct clay skins; many fine and common medium pores; few fine roots; non-calcareous; gradual smooth boundary.

Bt1 70 – 110 cm Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; slightly hard dry, very friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; many fine and common medium pores; few fine ferromanganese concretions; very few fine roots; non-calcareous; clear smooth boundary.

Bt2 110-200cm Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; few distinct grayish mottles; friable moist, very sticky and plastic wet; moderate medium sub-angular blocky structure; broken distinct clay skins; common fine, common medium and very few coarse pores; common fine ferromanganese concretions; very few fine roots; non-calcareous.

TABLE 34: Analytical data of Profile No: AJJP001 Jiga kebele, JabiTehnan woreda

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-20	20-70	70-110	110-200
Sand %	12	3	3	0
Silt %	34	10	19	0
Clay %	54	87	78	0
silt/clay	0.6	0.1	0.2	
Texture class	Clay	Clay	Clay	
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.3	5.1	5.3	6
pH-KCl	4	3.8	4.8	5
EC (dS/m)	0.1	0.1	0.1	0.1
Exch Ca ,,	23.5	22.6	18.1	16.3
Exch Mg ,,	12.7	13.6	19	6
Exch K ,,	1.2	0.7	0.6	0.6
Exch Na (cmol+/kg)	0.5	0.5	0.4	0.5
SUM	37.9	37.4	38.1	23.4
CEC ,,	40	39	39	32
CECclay	74.07	44.83	50.00	
BS %	94.75	95.90	97.69	73.13
OC %	2.2	1.4	0.8	
Total N %	12	0.08	0.08	

C/N	0.2	17.5	10.0
P Olsen (ppm)	6.6		
Av. S %	1.1		
Av Zn (mg/kg)	1.22		
Av Mn ,,	98.3		
Av Cu ,,	2.3		
Av Fe ,,	33.1		

SOIL PROFILE DESCRIPTION

Profile Number: **AJJP002**

Status: routine profile description

Date: 10/04/06EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, Jiga Kebele

Coord: 10°39'59.421"N ,37°22'18.839"E

Elevation: 2800 m

Soil climate: SU

Human Infl: Ploughing

Crops, barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: teff, maize ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Gleyic **Vertisols** (Pellic, Eutric)

Samples: A: 0-30 B: 30-110 C: 110-180 D: 108+

0-30 cm 10YR 4/2 (dry) and 10YR 2/2 (moist); clay; moderate fine and medium subangular blocky and moderate fine and medium angular blocky structure; hard (dry), firm (moist), sticky (wet), plastic (wet), many medium pores, many very fine roots; clear smooth boundary.

30-110 cm 10YR 3/1 (moist); clay; strong coarse prismatic structure; extremely hard (dry), extremely firm (moist) very sticky (wet), very plastic (wet), few fine pores, common distinct clay on pedfaces; few very fne rounded hard and soft manganiferous nodules; few medium roots; clear wavy boundary.

110-180 cm 10YR 4/2 (moist); clay; moderate medium and coarse subangular blocky and moderate medium and coarse angular blocky structure; friable to firm (moist), very sticky (wet), very plastic (wet, few fine pores, many distinct intersecting slickensides on pedfaces; few medium rounded hard and soft manganiferous nodules; very few fine roots; diffuse smooth boundary.

180+ cm Soft weathering material

TABLE 35: Analytical data of Profile No: AJJP002 Jiga kebele, JabiTehnan woreda

Horizon	**Ap**	**B**	**BC**	**C**
Depth (cm)	0-30	30-110	110-180	180-+
Sand %	5	9		
Silt %	12	12		
Clay %	83	80	63.71	57.43
silt/clay	0.1	0.2	0.0	0.0
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.73	1.93	2.1	2.03
pH-H2O (1:2.5)	7.7	8	7.6	8.2
pH-KCl	6.5	6.5	6.2	6.8
EC (dS/m)	0.5	0.9	0.7	0.5
Exch Ca ,,	24.6	36.7	20.8	22.6
Exch Mg ,,	20.2	37.2	51.5	20.8
Exch K ,,	0.1	0.2	0.2	0.2

