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MAJOR LAND RESOURCE AREAS OF UGANDA

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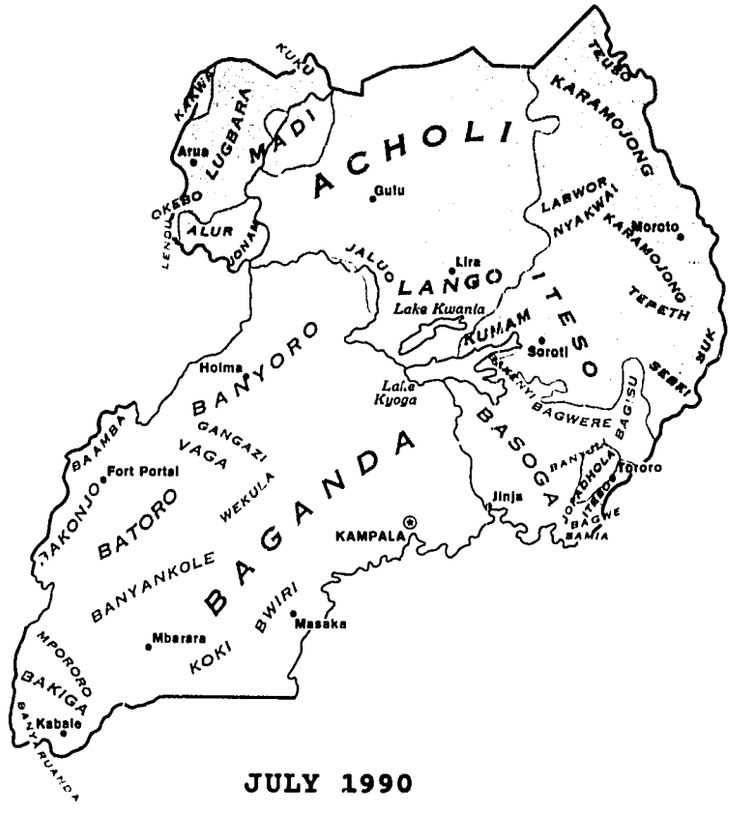
World Soil Resources

Soil Conservation Service - USDA

Washington D.C., USA



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MAJOR LAND RESOURCE AREAS OF UGANDA

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PREFACE

This study was originally envisaged only as a detailed evaluation of three agricultural experimental stations in Uganda. It was requested by the U. S. Agency for International Development (USAID/Kampala) and funded under the Natural Resources Management Support Project of the Africa Bureau of AID. The soil survey of the experimental stations was also a part of the Manpower for Agricultural Development (M/FAD) project of USAID, which was and is implemented by Ohio State University.

After the basic soil survey work was done in Uganda, and subsequent to discussions with the staff of USAID/Kampala and M/FAD, it was considered useful to make a more comprehensive appraisal of the soil resources of Uganda. However, due to travel constraints within the country, this was not feasible. Instead, an attempt was made to collate existing information and develop a preliminary report on the Major Land Resource Areas (MLRA) of Uganda.

The MLRA information would serve as a preliminary base-line information for selection of areas for development or for population reallocation program. It does not provide any detailed soils information for selection of farming systems technology; this would require a detailed soil survey program which we hope will be initiated soon.

It must be pointed out that the MLRA is a rapid appraisal of the country with little or no field checks or evaluation. In fact the scientists of the Soil Conservation Service involved in this project only visited the experimental stations indicated in this report. All three stations are located around Kampala.

This report was due in 1989 but due to unforeseen circumstances beyond the control of the authors, it was delayed.

David Yost
Hari Eswaran

April 1990

ACKNOWLEDGEMENTS

The soil survey of the three agricultural experimental stations of Uganda is the result of a collaborative activity by the Soil Science Department, Makerere University, and the Uganda Ministry of Agriculture and particularly the staff of the experimental station. The work was done in collaboration with the Manpower for Agriculture Development (M/FAD) project of USAID/Kampala, implemented by Ohio State University. The support, encouragement and facilities provided by all these institutions is gratefully acknowledged.

The persons who were involved in the field evaluation and who provided much of the basic information for the MLRA evaluation include:

a. Makerere University

Dr. Julius Zake
Ms. Joy Tumuhairwe

b. Ministry of Agriculture

Dr. William Fenster
Mr. Eribu Ssendiwanyo

c. Soil Conservation Service, USDA, USA

Dr. Don Goss
Mr. Dave Yost
Dr. Hari Eswaran

d. Ohio State University/ MFAD

Dr. Neil Smeck
Ms. Marie Rhaam

The initiation of the project and all the support provided was largely due to the previous Agricultural Development Officer of USAID/Kampala, Mr. Ken Lyvers. We greatly appreciate the role he played and our only regret is that we were unable to present the report before his departure from Uganda.

We also wish to record the support provided by the various Divisions of the Soil Conservation Service, particularly the Cartographic and Geographic Information Division, and the National Soil Survey Laboratories.

EXECUTIVE SUMMARY

The change of emphasis from increased productivity to sustainability of agriculture has taken place over the last few years. Most definitions of sustainable agriculture recognize some or all of the following as being an integral part of the system:

1. *Buffered against risks*
2. *Stabilized over time*
3. *Synchronized with climate*
4. *Harmonized with the environment*
5. *Sensitive to soil degradation*
6. *Responsive to changes*

The concept of sustainable agriculture does not, however, preclude increased production but in addition calls for a maintenance of the resource base. From an agronomic research point of view, the concept though simple, requires a marked change in research administration, the design and monitoring of field trials and the parameters to be measured. From a development point of view, socioeconomic considerations take on a more important role with farmer awareness and appreciation of the concept of sustainability becoming more crucial.

The resource of concern here is the soil and indirectly, all the components of the environment. In production surplus countries, water quality is an important issue particularly the pollution of the water resources through the use of some fertilizers, pesticides and herbicides. Even in this case, the soil through its buffering capacity, plays an important role in controlling the amount of pollutants reaching the water system. As the quantities of organic and inorganic compounds added to the soil in developing countries is significantly lower, water quality is not yet an issue in many of these countries and will not be considered here.

The purpose of this report is to evaluate the current constraints or limitations of knowledge of soil resources in Uganda. The paper focuses on the soil and its role in sustainable agriculture, recognizing that production and sustainability is a multi-faceted problem.

As a prerequisite of implementing sustainable agriculture programs, the Major Land Resource Areas (MLRAs) of Uganda needs to be known and to facilitate technology transfer, this must be in the context of Africa, at least the neighboring countries, and similar agroecological zones elsewhere. An attempt is made in this report to evaluate the MLRAs of Uganda.

MLRA maps are used at national levels:

1. *as a basis for making decisions about agricultural issues;*

2. *as a framework for organizing and conducting resource conservation programs;*

3. *for geographic organization of research and conservation needs and the data from these activities;*

4. *for coordinating technical guides between states and districts of a nation and between countries;*

5. *for organizing, displaying, and using data in physical resource inventories, and*

6. *to aggregate natural resource data.*

MLRAs are most important for agricultural planning and have value for interstate, regional, and national planning.

