CHARACTERIZATION OF AGRICULTURAL SOILS IN CASCAPE INTERVENTION WOREDAS IN SOUTHERN NATIONS NATIONALITIES PEOPLE REGIONAL STATE (SNNPRS)

Consultant: Alemayehu Kiflu

01 April 2015

Preface

Author is a Soil science staff of Hawassa University College of Agriculture School of Plant and Horticultural Sciences. This is a survey report of the 20 CASCAPE intervention Kebeles. It will be used as a basis for developing site specific and functional soil information that would guide soil fertility management decisions by smallholder farmers. Moreover, this will help in scaling up and extrapolating soil-based results of experiments. The study also contributes to the development of the national/regional soil information databases by the generated locally specific soil information. The field work was carried out betweeen October 2013 and May 2014 and the report was finalized in January 2015.

The author wants to acknowledge Dr. Eyasu Eliyas for his guidance in the whole study period. My deep appreciation also goes to Dr. Tesfaye Abebe who was very cooperative in making the necessary connectionis with the local people and arranged vehcle in time. I would like to acknowledge Ato Tibebu Desalegn who participates as an assistant in the field survey. Moreover I would like to thank the respective CASCAPE kebele representatives who participate in sampling and survey.

Table of Contents Page

1 INTRODUCTION 1

THE NEED FOR SITE SPECIFIC SOIL RESOURCE INFORMATION 1

1.1 OBJECTIVE 3

Specific objectives are: 3

1.2 SCOPE OF THE WORK 3

2. MATERIALS AND METHODS 5

2.1 PREPARATION 5

2.2 FIELD WORK 5

2.3 BACK TO OFFICE 6

2.4 SOIL SAMPLING AND PREPARATION 6

2.5 EXTRACTION METHODS USED AND LABORATORY ANALYSES PROCEDURE 7

2.6 FIELD WORK 7

2.6.1 Exploratory soil survey (reconnaissance) in the 4 CASCAPE kebeles. 7

2.6.2 Detailed characterization of soil profiles representative for the distinguished major soil types. 7

2.7 BACK TO OFFICE 8

PART 3 SOILS OF BULE WOREDA 9

3. RESULTS 9

3.1 DESCRIPTION OF THE ENVIRONMENT 9

3.1.1 Location 9

3.1.2 Overall land use and vegetation 11

Dero Kebele 11

Basura Kebele 13

Sika kebele 13

Illalcha Kebele 14

3.2. SOILS OF BULE WOREDA 16

3.2.1 The soil-landscape in Bule Woreda 16

3.2.1 Soil profile descriptions with analytical data for bule woreda 17

3.2.1.1 Profile site description for Dero Kebele 17
3.2.1.2. Profile site description for basura Kebele 25
3.2.1.3. Profile site description Sika 29
3.2.1.4 Profile site description for Illalcha 31
3.2.2 SYNTHESIS 36
PART 4 ENEMOR ENER WOREDA 43
4. DESCRIPTION OF THE ENVIRONMENT 43
4.1 LOCATION 43
Agata Kebele 45
Kunber Kebele 45
Gomosh Kebele 46
Kerebed Kebele 46
4.3 SOILS OF ENEMOR ENER WOREDA 47
4.3.1 The soil-landscape in Woreda 47
4.3.2 Soil profile descriptions with analytical data for Enemor Ener Woreda 48
4.3.2.1 Profile site description Agata Kebele 48
4.3.2.2. Profile site description Gomosh Kebele 50
4.3.2.3 Profile site description of Kerebed kebele 54
4.3.2.4. Profile site description of Kunber kebele 56
4.4 SYNTHESIS 60
PART 5 MALGA WOREDA 66
5. RESULTS 66
5.1 DESCRIPTION OF THE ENVIRONMENT 66
5.1.1 Location 66
5.1.2 Overall land use and vegetation 68
Guguma Kebele 68
Sintaro Kebele 69
Koche Kebele 70
Fito Ketemuna Kebele 70

5.2 SOILS OF MALGA WOREDA 71
5.2.1 The soil-landscape in Malga Woreda 71
5.2.2 Soil profile descriptions with analytical data 72
5.2.2.1 Profile site description of Fito ketemena Kebele 72
5.2.2.2. Profile site description Guguma Kebele 76
5.2.2.3. Profile site description Kocho Kebele 80
5.2.2.4. Profile site description Sintaro Kebele 82
5.3 SYNTHESIS 88
PART 6 MESRAK AZERNET BERBER WOREDA 95
6. RESULT 95
6.1 DESCRIPTION OF THE ENVIRONMENT 95
6.1.1 LOCATION 95
6.1.2 Overall Landuse and Vegitation 97
6.1.3 Intervention Kebeles 97
Adazer Abicho Kebele 97
Adazer Shebel Kebele 98
Emejar 98
Yerim Kebele 99
6.2 SOILS OF MISRAK AZERNET BERBERE WOREDA 99
6.2.1 The soil-landscape in Woreda 99
6.2.2 Soil profile descriptions with analytical data 100
6.2.2.1 Profile site description of Adazer Abicho Kebele 100
6.2.2.2 Profile site description of Adazer Shebel Kebele 102
6.2.2.3 Profile site description of Emejar Kebele 106
6.2.2.4 Profile site description of yerim Kebele 110
6.2.3 SYNTHESIS 112
PART 7 CHEHA WOREDA 118
7. RESULT 118
7.1 DESCRIPTION OF THE ENVIRONMENT 118

7.1.1 LOCATION 118
7.1.2 Overall Landuse and Vegitation 120
7.1.3 Intervention Kebeles 120
Ewan Kebele 120
Wordenen Kebele 121
Yeferzeye Kebele 122
Moche Kebele 123
7.2 SOILS OF CHEHA WOREDA 124
7.2.1 The soil-landscape in Woreda 124
7.2.2 Soil profile descriptions with analytical data 125
7.2.2.1 Profile site description Ewan Kebele 125
7.2.2.2 Profile site description Moche Kebele 127
7.2.2.3 Profile site description Yeferzeye Kebele 131
7.2.2.4 Profile site description Wordenen Kebele 135
7.3 SYNTHESIS 139
8. SUMMERY OF SOIL FERTILITY EVALUATION BY FARMERS' 146
9. SOIL FERTILITY MANAGEMENT PRACTICES IN THE STUDY AREAS. 146
10. SUMMERY AND CONCLUSION 147
11. REFERENCES 151

List of Figures **Page**

Fig 1 Location map of the CASCAPE Intervention Woredas 4
Fig 2 Location and map of Bule Woreda 10
Fig 3 Slope map of Dero and Basura Kebeles 12
Fig 4 The Overall Landscape of Dero and Basura Kebeles. 13
Fig 5 Slope map of Sika and Illalcha Kebeles 15
Fig 6 Sample Soil Profile at Dero Kebele (Chromic Luvisols) 37
Fig 7 Sample soil profile (Cambisol) 38
Fig 8 Sample Augedr description at Illalcha 39
Fig 9 Soil Map of Dero and Basura Kebele 40
Fig 10 Soil Map of Sika and Illalcha Kebele 41
Fig 11 Location Map of Enemor Ener Woreda 43
Fig 12 Slope map of Agata and Kunber Kebeles. 44
Fig 13 Slope map of Gomosh and Kerebed Kebele 46
Fig 14 Sub soiling practice in Gurage and Silty areas 61
Fig 15 Sample Soil Profile at Agata Kebele 62
Fig 16 Soil Map of Agata and Kunber Kebeles 63
Fig 17 Soil Map of Gomosg and Kerebed Kebeles 64
Fig 18 Location and Agro ecology map of Malga Woreda 66
Fig 19 Slope map of Guguma Kebeles 68
Fig 20 Slope map of Kocho and Sintaro Kebeles 69
Fig 21 Slope map of Fit Ketemuna Keblele 70
Fig 22 Sample Soil Profile at Fito Ketumena Kebele (Chromic Luvisols) 90
Fig 23 Sample soil profile in Sitaro(Chromic Cambisol). 90
Fig 24 Soil Map of Fitoketemena Kebele 91
Fig 25 Soil Map of Guguma Kebele 92
Fig 26 soil Map of Sintaro and Kocho kebeles 93
Fig 27 Location map of Mesrak Azernet Berber Woreda 95
Fig 28 Slope map of Adazer Abicho and Adazer Shebel Kebele 97
Fig 29 soil Map of Sintaro and Kocho kebeles 98

Fig 30 Slope map of Emejar and Yerim Kebele 95
Fig 31 Sample Soil Profile at Adazer Shebel Kebele (Chromic Luvisols) 112
Fig 32 Sample soil profile at Emejar Kebele (Vertisols) 113
Fig 33 Soil Map of Adazer Abicho and Adazer Shebel Kebeles 114
Fig 34 Soil Map of Emejar and Yerim Kebeles 115
Fig 35 Location Map for Cheha Woreda 117
Fig 36 Slope map of Ewan Kebeles 119
Fig 37 Slope Map of Wordenen Kebele 120
Fig 38 Slope map of Yeferzeye kebele 121
Fig 39 Slope map of Moche Kebele 122
Fig 40 Sample Soil Profile at Yeferzeye kebele 139
Fig 41 Soil Map of Ewan Kebele 140
Fig 42 Soil Map of Moche Kebele 141
Fig 43 Soil Map of Wordenen Kebele 142
Fig 44 Soil Map of Yeferzeye Kebele 143

List of Table **Page**

Table 1 Land use pattern of Bule Woreda 16
Table 2 Soil Description for Bu-De-P1 18
Table 3 Analytical data for Bu-De-P1 18
Table 4 Soil description for Bu-De-P2 20
Table 5 Analytical data for Bu-De-P2 20
Table 6 Soil Description for Bu-De-P3 22
Table 7 Analytical data for Bu-De-P3 23
Table 8 Soil Description for Bu-Ba-P1 25
Table 9 Analytical data for Bu-Ba-P1 26
Table 10 Soil Description for Bu-Ba-P2 27
Table 11 Analytical data for Bu-Ba-P2 28
Table 12 Soil Description for Bu-Si-P1 29
Table 13 Table with analytical data for Bu-Si-P1 30
Table 14 Soil Description Bu-Ila-P1 30
Table 15 Table with analytical data for Bu-Ila-P1 32
Table 16 Soil description Bu-Illa-P2 33
Table 17 Table with analytical data for Bu-Illa-P2 34
Table 18 Land use pattern of Enemor Ener Woreda 46
Table 19 Soil description for En-Ag-P1 47
Table 20 Table with analytical data for En-Ag-P1 49
Table 21 Soil Description for En-Go-P1 50
Table 22 Table with analytical data for En-Go-P1 50
Table 23 Soil Description for En-Go-P2 52
Table 24 table with analytical data for En-Go-P2 52
Table 25 Soil Description for En-Ke-P1 54
Table 26 Table with analytical data for En-Ke-P1 54
Table 27 Soil Description for En-Ku-P1 56
Table 28 Table with analytical data for En-Ku-P1 56
Table 29 Soil Description for En-Ku-P2 58

Table 30 Table with analytical data for En-Ku-P2 58
Table 31 Soil Description for Ma-Ft-P1 71
Table 32 Table with analytical data for Ma-Ft-P1 72
Table 33 Soil description for Ma-Ft-P2 73
Table 34 Soil Description for Ma-Gu-P1 74
Table 35 Table with analytical data fro Ma-Ft-P2 75
Table 36 with analytical data for Ma-Gu-P1 76
Table 37 Soil Description for Ma-Gu-P1 77
Table 38 Table with analytical data for Ma-Gu-P1 78
Table 39 Soil Description for Ma-Ko-P1 79
Table 40 Table with analytical data for Ma-Ko-P1 80
Table 41 Soil Descriptionfor Ma-Si-P1 81
Table 42 table with analytical data for Ma-Si-P1 83
Table 43 Soil Description for Ma-Si-P2 85
Table 44 Table with analytical data for Ma-Si-P2 86
Table 45 Land use pattern of Misrak Azernet Berbere Woreda 96
Table 46 Soil Description for Me-AzAb-P1 100
Table 47 Table with analytical data for Me-AzAb-P1 100
Table 48 Soil Description for Me-Az-Sb-P1 102
Table 50 Table with Analytical data for Me-Az-Sb-P1 102
Table 51 Soil Description for Me-Az-Sb-P2 104
Table 52 Table with analytical data for Me-Az-Sb-P2 104
Table 53 Soil Description for Me-Em-P1 106
Table 54 Table with analytical data for Me-Em-P1 106
Table 55 Soil Description for Me-Az-Em-P2 107
Table 56 Table with analytical data for Me-Az-Em-P2 108
Table 57 Soil Description for Me-Ye-P1 110
Table 58 Table with analytical Data for Me-Ye-P1 110
Table 59 Land use pattern of Cheha Woreda 118
Table 60 Soil Description of Ch-Ew-P1 124
Table 61 Table with analytical data for Ch-Ew-P1 124

Table 62 Soil Description for Ch-Mo-P1 126
Table 63 Table with analytical data Ch-Mo-P1 126
Table 64 Soil description for Ch-Mo-P2 128
Table 65 Table with analytical data for Ch-Mo-P2 128
Table 66 Soil description for Ch-Ye-P1 130
Table 67 Table with analytical data for Ch-Ye-P1 130
Table 68 Soil description for Ch-Ye-P2 132
Table 69 Table with analytical data for Ch-Ye-P2 132
Table 70 Soil description for Ch-Wo-P1 134
Table 71 Table with analytical data for Ch-Wo-P1 134
Table 72 Soil description for Ch-Wo-P2 136
Table 73 Table with analytical data for Ch-Wo-P2 136
Table 74 Farmer's classification and their associated properties 144
Table 75 Summery of soil types of the intervention Kebeles 146

List of Appendix **Page**

Appendix 1 Agro ecological map of SNNPRS 154

Appendix 2 Relief map of SNNPRS 155

Appendix 3 Average temperature map of SNNPRS 156

Appendix 4 Geology and Mineral occurrence map of SNNPRS 157

Appendix 5 Annual average rainfall map of SNNPRS 158

Appendix 6 Drainage and river basin map of SNNPRS 159

Appendix 7 Soil map of SNNPRS 160

Appendix 8 Soil landscape relation hip at Bule wored 161

Appendix 9 Soil landscape relationship at Enemorener woreda 162

Appendix 10 Soil landscape relationship at Mesrakazererntberber Woreda 163

Appendix 11 Soil landscape relationship at cheha woreda 164

Appendix 12 Soil landscape relationship at Malga woreda 165

List of Abbreviations and Acronyms

ACA	Awassa College of Agriculture
BWFED	Bule Woreda Finance and Economic Development
CASCAPE	Capacity building for scaling up of evidence-based best practices in agricultural production in Ethiopia
CSA	Central statistical Autority
DTPA	Diethylenetriaminepenta -acetic acid
Ethio SIS	Ethiopian Soil Information System
FAO	Food and Agricultural Organization
GPS	Geographical positioning system
GTP	Growth and Transformation Plan
MoA	Ministry of Agriculture
NUC	National Coordinaton Unit of the CASCAPE project
PRA	Participatory rural appraisal
SNNPRS	South Nations Nationalities People Regional State
WUR	Wageningen University and Research Centre

1 INTRODUCTION

The Southern Nations, Nationalities and People's Region (SNNPR) is located in the Southern and South-western part of Ethiopia. Geographically, the region is roughly lies between 4^{o}.43" - 8^{o}.58" North and 34^{o}.88"- 39^{o}.14" East. It is bordered by Kenya in the South, the South Sudan in Southwest, Gambella region in Northwest and surrounded by Oromiya region in Northwest, North and East directions. The total area of the region is estimated to be 109,015 Sq. Km which shares 10% of the country and the population size is 17,332,584 accounting nearly (in 2004E.C.) 20% of the total population of the country. The average population density of the region is 159 persons per sq. km, which makes the region to be one of the most populated parts of the country.

The region is a multination which consists of about 56 ethnic groups with their own distinct geographical location, language, cultures, and social identities living together. These various ethnic groups are classified into the Omotic, Cushetic, Nilo-Sahara and Semitic super language families. Among them Omotic and Cushetic are the most numerous and diversified ones with the largest area coverage in region respectively. Based on ethnic and linguistic identities at present the region is divided into 14 zones-sub-divided into 131 woredas and 4 special woredas and 22 town administrations. .According to zonal and special woredas reports of 2004 E.C there are 315 urban and 3709 rural kebeles in the region.

The need for site specific soil resource information

Soil is the most important basis of life, as most of the requirements of life come from it. Abundant growth of life is found on an area that has a good soil. From the records of past achievements, history tells us that civilization and soil fertility are closely interlinked (Taffa, 2002). Soil resources are finite and non-renewable over human time frames and are prone to degradation by misuse and poor management (Lal, 2000). The rapid increase in the world's population demands the production of increasing quantities of food, fiber, and fuel from the land. To meet these needs, vast tracts of land are being farmed more intensively, and large areas of grasslands are being overgrazed and degraded. Additionally, new and often marginal lands are being brought into production. But land must be carefully managed, in order to maintain or increase productivity. If it is not well managed, or if it is used in a way that is beyond its potential, soil degradation will inevitably occur (Ronggui, 2001).

Successful agriculture requires the sustainable use of soil resource, because soils can easily lose their quality and quantity within a short period of time for many reasons. Agricultural practice therefore requires basic knowledge of sustainable use of the land. A success in soil management to maintain the soil quality depends on the understanding of how the soil responds to agricultural practices over time. Recent interest in evaluating the quality of our soil resource has therefore been stimulated by increasing awareness that soil is critically important component of the earths biosphere, functioning not only in the production of food and fiber, but also in the maintenance of local, regional, and world

wide environmental quality (Wakene, 2001). On the other hand, feeding the ever-increasing human population is most challenging in areas like southern Ethiopia, where there is a very high population density. In addition, the topography has also a great impact on the soil quality and depth due to the interaction impact of cultivation practices and slope. However, the basis of this sustainable agricultural development is good quality of soil, since maintenance of soil quality is an integral part of sustainable agriculture.

Soil fertility is scientific discipline that integrates the basic principles of soil biology, chemistry, and physics to develop the practices leading to manage soil quality inparticilar nutrients in a profitable, environmentally sound manner (Thomas, 2000). The study of soil fertility evolved within ecosystems devoted primarily to the production of agricultural crops. The importance of soil fertility to world agriculture continues today as a spiraling world population and diminishing arable land base creates unprecedented pressure on science and pushing agriculturists to produce more food per unit area of land than ever before. Advances in plant genetics and others are increasing agricultural productivity. However, high crop yields mean greater depletion of nutrients and effects will be more sever in southern region where farmers are forced to intensively cultivate the land due to population pressure.

Studies on the nutrient availability across landscapes have become the focal point of much ecological research (Benning and Seastedt, 1995). Many studies identified soil nutrient availability to be an important factor controlling net primary productivity (Pastor and Post, 1986; Seastedt et al., 1991). Therefore, characterizing spatial variability and distribution of nutrients in relation to site characteristics including climate, land use, landscape position and other variables is critical for predicting rates of ecosystem processes (Schimel et al., 1991). Moreover such types of studies are useful in understanding how ecosystems work (Townsend et al., 1995) and assessing the effects of future land use change on nutrients (Kosmas et al., 2000).

Site specific soil surveys are made at scales that allow detailed information about soil properties and characteristics to be accurately mapped. Such features include soil chemical, morphological and physical properties, depth to water tables, presence of water stagnation, depth to bedrock or other restrictive layers, and other attributes that directly influence potential use of soils. These surveys provide reliable information for policy makers, officials, developers, and land owners.

As part of the Growth and Transformation Plan (GTP), the Ethiopian Government aims at increasing productivity. Low soil fertility is identified as one of the key challenges to meet the GTP objectives. Therefore, there is a need for a proper understanding of the soil resources and nutrient status in order to support more nuanced soil fertility management decisions by farmers. Such a nuanced approach should take into consideration the spatial scale diversities in soil nutrient stocks and flows which drive the soil's supply of nutrients. CASCAPE has entered into a collaboration agreement with ATA/MoA to assist EthioSIS in various ways including the following activities (i) soil sampling and fertility mapping of 30 CASCAPE intervention woredas (through composite topsoil samples); (ii) establishment of a modern and well-functioning national soil resource

database; (iii) training and capacity building in the area of soil fertility mapping (geo-statistics and soil data interpretation) and fertilizer recommendations (QUEFTS validation, fertilizer trials, etc.); and (iv) a soil characterization study conducting detailed soil profile studies and classification of agricultural soils in all 30 CASCAPE intervention woredas.

This report contains a soil characterization study with detailed soil profile studies and classification of agricultural soils in all 5 CASCAPE intervention woredas of southern region

1.1 Objective

The goal of the conducted study is to characterize and understand the qualities and behaviour of the major agricultural soils occurring in the 30 CASCAPE intervention Woredas based on properly observed and measured soil morphologic, physical and chemical properties. This will be the basis for developing site specific and functional soil information that would guide soil fertility management decisions by smallholder farmers. Moreover, this will help in scaling up and extrapolating soil-based results of experiments. The study also contributes to the development of the national/regional soil information database under EthioSIS by the generated locally specific soil information.

Specific objectives are:

- To survey soil variability and to identify major soil types in each Woreda (4 kebeles per Woreda) through auger observations (based on the outcome of preparatory base mapping including, the PRA results, farmers soil mapping) in relation to delineated major landforms.

- To characterise and classify the identified major agricultural soils by describing their morphological, physical and chemical properties through observations in soil pits, sampling and laboratory measurements.

- To develop general management recommendations (such as but not limited to fertilizer application, soil and water conservation, liming, etc., based on the above study and other available and/or recently collected soil data).

1.2 Scope of the work

The study was conducted on the agricultural lands of 20 kebeles in 5 CASCAPE intervention Woredas (4 kebeles per Woreda) in SNNPRS region (figure 1) areas and subsequently to use the information obtained as a basis for identifying potentials and constraints of the CASCAPE intervention area soils for designing integrated agricultural potential areas study and project preparation, through:

- Interpretation of topographic maps and aerial photographs to produce soil / landform map.

- Carrying out field survey and collecting soil samples for laboratory analysis.
- Preparation of soil report and map for selected kebeles of the actual and potential agricultural lands.

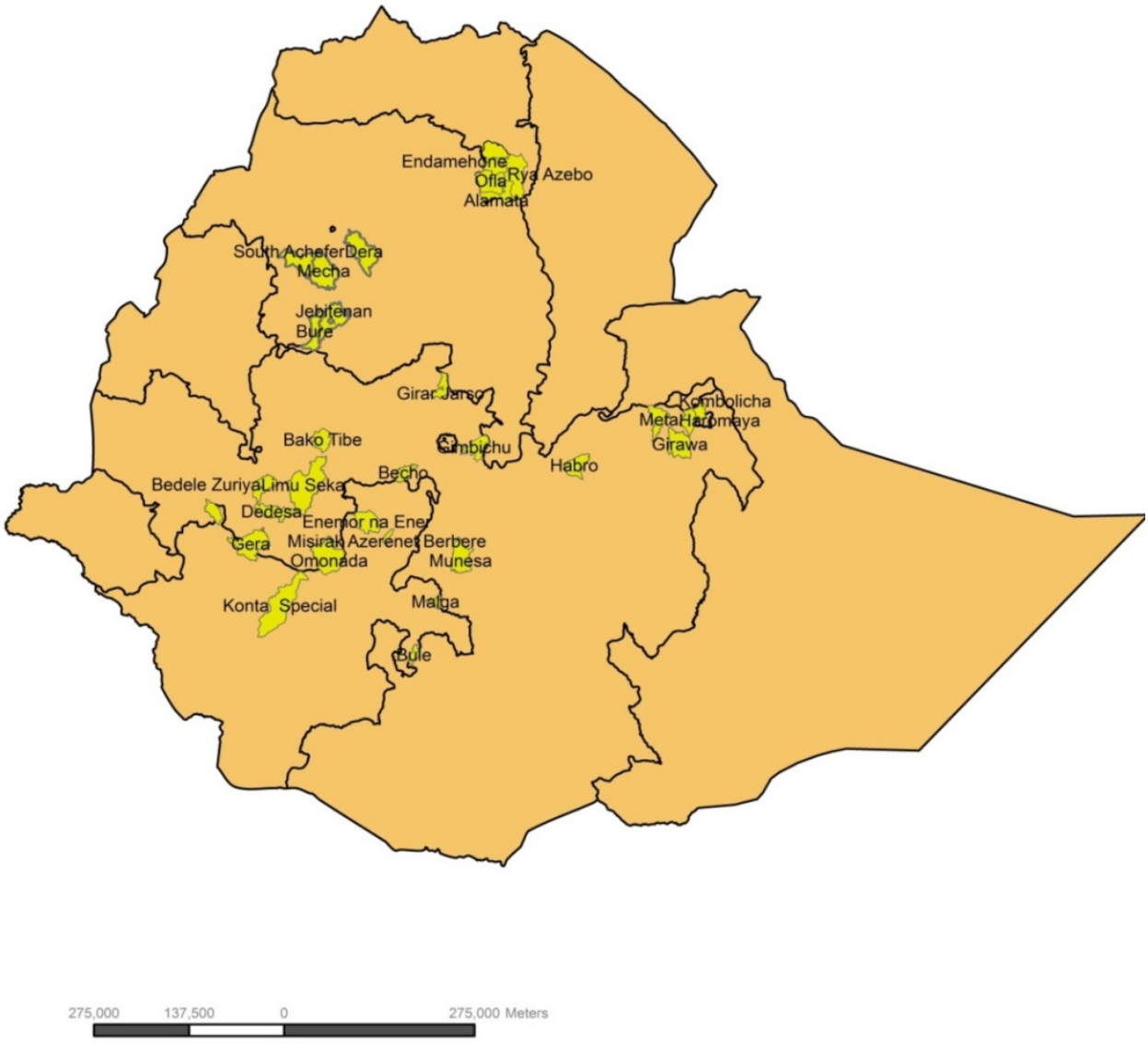


Fig1: Location map of the CASCAPE Intervention Woredas

2. Materials and methods

2.1 Preparation

- Collecte and compile existing data and prepare base maps of the 5 Woredas, using spatial databases including:
  - The Woredas and the 4 kebeles per Woreda; (shapefiles)
  - The location of the CASCAPE trial sites
  - Different kinds of Maps (See the Appendix)
  - 20 Topomap sheets at a scale of 1:50,000
  - Land cover / land use (agricultural lands)
  - Landforms and geology. Slope map was produced for each kebeles. The slopes choosen were 0-1 % Flat to level land, 1-5 % very gentley sloping to gently sloping, 5-10 % sloping, 10-15 % Strongly sloping, 15-30 % Moderately step and greater than 30 % as steep.
  - PRA results of four intervention Woredas. (Cheha Woreda doesn't have PRA) 2011 (participatory soil maps); obtained from regional CASCAPE coordinators
  - Regional soil maps (1: 250,000?); obtained (shapefiles) from BoPED's, with attribute data tables and profile data
  - SoTer (Soil and Terrain) of IGAD (FAO, 1998) at 1: 1 mln and original Soil and Geomorphology map of Ethiopia (FAO, 1984) at 1: 1 mln; shared by ISRIC.

ISRIC provided shape files (and kmz files for projection upon Google Earth) of the Woredas in combination with the 1998 SoTer files (including mapping units with information about the major landform, geology and others and the proportions of occurring soil types, at 1: 1 mln, together with scans (not GIS files) of the corresponding original 1984 soil map, and an extract out of the Africa Soil Profiles database. Additional data and information sources included the Ministry of Water Resources (river basin studies), Ministry of Agriculture, ATA, Atlas of Ethiopia (IFPRI); assessed centrally, and universities and the ISRIC library.

Defined and delineated 'major mapping units' (based on major landforms and geology) and 'minor mapping units' (based on the positions on the typical topo-sequence of the major landforms and on auxiliary information as soil maps, PRA study, land use, location of trial sites, etc.), together with the anticipated soil types per hypothesised mapping units, projected upon the topographic map.

2.2 Field work

Conduct an exploratory soil survey (reconnaissance) in the 4 CASCAPE kebeles per Woreda through road cuts, other visible means (soil surface colour; rock outcrops/stoniness.) and soil auger descriptions.

Following the base map point locations for observation were identified, georeferenced by GPS and augered. Augers were described according to the standard description form and following the guidelines for soil profile description (FAO, 2006), to a depth of at least 120 cm (bedrock permitting) with a minimum of 8 augers per kebele (also near trial sites). Auger description forms were provided by ISRIC.

The exploratory soil survey leads to the identification of the different major soil types, and their respective proportions, in each kebele and Woreda and on each topo-sequential position of each major landform.

Following the exploratory soil survey and the identified major soil types, representative point locations for detailed observation were identified, georeferenced by GPS and opened as soil pits. The opened soil profiles were described in detail according to the standard description form (provided by ISRIC) following the guidelines for soil profile description (FAO, 2006), designating master horizons with subordinate characteristics to a depth of at least 180 cm (bedrock permitting), for on average 6 soil pits per Woreda (minimally 4, maximally 8). The locations of the soil pits are not necessarily evenly distributed over all 4 kebeles but over all major soil types.

The designated soil horizons of the soil pits were sampled (at least 1 kg per sample) for soil analysis, with on average 4 (3-6) samples per profile; avoiding cross-contamination. Two samples were taken from thick horizons (sample area should never extend more than 30 cm). The samples were properly and traceably labeled and administrated, and the sample bags were opened, air dried, during storage before submission to the laboratory. One hidden sample was included per profile to check the quality of laboratory results.

2.3 Back to office

Submitted batch of administrated soil samples to the Water Works Design and Supervision Enterprise Laboratory Services, Sub Process Soil Fertility Section Addis Abeba. The consultant submitted the samples to the lab, with the sample administration shared with the NCU. Sample were prepared at ACA soil laboratory and sent for determination of key soil parameters including soil texture, pH H_2O and KCl, EC, organic C, total N, available (Olsen)-P, CEC and exchangeable bases (K, Ca, Mg, Na) and micronutrient for the surface soil samples. The consultant collected the results from the lab, and shared the results with NCU.

2.4 Soil Sampling and Preparation

All soil samples were air-dried, ground and passed through 2 mm sieve at the Soil Laboratory of the Awassa College of Agriculture. The physicochemical analyses of the soil samples were conducted at Water Works Design and Supervision Enterprise, Laboratory Service Sub Process soil fertility section laboratory following standard laboratory procedures. Duplicate soil samples from each profile were also included to cross check the result.

2.5 Extraction methods used and Laboratory Analyses procedure

Total nitrogen content was determined following the Kjeldhal method. The available phosphorus content of the soil was analyzed using 0.5M sodium bicarbonate extraction solution (pH 8.5) following the method of Olsen. The organic carbon determinations were made following the wet oxidation method of Walkley and Black. The exchangeable basic cations (K^+, Ca^{2+}, Mg^{2+} and Na^+) were extracted with 1 M- ammoniumacetate at pH 7.0. CEC of the soil was determined from ammonium acetate saturated sample. The excess ammonium acetate was removed by washing with ethanol. Finally, the exchangeable Ca^{+2} and Mg^{+2} in the ammonium acetate leachate were measured by atomic absorption spectrophotometry (AAS), and K^+ and Na^+ were determined by flame photometer.

Hydrometer method was used for the determination of soil particle size. The soil pH was measured using a glass combination pH meter in the supernatant solution of 1:2.5 soil to water and KCl solution ratio. The EC was measured by taking 10 gm of soil sample in 25 ml of water with a conductivity meter. A commonly used procedure called diethylenetriaminepenta -acetic acid or DTPA extraction was used to extract Cu, Fe, Mn and Zn from the samples. The micronutrients extracted with this method were measured by atomic absorption spectrophotometer at 248.3 nm, 279.5 nm, 324.7 nm, and 213.9 nm wavelength for Fe, Mn, Cu, and Zn, respectively.

2.6 Field work

2.6.1 Exploratory soil survey

Following the base map, a minimum of 8 augers per kebele was described (See the mapes under each woredas). The auger ID's, with reference to the corresponding major soil type and soil-landscape (mapping) unit, are provided in table format in the Annex and the observed site and layer data are compiled in data tables as given their respective Woreda results.

Following the exploratory soil survey, the delineations of the mapping units were adapted were necessary and the different major soil types, and their respective proportions, were identified per mapping unit and per kebele.

2.6.2 Detailed characterization of soil profiles representative for the distinguished major soil types.

Following the exploratory soil mapping representative soil profiles were characterized in detail, according to the agreed upon procedures. The location of the soil pits, projected upon the exploratory soil map, is shown in the result part of the respective woredas.

Following the detailed soil profile descriptions, the profiles were sampled and the samples were labeled and administrated according to the agreed upon procedures. The sample identifiers are specified hereunder in the detailed soil profile descriptions and the sample administration is also summarized in annex.

2.7 Back to office

Batch of 216 administrated soil samples was submitted to the soil laboratory. See annex for the sample administration shared with the NCU. A number of 216 samples, out of a total of 256, were selected for submission to the laboratory. The samples were prepared by the lab and analyzed for the key soil parameters. The results were collected from the lab, and the results shared with NCU, and given in the annex.

Concerning data processing, the profile data collected from augers and soil pits (site data and morphological, chemical and physical horizon data) were compiled in a database. The format of the data base was provided by ISRIC (tailored version of Africa Soil Profiles database).

Data compilation was followed by data analysis including error checking. Preliminary soil classifications were verified against analytical data and the profiles are classified according to WRB 2006. Few horizons which were classified as independent horizons in the field were finally merged as one because they are found to have similar property in the laboratory. The detail soil map was done for the intervention kebeles through geospatiac analysis techniques of ARC map. The respective area coverage was calculated by converting the number of counts from ARC map to percent and the percent value was converted to area coverage from the total area of the Kebele. A report was written per Woreda as follows.

Part 3 Soils of Bule Woreda

3. Results

3.1 Description of the Environment

3.1.1 Location

Bule Woreda is among the six Woredas in the Gedeo Zone of SNNPR. It is located in the southern part of Hawassa, 117 kilometers (km) from the region's capital and 27 km from the Zone's capital Dilla. Bule Woreda is bordered on the south, East and west by Oromiya region and on the north by Sidama zone.

The Woreda has a total area of 27,300 (ha), with its altitude ranging between 2,001–3,000 meters above sea level (masl). It comprises 30 kebeles (one town administration kebele), of which 18 (70%) have a dega agro-ecology, while the remaining 12 kebeles can be characterized as weyina dega (mid altitude) agro-ecology. Mean annual rainfall of the Woreda is 1401-1800 mm, with mean average temperature ranging between 12.6^{o}–20^{o}C. Geographically the Woreda is located between 6^{o}.07'- 6^{o}.37' North and 38^{o}.27'-38^{o}.77' East (Woreda office of Agriculture, CSA 2007).

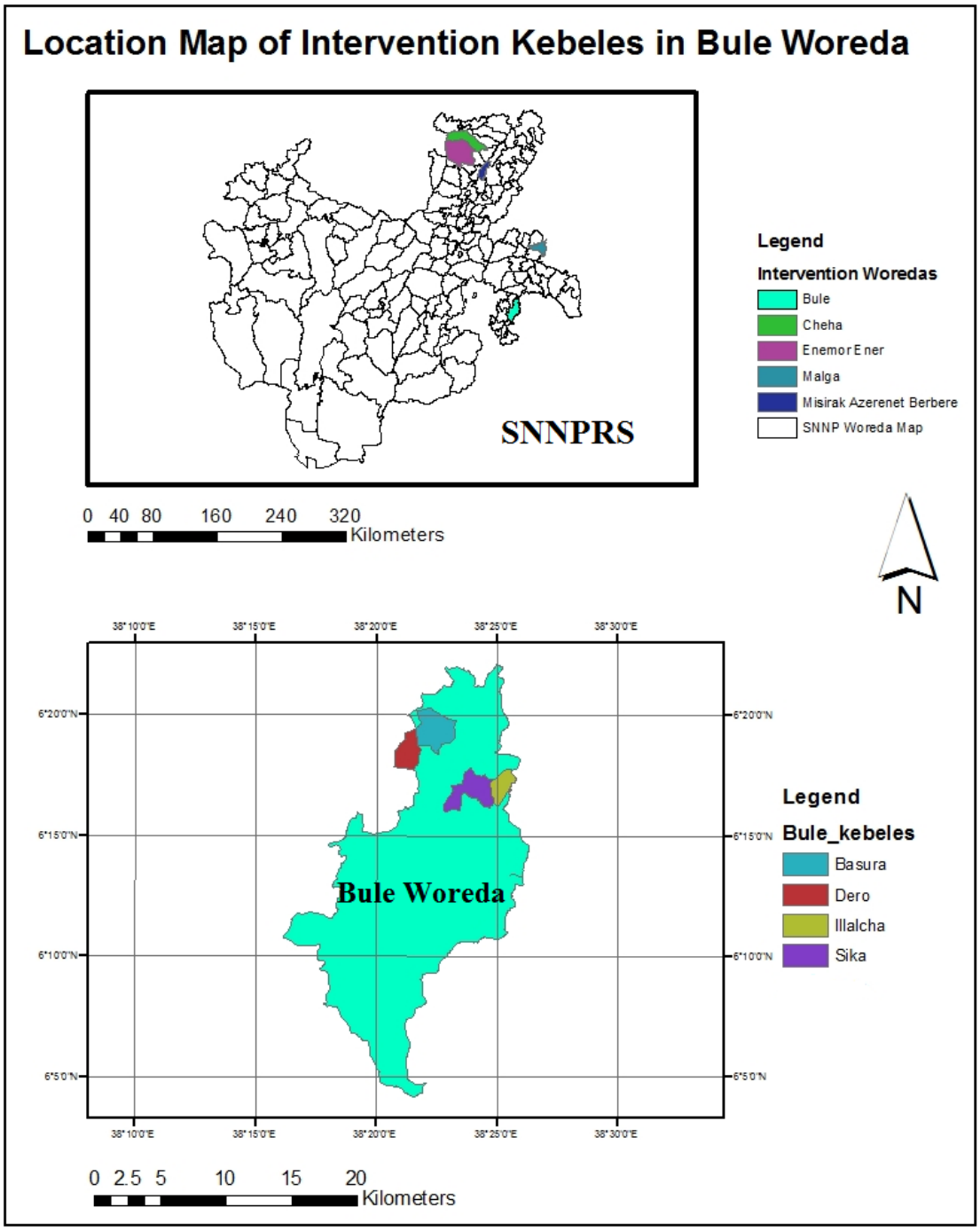


Fig 2 Location and map of Bule Woreda

3.1.2 Overall land use and vegetation

Land use in Gedio zone in general and Bule Woreda in particular is characterized by agroforestry practices. Very hilly areas with even more than 15 % slope are covered with different trees including coffee and Enset. Coffee is grown under shade trees. With regards to land use, 67.16% (18335.2 ha) of the land is used for growing annual and perennial crops, and 8.57 % (2340.61 ha) of the land is used for grazing. The Woreda is inhabited by 115,476 people; whereby 25,617 are male-headed households (MHHs) and 1,484 are female-headed households (FHHs) (BWFED 2011, CASCAPE Working Paper 2.4.1. 2014).

3.1.3 Intervention Kebeles

Dero Kebele.

The total land coverage of the kebele is 720 hectares. Only 1.5 ha of land can be regarded as communally owned. Enset is the leading crop in terms of land use coverage in the zone and Bule Woreda in particular. This also holds true for the Dero kebele, where the crop covers roughly 39% of the total land. Coffee is next in line to Enset in terms of land use coverage (37% of the land use is allotted to coffee). Settlements (are third in importance in terms of land use) occupy nearly 106 (14.72%) ha of land. Annual crops like maize, barley, faba bean, field pea and other crops follow fourth in terms of land use. In summary, more than 85% of the land is used to grow crops – both perennial and annual crops. Protected forests in the kebele cover 1.5 ha. Trees planted around homesteads are dominated by Eucalyptus. Trees serve as a fence and are used to satisfy the demand for firewood. There are also other indigenous trees in the homestead as part of agroforestry effort. The community as a whole has been practicing agroforestry (CASCAPE Working Paper 2.4.1, 2014).

Dero and Basura kebeles are known for their water resources. There are 16 water resources that have potential for irrigation and domestic use. However, only two rivers, namely; Welanso and Chaft are used. Limited awareness, knowledge to construct and utilize, and low economic status have resulted in low-level utilization of these resources.

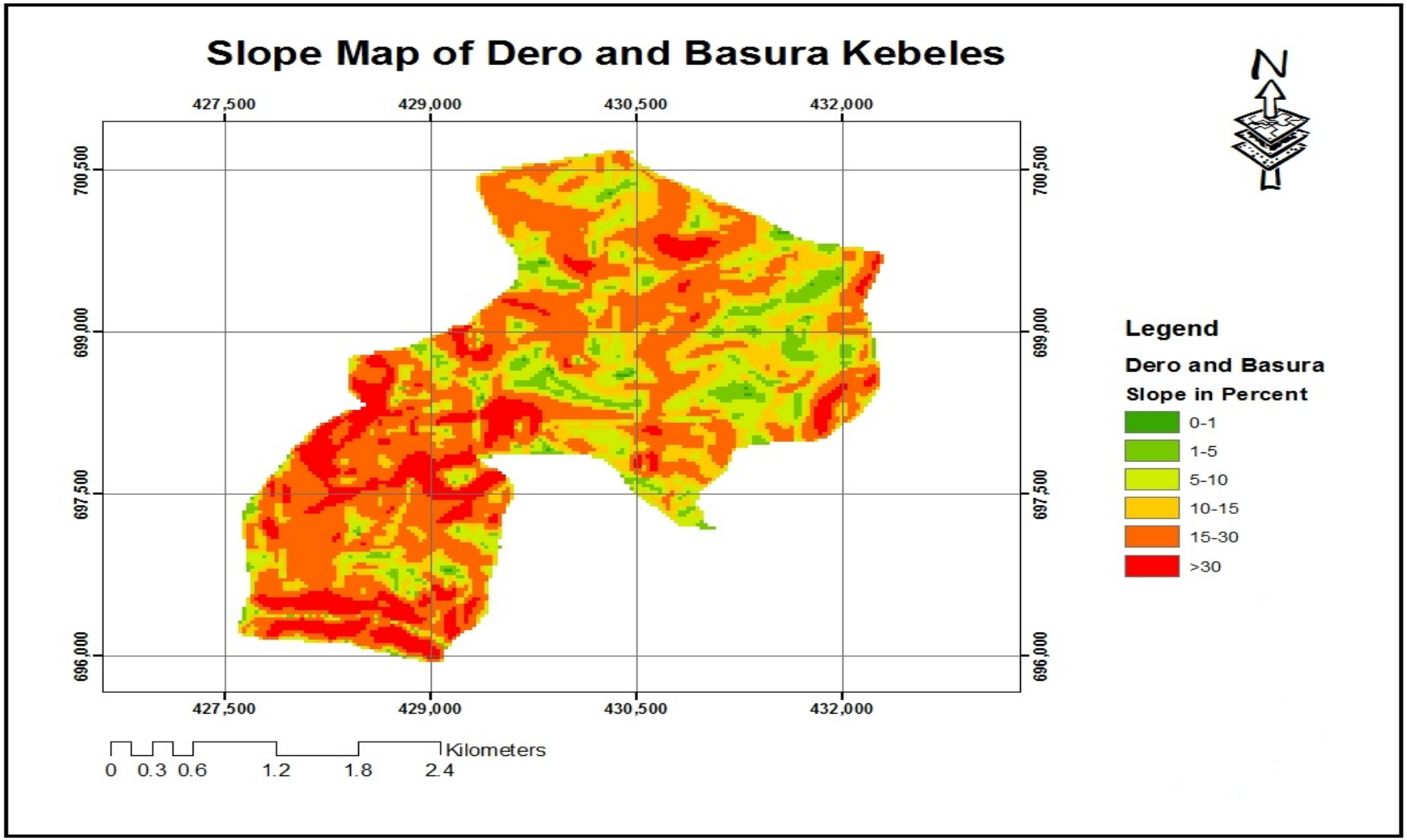


Fig 3 Slope map of Dero and Basura Kebeles

Basura Kebele

The total population of the kebele is 5011 of which 2532 are male and 2479 female, and there are 746 male headed and 201 female headed houses. The total area of Basura kebele is 800 ha. Less than 3 ha of land is regarded as communally owned. The rest, more than 97%, is owned by individuals. Like that of neghbouring Dero Kebele Enset is the leading crop in terms of land use coverage in Basur, where the crop covers roughly 30% of the total land. Coffee is next in line to Enset in terms of land use coverage (25% of the land use is allotted to coffee). Settlements (are third in importance in terms of land use) occupy nearly 14.72 % of land. Annual crops like maize, barley, faba bean, field pea and other crops follow fourth in terms of land use. In summary, more than 70 % of the land is used to grow crops – both perennial and annual crops. Of the total land in the kebele 30 % is steep Slope, 10 % Mountain, 50 % undulating and the remaining 10 % is flat land (CASCAPE Working Paper 2.4.1, 2014).

Fig.4. The Overall Landscape of Dero and Basura Kebeles.

Sika kebele

The total area of the kebele is 640 ha. There is no communal land for land use activities like grazing and community forests/protected areas. Land use tends to be mixed. From a total area crops, Enset, barley, maize, haricot bean and other crops take up 266.2 ha

(about 42 percent) of the total. Enset takes up the largest area of land, accounting for 37.8 percent of the total land available. This is followed by erected houses, where 160 ha have been allocated for this particular purpose. There are two major sub-basins in Sika kebele: Felawe and Kiltu, with hectare coverage of 285 and 270, respectively. There is a small-scale irrigation development in the Felawe sub-basin, though the topography of the kebele makes irrigation projects costly. In addition, there is a protected area of about 8 ha for forestry development (CASCAPE Working Paper 2.4.1, 2014).

Illalcha Kebele

It is a very large kebele compared with other intervention kebeles in the woreda. The kebele is bordered by Oromiya region in the East. More than 50 ha of the kebele is covered by marshy area. Illalcha covers 1404 ha. Annual crops like barley, maize, haricot bean and others cover 325 ha, grazing land covers 249 ha and vast areas of the kebele is covered by Perennial crops like Enset. There are 2379 male headed households and 2254 female headed households. Enset, haricot bean and barley are the dominant crops cultivated in the kebele.

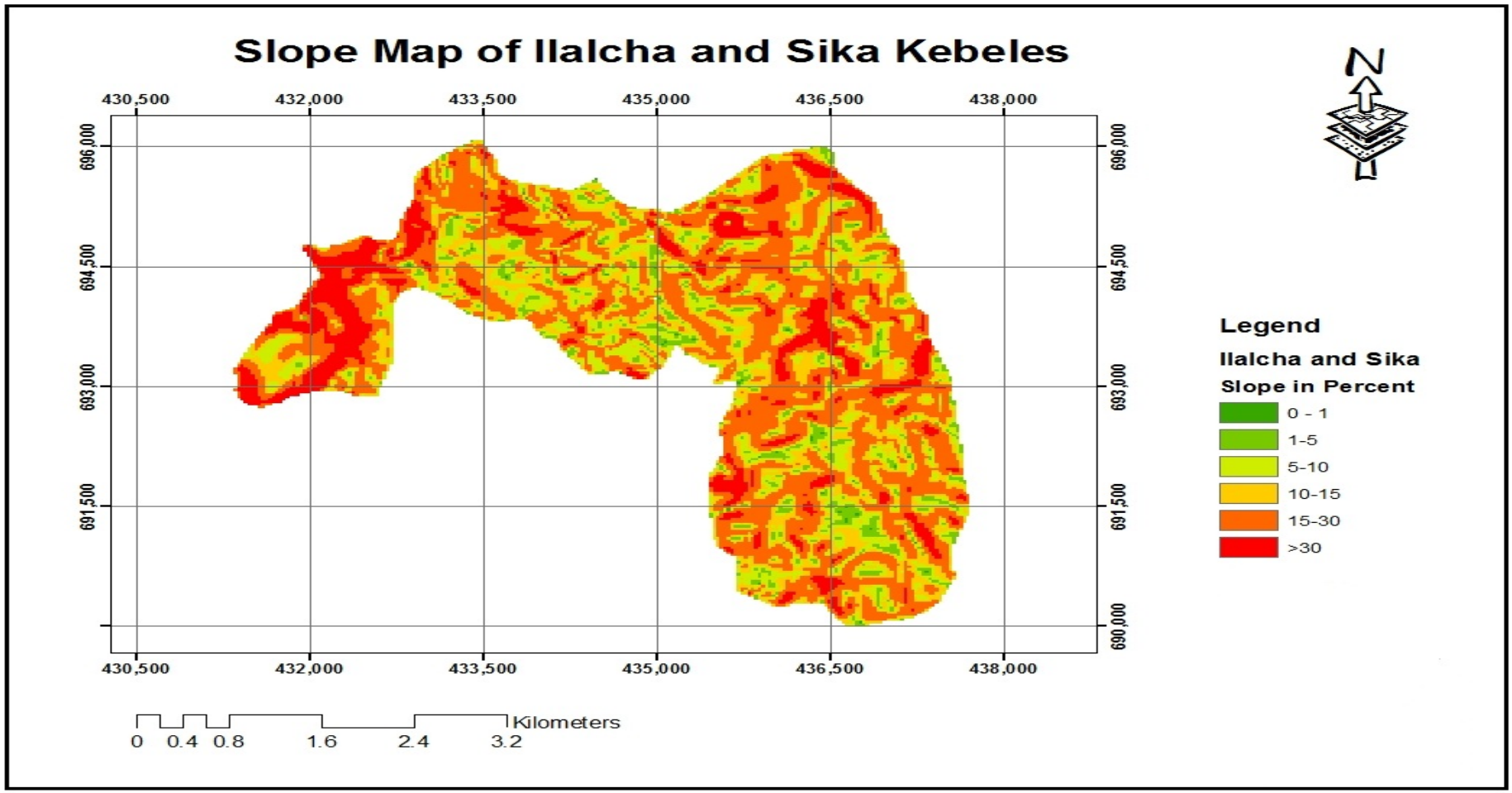


Fig 5 Slope map of Sika and Illalcha Kebeles

3.2. Soils of Bule Woreda

3.2.1 The soil-landscape in Bule Woreda

The geomorphology of Bule Woreda is described as moderately dissected side Slopes of extinct central volcanoes and other relic volcanic forms, often with small volcanic vent and cone remnants (Henricksen et. al., 1984). With regards to land use, 69.7% (or 19,028.17 ha) of the land is used for growing annual followed by perennial crops and grazing (Table 1)

Table 1 Land use pattern of Bule Woreda

No	Land Use	Area coverage (ha)	%
1	Annual and Perennial crops	18335	67
2	Grazing	2340	8
3	Forest	3942	14
4	Arable Land	880	3
5	Non Usable	507	1
6	Settlement and other	1293	4

Source: Woreda office of Agriculture

In Bule Woreda Dero and Basura kebeles are located relatively in the lower topographic position of the Woreda. Both kebeles are dominated by very mountains more that 25 % in some areas but covered by trees.

Sika and Illalcha kebeles are located in the upper part of the toposequence. They are found on the upper position in the landscape and are flat kebeles as compared with Dero and Basura kebeles.

By considering the topography, area coverage of the intervention Woreda and auger description two soil profiles were opened in each kebeles of Illalcha, and Basura kebeles. For Sika kebele one representative soil profile was opened. Dero kebele is very hilly and a toposequence was selected and three soil profiles representing the upper, Middle and lower slop positions of the kebele were opened.

Farmers in the area classify the soil based on soil color, water holding capacity and fertility status of the surface soil. Accordingly, they classify soils as red and black soils (in the local language Dimoke, and Tiloke respectively). As the translated names indicate Tiloke soils are black in color and they are fertile. On the other hand Dimoke soils are red in color and relatively speaking they are less fertile than the black soil. Based on farmers classification soils of the Luvisols are classified as black soils and Cambisols are classified as red soils (Demoke).

3.2.1 Soil profile descriptions with analytical data for bule woreda

3.2.1.1 Profile site description for Dero Kebele

Profile 1
Site characteristics

Profile code	**Bu-De-P1**
Soil classification	Nitic Luvisols
Location	Bule Woreda; Dero kebele
Coordinates	N 06^0 19" 13' E 38^0 21"33'
Elevation	2337 m
Date	19/03/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Volcanic (Basalts, tuffs, etc)
Land form	Sloping land, medium Gradient Mountain
Local physiography	Slopy,
Topographic position	Upper Slope
Soil Drainage	Well Drained
Macro relief	Hilly
Slope	Upper straight slope of ±13% over more than 3 km long. Exposure to W.
Land use	Agro-forestry, intensive land use. Enset and coffee are the main crops; other crops are maize and khat. Coffee shaded by trees. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms.
General information on the soil	
Parent material	Volcanic (Basalts, tuffs, etc)
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro-forestry

Table 2 Soil Description for Bu-De-P1

Hor.	Depth cm	Description
Ap	0-22	Dark reddish brown (5YR 3/2) Clay; many, weak, Very fine, granular structure; Soft when moist, slightly sticky and slightly plastic when wet; Few, fine, pores; common, fine, roots, diffuse smooth boundary.
Ah	22-75	Dark reddish brown (5YR 2.5/2) clay; moderate, very fine to medium, Sub angular blocky structure; friable when moist, sticky and plastic when wet; common, fine pores; very few, fine roots, diffuse smooth boundary.
AB	75-110	Dark reddish brown (5YR 3/3) clay; moderate, fine and medium, Sub angular blocky structure; friable when moist, sticky and plastic when wet; few, faint clay coatings; common, fine pores, gradual smooth boundary.
Bt1	110-145	Dark reddish brown (2.5YR 3/3). Clay: Moderate, fine and medium, sub angular blocky structure, friable when moist, sticky and plastic when wet, common, distinct clay coating, few, fine pores, diffuse smooth boundary.
Bt2	145+	Dark reddish brown (2.5YR 3/3). Clay: Moderate, fine and medium, sub angular blocky structure, friable when moist, sticky and plastic when wet, few, distinct clay coating, few, fine pores.

Table 3 Analytical data for Bu-De-P1

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	5.53	4.56	4.68	4.83	4.20
pH-KCL (1:2.5)	4.48	3.69	3.85	3.97	3.53
EC(ms/cm) (1:2.5)	0.08	0.03	0.03	0.06	0.03
Sand (%)	37.33	30.62	26.76	24.96	19.24
Silt (%)	20.18	28.18	22.62	23.58	28.38
Clay (%)	42.49	41.19	50.62	51.45	52.39
Silt clay ratio	0.47	0.68	0.44	0.45	0.54
Texture Class	clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.66	0.88	0.93	0.95	0.96
Exch. K(meq/100 gm of soil)	0.62	1.11	0.77	0.74	0.52
Exch. Ca(meq/100 gm of soil)	17.79	14.66	13.72	18.78	13.01
Exch. Mg(meq/100 gm of soil)	5.93	5.17	4.29	6.83	4.34
Ca/Mg	3.00	2.84	3.20	2.75	3.00
K/Mg	0.10	0.21	0.18	0.11	0.12
Sum of Cations (meq/100gm of soil)	25.00	21.82	19.71	27.30	18.83
CEC(meq/100 gm of soil)	35.45	33.75	29.36	35.72	28.28
PBS (%)	70.52	62.04	63.96	73.77	63.19
Organic Carbon (%)	2.33	2.02	1.85	1.79	1.56
Nitrogen (%)	0.19	0.17	0.17	0.13	0.11
C/N	12.26	11.88	10.88	13.77	14.18
Available P(mg P_2O_5/kg soil)	33.00				

Bulk density (gm/ Cm^3)	1.06	1.12	1.19	1.18	1.15
Available S (%)	1.45				
Exchangeable Sodium %(ESP)	1.87	2.61	3.17	2.65	3.40
Micronutrient					
Zn (mg/kg soil)	7.48				
Mn (mg/kg soil)	68.99				
Cu (mg/kg soil)	0.55				
Fe (mg/kg soil)	112.71				

Strongly Acidic Surface Soil pH 4.65

Profile 2
Site characteristics

Profile code	**Bu-De-P2**
Soil classification	Chromic Luvisols
Location	Bule Woreda; Dero kebele
Coordinates	N 06^0 18" 26' E 38^0 21"14'
Elevation	2174 m
Date	09/04/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Volcanic (Basalts, tuffs, etc)
Land form	Sloping land, medium Gradient Mountain
Local physiography	Slopy, Middle Slope
Soil Drainage	Well Drained
Macro relief	Hilly
Slope	Straight slope of ±12% over more than 300m m long. Exposure to W.
Land use	Agro-forestry, intensive land use. Enset and coffee are the main crops; other crops are maize and khat. Coffee shaded by trees. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms.

General information on the soil

Parent material	Volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 4 Soil description for Bu-De-P2

Hor.	Depth cm	Description
Ap	0-15	Dusky red (2.5YR 3/2) Clay; weak, Very fine, granular structure; very friable when moist, non-sticky and non-plastic when wet; Few, fine, pores; common, fine, roots, diffuse smooth boundary.
Ah	15-50	Dusky red (10R 3/3) clay; moderate, fine to coarse, Sub angular blocky structure; very friable when moist, sticky and plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary.
AB	50-75	Dark reddish brown (2.5YR 3/4) clay; moderate, fine to coarse, Sub angular blocky structure; friable when moist, sticky and plastic when wet; very few, faint clay coatings; common, fine pores, diffuse smooth boundary.
Bt1	75-155	Dark reddish brown (2.5YR 3/3). Clay: Moderate, fine and medium, angular blocky structure, friable when moist, sticky and plastic when wet, common, distinct clay coating, few, fine pores , diffuse smooth boundary.
Bt2	155+	Dusky red (10R 3/3). Clay: Moderate, fine to medium, angular blocky structure, friable when moist, sticky and plastic when wet, few, distinct clay coating, few, fine pores.

Table 5 Analytical data for Bu-De-P2

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	5.67	5.87	5.86	5.98	5.79
pH-KCL (1:2.5)	5.08	5.25	5.22	5.27	5.10
EC(ms/cm) (1:2.5)	0.07	0.07	0.06	0.06	0.05
Sand (%)	36.69	30.41	31.04	19.73	18.82
Silt (%)	20.39	22.48	15.91	24.62	24.19
Clay (%)	42.92	47.11	53.05	55.66	56.99
Silt to clay ratio	0.47	0.47	0.29	0.44	0.42
Texture Class	clay	clay	clay	Clay	Clay
Exch. Na(meq/100gm of soil)	0.95	0.95	0.88	0.93	0.97
Exch. K(meq/100 gm of soil)	1.29	0.97	1.31	2.86	0.80
Exch. Ca(meq/100 gm of soil)	19.65	21.32	17.76	16.20	16.26
Exch. Mg(meq/100 gm of soil)	6.84	7.68	5.92	5.12	5.57
Ca/Mg	2.87	2.78	3.00	3.16	2.92
K/Mg	0.19	0.13	0.22	0.56	0.14
Sum of Cations (meq/100gm of soil)	28.73	30.91	25.87	25.10	23.59
CEC(meq/100 gm of soil)	33.90	37.54	35.39	38.69	36.75
PBS(%)	84.75	79.83	70.61	62.50	61.58
Organic Carbon (%)	2.87	1.84	1.67	0.96	0.56
Nitrogen (%)	0.31	0.19	0.15	0.12	0.07
C/N	9.26	9.68	11.13	8.00	8.00

Available P(mg P_2O_5/kg soil)	36.70				
Bulk density (gm/ Cm^3)	1.17	1.23	1.14	1.20	1.12
Available S (%)	1.16				
Exchangeable Sodium %(ESP)	2.79	2.52	2.49	2.40	2.64
Micronutrient					
Zn (mg/kg soil)	24.71				
Mn (mg/kg soil)	69.89				
Cu (mg/kg soil)	2.99				
Fe (mg/kg soil)	90.74				

Profile 3
Site characteristics

Profile code	**Bu-De-P3**
Soil classification	Eutric Cambisols
Location	Bule Woreda; Dero kebele
Coordinates	N 06^0 18" 08' E 38^0 21"45'
Elevation	2038 m
Date	01/03/06 EC
Author	Alemayehu and Koos
Weather conditions	WC2
Geology	Volcanic (Basalts, tuffs, etc)
Land form	Sloping land, medium Gradient Mountain
Local physiography	Lower Slope
Macro relief	Hilly
Slope	Straight slope of ±20% over more than 200 m long. Exposure to W.
Land use	Agro-forestry, Intensive land use, Enset and coffee are the main crops; other crops are maize and khat. Coffee shaded by trees. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	few earth worms.