Exch Na (cmol+/kg)	1.1	2	1.6	1.2
SUM	46	76.1	74.1	44.8
CEC ,,	76	77	74	52
CECclay	91.57	96.25	116.15	90.55
BS %	60.53	98.83	100.14	86.15
OC %	3.7	1.3	0.8	0.7
Total N %	0.22	0.14	0.11	
C/N	16.8	9.3	7.3	
P Olsen (ppm)	8.1			
Av. S %	0.78			
Av Zn (mg/kg)	0.25			
Av Mn ,,	12.2			
Av Cu ,,	0.62			
Av Fe ,,	8.2			

SOIL PROFILE DESCRIPTION

Profile Number: **AJMP001**

Status: routine profile description

Date: 18/04/06EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, **MANA WUSTE GULT KEBELE**

Coord: 10°43'42.732"N 37°10'25.003"E

Elevation: 2049 m

Soil climate: SU

Human Infl: Plo:

Crops: barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize** ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: mollic **Nitisols** (Rhodic,humic)

Samples: A: 0-12 B: 12-36 C: 36-76 D:76-110 E:110-135 F:135-190

AP 0- 12 cm 5YR 3/3 (dry) and 5YR 3/2 (moist); clay; weak medium sub angular blocky structure; slightly hard (dry), very friable (moist), slightly sticky (wet), plastic (wet), common fine-medium pores, common fine- medium roots; non calcareous; clear smooth boundary

A 12-36 cm. dark reddish brown (5 YR3/3) moist; clay; moderate, fine to medium angular blocky structure; slightly hard when dry; friable when moist; sticky and plastic wet ; common very fine, few coarse pores; many fine and common roots; non calcareous; clear and smooth boundary/transition.

AB 36 – 76 cm. dark reddish brown (2.5 YR3/3) moist; clay; weak coarse sub angular blocky to angular block structure; hard when dry; friable moist; very sticky plastic wet; few thin clay cutans; common very fine, fine and medium, few coarse pores; many fine roots; non calcareous; gradual and smooth boundary.

Bt1 76 – 110cm. Very dark brown (2.5 YR3/4) moist, clay; strong coarse angular blocky structure; hard when dry; friable moist; very sticky plastic wet, common thin clay cutans; no

calcium carbonate mineral nodules; many fine interstitial pores; non calcareous; diffuse and smooth boundary.

Bt2 110-135cm. Dark red (2.5YR3/6) moist, clay; strong coarse angular blocky; sticky plastic wet, friable moist; many fine pores; many fine roots; gradual and smooth boundary.

Bt3 135-190 cm. Dark red (2.5YR 3/6) (moist); clay; weak fine and medium prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous;

TABLE 36: Analytical data of Profile No: AJMWP001 Mana wuste gult kebele, JabiTehnan woreda

Horizon	**Ap**	**AB**	**B**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-12	12-36	36-76	76-110	110-135	135-190
Sand %	17.2	16	5.87	10.2	10.4	10.9
Silt %	26.2	26.6	30.6	28.4	28.4	26.1
Clay %	56.6	57.4	63.5	61.3	61.1	62.9
silt/clay	0.5	0.5		0.5	0.5	0.4
Texture class	Clay	Clay		Clay	Clay	Clay
Bulk density	1.19	1.14	1.15	1.14	1.15	1.19
pH-H2O (1:2.5)	4.77	5	5.17	5.16	5.23	5.31
pH-KCl	3.9	4.1	4.2	4.2	4.3	4.4
EC (dS/m)	0.05	0.03	0.04	0.05	0.03	0.03
Exch Ca ,,	21.84	16.64	17.64	19.14	21.63	19.32
Exch Mg ,,	6.72	4.99	5.88	6.66	6.66	6.72
Exch K ,,	0.34	0.17	0.17	0.15	0.15	0.18
Exch Na (cmol+/kg)	1.52	1.52	1.55	1.66	1.57	1.52
SUM	30.42	23.49	25.24	27.63	30.01	27.71
CEC ,,	46.57	46.12	48.85	46.12	47.48	48.39
BS %	65.32	50.93	51.67	59.90	63.21	57.26
OC %	1.6	1.4	1.1	0.9	0.7	0.5
Total N %	0.2	0.16	0.14	0.11	0.1	0.06
C/N	8.0	8.8		8.2	7.0	8.3
P Olsen (ppm)	14.6					
Av. S %	0.76					
Av Zn (mg/kg)	1.24					
Av Mn ,,	100					
Av Cu ,,	2.17					
Av Fe ,,	35.7					