MLRAs are not suitable for farm-level evaluations. For these, detailed soil surveys are necessary. In this report, detailed soil surveys with accompanying soil characterization data are presented for three agricultural stations -- Kawanda, Kabanyolo, and Namulonge -- and some other sites. Similar information (at scale of about 1:20,000) must be generated on a systematic program of soil surveys for the whole country. This will permit the transfer of information and technology from experimental stations to farmers fields. Once the soil resources of the farmer is known, site-specific farming systems technology which includes conservation practises can be designed for the farmer.

There is an urgent need for a systematic soil survey program at a detailed level for the whole country. It is hoped that this preliminary evaluation will trigger such an activity. With the advent of Geographic Information Systems and the systems approach to agricultural research and development as a whole, base-line informations on the natural resources become critical to implementation of any development project or the application of the recent information technology for practical farming purposes.

Uganda has a range of soil and climatic conditions that permit a wide range of agricultural activity. It has been one of the wealthier countries in the past but the recent turbulent times has created a situation which calls for a complete restructuring, particularly of the infrastructures needed to implement a sustainable and environmentally sound program. The MFAD project of USAID has already made a

tremendous impact in this direction and the Ministry of Agriculture has made significant progress.

Recent reports indicate that there is rampant degradation of the natural resource base. There are no reliable estimates of soil loss and other forms of soil degradation. However, as the mode has been a subsistence form of agriculture in the recent past, one can speculate that soil degradation has been extensive.

What are the short term and long term actions that can be undertaken to bring Uganda back to its past glory. A stability in the political environment will contribute immensely and will enable the targeting of well conceived land development programs. Institutional strengthening is perhaps the foremost issue and should be considered as the priority activity in any donor funded program. This is a long term activity but should be persued simultaneously to any short term operational activities. The strengthening is not only of the technicians but also the institutions themselves; Uganda should develop centers of excellence which can collaborate and receive inputs from the international community.

On the short term, one could recommend a whole range of donor supported activities which includes:

1. *Developing MLRA maps (1:100,000). This requires the establishment of a national soil survey organization and implementation of a systematic soil survey program.*

2. *Making and interpreting large scale (Farm level) maps (1:10,000). Extension service to the farmers would require this information.*

3. *Strengthening soil laboratories through interlaboratory cross-checks, development of analytical methodologies and junior staff training. This is an essential back-stopping service to the national soil survey program.*

4. *Training on soil survey, soil classification and management of soils. Provide an opportunity for scientists of the region to get together and exchange experience and information.*

5. *Use and application of geographical information systems (GIS) to store and retrieve resource information. Although the investment is high, the returns are much more cost-effective than the traditional soil survey activities.*

6. *Land evaluation and a land use database. This monitoring activity is essential to ascertain the progress of the agriculture sector.*

7. *Utilizing the soil resource information for sustainable agriculture. This must be the motivating force in any agricultural research and development programs.*

1. INTRODUCTION

Major Land Resource Areas (MLRAs) consist of geographically associated soils, the majority of which have broadly similar patterns of climate, water resources, and land uses. The ideal way to define MLRAs is to compile them from detailed maps of districts or counties. However, in Uganda as in many countries, such maps are not available, MLRA maps are compiled from all available information. The maps are generally at a scale of 1: 1,000,000. More detailed maps may be made if there is sufficient information. The present discussion only deals with the scale of 1:1,000,000.

If compiled at the same scale, map unit boundaries on MLRA maps coincide with those on general soil maps. In a few instances, general soil map units are subdivided into two or more land resource areas because of significant and mappable differences in factors such as water resources, which dictate different land uses.

This report deals with the MLRAs of Uganda. In the fifties and sixties, there was an active soil survey program in Uganda and a large amount of soils data and soil maps were generated. Since then such activities have declined, and in the eighties they ceased. Consequently, the MLRA map was generated using the older information. The authors did not have an opportunity to traverse the country to check the delineations and provide site-specific information. Until this is done, the current MLRA report and map must be viewed as a first approximation. The basic purpose of compiling this report is to provide a rapid resource appraisal with existing information and to serve as an example of how such assessments could be used for national planning.

2. CONCEPT OF MLRAs

MLRA maps are used at national levels:

1. as a basis for making decisions about agricultural issues;

2. as a framework for organizing and conducting resource conservation programs;

3. for geographic organization of research and conservation needs and the data from these activities;

4. for coordinating technical guides between states and districts of a nation and between countries;

5. for organizing, displaying, and using data in physical resource inventories, and

6. to aggregate natural resource data.

MLRAs are most important for agricultural planning and have value for interstate, regional, and national planning.