General information on the soil

Parent material	Volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 6 Soil Description for Bu-De-P3

Hor.	Depth cm	Description
Ap	0-20	Yellowish red (5YR 4/6) Sandy Clay Loam; Moderate, Fine to Coarse, granular structure; friable when moist, non-sticky and non-plastic when wet; Few, fine, pores; common, fine to medium, roots, clear smooth boundary.
Bw1	20-55	Dark redish brown (2.5 YR 3/4) Sandy Clay; weak, fine to coarse, Sub angular blocky structure; very friable when moist, Slightly sticky and Slightly plastic when wet; few, faint clay coatings; common, fine pores; very few fine roots, gradual Irregular boundary.
Bw2	55-82	Dark reddish brown (2.5YR 3/4) Sandy Clay Loam; weak , medium to coarse, sub angular blocky structure; very friable when moist, slightly sticky and slightly plastic when wet; few, faint clay coatings; common, fine pores, gradual Irregular boundary.
Bw3	82-110	Dark red (2.5YR 3/6). Sandy Clay Loam: weak, Course, Sub angular blocky structure, friable when moist, Slightly sticky and slightly plastic when wet, very fine, few, distinct clay coating, few, fine pores, gradual Irregular boundary.
Bw4	110-140	Dark red (2.5 YR 3/3). Sandy Clay: weak, Medium to coarse, sum angular blocky structure, very friable when moist, slightly sticky and Slightly plastic when wet, very fine few, distinct clay coating, few, fine pores, gradual Irregular boundary.
Bw5	140-190	Dusky red (2.5 YR 3/6). Sandy Clay: weak, medium to coarse, sub angular blocky structure, loose when dry friable when moist, slightly sticky and Slightly plastic when wet, few, distinct clay coating, few, fine pores, gradual Irregular boundary.
C2	190+	Many Color, Clay loam: Moderate, weak, medium to coarse, sub angular blocky structure, loose when dry friable when moist, non sticky and non-plastic when wet, few, fine pores.

Table 7 Analytical data for Bu-De-P3

Horizon	AP	Bw1	Bw2	Bw3	Bw4	Bw5	C
pH-H_2O (1:2.5)	5.72	5.77	5.76	5.65	5.48	4.70	4.52
pH-KCL (1:2.5)	5.29	5.17	5.35	5.30	5.16	4.05	3.98
EC(ms/cm) (1:2.5)	0.13	0.05	0.05	0.05	0.06	0.06	0.05
Sand (%)	46.24	51.51	51.51	61.75	49.70	45.39	44.30
Silt (%)	23.33	9.09	14.14	10.07	12.07	18.20	17.14
Clay (%)	30.43	39.40	34.35	28.18	38.23	36.40	38.56
Silt to clay ratio	0.77	0.23	0.41	0.36	0.32	0.50	0.44
Texture Class	Sandy clay loam	Sandy clay	Sandy clay loam	Sandy clay loam	Sandy clay	Sandy clay	Clay loam
Exch. Na(meq/100gm of soil)	0.85	0.67	0.83	0.91	0.77	0.84	0.76
Exch. K(meq/100 gm of soil)	0.53	0.36	0.42	0.38	0.55	1.14	0.48
Exch. Ca(meq/100 gm of soil)	15.41	13.74	14.54	13.70	14.49	12.94	12.79
Exch. Mg(meq/100 gm of soil)	4.87	4.85	4.85	4.03	5.63	4.85	4.26
Ca/Mg	3.16	2.83	3.00	3.40	2.57	2.67	3.00
K/Mg	0.11	0.07	0.09	0.09	0.10	0.24	0.11
Sum of Cations (meq/100gm of soil)	21.66	19.61	20.64	19.02	21.44	19.78	18.30
CEC(meq/100 gm of soil)	34.39	30.30	26.35	24.52	27.99	27.25	27.81
Organic Carbon (%)	2.63	0.45	0.44	0.41	0.25	0.22	0.20
PBS (%)	62.98	64.75	78.33	77.57	76.60	72.55	65.77
Nitrogen (%)	0.27	0.05	0.04	0.06	0.03	0.03	0.02
Available P(mg P_2O_5/kg soil)	35.40						
Bulk density (gm/ Cm^3)	1.15	1.30	1.28	1.21	1.15	1.19	1.28
C/N	9.74	9.00	11.00	6.83	8.33	7.33	10.00

Available S (%)	1.47						
Exchangeable Sodium %(ESP)	2.46	2.20	3.13	3.71	2.75	3.10	2.73
Micronutrient							
Zn (mg/kg soil)	23.88						
Mn (mg/kg soil)	68.55						
Cu (mg/kg soil)	2.28						
Fe (mg/kg soil)	105.75						

3.2.1.2. Profile site description for Basura Kebele

Profile 1

Site characteristics

Profile code	**Bu-Ba-P1**
Soil classification	Chromic Luvisol
Location	Bule Woreda; Basura kebele
Coordinates	N 06^0 19" 06' E 38^0 22"54'
Elevation	2451 m
Date	01/04/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Volcanic (Basalts, tuffs, etc)
Land form	Sloping land, medium Gradient Mountain
Local physiography	Slopy, Upper Slope
Soil Drainage	Well Drained
Macro relief	Hilly
Slope	Straight slope of ±25% over more than 3km long.
Land use	Agro-forestry intensive land use. Enset and coffee are the main crops; other crops are maize and khat. Coffee shaded by trees. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms

General information on the soil

Parent material	Volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 8 Soil Description for Bu-Ba-P1

Hor.	Depth cm	Description
Ap	0-20	Dark Brown (7.5YR 3/2) Clay Loam; weak, Very Fine to fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; Few, fine, pores; common, fine to medium, roots, diffuse smooth boundary.
Bt1	20-55	Dark reddish brown (5 YR 3/2) Clay; weak, fine to coarse, sub angular blocky structure; slightly hard when dry, very friable when moist, Slightly sticky and Slightly plastic when wet; few, faint clay coatings; common, fine pores; very few fine roots, diffuse smooth boundary.

Bt2	55-115	Dark reddish brown (5YR 3/3) Clay; Moderate, very fine to medium, angular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common, distinct clay coatings; common, fine pores, diffuse smooth boundary.
C	115-150	Dark brown (7.5 YR 3/4). Clay: Moderate, medium to Course, Sub angular blocky structure, hard when dry, friable when moist, Sticks and plastic when wet, very fine, few, distinct clay coating, few, fine pores, Abrupt smooth boundary.
R	150+	Rock Layer, No reaction with HCl.

Table 9 Analytical data for Bu-Ba-P1

Horizon	AP	Bt1	Bt2	C
pH-H_2O (1:2.5)	6.14	5.13	4.55	3.91
pH-KCL (1:2.5)	5.45	4.19	3.69	3.23
EC(ms/cm) (1:2.5)	0.11	0.06	0.04	0.15
Sand (%)	40.26	31.13	28.80	30.50
Silt (%)	25.60	27.13	20.94	23.17
Clay (%)	34.14	41.74	50.26	46.34
Silt to clay ratio	0.75	0.65	0.42	0.50
Texture Class	Clay loam	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.67	0.85	0.56	0.60
Exch. K(meq/100 gm of soil)	0.31	0.17	0.18	0.29
Exch. Ca(meq/100 gm of soil)	20.41	16.67	12.54	12.60
Exch. Mg(meq/100 gm of soil)	6.80	5.84	4.18	4.20
Ca/Mg	3.00	2.85	3.00	3.00
K/Mg	0.05	0.03	0.04	0.07
Sum of Cations (meq/100gm of soil)	28.18	23.53	17.47	17.69
CEC(meq/100 gm of soil)	33.74	28.54	27.26	28.76
PBS(%)	83.55	82.45	64.05	61.51
Organic Carbon (%)	2.60	2.20	1.06	0.72
Nitrogen (%)	0.25	0.22	0.13	0.07
C/N	10.40	10.00	8.15	10.29
Available P(mg P_2O_5/kg soil)	30.30			
Bulk density (gm/ Cm^3)	1.10	1.14	1.13	1.11
Available S (%)	1.86			
Exchangeable Sodium %(ESP)	1.97	2.98	2.07	2.10
Micronutrient				
Zn (mg/kg soil)	17.59			
Mn (mg/kg soil)	75.15			
Cu (mg/kg soil)	0.57			
Fe (mg/kg soil)	103.46			

Profile 2

Site characteristics

Profile code	**Bu-Ba-P2**
Soil classification	Chromic Luvisols
Location	Bule Woreda; Basura kebele
Coordinates	N 06^0 19" 08' E 38^0 22"02'
Elevation	2366 m
Date	02/04/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Volcanic (Basalts, tuffs, etc)
Land form	Sloping land, medium Gradient Mountain
Local physiography	Slopy, Lower Slope
Macro relief	Hilly
Slope	Straight slope of ±18% over more than 3km m long.
Land use	Agro-forestry. Intensive land use. Enset and coffee are the main crops; other crops are maize and khat. Coffee shaded by trees. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms.

General information on the soil

Parent material	Volcanic
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 10 Soil Description for Bu-Ba-P2

Hor.	Depth cm	Description
Ap	0-22	Dark reddish brown (5YR 3/2) Clay; weak, Very Fine to fine, granular structure; very friable when moist, slightly sticky and non-plastic when wet; very few, fine, pores; common, fine to medium, roots, gradual smooth boundary.
AB	22-59	Dark reddish brown (5 YR 2.5/2) sandy Clay; weak, fine to medium, sub angular blocky structure; friable when moist, Slightly sticky and Slightly plastic when wet; few, faint clay coatings; common, fine pores; very few fine roots, diffuse smooth boundary.
Bt	59-90	Dark reddish brown (5YR 3/3) Clay; Moderate, very fine to medium, angular blocky structure; slightly hard when dry, firm when moist, sticky and plastic when wet; common, faint clay coatings; common, fine pores, diffuse smooth boundary.

C1	90-150	Dark brown (7.5 YR 3/4). Clay: Moderate, very fine to medium, Sub angular blocky structure, firm when moist, Slightly Sticks and plastic when wet, fine, few, diffuse clay coating, few, fine pores, gradual smooth boundary.
C2	150+	Dark brown (5 YR 3/3). Sandy Clay loam: Moderate, fine to course, Sub angular blocky structure, friable when moist, Slightly Sticky and slightly plastic when wet, fine, few, diffuse clay coating, few, pores.

Table 11 Analytical data for Bu-Ba-P2

Horizon	AP	AB	Bt	C1	C2
pH-H_2O (1:2.5)	4.93	5.60	4.74	4.41	4.00
pH-KCL (1:2.5)	4.18	4.74	3.79	3.46	3.25
EC(ms/cm) (1:2.5)	0.11	0.09	0.03	0.04	0.06
Sand (%)	42.67	45.52	26.65	34.79	45.21
Silt (%)	12.74	12.57	22.32	21.74	24.11
Clay (%)	44.59	41.90	51.02	43.47	30.68
Silt to clay ratio	0.29	0.30	0.44	0.50	0.79
Texture Class	clay	Sandy clay	clay	clay	Sandy clay loam
Exch. Na(meq/100gm of soil)	0.57	0.62	0.52	0.54	0.87
Exch. K(meq/100 gm of soil)	0.25	0.26	0.27	0.30	1.18
Exch. Ca(meq/100 gm of soil)	18.62	19.23	16.94	18.14	14.80
Exch. Mg(meq/100 gm of soil)	6.77	6.69	5.93	6.05	5.22
Ca/Mg	2.75	2.87	2.86	3.00	2.84
K/Mg	0.04	0.04	0.05	0.05	0.23
Sum of Cations (meq/100gm of soil)	26.21	26.79	23.66	25.04	22.07
CEC(meq/100 gm of soil)	33.58	30.44	34.07	37.57	35.95
Organic Carbon (%)	2.90	1.72	0.93	0.32	0.24
Nitrogen (%)	0.40	0.18	0.10	0.05	0.03
C/N	7.25	9.56	9.30	6.40	8.00
PBS(%)	78.05	88.04	69.45	66.62	61.39
Available P(mg P_2O_5/kg soil)	42.52				
Bulk density (gm/ Cm^3)	1.04	1.15	1.12	1.22	1.12
Available S (%)	1.61				
Exchangeable Sodium %(ESP)	1.70	2.03	1.51	1.45	2.42
Micronutrient					
Zn (mg/kg soil)	14.26				
Mn (mg/kg soil)	81.55				
Cu (mg/kg soil)	0.49				
Fe (mg/kg soil)	101.83				

3.2.1.3. Profile site description Sika

Profile 1

Site characteristics

Profile code	Bu-Si-P1
Soil classification	Chromic Luvisols
Location	Bule Woreda; Sika kebele
Coordinates	N 06^0 16" 39' E 38^0 24"33'
Elevation	2793 m
Date	02/04/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Volcanic (Basalts, tuffs, etc)
Land form	Sloping land, medium gradient hill
Local physiography	Slopy, Upper Slope
Soil Drainage	Well drained
Macro relief	Hilly
Slope	Straight slope of ±20% over more than 3km long.
Land use	Intensive land use. Enset and Barley, coffee are the main crops. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms

General information on the soil

Parent material	Volcanic
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 12 Soil Description for Bu-Si-P1

Hor.	Depth cm	Description
Ap	0-22	Dark brown (7.5YR 3/3) Sandy Clay Loam; weak, Very Fine to fine, granular structure; very friable when moist, non-sticky and non-plastic when wet; very few, fine, pores; common, fine to medium, roots, gradual smooth boundary.
Bt1	22-60	Dark reddish brown (5YR 4/3) Clay; moderate, fine to medium, Sub angular blocky structure; friable when moist, Slightly sticky and Slightly plastic when wet; few, faint clay coatings; common, fine few pores; very few fine roots, diffuse smooth boundary.

Bt2	60-81	Dark reddish brown (5YR4/4) Clay; weak, very fine to medium, angular blocky structure; slightly, very friable when moist, sticky and plastic when wet; common, distinct clay coatings; common, fine pores, very few fine roots, gradual smooth boundary.
BC	81-110	Yellowish red (5YR 4/6). Clay: weak, fine to course, angular blocky structure, very friable when moist, Sticky and plastic when wet, fine, faint clay coating, few, fine pores, diffuse smooth boundary.
C	110+	Yellowish red (5 YR 4/6). Clay: weak, fine to course, angular blocky structure, very friable when moist, Sticky and plastic when wet, fine, faint clay coating, few, fine pores. Very fine very few soft manganese concretion..

Table 13 Table with analytical data for Bu-Si-P1

Horizon	AP	Bt1	Bt2	BC	C
pH-H_2O (1:2.5)	6.02	5.53	5.42	5.48	6.11
pH-KCL (1:2.5)	4.69	4.70	4.70	4.66	5.26
EC(ms/cm) (1:2.5)	0.11	0.04	0.04	0.04	0.05
Sand (%)	68.15	34.02	34.37	36.89	30.66
Silt (%)	10.62	23.41	19.05	21.04	21.01
Clay (%)	21.23	42.57	46.58	42.07	48.33
Silt to clay ratio	0.50	0.55	0.41	0.50	0.43
Texture Class	Sandy clay loam	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.66	0.59	0.64	0.58	0.60
Exch. K(meq/100 gm of soil)	0.46	0.25	0.27	0.33	0.43
Exch. Ca(meq/100 gm of soil)	19.47	16.96	12.66	15.11	15.93
Exch. Mg(meq/100 gm of soil)	6.77	5.94	4.22	5.04	4.19
Ca/Mg	2.88	2.86	3.00	3.00	3.80
K/Mg	0.07	0.04	0.06	0.07	0.10
Sum of Cations (meq/100gm of soil)	27.36	23.74	17.79	21.06	21.15
CEC(meq/100 gm of soil)	31.28	29.96	27.06	27.37	28.71
Organic Carbon (%)	3.30	1.73	0.91	0.67	0.54
Nitrogen (%)	0.28	0.13	0.10	0.06	0.04
C/N	11.79	13.31	9.10	11.17	13.50
PBS(%)	87.47	79.24	65.74	76.95	73.67
Available P(mg P_2O_5/kg soil)	31.80				
Bulk density (gm/ Cm^3)	1.01	1.12	1.11	1.04	1.01
Available S (%)	1.83				
Exchangeable Sodium %(ESP)	2.12	1.97	2.37	2.13	2.10
Micronutrient					
Zn (mg/kg soil)	31.85				
Mn (mg/kg soil)	83.52				

Cu (mg/kg soil)	6.40				
Fe (mg/kg soil)	117.53				

3.2.1.4 Profile site description for Illalcha

Profile 1

Site characteristics

Profile code	Bu-Ila-P1
Soil classification	Chromic Luvisols
Location	Bule Woreda; Illalcha kebele
Coordinates	N 06^0 16" 13' and E 38^0 25"13'
Elevation	2840 m
Date	03/04/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Volcanic (Basalts, tuffs, etc)
Land form	level land, plateau
Local physiography	Sloppy, Upper Slope
Macro relief	Plateau
Slope	Straight slope of ±20% over more than 1km long.
Land use	intensive land use, Enset and Bamboo are the main crops; other crops are pulse and khat. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms

General information on the soil

Parent material	Volcanic
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 14 Soil Description Bu-Ila-P1

Hor.	Depth cm	Description
Ap	0-15	Dark reddish brown (5YR 3/3) Clay Loam; weak, very fine to Fine, granular structure; Dry loose, friable when moist, non-sticky and non-plastic when wet; Few, fine, pores; common, fine to medium, roots gradual smooth boundary.

Ah	15-45	Dark brown (7.5 YR 3/3) Clay; weak, fine to medium, Sub angular blocky structure; loose when dry, friable when moist, Slightly sticky and Slightly plastic when wet; few, faint clay coatings; few, fine pores; very fine few roots, gradual smooth boundary.
AB	45-90	Dark reddish brown (5YR 3/2) Clay Loam; weak , very fine to medium sub angular blocky structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; few, faint clay coatings; common, fine pores, gradual smooth boundary.
Bt1	90-116	Dark reddish brown (2.5 YR 3/3). Clay: weak, very fine to medium, angular blocky structure, firm when moist, Sticky and plastic when wet, very fine common distinct clay coating, few, very fine pores, diffuse smooth boundary.
Bt2	138+	Yellowish red (5YR4/6). Clay: weak, very fine to medium, sub angular blocky structure, firm when moist, sticky and Slightly plastic when wet, few, distinct clay coating, few, fine pores.

Table 15 Table with analytical data for Bu-Ila-P1

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	4.86	4.82	3.93	4.22	3.80
pH-KCL (1:2.5)	4.18	4.14	3.41	3.48	3.16
EC(ms/cm) (1:2.5)	0.14	0.03	0.02	0.02	0.05
Sand (%)	40.60	35.97	39.30	23.76	27.91
Silt (%)	20.52	22.79	23.85	29.00	28.40
Clay (%)	38.88	41.24	36.85	47.25	43.69
Silt to clay ratio	0.53	0.55	0.65	0.61	0.65
Texture Class	Clay loam	clay	Clay loam	Clay	clay
Exch. Na(meq/100gm of soil)	0.60	0.54	0.66	0.61	0.62
Exch. K(meq/100 gm of soil)	0.32	0.17	0.19	0.24	0.23
Exch. Ca(meq/100 gm of soil)	16.32	11.22	12.92	13.25	15.61
Exch. Mg(meq/100 gm of soil)	5.16	4.32	4.31	4.28	5.20
Ca/Mg	3.16	2.60	3.00	3.10	3.00
K/Mg	0.06	0.04	0.04	0.06	0.04
Sum of Cations (meq/100gm of soil)	22.40	16.25	18.08	18.36	21.67
CEC(meq/100 gm of soil)	28.95	26.74	31.84	27.87	27.81
Organic Carbon (%)	2.73	2.64	2.53	1.10	0.74
Nitrogen (%)	0.38	0.29	0.26	0.14	0.06
C/N	7.18	9.10	9.73	7.86	12.33
PBS(%)	77.37	60.77	56.78	65.95	77.89
Available P(mg P_2O_5/kg soil)	22.40	28.10			
Bulk density (gm/ Cm^3)	1.02	1.04	1.01	1.11	1.12
Available S (%)	1.16	1.27			
Exchangeable Sodium %(ESP)	2.06	2.04	2.06	2.17	2.24

Micronutrient					
Zn (mg/kg soil)	13.42	7.05			
Mn (mg/kg soil)	91.03	78.57			
Cu (mg/kg soil)	1.18	2.44			
Fe (mg/kg soil)	130.94	156.33			

Surface soil pH is very acidic.

Profile 2

Site characteristics

Profile code	Bu-Illa-P2
Soil classification	Chromic Luvisols
Location	Bule Woreda; Illalcha kebele
Coordinates	N 06^0 19" 06' E 38^0 22"54'
Elevation	2937 m
Date	03/04/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Volcanic (Basalts, tuffs, etc)
Land form	level land, Plateau
Local physiography	Crest
Macro relief	Hilly
Slope	level area with slope of ±8% over more than 10km long.
Land use	Intensive land use. Enset and Barly are the main crops. On average 0.5 ha per household. Some dairy cows (zero grazing).
Soil fauna	Few earth worms

General information on the soil

Parent material	Volcanic
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Intensive Agro forestry

Table 16 Soil description Bu-Illa-P2

Hor.	Depth cm	Description
Ap	0-23	Brown (7.5YR 4/4) Sandy Clay Loam; weak, very fine to Fine, granular structure; loose when moist, non-sticky and non-plastic when wet; fine Few pores; common, fine to medium, roots, diffuse smooth boundary, diffuse smooth boundary.

Ah	23-55	Dark reddish brown (7.5 YR 3/3) Clay; weak, very fine to fine, Sub angular blocky structure; loose when moist, Slightly sticky and non-plastic when wet; few, fine pores; very fine few roots, diffuse smooth boundary.
AB	55-80	Dark reddish brown (5YR 3/3) Clay Loam; weak , very fine to fine angular blocky structure; loose when moist, sticky and plastic when wet; few, faint clay coatings; common, fine pores, clear smooth boundary.
Bt1	80-130	Yellowish red (5 YR 4/6). Clay: weak, very fine to medium angular blocky structure, very friable when moist, sticky and Plastic when wet, very fine common distinct clay coating, few, fine pores, diffuse smooth boundary.
Bt2	130+	Yellowish red (5YR4/6). Clay: weak, very fine to medium, sub angular blocky structure, firm when moist, sticky and Slightly plastic when wet, common distinct clay coating, few, fine pores.

Table 17 Table with analytical data for Bu-Illa-P2

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	4.76	4.91	3.98	4.05	3.95
pH-KCL (1:2.5)	3.80	4.06	3.37	3.31	3.18
EC(ms/cm) (1:2.5)	0.17	0.06	0.02	0.02	0.02
Sand (%)	76.14	38.36	33.42	28.14	28.46
Silt (%)	2.17	18.71	21.48	24.15	19.51
Clay (%)	21.69	42.93	45.10	47.72	52.03
Silt to clay ratio	0.10	0.44	0.48	0.51	0.37
Texture Class	Sandy clay loam	clay	clay	Clay	clay
Exch. Na(meq/100gm of soil)	0.67	0.61	0.58	0.60	0.66
Exch. K(meq/100 gm of soil)	0.52	0.37	0.50	0.22	0.22
Exch. Ca(meq/100 gm of soil)	12.94	13.98	11.97	16.67	14.65
Exch. Mg(meq/100 gm of soil)	4.31	4.37	4.28	5.56	4.31
Ca/Mg	3.00	3.20	2.80	3.00	3.40
K/Mg	0.12	0.08	0.12	0.04	0.05
Sum of Cations (meq/100gm of soil)	18.44	19.32	17.33	23.04	19.83
CEC(meq/100 gm of soil)	31.87	32.76	30.68	29.26	28.10
Organic Carbon (%)	5.38	4.72	2.05	0.76	0.59
Nitrogen (%)	0.41	0.32	0.25	0.09	0.06
C/N	13.12	14.75	8.20	8.44	9.83
PBS(%)	57.86	59.00	56.49	78.78	70.60
Available P(mg P_2O_5/kg soil)	20.60	23.90			
Bulk density (gm/ Cm^3)	1.02	1.01	1.19	1.16	1.09
Available S (%)	1.89	1.54			
Exchangeable Sodium %(ESP)	2.12	1.86	1.88	2.06	2.33
Micronutrient					
Zn (mg/kg soil)	5.60	3.31			

Mn (mg/kg soil)	64.76	40.79			
Cu (mg/kg soil)	1.83	1.77			
Fe (mg/kg soil)	225.83	126.41			

3.2.2 Synthesis

In general Dero and Basura kebeles are located on the hilly side of the toposequence and Sika and Illalcaha kebeles are located on the upper topographic position. The dominant soil type in the Woreda is Chromic Luvisols, well drained, very deep, dark red, well structured, clay loam to clay soils with a general increase in clay contents from surface horizon down to the subsurface horizon, Silt to clay ration of the sub surface horizon greater than 0.4 and have thick (over 52 cm) dark reddish brown top soils. These soils dominate the whole areas of the intervention kebeles except for the depression areas in Dero kebele. Luvisols of Bule woreda have argic horizon with higher clay content in subsurface horizon than the over lying. They have clay texture and 8 % or more clay content than the surface soils.

In the lower position of Dero kebele Cambisols soil types is found. Cambisols of Dero are well drained, very deep, and red in color and slightly sticky slightly plastic soils. They are formed in colluvic material formed from sedimentation through erosion from the upper areas. These soils are characterized by a cambic horizon with texture of sandy clay loam or finer, higher chroma (> 3), redder Hue (2.5 YR), and higher clay content in the subsurface horizon than the surface horizon.

All surface horizons of Luvisols in Bule have a weak to moderate granular to Sub angular blocky structure. The subsurface horizons had both Sub angular and angular blocky structure. The better developed structure of the subsurface soils could be due to the relatively higher clay content of the subsurface horizons than that of the surface horizons (Ahn, 1993). The consistency of these soils in the surface layers of all pedons was found to be similar. In all cases the consistency was friable, slightly sticky and slightly plastic. On the other hand, the moist consistency of the subsurface horizons ranged from friable to firm, slightly sticky/slightly plastic to very sticky/very plastic when wet. The friable and slightly sticky/slightly plastic consistency observed in the surface horizons of all pedons could be attributed to the relative higher organic matter content of the surface than subsurface layers.

In most pedons, clay content increased with increase soil depth, forming argic horizons. Moreover, both the sand and silt contents were generally higher in the surface soils. According to Boul et al. (2003), the accumulation of clay in the subsurface horizon could be contributed by the in situ synthesis of secondary clays, the weathering of primary minerals in the B horizon, or the residual concentration of clays from the selective dissolution of more soluble minerals of coarser grain sized in the B horizon.

Silt/clay ratio is an important criterion used in the classification of tropical soils. Especially it is important to classify Luvisols from a similar soil type Nitosols. According to FAO (2006) Nitosols have a nitic horizon with Silt to clay ratio less than 0.4. It is also used in the evaluation of clay migration, stage of weathering and age of parent material and soils. The more highly weathered a soil is, the lower the silt fraction. Therefore, soils with silt/clay ratio of less than 0.15 are regarded as highly weathered (Van Wambeke, 1962). In all the cases the Silt to clay ratio is greater than 0.23 for most of the horizons meaning that soils around Bule Woreda are young soils in terms of weathering.

Many studies indicate that soil pH affects the availability of various nutrients, toxic elements and chemical species to plant roots. The pH is therefore a very good guide to some expected nutrient deficiencies and toxic effects (Brady 1984). Luvisols of Bule Woreda are found to be very acidic. For example both the surface and sub surface horizon soils of the upper profile in Dero have pH less than 4.83, sub soil horizons of upper profile in Basura are found to be very acidic (less than 4.55), Profile 2 of Basura are also found to be very acidic (up to 4.00), soils of Illalcah are also found to be very acidic, Profile 1 lower than 4.33 (reaching up to 3.8) and Profile 2 has pH value lower than 4.76 and some horizons up to 3.95. According to London (1984) soils having pH value less than 5.5 are categorized as acidic soils. This is because acidity could limit production and therefore there should be application of lime based additional laboratory tests for lime requirement. The CEC value of a soil tells the fertility status of a soil. According to London (1984) soils with CEC value between 25 to 40 Cmolc/Kg of soil could be less fertile soils and lime and potassium fertilizer could be required. Most of the surface horizons have CEC value between 25-40 Cmolc/Kg of soil. Ethiopian soils are assumed to have adequate amount of potassium. In the study area also indicate the amount of potassium in medium level (London 1991) indicating that there could be crop response to applied potassium fertilizer. Other cations like magnesium and calcium are found in adequate amount. In all profiles of Luvisols of Bule available Phosphorus content is high London (1984) classifies soils with available phosphorus content greater 15 ppm will not show fertilizer response to phosphorus fertilizer application. But Phosphorus uptake will be inhibited when calcium to magnesium ratio is < 3:1. In many horizons the surface horizons have calcium to magnesium ratio less than or equal to 3:1 indicating that phosphorus uptake may be inhibited. This is also an indication for the need of application of lime in the area. The potassium to magnesium ratio of Luvisols in the area is less than 1:1. According to London (1984) , if potassium to magnesium ratio is less than 1:1, vegetable and sugar beet production will be affected. As all the surface and sub surface horizons of Luvisols in Bule have potassium to magnesium ratio less than 0.5:1, then vegetable and sugar beet production is not recommended. Amount of total nitrogen are found to be medium and except for Illalcha profil 2 all the other surface soils have organic carbon content in low amount (London 1991). This could be due to crop removal and intensive plowing which favors organic matter decomposition.

Fig 6. Sample Soil Profile at Dero Kebele (Chromic Luvisols)

Fig 7. Sample soil profile (Cambisol)

Fig 8 Sample Augedr description at Illalcha

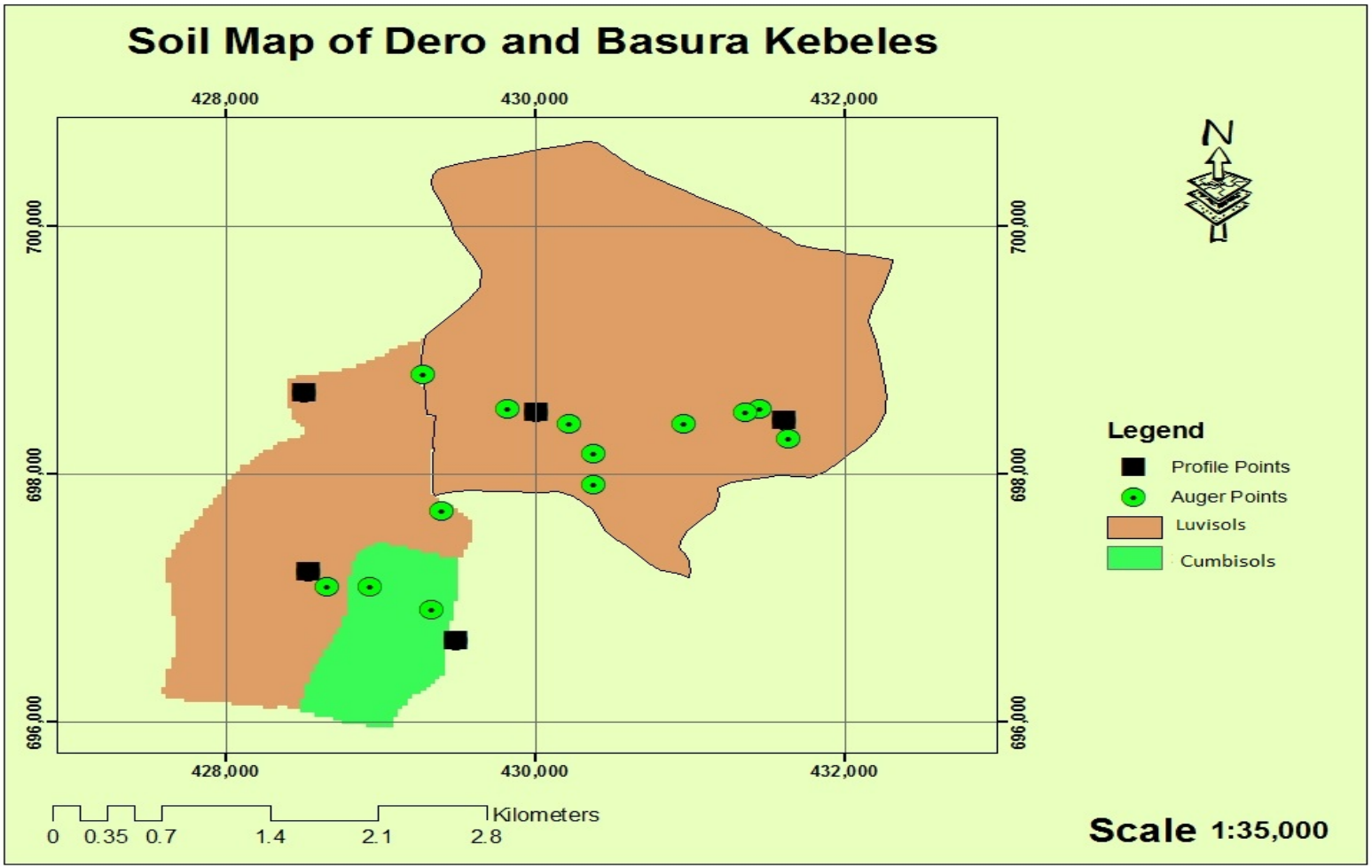


Fig 9 Soil Map of Dero and Basura Kebele

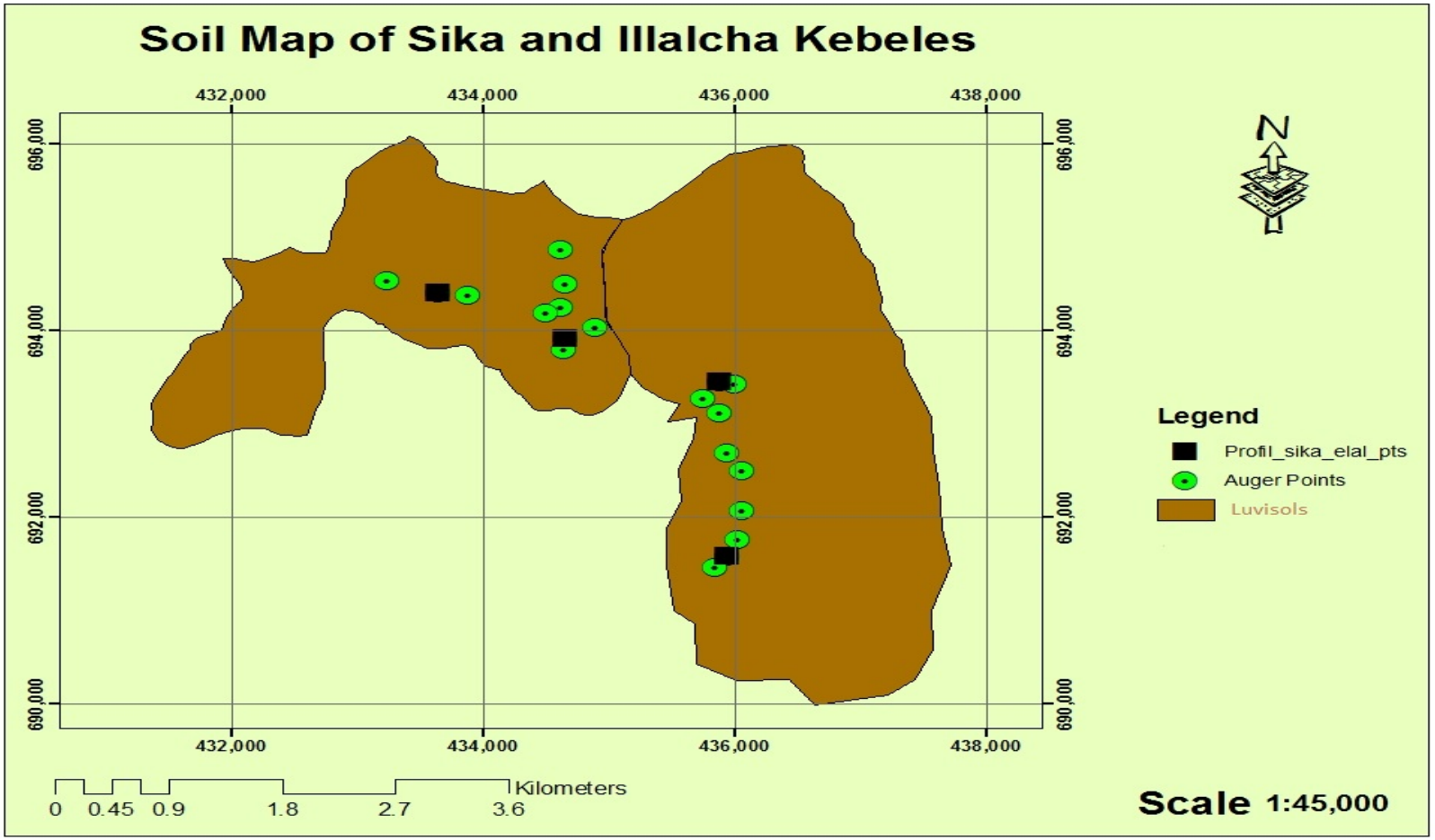


Fig 10 Soil Map of Sika and Illalcha Kebele

Part 4 Enemor Ener Woreda

4. Description of the Environment

4.1 Location

Enemor Ener is the largest Woreda within the CASCAPE projectin south region, both in terms of population size and total area. It is located between 7.35 - 8.13 North and 37.58-37.93 East. The mean maximum and minimum temperature is 25 and 12.5^{o}C respectively. The Woreda receives a mean annual rainfall between 801-1400. It has a total of 64 kebeles populated by 237,722 people. It also covers a total of 107,584 ha. Majority of the area is part of the Weiyena dega agro-climate zone, covering about 58.53% of the total land. It is followed by kolla with a total coverage of 25.25%, and dega accounting for the rest of the area (16.22%).

Enemor Ener Woreda is the second Woreda selected in Guragh zone. The Woreda is 452 km far from Hawassa and 4 kebeles are also selected in the Woreda for intervention by CASCAPE. Two of them are from high land area namely Agata and Kunber and the other two are low land areas namely Gomosh and Kerebed.

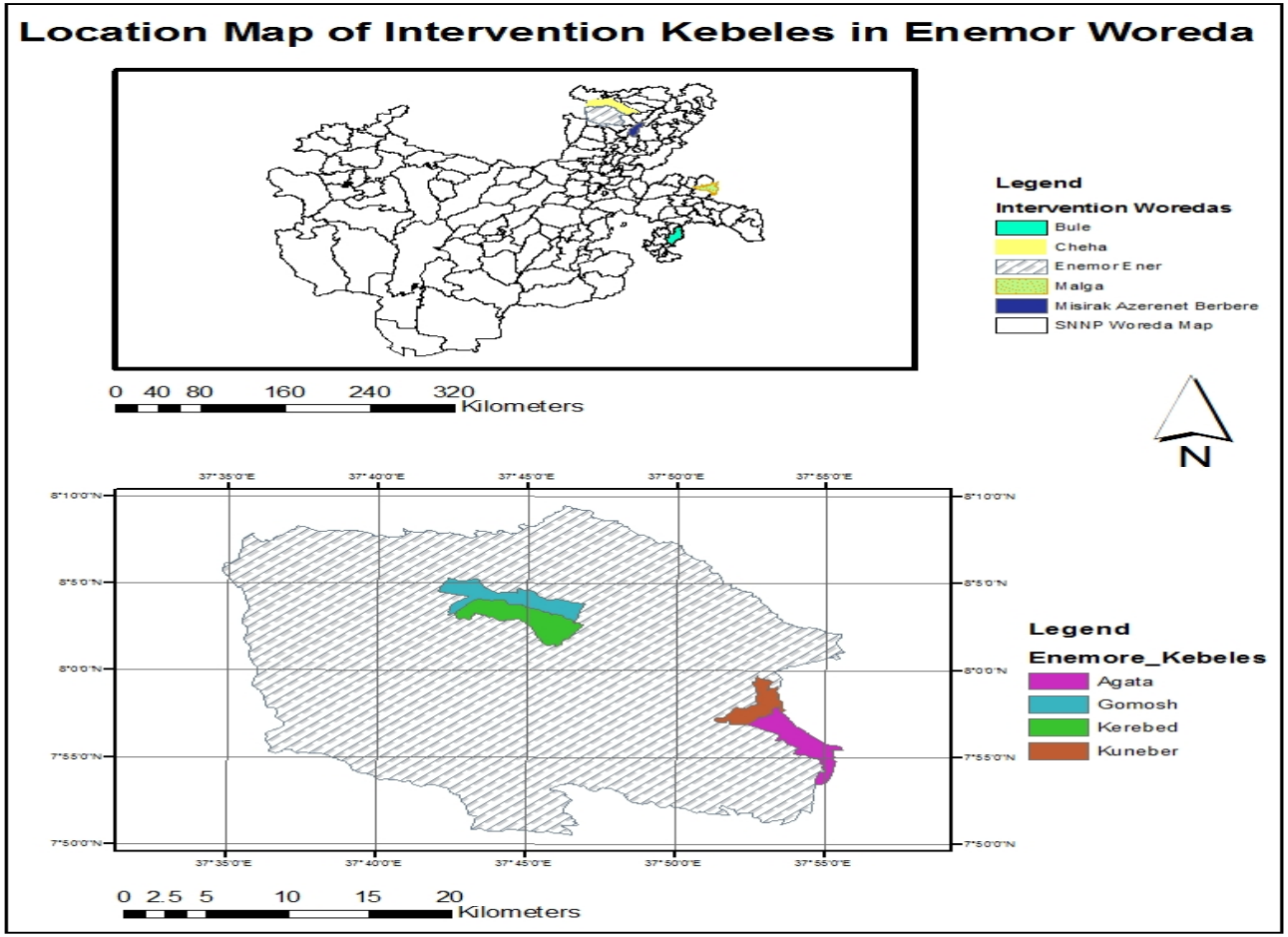


Fig 11 ocation Map of Enemor Ener Woreda

4.2 Intervention Kebeles

Agata Kebele

It is a high land kebele covering 1110 ha. The mean annual rainfall of the kebele is 1100 mm and the mean minimum and maximum temperature is 19^0 C and 24^0C respectively. As the topography of the kebele 85 % is steep Slope, 10 % undulating and 5 % is a flat land. The total households of the kebele is estimated to be 1655 of which 840 are female headed and 815 are male headed (Woreda Agricultural office).

Of the total area 475 ha of the land covered with Annual crop followed by perennial crops 400 ha, forest 55 ha, grazing land 50 ha, settlement 95 ha and 35 ha with other land use. Farmers usually cultivate different crops especially Enset is a very common crop in the area (CASCAPE Working Paper 2.4.2, 2014).

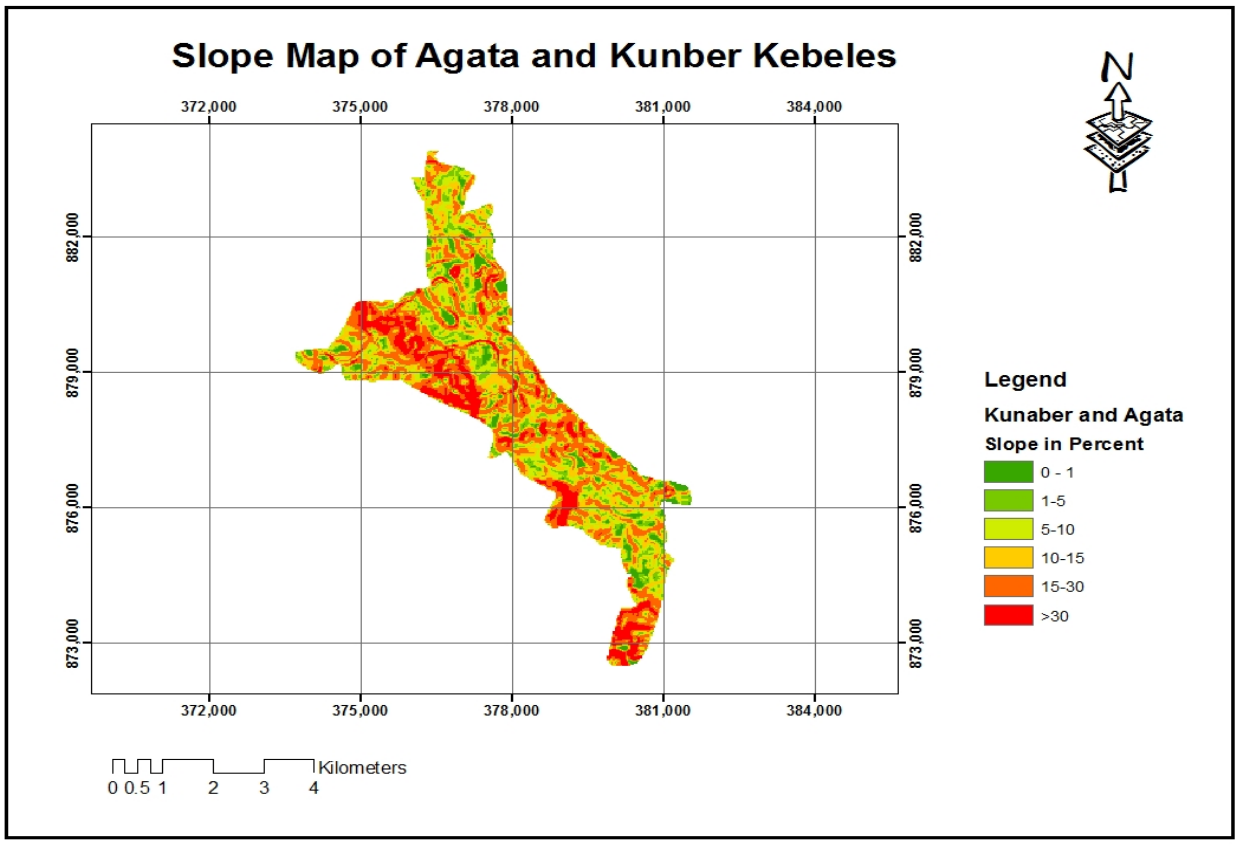


Fig 12 Slope map of Agata and Kunber Kebeles.

Kunber Kebele

Kunber kebele is adjacent to Agata kebele and it is also a high land kebele. It covers a total of 600 ha of which 68.3 % of the land in the kebele is cultivated by Annual and perennial crops, 11.6 % is covered by forest, 8.3 % is left for grazing and 9.1 % and 2.5

% is covered by settlement and other land use types. Of the total households 720 are female headed and 580 are male headed. The mean annual rainfall in the kebele is 1000 mm. the mean annual maximum and minimum temperature of the kebele is 25^0 C and 20^0C respectively. Topographically kebele is characterized by 75% steep Slope, 15 % undulating and 10 % flat area (Woreda office of Agriculture, CASCAPE Working Paper 2.4.2. 2014).

Gomosh Kebele

One of the low land kebeles of Enemor Ener wored is Gomosh kebele. It covers a total area of 800 ha of which 400 ha is covered by annual crops. Next to annual crops, perennial crops cover 225 ha, forest land 50 ha, grazing land 25, settlement 75 ha and the remaining 25 ha with other different types of land use. There are 1250 householdss in the kebele and 650 are female headed and 600 male headed. The kebele is flat with water logging problem especially in the rainy season. 95 % of the total land is a flat land and the remaining 5 % is undulating. The mean annual rainfall of the kebele is 850 mm and the mean maximum and minimum temperature of the kebele is 28^0c and 23^oc respectively (Woreda office of Agriculture, CASCAPE Working Paper 2.4.2. 2014).

Kerebed Kebele

Kerebed kebele is found adjacent with Gomosh kebele. A river between the two kebeles acts as a boundary. The total area of the kebele is 850 ha. Annual crops cover larg area in the kebele (450 ha) followed by perennial crops 160 ha, forest 75, grazing 50 ha, settlement 85 and other land use covers 30 ha. More than 95 % of the total area is flat and the remaining is medium undulating and gorge. Of the total 1340 householdss 665 are female headed and the remaining 675 are male headed. The kebele receives a mean annual rainfall of 850 mm with maximum and minimum temperature of 28^0 C and 23^o C like that of Gomosh kebele (Woreda office of Agriculture).

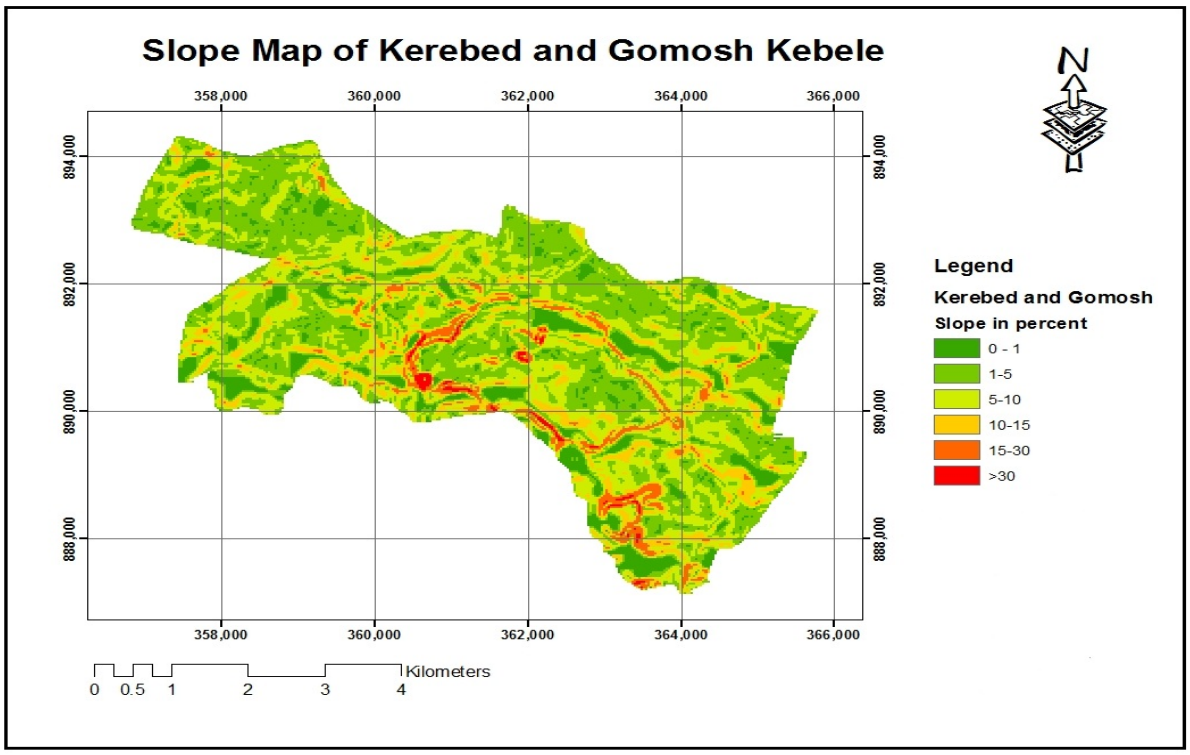


Fig 13 Slope map of Gomosh and Kerebed Kebele

4.3 Soils of Enemor Ener Woreda

4.3.1 The soil-landscape in Woreda

Henricksen et al., (1984) describe the geomorphology of Enemor Ener Woreda as moderately dissected side Slopes of extinct central volcanoes and other relic volcanic forms, often with small volcanic vent and cone remnants.Annual crops take the lead in terms of land use followed by grazing and mixed land use (Table below)

Table 18 Land use pattern of Enemor Ener Woreda

No	Land Use	Area coverage (ha)	Percent
1	Annual crops	27410	25
2	Perinial Crops	8000	7
3	Grazing	26340	24
4	Mixed land use	20000	18
5	Plantation Forest	4050	3
6	Natural Forest	2196	2
7	Roads and Social institution	4223	4
8	others	15365	14

Source: Woreda office of Agriculture

Agriculture is the dominant economic activity in the Woreda and crop production is the leading means of livelihood supplemented by livestock production. Major crops based on their level of importance are maize (6249 ha), teff (5,900 ha), wheat (5,600 ha), coffee (4,228 ha), barley (1,875 ha), faba bean (453 ha), pea (270 ha), and banana (122 ha). (Source: Woreda office of Agriculture, CASCAPE Working Paper 2.4.2. 2014)

In Enemor Ener Woreda Agata and Kunber kebeles are located in the upper Slope of the toposequence. Other two Kerebed and Gomosh are located on the lower Slope position. It seems that kerebed and Gomosh kebeles are water logged for some period of time in the rainy season. By considering the topography and area coverage of the intervention Woreda and auger description two soil profiles were opened in each kebeles of Gomosh, and Kunber. Because similar soil types were described by Auger description process for Agata and Kerebed kebele and one representative soil sample each was opened.

In the upper topographic positions Luvisols soil were found in both kebeles of Agata and Kunber Kebeles. Vertisols were founding the lower intervention kebeles Kerebed and Gomosh. As a summery like that of Neighboring Cheha Woreda upper areas are dominated by Luvisols and the Toe Slope and bottom areas position areas are found to be Vertisol.

Enset is the dominant crop in the area. Crops like Khat, maize and barley are also cultivated in the upper topographic position. Enset and Teff are common crops in the lower position areas. Vertisols of these areas are very hard to plough and it seems that teff is the only crop to be cultivated in the rainy season.

Farmers in the area classify the soil based on the color and characteristics of the surface soil like swelling and cracking property of the soil. Accordingly they classify as red and black soils (in the local language Chara Afer, and Gembena Afer respectively). Based on farmers classification Luvisols fall under Black soil (Gembena Afer) because the surface soil black and the Vertisols fall under Vertisols soil (Chara Afer) .

4.3.2 Soil profile descriptions with analytical data for Enemor Ener Woreda

4.3.2.1 Profile site description Agata Kebele

Profile 1

Site characteristics

Profile code	En-Ag-P1
Soil classification	Chromic Luvisols
Location	Enemor EnerWoreda; Agata kebele
Coordinates	N 07^0 56” 16’ E 37^0 53”32’
Elevation	2646 m
Date	03/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2

Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, plateau
Local physiography	level plain
Macro relief	Rolling Hilly
Slope	Level straight slope of ±2% over more than 200 m long.
Land use	Enset and maize; other crops are teff. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 19 Soil description for En-Ag-P1

Hor.	Depth cm	Description
Ap	0-28	Black (5YR 2.5/1) Clay loam; Moderate, fine to medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, clear smooth boundary.
Ah	28-62	Dark reddish brown (5YR 3/4) Sandy Clay loam; moderate, fine to medium, Sub angular blocky structure; hard when dry, fiable when moist, slightly sticky and slightly plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary.
Bt1	62-121	Dark reddish brown (2.5YR 2.5/3) clay loam; moderate, fine to medium, Sub angular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; few faint clay coating, common, fine pores, diffuse smooth boundary.
Bt2	121-175	Dark reddish brown (2.5 YR 3/4). Clay loam: Moderate, fine to course, angular blocky structure, firm when moist, sticky and plastic when wet, common prominent clay coating, few fine pores, diffuse smooth boundary.
Bt3	175+	Dark reddish brown (2.5 YR 2.5/4). Clay loam: Moderate, fine to course, angular blocky structure, firm when moist, sticky and plastic when wet, few, distinct clay coating, few fine pores.

Table 20 Table with analytical data for En-Ag-P1

Horizon	AP	Ah	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	5.94	5.28	4.57	4.75	4.84
pH-KCL (1:2.5)	5.12	4.42	3.71	3.90	3.97
EC(ms/cm) (1:2.5)	0.01	0.02	0.01	0.02	0.02
Sand (%)	40.76	50.04	36.53	36.84	36.72
Silt (%)	23.27	18.07	27.51	24.62	26.81
Clay (%)	35.97	31.89	35.97	38.54	36.47
Silt to clay ratio	0.65	0.57	0.76	0.64	0.74
Texture Class	Clay loam	Sandy clay loam	Clay loam	Clay loam	Clay loam
Exch. Na(meq/100gm of soil)	0.94	0.77	0.88	0.72	0.91
Exch. K(meq/100 gm of soil)	0.36	0.47	0.31	0.28	0.27
Exch. Ca(meq/100 gm of soil)	13.50	15.25	14.35	17.91	17.09
Exch. Mg(meq/100 gm of soil)	4.22	5.08	5.06	6.82	5.98
Sum of Cations (meq/100gm of soil)	19.02	21.57	20.61	25.74	24.25
CEC(meq/100 gm of soil)	27.06	29.47	27.98	31.98	31.11
Organic Carbon (%)	3.42	3.90	0.87	0.63	0.55
Nitrogen (%)	0.28	0.33	0.09	0.06	0.04
C/N	12.21	11.82	9.67	10.50	C/N
PBS(%)	70.29	73.19	73.62	80.46	PBS(%)
Available P(mg P_2O_5/kg soil)	33.00	25.90			
Bulk density (gm/ Cm^3)	1.02	1.00	1.10	1.08	1.05
Available S (%)	0.99	0.18			
Exchangeable Sodium %(ESP)	3.46	2.63	3.15	2.26	2.93
Micronutrient					
Zn (mg/kg soil)	1.96	4.03			
Mn (mg/kg soil)	43.12	65.54			
Cu (mg/kg soil)	1.48	1.87			
Fe (mg/kg soil)	71.89	109.52			

4.3.2.2. Profile site description Gomosh Kebele

Profile 1

Site characteristics

Profile code	En-Go-P1
Soil classification	Chromic Luvisol
Location	Enemor Enera Woreda; Gomosh kebele
Coordinates	N 08^0 03” 39’ E 37^0 46”16’
Elevation	1970 m
Date	01/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2

Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, Depression
Local physiography	level plain
Soil drainage	well drained
Macro relief	level
Slope	Level straight slope of ±1% over more than 5km long.
Land use	Enset; other crops are teff. On average 0.5 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 21 Soil Description for En-Go-P1

Hor.	Depth cm	Description
Ap	0-30	Reddish Black (2.5YR 2.5/1) Clay; Moderate, very fine to fine, granular structure; friable when moist, slightly sticky and slightly plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary, gradual smooth boundary.
AB	30-75	Reddish black (10R 2.5/1) Clay; moderate, very fine to fine, angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary, clear smooth boundary.
Bt1	75-110	Dark reddish brown (2.5YR 3/3) clay; moderate, very fine to fine, angular blocky structure; friable when moist, sticky and plastic when wet; common, fine pores, gradual smooth boundary.
Bt2	110-155	Reddish black (10R 2.5/1). Clay: Moderate, very fine to fine, angular blocky structure, friable when moist, sticky and plastic when wet, few fine pores, gradual smooth boundary.
C	155+	Dusky red (10R 3/3). Clay loam: Moderate, fine to coarse, angular blocky structure, firm when moist, sticky and plastic when wet, few fine pores.

Table 22 Table with analytical data for En-Go-P1

Horizon	Ap	AB	Bt1	Bt2	C
pH-H_2O (1:2.5)	4.96	5.22	5.44	5.31	5.35
pH-KCL (1:2.5)	4.16	4.37	4.49	4.42	4.39

EC(ms/cm) (1:2.5)	0.07	0.03	0.02	0.04	0.03
Sand (%)	36.34	35.76	32.09	30.46	37.73
Silt (%)	20.16	21.41	20.48	22.82	20.05
Clay (%)	43.50	42.83	47.43	46.72	42.22
Silt to clay ratio	0.46	0.50	0.43	0.49	0.47
Texture Class	clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	1.07	1.10	1.15	0.98	0.82
Exch. K(meq/100 gm of soil)	0.53	0.52	1.35	1.43	1.43
Exch. Ca(meq/100 gm of soil)	20.35	22.26	20.54	21.60	19.32
Exch. Mg(meq/100 gm of soil)	6.78	7.70	6.85	6.91	6.72
Sum of Cations (meq/100gm of soil)	28.74	31.57	29.90	30.92	28.29
CEC(meq/100 gm of soil)	36.87	35.82	37.22	37.10	34.24
Organic Carbon (%)	3.13	2.06	1.27	1.16	0.86
Nitrogen (%)	0.27	0.22	0.13	0.12	0.10
C/N	11.59	9.36	9.77	9.67	8.60
PBS(%)	77.92	88.16	80.31	83.34	82.62
Available P(mg P_2O_5/kg soil)	20.10				
Bulk density (gm/ Cm^3)	1.00	1.07	1.07	1.08	1.18
Available S (%)	0.37				
Exchangeable Sodium %(ESP)	2.90	3.06	3.10	2.63	2.40
Micronutrient					
Zn (mg/kg soil)	18.73				
Mn (mg/kg soil)	76.87				
Cu (mg/kg soil)	2.84				
Fe (mg/kg soil)	124.32				

Profile 2

Site characteristics

Profile code	En-Go-P2
Soil classification	Mesotropic Vertisol
Location	Cheha Woreda; Wordenen kebele
Coordinates	N 08^0 03” 14’ E 37^0 46”37’
Elevation	1977 m
Date	02/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, Depression
Local physiography	level plain
Soil drainage	poorly drained
Macro relief	level

Slope	Level straight slope of ±1% over more than 6km long.
Land use	Enset is main crop; other crops are teff. On average 0.5 ha per household. Some dairy cows (Common grazing).