SOIL PROFILE DESCRIPTION

Profile Number: **AJMP002**

Status: routine profile description

Date: 28/03/2006EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, **MANA WUSTE GULT KEBELE**

Coord: 10°44'23.475"N ,37°10'40.439"E

Elevation: : 2102 m

Soil climate: SU

Human Infl: Plo:

Crops: barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize** ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic Nitisols (2006

Samples: A: 0-10 B: 10-30 C: 30-65 D:65-100 E:100-132 F:132-180

AP 0- 10 cm 5YR 3/3 (dry) and 5YR 3/2 (moist); clay loam; weak medium sub angular blocky structure; slightly hard (dry), very friable (moist), slightly sticky (wet), slightly plastic (wet), common fine-medium pores, common fine- medium roots; non calcareous; clear smooth boundary

A 10-30 cm. dark reddish brown (5 YR3/3) moist; clay loam; moderate, fine to medium sub angular blocky structure; slightly hard when dry; friable when moist; sticky and plastic wet ; common very fine, few coarse pores; many fine and common roots; non calcareous; clear and smooth boundary/transition.

AB 30 – 65 cm. dark reddish brown (2.5 YR3/3) moist; clay; weak coarse sub angular blocky to angular block structure; hard when dry; friable moist; very sticky plastic wet; few thin clay cutans; common very fine, fine and medium, few coarse pores; many fine roots; non calcareous; gradual and smooth boundary.

Bt1 65 – 100cm. Very dark brown (2.5 YR3/4) moist, clay; strong coarse angular blocky structure; hard when dry; friable moist; very sticky plastic wet, common thin clay cutans; no calcium carbonate mineral nodules; many fine interstitial pores; non calcareous; diffuse and smooth boundary.

Bt2 100-132cm. Dark red (2.5YR3/6) moist, clay; strong coarse angular blocky; sticky plastic wet, friable moist; many fine pores; many fine roots; gradual and smooth boundary.

Bt3 132-180 cm. Dark red (2.5YR 3/6) (moist); clay; weak fine and medium sub prismatic structure; very friable (moist), sticky (wet), plastic (wet), many fine and very fine pores, very few fine roots; non calcareous;

TABLE 37: Analytical data of Profile No: AJMWP002 Mana wuste gult kebele, Jabi

Horizon	**Ap**	**B**	**Bt1**	**Bt2**	**BC**	**C**
Depth (cm)	0-10	10-30	30-65	65-100	100-132	132-180
Sand %	20.9	11.9	4.9	6.96	2.3	7.3
Silt %	22.3	26.4	35.7	34.1	34.8	26.5
Clay %	56.9	61.7	59.4	58.9	62.9	66.2
silt/clay	0.4	0.4	0.6	0.6	0.6	
Texture class	Clay	Clay	Clay	Clay	Clay	
Bulk density	1.18	1.14	1.12	1.11	1.11	1.14
pH-H2O (1:2.5)	5.03	5	5.2	5.1	5.3	4.5
pH-KCl	4.3	4.2	4.4	4.3	4.4	4.1
EC (dS/m)	0.1	0.04	0.04	0.02	0.06	0.02
Exch Ca ,,	23.52	20.6	17.47	15.81	18.48	19.48
Exch Mg ,,	7.56	6.59	5.82	5.82	6.72	7.49
Exch K ,,	0.75	0.25	0.15	0.13	0.17	0.15
Exch Na (cmol+/kg)	1.59	1.63	1.92	1.66	1.59	1.63
SUM	33.42	29.08	25.36	23.42	26.96	29.23

CEC ,,	53.87	46.57	43.41	46.12	47.48	45.22
BS %	62.04	62.44	58.42	50.78	56.78	64.63
OC %	1.6	1.1	0.9	0.9	0.7	0.5
Total N %	0.19	0.14	0.11	0.09	0.09	0.06
C/N	8.4	7.9	8.2	10.0	7.8	
P Olsen (ppm)	16.1					
Av. S %	0.98					
Av Zn (mg/kg)	1.11					
Av Mn ,,	94.1					
Av Cu ,,	1.96					
Av Fe ,,	38.5					