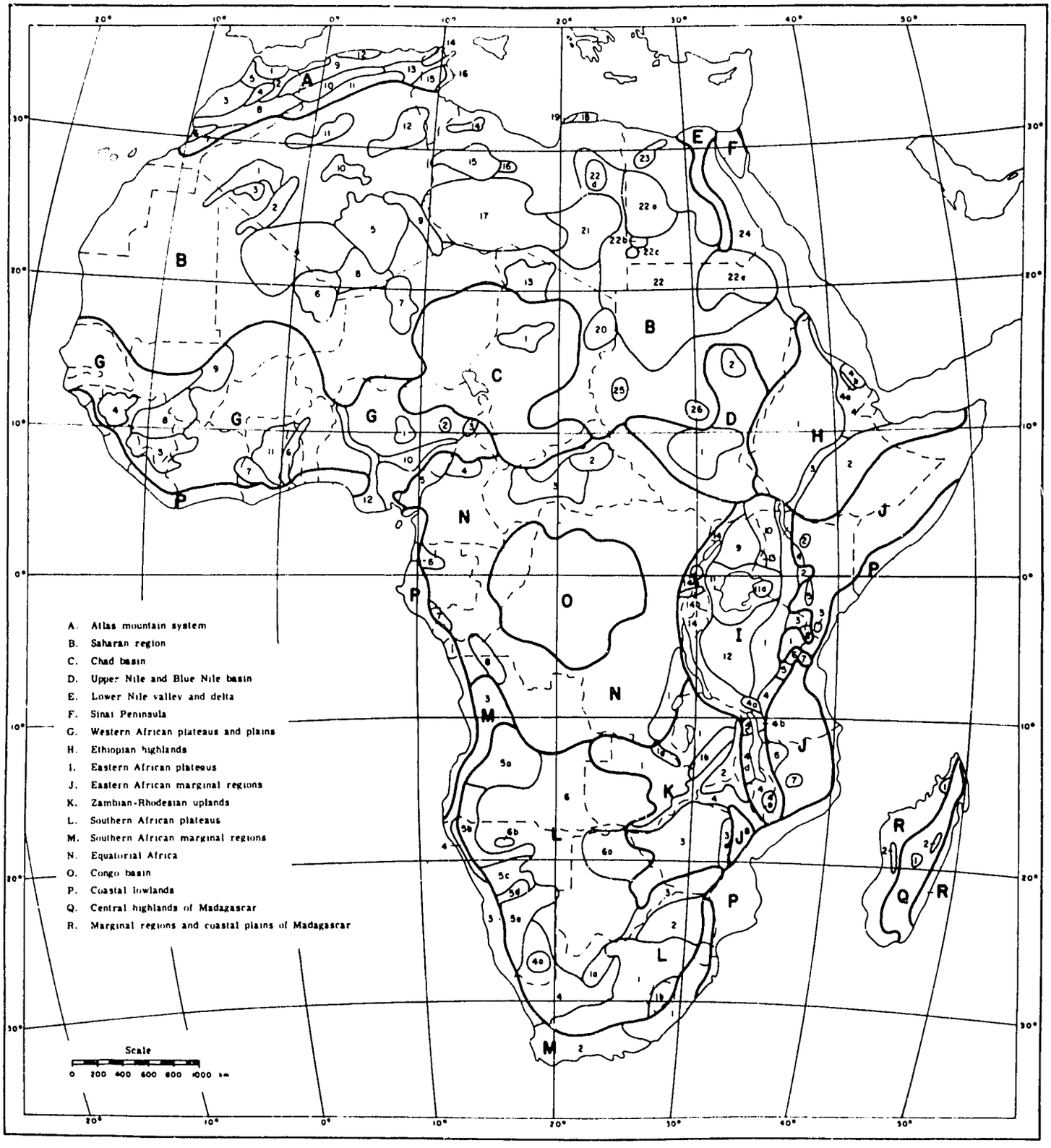


Fig. 1. Major Land Resource Areas (MLRA) map of Africa

3. MLRAs OF AFRICA

3.1. Major geographical regions

The continent of Africa is divided into 18 major geographical regions (FAO, 1977) each with a number of subdivisions. The major regions as shown in Fig. 1, are as follows:

A. Atlas mountain system
B. Saharan region
C. Chad basin
D. Upper Nile and Blue Nile basin
E. Lower Nile valley and delta
F. Sinai Peninsula
G. Western African plateaus and plains
H. Ethiopian highlands
I. Eastern African Plateaus
J. Eastern African marginal regions
K. Zambian-Zimbabwian uplands
L. Southern African plateaus
M. Southern African marginal regions
N. Equatorial Africa
O. Congo basin
P. Coastal lowlands
Q. Central highlands of Madagascar
R. Madagascar coastal plains and marginal lands

For the purpose of developing a first draft of the MLRA of Africa, these geographical units will be used (Fig. 1). However, when MLRA maps at a more detailed scale (e.g., 1:1,000,000) are to be developed, the units must be refined. Uganda occupies Unit I, which is characterized by vast, nearly level plateaus. Unit I, in Fig. 1, is bordered by the Rift Valleys with steep escarpments and volcanoes. Several other subunits have been recognized by FAO and for Unit I these are:

I 1. Rift valley, lying between Lake Rudolf and Lake Malawi
I 2. Mountains of eastern rift, such as Mount Kenya
I 3. Aberdare range, Mt. Kilimanjaro and Mt. Meru
I 4. Southern highlands
I 5. Rubeho mountains
I 6. Unguru mountains
I 7. Uluguru mountains
I 8. Pare-Usumbara range
I 9. Karamoja plains *
I 10. Chemorongi, Suk, and Cherangami mountains *
I 11. Central plateau *
I 12. Victoria basin *
I 13. Mt. Elgon *

I 14. Western Rift valley *

* Geographic regions in Uganda

3.2. Soil moisture and temperature regimes of Africa

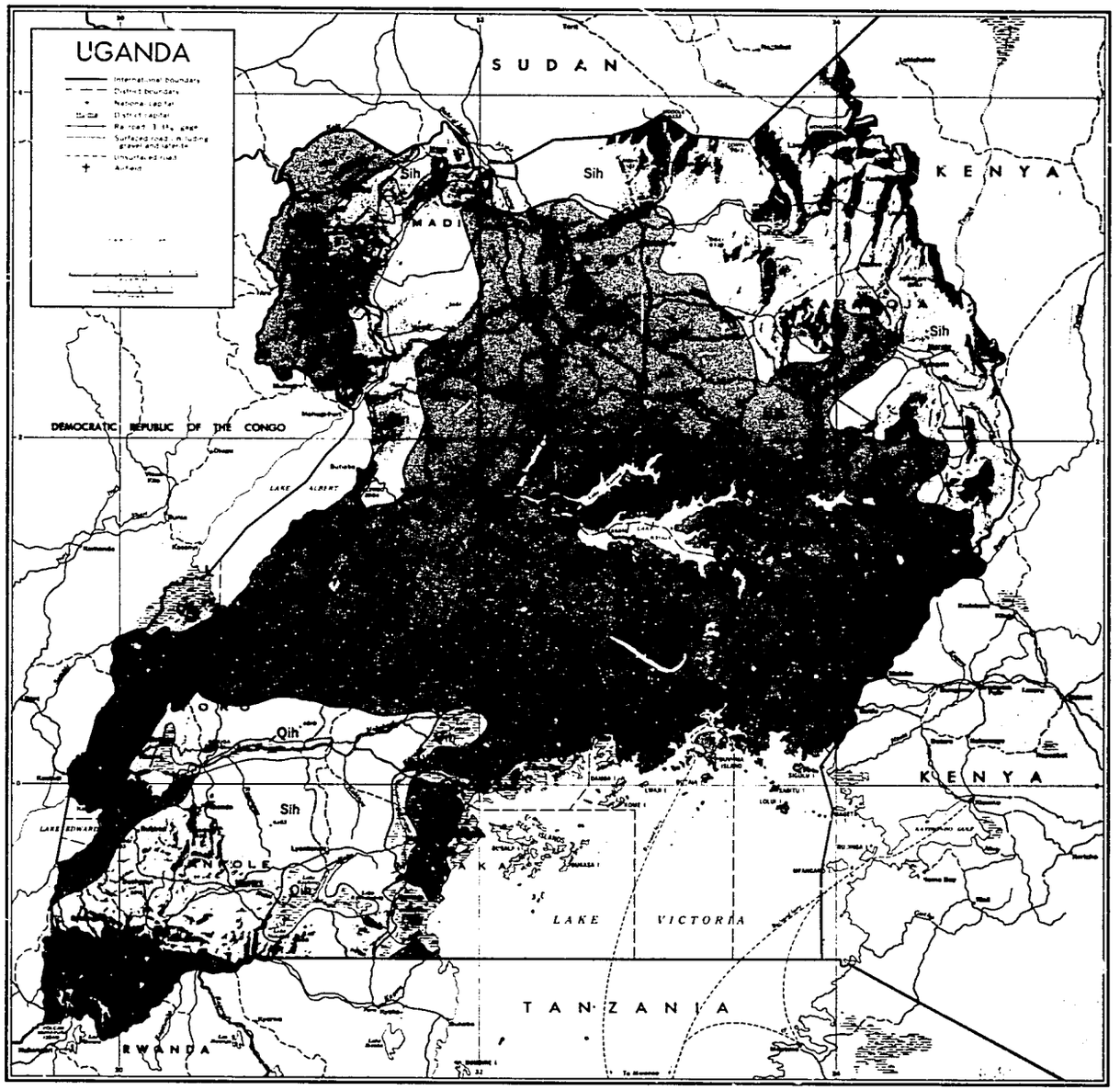
The soil moisture regimes (SMR) and temperature regimes (STR) of Africa have been documented by SMSS (Van Wambeke, 1982). Fig. 2, shows the distribution of SMRs and STRs in Africa. SMRs will not be used directly in the MLRA as the classification system of soils -- Soil Taxonomy -- incorporates them. Since STRs are only used at the family level in Soil Taxonomy, they will be included in the definition of the MLRA.