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Poorly Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	No
Flooding	No
Human influence	mixed agriculture

Table 23 Soil Description for En-Go-P2

Hor.	Depth cm	Description
Ap	0-25	Light olive gray (5Y 6/2), Sandy Clay loam; few fine, distinct clear, Yellowish red (5 YR 4/6) iron oxide mottles , fine, distinct, very fine to fine granular structure, firm when moist, slightly sticky and non-plastic when wet; many fine roots; clear, smooth boundary, few fine pores
AC	25-65	Light olive gray (5Y 6/2), clay loam; few fine, distinct clear, dark reddish brown (5 YR 3/3) iron oxide mottles, moderate, fine to medium Angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; few fine to very fine pores; few roots; diffused, smooth boundary.
C1	65- >90	Olive (5Y 5/2) clay; few fine, distinct clear, very dark grayish brown (10 YR 3/2) iron oxide mottles, moderate, very fine to fine Angular blocky structure; friable when moist, sticky and plastic when wet; continuous slickenside; few, fine pores; few, fine roots; gradual, smooth boundary.
C2	90-120	Dark grayish brown (10YR 4/2), clay, moderate fine to medium Angular blocky structure, friable when moist, sticky and plastic, fine few pores, clear and smooth boundary.
C3	120+	Dark reddish brown (5YR 3/4), clay, moderate fine to medium Angular blocky structure, friable when moist sticke and plastic, fine few pores.

Table 24 table with analytical data for En-Go-P2

Horizon	AP	AC	C1	C2	C3
pH-H_2O (1:2.5)	4.85	5.34	5.63	5.31	5.48
pH-KCL (1:2.5)	3.95	4.40	4.71	4.36	4.55
EC(ms/cm) (1:2.5)	0.03	0.03	0.02	0.04	0.04

Sand (%)	48.91	37.09	38.69	40.22	26.39
Silt (%)	19.81	27.85	30.66	17.08	23.82
Clay (%)	31.28	35.06	30.66	42.70	49.80
Silt to clay ratio	0.63	0.79	1.00	0.40	0.48
Texture Class	Sandy clay loam	Clay loam	Clay loam	clay	clay
Exch. Na(meq/100gm of soil)	0.87	1.11	1.08	1.05	1.37
Exch. K(meq/100 gm of soil))	0.38	0.29	0.26	0.53	0.60
Exch. Ca(meq/100 gm of soil)	16.64	15.66	14.70	22.11	25.82
Exch. Mg(meq/100 gm of soil)	5.82	5.77	4.90	7.65	8.61
Sum of Cations (meq/100gm of soil)	23.72	22.82	20.95	31.35	36.39
CEC(meq/100 gm of soil)	33.01	26.87	24.42	37.90	42.10
Organic Carbon (%)	1.80	0.67	0.35	0.30	0.23
Nitrogen (%)	0.16	0.07	0.04	0.03	0.03
C/N	11.25	9.57	8.75	10.00	7.67
PBS(%)	71.83	84.96	85.75	82.69	86.46
Available P(mg P_2O_5/kg soil)	25.30				
Bulk density (gm/ Cm^3)	0.99	1.09	1.24	1.22	1.19
Available S (%)	0.39				
Exchangeable Sodium %(ESP)	2.63	4.13	4.44	2.78	3.24
Micronutrient					
Zn (mg/kg soil)	9.27				
Mn (mg/kg soil)	84.12				
Cu (mg/kg soil)	3.50				
Fe (mg/kg soil)	139.55				

4.3.2.3 Profile site description of Kerebed kebele

Profile 1

Site characteristics

Profile code	En-Ke-P1
Soil classification	Mesotrophic vertisol
Location	Enemor Ener Woreda; Kerebed kebele
Coordinates	N 08^0 02” 56’ E 37^0 45”49’
Elevation	1970 m
Date	04/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Climate data	1300-1500 mm precipitation per year
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, depression
Local physiography	level plain
Soil drainage	poorly drained

Macro relief	level
Slope	Level straight slope of ±1% over more than 5km long.
Land use	Teff. On average 0.25 ha per household. Some dairy cows (Common grazing).

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Poorly Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 25 Soil Description for En-Ke-P1

Hor.	Depth cm	Description
Ap	0-25	Brown (10YR 4/3), Clay loam; moderate very fine to fine granular structure, firm when moist, slightly sticky and non-plastic when wet; many fine roots; clear, smooth boundary, few fine pores
AC	25- 90	Light olive gray (5Y 6/2) clay loam; few fine, distinct clear, dark yellowish brown (10 YR 4/4) iron oxide mottles, moderate, fine to course massive structure; friable when moist, slightly sticky and slightly plastic when wet; few, fine pores; few, fine roots; gradual, smooth boundary.
C1	90-128	Dark grayish brown (2.5Y 4/2), clay, few fine, distinct clear, dark yellowish red (5 YR 4/6) iron oxide mottles moderate fine to coarse massive structure, friable when moist, sticky and plastic, fine few pores, continuous slickensides, clear and smooth boundary.;
C2	128-162	Dark reddish gray (5YR 4/2), clay, moderate very fine to fine sab angular blocky structure, friable when moist very sticky and very plastic, fine few pores, gradual smooth boundary.
C3	162+	Dark yellowish brown (10YR 4/4), clay, moderate fine to medium sab angular blocky structure, friable when moist sticky and plastic, fine few pores.

Table 26 Table with analytical data for En-Ke-P1

Horizon	AP	AC	C1	C2	C3
pH-H_2O (1:2.5)	6.02	5.38	5.89	6.53	6.65
pH-KCL (1:2.5)	5.20	4.42	4.98	5.61	5.75
EC(ms/cm) (1:2.5)	0.10	0.05	0.05	0.10	0.10
Sand (%)	32.41	35.81	31.53	28.94	28.26
Silt (%)	36.96	30.52	31.58	22.21	25.38
Clay (%)	30.63	33.67	36.90	48.85	46.35

Silt to clay ratio	1.21	0.91	0.86	0.45	0.55
Texture Class	Clay loam	Clay loam	Clay	clay	clay
Exch. Na(meq/100gm of soil)	0.79	0.89	0.91	1.34	1.25
Exch. K(meq/100 gm of soil))	0.94	1.74	0.79	0.85	0.63
Exch. Ca(meq/100 gm of soil)	14.70	17.64	14.77	21.56	20.06
Exch. Mg(meq/100 gm of soil)	5.46	5.88	4.99	7.04	6.98
Sum of Cations (meq/100gm of soil)	21.90	26.16	21.46	30.79	28.91
CEC(meq/100 gm of soil)	31.96	31.04	25.33	38.26	36.97
Organic Carbon (%)	2.10	1.32	0.60	0.41	0.11
Nitrogen (%)	0.25	0.13	0.06	0.04	0.02
C/N	8.40	10.15	10.00	10.25	5.50
PBS(%)	68.49	84.25	84.72	80.48	78.23
Available P(mg P_2O_5/kg soil)	24.40				
Bulk density (gm/ Cm^3)	1.01	1.02	1.24	1.27	1.21
Available S (%)	0.76				
Exchangeable Sodium %(ESP)	2.49	2.88	3.59	3.50	3.38
Micronutrient					
Zn (mg/kg soil)	26.54				
Mn (mg/kg soil)	68.09				
Cu (mg/kg soil)	1.83				
Fe (mg/kg soil)	84.66				

4.3.2.4. Profile site description of Kunber kebele

Profile 1

Site characteristics

Profile code	En-Ku-P1
Soil classification	Chromic Luvisols
Location	Enemor Ener Woreda; Kunber kebele
Coordinates	N 07^0 57" 55' E 37^0 52"53'
Elevation	2498 m
Date	03/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, plateau
Local physiography	Undulating land
Soil drainage	well drained
Macro relief	Rolling Hilly
Slope	Level straight slope of ±3% over more than 1km long.
Land use	Enset; other crops are teff. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	In rainy season
Human influence	mixed agriculture

Table 27 Soil Description for En-Ku-P1

Hor.	Depth cm	Description
Ap	0-21	Black (5YR 2.5/1) sandy Clay loam; weak, very fine to fine, granular structure; soft when dry, very friable when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, diffuse smooth boundary.
Ah	21-52	Black (5YR 2.5/1) Clay loam; moderate, fine to medium, Sub angular blocky structure; slightly hard when dry, very friable when moist, non-sticky and non-plastic when wet; common, fine pores; very few, fine roots, clear smooth boundary.
AB	52-109	Dark reddish brown (2.5YR 3/3) clay loam; strong, fine to medium, angular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; few faint clay coating, common, fine pores, diffuse smooth boundary.
Bt1	109-131	Dark reddish brown (2.5 YR 3/3). Clay: Moderate, fine to course, Sub angular blocky structure, firm when moist, sticky and plastic when wet, common prominent clay coating, few fine pores, diffuse smooth boundary.
Bt2	131+	Dark reddish brown (5 YR 3/3). Clay: Moderate, fine to course, massive structure, firm when moist, sticky and plastic when wet, few, distinct clay coating, few fine pores.

Table 28 Table with analytical data for En-Ku-P1

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	5.29	4.49	4.88	5.64	5.04
pH-KCL (1:2.5)	4.40	3.69	3.94	4.73	4.26
EC(ms/cm) (1:2.5)	0.03	0.02	0.01	0.05	0.01

Sand (%)	48.55	36.97	36.52	32.69	21.84
Silt (%)	18.90	26.26	26.90	18.93	27.46
Clay (%)	32.55	36.77	36.58	48.38	50.70
Silt to clay ratio	0.58	0.71	0.74	0.39	0.54
Texture Class	Sandy clay loam	Clay loam	Clay loam	clay	clay
Exch. Na(meq/100gm of soil)	0.82	0.84	0.84	1.15	0.97
Exch. K(meq/100 gm of soil))	0.55	0.40	0.40	1.56	0.40
Exch. Ca(meq/100 gm of soil)	15.09	12.58	13.71	18.46	18.53
Exch. Mg(meq/100 gm of soil)	5.03	4.19	4.28	6.71	5.90
Sum of Cations (meq/100gm of soil)	21.49	18.00	19.23	27.89	25.80
CEC(meq/100 gm of soil)	33.72	28.25	29.34	34.66	34.79
Organic Carbon (%)	4.23	4.03	1.41	1.26	0.30
Nitrogen (%)	0.34	0.31	0.16	0.13	0.03
C/N	12.44	13.00	8.81	9.69	10.00
PBS(%)	63.73	63.75	65.54	80.44	74.16
Available P(mg P_2O_5/kg soil)	25.60				
Bulk density (gm/ Cm^3)	1.00	1.02	1.16	1.17	1.24
Available S (%)	1.27				
Exchangeable Sodium %(ESP)	2.43	2.97	2.86	3.32	2.79
Micronutrient					
Zn (mg/kg soil)	11.30				
Mn (mg/kg soil)	62.23				
Cu (mg/kg soil)	3.58				
Fe (mg/kg soil)	105.97				

Profile 2

Site characteristics

Profile code	**En-Ku-P2**
Soil classification	Chromic Luvisols
Location	Enemor Ener Woreda; Kunber kebele
Coordinates	N 07^0 57” 37’ E 37^0 52”37’
Elevation	2496 m
Date	04/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, plateau
Local physiography	Undulating land
Soil drainage	well drained
Macro relief	Rolling Hilly

Slope	Level straight slope of ±2% over more than 1km long.
Land use	Enset; other crops are teff. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 29 Soil Description for En-Ku-P2

Hor.	Depth cm	Description
Ap	0-25	Dark brown (7.5YR 3/2) Clay; moderate very fine to fine, granular structure; friable when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
Ah	25-67	Dark reddish brown (5YR 2.5/2) Clay; moderate, very fine to fine, Sub angular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; very few, fine roots, diffuse smooth boundary.
Bt1	67-92	Dark reddish brown (2.5YR 3/4) clay; moderate, fine to medium, Sub angular blocky structure; firm when moist, sticky and plastic when wet; distinct clay coating, common, fine pores, diffuse smooth boundary.
Bt2	92-138	Dark reddish brown (2.5 YR 3/4). Clay: Moderate, fine to medium, angular blocky structure, firm when moist, sticky and plastic when wet, common prominent clay coating, few fine pores, clear smooth boundary.
C	138+	Very Dark brown (7.5 YR 2.5/2). Clay: Moderate, fine to medium, angular blocky structure, firm when moist, sticky and plastic when wet, few, distinct clay coating, few fine pores.

Table 30 Table with analytical data for En-Ku-P2

Horizon	AP	Ah	Bt1	Bt2	C
pH-H_2O (1:2.5)	5.94	5.53	4.90	4.84	5.07
pH-KCL (1:2.5)	5.12	4.59	4.06	4.00	4.29

EC(ms/cm) (1:2.5)	0.03	0.02	0.02	0.02	0.04
Sand (%)	39.68	29.45	19.84	26.65	26.47
Silt (%)	15.08	15.20	24.58	19.42	21.63
Clay (%)	45.24	55.35	55.58	53.93	51.90
Silt to clay ratio	0.33	0.27	0.44	0.36	0.42
Texture Class	clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.97	1.24	1.05	1.03	1.05
Exch. K(meq/100 gm of soil))	1.10	0.89	0.70	0.45	0.50
Exch. Ca(meq/100 gm of soil)	22.30	17.26	15.32	16.31	18.92
Exch. Mg(meq/100 gm of soil)	7.72	6.04	5.11	5.15	6.02
Sum of Cations (meq/100gm of soil)	32.08	25.43	22.18	22.94	26.48
CEC(meq/100 gm of soil)	37.29	36.12	32.85	33.12	35.05
Organic Carbon (%)	3.48	3.08	0.79	0.52	0.13
Nitrogen (%)	0.33	0.32	0.07	0.06	0.02
C/N	10.55	9.63	11.29	8.67	6.50
PBS(%)	86.06	70.40	67.52	69.26	75.58
Available P(mg P_2O_5/kg soil)	56.20	24.20			
Bulk density (gm/ Cm^3)	0.99	0.95	1.10	1.18	1.24
Available S (%)	1.16	0.89			
Exchangeable Sodium %(ESP)	2.60	3.43	3.21	3.10	2.99
Micronutrient					
Zn (mg/kg soil)	21.25	6.86			
Mn (mg/kg soil)	87.29	67.02			
Cu (mg/kg soil)	2.84	2.31			
Fe (mg/kg soil)	95.52	100.25			

4.4 Synthesis

In Enemor Ener Woreda Agata and Kunber kebeles are located in the upper position of the landscape. Other two Kerebed and Gomosh are located on the lower position. Kerebed and Gomosh kebeles are water logged for some period of time in the rainy season.

The dominant soils in the Woreda are Chromic Luvisols, well drained, very deep, dark red, well structured, Sandy clay loam to clay soils with a general increase in clay contents from topsoil to subsoil; Silt to clay ration greater than 0.4, with thick (over 52 cm) dark reddish brown topsoils. These soils dominate the high land kebeles of whole Agata and Kunber kebele and upper parts of Gomosh kebele. In the bottom kebeles the area is dominated by Vertisols. The whole kerebed kebele and some parts of Gomosh kebele are covered by Vertisols. These soils are poorly drained, very deep, grey in color, having very hard consistency when dry, very sticky very plastic consistence when wet, with high swelling and cracking clay content.

Consistency of the soils in the surface layers of all pedons was found to be similar. In all cases the consistency was friable, slightly sticky and slightly plastic. On the other hand, the moist consistency of the subsurface horizons ranged from friable to firm, whereas the range was from to slightly sticky/slightly plastic to very sticky/very plastic when wet. The friable and slightly sticky/slightly plastic consistency observed in the surface horizons of all pedons could be attributed to the relative higher organic matter content of the surface than subsurface layers. All surface horizons of Luvisols in Enemor Ener have a weak to moderate granular to Sub angular blocky structure. The subsurface horizons of had both Sub angular and angular blocky structure. The better developed structure of the subsurface soils could be due to the relatively higher clay content of the subsurface horizons than that of the surface horizons (Ahn, 1993).

In all pedons, clay content increased with increasing soil depth, forming argillic horizons. Moreover, both the sand and silt contents were generally higher in the surface soil. According to Boul et al. (2003), the accumulation of clay in the subsurface horizon could be also contributed by the in situ synthesis of secondary clays, the weathering of primary minerals in the B horizon, or the residual concentration of clays from the selective dissolution of more soluble minerals of coarser grain sized in the B horizon.

Silt/clay ratios for Agata soils ranged from 0.57 to 0.76, In Kunber Profile 1, the range is between 0.39 and 0.74, In Profile 2 the range is from 0.27 to 0.44, In Kerebed the range is from 0.45 to 1.21 while Pedon 1 and 2 of Gomosh have a silt/clay range of 0.43 to 10.50 and 0.4 to 1.00 respectively. Silt/clay ratio is used in the evaluation of clay migration, stage of weathering and age of parent material and soils. The more highly weathered a soil is, the lower the silt fraction. Therefore, soils with silt/clay ratio of less than 0.15 are regarded as highly weathered (Van Wambeke, 1962). In all the cases the ratio is greater than 0.27 meaning that soils of Enemor Ener are young soils in terms of weathering.

Soil pH is a very good guide to some expected nutrient deficiencies and toxic effects (Brady 1984) Luvisols of Enemor Ener are found to be very acidic. Surface horizon soils of the Agata have pH 4.38, Profile 1 of Gomosh has 4.96, profile 1 of Kunber has 4.64 and profile 2 of Kunber has 5.39. According to London (1984) soils having pH value less than 5.5 are categorized as acidic soils. The CEC values of Luvisols in this area are found to be less than 40 Cmolc/Kg of clay soil and greater than 27.06 Cmolc/Kg of clay soil. According to London (1984) soils having CEC value between 25 to 40 Cmolc/Kg of clay soil may need some amount of lime and potassium fertilizer. As the soils are young the amount of cations are good for crop production and all the concentrations of cation in the different profiles are found to be satisfactory according to London (1984). Moreover available phosphorus and total nitrogen are found to be adequate for Luvisols of Enemor Ener areas but the amount of organic carbon content is found to be low according to London (1984). This could be due to crop removal in the area in coupled with sub soiling practice that distribute the organic matter down to the profile and increase organic matter decomposition.

Fig 14 Sub soiling practice in Gurage and Silty areas

In both soil types of Enemor Ener (Luvisols and Vertisols) as the amount of organic matter is low Nitrogen content of the surface soils is found to be medium for most soils (London 1991). The surface organic matter of content of Vertisols in Gomosh kebele is found to be low. This is common in Vertisols where there is swelling and cracking nature and churning of the surface organic matter. Other chemical properties like micro nutrients and basic cations are found to be sufficient for most agricultural crops according to the classification made by London (1984).

Vertisols of Enemor Ener have clay increase in the subsurface horizons (>30 %). They are firm when moist and sticky and plastic subsurface horizons when wet. The subsurface horizons have continious slickensides. Some of them especially in Gomosh have acidic surface horizons which could be due to cultivation coupled with fertilizer application. Nitrogen content in vetisols of Gomosh is in low level and in Kerebed it is in medium level. Moreover OC content is in very low level for both Kebeles. The general low level of nitrogen and OC content could be due to the cherning of organic matter by the weeting and drying process. All the other nutrients in both kebeles is found to be adequate for plant growth according to London (1984).

Fig 15 Sample Soil Profile at Agata Kebele

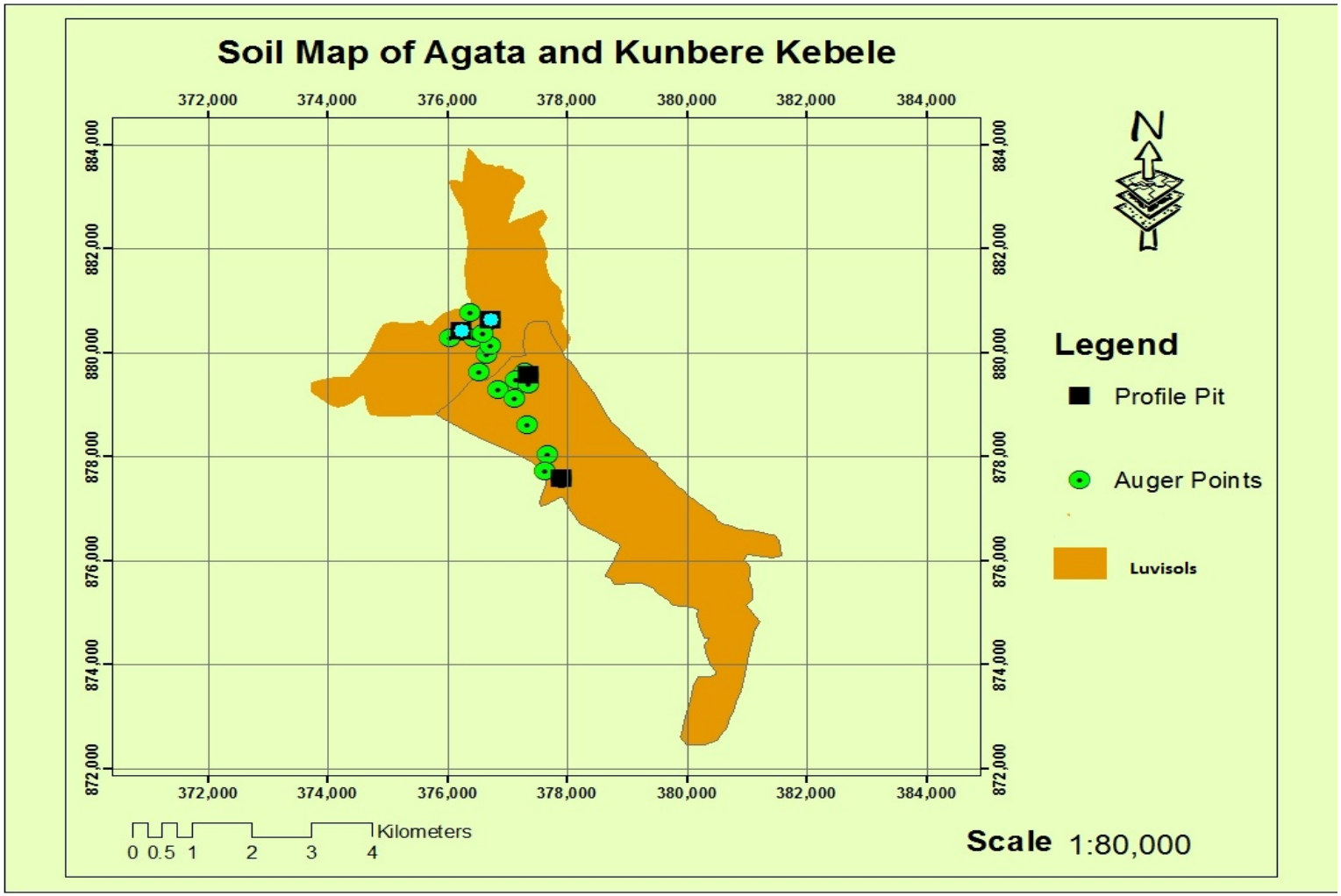


Fig 16 Soil Map of Agata and Kunber Kebeles

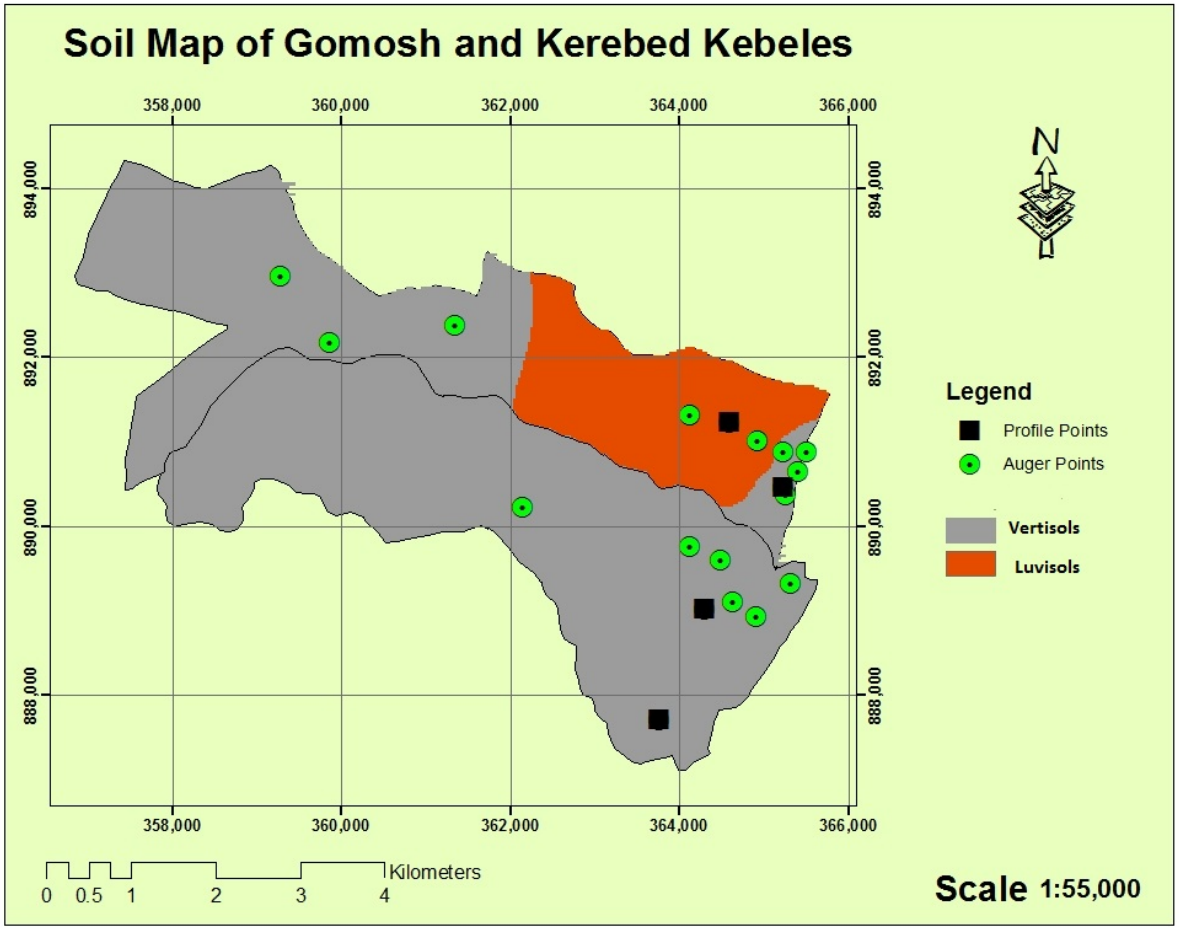


Fig 17 Soil Map of Gomosh and Kerebed Kebeles

Part 5 Malga Woreda

5. Results

5.1 Description of the environment

5.1.1 Location

Malga Woreda is found in the Sidama zone of the SNNP Region. The Woreda is bordered by Wondogenet in the north, by Goriche and Shebedino in the south, to the west by Tula Administration and to the East by Kokosa Woreda in Oromia Regional State. Malga is divided into 23 peasant associations (PAs), and has three rural towns. The capital town of Malga Woreda is Manicho which is located 26 kilometres (km) from the regional state capital, Hawassa town.

Average annual temperature varies from 12.6-20 ^{o}C, and average annual rainfall will vary from 1,201-1,600 mm. Elevation of the area ranges from between 1,501–3,000 metres above sea level (masl). The kebeles studied fall under two agro-ecological zones, namely dega (78 percent), while the remaining area (22 percent) falls under weiyna dega.

The Woreda had an estimated population of 127,844 in 2010, based on 2007 census projections (CSA, 2007). Sixty-five percent of the PAs are accessible by road throughout the year, while 22 percent of PAs are accessible only during the dry season and 13 percent of PAs are inaccessible throughout the whole year (CASCAPE Working Paper 2.4.3. 2014, Woreda office of Agriculture).

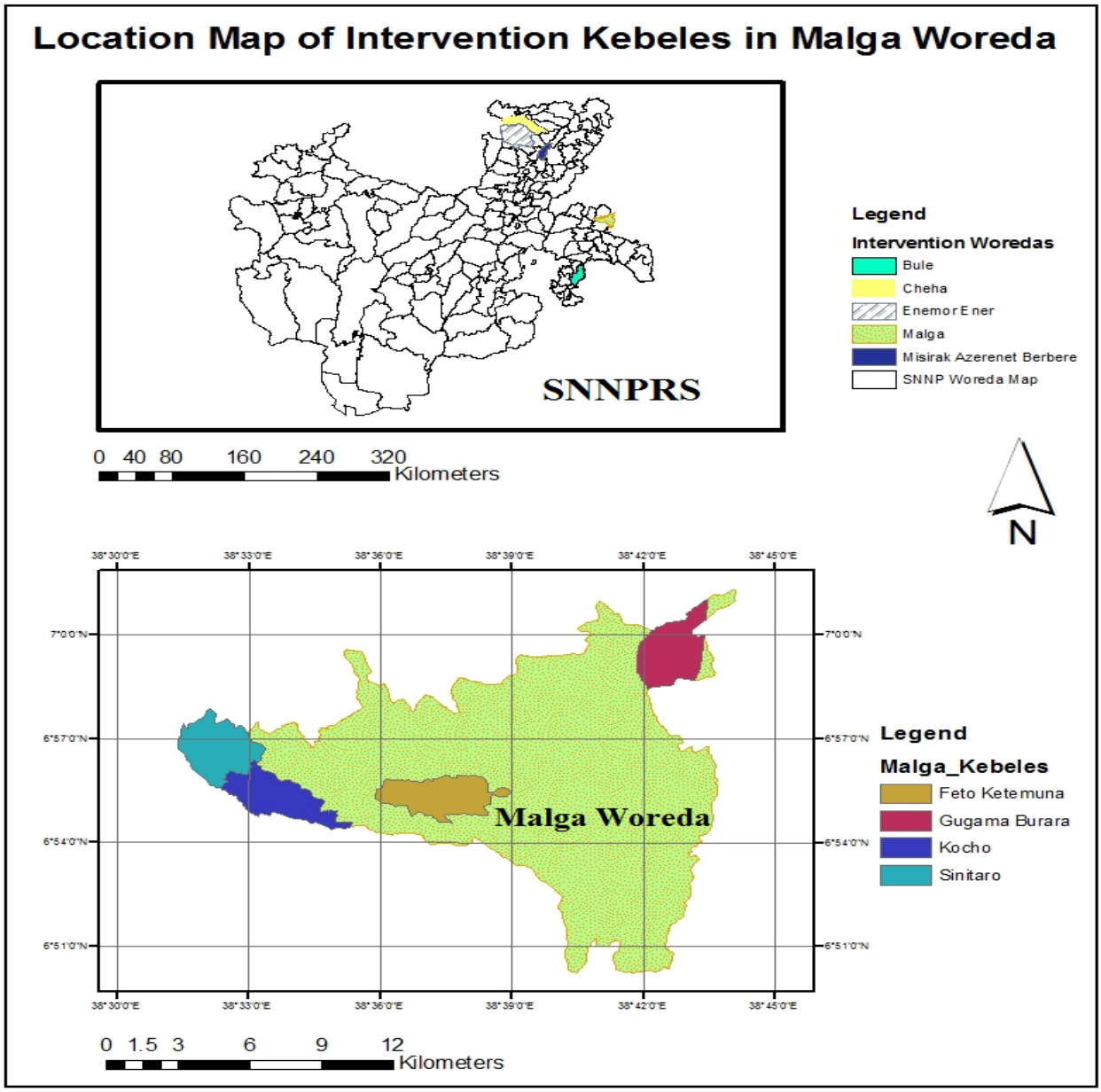


Fig 18. Location and Agro ecology map of Malga Woreda

5.1.2 Overall land use and vegetation

Based on the data from the Woreda, the total land area of Malga is 32,651 hectares (ha) of which an estimated 18,177 ha are under cultivated land, 6,988 ha are used for cereal and Enset production. Among the food crops, barley is the most important crop followed by potato.

In many areas of Guguma Enset, maize Barley and other cereals are commonly cultivated. Enset, maize and Khat are common in Fitoketemena, Sitaro and Kocho Kebele. Farmers in this area classify the soil based on the color of the surface soil. Accordingly they classify red and black soil (in the local language Dumo Busha, and Kolisho Busha respectively). Based on farmers' classification soils Luvisols are classified red soils (Dumo busha) and Cambisols are classified as black soils (Kolisho busha).

5.1.3 Intervention Kebeles

Guguma Kebele

Guguma kebele covering 640 ha. As the topography of the kebele 70 % is flat and the rest is undulation land. The total households of the kebele is estimated to be 1029 of which 510 are female headed and 519 are male headed. Of the total area 287 ha of the land covered with Annual crop followed by perennial crops 210 ha, forest 13 ha, grazing land 73 ha, settlement and other land use cover 57 ha. Farmers usually cultivate different crops especially barley and Enset are common in the area (Woreda office of Agriculture, CASCAPE Working Paper 2.4.3. 2014).

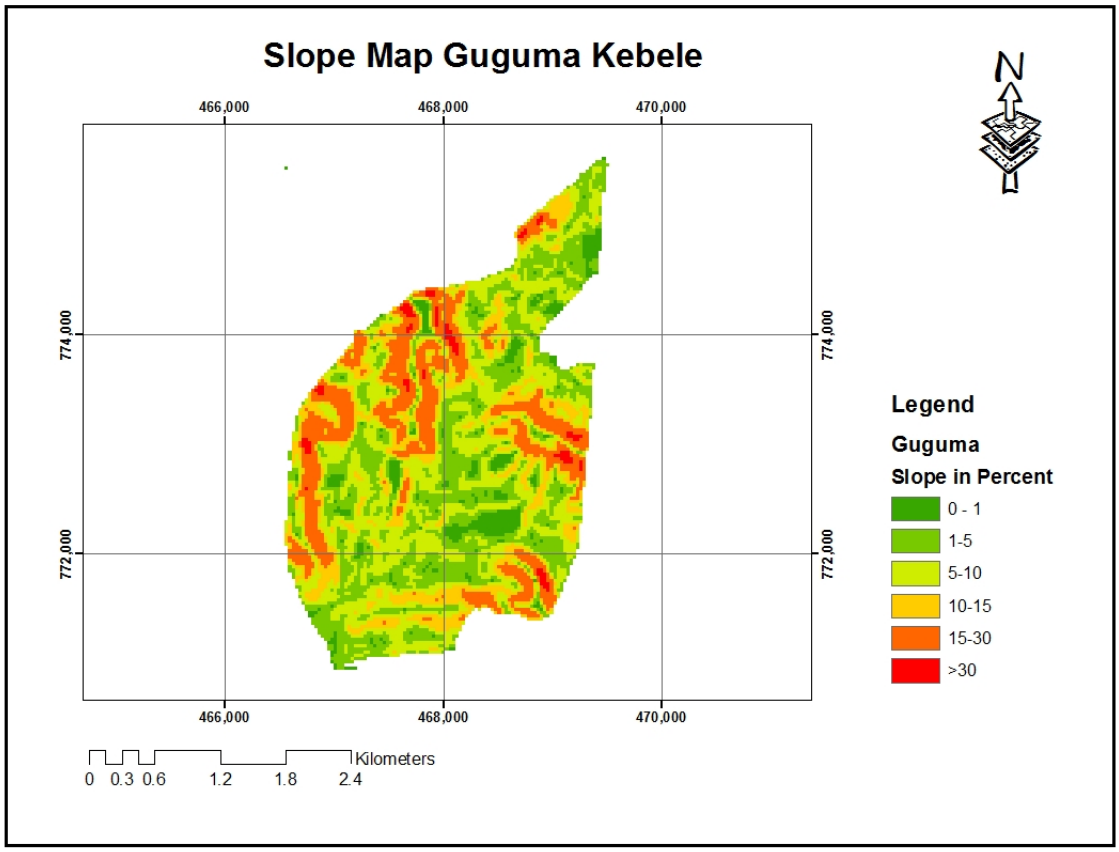


Fig 19. Slope map of Guguma Kebele

Sintaro Kebele

Sintaro kebele covers a total of 830 ha of which 206 ha of the land is cultivated by Annual crops and perennial crops covers 439 ha, 84 ha is covered by forest, 96 ha is left for grazing the other 55 ha is covered by settlement and other land use types. Of the total households 1926 are femel headed and 1910 are male headed. The total population of the kebele is 9450 of which 4700 are male and 4750 are femel. Topographically kebele is characterized by 72% flat land, 15 % undulating and 13 % is steep Slope (CASCAPE Working Paper 2.4.3. 2014).

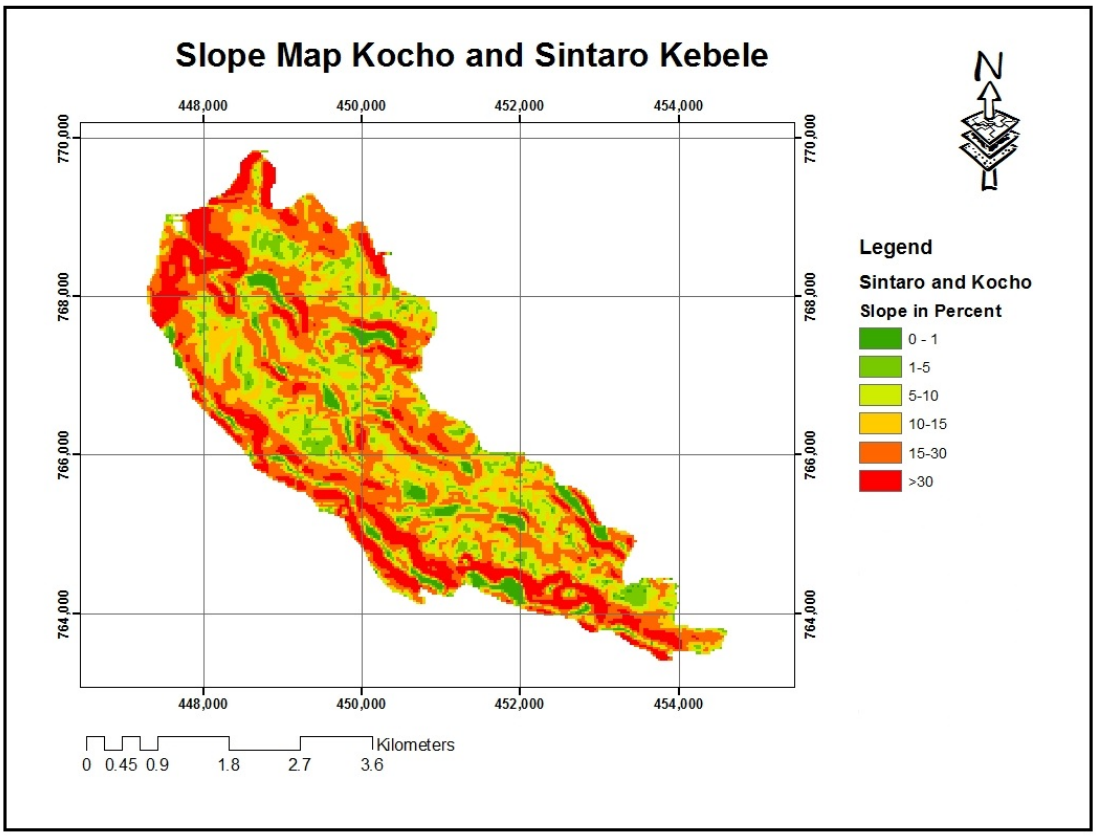


Fig 20 Slope map of Kocho and Sintaro Kebeles

Koche Kebele

One of the low land kebeles of Enemor and ener wored is Gomosh kebele. It covers a total area of 800 ha of which 400 ha is covered by annual crops. Next to annual crops, perineal crops cover 225 ha, forest land 50 ha, grazing land 25, settlement 75 ha and the remaining 25 ha with other different types of land use. There are 1250 householdss in the kebele and 650 are female headed and 600 male headed. The kebele is flat with some areas water logging problem especially in the rainy season. 59 % of the total land is a flat land and the remaining 41 % is undulating. The mean annual rainfall of the kebele is 850 mm and the mean maximum and minimum temperature of the kebele is 28^0c and 23^oc respectively (CASCAPE Working Paper 2.4.3. 2014, Woreda Office of Agriculture).

Fito Ketemuna Kebele

Fito ketemena is a hilly kebele. The total area of the kebele is 772 ha. Annual crops cover 342 ha in the kebele, perennial crops covers large area in the kebele 374 ha, forest 7 ha, grazing 28 ha, and settlement 85 and other land use covers 21 ha. More than 45 % of the total area (350) is undulating, 53% is mountainous and around 10 ha of the land is gorge. Of the total 967 householdss 528 are female headed and the remaining 439 are male headed (CASCAPE Working Paper 2.4.3. 2014, Woreda office of Agriculture).

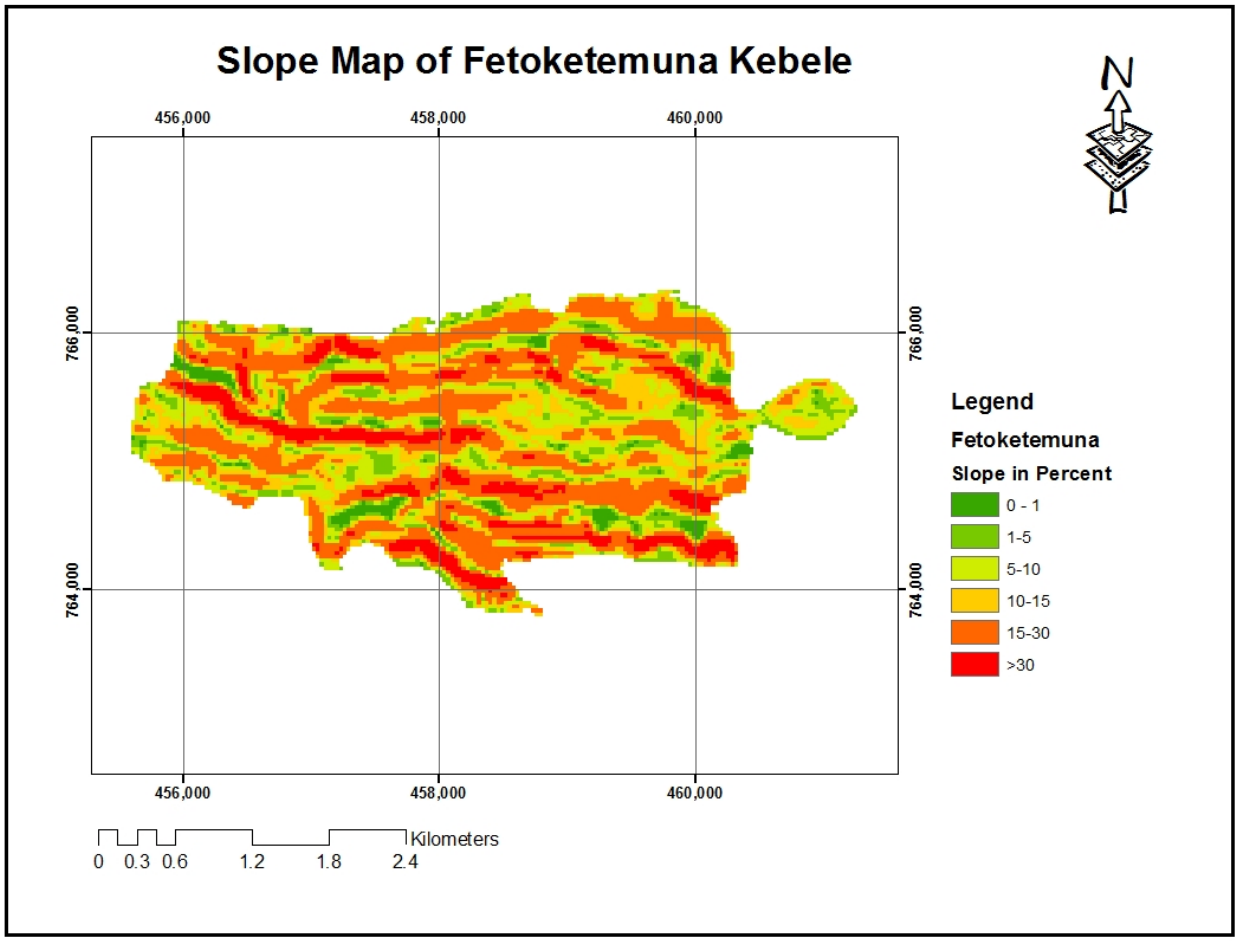


Fig 21. Slope map of Fit Ketemuna Keblele

5.2 Soils of Malga Woreda

5.2.1 The soil-landscape in Malga Woreda

Geomorphically the Woreda is characterized by steep severely dissected side slopes of extinct central volcano and relic volcanic forms, often with small volcano vent cone remnants ((Henricksen et. al., 1984)). Mixed farming (crop production and the rearing of livestock) is widely practised in the Malga Woreda, Major crops grown include barley, Enset, potato, and khat. Other crops cultivated are teff, wheat, maize, cabbage, carrots, faba bean, field pea, garlic, onion and sugar cane. Eucalyptus trees are grown to satisfy demands for firewood, timber for construction purposes and mulch. Cattle, shoat, equines and poultry are the main livestock found in Woreda (CASCAPE Working Paper 2.4.3. 2014).

By considering the topography and area coverage of the intervention Woreda and auger description two soil profiles were opened in each kebeles of Fito Ketemena, Guguma, and Sintaro kebeles. In Kocho one representative soil profile was opened.

5.2.2 Soil profile descriptions with analytical data

5.2.2.1 Profile site description of Fito ketemena Kebele

Profile 1

Profile code	Ma-Ft-P1
Soil classification	Orthoeutric Nitisol
Location	Malga Woreda; Fitoketemena kebele
Coordinates	N 06^0 55" 26' E 38^0 36"21'
Elevation	1981 m
Date	08/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Sloping land, medium gradient valley
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Lower Position Hilly
Slope	Sloping land slope of ±25% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.25 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 31 Soil Description for Ma-Ft-P1

Hor.	Depth cm	Description
Ap	0-21	Dark brown (7.5YR 3/4) sandy Clay loam; moderate very fine to fine, granular structure; friable when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, clear smooth boundary.
Ah	21-43	Dark reddish brown (5YR 3/2) sandy Clay loam; moderate, fine to medium, Sub angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; very fine faint clay coating ; very few, fine roots, gradual smooth boundary.

AB	43-85	Dark reddish brown (2.5YR 2.5/3) sandy clay; moderate, fine to coarse Sub angular blocky structure; very hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few faint clay coating, common, fine pores, diffuse smooth boundary.
Bt1	85-155	Dark reddish brown (2.5 YR 3/4). Clay: Moderate, fine to coarse, angular blocky structure, firm when moist, sticky and plastic when wet, few, prominent clay coating, few fine pores, diffuse smooth boundary.
Bt2	155+	Dark reddish brown (2.5 YR 3/3). Clay: Moderate, fine to coarse, angular blocky structure, friable when moist, sticky and plastic when wet, few, distinct clay coating, few fine pores.

Table 32 Table with analytical data for Ma-Ft-P1

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	5.25	6.27	6.32	5.67	4.66
pH-KCL (1:2.5)	4.45	5.42	5.40	4.83	3.72
EC(ms/cm) (1:2.5)	0.05	0.04	0.05	0.06	0.03
Sand (%)	58.70	49.32	49.40	36.53	36.17
Silt (%)	14.83	17.95	10.01	15.87	17.02
Clay (%)	26.47	32.73	40.59	47.60	46.81
Silt to clay ratio	0.56	0.55	0.25	0.33	0.36
Texture Class	Sandy clay loam	Sandy clay loam	Sandy Clay	clay	clay
Exch. Na(meq/100gm of soil)	0.68	0.48	0.61	0.92	0.79
Exch. K(meq/100 gm of soil))	0.40	0.50	1.74	3.90	1.57
Exch. Ca(meq/100 gm of soil)	17.74	16.43	13.88	15.19	16.96
Exch. Mg(meq/100 gm of soil)	5.91	5.48	5.05	5.06	5.94
Ca/Mg	3.00	3.00	2.75	3.00	2.86
K/Mg	0.07	0.09	0.34	0.77	0.26
Sum of Cations (meq/100gm of soil)	24.73	22.88	21.27	25.07	25.25
CEC(meq/100 gm of soil)	33.98	32.05	29.71	31.19	30.42
Organic Carbon (%)	3.45	1.85	1.16	0.65	0.63
Nitrogen (%)	0.31	0.22	0.13	0.07	0.06
C/N	11.13	8.41	8.92	9.29	10.50
PBS(%)	72.78	71.42	71.63	80.38	83.04
Available P(mg P_2O_5/kg soil)	21.70				
Bulk density (gm/ Cm^3)	1.10	1.14	1.14	1.17	1.09
Available S (%)	1.77				
Exchangeable Sodium %(ESP)	2.00	1.49	2.04	2.94	2.61
Micronutrient					
Zn (mg/kg soil)	23.30				
Mn (mg/kg soil)	78.10				
Cu (mg/kg soil)	0.34				

Fe (mg/kg soil)	109.93				

Profile 2

Profile code	Ma-Ft-P2
Soil classification	Chromic Rhodic Luvisol
Location	Malga Woreda; Fitoketemena kebele
Coordinates	N 06^0 55" 48' E 38^0 37"32'
Elevation	2512 m
Date	09/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Sloping land, medium gradient hill
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Rolling to Hilly
Slope	Sloping land slope of ±20% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.25 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	No
Human influence	Mixed agriculture

Table 33 Soil description for Ma-Ft-P2

Hor.	Depth cm	Description
Ap	0-18	Dark reddish brown (5YR 3/3) Clay; weak very fine, granular structure; hard when dry, friable when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
Ah	18-35	Dark reddish brown (2.5YR 3/3) sandy Clay; weak, very fine to medium, Sub angular blocky structure; hard when dry, friable when moist, slightly sticky and non-plastic when wet; common, fine pores;; very few, fine roots, diffuse smooth boundary.

Bt1	35-66	Dark reddish brown (2.5YR 3 /3) clay; moderate, very fine to medium angular blocky structure; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; few faint clay coating, common, fine pores, diffuse smooth boundary.
Bt2	66-115	Dark reddish brown (2.5 YR 2.5/4). Clay: Moderate, fine to coarse, angular blocky structure, friable when moist, sticky and plastic when wet, common distinct clay coating, few fine pores, clear smooth boundary.
Bt3	115+	Red (2.5 YR 4/6). Clay: Moderate, very fine to fine, angular blocky structure, firm when moist, sticky and plastic when wet, few, faint clay coating, few fine pores.

Table 34 Table with analytical data fro Ma-Ft-P2

Horizon	AP	Ah	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	5.7	4.94	4.02	3.88	4.77
pH-KCL (1:2.5)	4.9	4.17	3.09	3.02	3.82
EC(ms/cm) (1:2.5)	0.04	0.03	0.03	0.04	0.08
Sand (%)	34.65	46.77	43.32	33.86	23.31
Silt (%)	18.97	4.26	13.90	18.14	24.10
Clay (%)	46.38	48.97	42.77	48.01	52.59
Silt to clay ratio	0.41	0.09	0.32	0.38	0.46
Texture Class	clay	Sandy clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.75	0.88	0.90	0.57	0.80
Exch. K(meq/100 gm of soil)	0.32	0.40	0.32	0.39	0.50
Exch. Ca(meq/100 gm of soil)	17.64	18.66	14.42	12.72	13.95
Exch. Mg(meq/100 gm of soil)	5.88	5.94	4.24	4.24	5.23
Ca/Mg	3.00	3.14	3.40	3.00	2.67
K/Mg	0.05	0.07	0.08	0.09	0.10
Sum of Cations (meq/100gm of soil)	24.59	25.88	19.87	17.92	20.48
CEC(meq/100 gm of soil)	31.96	34.10	27.19	26.27	28.43
Organic Carbon (%)	2.15	1.54	1.06	1.05	0.69
Nitrogen (%)	0.25	0.18	0.13	0.10	0.08
C/N	8.60	8.56	8.15	10.50	8.63
PBS(%)	76.94	75.89	73.12	68.21	72.04
Available P(mg P_2O_5/kg soil)	26.80	23.70			
Bulk density (gm/ Cm^3)	1.07	1.10	1.12	1.04	1.06
Available S (%)	1.43	1.25			
Exchangeable Sodium %(ESP)	2.34	2.59	3.32	2.18	2.80
Micronutrient					
Zn (mg/kg soil)	35.15	15.54			
Mn (mg/kg soil)	50.28	64.80			

Cu (mg/kg soil)	0.57	0.47			
Fe (mg/kg soil)	84.99	84.73			

5.2.2.2. Profile site description Guguma Kebele

Profile 1

Site characteristics

Profile code	**Ma-Gu-P1**
Soil classification	Haplic Luvisol
Location	Malga Woreda; Guguma kebele
Coordinates	N 06^0 59" 21' E 38^0 42"32'
Elevation	2656 m
Date	10/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level Land, plain
Local physiography	Level land form
Soil drainage	well drained
Macro relief	Flat Area
Slope	Level straight land slope of ±5% over more than 10 km long.
Land use	Mixed cropping, intensive land use. Enset and Barly are the main crops; other crops are khat. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	In rainy season
Human influence	mixed agriculture

Table 35 Soil Description for Ma-Gu-P1

Hor.	Depth cm	Description
Ap	0-20	Dark reddish gray (2.5YR 3/1) Clay loam; moderate very fine to fine, granular structure; hard when dry, friable when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.

Ah	20-42	Very Dark gray (7.5YR 3/1) sandy Clay loam; moderate, very fine to medium, Sub angular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common, fine pores;; very few, fine roots, clear smooth boundary.
Bt1	42-88	Brown (10YR 4 /3) clay loam; strong, very fine to medium Sub angular blocky structure; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; common, fine pores, clear smooth boundary.
Bt2	88-129	Olive brown (2.5 YR 4/4). Sandy Clay: Moderate, fine to medium, angular blocky structure, friable when moist, sticky and plastic when wet, few fine pores, clear smooth boundary.
Bt3	129+	Brown (10 YR 4/3). Clay: strong, medium to coarse, angular blocky structure, very had when dry, very firm when moist, sticky and plastic when wet, few, few fine pores.

Table 36 with analytical data for Ma-Gu-P1

Horizon	AP	Ah	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	5.69	6.10	6.08	4.88	5.95
pH-KCL (1:2.5)	5.30	5.81	5.38	3.36	4.86
EC(ms/cm) (1:2.5)	0.07	0.06	0.05	0.02	0.05
Sand (%)	34.63	45.90	42.03	49.60	35.83
Silt (%)	31.63	20.81	22.77	14.70	17.11
Clay (%)	33.74	33.29	35.20	35.70	47.06
Silt to clay ratio	0.94	0.63	0.65	0.41	0.36
Texture Class	Clay loam	Sandy clay loam	Clay loam	Sandy clay	clay
Exch. Na(meq/100gm of soil)	0.99	0.85	0.90	0.93	0.87
Exch. K(meq/100 gm of soil)	0.57	0.47	0.43	0.54	0.71
Exch. Ca(meq/100 gm of soil)	17.66	19.12	13.24	15.09	14.48
Exch. Mg(meq/100 gm of soil)	5.89	5.82	4.14	5.87	5.11
Ca/Mg	3.00	3.29	3.20	2.57	2.83
K/Mg	0.10	0.08	0.10	0.09	0.14
Sum of Cations (meq/100gm of soil)	25.10	26.25	18.71	22.43	21.18
CEC(meq/100 gm of soil)	36.56	37.04	28.32	34.17	31.95
Organic Carbon (%)	2.76	2.37	0.65	0.30	0.27
Nitrogen (%)	0.22	0.16	0.07	0.03	0.02
C/N	12.55	14.81	9.29	10.00	13.50
PBS(%)	68.68	70.90	66.07	65.64	66.26
Available P(mg P_2O_5/kg soil)	39.30				
Bulk density (gm/ Cm^3)	1.15	1.15	1.30	1.31	1.29
Available S (%)	1.73				
Exchangeable Sodium %(ESP)	2.70	2.29	3.17	2.72	2.72

Micronutrient					
Zn (mg/kg soil)	24.04				
Mn (mg/kg soil)	58.33				
Cu (mg/kg soil)	0.93				
Fe (mg/kg soil)	68.22				

Profile 2

Profile code	**Ma-Gu-P2**
Soil classification	Haplic Luvisol
Location	Malga Woreda; Guguma kebele
Coordinates	N 06^0 59" 24' E 38^0 42"07'
Elevation	2661 m
Date	11/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	level land, plain
Local physiography	Level land form
Soil drainage	well drained
Macro relief	Flat Area
Slope	Level straight land slope of ±5% over more than 10 km long.
Land use	Mixed cropping, intensive land use. Enset and Barley are the main crops; other crops are khat. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	None
Surface stones	None
Erosion	Moderate Water erosion
Flooding	In rainy season
Human influence	Mixed agriculture

Table 37 Soil Description for Ma-Gu-P1

Hor.	Depth cm	Description
Ap	0-25	Dark brown (7.5YR 3/2) sandy Clay; weak fine to medium, granular structure; hard when dry, loose when moist, non-sticky and non-plastic when wet; Few fine pores; common, fine, roots, clear smooth boundary.

Bt1	25-63	Dark reddish brown (10YR 4/4) Clay; moderate, very fine to medium, Sub angular blocky structure; very friable when moist, sticky and plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary.
Bt2	63-90	Brown (10YR 4 /3) clay loam; moderate, fine to coarse angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common, fine pores, gradual smooth boundary.
Bt3	90-148	Yellowish brown (10 YR 5/4). Clay: weak, fine to medium, angular blocky structure, friable when moist, sticky and plastic when wet, few fine pores, clear smooth boundary.
C	148+	Brown (7.5 YR 4/4). Clay: weak fine to coarse, angular blocky structure, very firm when moist, sticky and plastic when wet, few, few fine pores.

Table 38 Table with analytical data for Ma-Gu-P1

Horizon	AP	Bt1	Bt2	Bt3	C
pH-H_2O (1:2.5)	5.67	5.99	5.17	4.78	5.24
pH-KCL (1:2.5)	4.95	5.16	4.39	3.87	4.37
EC(ms/cm) (1:2.5)	0.12	0.08	0.05	0.07	0.05
Sand (%)	54.43	38.06	42.28	26.02	34.93
Silt (%)	9.54	20.65	24.74	24.88	23.86
Clay (%)	36.03	41.30	32.98	49.11	41.21
Silt to clay ratio	0.26	0.50	0.75	0.51	0.58
Texture Class	Sandy clay	clay	Clay loam	Clay	clay
Exch. Na(meq/100gm of soil)	0.94	0.74	0.61	0.80	0.75
Exch. K(meq/100 gm of soil)	2.23	1.59	0.99	1.42	0.82
Exch. Ca(meq/100 gm of soil)	18.59	14.85	15.66	22.61	21.56
Exch. Mg(meq/100 gm of soil)	6.76	4.12	4.94	7.38	7.76
Ca/Mg	2.75	3.60	3.17	3.06	2.78
K/Mg	0.33	0.39	0.20	0.19	0.11
Sum of Cations (meq/100gm of soil)	28.51	21.29	22.20	32.21	30.89
CEC(meq/100 gm of soil)	35.81	30.48	26.87	37.25	37.50
Organic Carbon (%)	3.45	0.69	0.63	0.44	0.35
Nitrogen (%)	0.25	0.07	0.06	0.04	0.03
C/N	13.80	9.86	10.50	11.00	11.67
PBS(%)	79.64	69.88	82.62	86.47	82.37
Available P(mg P_2O_5/kg soil)	39.60				
Bulk density (gm/ Cm^3)	1.04	1.23	1.32	1.19	1.12
Available S (%)	1.70				

Exchangeable Sodium %(ESP)	2.62	2.41	2.27	2.14	2.00
Micronutrient					
Zn (mg/kg soil)	22.88				
Mn (mg/kg soil)	51.00				
Cu (mg/kg soil)	2.26				
Fe (mg/kg soil)	102.24				

5.2.2.3. Profile site description Kocho Kebele

Profile 1

Profile code	**Ma-Ko-P1**
Soil classification	Chomic Luvisols
Location	Malga Woreda; Kocho kebele
Coordinates	N 06^0 55" 54' E 38^0 33"01'
Elevation	2138 m
Date	12/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Sloping land, dissected plain
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Rolling to Hilly
Slope	Hilly land slope of ±15% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.25 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 39 Soil Description for Ma-Ko-P1

Hor.	Depth cm	Description

Ap	0-22	Dark reddish brown (5YR 3/2) Sandy Clay loam; weak fine to medium, granular structure; very friable when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, clear smooth boundary.
Ah	22-71	Dusky red (2.5YR 3/2) Clay; moderate, fine to medium, Sub angular blocky structure; very friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; very few, fine roots, diffuse smooth boundary.
Bt1	71-90	Dusky red (2.5YR 3 /2) clay; moderate, fine to coarse angular blocky structure; friable when moist, sticky and plastic when wet; few faint clay coating, common, fine pores, very few, fine roots, gradual smooth boundary.
Bt2	90-129	Dusky red (10 R 3/3). Clay: Moderate, fine to coarse, angular blocky structure, friable when moist, sticky and plastic when wet, common distinct clay coating, few fine pores, gradual smooth boundary.
Bt3	129+	Dark reddish brown (2.5 YR 2.5/3). Clay: Moderate, fine to coarse, angular blocky structure, friable when moist, sticky and plastic when wet, few, faint clay coating, few fine pores.