SOIL PROFILE DESCRIPTION

Profile Number: **AJJIP001**

Status: routine profile description

Date: 28/03/2006EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, **JIMAT KEBELE**

Coord: 10°39'33.407"N **E**37°19'29.398"

Elevation: : 2102 m

Soil climate: SU

Human Infl: Plo:

Crops: barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize** ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic **Nitisols** (Rhodic)

Samples: A: 0-12 B: 12-40 C: 40-90 D: 90-200+

AP 0-12cm Very dark greyish brown (10YR3/2), moist; rapidly permeable; clay; friable moist, very sticky and very plastic wet; strong medium sub-angular blocky structure; common fine and few medium pores; many fine roots; non-calcareous; clear smooth boundary.

AB 12-42cm Dark reddish brown (2.5YR3/3), moist; clay; moderately permeable; friable moist, very sticky and plastic wet; strong medium sub-angular blocky structure; common distinct clay skins; common fine and very few medium pores; common fine roots; non-calcareous; gradual smooth boundary

Bt142-90cm Dark reddish brown (2.5YR3/4), moist; clay; moderately permeable; friable moist, very sticky and plastic wet; weak medium sub-angular blocky structure; broken distinct clay skins; common fine and very few medium pores; few fine and very few coarse roots; non-calcareous; gradual smooth boundary.

Bt2 90-200cm Dark reddish brown (2.5YR3/4), moist; clay; rapidly permeable; friable moist, sticky and plastic wet; weak medium sub-angular blocky structure; many fine and very few medium pores; very few fine and very few coarse roots; non-calcareous

TABLE 38: Analytical data of Profile No: AJJIP001 Jimat kebele, JabiTehnan woreda

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-12	12-42	42-90	90-200
Sand %	18.5	12	2	
Silt %	22.5	21	18	
Clay %	58	74	81	
silt/clay	0.4	0.3	0.2	
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	4.7	4.9	4.5	4.7
pH-KCl	3.7	3.5	3.4	3.7
EC (dS/m)	0.4	0.1	0.5	0.1
Exch Ca ,,	19.7	25.1	31.4	9
Exch Mg ,,	16.1	20.6	18.8	12.7

Exch K ,,	0.2	0.1	0.1	0.1
Exch Na (cmol+/kg)	0.4	0.4	0.5	0.4
SUM	36.4	46.2	50.8	22.2
CEC ,,	41	49	54	28
CECclay	70.69	66.22	66.67	
BS %	88.78	94.29	94.07	79.29
OC %	3.6	2	1.1	0.2
Total N %	0.17	0.09	0.05	0.02
C/N	21.2	22.2	22.0	10.0
P Olsen (ppm)	8.1			
Av. S %	1.1			
Av Zn (mg/kg)	1			
Av Mn ,,	88.5			
Av Cu ,,	1.54			
Av Fe ,,	37.2			

SOIL PROFILE DESCRIPTION

Profile Number: **AJJIP002**

Status: routine profile description

Date: 29/03/2006EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, **JIMAT** Kebele

Coord: 10°38'44.452"N, **E**37°21'1.947"

Elevation: : 2102 m

Soil climate: SU

Human Infl: Plo:

Crops: barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize** ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Haplic **Vertisols** (Eutric chromic)

Samples: A: 0-15 B: 15-42 C: 42-105 D: 105-210+

0-15 Very dark greyish brown (10YR3/2), moist; heavy clay; common fine distinct reddish mottles; very hard dry, very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; common distinct clay skins; 74 mm crack width; common fine and few medium pores; common fine and few medium roots; common fine ferromanganese concretion; non-calcareous; clear smooth boundary.

15-42 Very dark grey (10YR3/1), moist; heavy clay; common medium distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; abundant prominent pressure faces; 40 mm crack width; few fine and few medium pores; common fine roots; few fine ferromanganese concretion; non-calcareous; clear smooth boundary.

42-105 Very dark grey (10YR3/1), moist; heavy clay; common fine distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; abundant prominent pressure faces; 40 mm crack width; few fine pores; few fine ferromanganese concretion; non-calcareous

105-200 Dark grey (10YR4/1), moist; clay; many fine gravels; firm moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; common faint clay skins; common fine and few medium pores; common fine ferromanganese concretion; non-calcareous..