3.3. Soils of Africa

The Soil Management Support Services (SMSS) has developed a first draft of the generalized soil map of Africa, based on the FAO soil map of the world. Part 1 of the map is a translation of the FAO units into Soil Taxonomy terms and Part 2, evaluates the major soil constraints. (These maps are not available for distribution). The MLRA is defined by the dominant soil. A list of dominant soils, based on these maps, is given in Appendix 1.

U S DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



SOIL TEMPERATURE AND MOISTURE REGIMES

LEGEND

Soil Temperature	Soil Moisture
Iso Mesic	Udic
Isothermic	Udic
Isohyperthermic	Udic
Sih	Ustic
Isothermic	Aridic
Qih	Aquic

Fig. 2. Soil moisture and temperature regimes of Uganda

SOURCE: Soil Management Support Services
Map prepared by Soil Conservation Service

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4. MAJOR LAND RESOURCE AREA MAP (MLRA) OF UGANDA

The Major Land Resource Area (MLRA) map of Uganda is a generalized map that displays the combined characteristics of soil composition, soil temperature, soil moisture, slope, land use, and vegetation at a scale of 1:1,000,000. This map is based on available data and is suitable for general land use planning. The objective of the MLRA map is to reveal areas with potential land use problems and the development of general plans for large areas of land use. The degree to which the objective can be achieved is largely dependent on the quality of input data and the constraints imposed by the map scale.

Soils input data are for soil associations at suborder, great group, and subgroup levels in Soil Taxonomy based on field observations (limited to few small areas), soil characterization data, and estimates based on a Uganda soil map published at a scale of 1:1,500,000 (Harrop, 1970). Vegetation data were developed using field observation (limited to few small areas) and estimates based on a Ugandan vegetation map at a scale of 1:1,500,000 (Jameson, 1970).

Soil temperature and soil moisture were evaluated by the Newhall Model using data from Wernstedts World Climate Data and other sources. Calculations were made using a software developed by Dr. A. Van Wambeke, Cornell University, New York. Slope determinations were primarily made using ONC charts and other sources. The combination of natural resource factors produced 23 map units which are described later. Fig. 3, shows the MLRA map of Uganda.

4. 1. Soil Moisture and Temperature Regimes of Uganda

An excellent account of the climate of Uganda is given by Jameson and McCallum (1970). Figs. 4, 5 and 6, are taken from their paper and show the distribution of mean annual rainfall, mean minimum temperatures, and mean annual maximum temperatures. There is a general decrease of annual rainfall in a northerly and north easterly direction and as shown by Jameson and McCallum, the population distribution pattern generally follows this pattern (Fig. 7). The area around Gulu in the north and Kabale in the southwest have the highest precipitation. The driest area in the country is around the eastern banks of Lake Albert and an area from Mbende to Mbarra. The hilly areas bordering Kenya are also dry.

Because the country occupies a raised plateau, the temperatures are generally in the cool range (fig. 5, 6). There is a general decrease in temperature with elevation; this is seen on Mt. Elgon, in the Kabale region, and on the Ruwenzeri range.

4.11 Soil Moisture and temperature regimes

Atmospheric climate gives a good indication of the agricultural potentials of a country. Studies on probability of rainfall based on long term records have been the basis for evaluation of the land for agricultural purposes. Table 1, (Samani and Hargraves, 1987) shows such an assessment for two stations in Uganda. In all such studies, including the estimations of soil moisture and temperature regimes provided later, long term reliable records are essential and this is one of the major limitations in Uganda.

An assessment of rainfall by itself does not provide the complete information needed to evaluate the soil potentials of a country. Much of the rain may be lost through run-off as on steep lands or on soils with impermeable layers at shallow depths. Lands located at a foot-slope position receive run-on and are wetter than predicted by rainfall analyses. Soils vary in their ability to retain or hold water. Typical Oxisols, or the highly weathered soils of the tropics, may have a water holding capacity near zero, and some may even repel water. On the other hand, an organic matter rich soil such as a Mollisol, or an Alfisol may have a very high available water holding capacity (AWHC). The AWHC is an important parameter. It indicates the amount of water stored by a soil which could be used by plants during a subsequent dry period. In Gulu, for example, though the months of January and February are dry, if the rainfall in November and December are sufficient, the drought is not felt in the 'dry' months.

In Soil Taxonomy -- the U. S. system of soil classification -- the soil moisture and temperature regimes are considered soil properties. These properties can and should be monitored at benchmark sites for a long and continous period. In Uganda such measurements are not available and so a computer model developed by Franklin Newhall of the Soil Conservation Service and modified by Van Wambeke (1982)[1], is used to estimate soil moisture and temperature regimes from atmospheric data.

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1 The authors wish to acknowledge the use of the Soil Moisture Regime software, developed by Dr. A. Van Wambeke of Cornell University. All the computations in this paper were made with this software. (Van Wambeke, 1982. Africa Soil Moisture Regimes. Publ. Soil Management Support Services, Tech. Monograph No. 3.)