Table 40 Table with analytical data for Ma-Ko-P1

Horizon	AP	Ah	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	6.38	6.31	5.67	5.55	5.27
pH-KCL (1:2.5)	5.49	5.44	4.78	4.63	4.37
EC(ms/cm) (1:2.5)	0.13	0.07	0.06	0.07	0.06
Sand (%)	48.25	30.50	28.79	28.47	25.18
Silt (%)	20.06	27.38	25.90	20.59	22.77
Clay (%)	31.68	42.12	45.32	50.94	52.05
Silt to clay ratio	0.63	0.65	0.57	0.40	0.44
Texture Class	Sandy clay loam	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.61	0.51	1.25	0.77	1.01
Exch. K(meq/100 gm of soil)	1.65	1.56	0.80	0.56	0.57
Exch. Ca(meq/100 gm of soil)	14.74	15.96	20.60	19.82	21.56
Exch. Mg(meq/100 gm of soil)	5.48	5.88	6.87	6.89	7.76
Ca/Mg	2.69	2.71	3.00	2.88	2.78
K/Mg	0.30	0.27	0.12	0.08	0.07
Sum of Cations (meq/100gm of soil)	22.48	23.91	29.52	28.04	30.91
CEC(meq/100 gm of soil)	32.05	31.50	34.06	32.78	37.50
Organic Carbon (%)	1.79	1.13	0.74	0.55	0.46
Nitrogen (%)	0.19	0.13	0.11	0.08	0.06
C/N	9.42	8.69	6.73	6.88	7.67
PBS(%)	70.14	75.90	86.67	85.54	82.40
Available P(mg P_2O_5/kg soil)	33.70				

Bulk density (gm/ Cm^3)	1.04	1.12	1.16	1.16	1.21
Available S (%)	1.30				
Exchangeable Sodium %(ESP)	1.91	1.62	3.67	2.34	2.70
Micronutrient					
Zn (mg/kg soil)	24.90				
Mn (mg/kg soil)	69.80				
Cu (mg/kg soil)	1.39				
Fe (mg/kg soil)	70.65				

Surface Soil pH is Acidic

5.2.2.4. Profile site description Sintaro Kebele

Profile 1

Profile code	Ma-Si-P1
Soil classification	Chromic Cambisols
Location	Malga Woreda; Sintaro kebele
Coordinates	N 06^0 56" 07' E 38^0 32"42'
Elevation	2079 m
Date	13/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	level land, Depression
Local physiographic	Flat area
Macro relief	rolling to Hilly
Soil drainage	well drained
Slope	Hilly land slope of ±7% over more than 2 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.25 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	In rainy season
Human influence	mixed agriculture

Table 41 Soil Descriptionfor Ma-Si-P1

Hor.	Depth cm	Description
Ap	0-20	Brown (10YR 4/3) Sandy Clay loam; weak very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, clear smooth boundary.
Ah	20-45	Very dark grayish brown (10YR 3/2) Sandy Clay loam; moderate, fine to coarse Sub angular blocky structure; very friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; few faint clay coating; very few, fine roots, clear smooth boundary.
Bw1	45-63	Olive brown (2.5Y 4 /3) clay loam; moderate, fine to coarse Sub angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common, fine pores, very few, fine roots, gradual smooth boundary.
Bw2	63-80	Reddish brown (2.5 YR 4/4). Sandy Clay loam: Moderate, very fine to medium Sub angular blocky structure, firm when moist, non-sticky and non-plastic when wet, common distinct clay coating, and few fine pores, clear smooth boundary.
C1	80-99	Greenish gray (Glay1 6/5GY). Sandy Clay loam: weak very fine to medium, Sub angular blocky structure, firm when moist, non-sticky and non-plastic when wet, few fine pores, clear smooth boundary
C2	99-150	Olive gray (5 Y 4/2). Sandy Clay loam: weak, very fine to medium, Sub angular blocky structure, firm when moist, non-sticky and non-plastic when wet, few fine pores, clear smooth boundary.
C3	150+	Dark reddish brown (2.5 Y 3/3). Sandy Clay loam: weak very fine to medium, Sub angular blocky structure, firm when moist, non-sticky and non-plastic when wet, few fine pores

Table 42 table with analytical data for Ma-Si-P1

Horizon	AP	Ah	Bw1	Bw2	C1	C2	C3
pH-H_2O (1:2.5)	4.48	4.87	5.02	5.35	5.98	5.83	6.03
pH-KCL (1:2.5)	3.59	4.06	4.07	4.49	5.18	5.02	5.17
EC(ms/cm) (1:2.5)	0.03	0.04	0.04	0.04	0.03	0.03	0.03
Sand (%)	58.34	52.74	39.04	61.43	67.66	65.69	61.41
Silt (%)	8.33	17.47	28.45	12.18	8.09	8.07	10.15
Clay (%)	33.33	29.79	32.51	26.39	24.26	26.24	28.43
Silt to clay ratio	0.25	0.59	0.88	0.46	0.33	0.31	0.36
Texture Class	Sandy clay loam	Sandy clay loam	Clay loam	Sandy clay loam	Sandy clay loam	Sandy clay loam	Sandy clay loam
Exch. Na(meq/100gm of soil)	0.60	0.64	0.71	0.69	0.58	0.74	0.52
Exch. K(meq/100 gm of soil)	0.41	0.28	0.21	0.72	2.30	1.97	2.42
Exch. Ca(meq/100 gm of soil)	17.47	14.79	16.26	16.24	13.75	14.53	14.21
Exch. Mg(meq/100 gm of soil)	5.82	4.93	5.69	5.68	4.85	5.65	4.87
Ca/Mg	3.00	3.00	2.86	2.86	2.84	2.57	2.92
K/Mg	0.07	0.06	0.04	0.13	0.47	0.35	0.50
Sum of Cations (meq/100gm of soil)	24.30	20.65	22.86	23.33	21.48	22.88	22.02
CEC(meq/100 gm of soil)	30.75	26.79	27.83	29.13	26.37	26.76	30.45
Organic Carbon (%)	1.32	1.19	0.75	0.42	0.38	0.37	0.31
Nitrogen (%)	0.13	0.10	0.07	0.04	0.04	0.03	0.02
C/N	10.15	11.90	10.71	10.50	9.50	12.33	15.50
PBS(%)	79.02	77.04	82.18	80.09	81.46	85.54	72.32
Available P(mg P_2O_5/kg soil)	32.80	26.50					
Bulk density (gm/ Cm^3)	1.06	1.14	1.29	1.23	1.15	1.15	1.06
Available S (%)	1.55	1.13					
Exchangeable Sodium %(ESP)	1.94	2.40	2.54	2.36	2.20	2.75	1.71

Micronutrient							
Zn (mg/kg soil)	9.24	8.29					
Mn (mg/kg soil)	51.73	38.54					
Cu (mg/kg soil)	0.43	0.73					
Fe (mg/kg soil)	83.30	97.12					

Profile 2

Profile code	Ma-Si-P2
Soil classification	Orthoeutric Nitisol
Location	Malga Woreda; Sintaro kebele
Coordinates	N 06^0 56" 23' E 38^0 33"00'
Elevation	2124 m
Date	13/04/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Hilly
Local physiographic	Upper Slope
Soil drainage	well drained
Macro relief	rolling to Hilly
Slope	Level Plain land slope of ±4% over more than 2 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.25 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 43 Soil Description for Ma-Si-P2

Hor.	Depth cm	Description
Ap	0-22	Very dark brown (7.5YR 2.5/2) Sandy Clay loam; weak very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
Ah	22-48	Dark reddish brown (5YR 2.5/2) Sandy Clay loam; moderate, fine to coarse Sub angular blocky structure; very friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; few faint clay coating; very few, fine roots, gradual smooth boundary.

Bt1	48-71	Dark Reddish brown (2.5Y 2.5 /3) clay loam; moderate, fine to coarse Sub angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common, fine pores, very few, fine roots, gradual smooth boundary.
Bt2	71-120	Dusky red (10 R 3/3). Sandy Clay loam: Moderate, very fine to medium Sub angular blocky structure, firm when moist, non-sticky and non-plastic when wet, common distinct clay coating, and few fine pores, clear smooth boundary.
BC	120+	Dark Brown (10YR 3/3). Sandy Clay loam: weak very fine to medium, Sub angular blocky structure, firm when moist, non-sticky and non-plastic when wet, common faint clay coating, few fine pores

Table 44 Table with analytical data for Ma-Si-P2

Horizon	AP	Ah	Bt1	Bt2	BC
pH-H_2O (1:2.5)	6.07	7.35	6.31	5.03	7.65
pH-KCL (1:2.5)	5.25	6.49	5.48	4.16	6.78
EC(ms/cm) (1:2.5)	0.07	0.08	0.10	0.09	0.20
Sand (%)	60.70	41.95	35.61	24.83	46.39
Silt (%)	9.31	24.28	17.17	17.18	11.56
Clay (%)	29.99	33.77	47.22	57.99	42.05
Silt to clay ratio	0.31	0.72	0.36	0.30	0.27
Texture Class	Sandy clay loam	Clay loam	clay	clay	Sandy clay
Exch. Na(meq/100gm of soil)	0.34	0.63	0.56	1.06	0.54
Exch. K(meq/100 gm of soil)	0.72	1.13	0.65	0.62	1.67
Exch. Ca(meq/100 gm of soil)	14.88	20.22	18.80	22.24	23.08
Exch. Mg(meq/100 gm of soil)	5.37	6.74	5.98	6.84	7.97
Ca/Mg	2.77	3.00	3.14	3.25	2.90
K/Mg	0.13	0.17	0.11	0.09	0.21
Sum of Cations (meq/100gm of soil)	21.30	28.72	25.99	30.76	33.26
CEC(meq/100 gm of soil)	27.40	38.92	39.93	40.90	40.59
Organic Carbon (%)	3.09	1.76	1.32	0.70	1.10
Nitrogen (%)	0.25	0.21	0.13	0.07	0.10
C/N	12.36	8.38	10.15	10.00	11.00
PBS(%)	77.77	73.79	65.09	75.21	81.94
Available P(mg P_2O_5/kg soil)	30.60				
Bulk density (gm/ Cm^3)	1.15	1.18	1.09	1.09	1.09
Available S (%)	1.38				
Exchangeable Sodium %(ESP)	1.25	1.62	1.40	2.59	1.33
Micronutrient					
Zn (mg/kg soil)	21.73				
Mn (mg/kg soil)	59.61				

Cu (mg/kg soil)	1.16				
Fe (mg/kg soil)	70.73				

5.3 Synthesis

Undulating kebeles like Fito and Sintaro kebeles are characterized by different soils, while Flat kebeles like Guguma and Kocho are dominated by one type of soil. The dominant soil type in the Woreda is Luvisols, well drained, very deep, dark red, well structured, clay loam to clay soils with a general increase in clay contents from topsoil to subsoil; Silt to clay ration of the sub surface horizon greater than 0.4, with thick (over 25 cm) dark reddish top soils. These soils are found in Guguma, Kocho, and half of both Sitaro and Fitoketumena kebeles.

In the upper profile of Sitaro and lower profiles of Fitoketumena Nitosols, which are deep (> 2m), dark reddish brown in color , strongly weathered clay soils with shiny ped faces, gradual boundaries that makes the horizon identification very difficult, high clay content in the subsurface horizon with Silt to clay ratio less than 0.40 for the subsurface horizon. The above properties give Nitosols of Malga to have a nitic horizon. In the lower parts of Sitaro Cambisols are found. These Cambisols have a colluvic material formed from sedimentation through erosion from the upper areas. These soils are characterized by a cumbic horizon with texture of sandy clay loam or finer, higher chroma (> 3), redder Hue (2.5 YR), and higher clay content in the subsurface horizon than the surface horizon.

All surface horizons of Luvisols in Malga area had a weak to moderate granular structure. The subsurface horizons had both Sub angular and angular blocky structure. The better developed structure of the subsurface soils could be due to the relatively higher clay content of the subsurface horizons than that of the surface horizons (Ahn, 1993). The consistency of the soils in the surface layers of all pedons was found to be similar. In all cases the consistency of the surface soils was friable, non-sticky and non-plastic. On the other hand, the moist consistency of the subsurface horizons ranged from friable to firm, whereas the range was from to slightly sticky/slightly plastic to sticky/plastic when wet. The friable and slightly sticky/slightly plastic consistency observed in the surface horizons of all pedons could be attributed to the relative higher organic matter content of the surface than subsurface layers. In all pedons, clay content increased with increasing soil depth, forming argic horizons. Moreover, both the sand and silt contents were generally higher in the surface soil. According to Boul et al. (2003), the accumulation of clay in the subsurface horizon could be also contributed by the in situ synthesis of secondary clays, the weathering of primary minerals in the B horizon, or the residual concentration of clays from the selective dissolution of more soluble minerals of coarser grain sized in the B horizon. Because it is also used in the evaluation of clay migration, stage of weathering and age of parent material and soils, Silt/clay ratio is an important criterion used in the classification of tropical soils. The more highly weathered a soil is, the lower the silt fraction. Therefore, soils with silt/clay ratio of less than 0.15 are regarded as highly weathered (Van Wambeke, 1962). In all the cases of Luvisols (except

for fito ketumena profile 2 Ah horizone) the Silt to clay ratio is greater than 0.27 meaning that Luvisols of Malga Woreda are young soils in terms of weathering.

Some Luvisols of Malga Woreda are found to be very acidic. For example in Fito Ketemena both the surface and the sub surface horizons are very acidic with pH value less than 4.97 (reaching up to 3.88). According to London (1984) soils having pH value less than 5.5 are categorized as acidic soils. Therefore acidity could limit production and there should be application of lime based additional laboratory tests for lime requirementinorder to solve the problem. The CEC value of a soil tells the fertility status of a soil. Luvisols in malga Woreda are found to be less than 40 Cmolc/Kg of soil for the surface and subsurface horizons. According to London (1984) soils having CEC value between 25 to 40 Cmolc/Kg of clay soil are less fertile and may need some of lime. Ethiopian soils are assumed to have adequate amount of potassium. For Luvisols of Malga Woreda most soils have available potassium content in adequate amount for plant growth. According to London (1984) other cations like magnesium and calcium are found in adequate amount. In all Luvisols of Malga Woreda available Phosphorus content is high. But Phosphorus uptake will be inhibited when calcium to magnesium ratio is < 3:1. Some surface horizons have calcium to magnesium ratio less than 3:1 (Ma-Gu-P2 with 2.75 and Kocho soils indicating that phosphorus uptake may be inhibited in these kebeles. This is also an indication for the need of application of lime in the area. The potassium to magnesium ratio of Luvisols in the area is less than 1:1. According to London (1984) if potassium to magnesium ratio less than 1:1, vegetable and sugar beet production will be affected. As all the surface and sub surface horizons of Luvisols in Malga have potassium to magnesium ratio has less that 0.39:1, then vegetable and sugar beet production is not recommended. Amount of total nitrogen are found in Luvisols of Maga Woreda is variable. Luvisols in Kocho have low Nitorgen content (London 1991). Other Luvisols in Guguma and Fito have Medium level of nitrogen. The presence of low nitrogen content could be due to crop removal and intensive plowing which favors organic matter decomposition.

In the upper profile of Sitaro and lower profiles of Fitoketumena deep (> 2m), dark reddish brown in color , strongly weathered clay soils with shiny ped faces, gradual boundaries that makes the horizon identification very difficult, high clay content Nitosols were found. The subsurface horizons have Silt to clay ratio less than 0.40.

The subsurface horizons of Nitosols in malga Woreda had both Sub angular and angular blocky structure. Surface horizons had a weak to moderate granular structure. The better developed structure of the subsurface soils could be due to the relatively higher clay content of the subsurface horizons than that of the surface horizons (Ahn, 1993). The consistency of the soils in the surface layers of all pedons are found to be similar in that surface soils are friable, non-sticky and non-plastic. On the other hand, the moist consistency of the subsurface horizons ranged from friable to firm, whereas the range was from to sticky and plastic when wet. The sticky and plastic consistency observed in the sub surface horizons of all pedons could be attributed to the relative higher clay content in the sub surface horizons. In all pedons, clay content increased with increasing soil depth. Having Silt to clay ratio of the sub surface horizon less than 0.40. They have nitic

horizon with gradual to diffuse horizon boundary. Moreover, both the sand and silt contents were generally higher in the surface soil. According to Boul et al. (2003), the accumulation of clay in the subsurface horizon could be also contributed by the in situ synthesis of secondary clays, the weathering of primary minerals in the B horizon, or the residual concentration of clays from the selective dissolution of more soluble minerals of coarser grain sized in the B horizon.

Nitosols in Fito ketumena kebele are found to be acidic in the surface horizons with pH 5.25. According to London (1984) soils having pH value less than 5.5 are categorized as acidic soils. Therefore acidity could limit production and there should be application of lime based additional laboratory tests for lime requirementinorder to solve the problem. According to London (1984) soils with CEC value between 2.-40 Cmolc/Kg of soil are categorized high but may need small quantity of lime and potassium. Nitosols in malga Woreda have CEC value between 25-40 Cmolc/Kg of soil. Surface horizons in Nitosols ogf Fito kebele havemedium levele of Potassium and Nitosols of Sitaro have adequate amount of potassium. Cations like magnesium and calcium are found in adequate amount for Nitosols of malga Woreda. In all Nitosols of malga available Phosphorus content is high (London 1991). Amount of total nitrogen are found in Nitisols of Maga Woreda is found to be adequate.

Cambisols in Sintaro are Brown in color with granular surface structure. They have subangular structure in the subsurface horizon and have cumbic shrizon which could develop the deposition of materials from the upper areas of Kocho and Sintaro. The Silt to clay ration is greater than 0.15 indicatinfthey are yound interms of weathering stage. But they have calsium to Magnesium ratio of 3 for surface horizons and less than 3 for sub surface horizons. This indicates that although available phosphrous in such soils is in adequate amount the uptake could be depressed and therefore application of phosphrous fertilizer could have a response. Moreover, the pH of the surface soils in Cambisols of Malge is less than 5.5 indicating the need for liming based on appropriet laboratory test. Nitrogen and organic carbon content in such soils is found in low and very low amount. Therefor, application of nitrogen fertilizer and organic matter could increase the nutrient quality of the soils in the area.

Fig 22. Sample Soil Profile at Fito Ketumena Kebele (Chromic Luvisols)

Fig 23Sample soil profile in Sitaro(Chromic Cambisol).

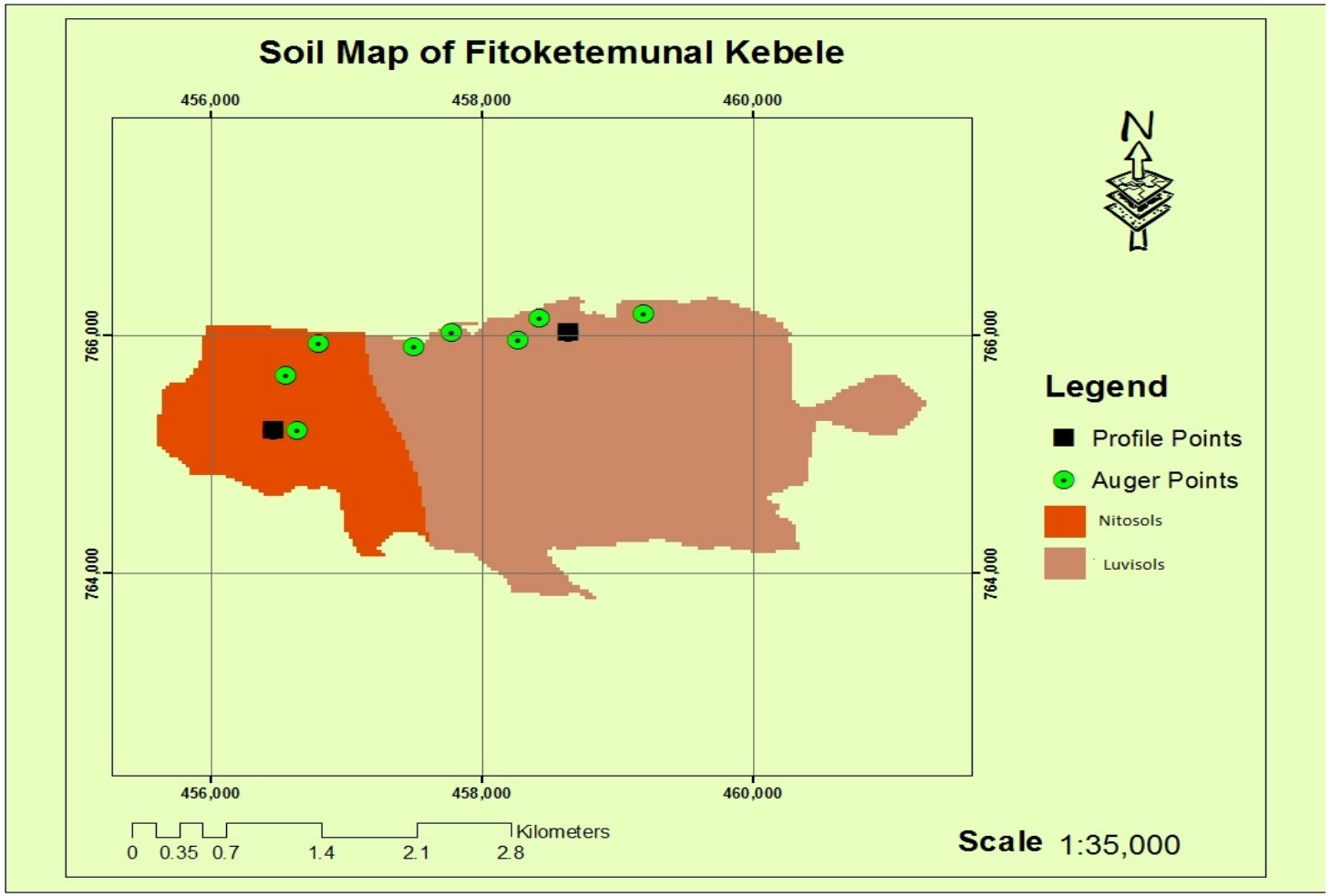


Fig 24 Soil Map of Fitoketemena Kebele

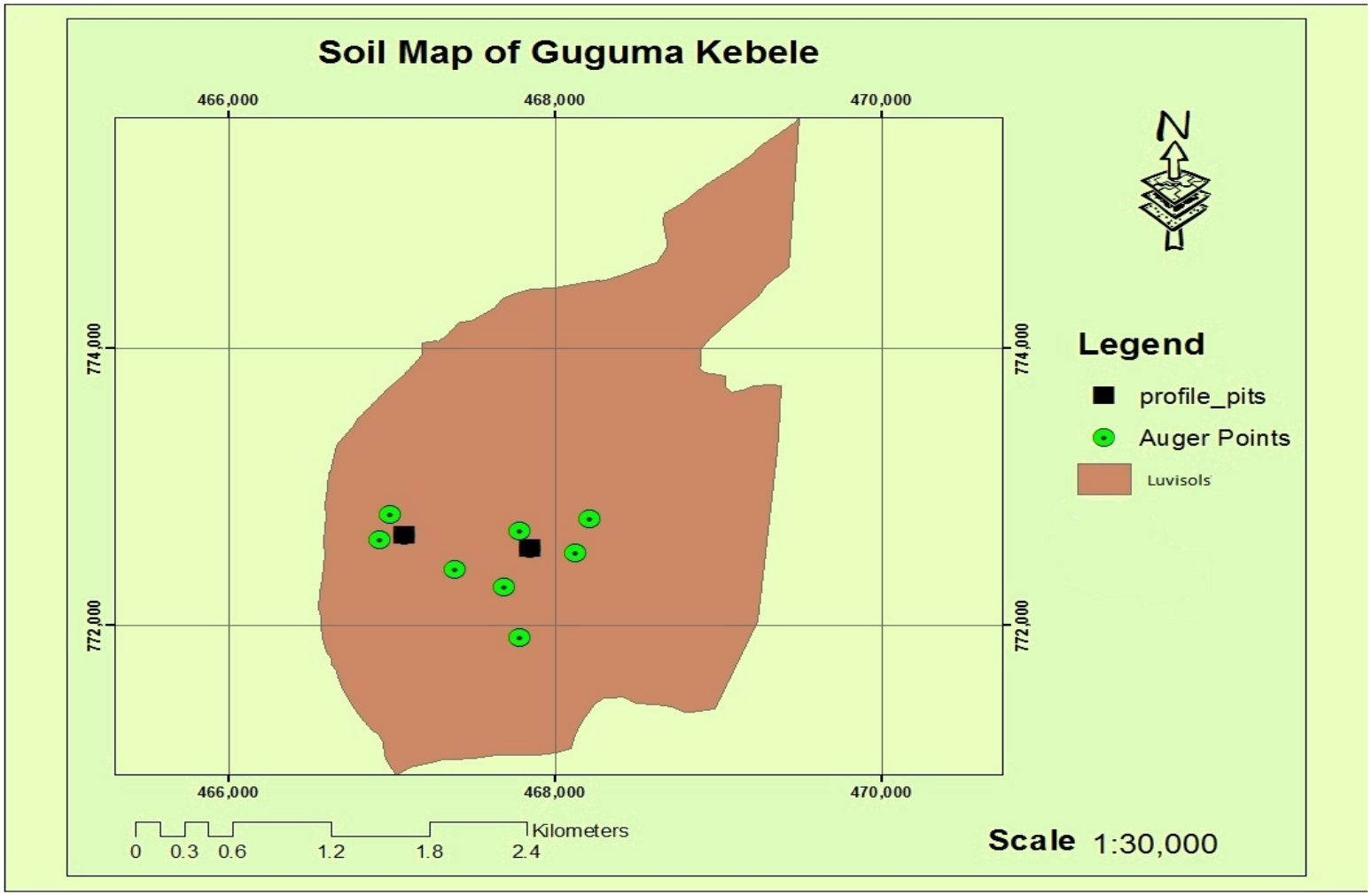


Fig 25 Soil Map of Guguma Kebele

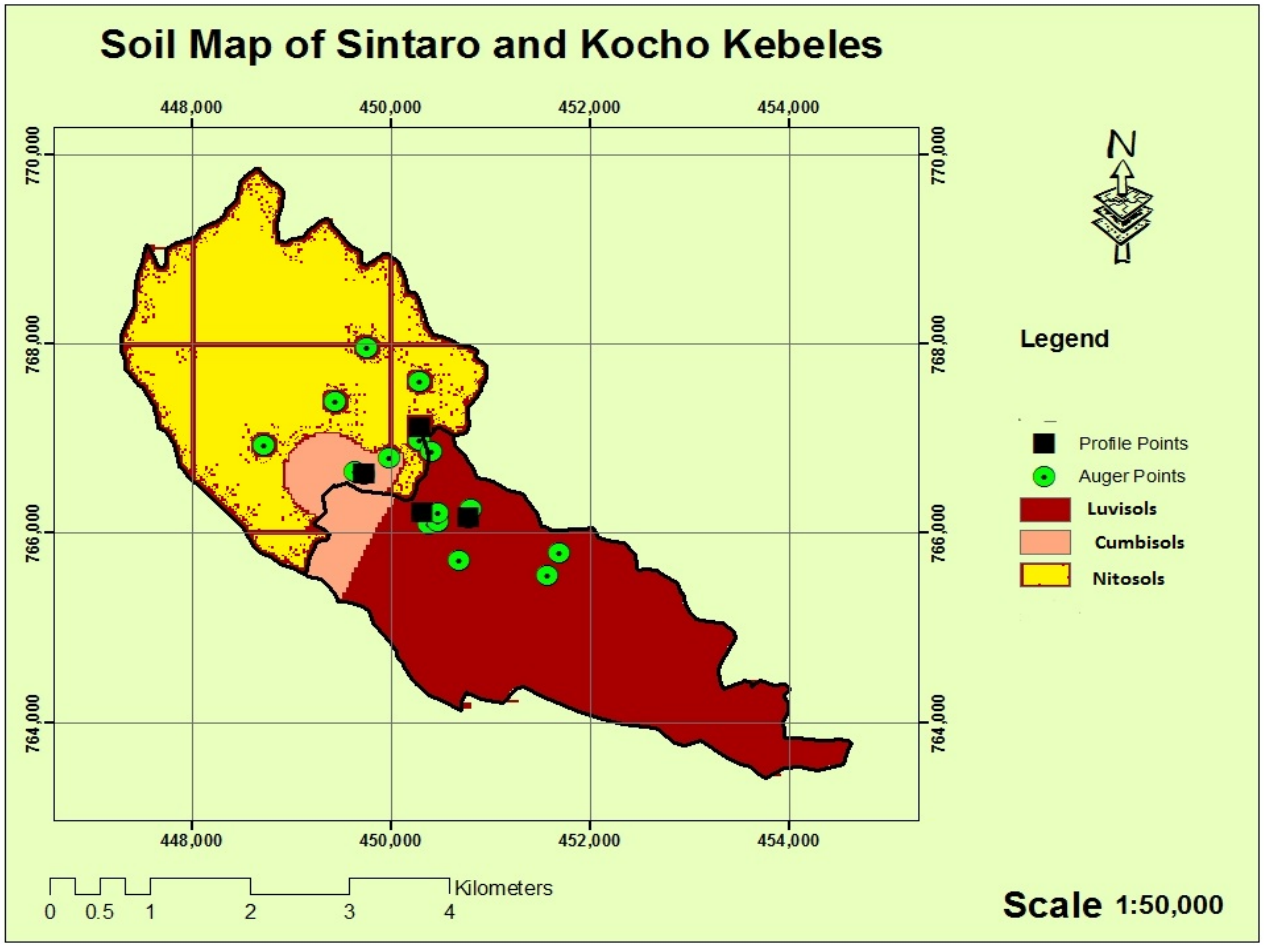


Fig 26 soil Map of Sintaro and Kocho kebeles

Part 6 Mesrak Azernet Berber Woreda

6. Result

6.1 Description of the Environment

6.1.1 Location

Misrak Azernet Berbere is a recently established Woreda. It is found in the eastern part of the Silte zone and is about 50 km from its capital, Werabe. The Woreda is lcated in the geographic locations from $07^0$41''05' to $07^0$55''16' north and from $37^0$56''37' to $38^0$06''22'' East. In the northwest it is bordered by the Gurage zone and the South-Merab Azernet Berbere Woreda, and bordered to the northeast by the Alicho Werero Woreda and to the south by the Hadya zone. The town of Kilto is the capital of the Woreda, which is located 221 km away from Addis Ababa and 274 km from the capital SNNPRS, Hawassa.

The total number of inhabitants is 55,264. There are 24,922 are males and 30,342 are females (Misrak Azernet Berbere Woreda, 2011). The number of male headed households (MHHs) is 10,719 and the number of female headed households (FHHs) is 1,620. The Woreda comprises 18 kebeles with a total area of 19,404 hectares (ha). The average annual rainfall of 800 to 1100 mm, sufficient to support the cultivation of major crops like wheat, teff, maize, barley, Enset, vegetables, potato, faba bean and field pea. Misrak Azernet Berbere Woreda has average minimum and maximum temperature of 11 and 26 respectively.

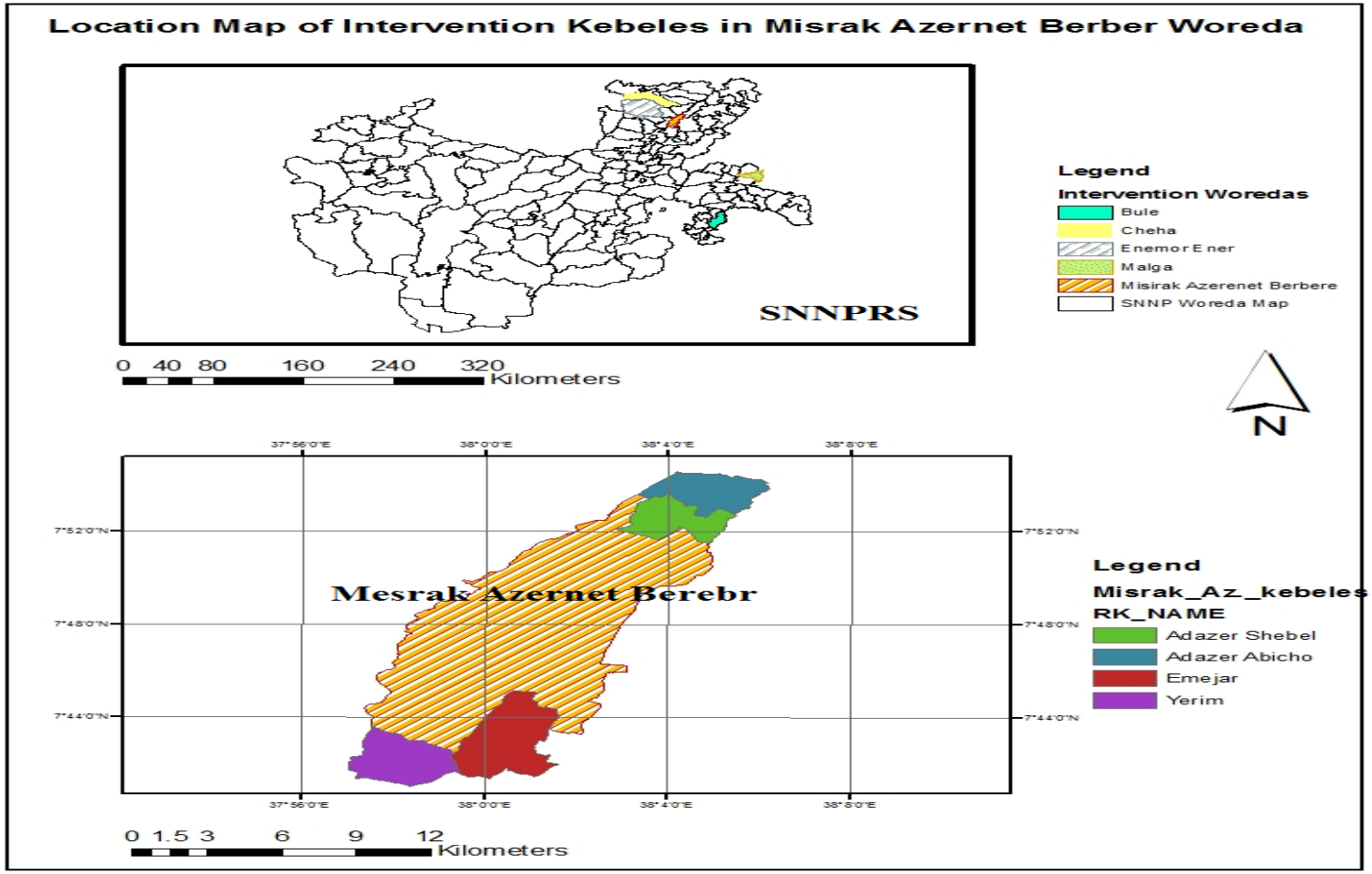


Fig 20 Location map of Mesrak Azernet Berber Woreda

6.1.2 Overall Land use and Vegetation

With regards to land use, most of the lands in the kebele are covered in crops (annual and perennial), especially in Enset. Based on the PRA study of the area of the lands used for annual crops, nearly 40% are in wheat, 20% in teff, and 10% of the lands are in sorghum. Nowadays, however, khat is replacing these crops because of the good returns obtained from its sale. Annual crops take the lead in terms of land use followed by grazing and mixed land use Table below.

Table 45 Land use pattern of Misrak Azernet Berbere Woreda

No	Land Use	Area coverage (ha)	%
1	Annual and Perinial crops	6208	31.9934
2	Grazing	1644	8.47248
3	Forest	679	3.499278
4	Mixed land Use	3325	17.13564
5	Settlement and other	7548	38.8992

Source: Woreda office of Agriculture

6.1.3 Intervention Kebeles

Adazer Abicho Kebele

It is a high land kebele covering 1150 ha. The average annual rainfall of the kebele between1600-2200 mm and the mean average temperature is 16^0 C. As the topography of the kebele 75 % is flat and the rest is undulating and mountainious. Of the total area 517 ha of the land covered with Annual crop followed by perennial crops 369 ha, forest 64 ha, grazing land 36 ha, settlement and other land use 164 ha (Woreda Office of Agriculture).

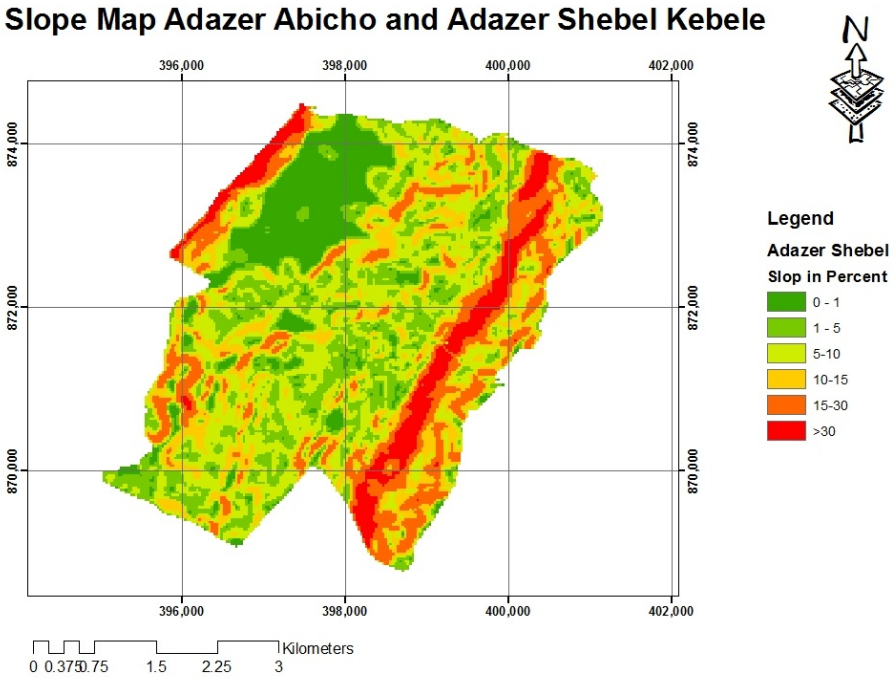


Fig 21 Slope map of Adazer Abicho and Adazer Shebel Kebele

Adazer Shebel Kebele

It is also a high land kebele covering 1208 ha. The average annual rainfall of the kebele between1400-2100 mm and the mean average temperature is 18^0 C. As the topography of the kebele 65 % is flat and the rest is undulating and mountainious. Annual crop cover about 630 ha followed by perennial crops 420 ha, forest 48 ha, grazing land 12 ha, settlement and other land use 98 ha (Woreda Office of Agriculture).

Emejar

One of the low land kebeles of Mesrak Azernet Berber Woreda is Emejar kebele. It covers a total area of 1180 ha of which 569 ha is covered by annual crops. Next to annual crops, perineal crops cover 450 ha, forest covers about 26 ha, grazinf 22 ha and the remaining 113 ha is covered by settlement and other types of land use types. There are 1250 householdss in the kebele and 650 are female headed and 600 male headed. The kebele is flat with water logging problem especially in the rainy season. 90 % of the total land is a flat land and the remaining 10 % is undulating (Woreda Office of Agriculture).

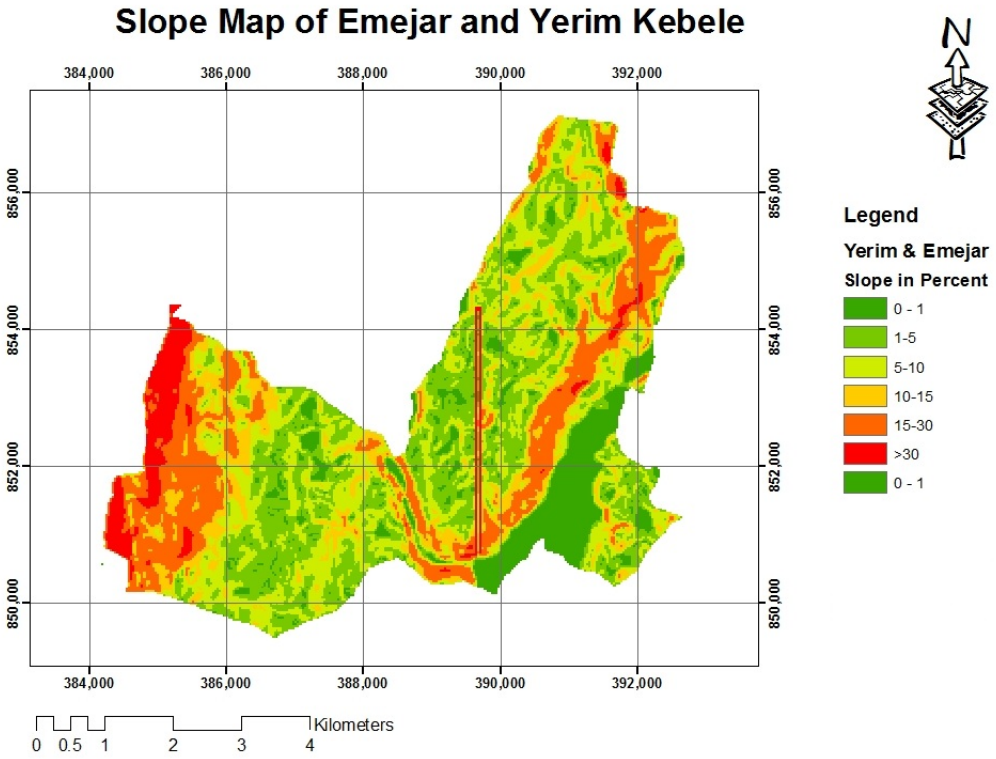


Fig 22 Slope map of Emejar and Yerim Kebele

Yerim Kebele

Yerim is one of the Kerebed kebele is found adjacent with gomosh kebele. The total area of the kebele is 840 ha. Annual crops cover larg area in the kebele (240 ha) followed by perennial crops 347 ha, forest 37, grazing 17 ha, settlement and other land use covers 199 ha. More than 42 % of the total area is flat, 35 % mountain and the remaining is medium undulating and gorge. The kebele recives a mean annual rainfall of 1450-2100 mm with average temperature of 20^0c (Woreda Office of Agriculture).

6.2 Soils of Misrak Azernet Berbere Woreda

6.2.1 The soil-landscape in Woreda

Geomorphically the low land kebeles (Yerim and Emejar) are characterized by Minor rever gorges and ravines land form (Henricksen et. al., 1984). .Adazer Abiche and Adazer Shebel kebeles are high land areas. Geomorphically these kebeles are characterized by moderately dissected side slopes and piedmont zones residual landform (Henricksen et. al., 1984).

In Misrak Azernet Berbere Woreda Adazer Abicho and Adazer Shebel kebeles are high land kebeles and the soils of these kebeles are well drained. Other two yerim and Emejar kebeles are located on the lower Slope position and are poorly drained areas especially in

rainy time. By considering the topography and area coverage of the intervention kebeles and auger description two soil profiles were opened in each kebeles of Adazer abicho and Emejar kebeles. In Yerim and Adazed Shebel kebeles one representative soil sample each was opened.

In the upper topographic position and well drained areas Luvisol soil type are found in Adazer Abiche and Adazer Shebel and in well drained areas of Emejar and Yerim Kebeles. Vertisol soil types are founding in most of the lower and poorly drained intervention kebeles (Emejar and Yerim kebele). As a summery vast area of the intervention kebeles are covered by luvisol soil types and the Toe Slope position areas are found to be Vertisol.

Farmers in the area classify the soil based on the color of the surface soil. Accordingly they classify red and black soil (in the local language Dumo Busha, and Kolisho Busha respectively). Based on farmer's classification soils Nitosolr are classified red soils (Dumo busha) and Luvisols are classified as black soils (Kolisho busha).

6.2.2 Soil profile descriptions with analytical data

6.2.2.1 Profile site description of Adazer Abicho Kebele

Profile 1

Profile code	Me-AzAb-P1
Soil classification	Chomic Luvisols
Location	Mesrak Azernet berber Woreda; Adazer Abicho kebele
Coordinates	N 07^0 53" 42' E 38^0 05"31'
Elevation	2676 m
Date	12/05/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	Moist
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level Land, Plateau
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Flat land form
Slope	Level Plain land slope of ±1.5% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)

Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 46 Soil Description for Me-AzAb-P1

Hor.	Depth cm	Description
Ap	0-30	Dark Brown (7.5 YR 3/4) Sandy Clay loam; weak very fine, granular structure; friable when moist, slightly sticky and slightly plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
Ah	30-70	Dark brown (7.5YR 3/3) Clay; moderate, very fine coarse Sub angular blocky structure; firm when moist, slightly sticky and slightly plastic when wet; common fine pores; very few, fine roots, gradual smooth boundary.
AB	70-115	Dark Reddish brown (2.5Y 3/3) clay; moderate, fine to medium angular blocky structure; firm when moist, slightly sticky and slightly plastic when wet; common, fine pores, few faint clay coating, very few, fine roots, diffuse smooth boundary.
Bt1	115-155	Dark Reddish brown (2.5 YR 3/3). Clay: Moderate, very fine to medium angular blocky structure, firm when moist, sticky and plastic when wet, common distinct clay coating, and few fine pores, diffuse smooth boundary.
Bt2	155+	Dark reddish brown (5 YR 3/3). Clay: weak very fine to medium, Sub angular blocky structure, firm when moist, sticky and plastic when wet, common faint clay coating, few fine pores

Table 47 Table with analytical data for Me-AzAb-P1

Horizon	AP	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	4.85	5.03	5.06	5.19	5.33
pH-KCL (1:2.5)	4.00	4.12	4.27	4.43	4.61
EC(ms/cm) (1:2.5)	0.06	0.03	0.02	0.02	0.02
Sand (%)	50.75	22.01	22.62	20.95	24.55
Silt (%)	22.01	26.35	32.86	33.73	27.25
Clay (%)	27.24	51.64	44.52	45.32	48.20
Silt to clay ratio	0.81	0.51	0.74	0.74	0.57
Texture Class	Sandy clay loam	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	1.21	1.11	0.94	1.26	1.11
Exch. K(meq/100 gm of soil)	0.61	0.50	0.46	0.39	0.40
Exch. Ca(meq/100 gm of soil)	13.44	15.12	16.96	15.12	16.80
Exch. Mg(meq/100 gm of soil)	4.20	5.04	5.94	5.04	5.88
Ca/Ma	3.20	3.00	2.86	3.00	2.86

K/Mg	0.15	0.10	0.08	0.08	0.07
Sum of Cations (meq/100gm of soil)	19.46	21.77	24.29	21.81	24.19
CEC(meq/100 gm of soil)	27.39	30.13	27.19	27.39	29.22
Organic Carbon (%)	2.09	1.93	1.09	0.45	0.38
Nitrogen (%)	0.22	0.19	0.13	0.06	0.04
C/N	9.50	10.16	8.38	7.50	9.50
PBS(%)	71.05	72.25	89.37	79.63	82.79
Available P(mg P_2O_5/kg soil)	25.00	22.80			
Bulk density (gm/ Cm^3)	1.14	1.03	1.11	1.13	1.02
Available S (%)	0.74	0.84			
Exchangeable Sodium %(ESP)	4.40	3.70	3.46	4.60	3.81
Micronutrient					
Zn (mg/kg soil)	16.91	8.53			
Mn (mg/kg soil)	74.44	81.76			
Cu (mg/kg soil)	1.80	1.62			
Fe (mg/kg soil)	95.28	91.03			

6.2.2.2 Profile site description of Adazer Shebel Kebele

Profile 1

Profile code	Me-Az-Sb-P1
Soil classification	Chomic Luvisols
Location	Mesrak Azernet berber Woreda; Adazer Sebel kebele
Coordinates	N 07^0 52” 33’ E 38^0 03”49’
Elevation	2565 m
Date	11/05/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level Land, Plateau
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Flat land form
Slope	Level Plain land slope of ±1.5% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced

Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 48 Soil Description for Me-Az-Sb-P1

Hor.	Depth cm	Description
A	0-15	Dark Reddish brown (5 YR 3/4) Clay; moderate very fine to medium, granular structure; slightly hard when dry, friable when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
AB	15-42	Dark Reddish brown (2.5YR 3/4) Clay; moderate, very fine to medium Sub angular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common fine pores; very few, fine roots, gradual smooth boundary.
Bt1	42-105	Dark Reddish brown (5YR 3/3) clay; strong, fine to medium angular blocky structure; slightly hard when dry, firm when moist, slightly sticky and slightly plastic when wet; common, fine pores, few faint clay coating, very few, fine roots, diffuse smooth boundary.
Bt2	105-145	Dark Reddish brown (2.5 YR 3/3). Clay: strong, very fine to medium angular blocky structure, very hard when dry, friable when moist, sticky and plastic when wet, common distinct clay coating, and fine pores, diffuse smooth boundary.
Bt3	145+	Dark reddish brown (5 YR 3/4). Clay: weak very fine to medium, Sub angular blocky structure, very hard when dry, friable when moist, sticky and plastic when wet, common faint clay coating, few fine pores

Table 50 Table with Analytical data for Me-Az-Sb-P1

Horizon	A	AB	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	4.63	4.67	4.74	4.82	4.84
pH-KCL (1:2.5)	5.90	3.87	3.98	4.00	4.04
EC(ms/cm) (1:2.5)	0.06	0.04	0.02	0.02	0.02
Sand (%)	38.66	25.58	22.95	23.83	28.23
Silt (%)	12.48	31.45	32.72	29.62	25.33
Clay (%)	48.86	42.97	44.33	46.55	46.44
Silt to clay ratio	0.26	0.73	0.74	0.64	0.55
Texture Class	clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	1.14	0.99	1.00	1.00	1.02
Exch. K(meq/100 gm of soil)	1.39	0.69	0.53	0.59	0.62
Exch. Ca(meq/100 gm of soil)	15.81	14.28	15.12	15.96	15.12

Exch. Mg(meq/100 gm of soil)	5.82	5.04	5.04	5.88	5.04
Ca/Ma	2.72	2.83	3.00	2.71	3.00
K/Mg	0.24	0.14	0.11	0.10	0.12
Sum of Cations (meq/100gm of soil)	24.16	21.00	21.69	23.44	21.81
CEC(meq/100 gm of soil)	36.17	29.22	24.65	27.39	26.48
Organic Carbon (%)	1.70	1.51	0.93	0.84	0.12
Nitrogen (%)	0.19	0.16	0.13	0.10	0.01
C/N	8.95	9.44	7.15	8.40	12.00
PBS(%)	66.80	71.87	87.99	85.54	82.33
Available P(mg P_2O_5/kg soil)	24.10				
Bulk density (gm/ Cm^3)	1.06	1.06	1.10	1.21	1.30
Available S (%)	1.26				
Exchangeable Sodium %(ESP)	3.15	3.38	4.07	3.67	3.86
Micronutrient					
Zn (mg/kg soil)	8.89				
Mn (mg/kg soil)	79.05				
Cu (mg/kg soil)	2.07				
Fe (mg/kg soil)	99.83				

Profile 2

Profile code	Me-Az-Sb-P2
Soil classification	Haplic Luvisols
Location	Mesrak Azernet berber Woreda; Adazer Sebel kebele
Coordinates	N 07^0 52” 53’ E 38^0 04”35’
Elevation	2607 m
Date	10/05/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC3
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level Land, Plateau
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Flat land form
Slope	Level Plain land slope of ±1.5% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained

Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 51 Soil Description for Me-Az-Sb-P2

Hor.	Depth cm	Description
Ap	0-20	Dark Reddish brown (5 YR 3/3) Clay Loam; moderate very fine to fiine, granular structure; hard when dry, firm when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
AB	20-65	Dark Reddish brown (2.5YR 3/3) Clay; moderate, fine angular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few faint clay coating, common fine pores; very few, fine roots, diffuse smooth boundary.
Bt1	65-140	Dark Reddish brown (2.5Y 3/3) clay; moderate, fine to medium angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common, fine pores, few faint clay coating, very few, fine roots, Gradual smooth boundary.
Bt2	140+	Brown (7.5 YR 4/4). Clay: strong, medium Sub angular blocky structure, hard when dry, firm when moist, sticky and plastic when wet, common distinct clay coating, and few fine pores.

Table 52 Table with analytical data for Me-Az-Sb-P2

Horizon	Ap	AB	Bt1	Bt2
pH-H_2O (1:2.5)	5.47	4.51	4.86	4.96
pH-KCL (1:2.5)	4.64	3.66	4.03	4.20
EC(ms/cm) (1:2.5)	0.03	0.02	0.02	0.02
Sand (%)	32.88	31.83	23.18	22.86
Silt (%)	27.27	26.22	28.41	28.93
Clay (%)	39.85	41.95	48.41	48.21
Silt to clay ratio	0.68	0.63	0.59	0.60
Texture Class	Sandy Clay loam	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.82	1.08	1.00	1.12
Exch. K(meq/100 gm of soil)	1.04	0.90	0.59	0.60
Exch. Ca(meq/100 gm of soil)	14.28	14.28	15.96	18.83
Exch. Mg(meq/100 gm of soil)	4.20	4.20	5.88	5.99
Ca/Ma	3.40	3.40	2.71	3.14
K/Mg	0.25	0.21	0.10	0.10
Sum of Cations (meq/100gm of soil)	20.35	20.46	23.44	26.54

CEC(meq/100 gm of soil)	28.30	29.67	27.85	31.17
Organic Carbon (%)	2.58	1.59	0.59	0.16
Nitrogen (%)	0.25	0.13	0.07	0.01
C/N	10.32	12.23	8.43	16.00
PBS(%)	71.87	68.96	84.13	85.15
Available P(mg P_2O_5/kg soil)	26.10			
Bulk density (gm/ Cm^3)	1.02	1.05	1.19	1.24
Available S (%)	0.90			
Exchangeable Sodium %(ESP)	2.90	3.63	3.61	3.58
Micronutrient				
Zn (mg/kg soil)	10.46			
Mn (mg/kg soil)	72.24			
Cu (mg/kg soil)	1.86			
Fe (mg/kg soil)	105.00			

6.2.2.3 Profile site description of Emejar Kebele

Profile 1

Profile code	**Me-Em-P1**
Soil classification	Mesotrophic Vertisol
Location	Mesrak Azernet berber Woreda; Emejar kebele
Coordinates	N 07^0 43” 20’ E 38^0 00”06’
Elevation	2097 m
Date	09/05/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level Land, Plateau
Local physiographic	Toe Slope
Soil drainage	poorly drained
Macro relief	Flat land form
Slope	Level Plain land slope of ±1.5% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion

Flooding In rainy season
Human influence mixed agriculture

Table 53 Soil Description for Me-Em-P1

Hor.	Depth cm	Description
Ap	0-20	Light olive gray. (5Y 6/2) sandy Clay; Moderate very fine to fine sub granular structure; very friable when moist, slightly sticky and non-plastic when wet; common, fine to medium, roots, clear smooth boundary.
AC	20-40	Dark greenish gray (GLEY1 4/10Y) Clay loam; moderate, coarse, massive structure; slightly hard when dry, friable when moist, sticky and plastic when wet; very fine few roots, gradual wavy boundary.
C1	40-95	Very Dark bluish gray (GLEY2 3/5PB) Clay; moderate, very fine to fine angular blocky structure; firm when moist, very sticky and very plastic when wet; few distinct slickensides; few, fine pores, very fine very few roots, gradual wavy boundary.
C2	95-135	Very Dark bluish gray (GLAY2 3/5PB). Clay: moderate, fine to medium angular blocky structure, friable when moist, very Sticky and very plastic when wet, distinct slickensides, gradual smooth boundary.
C3	135+	Very Dark bluish gray (GLAY2 3/5PB). Clay: moderate, very fine to fine angular blocky structure, friable when moist, sticky and Plastic when wet.

Table 54 Table with analytical data for Me-Em-P1

Horizon	AP	AC	C1	C2	C3
pH-H_2O (1:2.5)	5.42	6.07	7.48	7.77	7.65
pH-KCL (1:2.5)	4.48	5.11	6.61	6.85	6.74
EC(ms/cm) (1:2.5)	0.07	0.04	0.26	0.28	0.29
Sand (%)	49.70	38.46	14.55	13.06	15.28
Silt (%)	12.58	26.67	19.11	29.36	29.71
Clay (%)	37.73	34.87	66.34	57.58	55.02
Silt to clay ratio	0.33	0.76	0.29	0.51	0.54
Texture Class	Sandy clay	Clay loam	clay	clay	clay
Exch. Na(meq/100gm of soil)	1.02	1.43	2.94	3.19	2.56
Exch. K(meq/100 gm of soil)	0.34	0.27	1.29	1.20	1.31
Exch. Ca(meq/100 gm of soil)	15.12	12.36	37.74	29.75	35.75
Exch. Mg(meq/100 gm of soil)	5.88	4.12	11.99	8.88	12.21
Ca/Ma	2.57	3.00	3.15	3.35	2.93
K/Mg	0.06	0.07	0.11	0.14	0.11
Sum of Cations (meq/100gm of soil)	22.37	18.19	53.96	43.01	51.83
CEC(meq/100 gm of soil)	34.24	27.77	62.74	47.30	54.50
Organic Carbon (%)	2.56	1.32	0.89	0.67	0.56
Nitrogen (%)	0.21	0.13	0.11	0.08	0.06

C/N	12.19	10.15	8.09	8.38	9.33
PBS(%)	65.30	65.47	86.01	90.95	95.10
Available P(mg P_2O_5/kg soil)	28.20				
Bulk density (gm/ Cm^3)	1.03	1.02	1.16	1.02	1.05
Available S (%)	0.98				
Exchangeable Sodium %(ESP)	2.99	5.16	4.69	6.73	4.70
Micronutrient					
Zn (mg/kg soil)	9.07				
Mn (mg/kg soil)	72.24				
Cu (mg/kg soil)	2.34				
Fe (mg/kg soil)	134.26				

Profile 2

Profile code	Me-Az-Em-P2
Soil classification	Chomic Luvisols
Location	Mesrak Azernet berber Woreda; Adazer Sebel kebele
Coordinates	N 07^0 44" 58' E 38^0 00"55'
Elevation	2181 m
Date	09/05/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Medium Gradient Hill
Local physiographic	Undulating land form
Soil drainage	well drained
Macro relief	Rolling to Hilly
Slope	Slope of ±13% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.
General information on the soil	
Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 55 Soil Description for Me-Az-Em-P2

Hor.	Depth cm	Description
Ap	0-20	Dark Reddish brown (5 YR 3/3) Clay; moderate fine to medium, sub angular blocky structure; slightly hard when dry, firm when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
Bt1	20-59	Dark Reddish brown (2.5YR 3/4) Clay; moderate, fine to medium Sub angular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few faint clay coating, common fine pores; very few, fine roots, diffuse smooth boundary.
Bt2	59-105	Dark Reddish brown (2.5Y 3/3) clay loam; moderate, fine to coarse angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common, fine pores, common faint clay coating, very few, fine roots, gradual smooth boundary.
Bt3	105-160	Dark Reddish brown (5 YR 3/3). Clay loam: moderate, fine to medium angular blocky structure, firm when moist, sticky and plastic when wet, common distinct clay coating, and few fine pores, diffuse smooth boundary.
C1	160-190	Dark brown (7.5YR 3/3) clay loam; moderate, fine to medium angular blocky structure; firm when moist, sticky and slightly plastic when wet; common, fine pores, few faint clay coating, very few, fine roots, dgradu smooth boundary.
C2	190+	Dark Reddish brown (2.5YR 3/4) sandy clay loam; moderate, coarse massive structure; hard when dry, friable when moist, lightly sticky and slightly plastic when wet; common, fine pores, very few, fine roots.