TABLE 39: Analytical data of Profile No: AJJIP002 Jimat kebele, JabiTehnan

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-15	15-42	42-105	105-200
Sand %	7	3	1	
Silt %	43	20	18	
Clay %	49	77	81	
silt/clay	0.9	0.3	0.2	
Texture class	SIC	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	6.7	6.5	6.7	7.5

pH-KCl	5.2	5	4.6	5.8
EC (dS/m)	0.1	0.1	0.1	0.1
Exch Ca ,,	17	8.1	13.4	9.9
Exch Mg ,,	11.6	5.4	2.7	8.1
Exch K ,,	1.4	0.9	0.1	0.4
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.1
SUM	30.1	14.5	16.3	18.5
CEC ,,	56	36	30	26
CECclay	114.29	46.75	37.04	
BS %	53.75	40.28	54.33	71.15
OC %	4.8	1.7	0.9	0.6
Total N %	0.22	0.12	0.11	0.05
C/N	21.8	14.2	8.2	12.0
P Olsen (ppm)	10			
Av. S %	0.85			
Av Zn (mg/kg)	0.25			
Av Mn ,,	12.2			
Av Cu ,,	0.62			
Av Fe ,,	8.2			

Photograph

SOIL PROFILE DESCRIPTION

Profile Number: **AJZTP001**

Status: routine profile description

Date: 30/03/2006EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, **ZEBA TSIONKEBELE**

Coord: N 10°42'35.739", **E**37°8'39.406"

Elevation: : 2102 m

Soil climate: SU

Human Infl: Plo:

Crops: barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize** ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Luvic Nitisols (Rhodic)

Samples: A: 0-28 B: 28-52 C: 52-88 D: 88-125 E: 125-200+

AP 0-28cm Dark reddish brown (5YR3/3), moist; clay; hard dry, friable moist, very sticky and very plastic wet; moderate very coarse sub-angular blocky structure; many fine, many medium and many coarse pores; common fine roots; non calcareous; clear smooth boundary.

AB 28-52cm Dark reddish brown (2.5YR3/4), moist; clay; hard dry, very friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; common distinct clay skins; many fine, common medium and common coarse pores; common animal borrow; non-calcareous; gradual smooth boundary.

Bt1 52-88cm Dark red (2.5YR3/6), moist; clay; very friable moist, very sticky and very plastic wet; moderate coarse sub-angular blocky structure; few distinct clay skins; many fine, common medium and few coarse pores; few animal borrow; non-calcareous; clear smooth boundary.

Bt2 88-125cm Dark red (2.5YR3/6), moist; light clay; many gravels and common stones; very friable moist, sticky and plastic wet; weak very coarse sub-angular blocky structure; many fine, common medium and few coarse pores; common coarse ferromanganese concretion; non-calcareous; gradual smooth boundary.

Bt3 125-200cm Dark red (2.5YR3/6), moist; light clay; many gravels; very friable moist, sticky and plastic wet; weak coarse sub-angular blocky structure; many fine, common medium and common coarse pores; common coarse ferromanganese concretion; non-calcareous.

TABLE 40: Analytical data of Profile No: AJZTP001 Zeba Tsionkebele, JabiTehnan

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth (cm)	0-28	28-52	52-88	88-125	125-200
Sand %	4	2	2	5	
Silt %	21	17	16	19	
Clay %	75	81	81	75	
silt/clay	0.3	0.2	0.2	0.3	
Texture class	Clay	Clay	Clay	Clay	Clay
Bulk density	1.12	1.07	1.02	1.16	1.17
pH-H2O (1:2.5)	5.7	5.4	5.5	5.3	5.08
pH-KCl	4.8	5	5.1	4.6	4.32
EC (dS/m)	0.05	0.06	0.11	0.01	0.01
Exch Ca ,,	16.1	10.8	12.5	9	
Exch Mg ,,	10	8.1	10.8	9	
Exch K ,,	0.3	0.1	0.1	0.1	
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.1	
SUM	26.5	19.1	23.5	18.2	
CEC ,,	37	28	29	26	
CECclay	49.33	34.57	35.80	34.67	