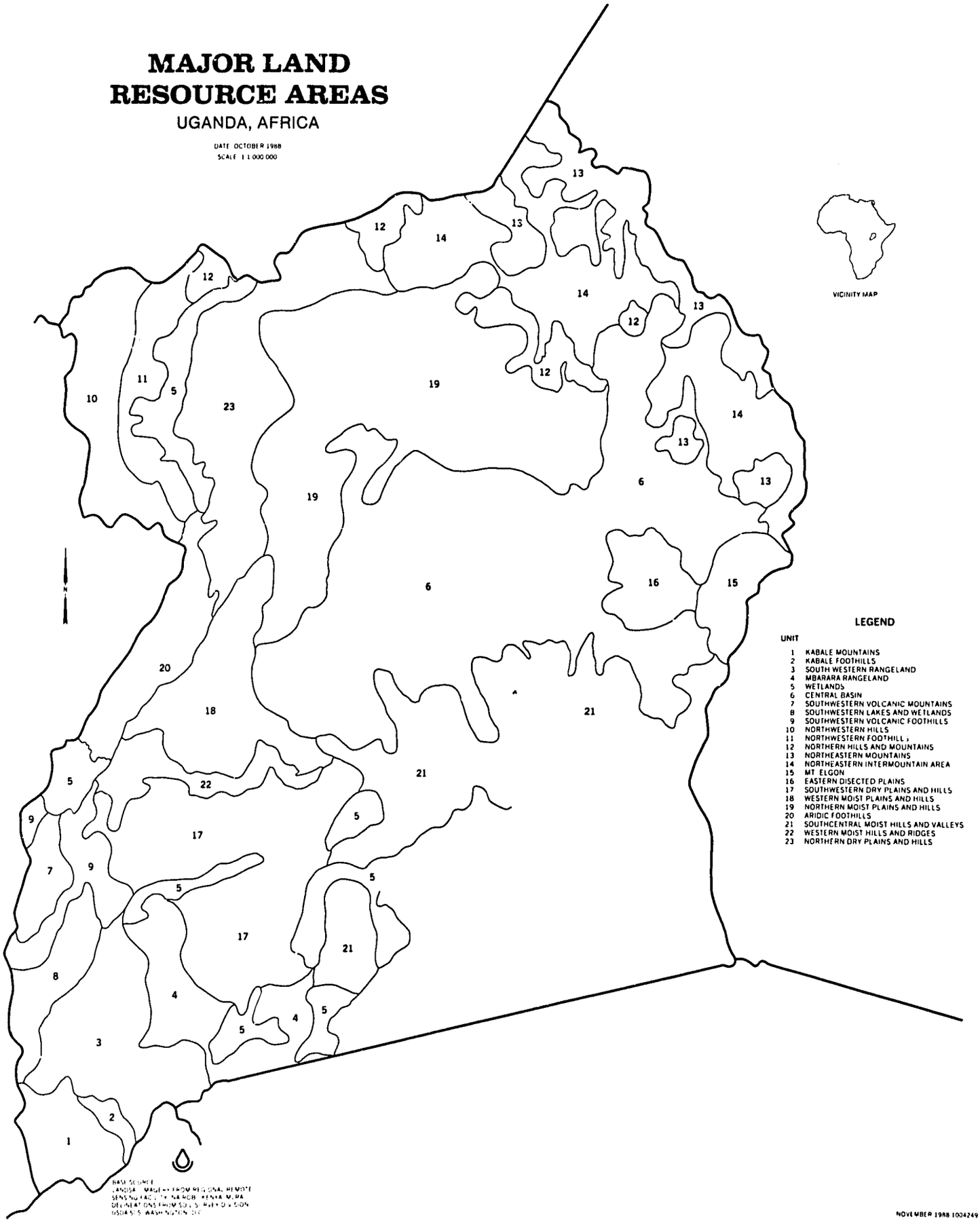


Fig. 3. Major Land Resource Areas (MLRA) of Uganda

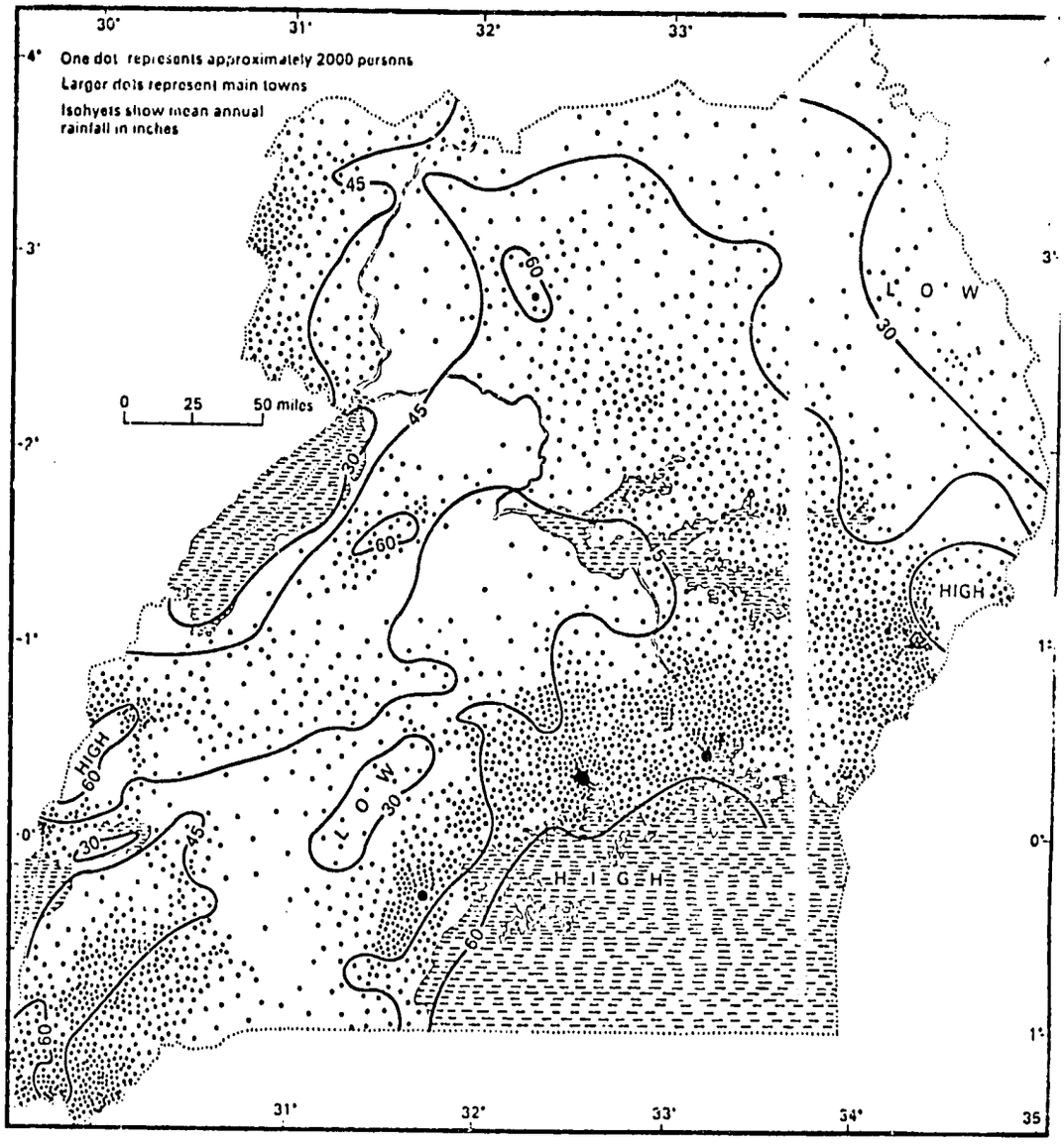


Fig. 4. Mean annual rainfall of Uganda