Table 56 Table with analytical data for Me-Az-Em-P2

Horizon	Ap	Bt1	Bt2	Bt3	C1	C2
pH-H_2O (1:2.5)	5.36	5.33	5.56	5.81	5.87	5.89
pH-KCL (1:2.5)	4.45	4.52	4.70	5.05	5.03	5.00
EC(ms/cm) (1:2.5)	0.04	0.04	0.02	0.03	0.03	0.03
Sand (%)	33.98	33.31	39.09	38.84	41.02	57.97
Silt (%)	24.10	21.17	23.10	24.25	22.12	12.61
Clay (%)	41.92	45.52	37.81	36.91	36.86	29.42
Silt to clay ratio	0.57	0.47	0.61	0.66	0.60	0.43
Texture Class	clay	clay	Clay loam	Clay loam	Clay loam	Sandy clay loam
Exch. Na(meq/100gm of soil)	0.91	0.94	0.97	1.02	0.82	0.75
Exch. K(meq/100 gm of soil)	0.96	0.83	0.70	0.72	0.75	0.87
Exch. Ca(meq/100 gm of soil)	15.96	12.72	13.44	15.96	11.76	12.60
Exch. Mg(meq/100 gm of soil)	5.04	4.24	4.20	5.88	4.20	4.20
Ca/Ma	3.17	3.00	3.20	2.71	2.80	3.00

K/Mg	0.19	0.20	0.17	0.12	0.18	0.21
Sum of Cations (meq/100gm of soil)	22.87	18.73	19.31	23.58	17.54	18.42
CEC(meq/100 gm of soil)	31.96	26.27	24.65	26.93	23.28	21.91
Organic Carbon (%)	1.09	0.88	0.22	0.20	0.15	0.12
Nitrogen (%)	0.07	0.06	0.03	0.02	0.01	0.01
C/N	15.57	14.67	7.33	10.00	15.00	12.00
PBS(%)	71.56	71.30	78.34	87.56	75.30	84.07
Available P(mg P_2O_5/kg soil)	22.90					
Bulk density (gm/ Cm^3)	1.28	1.14	1.15	1.22	1.24	1.21
Available S (%)	0.84					
Exchangeable Sodium %(ESP)	2.86	3.58	3.93	3.80	3.53	3.42
Micronutrient						
Zn (mg/kg soil)	3.90					
Mn (mg/kg soil)	61.26					
Cu (mg/kg soil)	0.62					
Fe (mg/kg soil)	72.67					

6.2.2.4 Profile site description of yerim Kebele

Profile 1

Profile code	**Me-Ye-P1**
Soil classification	Chomic Luvisols
Location	Mesrak Azernet berber Woreda; Yerim kebele
Coordinates	N 07^0 42” 04’ E 37^0 58”06’
Elevation	2140 m
Date	13/05/2006 EC
Authors	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC2
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Medium Gradient Hill
Local physiographic	Flat land form
Soil drainage	well drained
Macro relief	Flat land form
Slope	Level Plain land slope of ±13% over more than 1 km long.
Land use	Mixed cropping, intensive land use. Enset and khat are Common. On average 0.5 ha per household. Some communal grazing, some dairy cows (zero grazing).
Soil fauna	Few termites; earth worms.

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none

Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 57 Soil Description for Me-Ye-P1

Hor.	Depth cm	Description
A	0-15	Dark yellowish brown (10 YR 3/4) sand Clay Loam; moderate fine to medium, granular structure; slightly hard when dry, fiable when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, diffuse smooth boundary.
AB	15-45	Dark brown (10YR 3/3) sandy clay loam. Clay; moderate, fine to medium Sub angular blocky structure; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; few faint clay coating, common fine pores; very few, fine roots, gradual smooth boundary.
Bt1	45-75	Dark brown (7.5YR 3/4) clay loam; moderate, fine to medium angular blocky structure; very hard when dry, firm when moist, sticky and slightly plastic when wet; common, fine pores, few faint clay coating, very few, fine roots, diffuse smooth boundary.
Bt2	75-131	Dark brown (7.5 YR 3/4). Clay: strong, fine to medium massive structure, very hard when dry, friable when moist, sticky and plastic when wet, common distinct clay coating, and few fine pores, gradual smooth boundary.
Bt3	131+	Dark yellowish brown (10YR 4/4) clay; moderate, fine to medium massive structure, very hard when dry; firm when moist, sticky and plastic when wet; common, fine pores, few faint clay coating, very few, fine roots.

Table 58 Table with analytical Data for Me-Ye-P1

Horizon	A	AB	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	5.80	5.87	5.97	6.04	6.26
pH-KCL (1:2.5)	4.96	4.90	5.18	5.17	5.33
EC(ms/cm) (1:2.5)	0.05	0.09	0.11	0.09	0.05
Sand (%)	55.92	46.06	35.32	39.77	36.40
Silt (%)	20.99	26.44	25.87	15.06	22.64
Clay (%)	23.09	27.50	38.81	45.17	40.96
Silt to clay ratio	0.91	0.96	0.67	0.33	0.55
Texture Class	Sandy clay loam	Sandy clay loam	Clay loam	clay	clay
Exch. Na(meq/100gm of soil)	0.82	1.00	0.78	0.93	1.02
Exch. K(meq/100 gm of soil)	0.56	0.88	0.90	1.31	1.06
Exch. Ca(meq/100 gm of soil)	15.12	16.80	18.83	25.68	20.54
Exch. Mg(meq/100 gm of soil)	5.04	5.88	6.85	8.56	6.85
Ca/Ma	3.00	2.86	2.75	3.00	3.00

K/Mg	0.11	0.15	0.13	0.15	0.15
Sum of Cations (meq/100gm of soil)	21.54	24.57	27.36	36.48	29.48
CEC(meq/100 gm of soil)	26.93	35.61	32.10	43.73	35.82
Organic Carbon (%)	1.64	0.84	0.53	0.16	0.10
Nitrogen (%)	0.21	0.10	0.06	0.02	0.01
C/N	7.81	8.40	8.83	8.00	10.00
PBS(%)	79.99	68.97	85.23	83.42	82.27
Available P(mg P_2O_5/kg soil)	26.90				
Bulk density (gm/ Cm^3)	1.27	1.24	1.23	1.23	1.15
Available S (%)	1.50				
Exchangeable Sodium %(ESP)	3.05	2.82	2.43	2.13	2.86
Micronutrient					
Zn (mg/kg soil)	6.06				
Mn (mg/kg soil)	60.77				
Cu (mg/kg soil)	0.98				
Fe (mg/kg soil)	67.41				

6.2.3 Synthesis

Higher altitude and well drained kebeles of Adazer abicho and Adazer Shebel kebeles, and lower altitude kebeles areas which are on the escarpment and well drained are characterized by Luvisols. Luvisols are well drained, very deep, dark red, well structured, Sandy clay loam to clay soils with a general increase in clay contents from topsoil to subsoil; with thick (over 15 cm) dark reddish top soils. low land, flat and water logged kebeles of Emejar and Yerim areas are dominated by Vertisols, high clay content, glay color, very hard consistency when dry and very sticky very plastic when wet and have slikenside.

Surface horizons of Luvisols in Mesrak Azernet Woreda have a weak to moderate granular structure. The subsurface horizons had both weak to moderate Sub angular and angular blocky structure. Higher clay content in the subsurface could attribute to a better developed structure (Ahn, 1993). The consistency of the surface layers of all pedons was found to be friable to firm when moist, non-sticky to slightly sticky and non-plastic to slightly plastic when wet. On the other hand, the moist consistency of the subsurface horizons ranged from friable to firm when moist, whereas the range was from to slightly sticky/slightly plastic to sticky/plastic when wet. In all pedons, clay content increased with increasing soil depth, forming argilic horizons. Moreover, both the sand and silt contents were generally higher in the surface soil. According to Boul et al., (2003), the accumulation of clay in the subsurface horizon could be also contributed by the in situ synthesis of secondary clays, the weathering of primary minerals in the B horizon, or the residual concentration of clays from the selective dissolution of more soluble minerals of coarser grain sized in the B horizon. The more highly weathered a soil is, the lower the silt clay fraction. According to the classification made by Van Wambeke (1962), Soils of Mesrak Azernet Berber have higher silt to clay fraction (>0.15). Therefore it can be concluded that the soils are young interms of weathering stage.

Majority of Luvisols of Mesrak Azernet Berber Woreda are found to be very acidic. For example all the horizons in Adazer Abicho, Both profiles of Adazer Shebel and Luvisols of Emejar are found to have soil pH less than 5.3 and some surface horizons in Adazer Shebel are below 4.6 and are very acidic. According to London (1984) soils having pH value less than 5.5 are categorized as acidic soils. Therefore acidity could limit production and there should be application of lime based additional laboratory tests for lime requirement in order to solve the problem. The amount of potassium, Calcium and magnesium is found to be in adequate amount. All the profiles have adequate level of available Phosphorus according to the classification made by London (1984) . But Phosphorus uptake may be inhibited when calcium to magnesium ratio is < 3:1. Surface soils of Ad-S-P1 have low ratio indicating that phosphorus uptake may be inhibited in these kebeles. This is also an indication for the need of application of lime in the area. Some Luvisols in Mesrak Azernet Berber have low Nitorgen content (London, 1991). Especially soils of Em-P1 and Ad Sb-P1 have very low nitrogen and soils of As-P2, Ye-P1 and Ad-A-P1 have low nitrogen content.

Vertisols of Emejar and Yerim are characterized as soils having PBS by 1M NH_4OAc greater than 65 % through out the profile. The soils are poorly drained, gray color soil, with diffused horizon boundaries and horizon more than 48% clay with slikensides. The surface horizons have very friable consitancy when moist and slightly sticky slightly plastic when wet. The surface horizon has very wide cracks. All of the horizons have CEC by 1M NH_4OAc less than 27.77 $cmol_c$/kg clay. They have medium level of nitrogen and low level of organic carbon content. The subsurface horizons have angular blocky structure, very sticky very plastic consistency with distinct slickenside.

Fig 23 Sample Soil Profile at Adazer Shebel Kebele (Chromic Luvisols)

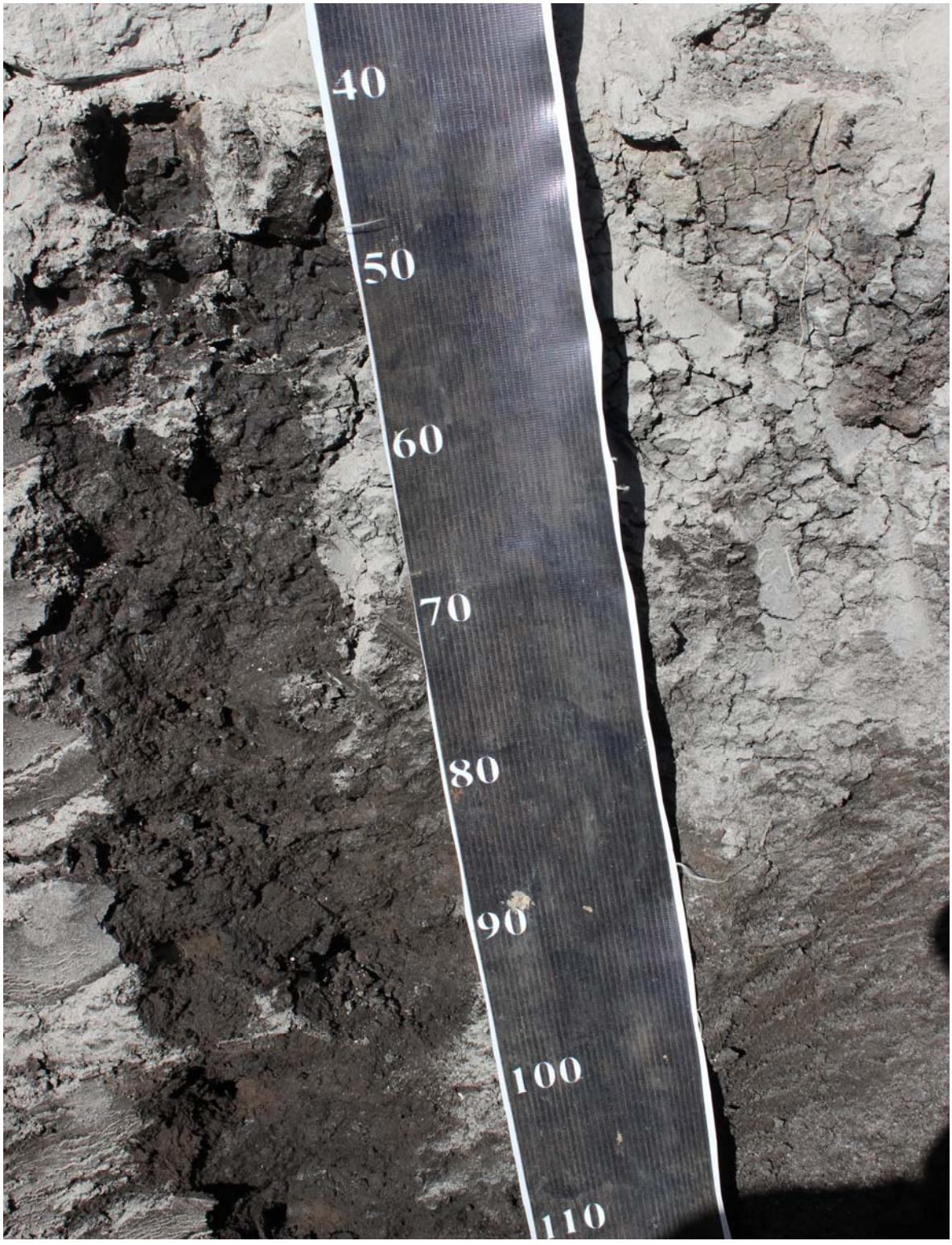


Fig 32 Sample soil profile at Emejar Kebele (Vertisols)

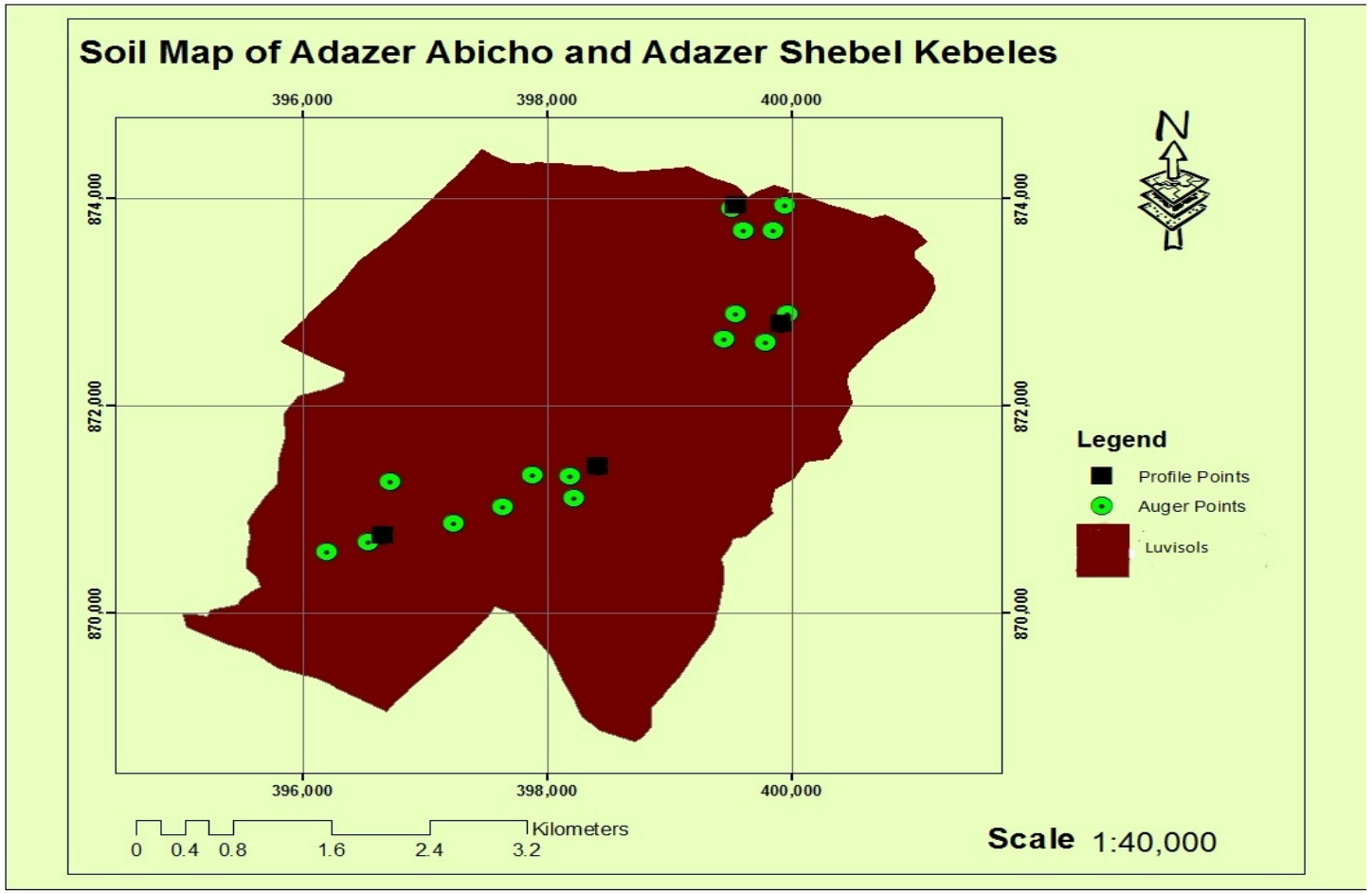


Fig 33 Soil Map of Adazer Abicho and Adazer Shebel Kebeles

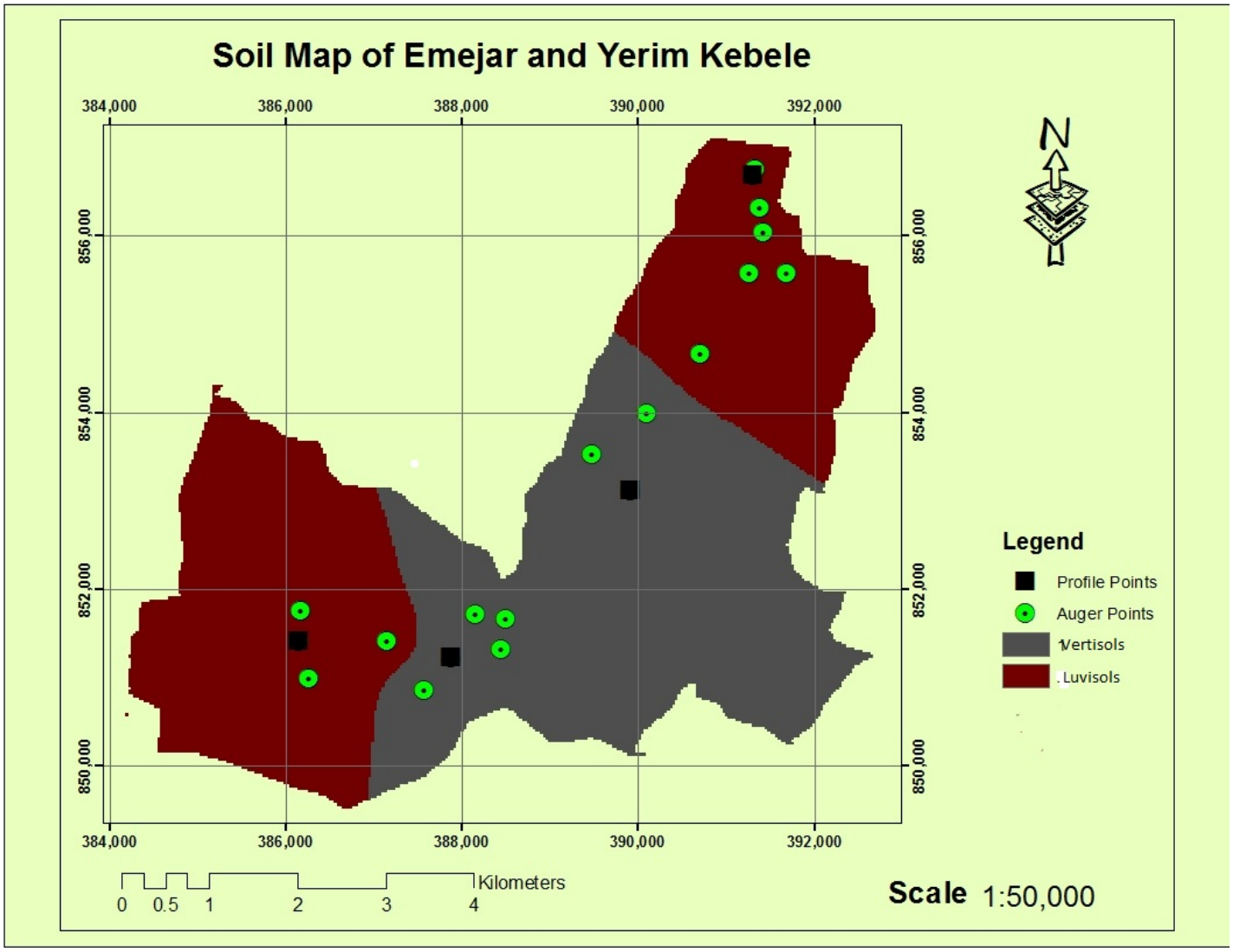


Fig 34 Fig 34 Soil Map of Emejar and Yerim Kebeles

Part 7 Cheha Woreda

7. Result

7.1 Description of the Environment

7.1.1 Location

Cheha Woreda is located between 7.99-8.25 latitude north and 37.59-38.06 East. The mean maximum and minimum temperature is 27 and 18 respectively. The Woreda receives a rainfall between 900-1500. It has a total of 64 kebeles populated by 237,722 people. It also covers a total of 43972 hectares (ha). Majority of the area is part of the weiyena dega agro-climate zone, covering about 80 % of the total land and followed by dega with a total coverage of 20 %.

Cheha Woreda is bordered by Abeshge Woreda at the North, |Geta and Enemor Woresa at the south, Ezha and Gumer Woredas at the East and both Yem especial Woreda and Oromiya region at the west. Eheha Woreda is the second Woreda selected in guragh zone. The Woreda is 460 km far from Hawassa and like all other intervention Woredas 4 kebeles are also selected in the Woreda. Two of them are from high land namely Moche and Yeferzeye and the other two are low land areas namely Ewan and Wordenen.

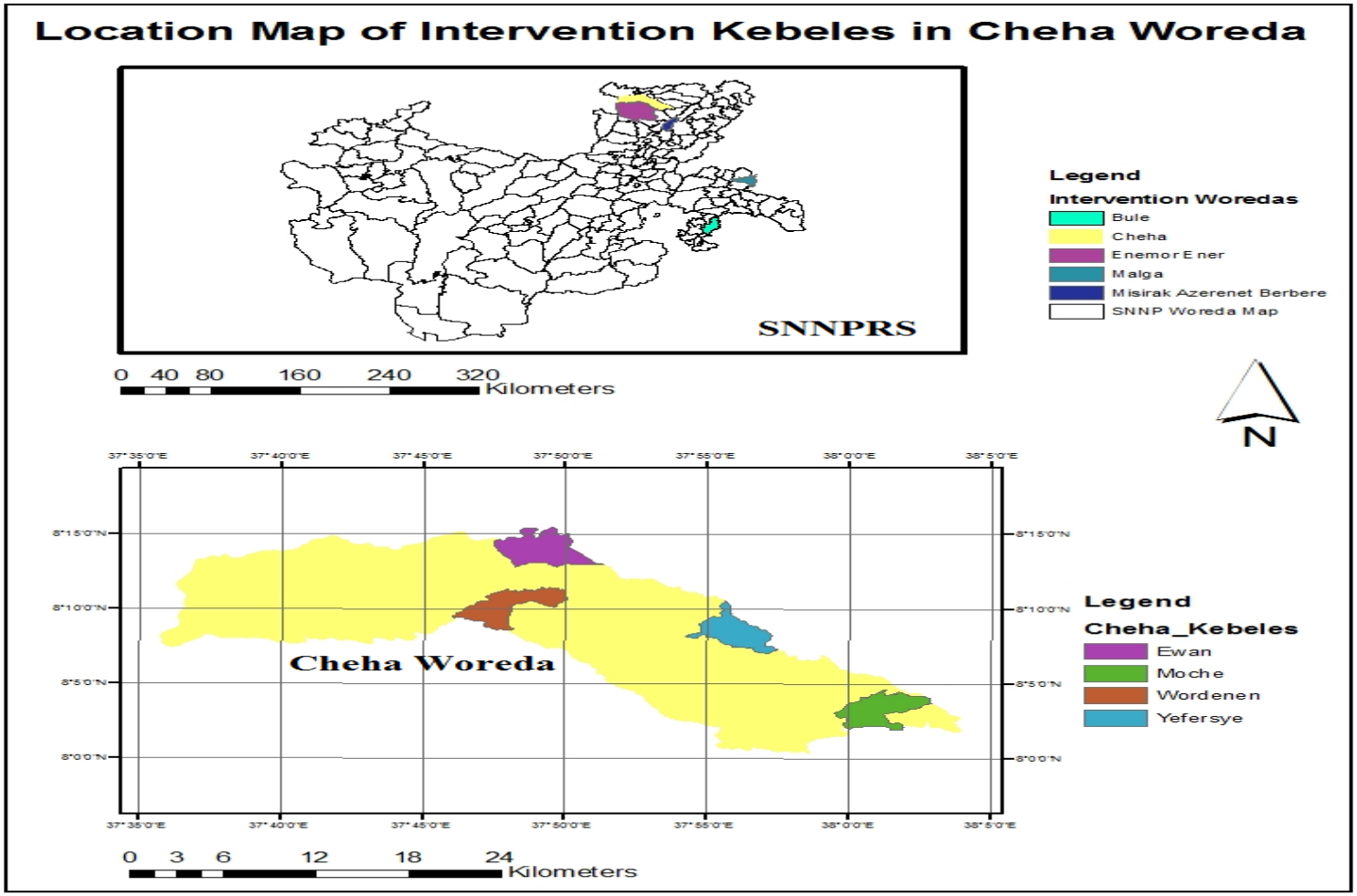


Fig 35 Location Map for Cheha Woreda

7.1.2 Overall Landuse and Vegitation

Agriculture is the dominant economic activity in the Woreda and crop production is the leading means of livelihood supplemented by livestock production. Major crops based on their level of importance are wheat, teff, pea, horse bear, noog bear and Maize from annual crops and Enset, coffee, cataedulis, acocado mango and lemon from perennial crops (Source: Woreda office of Agriculture). Annual crops take the lead in terms of land use followed by perennial crops table below.

Table 59 Land use pattern of Cheha Woreda

No	Land Use	Coverage (ha)	Percent
1	Annual Crops	13106	29
2	Perennial Crops	12686	28
3	Grazing Land	1465	3
4	Forest Land	5877	13
5	Degraded Land	2504	5
6	potentially uncultivated	3171	7
7	Miscellaneous Land use	5163	11

Source: Woreda office of Agriculture

7.1.3 Intervention Kebeles

Ewan Kebele

It is a low land and flat kebele covering 1800 ha. As the topography of the kebele around 90 % if flat and 10 % undulating land. The total households of the kebele are estimated to be 660 of which 96 are female headed and 564 are male headed. Of the total area of 1800 ha 695 ha is covered by Annual crops, 349 ha is covered by Perinial crops, 500 ha of the land is covered by forest and the rest 256 ha is occupied by other land use types including settlement (Woreda Office of Agriculture).

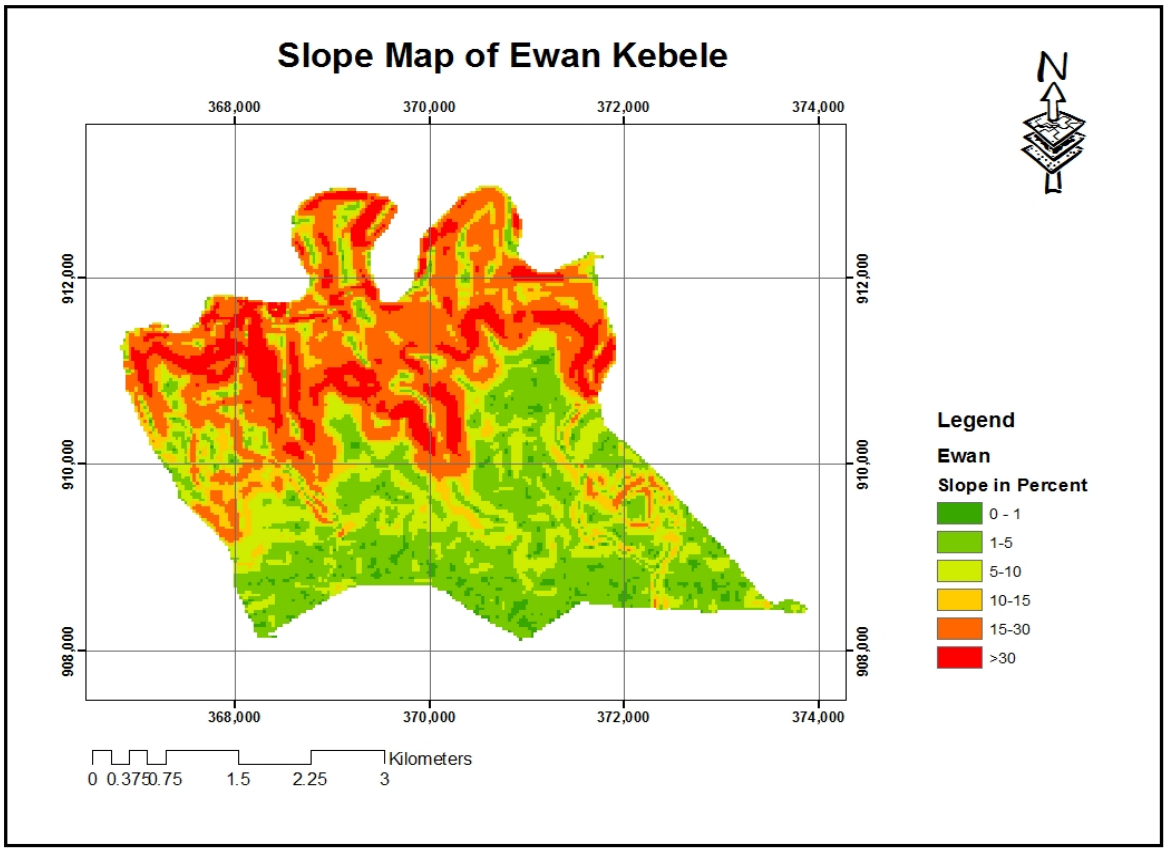


Fig 36. Slope map of Ewan Kebeles

Wordenen Kebele

Like that of Ewan Kebele Wordenen kebele is a flat and water logged kebele. The total area of the kebele is 750 ha. Of the total land 211 ha is covered by annual crops and 309 ha is covered by perennial crops, 140 by forest and the rest covered by other land use types. The kebele is a flat kebele nearly 90 % and other 10 % is undulating land. There are 261 male headed households and 56 female headed households (Woreda Office of Agriculture).

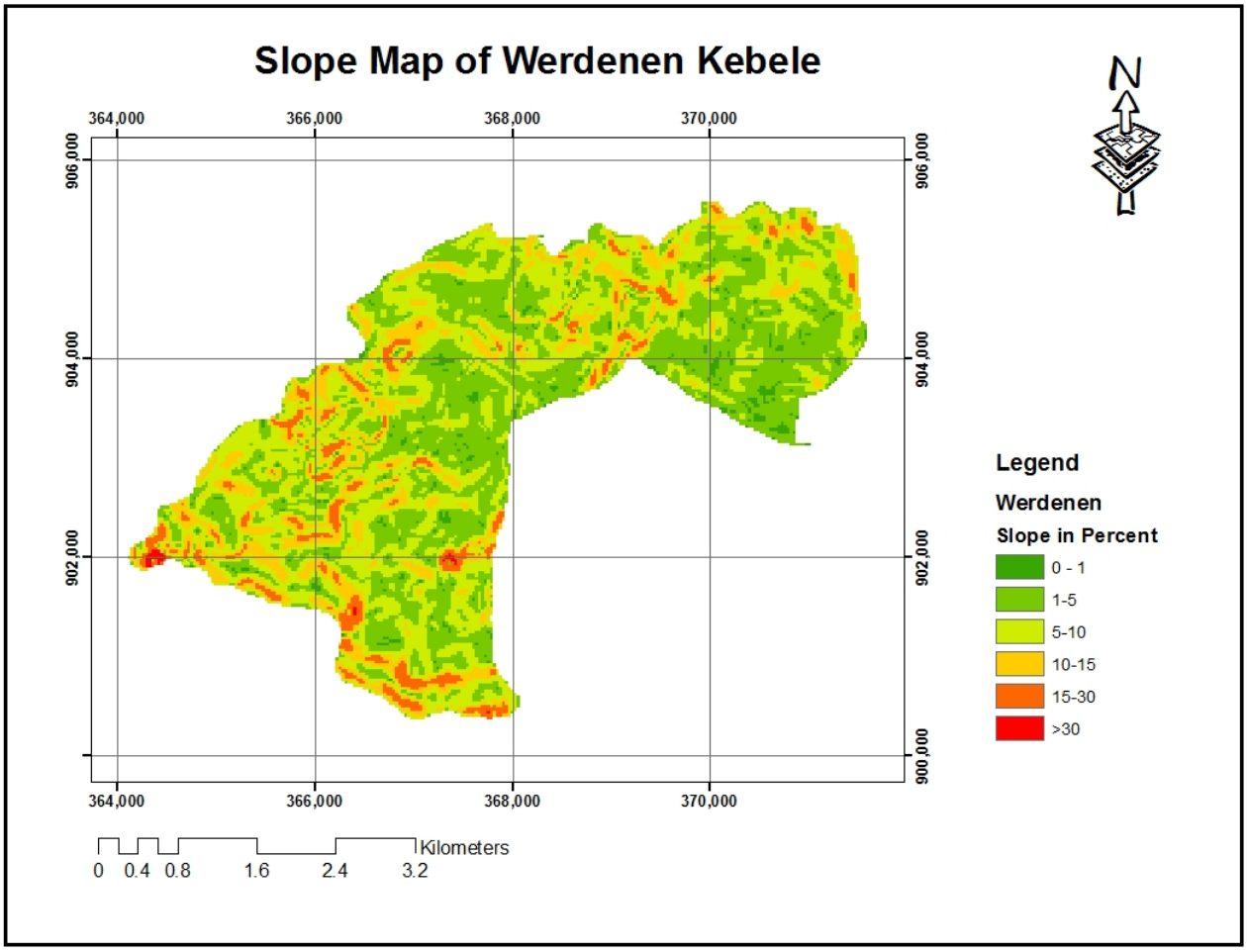


Fig 37 Slope Map of Wordenen Kebele

Yeferzeye Kebele

It is a well drained kebele covering 900 ha of land. There are 302 male headed households and 103 female headed households. 65 % of land is flat and 35 % is undulating land. 402 ha of the land is covered by perennial crops and 189 ha is covered by annual crops. Nearly 200 ha of land is covered by forest and the rest is covered by other land use types (Woreda Office of Agriculture).

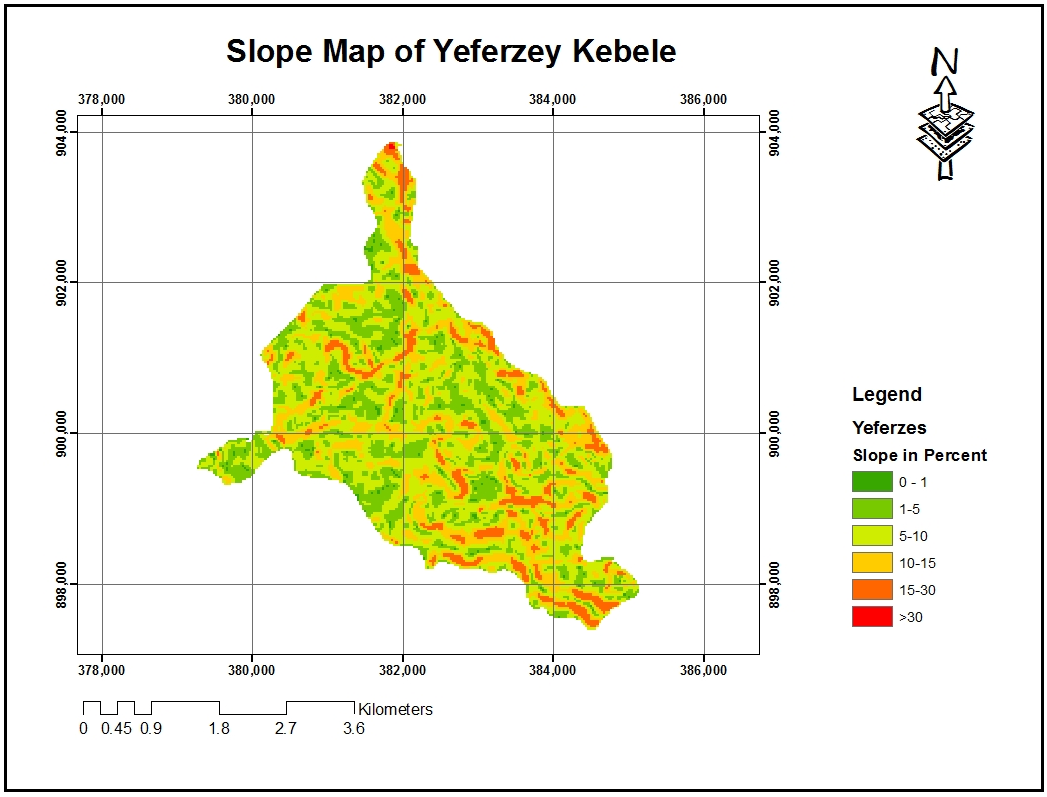


Fig 38. Slope map of Yeferzeye kebele

Moche Kebele

Moch is a high land kebele. It covers a total area of 848 ha. Of which 308 ha is covered by perennial crops and 205 ha is covered by annual crops, 201 ha is covered by forest and the remaining land is occupied by other types of land use. There are 589 male headed households and 121 female headed households. About topography 40 % is medium steep, 50 % undulating and 10 % flat land (Woreda Office of Agriculture).

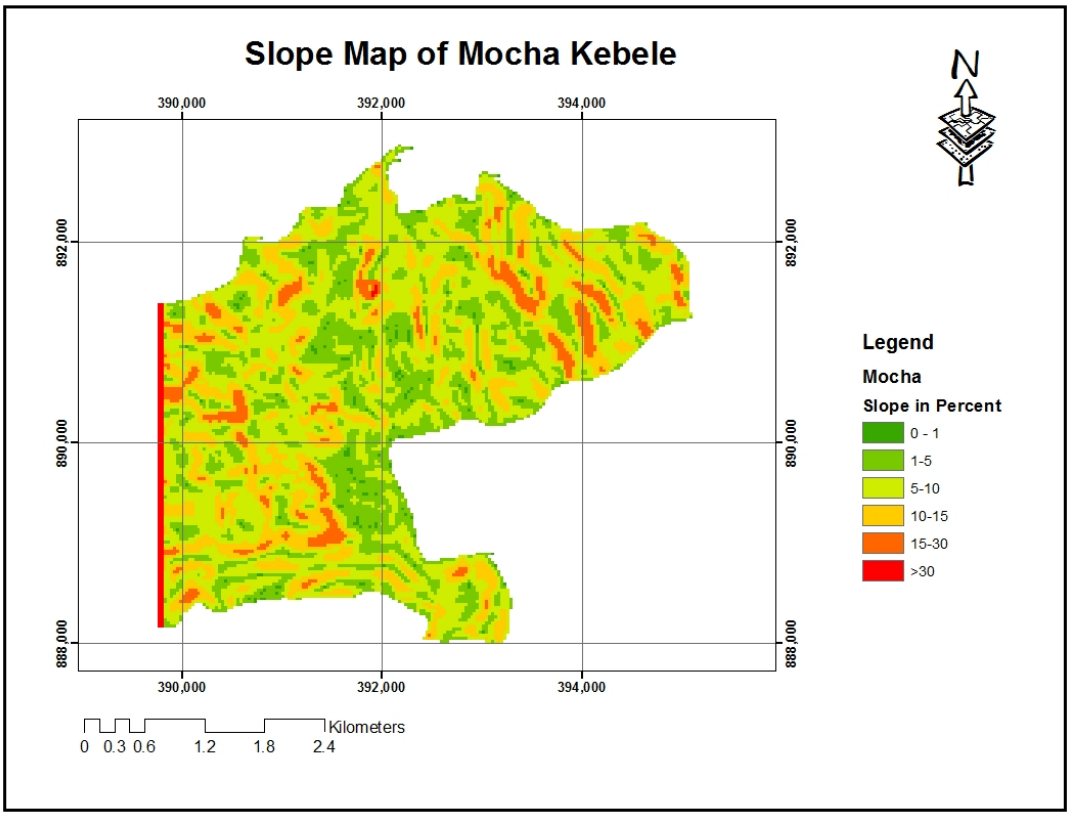


Fig 39 Slope map of Moche Kebele

7.2 Soils of Cheha Woreda

7.2.1 The soil-landscape in Woreda

Accordind to (Henricksen et. al., 1984) the geomorphology of Cheha Woreda is characterized as slightly dissected side slops and piedmonts of extinct central volcanoes and other related forms with associated parasitic cone and vent remnants.

In Cheha Woreda Moche and Yeferzeye kebeles are located in the upper Slope of the toposequence. The other two Ewan and Wordenen kebeles are located on the lower Slope position. It seems that Wordenen and Ewan Kebeles are water logged for some period of time in the rainy season. By considering the topography and area coverage of the intervention Woreda and auger description two soil profiles were opened in each kebeles of Moche, Yeferzeye, and Wordenen. Because similar soil types were described by Auger description process for Ewan Kerebed kebele and one representative soil sample was opened.

In the upper topographic position areas Luvisols soil type was found both kebeles of Moche, Yeferzeye and some parts of Wordenen. Vertisol soil type was found in the lower intervention Ewan and Some portions of Wordenen kebele. As a summery like that of Neighboring Enemor Ener Woreda upper areas are Luvisols and the Toe Slope position areas are found to be Vertisol.

Vetisols of Cheha Woreda have very deep and wide cracks, slickenside with very hard consistency when dry, sharp edge structure and heavy clay soils through out. All the Luvisols of Cheha in the area are deep > 200 cm, well drained, red in color, have CEC of sub surface horizon < 36 Cmolc/kg clay, well drained soils with clay increase in the sub surface horizons.

Farmers in the area classify the soil based on the color of the surface soil. Accordingly they classify red and black soil (in the local language Busha Afer, and Tikur Afer respectively). Based on farmer's classification Luvisols fall under Red soil (Busha Afer) and the Vertisols fall under Black soil (Tikur Afer).

7.2.2 Soil profile descriptions with analytical data

7.2.2.1 Profile site description Ewan Kebele

Profile 1

Site characteristics

Profile code	Ch-Ew-P1
Soil classification	Hypereutric Vertisol
Location	Cheha Woreda; Ewan kebele
Coordinates	N 08^0 13" 43' E 37^0 48"45'
Elevation	1908 m
Date	26/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, valley floor
Local physiography	Level
Macro relief	Flat
Slope	Level straight slope of ±1% over more than 10km long.
Land use	intensive land use. Teff is the main crops on average 1 ha per household. Some dairy cows.
Soil fauna	Few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium very closely spaced
Drainage	Poorly Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 60 Soil Description of Ch-Ew-P1

Hor.	Depth cm	Description
Ap	0-20	Dark gray (5Y 4/1) Clay; Moderate fine to medium sub granular structure; very hard when dry, friable when moist, very sticky and very plastic when wet; common, fine to medium, roots, clear smooth boundary.
AC	20-70	Very Dark gray (5 Y 3/1) Clay; moderate, medium to course, angular blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; very fine few roots, gradual, wavy boundary.
C1	70-110	Very Dark greenish gray (GLEY1 3/10GY) Clay; moderate, fine to course angular blocky structure; firm when moist, very sticky and very plastic when wet; few distinct slickensides; few, fine pores, very fine fery few roots, Clear wavy boundary.
C2	110-155	Dark greenish gray (GLAY1 4/10GY). Clay: moderate, fine to course angular blocky structure, firm when moist, very Sticky and very plastic when wet, distinct slickensides, clear wavy boundary.
C3	155+	Olive (5Y5/3). Clay: weak, very fine to medium, sub angular blocky structure, firm when moist, sticky and plastic when wet.

Table 61 Table with analytical data for Ch-Ew-P1

Horizon	A	AC	C1	C2	C3
pH-H_2O (1:2.5)	6.28	5.73	6.08	7.29	7.11
pH-KCL (1:2.5)	5.47	4.88	5.24	6.46	6.28
EC(ms/cm) (1:2.5)	0.14	0.10	0.11	0.20	0.10
Sand (%)	24.22	24.63	21.39	11.16	20.08
Silt (%)	21.49	25.87	26.59	20.06	33.77
Clay (%)	54.29	49.49	52.02	68.78	46.15
Silt to clay ratio	0.40	0.52	0.51	0.29	0.73
Texture Class	clay	clay	clay	Clay	clay
Exch. Na(meq/100gm of soil)	0.65	0.95	1.01	0.93	0.82
Exch. K(meq/100 gm of soil)	0.56	0.70	0.73	0.51	0.42
Exch. Ca(meq/100 gm of soil)	33.03	28.44	28.60	29.99	26.24
Exch. Mg(meq/100 gm of soil)	10.71	8.89	9.08	10.60	8.90
Ca to Mg ration	3.08	3.20	3.15	2.83	2.95
K to Mg ratio	0.05	0.08	0.08	0.05	0.05
Sum of Cations (meq/100gm of soil)	44.96	38.97	39.42	42.03	36.38
CEC(meq/100 gm of soil)	52.89	44.92	47.37	47.55	44.48
Organic Carbon (%)	1.07	1.03	0.84	0.50	0.38
Nitrogen (%)	0.11	0.09	0.08	0.05	0.03
C/N	9.73	11.44	10.50	10.00	12.67
PBS(%)	84.99	86.78	83.22	88.39	81.79
Available P(mg P_2O_5/kg soil)	32.10				

Bulk density (gm/ Cm^3)	1.25	1.18	1.14	1.14	1.07
Available S (%)	0.65				
Exchangeable Sodium %(ESP)	1.23	2.11	2.13	1.96	1.85
Micronutrient					
Zn (mg/kg soil)	4.01				
Mn (mg/kg soil)	49.72				
Cu (mg/kg soil)	1.92				
Fe (mg/kg soil)	63.52				

7.2.2.2 Profile site description Moche Kebele

Profile 1

Site characteristics

Profile code	Ch-Mo-P1
Soil classification	Chromic Luvisols
Location	Cheha Woreda; Moche Kebele
Coordinates	N 08^0 02" 59' E 38^0 00"50'
Elevation	2243 m
Date	23/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land, Plain
Local physiography	Slopy, middle Slope
Soil drainage	well drained
Macro relief	Hilly
Slope	level straight slope of ±3% over more than 500 m long. .
Land use	Enset and maize; other crops are teff and khat. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 62 Soil Description for Ch-Mo-P1

Hor.	Depth cm	Description
Ap	0-25	Dark reddish brown (5YR 3/2) Clay; Moderate, Very fine to medium, granular structure; Hard when dry, Loose when moist, non-sticky and non-plastic when wet; few, fine, pores; common, fine, roots, gradual smooth boundary.
Ah	25-60	Dark reddish brown (2.5YR 3/3) clay loam; moderate, fine to medium, Sub angular blocky structure; hard when dry, firm when moist, no sticky and non-plastic when wet; common, fine pores; very few, fine roots, diffuse smooth boundary.
AB	60-100	Dark reddish brown (2.5YR 3/4) clay; moderate, fine, Sub angular blocky structure; slightly hard when dry, very friable when moist, slightly sticky and non-plastic when wet; common, fine pores. Very few, few distinct clay coating; fine roots, diffuse smooth boundary.
Bt1	100-150	Dark reddish brown (2.5 YR 2.5/3). Clay: Moderate, fine and medium, angular blocky structure, friable when moist, sticky and plastic when wet, common, distinct clay coating, few, fine pores, diffuse smooth boundary.
Bt2	150+	Dark reddish brown (2.5 YR 2.5/3). Clay: Moderate, medium to course, angular blocky structure, firm when moist, slightly sticky and slightly plastic when wet, common, distinct clay coating, few, fine pores.

Table 63 Table with analytical data Ch-Mo-P1

Horizon	A	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	4.48	4.79	4.93	5.12	4.91
pH-KCL (1:2.5)	3.63	4.06	4.13	4.27	3.96
EC(ms/cm) (1:2.5)	0.04	0.02	0.02	0.02	0.02
Sand (%)	31.31	44.69	27.63	32.59	33.78
Silt (%)	24.69	20.21	25.54	23.54	19.23
Clay (%)	44.01	35.10	46.83	43.87	47.00
Silt to clay ratio	0.56	0.58	0.55	0.54	0.41
Texture Class	Sandy clay	Clay loam	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.80	1.03	0.94	0.85	1.02
Exch. K(meq/100 gm of soil)	0.47	0.43	0.39	0.42	0.50
Exch. Ca(meq/100 gm of soil)	13.67	15.26	14.42	17.04	15.32
Exch. Mg(meq/100 gm of soil)	4.27	5.09	5.09	6.82	5.96
Ca to Mg ration	3.20	3.00	2.83	2.50	2.57
K to Mg ratio	0.11	0.08	0.08	0.06	0.08
Sum of Cations (meq/100gm of soil)	19.21	21.82	20.84	25.12	22.80
CEC(meq/100 gm of soil)	30.18	30.88	28.11	32.41	31.46
Organic Carbon (%)	3.80	2.14	1.02	0.65	0.41
Nitrogen (%)	0.28	0.22	0.12	0.06	0.04

C/N	13.57	9.73	8.50	10.83	10.25
PBS(%)	63.65	70.63	74.14	77.54	72.47
Available P(mg $P_2O_{5/}$kg soil)	15.70	15.00			
Bulk density (gm/ Cm^3)	0.93	0.98	1.00	1.10	1.07
Available S (%)	1.23	1.31			
Exchangeable Sodium %(ESP)	2.65	3.34	3.34	2.63	3.24
Micronutrient					
Zn (mg/kg soil)	4.20	1.82			
Mn (mg/kg soil)	76.60	32.52			
Cu (mg/kg soil)	2.15	1.56			
Fe (mg/kg soil)	83.47	76.31			

Profile 2

Site characteristics

Profile code	Ch-Mo-P2
Soil classification	Chromic Luvisols
Location	Cheha Woreda; Moche kebele
Coordinates	N 08^0 03" 40' E 38^0 00"54'
Elevation	2605 m
Date	24/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Mountainous
Local physiography	level land, plain
Soil Drainage	Well drained
Macro relief	Hilly
Slope	Level straight slope of ±1.5% over more than 1km long.
Land use	Enset and maize; other crops are teff and khat. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 64 Soil description for Ch-Mo-P2

Hor.	Depth cm	Description
Ap	0-35	Yellowish red (5YR 4/6) Clay; weak, fine to medium, granular structure; friable when moist, non-sticky and non-plastic when wet; Few, fine, pores; common, fine, roots, clear smooth boundary.
Ah	35-68	Dark reddish brown (5YR 3/4) clay; moderate, fine to medium, Sub angular blocky structure; firm when moist, sticky and plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary.
Bt1	68-105	Dark reddish brown (2.5YR 3/4) clay; moderate, fine to medium, angular blocky structure; friable when moist, sticky and plastic when wet; few distinct clay coating; common, fine pores, diffuse smooth boundary.
Bt2	105-140	Dark reddish brown (2.5 YR 2.5/3). Clay: Moderate, medium to course, angular blocky structure, friable when moist, sticky and plastic when wet, common, distinct clay coating, few, fine pores, diffuse smooth boundary.
Bt3	140+	Dark reddish brown (2.5 YR 2.5/3). Clay: Moderate, medium to course, angular blocky structure, firm when moist, slightly sticky and plastic when wet, few, distinct clay coating, few, fine pores.

Table 65 Table with analytical data for Ch-Mo-P2

Horizon	Ap	Ah	Bt1	Bt2	Bt3
pH-H_2O (1:2.5)	4.72	4.58	4.63	4.80	4.89
pH-KCL (1:2.5)	4.00	3.72	3.84	4.00	4.12
EC(ms/cm) (1:2.5)	0.03	0.02	0.02	0.02	0.02
Sand (%)	41.85	30.38	22.31	24.08	25.99
Silt (%)	17.97	17.93	26.61	28.20	31.11
Clay (%)	40.18	51.69	51.08	47.72	42.91
Silt to clay ratio	0.45	0.35	0.52	0.59	0.73
Texture Class	Sandy clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.95	1.02	1.09	1.01	1.00
Exch. K(meq/100 gm of soil)	0.61	0.45	0.52	0.48	0.48
Exch. Ca(meq/100 gm of soil)	15.18	14.31	14.42	18.97	19.65
Exch. Mg(meq/100 gm of soil)	5.90	4.21	5.09	6.90	5.98
Ca to Mg ration	2.57	3.40	2.83	2.75	3.29
K to Mg ratio	0.10	0.11	0.10	0.07	0.08
Sum of Cations (meq/100gm of soil)	22.64	19.99	21.11	27.36	27.12
CEC(meq/100 gm of soil)	32.08	32.93	29.96	31.40	32.04
Organic Carbon (%)	2.83	1.24	0.54	0.46	0.27
Nitrogen (%)	0.22	0.10	0.04	0.03	0.02

C/N	12.86	12.40	13.50	15.33	13.50
PBS(%)	70.57	60.70	70.49	87.13	84.61
Available P(mg P_2O_5/kg soil)	19.50				
Bulk density (gm/ Cm^3)	1.01	1.10	1.14	1.13	1.15
Available S (%)	0.91				
Exchangeable Sodium %(ESP)	2.97	3.11	3.63	3.22	3.13
Micronutrient					
Zn (mg/kg soil)	7.01				
Mn (mg/kg soil)	79.07				
Cu (mg/kg soil)	3.07				
Fe (mg/kg soil)	79.88				

7.2.2.3 Profile site description Yeferzeye Kebele

Profile 1

Site characteristics

Profile code	Ch-Ye-P1
Soil classification	Chromic Luvisols
Location	Cheha Woreda; Moche kebele
Coordinates	N 08^0 08" 41' E 37^0 55"41'
Elevation	2067 m
Date	25/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Lower Slope
Local physiography	Level land, Plain
Soil drainage	well drained
Macro relief	Level Plain
Slope	Level straight slope of ±1% over more than 3km long.
Land use	Enset and maize; other crops are teff and khat. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 66 Soil description for Ch-Ye-P1

Hor.	Depth cm	Description
Ap	0-30	Dark reddish brown (2.5YR 2.5/3) Clay; Moderate, fine to medium, granular structure; hard when dry, firm when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, gradual smooth boundary.
Ah	30-65	Dark brown (7.5YR 3/2) clay; moderate, fine to coarse, Sub angular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common, fine pores; very few, fine roots, diffuse smooth boundary.
AB	65-115	Dark reddish brown (5YR 3/3) clay; strong, fine to course, angular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few distinct clay coating, common, fine pores, diffuse smooth boundary.
Bt1	115-160	Dark reddish brown (2.5 YR 3/4). Clay: Moderate, fine to course, angular blocky structure, friable when moist, sticky and plastic when wet, common, distinct clay coating, few, fine pores, diffuse smooth boundary.
Bt2	160+	Dark reddish brown (2.5 YR 2.5/3). Clay: Moderate, fine to course, angular blocky structure, friable when moist, sticky and slightly plastic when wet, common, distinct clay coating, few, fine pores.

Table 67 Table with analytical data for Ch-Ye-P1

Horizon	Ap	Ah	A2	Bt1	Bt2
pH-H_2O (1:2.5)	5.13	4.94	4.91	5.84	4.77
pH-KCL (1:2.5)	4.22	4.06	4.14	5.02	3.89
EC(ms/cm) (1:2.5)	0.12	0.03	0.08	0.10	0.03
Sand (%)	33.15	37.28	27.23	36.22	24.12
Silt (%)	20.16	20.20	27.82	19.13	26.72
Clay (%)	46.69	42.52	44.94	44.65	49.16
Silt to clay ratio	0.43	0.48	0.62	0.43	0.54
Texture Class	clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	0.96	1.11	1.28	1.22	1.25
Exch. K(meq/100 gm of soil)	0.87	0.67	0.74	1.57	0.64
Exch. Ca(meq/100 gm of soil)	19.47	17.79	18.83	19.50	16.11
Exch. Mg(meq/100 gm of soil)	5.92	5.93	6.85	6.78	5.94
Ca to Mg ration	3.29	3.00	2.75	2.88	2.71
K to Mg ratio	0.15	0.11	0.11	0.23	0.11
Sum of Cations (meq/100gm of soil)	27.22	25.50	27.70	29.07	23.94
CEC(meq/100 gm of soil)	36.80	38.22	36.29	35.49	35.95
Organic Carbon (%)	1.71	1.32	1.15	1.02	0.71
Nitrogen (%)	0.19	0.13	0.10	0.07	0.06

C/N	9.00	10.15	11.50	14.57	11.83
PBS(%)	73.97	66.72	76.33	81.91	66.59
Available P(mg P_2O_5/kg soil)	22.80				
Bulk density (gm/ Cm^3)	1.09	1.05	1.01	1.04	0.96
Available S (%)	0.91				
Exchangeable Sodium %(ESP)	2.60	2.89	3.54	3.43	3.49
Micronutrient					
Zn (mg/kg soil)	4.42				
Mn (mg/kg soil)	63.07				
Cu (mg/kg soil)	0.65				
Fe (mg/kg soil)	78.76				

Profile 2

Site characteristics

Profile code	Ch-Ye-P2
Soil classification	Chromic Luvisols
Location	Cheha Woreda; Moche kebele
Coordinates	N 08^0 08" 07' E 37^0 55"54'
Elevation	2074 m
Date	27/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Climate data	1300-1500 mm precipitation per year
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land Plain
Local physiography	level plain
Soil drainage	well drained
Macro relief	Hilly
Slope	Level straight slope of ±1.5% over more than 5 km long.
Land use	Enset and maize; other crops are teff and khat. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	No
Human influence	mixed agriculture

Table 68 Soil description for Ch-Ye-P2

Hor.	Depth cm	Description
Ap	0-25	Reddish brown (5YR 4/4) Clay; Moderate, fine to medium, sub angular blocky structure; firm when moist, non-sticky and non-plastic when wet; Few fine, pores; common, fine, roots, diffuse smooth boundary.
Ah	25-62	Reddish brown (5YR 4/4) Clay; moderate, fine to coarse, Sub angular blocky structure; firm when moist, non-sticky and non-plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary.
AB	62-103	Dark reddish brown (2.5YR 3/4) clay; moderate, fine to course, angular blocky structure; friable when moist, sticky and slightly plastic when wet; few distinct clay coating, common, fine pores, diffuse smooth boundary.
Bt1	103-172	Dark reddish brown (2.5 YR 3/3). Clay: Moderate, fine to course, angular blocky structure, friable when moist, sticky and slightly plastic when wet, common, distinct clay coating, few, fine pores, diffuse smooth boundary.
Bt2	172+	Dark yellowish brown (10 YR 3/3). Clay: Moderate, fine to course, angular blocky structure, friable when moist, sticky and slightly plastic when wet, common distinct clay coating, few, fine pores.