BS %	71.62	68.21	81.03	70.00
OC %	3	1.2	0.9	0.8
Total N %	0.15	0.12	0.08	0.06
C/N	20.0	10.0	11.3	13.3
P Olsen (ppm)	7.7			
Av. S %	1.1			
Av Zn (mg/kg)	1.2			
Av Mn ,,	78.5			
Av Cu ,,	1.3			
Av Fe ,,	38.2			

SOIL PROFILE DESCRIPTION

Profile Number: **AJZTP002**

Status: routine profile description

Date: 01/04/2006EC

Author(s): Mekonnen Getahun

Location: Jabi Tehnan woreda, **ZEBA TSION Kebele**

Coord: N 10°41'39.794 **E**37°8'37.628"

Elevation: ---- m

Soil climate: SU

Human Infl: Plo:

Crops: barley, wheat**, potato, cabbage**

Land Form: Valley

Position: **middle slope (MS)**

Slope form: SV

Slope: 2-5%

Topography: 5-10%

Land Use: Rainfed arable cultivation (AA4) and commercial

Crops: **teff, maize** ughing (Pl), surface compaction (Sc)& millet(CeMi)

Vegetation: eucalyptus

Parent Materials: In-situ weathered rock derived from basalt

Rock Outcrops: none(N)

Coarse surface fragments: N

Erosion: **Gully and rill erosion** (WG)

Sealing/Crusting: none

Surface cracks: wide (2-5cm)

Rock fragments and artifact: N

Mottling: N

Eff. Soil Depth: > 150 cm

Drainage: Permeability: extremely poorly drained; external drainage: slow

Water table: Unknown

FAO-WRB 2006 soil classification: Vertic Vertisols (chromic, eutric)

Samples: A: 0-27 B: 27-58 C: 58-88 D: 88-200+

0-27cm Very dark grey (10YR3/1), moist; heavy clay; common fine distinct reddish mottles; very hard dry, very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; common distinct clay skins; 50 mm crack width; common fine, common medium and common coarse pores; common fine and few medium roots; very few fine ferromanganese concretion; non-calcareous; gradual smooth boundary..

27-58 Very dark grey (10YR3/1), moist; heavy clay; common medium distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; many prominent pressure face; 60 mm crack width; few fine, few medium and very few coarse pores; few fine roots; few fine ferromanganese concretion; non-calcareous; clear smooth boundary..

58-88 Very dark grey (10YR3/1), moist; heavy clay; common medium distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; many prominent pressure face; 60 mm crack width; few fine, few medium and very few coarse pores; few fine roots; few fine ferromanganese concretion; non-calcareous; clear smooth boundary..

88-200 Very dark greyish brown (10YR3/2), moist; heavy clay; common medium distinct reddish mottles; very firm moist, very sticky and very plastic wet; strong very coarse angular blocky structure; abundant prominent pressure face; 25 mm crack width; few fine and very few medium pores; few fine roots; few fine ferromanganese concretion; non-calcareous; clear smooth boundary.

TABLE 41: Analytical data of Profile No: AJZTP002 Zeba Tsionkebele, JabiTehnan

Horizon	**Ap**	**AB**	**Bt1**	**Bt2**
Depth (cm)	0-27	27-58	58-88	88-200
Sand %	34	27	23	23

Silt %	28	25	22	22
Clay %	37	48	55	55
silt/clay	0.8	0.5	0.4	0.4
Texture class	Clay	Clay	Clay	Clay
Bulk density	1.14	1.07	1.02	1.16
pH-H2O (1:2.5)	5.7	5.6	5.4	5.6
pH-KCl	4.8	4.6	4.7	4.8
EC (dS/m)	0.1	0.1	0.1	0.1
Exch Ca ,,	10.8	9	11.6	9.9
Exch Mg ,,	4.3	5.2	6.3	8.1
Exch K ,,	0.5	0.3	0.3	0.4
Exch Na (cmol+/kg)	0.1	0.1	0.1	0.1
SUM	15.7	14.6	18.3	18.5
CEC ,,	31	26	25	26
CECclay	83.78	54.17	45.45	47.27
BS %	50.65	56.15	73.20	71.15
OC %	1.7	1.3	0.8	0.6
Total N %	0.09	0.08	0.06	0.05
C/N	18.9	16.3	13.3	12.0
P Olsen (ppm)	13.7			
Av. S %	1.1			
Av Zn (mg/kg)	0.25			
Av Mn ,,	12.2			
Av Cu ,,	0.62			
Av Fe ,,	8.2			