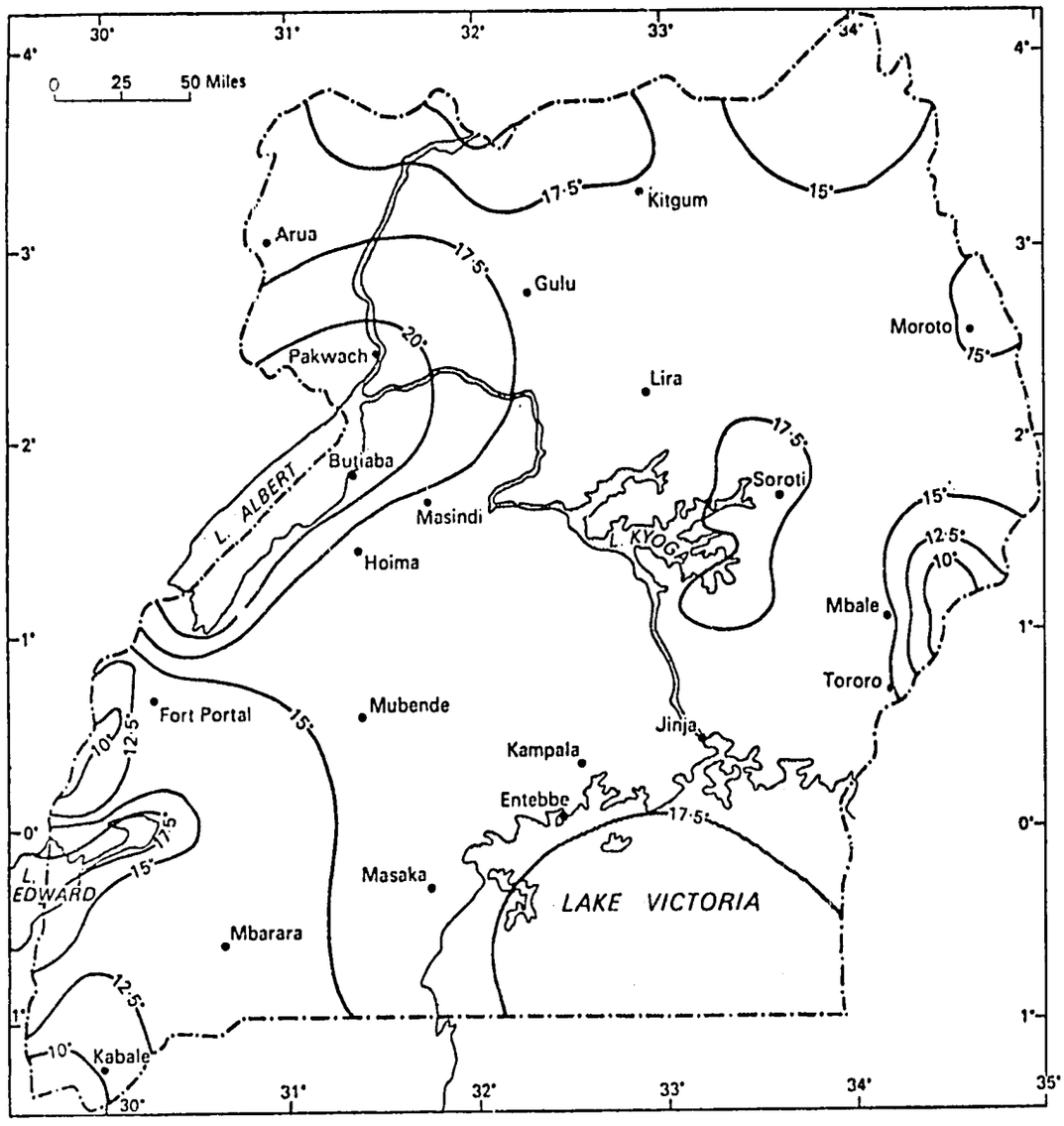


Fig. 5. Mean minimum temperatures (^{0}C) of Uganda

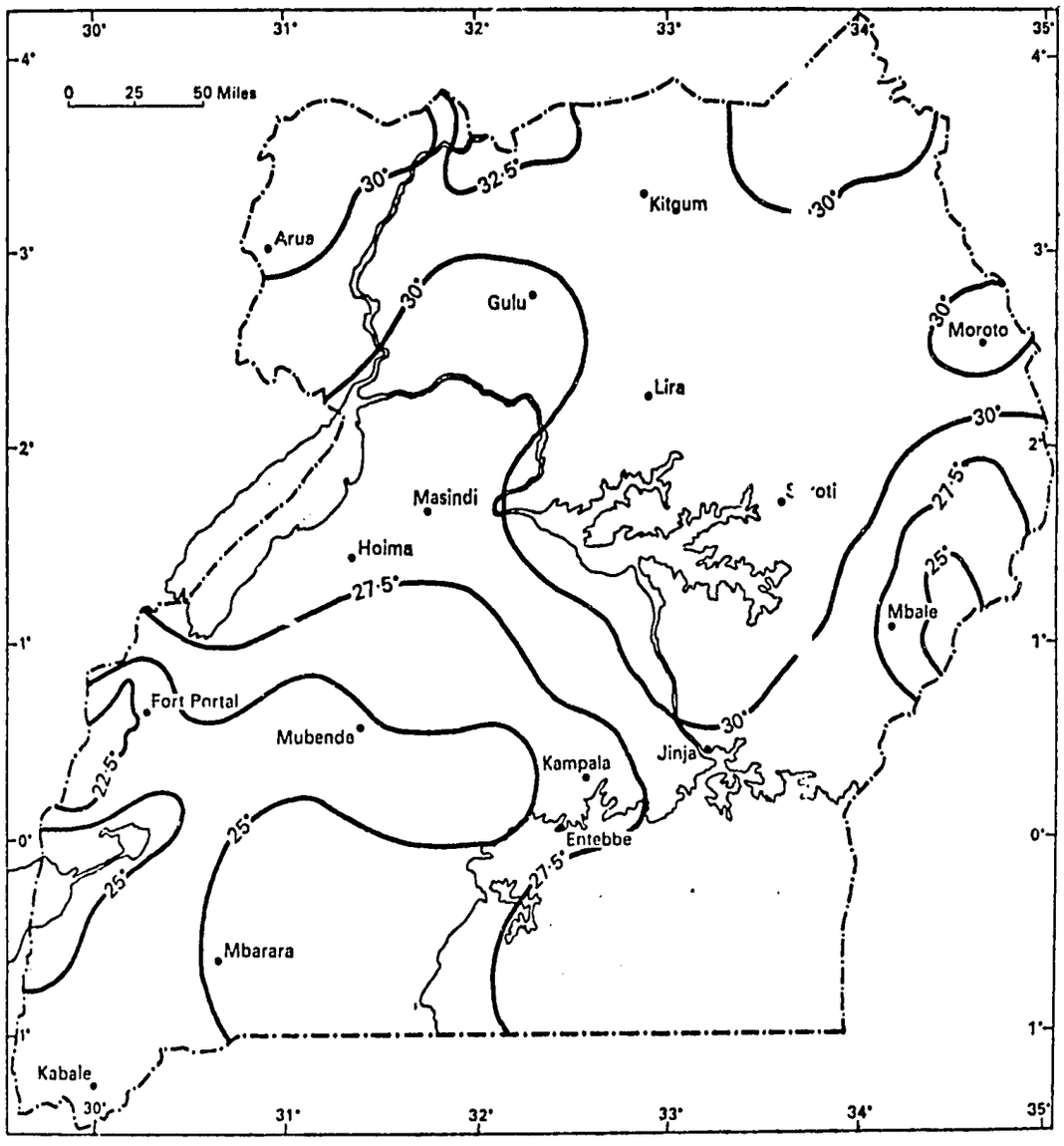
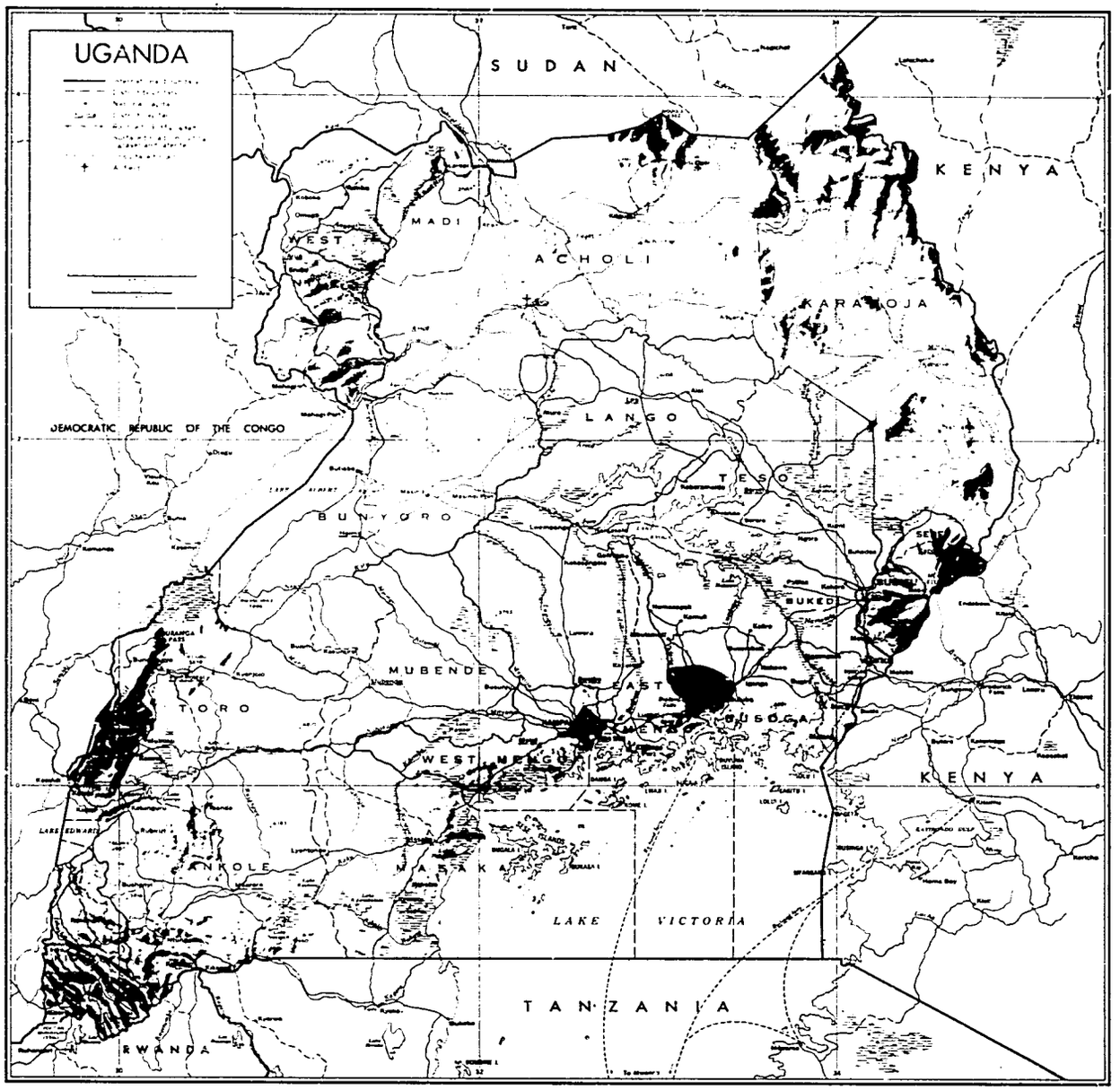