Table 69 Table with analytical data for Ch-Ye-P2

Horizon	Ap	Ah	AB	Bt1	Bt2
pH-H_2O (1:2.5)	4.66	4.33	4.56	4.34	4.63
pH-KCL (1:2.5)	3.81	3.54	3.70	3.61	3.82
EC(ms/cm) (1:2.5)	0.03	0.02	0.02	0.02	0.02
Sand (%)	41.91	38.45	23.55	23.49	23.87
Silt (%)	17.95	20.16	27.61	28.69	26.43
Clay (%)	40.13	41.39	48.84	47.83	49.69
Silt to clay ratio	0.45	0.49	0.57	0.60	0.53
Texture Class	clay	clay	clay	Clay	clay
Exch. Na(meq/100gm of soil)	1.22	1.20	1.07	1.21	0.97
Exch. K(meq/100 gm of soil)	0.51	0.41	0.51	0.50	0.50
Exch. Ca(meq/100 gm of soil)	15.12	15.26	15.26	14.84	15.96
Exch. Mg(meq/100 gm of soil)	5.04	5.94	5.09	5.09	5.88
Ca to Mg ration	3.00	2.57	3.00	2.92	2.71
K to Mg ratio	0.10	0.07	0.10	0.10	0.09
Sum of Cations (meq/100gm of soil)	21.89	22.81	21.93	21.63	23.30
CEC(meq/100 gm of soil)	31.96	32.72	31.34	32.26	28.30
Organic Carbon (%)	2.62	1.76	1.22	0.77	0.47
Nitrogen (%)	0.28	0.19	0.13	0.08	0.04

C/N	9.36	9.26	9.38	9.63	11.75
PBS(%)	68.49	69.71	69.97	67.08	82.37
Available P(mg P_2O_5/kg soil)	16.70				
Bulk density (gm/ Cm^3)	0.92	0.96	0.96	0.99	1.02
Available S (%)	0.83				
Exchangeable Sodium %(ESP)	3.83	3.66	3.41	3.75	3.42
Micronutrient					
Zn (mg/kg soil)	1.80				
Mn (mg/kg soil)	61.26				
Cu (mg/kg soil)	1.39				
Fe (mg/kg soil)	70.73				

7.2.2.4 Profile site description Wordenen Kebele

Profile 1

Site characteristics

Profile code	Ch-Wo-P1
Soil classification	Chromic Rohdic Luvisols
Location	Cheha Woreda; Wordenen kebele
Coordinates	N 08^0 09" 37' E 37^0 46"33'
Elevation	1893 m
Date	28/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land valley floor
Local physiography	level plain
Soil drainage	well drained
Macro relief	level
Slope	Level straight slope of ±2% over more than 5 km long.
Land use	Enset and maize; other crops are teff. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Well Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	In rainy season
Human influence	mixed agriculture

Table 70 Soil description for Ch-Wo-P1

Hor.	Depth cm	Description
Ap	0-22	Reddish brown (2.5YR 3/3) Clay; Moderate, fine to medium, granular structure; firm when moist, slightly sticky and non-plastic when wet; Few fine, pores; common, fine, roots, diffuse smooth boundary.
Ah	22-50	Dusky red (2.5YR 3/2) Clay; moderate, fine to medium, Sub angular blocky structure; friable when moist, slightly sticky and slightly plastic when wet; common, fine pores; very few, fine roots, gradual smooth boundary.
Bt1	50-95	Dark reddish brown (2.5YR 3/4) clay; moderate, fine to course, Sub angular blocky structure; firm when moist, sticky and plastic when wet; few faint clay coating, common, fine pores, diffuse smooth boundary.
Bt2	95-120	Dark reddish brown (2.5 YR 3/4). Clay: Moderate, fine to medium, angular blocky structure, firm when moist, sticky and plastic when wet, common distinct clay coating, few, fine pores, diffuse smooth boundary.
C	120+	Dark reddish brown (2.5 YR 3/4). Clay: Moderate, fine to medium, angular blocky structure, firm when moist, sticky and plastic when wet, few, fine pores.

Table 71 Table with analytical data for Ch-Wo-P1

Horizon	AP	Ah	Bt1	Bt2	C
pH-H_2O (1:2.5)	6.51	5.27	4.40	4.43	4.40
pH-KCL (1:2.5)	5.66	4.51	3.68	3.69	3.65
EC(ms/cm) (1:2.5)	0.10	0.07	0.08	0.05	0.05
Sand (%)	22.54	24.79	19.21	23.41	28.79
Silt (%)	40.32	30.72	30.83	26.59	33.20
Clay (%)	37.14	44.49	49.96	49.99	38.01
Silt to clay ratio	1.09	0.69	0.62	0.53	0.87
Texture Class	Clay loam	clay	clay	clay	Clay loam
Exch. Na(meq/100gm of soil)	0.70	0.86	0.90	0.92	0.92
Exch. K(meq/100 gm of soil)	2.01	1.60	1.29	1.50	1.10
Exch. Ca(meq/100 gm of soil)	19.89	21.12	16.10	17.81	14.08
Exch. Mg(meq/100 gm of soil)	6.77	7.60	5.08	5.94	4.69
Ca to Mg ration	2.94	2.78	3.17	3.00	3.00
K to Mg ratio	0.30	0.21	0.25	0.25	0.23
Sum of Cations (meq/100gm of soil)	29.37	31.19	23.37	26.17	20.79
CEC(meq/100 gm of soil)	35.88	38.11	32.23	31.80	28.75
Organic Carbon (%)	3.66	2.23	0.94	0.70	0.57
Nitrogen (%)	0.31	0.25	0.10	0.07	0.05
C/N	11.81	8.92	9.40	10.00	11.40

PBS(%)	81.86	81.82	72.51	82.30	72.31
Available P(mg P_2O_5/kg soil)	23.80	30.30			
Bulk density (gm/ Cm^3)	0.93	0.93	1.03	0.98	1.01
Available S (%)	0.53	0.43			
Exchangeable Sodium %(ESP)	1.95	2.27	2.80	2.90	3.19
Micronutrient					
Zn (mg/kg soil)	23.61	9.51			
Mn (mg/kg soil)	75.64	75.39			
Cu (mg/kg soil)	2.00	1.87			
Fe (mg/kg soil)	79.83	84.57			

Profile 2

Site characteristics

Profile code	Ch-Wo-P2
Soil classification	Hypereutric vertisol
Location	Cheha Woreda; Wordenen kebele
Coordinates	N 08^0 10" 02' E 37^0 47"48'
Elevation	1926 m
Date	29/05/06 EC
Author	Alemayehu Kiflu and Tibebu Desalegn
Weather conditions	WC1
Geology	Magdala group, Rhyolites, Trachytes, rhyolites and tracytic tuffs.
Land form	Level land valley floor
Local physiography	level plain
Soil drainage	poorly drained
Macro relief	level
Slope	Level straight slope of ±1% over more than 10 km long.
Land use	Enset and maize; other crops are teff. On average 0.25 ha per household. Some dairy cows (Common grazing).
Soil fauna	few earth worms

General information on the soil

Parent material	Basalt volcanic material
Moisture condition	Dry topsoil, with moist subsoil
Cracking	Fine Medium Very closely spaced
Drainage	Drained
Groundwater	Very deep (> 2m)
Rock outcrops	none
Surface stones	none
Erosion	Moderate Water erosion
Flooding	In rainy season
Human influence	mixed agriculture

Table 72 Soil description for Ch-Wo-P2

Hor.	Depth cm	Description
Ap	0-25	Very dark greenish gray (Glay 1/3/10Y) Clay; strong fine to medium angulayblocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; common, fine to medium, roots, gradual wavy boundary.
AC1	25-65	Very dark greenish gray (Glay 1/3/10Y) Clay; strong fine to medium angular blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; common, fine to medium, roots, clear wavy boundary.
AC2	65-92	Dark greenish gray (GLEY1/4/10Y) Clay; moderate, medium to course angular blocky structure; friable when moist, very sticky and very plastic when wet; few distinct slickenside; few, fine pores, very fine very few roots, clear wavy boundary.
C1	92-160	Very Dark bluish gray (GLAY2 3/5PB). Clay: moderate, medium to course angular blocky structure, friable when moist, very Sticky and very plastic when wet, distinct slickenside, gradual wavy boundary.
C2	160+	Very Dark bluish gray (GLAY2 3/10B). Clay: moderate, medium to coarse angular blocky structure, friable when moist, very sticky and very Plastic when wet.

Table 73 Table with analytical data for Ch-Wo-P2

Horizon	Ap	AC1	AC2	C1	C2
pH-H_2O (1:2.5)	5.21	5.37	6.21	5.34	5.39
pH-KCL (1:2.5)	4.31	4.42	5.31	4.56	4.43
EC(ms/cm) (1:2.5)	0.10	0.05	0.14	0.06	0.07
Sand (%)	26.47	20.11	18.93	18.90	20.63
Silt (%)	24.87	15.53	15.55	11.26	24.59
Clay (%)	48.66	64.36	65.52	69.84	54.77
Silt to clay ratio	0.51	0.24	0.24	0.16	0.45
Texture Class	clay	clay	clay	clay	clay
Exch. Na(meq/100gm of soil)	1.01	0.67	1.30	0.81	0.81
Exch. K(meq/100 gm of soil)	0.57	0.65	0.74	0.66	0.53
Exch. Ca(meq/100 gm of soil)	21.50	26.38	34.32	32.92	26.52
Exch. Mg(meq/100 gm of soil)	7.74	8.79	11.88	10.68	8.84
Ca to Mg ration	2.78	3.00	2.89	3.08	3.00
K to Mg ratio	0.07	0.07	0.06	0.06	0.06
Sum of Cations (meq/100gm of soil)	30.82	36.49	48.25	45.06	36.70
CEC(meq/100 gm of soil)	39.73	43.96	52.13	52.22	49.48
Organic Carbon (%)	2.04	1.06	1.03	0.85	0.71
Nitrogen (%)	0.17	0.14	0.11	0.08	0.05
C/N	12.00	7.57	9.36	10.63	14.20

PBS(%)	77.57	83.01	92.54	86.31	74.17
Available P(mg P_2O_5/kg soil)	29.00				
Bulk density (gm/ Cm^3)	0.95	1.21	1.15	1.14	1.24
Available S (%)	0.99				
Exchangeable Sodium %(ESP)	2.54	1.52	2.50	1.56	1.63
Micronutrient					
Zn (mg/kg soil)	12.35				
Mn (mg/kg soil)	72.55				
Cu (mg/kg soil)	2.54				
Fe (mg/kg soil)	75.75				

7.3 Synthesis

Soils in Cheha Woreda are dominated by Chromic Luvisols, well drained, very deep (>2 m), red color, well structured, sandy clay loam to clay soils with a general increase in clay contents from topsoil to subsoil, Silt to clay ration greater than 0.35, with thick (over 50 cm) reddish brown top soils. These soils dominate the whole high land kebeles of Moche yeferzeye and small portion of Wordenen kebele. In the lower topograpHic areas Vertisols dominate and are found in the whole Ewan and larger portions of Wordenen kebele. These soils are poorly drained, very deep, glay in color, very hard consistency when dry, very sticky very plastic consistence, with high swelling and cracking clay content.

Surface horizons of Luvisols in the Cheha had a weak to moderate granular to Sub angular blocky structure. The subsurface horizons of had moderate and Sub angular and angular blocky structure. This indicate that there is relatively better developed structure of the subsurface soils, which could be due to the relatively higher clay content of the subsurface horizons than that of the surface horizons (Ahn, 1993). The consistency of the soils in the surface layers was found to be firm and friable and from non-sticky non-plastic to slightly sticky to slightly plastic. On the other hand, the moist consistency of the subsurface horizons ranged from friable to firm, with sickness and plasticity range was from to slightly sticky/slightly plastic to very sticky/very plastic when wet. The friable and slightly sticky/slightly plastic consistency observed in the surface horizons of all pedons could be attributed to the relative higher organic matter content of the surface than subsurface layers.

In all Luvisol, clay content increased with increasing soil depth, forming argillic horizons. Moreover, both the sand and silt contents were generally higher in the surface soil. According to Boul et al. (2003), the accumulation of clay in the subsurface horizon could be also contributed by the in situ synthesis of secondary clays, the weathering of primary minerals in the B horizon, or the residual concentration of clays from the selective dissolution of more soluble minerals of coarser grain sized in the B horizon.

Silt to clay ratios for Luvisols of Moche soils ranged from 0.35 to 0.73, In Yeferzeye from 0.43 to 62 and in Luvisols of Wordenen it range from 0.53 to 1.03 (Table 73 above). Silt/clay ratio is an important criterion used in the classification of tropical soils. It is also used in the evaluation of clay migration, stage of weathering and age of parent material and soils. The more highly weathered a soil is, the lower the silt fraction. Therefore, soils with silt/clay ratio of less than 0.15 are regarded as highly weathered (Van Wambeke, 1962). In all the cases the Silt to clay ratio is greater than 0.35 meaning that soils of Luvisols Cheha are young soils in terms of weathering.

Luvisols of Cheha are found to be very acidic. Surface horizon soils of the Moche have pH 4.48-4.76 for profile 1 and 4.58-4.72 for profile 2, Profile 1 of yeferzeye has 5.13-4.77, profile 2 has 4.33- 4.66. Luvisols in Wordenen kebele have H value of 5.27-6.51. According to London (1984) soils having pH value less than 5.5 are categorized as acidic soils. Therefore all Luvisols in Cheha Woreda have a pH value less than 5.5 and are very acidic and liming is a need in the area based on laboratory analysis. In all the profiles of Luvisols of Cheha the CEC is less than 40 Cmolc/Kg of clay soil and greater than 28.11 Cmolc/Kg of clay soil. According to London (1984) soils having CEC value between 25 to 40 Cmolc/Kg of clay soil may need some amount of lime and potassium fertilizer. As the soils are young the amount of cations are good for crop production and all the concentrations of cation in the different profiles are found to be satisfactory according to London (1984) . Moreover available phosphorus and total nitrogen are found to be adequate for Luvisols of Cheha except for soils of Yeferzeye where it is found in low amount according to London (1984) . The amount of organic carbon content is found to be low according to London (1984) . Even some profiles like Ch-Ye-P1 are found to have very low organic carbon content. This could be due to crop removal in the area.

Vertisols of Ewan and Wordenen kebeles have a surface consistency of very hard when dry, firm when moist, very sticky and very plastic when wet. They have subsurface consistency of friable when moist, very Sticky and very plastic when wet with distinct slickenside. In both kebeles the amount of organic carbon is low (London 1991). This could be due to the churning effect of Vertisols when they undergo swelling and cracking. Moreover the amount of nitrogen is found to be in low amount and nitrogen fertilizer may have a response. All other nutrients are found to be in adequate level according to London (1984) .

Fig 30. Sample Soil Profile at yeferzeye kebele

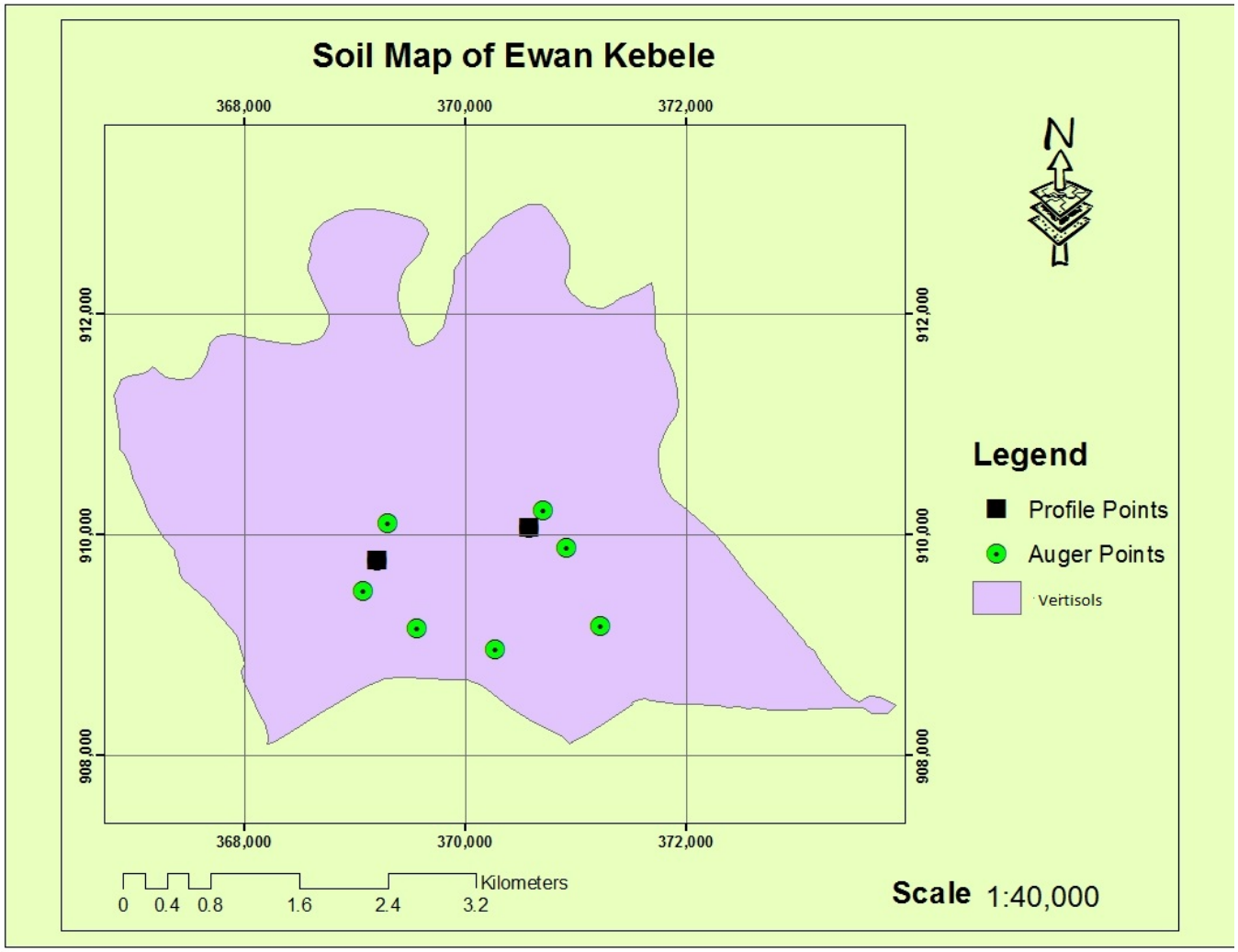


Fig 41 Soil Map of Ewan Kebele

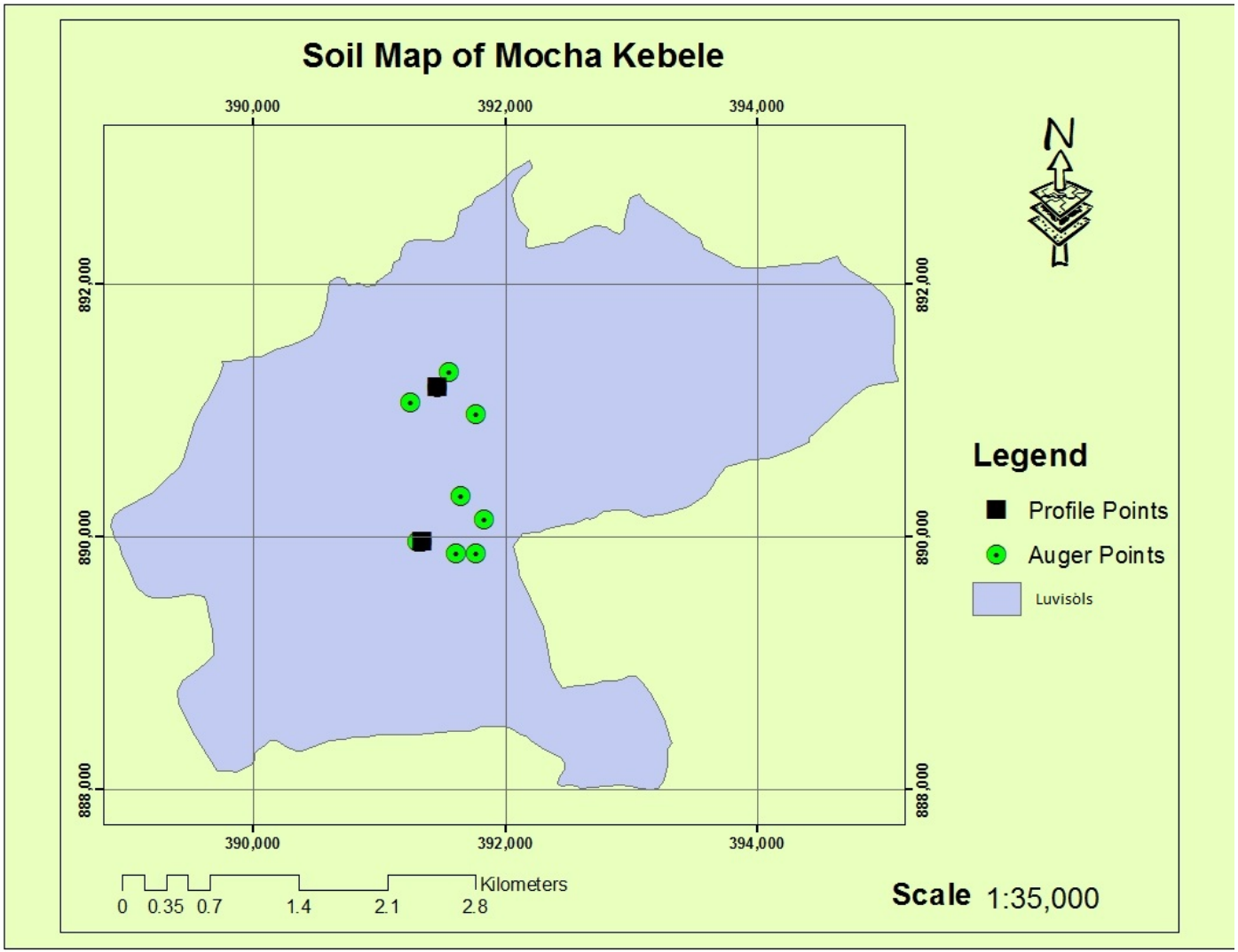


Fig 42 Soil Map of Moche Kebele

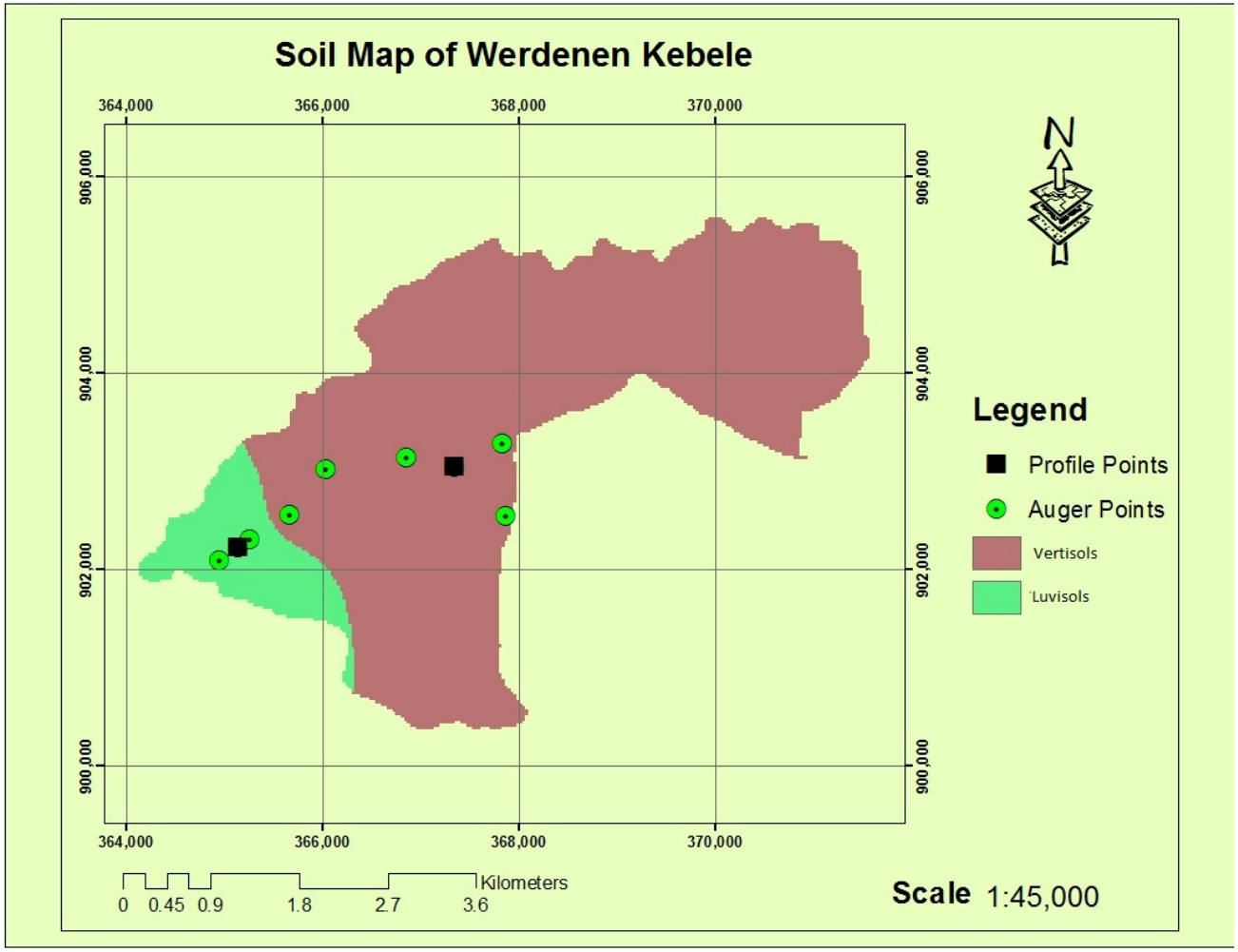


Fig 43 Soil Map of Wordenen Kebele

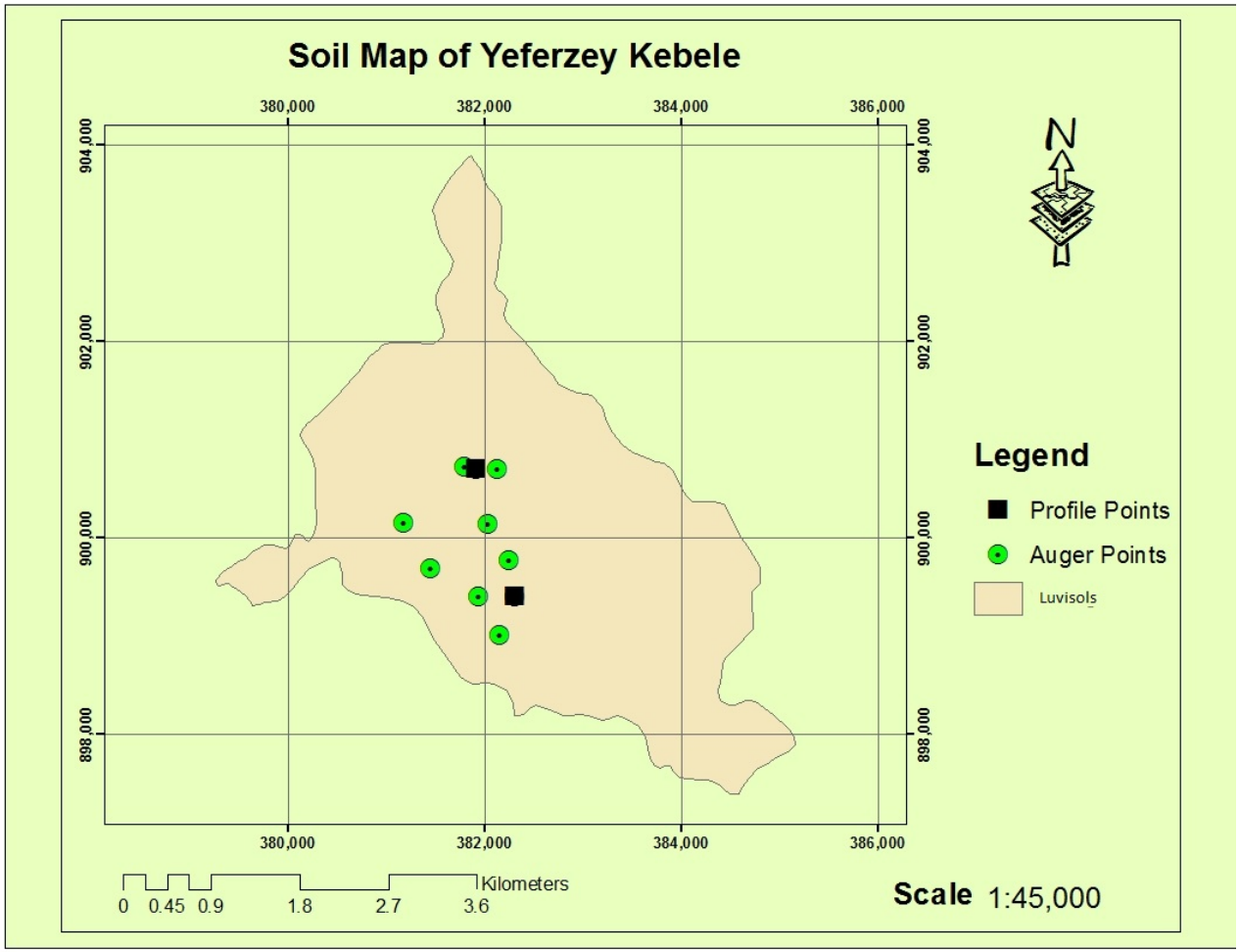


Fig 44 Soil Map of Yeferzeye Kebele

8. Summery of Soil Fertility evaluation by Farmers'

Farmers in the study area have common criteria to evaluate and identify their soils. As a major criterion farmers used soil color, texture, water holding capacity and workability to classify into different groups. According to their criteria farmers categorized their soils into: Black, Red soil and Hiber/Sancha (Vertisols). Some of the properties farmers used and their associated properties are shown in the following table (Table).

Table 74 Farmer's classification and their associated properties

Soil Type by farmers	WRB soil type	Color	Fertility status	Water holding capacity	limitations
Gembana/ Chara/Mune/Tiloke/ Kolisho/	Luvisol/Nitosol	Black	Medium	Medium	Less fertile
Bush/Demoke/Dumo	Cambisols	Red	Medium	medium	Less fertile
Hiber/Sancha	Vertisol	Black	high	high	workability

In their critical analysis farmers in different settings classify and manage soil productivity as amulti-faceted concept. It includes factors such as the soils' capacity for sustainable productivity, its permeability, and water holding capacity, drainage, tillage, fertilizer requirement and how easy it is to work. According to Corbeels et al., (2000), soil color is an important criterion for farmers, as it often reflects the soil's hidden parent material, which determines specific soil characteristics. The texture of the surface layer has also influence on many other soil properties and gives farmers a clear indication of to whether a soil can be cultivated after the first rains of the season.

Farmers view soil fertility in relative terms and their classification is often related to soil color. Farmers ranked Hiber/Sancha (Vertisols) to be the best soil in terms of productivity in years of moderate rainfall. According to farmers in the area, due to its high water holding capacity, this soil gives better yield than other soils at times of low rainfall. . The major limitation of this soil is stickyness when wet and very hard consistency when dry; making it difficult to till at both extremes of water content. Moreover black soils (Mostly Luvisols but some time Nitosols) are also fertile but at different stage of fertility status. The black colors of soils as indicators of good soils are reflections of the high amounts of organic matter content in the soil, hence high availability of plant nutrients, high capacity to retain nutrients in exchangeable forms, high moisture retention and storage and source of energy and carbon for soil micro-organisms.

9. Soil Fertility Management Practices in the study areas

Tillage Practices: Farmers used oxen to pull the local plough '*Maresha*'. Most of the farmers in the highland areas cultivate their land 3-5 times before planting. They argue that increasing the frequency of tillage is the way of improving soil productivity. Some

times they also plant different pulses crops on marginal lands, rotate crops and increase fertility. In Guraghe and Silty zone deep tillage by hand digging is practiced (similar with sub soiling). Due to this many profiles are found to have a thick Ah horizone. According to the farmers such practice helps to increase fertility.

Agro-forestry. Soil fertility and improvement under trees and agro-forestry systems is related to increases in soil properties and erosion. Besides their role in above-ground carbon sequestration and increase carbon stocks and soil fertility, agro-forestry systems have also many merits in conserving the soils especially in Ethiopia known by undulating land form where erosion is severe. Accordingly because agro-forestry is practiced in the area (Bule Woreda) all the soils are found to be very deep greater than 150 cm. therefore, agro-forestry practices are very much effective even in areas greater than 25% Slope. Such practices have to be adopted in other areas of Ethiopia as Ethiopia is known by sloppy areas where topography play great role in removing surface soil and nutrients.

Crop Residues: Although **f**armers of the study area are well aware of the advantage of returning crop residues to soil fertility, the practice of decomposing crop residues *insitu* is is not a well known practice. But, only very few farmers around retain most crop residues in their field. This is because crop residues are used as construction material, fuel and source of animal feed.

Mineral Fertilizers: Farmers used low rates of mineral fertilizers due to the current high prices of chemical fertilizers. As a common rule farmers apply only 100 kg DAP/ha for cereals. This rate is by far lower than the blanket recommendation (100 kg DAP and 100 kg Urea) for the area. Morover, soil and crop specific fertilizer recommendations are needed. In this region, with many acidic soils, non-acidifying fertilizers are recommended as well as regular liming.

Fallowing: The study clearly depicted due to the ever increasing population pressure, long term fallowing is currently abandoned in the study area. But, farmers know the benefit of fallowing to restore soil fertility. Currently, the common practice in the area is seasonal fallowing i.e. leaving the land fallow for one or two seasons. This is however, too short period for restoration of soil fertility.

10. Summary and Conclusion

Generally Luvisols dominates most of the intervention kebeles. Other soil types like Fluvisole, Nitosols are also found in some pocket and depression areas of the different areas. Moreover, Vertisols are also found and become common in lower areas and water logged areas. Farmers also classify the soils around their areas based on their criteria but many of the criteria's used by farmers are general and consider only the surface soil properties. Most of the farmers used soil color as a main criteria. Finally from the soil analysis it is found that some soils are found to be very acidic and need application of lime.

Table 75 Summary of major soil types of agricultural lands of the intervention Kebeles

Zone	Woreda	Kebele	Pedon	Soil Type	Suffix qualifiers	Area Coverage
Silte	Mesrak Azernet	Emejar	Me-Az--Em-P1	Vertisol	Mesotrophic	34.61 % (408.47 ha)
Silte	Mesrak Azernet	Emejar	Me-Az-Em-P2	Luvisols	Chromic	65.39 % (771.52 ha)
Silte	Mesrak Azernet	Yerim	Me-Az-Ye-P1	Vertisol	Chromic	25.21 % (211.79 ha)
Silte	Mesrak Azernet	Yerim	Me-Az-Ye-P2	Luvisols	Chromic	75.79 % (628.21 ha)
Silte	Mesrak Azernet	Adazer Shebel	Me-Az-Sb-P1	Luvisols	Chromic	The whole kebele
Silte	Mesrak Azernet	Adazer Shebel	Me-Az-Sb-P2	Luvisols	Haplic	The whole kebele
Silte	Mesrak Azernet	Adazer Abicho	Me-Azab-P1	Luvisols	Chromic	The whole kebele
Gurage	Enemor Ener	Kunber	En-Ku-P1	Luvisols	Chromic	The whole kebele
Gurage	Enemor Ener	Kunber	En-Ku-P2	Luvisols	Chromic	The whole kebele
Gurage	Enemor Ener	Agata	En-Ag-P1	Luvisols	Chromic Rhodic	The whole kebele
Gurage	Enemor Ener	Kerebed	En-Ke-P1	Vertisol	Mesotrophic	The whole kebele
Gurage	Enemor Ener	Gomosh	En-Go-P1	Luvisols	Chromic, Rohdic	34.71 % (277.68 ha)
Gurage	Enemor Ener	Gomosh	En-Go-P2	Vertisol	Mesotropic	65.29 % (522.32 ha)
Gedio	Bule	Dero	Bu-De-P1	Luvisols	Chromic, Rohdic	75.95 % (546.77 ha)
Gedio	Bule	Dero	Bu-De-P2	Luvisols	Chromic, Rohdic	
Gedio	Bule	Dero	Bu-De-P3	Cumbisol	Eutric	24% (173.22 ha)
Gedio	Bule	Basura	Bu-Ba-P1	Luvisols	Chromic	The whole kebele
Gedio	Bule	Basura	Bu-Ba-P2	Luvisols	Chromic	The whole kebele
Gedio	Bule	Sika	Bu-Si-P1	Luvisols	Chromic	The whole kebele
Gedio	Bule	Illalcha	Bu-Ila-P1	Luvisols	Chromic	The whole kebele
Gedio	Bule	Illalcha	Bu-Illa-P2	Luvisols	Chromic	The whole kebele
Sidama	Malga	Fitoketemuna	Ma-Ft-P1	Nitosols	Orthoeutric	27.1% (195.32 ha)

Sidama	Malga	Fitoketemuna	Ma-Ft-P2	Luvisols	Chromic Rohdic	72.94% (526.67)
Sidama	Malga	Kocho	Ma-Ko-P1	Luvisols	Chromic, Rohdic	The whole kebele
Sidama	Malga	Sintaro	Ma-Si-P1	Cumbisol	Chromic	7.01 % (58.13 ha)
Sidama	Malga	Sintaro	Ma-Si-P2	Nitosols	Rhodic Orthoeutric	92.99 (771.86 ha)
Sidama	Malga	Guguma	Ma-Gu-P1	Luvisols	Haplic	The whole kebele
Sidama	Malga	Guguma	Ma-Gu-P2	Luvisols	Haplic	The whole kebele
Gurage	Cheha	Moche	Ch-Mo-P1	Luvisols	Chromic	The whole kebele
Gurage	Cheha	Moche	Ch-Mo-P2	Luvisols	Chromic, Rohdic	The whole kebele
Gurage	Cheha	Yeferzeye	Ch-Ye-P1	Luvisols	Chromic, Rohdic	The whole kebele
Gurage	Cheha	Yeferzeye	Ch-Ye-P2	Luvisols	Chromic	The whole kebele
Gurage	Cheha	Ewan	Ch-Ew-P1	Vertisol	Hyper Eutric	The whole kebele
Gurage	Cheha	Wordenen	Ch-Wo-P1	Luvisols	Chromic, Rohdic	10.56% (79.21 ha)
Gurage	Cheha	Wordenen	Ch-Wo-P2	Vertisol	Hyper Eutric	89.44% (670.78 ha)

From the macronutrients nitrogen is found in low and medium level. Phosphrous is found in adequate amount but due to the calcium to magnesium ratio which is less than three in most cases, the uptake of phosphrous will be affected. Moreover because the pH of most surface horizons is below 5.5 there may be a need for liming and this will inturn increase the uptake of phosphrous but lime application depends on the laboratory test and therefore there should be a liming requirement test before taking any decision. Due to harvest of both the yield and the straw, the amount of organic carbon content in mist soils is found in low level and therefore there should be application of orgamic materials so as to increase both physical and chemical properties of the soils. Concerning the micro nutrients all the surface horizons are found to have in adequate level for plant.

11. References

Ahn, P., 1993. Tropical soils and Fertilizer use. Intermediate tropical agriculture serious. Long man Group UK limited. Malaysia. 264p.

Benning, T. L. and T. R. Seastedt. 1995. Landscape-level interactions between topographic features and nitrogen limitation in tall grass prairie. Landscape Ecology, 10: 337-348.

Boul, S.W., R. J. Southard, R. C., Graham, and P. A., McDaniel. 2003. Soil genesis and classification.5th ed. Iowa State University Press. Ames, USA.

Brady, N. C. (1984). 'The nature and properties of soil.' (Macmillan: New York.)

BWFED (Bule Woreda Finance and Economic Development) (unpublished) 2011. Bule Woreda Socio-*economy and Biophysical Profile*. Bule, Ethiopia.

CASCAPE Working Paper 2.4.1. 2014. Participatory Rural Appraisal Report: Bule Woreda, Southern Nations, Nationalities and Peoples' Region. South Innovation Team. Hawassa University.

CASCAPE Working Paper 2.4.2. 2014. Participatory Rural Appraisal Report: Enemor ena Ener Woreda, Southern Nations, Nationalities and Peoples' Region. South Innovation Team. Hawassa University.

CASCAPE Working Paper 2.4.3. 2014. Participatory Rural Appraisal Report: MalgaWoreda , Southern Nations, Nationalities and Peoples' Region. South Innovation Team. Hawassa University.

CASCAPE Working Paper 2.4.4. 2014. Participatory Rural Appraisal Report: Mesrak Azernet Berber Woreda, Southern Nations, Nationalities and Peoples' Region. South Innovation Team. Hawassa University.

Central Statistical Agency, Federal Democratic Republic of Ethiopia (2007). Statistical Report of the 2007 Population and Housing Census. Addis Ababa, Ethiopia.

Corbeels, M., Abebe Shiferaw and Mitiku Haile, 2000. Farmers' knowledge of soil fertility and local management strategies in Tigray, Ethiopia. Managing Africa's Soils, No. 10, IIED, London, UK.

CSA (Central Statistical Agency of the Federal Democratic Republic of Ethiopia, 2007. Statistical report of the 2007 population and housing census. Addis Ababa, Ethiopia.

Enemor ena Ener *Woreda* Finance and Economic Development Office (2011). *Enemor ena Ener Woreda Socio-economy and Biophysical Profile*. Unpublished Report, Gunchere, Ethiopia.

FAO. 1998. World reference base for soil resources. FAO, ISRIC and ISSS, Rome.

FAO. 2006. Guidelines for Soil Description. Food and Agriculture Organization of the United States. Rome.

Fikre Melese. 2003. Pedogenesis of major volcanic soils of the southern central Rift Valley region, Ethiopia. MSc Thesis. University of Saskatchewan, Saskatoon, Canada.

Hazelton P. and Murphy B. 2007. Interpreting soil test results, what do all the numbers mean? CSIRO Publishing. pp169.

Henricksen B. L., S. Ross, Sultan Tilimo and H. Y. Wijntje-Bruggeman. .1984. Ethiopia, Geomorphology and Soils. United Nation Development Program. Food and Agriculture Organization of the United Nations. Rome.

Kosmas, C., S. Gerontidis, and M. Marathianou. 2000. The effect of land use change on soils and vegetation over various lithological formations on Lesvos (Greece). Catena, 40: 51-68.

Lal, R. 2000. Soil management in the developing countries. Soil Sci. 165:57-72. Cited by Fikre, 2003.

London J.R. 1991. Booker Tropical Soil Manual: a Handbook for Soil Survey and Agricultural Land Evaluation in the Tropics and Subtropics. London and New York: Longman (1984), pp. 450.

Malga Woreda Finance and Economic Development Office (2011).Malga Woreda Socio-economy and Biophysical Profile. Unpublished Report, Manicho, Ethiopia.

Misrak Azernet Berbere *woreda* Finance and Economic Development Office (2011). Misrak Azernet Berbere *woreda* Socio-economy and Biophysical Profile. Unpublished Report, Kiltu, Ethiopia.

Pastor, J. and W. M. Post, 1986. Influence of climate, soil moisture and succession on forest carbon nitrogen cycles. Biogeochemistry, 2: 3-27.

Ronggui, W. 2001. Effect of land use on soil fertility and phosphorus dynamics in sub-alpine grassland soil of Gansu, China. PhD Dissertation, University of Saskatchewan, Canada.

SAS .1997. SAS Institute Inc., Cary. NC. USA.

Schimel, D. S., T. G. Kittel, A. K. Knapp, T. R. Seastedt, W. J. Parton, and V. B. Brown. 1991. Physiological interactions along resource gradients in tall grass prairie. Ecology, 72: 672-684.

Seastedt, T. R., J. M. Briggs and D. J. Gibson. 1991. Controls of nitrogen limitation in tall grass prairie. Oecologia, 87: 72-79.

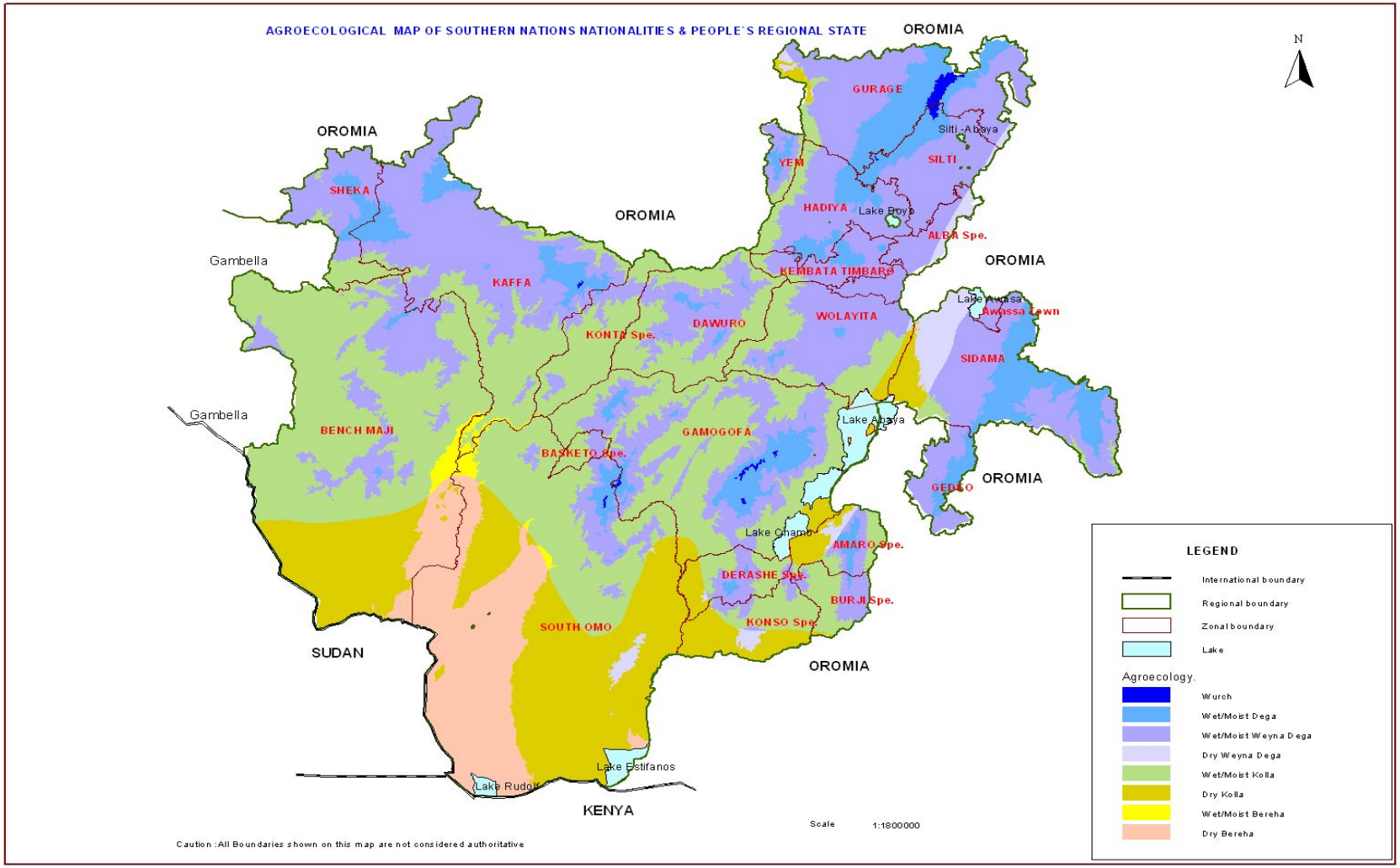
Taffa Tulu. 2002. Soil and water conservation for sustainable agriculture CTA. Mega Publishing Agency. Addis Abeba.

Thomas S. J., 2000. Soil fertility Evaluation. Sumner M. E. (ed) Handbook of soil science .CRC press.

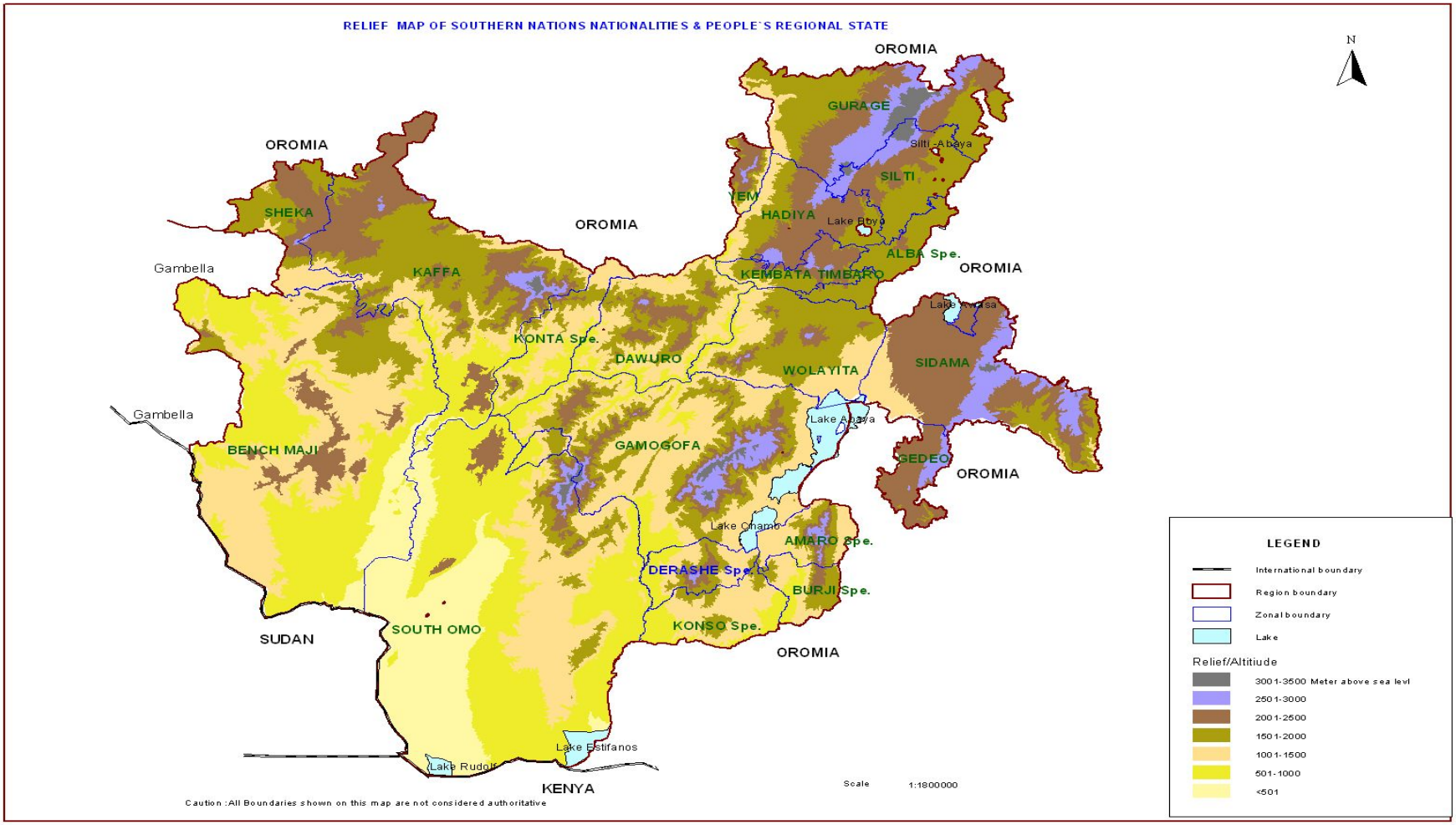
Townsend, A. R., P. M. Vitousek and S. E. Trumbore. 1995. Soil organic matter dynamics along gradients in temperature and land use on the island of Hawaii. *Ecology*, 76: 721-733.

Van Wambeke, A.R. 1962. Criteria for classifying tropical soils by age. Journal of soil sci. 13: 124-132.

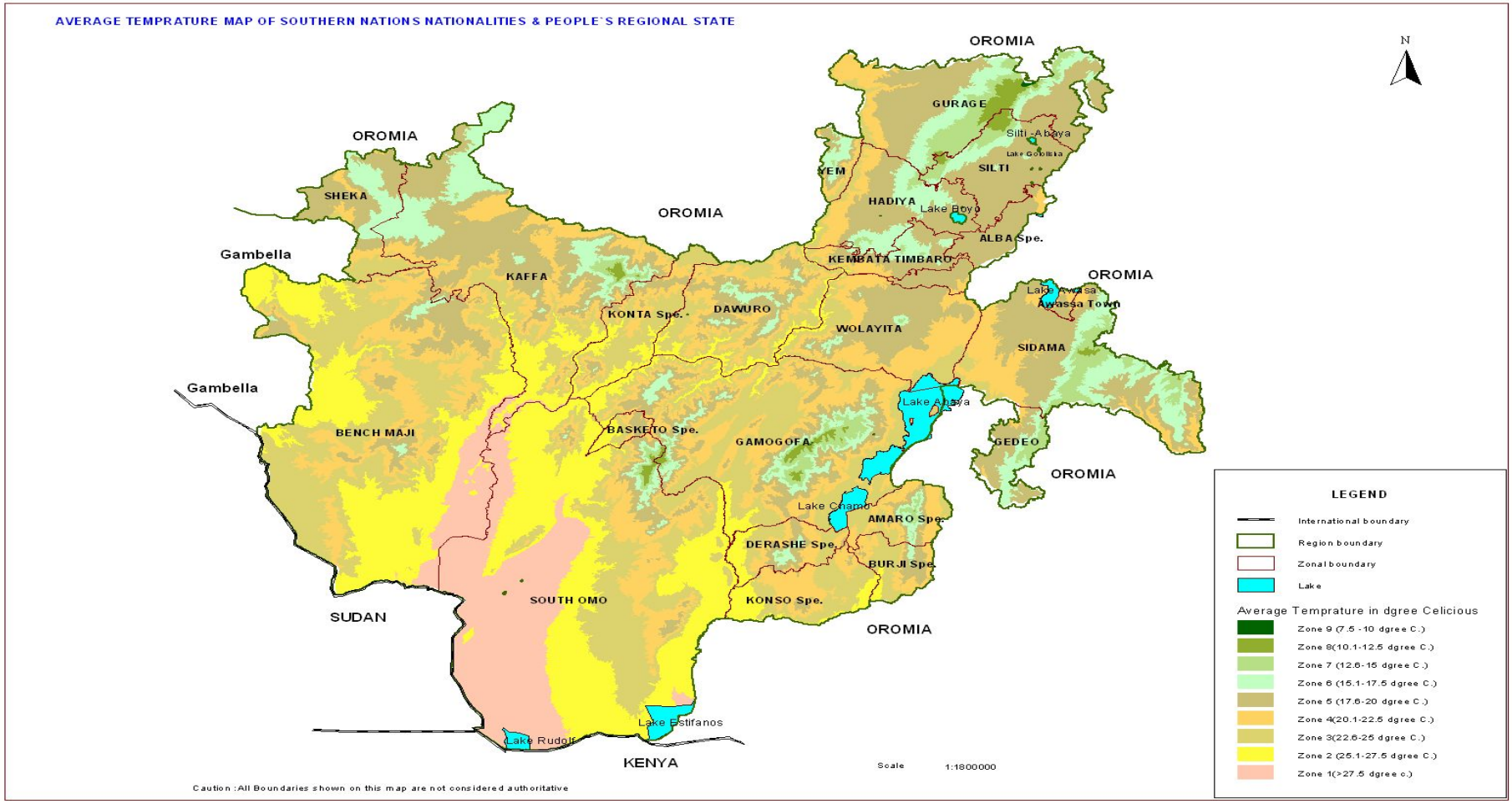
Wakene Negassa, 2001. Assessment of Important Physicochemical Properties of Nitosols under Different Management Systems in Bako Area, Western Ethiopia. M.Sc. Thesis, Alemaya University, Alemaya. pp 109.