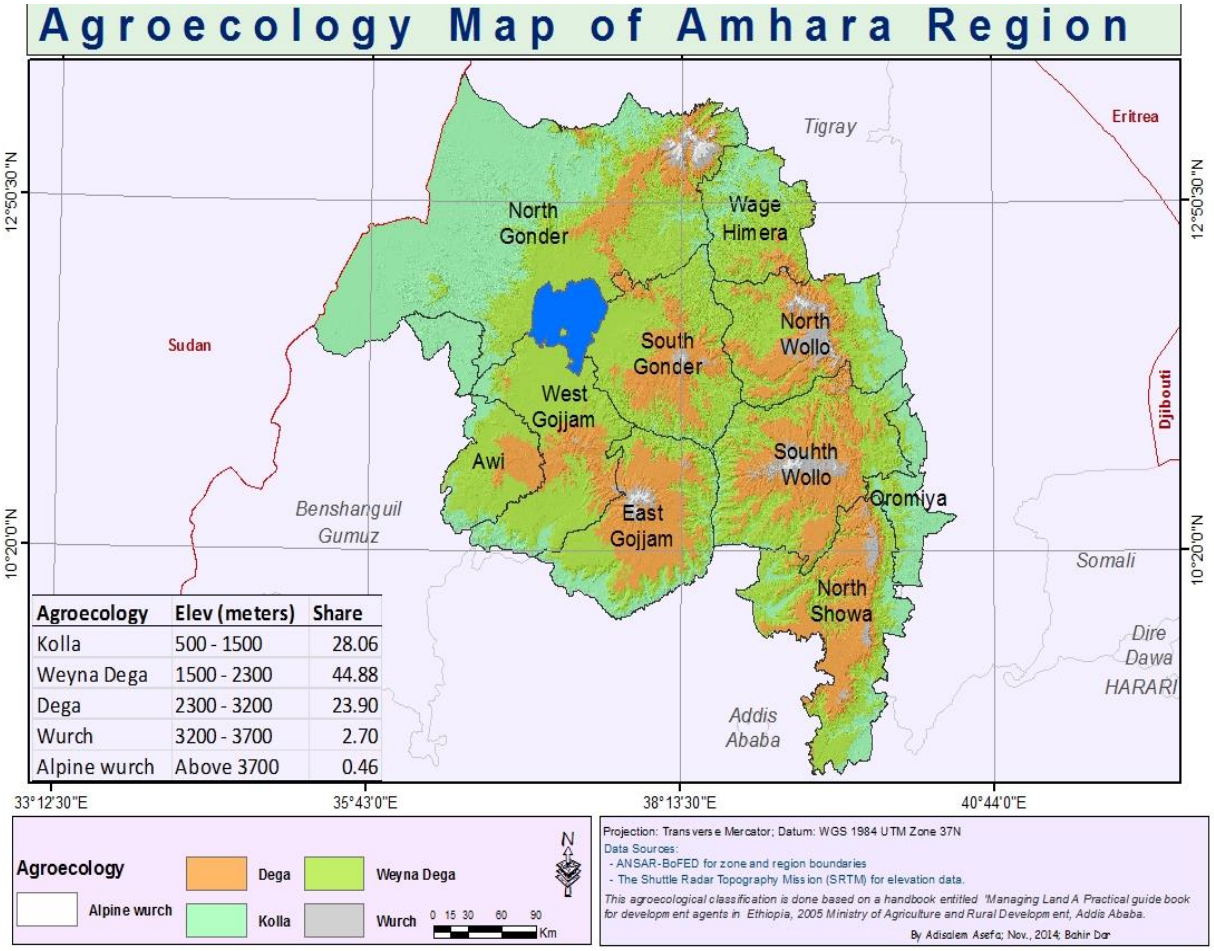

FIGURE 1: Agro-ecological map of Amhara Region based on Elevation