Fig. 6. Mean annual maximum temperatures (0C) of Uganda



POPULATION DENSITY BY DISTRICTS

Source: Census 1980

LEGEND

- Over 300
- 200 - 300
- 100 - 200
- 25 - 100
- Below 25/km2

SOURCE: United Nations Environment Programme
Global Environment Monitoring System and
Global Resource Information Database
Map prepared by Soil Conservation Service

Fig. 7. Population density distribution in Uganda

The results of the application of the models are given in Appendix II. There are many climatic stations with rainfall data but only afew have temperature data. Only those stations with both rainfall and temperature data were used in this study. The published data available provide the monthly means of several years observations. As indicated previously, it would be preferable to make annual assessments and make the evaluations on a probability basis.

The model estimates the moisture states of the soil. First if the soil is dry (a numeral 1 is used in the moisture calender), it means that the moisture control section is at a tension of more than 15 bars; at this moisture content, most plants cannot obtain water from the soil. If the soil moisture control section is moist (numeral 3), the control section is at a suction of less than 1/3 bar or the water is readily available to plants. A numeral 2 is used for the intermediate situation when the soil moisture control section is partly dry or partly moist.

The number of dry or partly dry/moist days is important and this is the major limitation to agriculture. The moisture calender developed for each station, shows the moisture status -- 3, 2, or 1 -- and such information can be used for irrigation scheduling, fertilizer application, general evaluation of the soils and of course for soil classification purposes.

Fig. 8 illustrates the annual variations for Gulu. The period, 1952 to 1954, is striking as there was a significant dry period in these years, particularly in 1953. In the moisture calendar for Gulu 53 (Appendix III), it is estimated that there were 51 dry days and 62 partly dry days in 1953. With long term data, the probability of such dry periods could be better estimated. With such information, planting of crops, such as cotton, could be better scheduled. The ten year data of Gulu presented in Appendix III illustrates another point made earlier. The rainfall data indicates that November and December are generally dry months as there is less than 75 mm of rain per month. However, the moisture calendar indicates that soil moisture is not a problem; there is sufficient stored moisture to supply the crop adequately. Moisture stress only starts in mid-January and February and only in less than four years out of ten.

Extended periods of soil moisture stress occur in many parts of Uganda (Appendix II and Fig. 2). Butiaba is the driest station encountered in this study. It has an estimated 196 dry days, 164 partly dry days and zero days when the entire soil moisture control section is moist -- the area has an 'aridic' soil moisture regime.

UGANDA

STATION ENTEBBE LAT 0 6 N LONG 32 30 E ELEV 1146.0 M 82 YEARS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TMAX	27.	27.	27.	26.	25.	25.	25.	25.	26.	26.	26.	26.
TMIN	17.	17.	18.	18.	18.	17.	16.	16.	17.	17.	17.	17.
ETP	133.	122.	134.	117.	112.	108.	114.	122.	129.	134.	122.	125.
TEMC	22.	22.	22.	22.	21.	21.	21.	21.	21.	22.	22.	21.
SDT	0.5	0.6	0.6	0.5	0.5	0.4	0.4	0.5	0.6	0.5	0.5	0.5
PM	74.	92.	163.	260.	248.	118.	76.	79.	76.	102.	145.	115.
RPAR	2.2	2.6	5.3	9.4	5.6	3.5	2.0	2.7	2.7	3.8	3.8	2.9
SDPM	49.	51.	67.	84.	106.	65.	47.	46.	44.	52.	73.	66.
RDAY	9.0	8.0	14.1	16.9	16.2	10.6	7.0	6.4	7.8	11.1	13.3	9.6
SDRD	4.9	3.2	3.1	3.4	3.2	3.7	3.2	2.3	3.2	3.5	5.0	3.6

STATION GULU/UGANDA LAT 2 48 N LONG 32 18 E ELEV 1105.0 M 26 YEARS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TMAX	32.	32.	31.	29.	28.	28.	27.	27.	28.	29.	30.	30.
TMIN	16.	17.	18.	18.	18.	17.	17.	17.	17.	17.	16.	16.
ETP	172.	162.	176.	149.	141.	130.	130.	139.	147.	156.	152.	158.
TEMC	24.	24.	24.	23.	23.	22.	22.	22.	22.	23.	23.	23.
SDT	0.8	0.8	0.8	0.6	0.7	0.6	0.4	0.5	0.4	0.4	0.5	0.7
PM	18.	36.	96.	184.	180.	150.	159.	230.	198.	195.	102.	40.
RPAR	0.5	0.8	3.5	10.6	9.8	8.6	7.6	10.8	3.9	13.5	3.1	0.7
SDPM	21.	31.	48.	64.	61.	56.	58.	70.	100.	59.	62.	38.
RDAY	2.3	4.6	8.6	14.8	15.5	12.6	13.7	16.5	16.1	18.2	11.0	4.5
SDRD	3.2	2.6	2.1	2.9	4.1	2.8	3.5	3.6	4.7	3.1	4.9	3.2

Table 1. Moisture balance evaluations for two stations in Uganda (Samani and Hargraves, 1987)

Fig. 2 is the soil moisture and temperature map of Uganda. The units employed in the legend are explained below:

1. Udic-isomesic: This is in the high mountain area of Mt. Elgon. The isomesic soil temperature regime indicates that the mean annual soil temperature is between 8-15 ^{o}C; the lower slopes have an isothermic (15-22 ^{o}C) soil temperature regime. The soil moisture regime is udic due to the high rainfall in the area. The steep slopes are the major limitation to land use and the area would be better under forest.