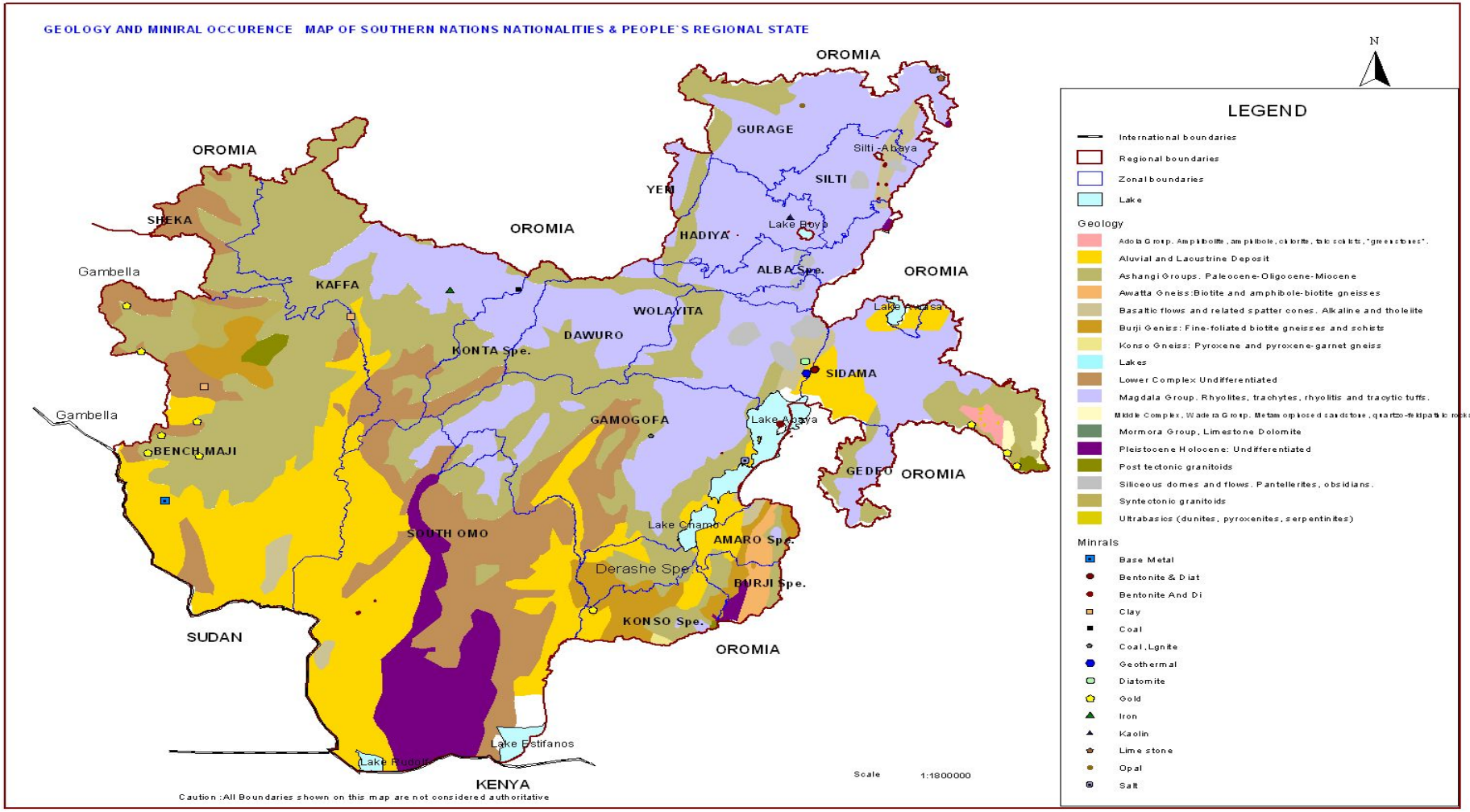
Appendix1 Agro ecological map of SNNPRS



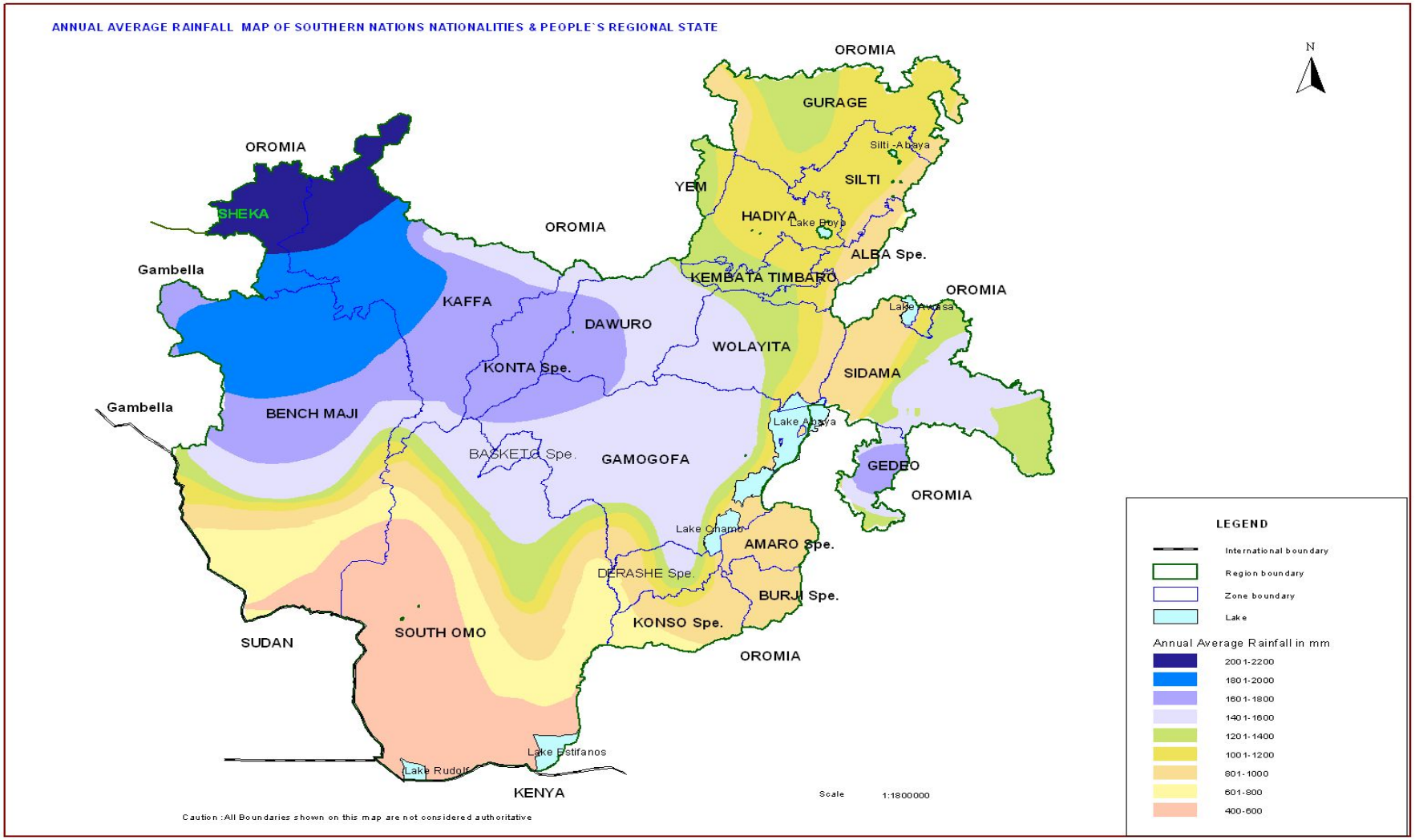
Appendix 2 Relief map of SNNPRS



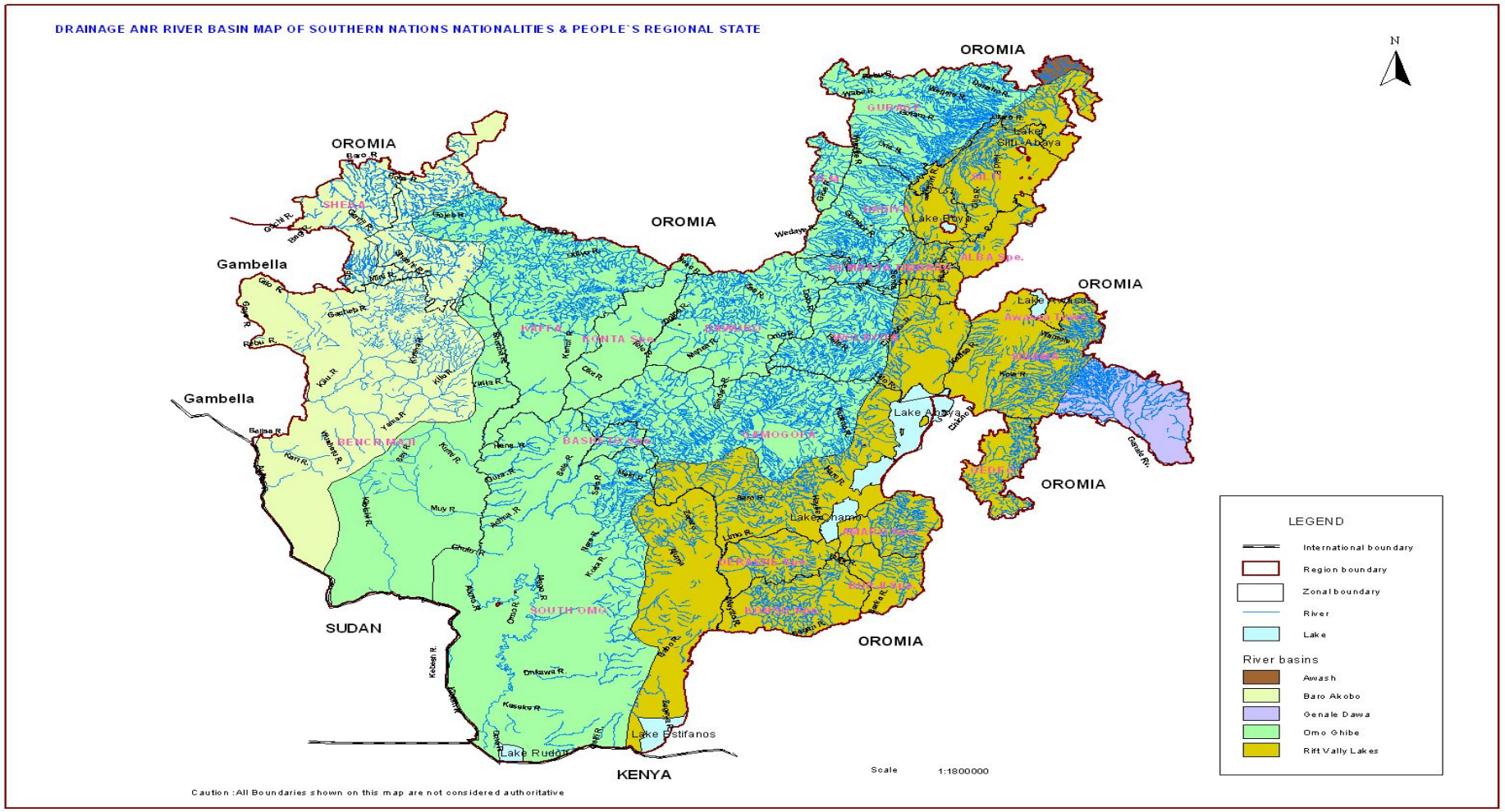
Appendix 3 Average temperature map of SNNPRS



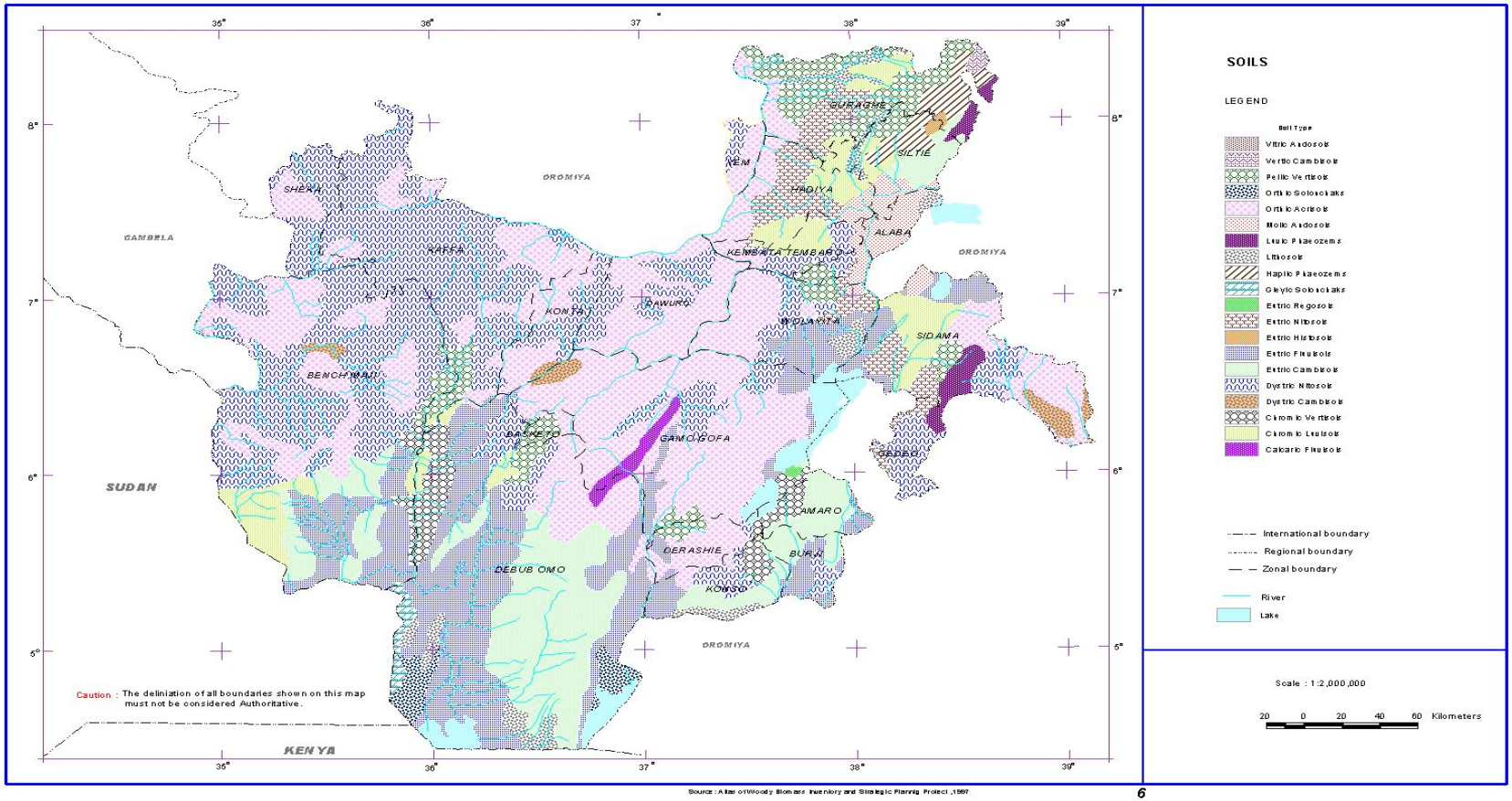
Appendix 4 Geology and Mineral occurrence map of SNNPRS



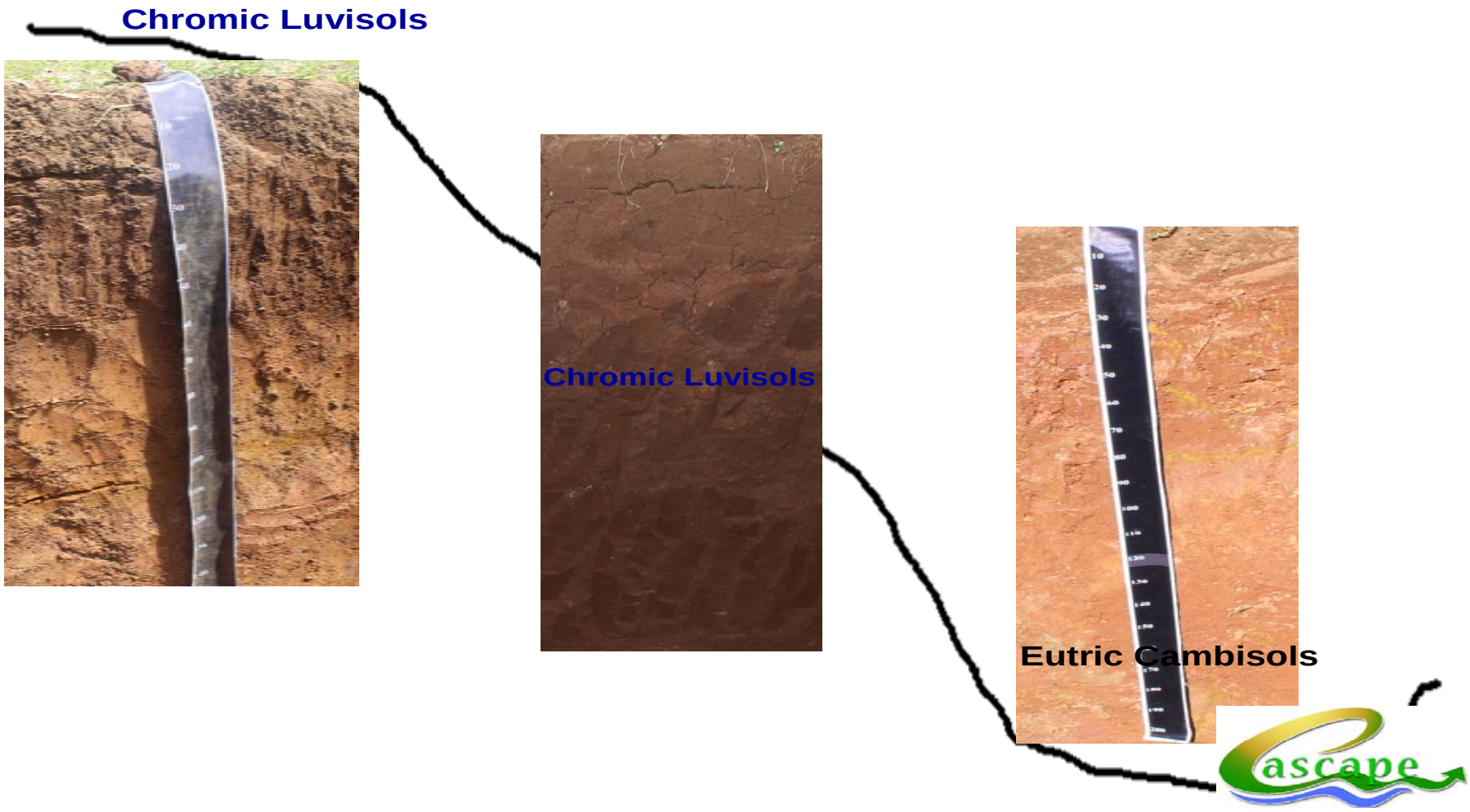
Appendix 5 Annual average rainfall map of SNNPRS



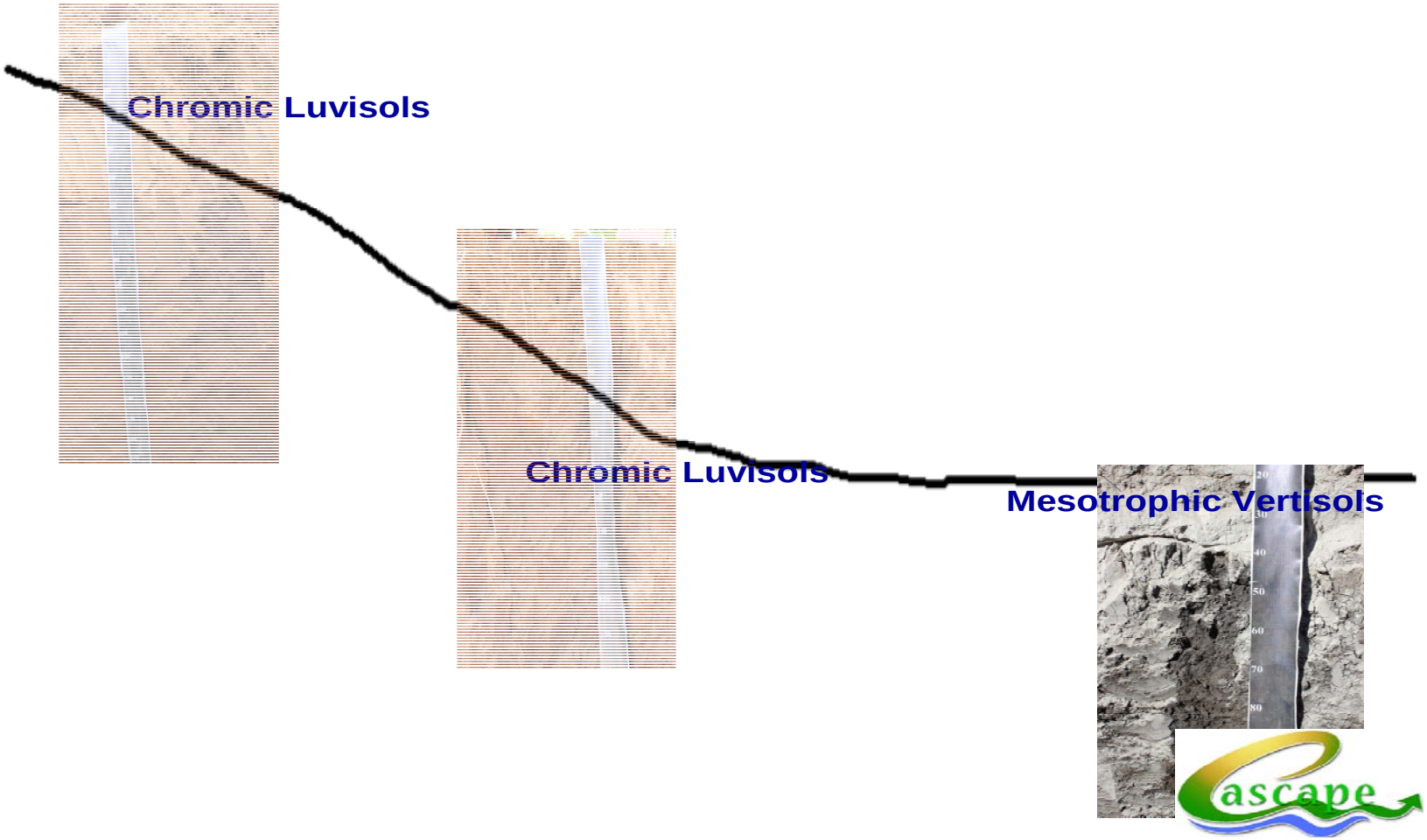
Appendix 6 Drainage and river basin map of SNNPRS



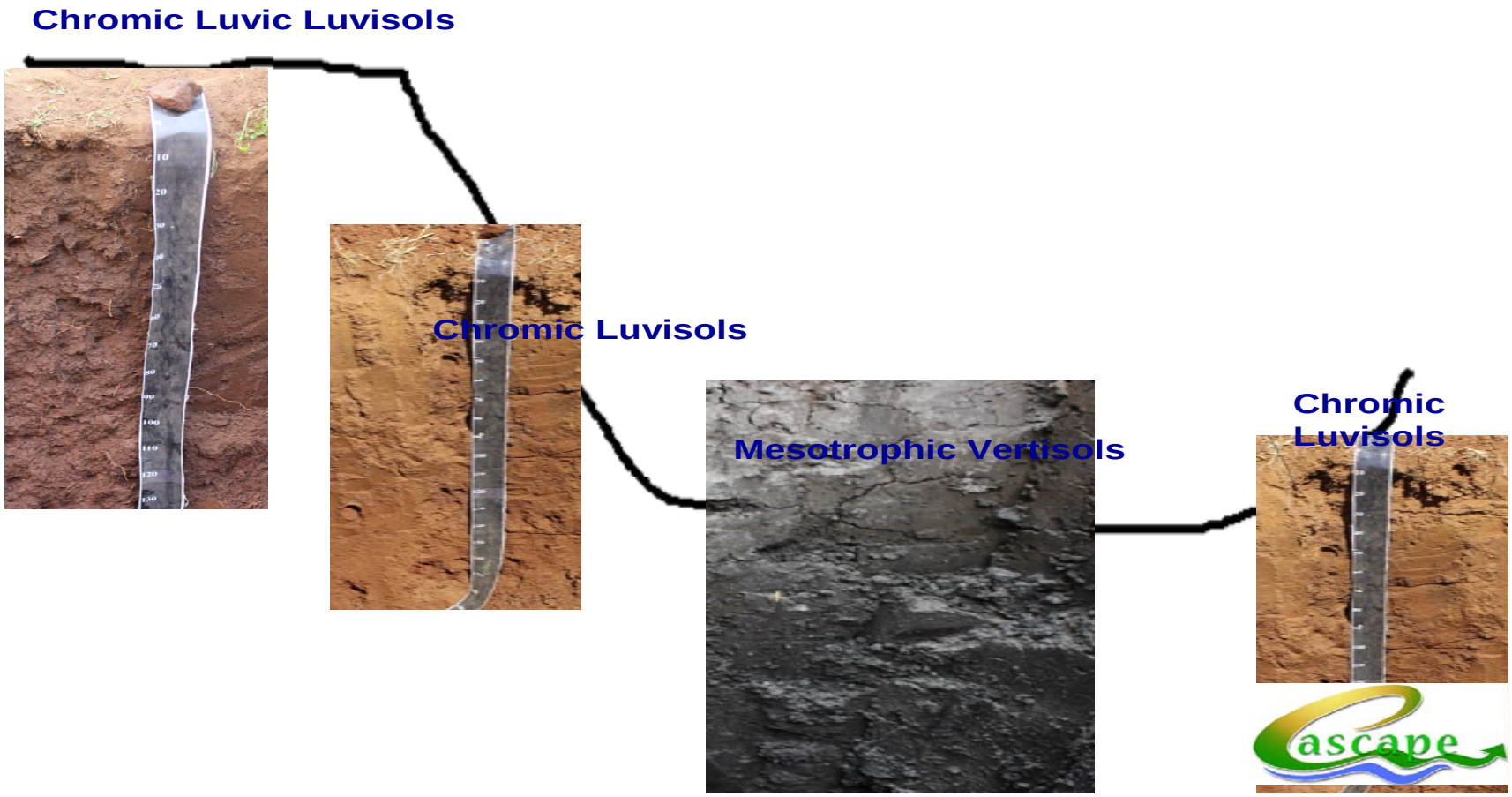
Appendix 7 Soil map of SNNPRS



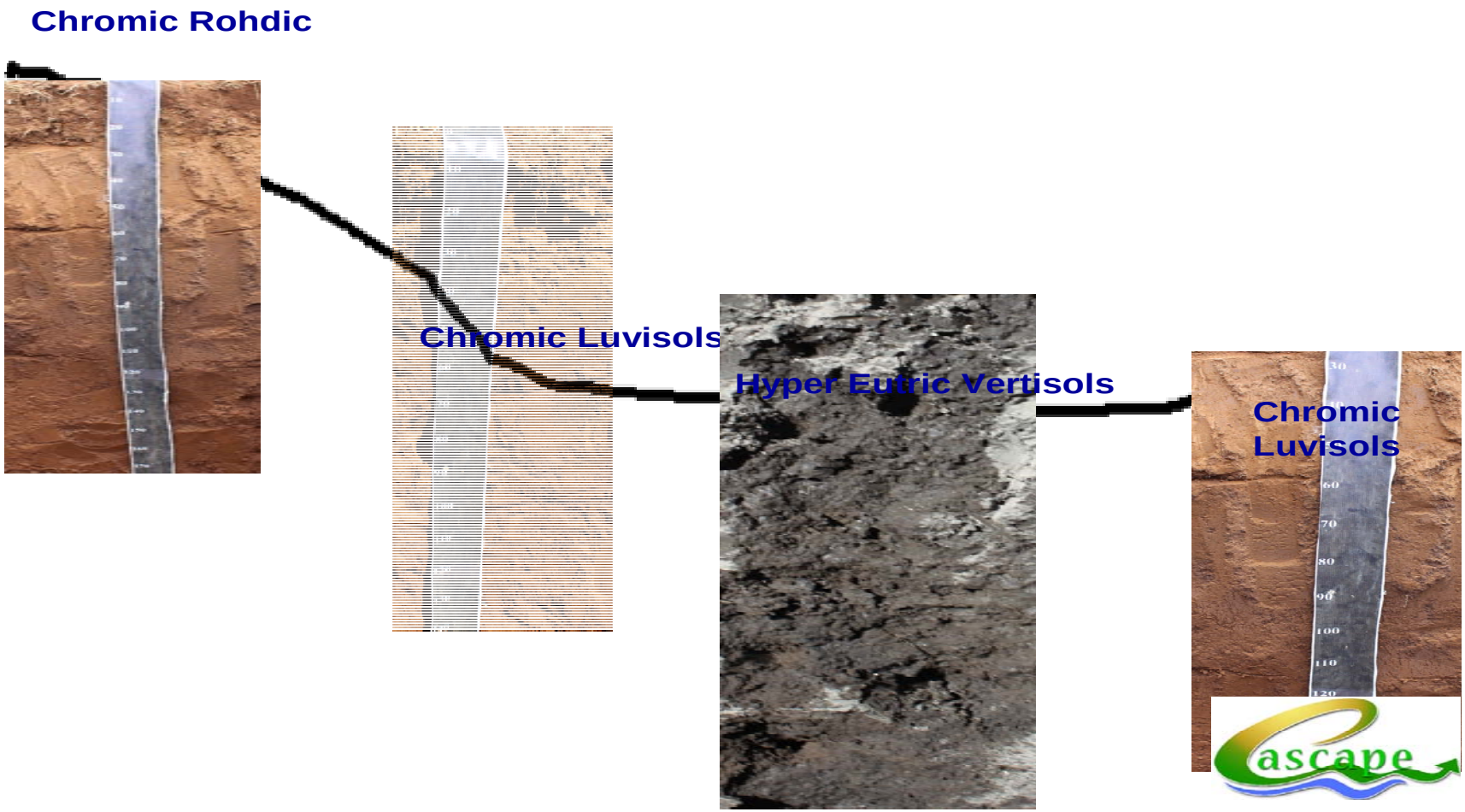
Appendix 8 Soil landscape relation hip at Bule woreda



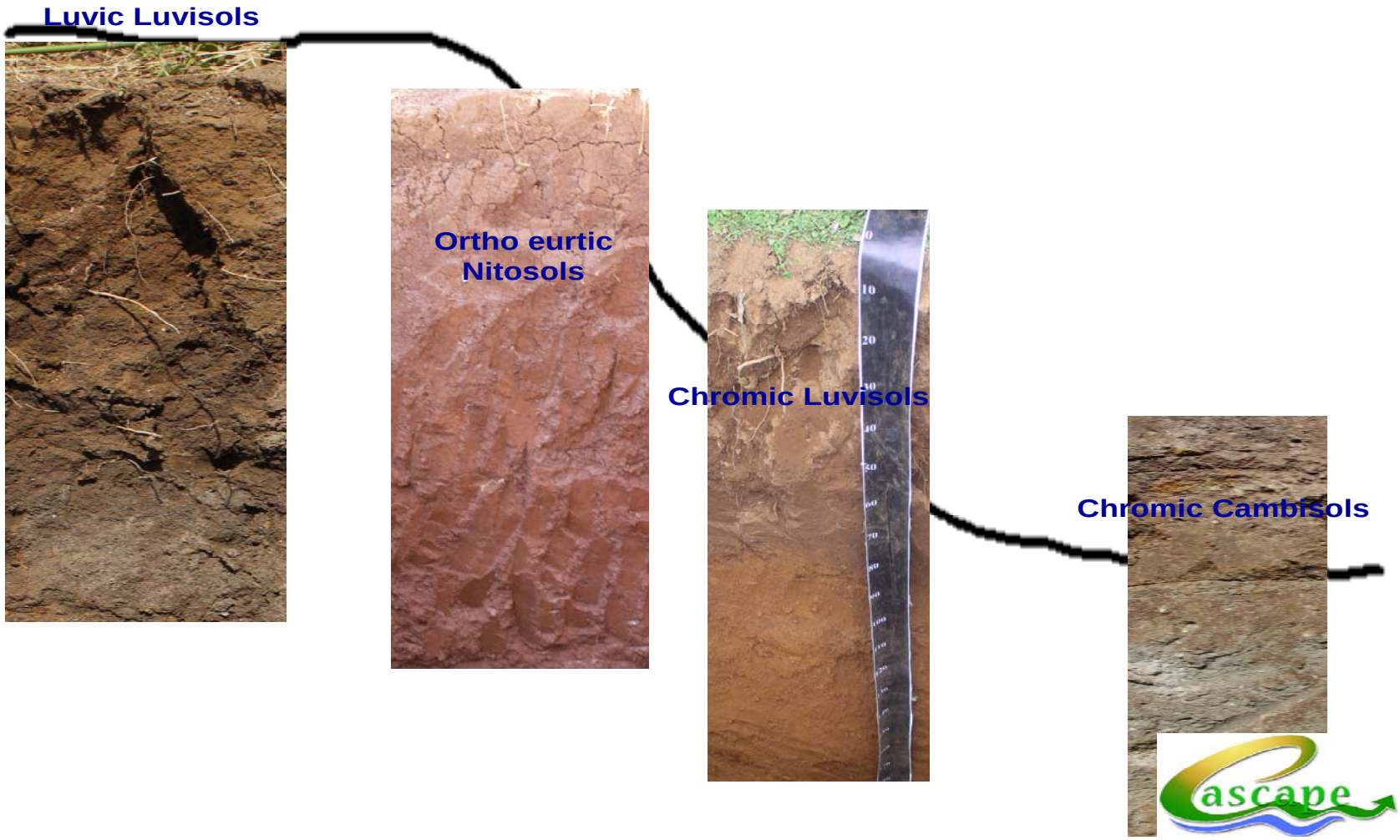
Appendix 9 Soil landscape relationship at Enemorener woreda



Appendix 10 Soil landscape relationship at Mesrakazererntberber Woreda



Appendix 11 Soil landscape relationship at cheha woreda



Appendix 12 Soil landscape relationship at Malga woreda

CODE	HORI	Text	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
BULLE	ILLALCHA		P 1																		
SNNPRS 1	Ap	Clay loam	4.33	3.5	0.14	0.6	0.32	16.32	5.16	22.4	28.95	2.73	0.38	28.5	1.02	1.16	2.06	13.42	91.03	1.18	130.94
SNNPRS 2	AB	Clay	3.99	3.37	0.03	0.54	0.17	11.22	4.32	16.25	26.74	2.64	0.29	36.7	1.04	1.27	2.04	7.05	78.57	2.44	156.33
SNNPRS 3	B1	Clay loam	3.93	3.41	0.02	0.66	0.19	12.92	4.31	18.08	31.84	2.53	0.26		1.01		2.06				
SNNPRS 4	B2	Clay	4.16	3.44	0.02	0.57	0.23	13.59	4.25	18.64	27.7	1.34	0.16		1.16		2.07				
SNNPRS 5	B3	Clay	4.27	3.51	0.02	0.64	0.24	12.9	4.3	18.08	28.04	0.86	0.11		1.12		2.24				
SNNPRS 6	BC	Clay	3.8	3.16	0.05	0.62	0.23	15.61	5.2	21.67	27.81	0.74	0.06		1.12		2.24				
SNNPRS 7	B2	Clay	4.04	3.28	0.03	0.62	0.19	13.01	4.34	18.16	28.75	1.39	0.18		1.01		2.16				
BULLE	ILLALCHA		P 2																		
SNNPRS 8	Ap	Sandy lcay loam	4.76	3.8	0.17	0.67	0.52	12.94	4.31	18.44	31.87	5.38	0.41	20.6	1.02	1.89	2.12	5.6	64.76	1.83	225.83
SNNPRS 9	AB	Clay	4.77	3.79	0.06	0.61	0.37	13.98	4.37	19.32	32.72	4.72	0.32	20.2	1.01	1.54	1.86	3.31	40.79	1.77	126.41
SNNPRS 10	B1	Clay	3.98	3.37	0.02	0.58	0.5	11.97	4.28	17.33	30.68	2.05	0.25		1.19		1.88				
SNNPRS 11	B2	Clay	4	3.28	0.02	0.57	0.26	15.31	5.1	21.24	28.19	0.82	0.1		1.18		2.03				
SNNPRS 12	BC1	Clay	4.1	3.33	0.02	0.63	0.17	18.03	6.01	24.83	30.32	0.69	0.08		1.13		2.09				
SNNPRS 13	BC2	Clay	3.95	3.18	0.02	0.66	0.22	14.65	4.31	19.83	28.1	0.59	0.06		1.09		2.33				
SNNPRS 14	Ap	Sandy Clay Loam	3.89	3.14	0.16	0.73	0.46	14.07	4.4	19.65	32.01	5.28	0.4	24.7	1.01	1.97	2.27	8.98	57.53	2.29	107.45
BULLE	SIKA		P 1																		
SNNPRS 15	Ap	Sandy Clay Loam	5.54	4.69	0.11	0.66	0.46	19.47	6.77	27.36	31.28	3.3	0.28	31.8	1.01	1.83	2.12	31.85	83.52	6.4	117.53
SNNPRS 16	B1	Clay	5.53	4.7	0.04	0.59	0.25	16.96	5.94	23.74	29.96	1.73	0.13		1.12		1.97				
SNNPRS 17	B2	Clay	5.42	4.7	0.04	0.64	0.27	12.66	4.22	17.79	27.06	0.91	0.1		1.11		2.37				
SNNPRS 18	BC	Clay	5.48	4.66	0.04	0.58	0.33	15.11	5.04	21.06	27.37	0.67	0.06		1.04		2.13				
SNNPRS 19	C	Clay	6.11	5.26	0.05	0.6	0.43	15.93	4.19	21.15	28.71	0.54	0.04		1.01		2.1				
SNNPRS 20	BC	Clay	6.2	5.3	0.05	0.58	0.2	15.94	5.04	21.77	27.82	0.71	0.06		1.03		2.1				

BULLE	HORI	Text	P 1																		
CODE	BASURA		pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
SNNPRS 21	Ap	Clay Loam	6.14	5.45	0.11	0.67	0.31	20.41	6.8	28.18	33.74	2.6	0.25		1.1	1.86	1.97	17.59	75.15	0.57	103.46
SNNPRS 22	B1	Clay	5.13	4.19	0.06	0.85	0.17	16.67	5.84	23.53	28.54	2.2	0.22	30.3	1.14		2.98				
SNNPRS 23	B2	Clay	4.55	3.69	0.04	0.56	0.18	12.54	4.18	17.47	27.26	1.06	0.13		1.13		2.98				
SNNPRS 24	C	Clay	3.91	3.23	0.15	0.6	0.29	12.6	4.2	17.69	28.76	0.72	0.07		1.11		2.1				
SNNPRS 25	Ap	Clay Loam	6.15	5.4	0.09	0.63	0.32	19.1	6.64	26.69	33.85	2.51	0.25	47.2	1.12	1.8	1.87	15.66	79.05	0.94	91.88
SNNPRS 26	B3	Sandy Clay Loam	5.94	5.19	0.05	0.89	0.4	12.89	4.03	18.21	25.39	0.42	0.06		1.16		3.52				
BULLE	BASURA		P 2																		
SNNPRS 27	Ap	Clay	4.93	4.18	0.11	0.57	0.25	18.62	6.77	26.21	33.58	2.9	0.4	42.52	1.04	1.61	1.7	14.26	81.55	0.49	101.83
SNNPRS 28	B1	Sandy Clay	5.6	4.74	0.09	0.62	0.26	19.23	6.69	26.79	30.44	1.72	0.18		1.15		2.03				
SNNPRS 29	B2	Clay	4.74	3.79	0.03	0.52	0.27	16.94	5.93	23.66	34.07	0.93	0.1		1.12		1.51				
SNNPRS 30	C1	Clay	4.41	3.46	0.04	0.54	0.3	18.14	6.05	25.04	37.57	0.32	0.1		1.22		1.45				
SNNPRS 31	C2	Sandy Clay Loam	4	3.25	0.06	0.87	1.18	14.8	5.22	22.07	35.95	0.24	0.03		1.12		2.42				

BULLE	HOR	Text	P 3																		
CODE	DERO		pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
SNNPRS 32	Ap	Sandy Clay Loam	5.72	5.29	0.13	0.85	0.53	15.41	4.87	21.66	34.39	2.63	0.27	35.4	1.15	1.47	2.46	23.88	68.55	2.28	105.75
SNNPRS 33	B1	Sandy Mlay	5.77	5.17	0.05	0.67	0.36	13.74	4.85	19.61	30.3	0.45	0.05		1.3		2.2				
SNNPRS 34	B2	Sandy Clay Loam	5.76	5.35	0.05	0.83	0.42	14.54	4.85	20.64	26.35	0.44	0.04		1.28		3.13				
SNNPRS 35	B3	Sandy Clay Loam	5.65	5.3	0.05	0.91	0.38	13.7	4.03	19.02	24.52	0.41	0.06		1.21		3.71				
SNNPRS 36	B4	Sandy Clay	5.48	5.16	0.06	0.77	0.55	14.49	5.63	21.44	27.99	0.25	0.03		1.15		2.75				
SNNPRS 37	B5	Sandy Clay	4.7	4.05	0.06	0.84	1.14	12.94	4.85	19.78	27.25	0.22	0.03		1.19		3.1				
SNNPRS 38	C	Clay Loam	4.52	3.98	0.05	0.76	0.48	12.79	4.26	18.3	27.81	0.2	0.02		1.28		2.73				
BULLE	DERO		P 1																		
SNNPRS 39	Ap	Clay	4.65	3.9	0.08	0.66	0.62	17.79	5.93	25	35.45	2.33	0.19	33	1.06	1.45	1.87	7.48	68.99	0.55	112.71
SNNPRS 40	B1	Clay	4.56	3.69	0.03	0.88	1.11	14.66	5.17	21.82	33.75	2.02	0.17		1.12		2.61				
SNNPRS 41	B2	Clay	4.68	3.85	0.03	0.93	0.77	13.72	4.29	19.71	29.36	1.85	0.17		1.19		3.17				
SNNPRS 42	B3	Clay	4.83	3.97	0.06	0.95	0.74	18.78	6.83	27.3	35.72	1.79	0.13		1.18		2.65				
SNNPRS 43	B4	Clay	4.2	3.53	0.03	0.96	0.52	13.01	4.34	18.83	28.28	1.56	0.11		1.15		3.4				
SNNPRS 44	B1	Clay	4.62	3.77	0.04	0.91	1.12	14.84	4.36	21.23	32.73	2.1	0.17		1.12		2.78				
BULLE	DERO		P 2																		
SNNPRS 45	Ap	Clay	5.67	5.08	0.07	0.95	1.29	19.65	6.84	28.73	33.9	2.87	0.31	36.7	1.17	1.16	2.79	24.71	69.89	2.99	90.74
SNNPRS 46	Bt1	Clay	5.87	5.25	0.07	0.95	0.97	21.32	7.68	30.91	37.54	1.84	0.19		1.23		2.52				
SNNPRS 47	Bt2	Clay	5.86	5.22	0.06	0.88	1.13	17.76	5.92	25.87	35.39	1.67	0.15		1.14		2.49				
SNNPRS 48	Bt3	Clay	5.95	5.29	0.05	0.92	2.16	16.16	5.1	24.34	38.36	1.15	0.13		1.21		2.41				
SNNPRS 49	Bt4	Clay	6	5.25	0.06	0.93	3.56	16.23	5.13	25.83	39.01	0.77	0.1		1.19		2.38				
SNNPRS 50	C1	Clay	5.7	5.1	0.05	0.85	0.78	16.23	5.98	23.85	37.15	0.72	0.09		1.14		2.3				
SNNPRS 51	C2	Clay	5.88	5.09	0.05	1.08	0.81	16.29	5.15	23.33	36.35	0.39	0.05		1.09		2.97				
SNNPRS 52	Bt2	Sandy Clay	5.85	5.26	0.06	0.84	1.26	17.07	5.98	25.14	33.87	1.69	0.15		1.21		2.47				

MALGA	HORI	Texture	P 1																		
CODE	GUGUMA		pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
SNNPRS 53	Ap	Clay Loam	5.69	5.3	0.07	0.99	0.57	17.66	5.89	25.1	36.56	2.76	0.22	39.3	1.15	1.73	2.7	24.04	58.33	0.93	68.22
SNNPRS 54	B	Sandy Clay Loam	6.1	5.81	0.06	0.85	0.47	19.12	5.85	26.25	37.04	2.37	0.16		1.15		2.29				
SNNPRS 55	BC1	Clay Loam	6.08	5.38	0.05	0.9	0.43	13.24	4.14	18.71	28.32	0.65	0.07		1.3		3.17				
SNNPRS 56	BC2	Sandy Clay	4.88	3.36	0.02	0.93	0.54	15.09	5.87	22.43	34.17	0.3	0.03		1.31		2.72				
SNNPRS 57	C	Clay	5.95	4.86	0.05	0.87	0.71	14.48	5.11	21.18	31.95	0.27	0.02		1.29		2.72				
SNNPRS 58	Ap	Clay	5.79	5.25	0.07	1.04	0.54	18.46	6.71	26.75	38.77	2.65	0.21	37	1.12	1.77	2.68	22.05	59.31	1.6	76.64
MALGA	GUGUMA		P 2																		
SNNPRS 59	Ap	Sandy Clay	5.67	4.95	0.12	0.94	2.23	18.59	6.76	28.51	35.81	3.45	0.25	39.6	1.04	1.7	2.62	22.88	51	2.26	102.24
SNNPRS 60	B1	Clay	5.99	5.16	0.08	0.74	1.59	14.85	4.12	21.29	30.48	0.69	0.07		1.23		2.41				
SNNPRS 61	B2	Clay Loam	5.17	4.39	0.05	0.61	0.99	15.66	4.94	22.2	26.87	0.63	0.06		1.32		2.27				
SNNPRS 62	C1	Clay	4.47	3.54	0.07	0.68	1.5	16.83	5.89	24.9	31.1	0.45	0.04		1.24		2.18				
SNNPRS 63	C2	Clay	5.08	4.2	0.07	0.91	1.34	28.39	8.87	39.51	43.4	0.43	0.04		1.14		2.09				
SNNPRS 64	C3	Clay	5.24	4.37	0.05	0.75	0.82	21.56	7.76	30.89	37.5	0.35	0.03		1.12		2				
SNNPRS 65	B1	Clay	5.41	4.58	0.06	0.66	1.49	15.13	5.04	22.32	31.07	0.7	0.09		1.21		2.12				

MALGA	HORIZO	Texture	P 1																		
CODE	SINTARO		pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
SNNPRS 66	Ap	Sandy clay loam	4.48	3.59	0.03	0.6	0.41	17.47	5.82	24.3	30.75	1.32	0.13	32.8	1.06	1.55	1.94				
SNNPRS 67	AB	Sandy clay loam	4.87	4.06	0.04	0.64	0.28	14.79	4.93	20.65	26.79	1.19	0.1	26.5	1.14	1.13	2.4	8.29	38.54	0.73	97.12
SNNPRS 68	B	Clay loam	5.02	4.07	0.04	0.71	0.21	16.26	5.69	22.86	27.83	0.75	0.07		1.29		2.54				
SNNPRS 69	BC	Sandy clay loam	5.35	4.49	0.04	0.69	0.72	16.24	5.68	23.33	29.13	0.42	0.04		1.23		2.36				
SNNPRS 70	C1	Sandy clay loam	5.98	5.18	0.03	0.58	2.3	13.75	4.85	21.48	26.37	0.38	0.04		1.15		2.2				
SNNPRS 71	C2	Sandy clay loam	5.83	5.02	0.03	0.74	1.97	14.53	5.65	22.88	26.76	0.37	0.03		1.15		2.75				
SNNPRS 72	C3	Sandy clay loam	6.03	5.17	0.03	0.52	2.42	14.21	4.87	22.02	30.45	0.31	0.02		1.06		1.71				
SNNPRS 73	Ap	Sandy clay loam	4.79	4	0.03	0.61	0.43	18.27	5.81	25.12	31.59	1.42	0.15	36.1	1.06	1.67	1.94	9.38	59.95	0.46	92.85
MALGA	SINTARO		P 2																		
SNNPRS 74	Ap	Sandy clay loam	6.07	5.25	0.07	0.34	0.72	14.88	5.37	21.3	27.4	3.09	0.25	30.6	1.15	1.38	1.25	21.73	59.61	1.16	70.73
SNNPRS 75	B4	Sandy clay	7.65	6.78	0.2	0.54	1.67	23.08	7.97	33.26	40.59	1.1	0.1		1.09		1.33				
SNNPRS 76	B2	Clay	6.31	5.48	0.1	0.56	0.65	18.8	5.98	25.99	39.93	1.32	0.13		1.09		1.4				
SNNPRS 77	B3	Clay	5.03	4.16	0.09	1.06	0.62	22.24	6.84	30.76	40.9	0.7	0.07		1.09		2.59				
SNNPRS 78	B1	Clay loam	7.35	6.49	0.08	0.63	1.13	20.22	6.74	28.72	38.92	1.76	0.21		1.18		1.62				
SNNPRS 79	B1	Sandy clay loam	7.59	6.7	0.22	0.62	1.24	21.48	7.16	30.51	38.92	1.73	0.19		1.07		1.6				
MALGA	KOCHO		P 2																		
SNNPRS 80	Ap	Sandy clay loam	6.38	5.49	0.13	0.61	1.65	14.74	5.48	22.48	32.05	1.79	0.19	33.7	1.04	1.3	1.91	24.9	69.8	1.39	70.65
SNNPRS 81	B1	Clay	6.31	5.44	0.07	0.51	1.56	15.96	5.88	23.91	31.5	1.13	0.13		1.12		1.62				
SNNPRS 82	B2	Clay	5.67	4.78	0.06	1.25	0.8	20.6	6.87	29.52	34.06	0.74	0.11		1.16		3.67				
SNNPRS 83	B3	Clay	5.55	4.63	0.07	0.77	0.56	19.82	6.89	28.04	32.78	0.55	0.08		1.16		2.34				
SNNPRS 84	B4	Clay	5.27	4.37	0.06	1.01	0.57	21.56	7.76	30.91	37.5	0.46	0.06		1.21		2.7				
SNNPRS 85	B1	Clay	6.31	5.48	0.08	0.5	1.63	16.1	5.08	23.31	32.69	1.17	0.13		1.13		1.52				

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
MALGA	FITO KETEMENA		P 1																		
SNNPRS 86	Ap	Sandy clay loam	5.25	4.45	0.05	0.68	0.4	17.74	5.91	24.73	33.98	3.45	0.31	26	1.1	1.77	2	23.3	78.1	0.34	109.93
SNNPRS 87	B1	Sandy clay loam	6.27	5.42	0.04	0.48	0.5	16.43	5.48	22.88	32.05	1.85	0.22		1.14		1.49				
SNNPRS 88	B2	Sandy clay	6.2	5.27	0.04	0.48	0.96	13.4	4.61	19.45	27.31	1.33	0.16		1.12		1.77				
SNNPRS 89	B3	Sandy clay	6.44	5.53	0.05	0.74	2.52	14.35	5.49	23.09	32.11	0.99	0.1		1.16		2.31				
SNNPRS 90	B4	Clay	5.67	4.83	0.06	0.92	3.9	15.19	5.06	25.07	31.19	0.65	0.07		1.17		2.94				
SNNPRS 91	B5	clay	4.66	3.72	0.03	0.79	1.57	16.96	5.94	25.25	30.42	0.63	0.06		1.09		2.61				
SNNPRS 92	B4	Sandy clay loam	5.69	4.74	0.05	0.95	3.77	14.28	5.04	24.04	30.13	0.64	0.07		1.14		3.15				
MALGA	FITO KETEMENA		P 2																		
SNNPRS 93	Ap	Clay	4.97	4.14	0.04	0.75	0.32	17.64	5.88	24.59	31.96	2.15	0.25	26.8	1.07	1.43	2.34	35.15	50.28	0.57	84.99
SNNPRS 94	AB	Sandy clay	4.94	4.17	0.03	0.88	0.4	18.66	55.94	25.88	34.1	1.54	0.18	30.4	1.1	1.25	2.59	15.54	64.8	0.47	84.73
SNNPRS 95	B1	Clay	4.02	3.09	0.03	0.9	0.32	14.42	4.24	19.87	27.19	1.06	0.13		1.12		3.32				
SNNPRS 96	B2	Clay	3.88	3.02	0.04	0.57	0.39	12.72	4.24	17.92	26.27	1.05	0.1		1.04		2.18				
SNNPRS 97	B3	Clay	4.77	3.82	0.08	0.8	0.5	13.95	5.23	20.48	28.43	0.69	0.08		1.06		2.8				
SNNPRS 98	AB	clay	5.04	4.24	0.03	0.85	0.41	16.96	5.94	24.16	32.72	1.53	0.16	32.4	1.04	0.79	2.59	11.22	58.15	0.26	72.96

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
M/AZERNET BERBER	YERIM		P 2																		
SNNPRS 99	A	Sandy clay loam	5.8	4.96	0.05	0.82	0.56	15.12	5.04	21.54	26.93	1.64	0.21	30.5	1.27	1.5	3.05	6.06	60.77	0.98	67.41
SNNPRS 100	B	Sandy clay loam	5.87	4.9	0.09	1	0.88	16.8	5.88	24.57	35.61	0.84	0.1		1.24		2.82				
SNNPRS 101	BC	Clay loam	5.97	5.18	0.11	0.78	0.9	18.83	6.85	27.36	32.1	0.53	0.06		1.23		2.43				
SNNPRS 102	C1	Clay	6.04	5.17	0.09	0.93	1.31	25.68	8.56	36.48	43.73	0.16	0.02		1.23		2.13				
SNNPRS 103	C2	Clay	6.26	5.33	0.05	1.02	1.06	20.54	6.85	29.48	35.82	0.1	0.01		1.15		2.86				
SNNPRS 104	A	Sandy clay loam	5.88	5.02	0.05	0.9	0.54	14.98	4.16	20.58	27.13	1.66	0.19	27.4	1.27	1.57	3.33	5.32	70.83	0.56	72.94
M/AZERNET BERBER	EMEJAR		P 1																		
SNNPRS 105	Ap	Sandy clay	5.42	4.48	0.07	1.02	0.34	15.12	5.88	22.37	34.24	2.56	0.21	28.2	1.03	0.98	2.99	9.07	72.24	2.34	134.26
SNNPRS 106	B1	Clay loam	6.07	5.11	0.04	1.43	0.27	12.36	4.12	18.19	27.77	1.32	0.13		1.02		5.16				
SNNPRS 107	B2	Clay	7.48	6.61	0.26	2.94	1.29	37.74	11.99	53.96	62.74	0.89	0.11		1.16		4.69				
SNNPRS 108	B3	Clay	7.77	6.85	0.28	3.19	1.2	29.75	8.88	43.01	47.3	0.67	0.08		1.02		6.73				
SNNPRS 109	B4	Clay	7.65	6.74	0.29	2.56	1.31	35.75	12.21	51.83	54.5	0.56	0.06		1.05		4.7				
SNNPRS 110	B3	Clay	8.13	7.25	0.29	3.14	1.25	29.3	8.44	42.13	45.85	0.66	0.08		1.03		6.84				
M/AZERNET BERBER	EMEJAR		P 2																		
SNNPRS 111	A	Clay	5.36	4.45	0.04	0.91	0.96	15.96	5.04	22.87	31.96	1.09	0.07	22.9	1.28	0.84	2.86	3.9	61.26	0.62	72.67
SNNPRS 112	B1	Clay	5.33	4.52	0.04	0.94	0.83	12.72	4.24	18.73	26.27	0.88	0.06		1.14		3.58				
SNNPRS 113	B2	Clay loam	5.56	4.7	0.02	0.97	0.7	13.44	4.2	19.31	24.65	0.22	0.03		1.15		3.93				
SNNPRS 114	BC	Clay loam	5.81	5.05	0.03	1.02	0.72	15.96	5.88	23.58	26.93	0.2	0.02		1.22		3.8				
SNNPRS 115	C1	Clay loam	5.87	5.03	0.03	0.82	0.75	11.76	4.2	17.54	23.28	0.15	0.01		1.24		3.53				
SNNPRS 116	C2	Sandy clay loam	5.89	5	0.03	0.75	0.87	12.6	4.2	18.42	21.91	0.12	0.01		1.21		3.42				
SNNPRS 117	A	Sandy clay loam	5.34	4.5	0.04	0.9	0.96	14.98	4.99	21.83	30.75	1	0.07	24.1	1.24	0.89	2.94	7.49	61.88	1.4	68.69

CODE	HORI	Text	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
M/AZERNET BERBER	ADAZER ABICHO		P 1																		
SNNPRS 118	Ap	Sandy clay loam	4.85	4	0.06	1.21	0.61	13.44	4.2	19.46	27.39	2.09	0.22	25	1.14	0.74	4.4	16.91	74.44	1.8	95.28
SNNPRS 119	Ab	Clay	5.03	4.12	0.03	1.11	0.5	15.12	5.04	21.77	30.13	1.93	0.19	22.8	1.03	0.84	3.7	8.53	81.76	1.62	91.03
SNNPRS 120	B1	Clay	5.06	4.27	0.02	0.94	0.46	16.96	5.94	24.29	27.19	1.09	0.13		1.11		3.46				
SNNPRS 121	B2	Clay	5.19	4.43	0.02	1.26	0.39	15.12	5.04	21.81	27.39	0.45	0.06		1.13		4.6				
SNNPRS 122	B3	Clay	5.33	4.61	0.02	1.11	0.4	16.8	5.88	24.19	29.22	0.38	0.04		1.02		3.81				
SNNPRS 123	B3	clay	5.25	4.49	0.02	1.08	0.48	17.64	5.88	25.08	30.59	0.39	0.04		1.2		3.52				
M/AZERNET BERBER	ADAZER SHEBEL		P 1																		
SNNPRS 124	A	Clay	4.63	5.9	0.06	1.14	1.39	15.81	5.82	24.16	36.17	1.7	0.19	24.1	1.06	1.26	3.15	8.89	79.05	2.07	99.83
SNNPRS 125	B1	Clay	4.67	3.87	0.04	0.99	0.69	14.28	5.04	21	29.22	1.51	0.16		1.06		3.38				
SNNPRS 126	B2	Clay	4.74	3.98	0.02	1	0.53	15.12	5.04	21.69	24.65	0.93	0.13		1.1		4.07				
SNNPRS 127	B3	Clay	4.82	4	0.02	1	0.59	15.96	5.88	23.44	27.39	0.84	0.1		1.21		3.67				
SNNPRS 128	B4	Clay	4.84	4.04	0.02	1.02	0.62	15.12	5.04	21.81	26.48	0.12	0.01		1.3		3.86				
SNNPRS 129	B1	Clay	4.39	3.81	0.04	0.88	0.69	14.28	5.04	20.89	29.22	1.16	0.16		1.05		3				
M/AZERNET BERBER	ADAZER SHEBEL		P 2																		
SNNPRS 130	A	Clay loam	4.58	3.77	0.03	0.82	1.04	14.28	4.2	20.35	28.3	2.58	0.25	26.1	1.02	0.9	2.9	10.46	72.24	1.86	105
SNNPRS 131	B1	Clay	4.51	3.66	0.02	1.08	0.9	14.28	4.2	20.46	29.67	1.59	0.13		1.05		3.63				
SNNPRS 132	B2	Clay	4.86	4.03	0.02	1	0.59	15.96	5.88	23.44	27.85	0.59	0.07		1.19		3.61				
SNNPRS 133	BC	clay	4.96	4.2	0.02	1.12	0.6	18.83	5.99	26.54	31.17	0.16	0.01		1.24		3.58				
SNNPRS 134	A	Sandy clay loam	4.65	3.81	0.03	0.83	1.01	14.14	4.99	20.98	28.94	2.66	0.26	22.9	1.03	1.32	2.88	12.11	77.35	2.58	100.63

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
ENEMOR ENA ENER	KEREBED		P 2																		
SNNPRS 135	Ap	Clay loam	6.02	5.2	0.1	0.79	0.94	14.7	5.46	21.9	31.96	2.1	0.25	24.4	1.01	0.76	2.49	12.11	77.35	2.58	100.63
SNNPRS 136	B1	Clay loam	5.38	4.42	0.05	0.89	1.74	17.64	5.88	26.16	31.04	1.32	0.13		1.02		2.88				
SNNPRS 137	B2	Clay loam	5.61	4.66	0.03	0.93	0.76	14.83	4.94	21.47	25.08	0.62	0.07		1.12		3.71				
SNNPRS 138	B3	Clay	6.17	5.29	0.06	0.89	0.82	14.7	5.04	21.44	25.57	0.57	0.04		1.36		3.46				
SNNPRS 139	B4	Clay	6.53	5.61	0.1	1.34	0.85	21.56	7.04	30.79	38.26	0.41	0.04		1.27		3.5				
SNNPRS 140	B5	Clay	6.65	5.75	0.1	1.25	0.63	20.06	6.98	28.91	36.97	0.11	0.02		1.21		3.38				
SNNPRS 141	Ap	Clay	5.34	4.36	0.05	0.78	1.64	14.14	4.99	21.56	31.2	2.09	0.25	20.2	1.03	0.74	2.49	19.78	71.31	2.09	76.62
ENEMOR ENA ENER	GOMOSH		P 1																		
SNNPRS 142	Ap	Clay	4.96	4.16	0.07	1.07	0.53	20.35	6.78	28.74	36.87	3.13	0.27	20.1	1	0.37	2.9	18.73	76.87	2.84	124.32
SNNPRS 143	B1	Clay	5.22	4.37	0.03	1.1	0.52	22.26	7.7	31.57	35.82	2.06	0.22		1.07		3.06				
SNNPRS 144	B2	Clay	5.44	4.49	0.02	1.15	1.35	20.54	6.85	29.9	37.22	1.27	0.13		1.07		3.1				
SNNPRS 145	B3	Clay	5.31	4.42	0.04	0.98	1.43	21.6	6.91	30.92	37.1	1.16	0.12		1.08		2.63				
SNNPRS 146	B4	Clay	5.35	4.39	0.03	0.82	1.43	19.32	6.72	28.29	34.24	0.86	0.1		1.18		2.4				
SNNPRS 147	Ap	Clay	4.97	4.13	0.08	1.02	0.53	21	7.56	30.11	36.52	2.9	0.25	17.4	1.01	0.34	2.8	18.62	81.27	2.83	120.56
ENEMOR ENA ENER	GOMOSH		P 2																		
SNNPRS 148	Ap	Sandy clay loam	4.85	3.95	0.03	0.87	0.38	16.64	5.85	23.72	33.01	1.8	0.16	25.3	0.99	0.39	2.63	9.27	84.12	3.5	139.55
SNNPRS 149	B1	Clay loam	5.34	4.4	0.03	1.11	0.29	15.66	5.77	22.82	26.87	0.67	0.07		1.09		4.13				
SNNPRS 150	B2	Clay	5.63	4.71	0.02	1.08	0.26	14.7	4.9	20.95	24.42	0.35	0.04		1.24		4.44				
SNNPRS 151	B3	Clay	5.31	4.36	0.04	1.05	0.53	22.11	7.56	31.35	37.9	0.3	0.03		1.22		2.78				
SNNPRS 152	B4	Clay	5.48	4.55	0.04	1.37	0.6	25.82	8.61	36.39	42.1	0.23	0.03		1.19		3.24				
SNNPRS 153	B4	Clay	5.55	4.62	0.04	1.36	0.59	26.59	9.43	37.97	41.48	0.24	0.03		1.19		3.28				

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
ENEMOR ENA ENER	AGATA		P 1																		
SNNPRS 154	Ap	Clay loam	4.38	3.64	0.01	0.94	0.36	13.5	4.22	19.02	27.06	3.42	0.28	33	1.02	0.99	3.46	1.96	43.12	1.48	71.89
SNNPRS 155	AB	Sandy clay loam	4.96	4	0.02	0.77	0.47	15.25	5.08	21.57	29.47	3.9	0.33	25.9	1	0.18	2.63	4.03	65.54	1.87	109.52
SNNPRS 156	B1	Clay loam	4.57	3.71	0.01	0.88	0.31	14.35	5.06	20.61	27.97	0.87	0.09		1.1		3.15				
SNNPRS 157	B2	Clay loam	4.75	3.9	0.02	0.72	0.28	17.91	6.82	25.74	31.98	0.63	0.06		1.08		2.26				
SNNPRS 158	B3	Clay loam	4.84	3.97	0.02	0.91	0.27	17.09	5.98	24.25	31.11	0.55	0.04		1.05		2.93				
SNNPRS 159	AB	Sandy clay loam	4.55	3.76	0.03	0.74	0.45	14.4	4.24	19.82	28.55	3.87	0.34	28.8	1.05	1.23	2.56	3.95	54.45	1.9	108.29
ENEMOR ENA ENER	KUNBER		P 1																		
SNNPRS 160	Ap	Sandy clay loam	4.64	3.82	0.03	0.82	0.55	15.09	5.03	21.49	33.72	4.23	0.34	30.8	1	1.27	2.43	11.3	62.23	3.58	105.97
SNNPRS 161	AB	Clay loam	4.49	3.69	0.02	0.84	0.4	12.58	4.19	18	28.25	4.03	0.31		1.02		2.97				
SNNPRS 162	B1	Clay loam	4.88	3.94	0.01	0.84	0.4	13.71	4.28	19.23	29.34	1.41	0.16		1.16		2.86				
SNNPRS 163	B2	Clay	5.64	4.73	0.05	1.15	1.56	18.46	6.71	27.98	34.66	1.26	0.13		1.17		3.32				
SNNPRS 164	C	Clay	5.04	4.26	0.01	0.97	0.4	18.53	5.9	25.8	34.79	0.3	0.03		1.24		2.79				
SNNPRS 165	Ap	Clay	4.73	3.92	0.03	0.84	0.55	15.93	5.87	23.18	34.17	4.36	0.34	26.7	0.9	1.17	2.45	10.4	65.41	3.25	99.17
ENEMOR ENA ENER	KUNBER		P 2																		
SNNPRS 166	Ap	Clay	5.39	4.6	0.03	0.97	1.1	22.3	7.72	32.08	37.29	3.48	0.33	56.2	0.99	1.16	2.6	21.25	87.29	2.84	95.52
SNNPRS 167	AB	Clay	5	4.14	0.02	1.24	0.89	17.26	6.04	25.43	36.12	3.08	0.32	24.2	0.95	0.89	3.43	6.89	67.02	32.31	100.25
SNNPRS 168	B1	Clay	4.9	4.06	0.02	1.05	0.7	15.32	5.11	22.18	32.85	0.79	0.07		1.1		3.21				
SNNPRS 169	B2	Clay	4.84	4	0.02	1.03	0.45	16.31	5.15	22.94	33.12	0.52	0.06		1.18		3.1				
SNNPRS 170	C	Clay	5.07	4.29	0.04	1.05	0.5	18.92	6.02	26.48	35.05	0.13	0.02		1.24		2.99				
SNNPRS 171	Ap	Clay	5.35	4.53	0.04	1	1.08	23.92	8.54	34.55	38.08	3.49	0.34	57.5	1.03	1.09	2.63	22.12	76.1	2.49	81.49

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
CHEHA	EWAN		P 1																		
SNNPRS 172	A	Clay	6.28	5.47	0.14	0.65	0.56	33.03	10.71	44.96	52.89	1.07	0.11	32.1	1.25	0.65	1.23	4.01	49.72	1.92	63.53
SNNPRS 173	B1	Clay	5.73	4.88	0.1	0.95	0.7	28.44	8.89	38.97	44.92	1.03	0.09		1.18		2.11				
SNNPRS 174	B2	Clay	6.08	5.24	0.11	1.01	0.73	28.6	9.08	39.42	47.37	0.84	0.08		1.14		2.13				
SNNPRS 175	B3	Clay	7.25	6.37	0.2	0.87	0.47	27.97	9.48	38.79	45.12	0.54	0.05		1.18		1.93				
SNNPRS 176	BC	Clay	7.33	6.55	0.19	0.99	0.55	32.01	11.72	45.27	49.98	0.45	0.04		1.1		1.98				
SNNPRS 177	C	Clay	7.11	6.28	0.1	0.82	0.42	26.24	8.9	36.38	44.48	0.38	0.03		1.07		1.85				
SNNPRS 178	B2	Clay	5.76	4.89	0.18	0.99	0.74	27.6	8.01	37.35	48.39	0.82	0.08		1.19		2.04				
CHEHA	WORDENEN		P 2																		
SNNPRS 179	Ap	Clay loam	6.51	5.66	0.1	0.7	2.01	19.89	6.77	29.37	35.88	3.66	0.31	23.8	0.93	0.53	1.95	23.61	75.64	2	79.83
SNNPRS 180	AB	Clay	5.27	4.51	0.07	0.86	1.6	21.12	7.6	31.19	38.11	2.23	0.25	30.3	0.93	0.43	2.27	9.51	75.39	1.87	84.57
SNNPRS 181	B1	Clay	4.4	3.68	0.08	0.9	1.29	16.1	5.08	23.37	32.23	0.94	0.1		1.03		2.8				
SNNPRS 182	B2	Clay	4.43	3.69	0.05	0.92	1.5	17.81	5.94	26.17	31.8	0.7	0.07		0.98		2.9				
SNNPRS 183	B3	Clay loam	4.43	3.72	0.05	0.98	1.32	12.79	4.26	19.36	29.66	0.61	0.06		0.99		3.31				
SNNPRS 184	B4	Clay loam	4.37	3.58	0.05	0.85	0.88	15.36	5.12	22.22	27.83	0.52	0.04		1.03		3.07				
SNNPRS 185	B3	Clay loam	4.36	3.59	0.06	0.94	1.52	11.02	3.39	16.88	27.19	0.63	0.06		0.99		3.46				
CHEHA	WORDENEN		P 1																		
SNNPRS 186	A	Clay	5.21	4.31	0.1	1.01	0.57	21.5	7.74	30.82	39.73	2.04	0.17	29	0.95	0.99	2.54	12.35	72.55	2.54	75.75
SNNPRS 187	B1	Clay	5.37	4.42	0.05	0.67	0.65	26.38	8.79	36.49	43.96	1.06	0.14		1.21		1.52				
SNNPRS 188	B2	Clay	6.21	5.31	0.14	1.3	0.74	34.32	11.88	48.25	52.13	1.03	0.11		1.15		2.5				
SNNPRS 189	B3	Clay	5.34	4.56	0.06	0.81	0.66	32.92	10.68	45.06	52.22	0.85	0.08		1.14		1.56				
SNNPRS 190	B4	Clay	5.39	4.43	0.07	0.81	0.53	26.52	8.84	36.7	49.48	0.71	0.05		1.24		1.63				
SNNPRS 191	A	Clay	5.33	4.37	0.1	0.93	0.56	19.61	6.82	27.92	39.4	2.05	0.16	23.5	0.94	0.84	2.35	4.66	70.38	2.23	76.53

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
CHEHA	MOCHE		P 1																		
SNNPRS 192	A	Clay	4.48	3.63	0.04	0.8	0.47	13.67	4.27	19.21	30.18	3.8	0.28	15.7	0.93	1.23	2.65	4.2	76.6	2.15	83.47
SNNPRS 193	AB	Clay loam	4.79	4.06	0.02	1.03	0.43	15.26	5.09	21.82	30.88	2.14	0.22	15	0.98	1.31	3.34	1.82	32.52	1.56	76.31
SNNPRS 194	B1	Clay	4.93	4.13	0.02	0.94	0.39	14.42	5.09	20.84	28.11	1.02	0.12		1		3.34				
SNNPRS 195	B2	Clay	5.12	4.27	0.02	0.85	0.42	17.04	6.82	25.12	32.41	0.65	0.06		1.1		2.63				
SNNPRS 196	B3	Clay	4.91	3.96	0.02	1.02	0.5	15.32	5.96	22.8	31.46	0.41	0.04		1.07		3.24				
SNNPRS 197	A	Sandy clay	4.45	3.66	0.04	0.82	0.45	13.71	4.28	19.26	29.34	3.86	0.28	16.1	0.96	1.27	2.79	2.23	84.06	2.02	88.67
CHEHA	MOCHE		P 2																		
SNNPRS 198	Ap	Clay	4.72	4	0.03	0.95	0.61	15.81	5.9	22.64	32.08	2.83	0.22	19.5	1.01	0.91	2.97	7.01	79.07	3.07	79.88
SNNPRS 199	B1	Clay	4.58	3.72	0.02	1.02	0.45	14.31	4.21	19.99	32.93	1.24	0.1		1.1		3.11				
SNNPRS 200	B2	Clay	4.63	3.84	0.02	1.09	0.52	14.42	5.09	21.11	29.96	0.54	0.04		1.14		3.63				
SNNPRS 201	B3	Clay	4.8	4	0.02	1.01	0.48	18.97	6.9	27.36	31.4	0.46	0.03		1.13		3.22				
SNNPRS 202	B4	Clay	4.89	4.12	0.02	1	0.48	19.65	5.98	27.12	32.04	0.27	0.02		1.15		3.13				
SNNPRS 203	Ap	Sandy clay	4.67	3.81	0.07	0.97	0.62	13.49	4.22	19.29	30.7	2.76	0.22	18.3	0.99	0.87	3.16	5.84	73.46	2.5	88.88

CODE	HORI	Texture	pH H2O	pH KCl	EC	Na	K	Ca	Mg	SUM	CEC	OC	N	P	BD	S	ESP	Zn	Mn	Cu	Fe
CHEHA	YEFERZEYE		P 1																		
SNNPRS 204	A	Clay	5.13	4.22	0.12	0.96	0.87	19.47	5.92	27.22	36.8	1.71	0.19	22.8	1.09	0.91	2.6	4.42	63.07	0.65	78.76
SNNPRS 205	B1	Clay	4.94	4.06	0.03	1.11	0.67	17.79	5.93	25.5	38.22	1.32	0.13		1.05		2.89				
SNNPRS 206	B2	Clay	4.91	4.14	0.08	1.28	0.74	18.83	6.85	27.7	36.29	1.15	0.1		1.01		3.54				
SNNPRS 207	B3	Clay	5.84	5.02	0.1	1.22	1.57	19.5	6.78	29.07	35.49	1.02	0.07		1.04		3.43				
SNNPRS 208	B4	Clay	4.77	3.89	0.03	1.25	0.64	16.11	5.94	23.94	35.95	0.71	0.06		0.96		3.49				
SNNPRS 209	B2	Clay	5.11	4.18	0.08	1.31	0.72	17.64	5.88	25.56	36.52	1.21	0.1		1.01		3.6				
CHEHA	YEFERZEYE		P 2																		
SNNPRS 210	A	Clay	4.66	3.81	0.03	1.22	0.51	15.12	5.04	21.89	31.96	2.62	0.28	16.7	0.92	0.83	3.83	1.8	61.26	1.39	70.73
SNNPRS 211	B1	Clay	4.33	3.54	0.02	1.2	0.41	15.26	5.94	22.81	32.72	1.76	0.19		0.96		3.66				
SNNPRS 212	B2	Clay	4.56	3.7	0.02	1.07	0.51	15.26	5.09	21.93	31.34	1.22	0.13		0.96		3.41				
SNNPRS 213	B3	Clay	4.32	3.58	0.02	1.22	0.51	14.42	4.24	20.38	31.8	0.84	0.09		1.04		3.83				
SNNPRS 214	B4	Clay	4.35	3.63	0.02	1.2	0.48	15.26	5.94	22.88	32.72	0.7	0.07		0.93		3.66				
SNNPRS 215	B5	Clay	4.63	3.82	0.02	0.97	0.5	15.96	5.88	23.3	28.3	0.47	0.04		1.02		3.42				
SNNPRS 216	B3	Clay	4.44	3.69	0.02	1.21	0.53	14.28	5.04	21.05	31.04	0.85	0.09		0.97		3.88				

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Si-A-1**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘33“**	GPS N **06°16‘58“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2777**	
Major landform (t4) **S (H)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) 20	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-60**	**60-100**	**100+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5RY3/3**	**5RY3/3**	**5RY3/2**	**5RY4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Si-A-2**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘32“**	GPS N **06°17‘10“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2798**	
Major landform (t4) **S (H)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **18**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Bt1	Bt2	BC	C
Depth interval (cm)		0 -23	23-61	61-90	90-112	112+
Hor. Boundary Distinct. (t24)		D	D	G	D	
Texture class (f4, t25)		CL	C	C	C	CL
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N		N
Colour munsell code moist		7.5RY3/2	5RY3/3	5RY3/3	5RY4/3	7.5RY3/3
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N		N
Carbonates (t38) by HCl		N	N	N	N	
Consistency, Wet (t55, 56)		SST SPL	ST PL	ST SPL	ST PL	ST PL
Moisture status (t57)		M	M	M	M	
Cementation	Nature (t71) Degree (t72)	N	N	N		N
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N		N
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Si-A-3**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘08“**	GPS N **06°16‘54“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2703**	
Major landform (t4) **S (H)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **14**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Bt1	Bt2	BC
Depth interval (cm)		**0 -25**	**25-68**	**68-115**	**115+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5RY3/2**	**5RY3/3**	**5RY3/3**	**5RY4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Si-A-4**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘32“**	GPS N **06°16‘50“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2767**	
Major landform (t4) **S (E)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **LuCo**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**BC**	**C**
Depth interval (cm)		**0 -21**	**21-53**	**53-94**	**94-115**	**115+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		**N**
Colour munsell code moist		**7.5RY3/2**	**5RY3/3**	**5RY3/3**	**5RY4/3**	**5RY4/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**		**N**
Carbonates (t38) by HCl		**N**	**N**	**N**		
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**SST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**		
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**		**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**		**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Si-A-5**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°23‘47“**	GPS N **06°16‘59“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2651**	
Major landform (t4) S **(E)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **10**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Bt1	Bt2	BC	C
Depth interval (cm)		0 -16	16-60	60-98	98-115	115+
Hor. Boundary Distinct. (t24)		D	G	D	G	
Texture class (f4, t25)		SC	CL	C	CL	C
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N		N
Colour munsell code moist		7.5RY3/2	5RY3/3	5RY3/3	5RY4/3	5RY4/3
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N		N
Carbonates (t38) by HCl		N	N	N	N	
Consistency, Wet (t55, 56)		SST SPL	ST SPL	ST PL	ST PL	ST PL
Moisture status (t57)		M	M	M	M	
Cementation	Nature (t71) Degree (t72)	N	N	N		N
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N		N
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Si-A-6**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘41“**	GPS N **06°16‘43“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2785**	
Major landform (t4) **S (E)**	Position in landform, description **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 13	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**	**BC**
Depth interval (cm)		**0 -17**	**17-57**	**57-97**	**97-125**	**125+**
Hor. Boundary Distinct. (t24)		**C**	**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		**N**
Colour munsell code moist		**7.5RY3/3**	**5RY3/3**	**5RY3/3**	**5RY4/3**	**5RY3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**	
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**		**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**		**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Ba-A-7**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘28“**	GPS N **06°16‘48“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2751**	
Major landform (t4) S **(E)**	Position in landform, description **UP**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**C**
Depth interval (cm)		**0 -21**	**21-68**	**68-112**	**112+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SC**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5RY3/2**	**5RY3/3**	**5RY3/3**	**5RY4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Sika

Profile ID **Ba-A-8**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°24‘33“**	GPS N **06°16‘35“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2767**	
Major landform (t4) **S (E)**	Position in landform, description **UP**		
Position on slope (f2) **LP**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -25**	**25-79**	**79-127**	**127+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY3/2**	**5RY2.5/2**	**5RY3/3**	**5RY4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa-A-1**	Date **14-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘12“**	GPS N **06°15‘19“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2948**	
Major landform (t4) **S (H)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **5**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -22**	**22-55**	**55-87**	**87-129**	**129+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 4/4**	**7.5YR4/3**	**5YR4/3**	**5YR4/6**	**5YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST SPL**	**ST SPL**	**ST PL**	**ST PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-2**	Date 14-03-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘18“**	GPS N **06°15‘29“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2939**	
Major landform (t4) **S (H)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -23**	**23-59**	**59-87**	**87-119**	**119+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	**D**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		**N**
Colour munsell code moist		**7.5YR 4/4**	**7.5YR4/2**	**5YR4/3**	**5YR4/6**	**5YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**		**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**		**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**		**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-3**	Date 14-03-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘19“**	GPS N **06°15‘39“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2918**	
Major landform (t4) **S (H)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **14**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -15**	**15-50**	**50-92**	**92-120**	**120+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	**G**	**G**
Texture class (f4, t25)		**CL**	**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		**N**
Colour munsell code moist		**7.5YR 4/3**	**7.5YR4/2**	**5YR4/3**	**5YR4/4**	**5YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**		**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**		**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**		**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-4**	Date 14-03-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘19“**	GPS N **06°15‘53“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2936**	
Major landform (t4) **S (E)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **LuCo**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -21**	**21-59**	**59-95**	**95-125**	**125+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 4/3**	**7.5YR4/2**	**5YR4/4**	**5YR4/4**	**5YR4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-5**	Date **14-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘13“**	GPS N **06°16‘13“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2853**	
Major landform (t4) S **(E)**	Position in landform, description **LL**		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -16**	**16-60**	**60-98**	**98-115**	**115+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**D**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 4/3**	**7.5YR4/2**	**5YR4/3**	**5YR4/6**	**5YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-6**	Date **14-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘15“**	GPS N **06°15‘59“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2894**	
Major landform (t4) **S (E)**	Position in landform, description **LL**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 13	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**ABt2**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -20**	**20-50**	**50-95**	**95-120**	**120+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**7.5YR3/3**	**5YR3/3**	**2.5YR3/3**	**5YR4/6**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-7**	Date **14-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘17“**	GPS N **06°16‘23“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2751**	
Major landform (t4) S **(E)**	Position in landform, description **UP**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -21**	**21-50**	**50-81**	**81-113**	**113+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	**G**	
Texture class (f4, t25)		**SL**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/3**	**7.5YR3/2**	**5YR3/3**	**5YR3/3**	**5YR4/6**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**		
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	N	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Illalcha

Profile ID **Illa -A-8**	Date **14-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°25‘09“**	GPS N **06°16‘18“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2820**	
Major landform (t4) **S (E)**	Position in landform, description **UP**		
Position on slope (f2) **LP**	Slope form (t6) **S/S**	Slope (%) **13**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -25**	**25-49**	**49-81**	**81-101**	**101+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**C**	**N**
Colour munsell code moist		**5YR3/3**	**7.5YR3/2**	**2.5YR3/3**	**5YR3/3**	**5YR4/6**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**C**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**C**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	N	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-1**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘33“**	GPS N **06°19‘13“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2337**	
Major landform (t4) **S (H)**	Position in landform, description **Lower**		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **13**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Ah	AB	Bt
Depth interval (cm)		**0 -20**	**20-75**	**75-95**	**95+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY3/2**	**5RY2.5/2**	**2.5RY3/3**	**2.5RY3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**SST** **SPL**	**SST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-2**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘38“**	GPS N **06°19‘18“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2317**	
Major landform (t4) **S (H)**	Position in landform, description **Lower**		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Ah	AB	Bt
Depth interval (cm)		**0 -23**	**23-70**	**70-100**	**100+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY3/2**	**5RY2.5/2**	**2.5RY3/3**	**2.5RY3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **SPL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-3**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘42“**	GPS N **06°18‘42“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2217**	
Major landform (t4) **S (H)**	Position in landform, description **Lower**		
Position on slope (f2) **M**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Ah	AB	Bt
Depth interval (cm)		0 -25	25-75	75-105	105+
Hor. Boundary Distinct. (t24)		D	D	G	
Texture class (f4, t25)		C	C	C	C
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N	N
Colour munsell code moist		5RY3/3	5RY3/2	2.5RY3/3	2.5RY3/2
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N	N
Carbonates (t38) by HCl		N	N	N	N
Consistency, Wet (t55, 56)		SST SPL	ST SPL	SST SPL	ST SPL
Moisture status (t57)		M	M	M	M
Cementation	Nature (t71) Degree (t72)	N	N	N	N
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N	N
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-4**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘18“**	GPS N **06°18‘22“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2063**	
Major landform (t4) **S (E)**	Position in landform, description **Lower**		
Position on slope (f2) **M**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **LuCo**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -18**	**18-65**	**65-92**	**92+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**D**	
Texture class (f4, t25)		**C**	**C**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5RY3/2**	**5RY2.5/2**	**2.5RY3/3**	**5RY3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**SST** **SPL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-5**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘14“**	GPS N **06°18‘26“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2174**	
Major landform (t4) S **(E)**	Position in landform, description **Upper**		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -16**	**16-60**	**60-85**	**85+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**D**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5RY3/2**	**2.5RY3/2**	**2.5RY3/3**	**5RY3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **SPL**	**SST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-6**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘27“**	GPS N **06°18‘22“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2075**	
Major landform (t4) **S (E)**	Position in landform, description **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 15	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**B1**	**B2**	**B3**
Depth interval (cm)		**0 -15**	**15-55**	**55-97**	**97+**
Hor. Boundary Distinct. (t24)		**C**	**C**	**G**	
Texture class (f4, t25)		**SC**	**SCL**	**SCL**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY4/6**	**5RY3/4**	**5RY3/3**	**10RY3/6**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**NST** **NPL**	**SST** **SPL**	**SST** **SPL**	**SST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-7**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘40“**	GPS N **06°18‘16“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2067**	
Major landform (t4) S **(E)**	Position in landform, description **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 18	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**B1**	**B2**	**B3**
Depth interval (cm)		**0 -15**	**15-62**	**62-102**	**102+**
Hor. Boundary Distinct. (t24)		**C**	**C**	**G**	
Texture class (f4, t25)		**SC**	**SC**	**SCL**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY4/6**	**2.5RY3/4**	**5RY3/3**	**2.5RY3/6**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**NST** **NPL**	**SST** **SPL**	**SST** **PL**	**SST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Dero

Profile ID **De-A-8**	Date **10-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘45“**	GPS N **06°18‘08“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2038**	
Major landform (t4) **S (E)**	Position in landform, description **Upper**		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) 22	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**B1**	**B2**	**B3**
Depth interval (cm)		**0 -20**	**20-65**	**65-95**	**95+**
Hor. Boundary Distinct. (t24)		**C**	**C**	**G**	
Texture class (f4, t25)		**SCL**	**SCL**	**SCL**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY4/6**	**2.5RY3/4**	**5RY3/3**	**10RY3/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**NST** **NPL**	**SST** **SPL**	**SST** **SPL**	**SST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-1**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘55“**	GPS N **06°19‘01“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2479**	
Major landform (t4) **S (H)**	Position in landform, description **Middle**		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **18**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	C
Depth interval (cm)		**0 -20**	**20-60**	**60-95**	**95+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY3/3**	**5RY23/2**	**5RY3/2**	**5RY2.5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID Ba-**A-2**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘49“**	GPS N **06°19‘09“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2439**	
Major landform (t4) **S (H)**	Position in landform, description **Middle**		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -23**	**23-51**	**51-100**	**100+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5RY3/3**	**2.5RY3/2**	**5RY3/2**	**5RY3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-3**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘46“**	GPS N **06°19‘08“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2436**	
Major landform (t4) **S (H)**	Position in landform, description **Middle**		
Position on slope (f2) **M**	Slope form (t6) **S/S**	Slope (%) **15**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -25**	**25-58**	**58-95**	**95+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**D**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY3/2**	**5RY3/2**	**5RY2.5/3**	**5RY3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**SST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-4**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘33“**	GPS N **06°19‘05“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2331**	
Major landform (t4) **S (E)**	Position in landform, description **Middle**		
Position on slope (f2) **M**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **LuCo**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**C1**
Depth interval (cm)		**0 -18**	**18-61**	**61-89**	**89+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**D**	**G**
Texture class (f4, t25)		**CL**	**C**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5RY3/3**	**2.5RY3/2**	**5RY3/2**	**5RY3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**SST** **PL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-5**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘09“**	GPS N **06°19‘05“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2322**	
Major landform (t4) S **(E)**	Position in landform, description **Middle**		
Position on slope (f2) **M**	Slope form (t6) **S/S**	Slope (%) **10**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**C1**	C2
Depth interval (cm)		**0 -16**	**16-60**	**60-98**	**98+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**D**	
Texture class (f4, t25)		**SC**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5RY4/2**	**5RY3/2**	**5RY3/2**	**7.5RY3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-6**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°21‘56“**	GPS N **06°19‘09“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2340**	
Major landform (t4) **S (E)**	Position in landform, description **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 13	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Bt1	Bt2	C1
Depth interval (cm)		0 -15	15-65	65-97	97+
Hor. Boundary Distinct. (t24)		C	D	G	G
Texture class (f4, t25)		SCL	CL	C	C
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N	
Colour munsell code moist		5RY3/2	5RY2.5/2	5RY3/3	7.5RY3/3
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N	
Carbonates (t38) by HCl		N	N	N	N
Consistency, Wet (t55, 56)		SST SPL	ST SPL	ST PL	ST PL
Moisture status (t57)		M	M	M	M
Cementation	Nature (t71) Degree (t72)	N	N	N	
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N	
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-7**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘14“**	GPS N **06°18‘58“**	
(Base) map unit ID	Topography (t7) 1**5-30**	Elevation (m.) **2336**	
Major landform (t4) S **(E)**	Position in landform, description **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 8	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**C1**
Depth interval (cm)		**0 -17**	**17-68**	**68-102**	**102+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	**D**
Texture class (f4, t25)		**SC**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	
Colour munsell code moist		**5RY4/2**	**5RY3/2**	**5RY3/2**	**7.5RY3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Bule Woreda

Kebele Basura

Profile ID **Ba-A-8**	Date **11-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Bule**	GPS E **38°22‘14“**	GPS N **06°18‘49“**	
(Base) map unit ID	Topography (t7) **5-30**	Elevation (m.) **2257**	
Major landform (t4) **S (E)**	Position in landform, description **Middle**		
Position on slope (f2) **L**	Slope form (t6) **S/S**	Slope (%) 22	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **5** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater N	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Tiloke**	Field WRB		

Horizon (t85)		Ap	Bt1	Bt2	C1
Depth interval (cm)		**0 -19**	**19-70**	**70-102**	**102+**
Hor. Boundary Distinct. (t24)		**C**	**C**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	
Colour munsell code moist		**5RY3/2**	**5RY2.5/2**	**5RY3/3**	**7.5RY3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-1**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘40“**	GPS N **08°02‘37“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1977**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -23**	**23-88**	**88-117**	**117+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/3**	**5Y6/2**	**2.5Y4/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**ST PL**	**ST PL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-2**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘27“**	GPS N **08°02‘24“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1980**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -27**	**27-80**	**80-120**	**120+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/2**	**5Y6/3**	**2.5Y4/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**VST** **VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-3**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘18“**	GPS N **08°02‘30“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1978**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -25**	**25-90**	**90-122**	**122+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/3**	**5Y6/3**	**2.5Y3/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**VST PL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-4**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘13“**	GPS N **08°02‘46“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1974**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -24**	**24-88**	**88-118**	**118+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/3**	**5Y6/2**	**2.5Y4/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST PL**	**ST PL**	**VST PL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-5**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘03“**	GPS N **08°02‘13“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1984**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -27**	**27-88**	**88-126**	**126+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/3**	**5Y6/3**	**2.5Y3/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **PL**	**ST** **PL**	**ST** **PL**	**VST** **VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-6**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°45‘53“**	GPS N **08°02‘27“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1971**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -27**	**27-90**	**90-127**	**127+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/3**	**5Y6/3**	**2.5Y4/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**VST** **VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-7**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘07“**	GPS N **08°02‘27“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1970**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -28**	**28-89**	**89-125**	**125+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/2**	**5Y6/2**	**2.5Y3/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**VST** **VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor enerWoreda

Kebele Kerebed

Profile ID **Ke-A-8**	Date 20-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°44‘56“**	GPS N **08°03‘05“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1942**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -24**	**24-88**	**88-126**	**126+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR4/3**	**5Y6/3**	**2.5Y3/2**	**5Y5/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST PL**	**ST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-1**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘01“**	GPS N **08°03‘42“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1975**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree S		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage W	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -28**	**28-65**	**65-100**	**100+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR2.5/1**	**10R2.5/1**	**2.5YR3/3**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-2**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘15“**	GPS N **08°03‘36“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1978**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **1** Degree **S**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -29**	**29-75**	**75-111**	**111+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**10R2.5/1**	**10R3/3**	**2.5YR3/3**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**ST VPL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-3**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘46“**	GPS N **08°03‘28“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1983**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -27**	**27-95**	**95-122**	**122+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**5Y6/2**	**5Y5/2**	**10YR4/1**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**W**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-4**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘37“**	GPS N **08°03‘28“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1977**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -26**	**26-88**	**88-118**	**118+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**5Y6/1**	**5Y5/2**	**5Y4/1**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST VPL**	**ST PL**	**ST PL**
Moisture status (t57)		**D**	**SM**	**M**	**W**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-5**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘43“**	GPS N **08°03‘20“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1981**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -25**	**25-75**	**75-106**	**106+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**5Y6/2**	**5Y5/2**	**10YR4/1**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**D**	**SM**	**M**	**W**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-6**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°43‘22“**	GPS N **08°04‘35“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1925**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -22**	**22-90**	**90-127**	**127+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**5Y6/1**	**5Y5/2**	**10YR4/1**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**D**	**SM**	**M**	**W**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-7**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°44‘29“**	GPS N **08°04‘16“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1938**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -24**	**24-87**	**87-115**	**115+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**5Y6/1**	**5Y5/1**	**5Y4/1**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**D**	**SM**	**M**	**W**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for EnemorWoreda

Kebele Gomosh

Profile ID **Go-A-8**	Date 22-04-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°43‘41“**	GPS N **08°04‘09“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1901**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Gembena Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -27**	**27-94**	**94-123**	**123+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**5Y6/1**	**5Y5/1**	**5Y4/1**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**D**	**SM**	**M**	**W**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-1**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°52‘42“**	GPS N **07°58‘00“**	
(Base) map unit ID	Topography (t7) **0-5**	Elevation (m.) **2478**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -20**	**20-55**	**55-105**	**105+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**5YR2.5/2**	**2.5YR3/3**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**NST** **NPL**	**SST** **SPL**	**SST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-2**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°52‘44“**	GPS N **07°57‘44“**	
(Base) map unit ID	Topography (t7) **5-5**	Elevation (m.) **2500**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **5**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -20**	**20-55**	**55-100**	**100+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**5YR2.5/2**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**NST** **NPL**	**SST** **SPL**	**SST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-3**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°52‘31“**	GPS N **07°57‘44“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2471**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -22**	**22-69**	**69-112**	**112+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**5YR2.5/1**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **NPL**	**SST** **SPL**	**SST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-4**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°52‘49“**	GPS N **07°57‘47“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2487**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -21**	**21-62**	**62-111**	**111+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**5YR2.5/1**	**5YR3/3**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **NPL**	**SST** **SPL**	**ST** **SPL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-5**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°52‘53“**	GPS N **07°57‘39“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2490**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		Ap	Ah	AB	Bt
Depth interval (cm)		0 -24	24-54	54-107	107+
Hor. Boundary Distinct. (t24)		D	D	G	
Texture class (f4, t25)		SCL	CL	CL	C
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N	N
Colour munsell code moist		2.5YR2.5/1	5YR2.5/2	5YR3/4	2.5YR3/2
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N	N
Carbonates (t38) by HCl		N	N	N	N
Consistency, Wet (t55, 56)		NST SPL	ST SPL	ST SPL	ST PL
Moisture status (t57)		M	M	M	M
Cementation	Nature (t71) Degree (t72)	N	N	N	N
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N	N
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-6**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°52‘51“**	GPS N **07°57‘34“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2499**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**B t2**
Depth interval (cm)		**0 -24**	**24-69**	**69-100**	**100+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**CL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR3/3**	**7.5YR3/2**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-7**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘23“**	GPS N **07°56‘21“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2608**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **5**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		Ap	Ah	Bt1	Bt2
Depth interval (cm)		0 -27	27-60	60-108	108+
Hor. Boundary Distinct. (t24)		D	G	G	
Texture class (f4, t25)		CL	CL	CL	CL
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N	N
Colour munsell code moist		7.5YR3/2	7.5YR3/2	2.5YR3/4	2.5YR3/3
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N	N
Carbonates (t38) by HCl		N	N	N	N
Consistency, Wet (t55, 56)		SST SPL	ST SPL	ST PL	ST PL
Moisture status (t57)		M	M	M	M
Cementation	Nature (t71) Degree (t72)	N	N	N	N
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N	N
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Kunber

Profile ID **Kun-A-8**	Date **21-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘32“**	GPS N **07°56‘44“**	
(Base) map unit ID	Topography (t7) 0-**5**	Elevation (m.) **2633**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -28**	**28-62**	**62-120**	**120+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**5YR2.5/2**	**2.5YR3/3**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-1**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘07“**	GPS N **07°57‘18“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2533**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **7**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -27**	**27-59**	**59-105**	**105+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**2.5YR3/4**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-2**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘12“**	GPS N **07°57‘23“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2526**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -24**	**24-55**	**55-95**	**95+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR2.5/1**	**2.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **SPL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-3**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘14“**	GPS N **07°57‘15“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2537**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **7**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -22**	**22-71**	**71-115**	**115+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**2.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **SPL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-4**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘06“**	GPS N **07°57‘06“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2520**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **7**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -25**	**25-69**	**69-112**	**112+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**2.5YR3/4**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-5**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘13“**	GPS N **07°56‘50“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2554**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **7**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -24**	**24-54**	**54-97**	**97+**
Hor. Boundary Distinct. (t24)		**D**	**D**	**G**	
Texture class (f4, t25)		**CL**	**SL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR2.5/1**	**2.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-6**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘24“**	GPS N **07°56‘13“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2612**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -27**	**27-59**	**59-105**	**105+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR2.5/1**	**2.5YR3/4**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **SPL**	**ST** **PL**	**ST** **SPL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-7**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘23“**	GPS N **07°56‘21“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2608**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **5**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -27**	**27-60**	**60-108**	**108+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR2.5/1**	**2.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Enemor Ener Woreda

Kebele Agata

Profile ID **Aga-A-8**	Date **19-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Enemor Enre**	GPS E **37°53‘32“**	GPS N **07°56‘44“**	
(Base) map unit ID	Topography (t7) 0-**5**	Elevation (m.) **2633**	
Major landform (t4) **S (H)**	Position in landform, description **LP**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **M** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **150**	
Local soil name **Chara Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -28**	**28-62**	**62-120**	**120+**
Hor. Boundary Distinct. (t24)		**D**	**G**	**G**	
Texture class (f4, t25)		**CL**	**CL**	**CL**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/1**	**2.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **SPL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-1**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°32‘39“**	GPS N **06°56‘08“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2073**	
Major landform (t4) **L (D)**	Position in landform, Upper		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt**	**BC**	**C**
Depth interval (cm)		**0 -20**	**20-42**	**42-70**	**70-116**	**116+**
Hor. Boundary Distinct. (t24)		**C**	**C**	**G**	**G**	
Texture class (f4, t25)		**SC**	**SCL**	**CL**	**SC**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR 5/3**	**10YR4/2**	**2.5Y 4/4**	**2.5YR 4/3**	**GLEY1 5/5GY**
Mottles	Abundance (t32) Size (t33) Prominence (34)	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**SST SPL**	**ST PL**	**SST PL**	**SST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-2**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°32‘46“**	GPS N **06°56‘09“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2087**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt**	**BC**	**C**
Depth interval (cm)		**0 -22**	**22-41**	**41-67**	**67-103**	**103+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SCL**	**CL**	**SC**	**SCL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR 5/3**	**10YR4/2**	**2.5Y 4/4**	**2.5YR 4/4**	**GLEY1 6/5GY**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST SPL**	**ST PL**	**SST SPL**	**ST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-3**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°32‘32“**	GPS N **06°56‘32“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2054**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-50**	**50-73**	**73-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 3/3**	**5YR 3/3**	**5YR 3/2**	**10R 3/3**	**10YR 4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST PL**	**VST PL**	**SST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-4**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘02“**	GPS N **06°56‘37“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2067**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 6	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-50**	**50-73**	**73-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 3/2**	**5YR 3/3**	**5YR 3/2**	**2.5YR 3/2**	**10YR 4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST PL**	**VST PL**	**SST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-5**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘00“**	GPS N **06°56‘19“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2118**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**1**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-50**	**50-73**	**73-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 3/3**	**5YR 3/3**	**5YR 3/2**	**2.5YR 3/2**	**10YR 4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST PL**	**VST PL**	**SST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-6**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘02“**	GPS N **06°56‘16“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2119**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-50**	**50-73**	**73-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 3/3**	**5YR 3/3**	**5YR 3/2**	**10R 3/3**	**10YR 4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST PL**	**VST PL**	**SST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-7**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°32‘40“**	GPS N **06°56‘53“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2068**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-50**	**50-73**	**73-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 4/3**	**5YR 3/3**	**5YR 3/2**	**2.5YR 3/2**	**10YR 4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST PL**	**VST PL**	**SST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Sintaro

Profile ID **Sint-A-8**	Date **17-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°36‘27“**	GPS N **06°55‘21“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2452**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**BC**
Depth interval (cm)		**0 -22**	**22-50**	**50-73**	**73-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**	**SC**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR 3/4**	**5YR 3/4**	**5YR 3/2**	**10R 3/3**	**10YR 4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST PL**	**VST PL**	**SST SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-1**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘13“**	GPS N **06°55‘37“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2187**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -20**	**20-39**	**39-70**	**70-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST PL**	**ST PL**	**VST PL**	**VST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-2**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘40“**	GPS N **06°55‘32“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2221**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -22**	**22-40**	**40-70**	**70-120**	**120+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST PL**	**ST PL**	**VST PL**	**VST VPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-3**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘03“**	GPS N **06°55‘51“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2164**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt1**	**Bt3**
Depth interval (cm)		**0 -25**	**25-40**	**40-73**	**73-122**	**122+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST SPL**	**ST PL**	**VST PL**	**VST VPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-4**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘06“**	GPS N **06°55‘52“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2161**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -23**	**23-45**	**45-80**	**89+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SCL**	**SL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**SST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-5**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘06“**	GPS N **06°55‘54“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2154**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -20**	**20-55**	**55-96**	**96+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-6**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘17“**	GPS N **06°55‘55“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2475**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -19**	**19-45**	**45-83**	**83+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-7**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘45“**	GPS N **06°55‘40“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2223**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -22**	**22-55**	**55-96**	**96+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Kocho

Profile ID **Kocho-A-8**	Date **18-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°33‘11“**	GPS N **06°55‘32“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2139**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -22**	**22-45**	**45-99**	**99+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-1**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘44“**	GPS N **06°59‘28“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2655**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -20**	**20-45**	**45-90**	**90-123**	**123+**
Hor. Boundary Distinct. (t24)		**G**	**C**	**G**	**C**	
Texture class (f4, t25)		**CL**	**SC**	**CL**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST SPL**	**ST PL**	**ST SPL**	**VST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-2**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘30“**	GPS N **06°59‘25“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2650**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -22**	**22-45**	**45-85**	**85-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**C**	**G**	**C**	
Texture class (f4, t25)		**CL**	**SC**	**CL**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST SPL**	**ST PL**	**ST SPL**	**VST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-3**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘41“**	GPS N **06°59‘20“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2657**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -24**	**24-50**	**50-85**	**85-113**	**113+**
Hor. Boundary Distinct. (t24)		**G**	**C**	**G**	**C**	
Texture class (f4, t25)		**CL**	**SC**	**CL**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST SPL**	**ST PL**	**ST SPL**	**VST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-4**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘27“**	GPS N **06°59‘20“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2664**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -25**	**25-65**	**65-92**	**92+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-5**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘30“**	GPS N **06°59‘00“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2663**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -22**	**22-60**	**60-98**	**98+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-6**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘17“**	GPS N **06°59‘16“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2655**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -25**	**25-68**	**68-102**	**102+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-7**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘02“**	GPS N **06°59‘23“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2661**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -27**	**27-70**	**70-100**	**100+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for MalgaWoreda

Kebele Guguma

Profile ID **Gu-A-8**	Date **16-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.)	GPS E **38°42‘04“**	GPS N **06°59‘29“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2655**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 1 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage M		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm)	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -21**	**21-60**	**60-102**	**102+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-1**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°37‘33“**	GPS N **06°55‘53“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2531**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -20**	**20-39**	**39-70**	**70-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST PL**	**ST PL**	**VST PL**	**VST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-2**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°37‘25“**	GPS N **06°55‘52“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2516**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -22**	**22-40**	**40-70**	**70-120**	**120+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST PL**	**ST PL**	**VST PL**	**VST VPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-3**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°37‘20“**	GPS N **06°55‘46“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2499**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **9**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt1**	**Bt3**
Depth interval (cm)		**0 -25**	**25-40**	**40-73**	**73-122**	**122+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist						
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**ST SPL**	**ST PL**	**VST PL**	**VST VPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-4**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°37‘07“**	GPS N **06°55‘48“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2498**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -23**	**23-45**	**45-80**	**89+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SCL**	**SL**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**SST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-5**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°36‘55“**	GPS N **06°55‘44“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2479**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -20**	**20-55**	**55-96**	**96+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-6**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°36‘32“**	GPS N **06°55‘45“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2475**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -19**	**19-45**	**45-83**	**83+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-7**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°36‘24“**	GPS N **06°55‘36“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2429**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -22**	**22-55**	**55-96**	**96+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Malga Woreda

Kebele Fito ketemena

Profile ID **Fike-A-8**	Date **15-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Malga**	GPS E **38°36‘27“**	GPS N **06°55‘21“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2452**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -22**	**22-45**	**45-99**	**99+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**ST SPL**	**ST SPL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-1**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°58‘04“**	GPS N **07°42‘16“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2160**	
Major landform (t4) **S (H)**	Position in landform, **Middle**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**1**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **M** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -19**	**19-50**	**50-80**	**80-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR3/4**	**10YR3/3**	**7.5YR3/**	**7.5YR3/4**	**10YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	
Consistency, Wet (t55, 56)		**SST SPL**	**SST PL**	**SST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**D**	**D**	**D**	**D**	**D**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**		**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-2**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°58‘36“**	GPS N **07°42‘16“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2146**	
Major landform (t4) **S (H)**	Position in landform, **Middle**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -20**	**20-51**	**51-82**	**82-130**	**130+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	**D**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**		
Colour munsell code moist		**10YR3/6**	**10YR3/3**	**7.5YR3/4**	**7.5YR3/4**	**10YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**SST SPL**	**SST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**D**	**D**	**D**	**D**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-3**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°58‘07“**	GPS N **07°41‘51“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2144**	
Major landform (t4) **S (H)**	Position in landform, **Middle**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**	**Bt3**
Depth interval (cm)		**0 -23**	**23-69**	**69-107**	**107-130**	**130+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	**D**	
Texture class (f4, t25)		**SCL**	**SC**	**SC**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**10YR3/4**	**10YR3/4**	**7.5YR3/4**	**7.5YR3/3**	**10YR3/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**SST SPL**	**SST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**D**	**D**	**D**	**D**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-4**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°59‘09“**	GPS N **07°42‘15“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2074**	
Major landform (t4) **L (V)**	Position in landform, **middle**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -23**	**23-59**	**59-114**	**114+**
Hor. Boundary Distinct. (t24)		**C**	**D**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**GLAY1 4/10Y**	**GLAY2 3/5PB**	**GLAY2 3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-5**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°59‘20“**	GPS N **07°42‘13“**	
(Base) map unit ID	Topography (t7) 2-**5**	Elevation (m.) **2057**	
Major landform (t4) **L (V)**	Position in landform, **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 2	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**	**C3**
Depth interval (cm)		**0 -21**	**21-48**	**48-83**	**83-121**	**121+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	**D**	
Texture class (f4, t25)		**SCL**	**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**GLAY1 4/10Y**	**GLAY2 3/5B**	**GLAY2 3/10B**	**GLAY2 3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**SST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-6**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°58‘27“**	GPS N **07°41‘50“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2130**	
Major landform (t4) **L (V)**	Position in landform, **Middle**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 1**3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) B		
Erosion (t16,17, 18)	Category **W** Area % **1** Degree **1**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **W**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Kolisho busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**	**C3**
Depth interval (cm)		**0 -20**	**20-71**	**71-102**	**102-132**	**132+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**D**	**D**	
Texture class (f4, t25)		**SC**	**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/1**	**GLAY1 4/10Y**	**GLAY2 3/5B**	**GLAY2 3/5PB**	**GLAY2 3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**SST** **PL**	**SST** **SPL**	**SST** **SPL**
Moisture status (t57)		**SM**	**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-7**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°59‘25“**	GPS N **07°42‘02“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2049**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **1** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **E**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Kolisho busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**	**C3**
Depth interval (cm)		**0 -25**	**25-78**	**78-102**	**102-125**	**125+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**D**	**D**	
Texture class (f4, t25)		**SC**	**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)J	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/2**	**GLAY1 4/5GY**	**GLAY2 3/5B**	**GLAY2 3/5PB**	**GLAY2 3/10B**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**SST** **PL**	**SST** **SPL**	**SST** **SPL**
Moisture status (t57)		**SM**	**SM**	**M**	**M**	**M**
Cementation	**N**	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	**N**	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Yerim

Profile ID **Ye-A-8**	Date **18-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°59‘52“**	GPS N **07°43‘14“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2098**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **E**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Kolisho busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C1**	C3
Depth interval (cm)		**0 -25**	**25-48**	**58-97**	**97-129**	**129+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**		
Texture class (f4, t25)		**SCL**	**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y6/1**	**GLAY1**	**GLAY2**	**GLAY2**	**GLAY2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-1**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **38°00‘55“**	GPS N **07°44‘36“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2178**	
Major landform (t4) **S (E)**	Position in landform, **Middle**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **M** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -22**	**22-60**	**60-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**5YR3/4**	**2.5YR3**	**5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-2**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **38°00‘52“**	GPS N **07°44‘59“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2192**	
Major landform (t4) **S (E)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **13**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **4** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -22**	**22-56**	**56-105**	**105+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**5YR3/3**	**2.5YR3**	**5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**SST** **SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-3**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **38°00‘50“**	GPS N **07°44‘21“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2163**	
Major landform (t4) **S (E)**	Position in landform, **Middle**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -25**	**25-70**	**70-107**	**107+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**Cl**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**5YR3/3**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**SST** **SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-4**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **38°01‘04“**	GPS N **07°44‘21“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2157**	
Major landform (t4) **L (P)**	Position in landform, **middle**		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **3** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -20**	**20-60**	**60-104**	**104+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**CL**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**2.5YR3/4**	**2.5YR3/3**	**5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**SST** **SPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-5**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **38°00‘32“**	GPS N **07°43‘51“**	
(Base) map unit ID	Topography (t7) 10**-15**	Elevation (m.) **2148**	
Major landform (t4) **S (E)**	Position in landform, Upper		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 1**3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) **B**		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -21**	**21-68**	**68-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**Cl**	**Cl**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**2.5YR3/4**	**5YR3/3**	**5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**SST** **PL**	**SST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-6**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°00‘51“**	GPS N **07°44‘57“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2181**	
Major landform (t4) **S (E)**	Position in landform, **Middle**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) 1**3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **V** Size (cm.) B		
Erosion (t16,17, 18)	Category **W** Area % **1** Degree **1**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **W**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Kolisho busha**	Field WRB		

Horizon (t85)		**Ap**	**Bt1**	**Bt2**	**Bt3**
Depth interval (cm)		**0 -21**	**21-50**	**60-102**	**102+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**D**	
Texture class (f4, t25)		**SL**	**CL**	**Cl**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**SST** **PL**	**SST** **SPL**
Moisture status (t57)		**SM**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-7**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **38°00‘29“**	GPS N **07°43‘29“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2121**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **1** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **E**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Kolisho busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -21**	**21-57**	**57-105**	**105+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SC**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST SPL**	**SST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Emejar

Profile ID **Em-A-8**	Date **17-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak**	GPS E **37°59‘52“**	GPS N **07°43‘14“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2098**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **LS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **E**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Kolisho busha**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -22**	**22-51**	**51-97**	**97+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**SC**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist					
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-1**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°03‘38“**	GPS N **07°52‘30“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2561**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > **200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -20**	**20-55**	**55-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/3**	**2.5YR3/**	**2.5YR3/**	**10YR4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-2**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°04‘36“**	GPS N **07°52‘470“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2630**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -28**	**28-69**	**69-105**	**105+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/3**	**2.5YR3/3**	**2.5YR3/**	**7.5YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-3**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°04‘25“**	GPS N **07°52‘54“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2622**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AB**	**Bt1**	**Bt1**
Depth interval (cm)		**0 -15**	**15-49**	**49-100**	**100+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/3**	**5YR3/3**	**2.5YR3/**	**7.5YR4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-4**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°04‘35“**	GPS N **07°52‘54“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2627**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		Ap	AB	Bt1	Bt2
Depth interval (cm)		0 -25	25-71	71-112	112+
Hor. Boundary Distinct. (t24)		G	G	G	
Texture class (f4, t25)		SCL	C	C	C
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	N	N	N	N
Colour munsell code moist		5YR3/3	2.5YR3/3	2.5YR3/3	7.5YR4/4
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	N	N	N	N
Carbonates (t38) by HCl		N	N	N	N
Consistency, Wet (t55, 56)		SST SPL	ST PL	ST PL	ST PL
Moisture status (t57)		SM	M	M	M
Cementation	Nature (t71) Degree (t72)	N	N	N	N
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N	N	N	N

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-5**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°03‘47“**	GPS N **07°52‘52“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2583**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -25**	**25-65**	**65-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**2.5YR3/4**	**2.5YR3/3**	**7.5YR4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-6**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°04‘04“**	GPS N **07°52‘39“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2595**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -25**	**25-66**	**66-118**	**118+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/3**	**2.5YR3/4**	**5YR3/3**	**7.5YR4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-7**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°03‘41“**	GPS N **07°52‘33“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2568**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -22**	**22-75**	**75-116**	**116+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/3**	**2.5YR3/3**	**5YR3/3**	**10YR4/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Shebel

Profile ID **AdSh-A-8**	Date **16-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°04‘17“**	GPS N **07°52‘44“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2613**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -25**	**25-72**	**72-100**	**100+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/3**	**5YR3/3**	**2.5YR3/**	**7.5YR4/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-1**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘19“**	GPS N **07°53‘45“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2680**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -22**	**22-60**	**60-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**D**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/3**	**7.5YR3/4**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-2**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘33“**	GPS N **07°53‘45“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2677**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -29**	**29-76**	**76-115**	**115+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/4**	**7.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-3**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘27“**	GPS N **07°53‘36“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2676**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -30**	**30-73**	**73-117**	**117+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/4**	**7.5YR3/4**	**2.5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-4**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘16“**	GPS N **07°53‘37“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2676**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -27**	**27-73**	**73-114**	**114+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/3**	**7.5YR3/**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-5**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘32“**	GPS N **07°54‘19“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2687**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -23**	**23-68**	**68-100**	**100+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/3**	**7.5YR3/**	**2.5YR3/**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-6**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘18“**	GPS N **07°54‘18“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2661**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -25**	**25-69**	**69-114**	**114+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**D**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/3**	**7.5YR3/**	**2.5YR3/**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-7**	Date **15-04-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘29“**	GPS N **07°54‘11“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2683**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -27**	**27-57**	**57-105**	**105+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/3**	**7.5YR3/3**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for Mesrak Azernet Berber Woreda

Kebele Adazer Abicho

Profile ID **AdAb-A-8**	Date **02-03-06**	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°05‘21“**	GPS N **07°54‘11“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **2673**	
Major landform (t4) **L (P)**	Position in landform, Upper		
Position on slope (f2) **CR**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) **> 200**	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -28**	**28-68**	**68-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**7.5YR4/3**	**7.5YR3/**	**2.5YR3/**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-1**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°48‘41“**	GPS N **08°13‘14“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1924**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -20**	**20-68**	**68-97**	**97+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/1**	**5Y3/2**	**GLAY1 4/10GY**	**5Y5/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**VST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-2**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°48‘48“**	GPS N **08°13‘54“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1911**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -18**	**18-55**	**55-95**	**95+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/2**	**5Y3/1**	**GLAY1 4/5GY**	**5Y5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST VPL**	**VST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-3**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°48‘57“**	GPS N **08°13‘23“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1943**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -22**	**22-75**	**75-112**	**112+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/1**	**5Y3/1**	**GLAY1 4/5GY**	**5Y5/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**VST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-4**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°49‘20“**	GPS N **08°13‘17“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1937**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -20**	**20-58**	**58-98**	**98+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/1**	**5Y3/1**	**GLAY1 4/10GY**	**5Y5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST PL**	**VST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-5**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°49‘51“**	GPS N **08°13‘44“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1932**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -17**	**17-68**	**68-106**	**106+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/2**	**5Y3/2**	**GLAY1 4/5GY**	**5Y5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-6**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°49‘41“**	GPS N **08°13‘47“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1927**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -22**	**22-50**	**50-107**	**107+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/1**	**5Y3/2**	**GLAY1**	**5Y5/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**VST PL**	**VST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-7**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°49‘34“**	GPS N **08°13‘58“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1923**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -18**	**18-71**	**71-115**	**115+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y5/1**	**5Y3/1**	**GLAY1**	**5Y5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST VPL**	**VST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Ewan

Profile ID **Ew-A-8**	Date 15-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°49‘30“**	GPS N **08°13‘53“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1927**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **V** Depth (cm) **V** Distance (m) **D**		
Surface drainage S	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC**	**C1**	**C2**
Depth interval (cm)		**0 -21**	**21-68**	**68-113**	**113+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5Y4/1**	**5Y3/2**	**GLAY1**	**5Y5/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**VST VPL**	**ST VPL**	**VST VPL**	**VST VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-1**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘37“**	GPS N **08°08‘50“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2062**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -28**	**28-65**	**65-110**	**110+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR2.5/3**	**2.5YR3/4**	**5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-2**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘48“**	GPS N **08°08‘49“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2076**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **5**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -32**	**32-69**	**69-113**	**113+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/3**	**2.5YR3/3**	**5YR3/3**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-3**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘45“**	GPS N **08°08‘31“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2069**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -26**	**26-69**	**69-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/4**	**2.5YR3/3**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**DM**	**SM**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-4**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘17“**	GPS N **08°08‘31“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2048**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **7**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -27**	**27-65**	**65-100**	**100+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/4**	**2.5YR3/**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SD**	**SM**	**SM**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-5**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘26“**	GPS N **08°08‘16“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2053**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **5**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -20**	**20-65**	**65-109**	**109+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/3**	**2.5YR3/2**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SD**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-6**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘42“**	GPS N **08°08‘07“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2061**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -24**	**24-60**	**60-100**	**108+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR4/4**	**5YR4/3**	**2.5YR3/4**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-7**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘52“**	GPS N **08°08‘19“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2053**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) 7	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -23**	**23-70**	**70-101**	**101+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR4/3**	**5YR4/3**	**2.5YR3/4**	**2.5YR3/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Yeferzeye

Profile ID **Ye-A-8**	Date 17-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°55‘49“**	GPS N **08°07‘54“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **2072**	
Major landform (t4) **L (P)**	Position in landform, Middle		
Position on slope (f2) **MS**	Slope form (t6) **S/S**	Slope (%) **6**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 2 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -27**	**27-62**	**62-100**	**100+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**CL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR4/4**	**5YR4/3**	**2.5YR3/**	**2.5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Wordenen

Profile ID **Wo-A-1**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘37“**	GPS N **08°09‘40“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **1895**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **7**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **V**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -20**	**20-58**	**58-104**	**104+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/3**	**2.5YR3/2**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Wordenen

Profile ID **Wo-A-2**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘27“**	GPS N **08°09‘33“**	
(Base) map unit ID	Topography (t7) **5-10**	Elevation (m.) **1890**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **8**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % **2** Degree **V**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage W	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -20**	**20-61**	**61-99**	**99+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**2.5YR3/3**	**2.5YR3/**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **PL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for WordenenWoreda

Kebele Wordenen

Profile ID **Wo-A-3**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°48‘01“**	GPS N **08°10‘12“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1941**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC1**	**AC2**	**C**
Depth interval (cm)		**0 -22**	**22-71**	**71-107**	**107+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**GLAY 1/3/10Y**	**GLAY 1/3/10Y**	**GLAY 1/4/5GY**	**GLAY 2/3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**SM**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for WordenenWoreda

Kebele Wordenen

Profile ID **Wo-A-4**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°48‘02“**	GPS N **08°09‘48“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1941**	
Major landform (t4) **L (D)**	Position in landform, **Lower**		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AC1**	**AC2**	**C**
Depth interval (cm)		**0 -20**	**20-63**	**63-104**	**104+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**GLAY 1/3/10GY**	**GLAY 1/3/10Y**	**GLAY 1/4/5GY**	**GLAY 2/3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**D**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for WordenenWoreda

Kebele Wordenen

Profile ID **Wo-A-5**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°47‘29“**	GPS N **08°10‘07“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1926**	
Major landform (t4) **L (D)**	Position in landform, Lower		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **3**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC1**	**AC2**	**C**
Depth interval (cm)		**0 -22**	**22-70**	**70-94**	**94+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**GLAY 1/3/10GY**	**GLAY 1/3/10Y**	**GLAY 2/4/10G**	**GLAY 2/3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for WordenenWoreda

Kebele Wordenen

Profile ID **Wo-A-6**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **36°47‘02“**	GPS N **08°10‘03“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1924**	
Major landform (t4) **L (D)**	Position in landform, Lower		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name Tikur Afer	Field WRB		

Horizon (t85)		**Ap**	**AC1**	**AC2**	**C**
Depth interval (cm)		**0 -25**	**25-69**	**69-114**	**114+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**GLAY 1/3/5GY**	**GLAY 1/3/10Y**	**GLAY 2/3/10G**	**GLAY 2/3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for WordenenWoreda

Kebele Wordenen

Profile ID **Wo-A-7**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°46‘50“**	GPS N **08°09‘48“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1917**	
Major landform (t4) **L (D)**	Position in landform, Lower		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **4**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **F** Depth (cm) **S** Distance (m) **C**		
Surface drainage **S**	Soil drainage **I**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Tikur Afer**	Field WRB		

Horizon (t85)		**Ap**	**AC1**	**AC2**	**AC3**
Depth interval (cm)		**0 -23**	**23-70**	**70-109**	**109+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**GLAY 1/3/10GY**	**GLAY 1/3/10Y**	**GLAY 2/4/10G**	**GLAY 2/3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for WordenenWoreda

Kebele Wordenen

Profile ID **Wo-A-8**	Date 16-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°47‘48“**	GPS N **08°10‘02“**	
(Base) map unit ID	Topography (t7) **2-5**	Elevation (m.) **1926**	
Major landform (t4) **L (D)**	Position in landform, Lower		
Position on slope (f2) **TS**	Slope form (t6) **S/S**	Slope (%) **2**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **N** Area % Degree		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) **N** Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Dumo busha**	Field WRB		

Horizon (t85)		**Ap**	**AC1**	**AC2**	**AC3**
Depth interval (cm)		**0 -25**	**25-68**	**68-94**	**94+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**C**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**GLAY 1/3/10GY**	**GLAY 1/3/10Y**	**GLAY 2/4/10G**	**GLAY 2/3/5PB**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t38) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **PL**	**VST** **VPL**	**VST** **VPL**	**VST** **VPL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-1**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°00‘57“**	GPS N **08°03‘44“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2576**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -28**	**28-65**	**65-110**	**110+**
Hor. Boundary Distinct. (t24)		**CS**	**GS**	**GS**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR4/6**	**5YR3/4**	**2.5YR3/3**	**2.5YR2.5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-2**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°01‘04“**	GPS N **08°03‘33“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2601**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -32**	**32-69**	**69-115**	**115+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR4/6**	**5YR3/4**	**2.5YR3/4**	**2.5YR2.5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-3**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°01‘00“**	GPS N **08°03‘12“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2635**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -25**	**25-59**	**59-110**	**110+**
Hor. Boundary Distinct. (t24)		**G**	**G**	**G**	
Texture class (f4, t25)		**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/2**	**5YR3/4**	**5YR3/3**	**2.5YR2.5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-4**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **37°01‘06“**	GPS N **08°03‘06“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2644**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -21**	**21-65**	**65-97**	**97+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**CL**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/2**	**5YR3/4**	**5YR3/3**	**2.5YR2.5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-5**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°0‘47“**	GPS N **08°03‘36“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2592**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -20**	**20-65**	**65-109**	**109+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR4/6**	**5YR3/3**	**2.5YR3/4**	**2.5YR2.5/4**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-6**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°00‘59“**	GPS N **08°02‘57“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2661**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **11**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt**
Depth interval (cm)		**0 -30**	**30-60**	**60-108**	**108+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SC**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**5YR3/4**	**5YR3/3**	**2.5YR2.5/3**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SD**	**M**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-7**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°01‘04“**	GPS N **08°02‘57“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2662**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **12**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**Bt1**	**Bt2**
Depth interval (cm)		**0 -32**	**32-71**	**71-116**	**116+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**5YR3/3**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**SST** **SPL**	**ST** **PL**	**ST** **PL**	**ST** **PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**

AUGER SITE

Description for ChehaWoreda

Kebele Moche

Profile ID **Mo-A-8**	Date 18-05-06	Surveyor **Alemayehu K.**	Status (t1) **4.1**
Location (admin.) **Mesrak Azernet Berber**	GPS E **38°00‘49“**	GPS N **08°03‘00“**	
(Base) map unit ID	Topography (t7) **10-15**	Elevation (m.) **2641**	
Major landform (t4) **S (H)**	Position in landform, Middle		
Position on slope (f2) **UP**	Slope form (t6) **S/S**	Slope (%) **13**	
Land Use (t8) **AA4**	Crop (t9) **Ce**	Human infl.(t10) **FE**	
Geology description	Parent material (t12) **I**		
Outcrops/stoniness (t15)	Cover (%) **N** Size (cm.)		
Erosion (t16,17, 18)	Category **W** Area % 4 Degree **M**		
Sealing (t20)	Thickness (mm) **N** Consistence		
Cracks (t21)	Width (cm) N Depth (cm) Distance (m)		
Surface drainage **W**	Soil drainage **W**		
Depth to groundwater **N**	Depth to bedrock (cm) **N**	Rootable depth (cm) > 150	
Local soil name **Busha Afer**	Field WRB		

Horizon (t85)		**Ap**	**Ah**	**AB**	**Bt1**
Depth interval (cm)		**0 -29**	**29-62**	**62-100**	**100+**
Hor. Boundary Distinct. (t24)		**C**	**G**	**G**	
Texture class (f4, t25)		**SCL**	**C**	**C**	**C**
Coarse fragment	Abundance % (t26) Size mm (27) Weathering stage (t29)	**N**	**N**	**N**	**N**
Colour munsell code moist		**5YR3/4**	**5YR3/3**	**5YR3/3**	**5YR3/2**
Mottles	Abundance (t32) Size (t33) Prominence (34) Color Munsell code	**N**	**N**	**N**	**N**
Carbonates (t37) by HCl		**N**	**N**	**N**	**N**
Consistency, Wet (t55, 56)		**ST SPL**	**ST PL**	**ST PL**	**ST PL**
Moisture status (t57)		**SD**	**SM**	**M**	**M**
Cementation	Nature (t71) Degree (t72)	**N**	**N**	**N**	**N**
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	**N**	**N**	**N**	**N**