2. Udic-isothermic: This unit occurs in the south of the country, around Kabale and on the western volcanic area. Again, slopes are the major limitation. The area already has a high population pressure and soil conservation is a major concern. The soil moisture and temperature regimes suggest that the area is suitable for many temperate crops such as potatoes.

3. Udic-isohyperthermic: the mean annual soil temperature is more than 22 ^{o}C and this unit occupies the largest area in the countruy. This is the fertile crescent of the country and has a high population density. Both the temperature and moisture are suitable for a range of tropical and subtropical crops, particularly export oriented crops such as coffee and cocoa. There is a probability of moisture stress for about two months in two out of ten years.

4. Ustic-isohyperthermic: ustic signifies an important dry period and the need for supplemental irrigation during this period. However, the soil moisture and temperature regimes indicate suitable conditions for cotton, sugar-cane, and cassava. Kitgum is an example of an area with an ustic-isohyperthermic condition and the data (Appendix II) show that the soils have about 53 days of dry period and 75 days of partly dry conditions. The moist period is about 232 days and this is sufficiently long for most crops. The dry period begins about the beginning of January and continues until about the middle of May.

5. Aridic-isohyperthermic: the eastern coast of Lake Albert is the driest part of the country. This unit is delineated separately despite the fact that there is only one station for which data were available. Butiaba has a rainfall of 763 mm, but the high temperature results in high evapo-

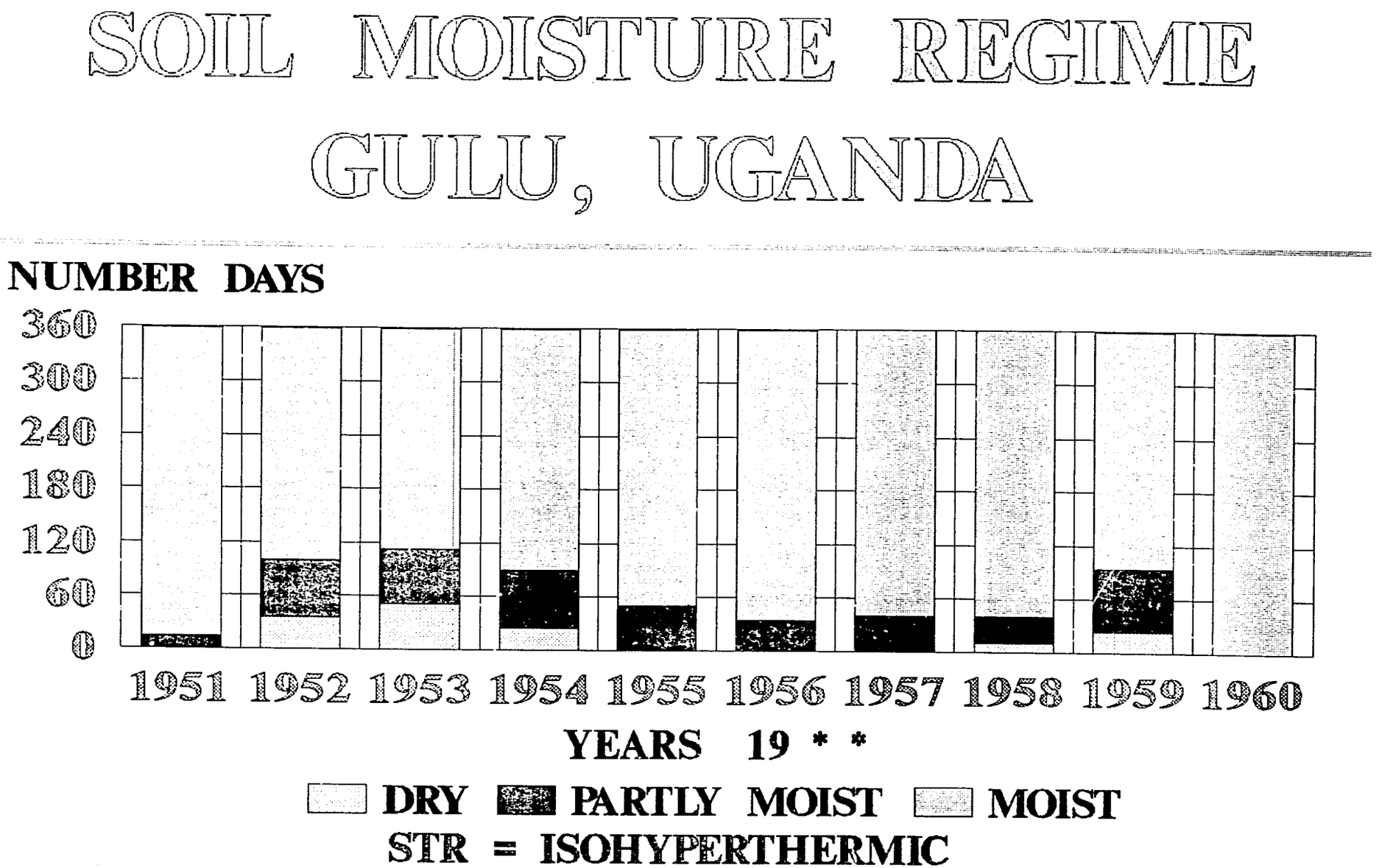


Fig. 8. SMR variations in Gulu, Uganda

transpiration. Irrigation is needed for any form of agriculture in this area.

6. Aquic-isohyperthermic: These are the wet areas or the swampy lands. They are potential rice growing areas of the country. They are also fragile ecosystems and it would be preferable that they remain as wetlands.

4.2. Vegetation

An excellent account of vegetation of Uganda is given by Langdale-Brown (in Jameson, 1970). The range of soil moisture and temperature regimes prevailing in Uganda results in a variety of plant species. In recent times, the spectrum of vegetation has being reduced due to over-grazing and other anthropic influence, particularly deforestation and harvesting for fuel-wood. The vegetation ranges from sub-alpine forests to humid tropical vegetation interspersed with savannah, bamboo, and wetland vegetation types. Within an ecological zone determined by climate, vegetation type variations result from differences in soils and slopes.

Langdale-Brown (loc cit) recognize nineteen vegetation types:

1. High Montane Moorland
2. High Montane Heath
3. Moist Montane Forest

-- The above three vegetation types occur at elevations of more than 2,500 m where the STR is isomesic or cooler. The SMR is generally udic and there is a slow change in vegetation types up to the tree line. The low temperatures and high moisture promote accumulation of peat which supports the High montane heath type of vegetation.

4. Dry Montane Forest
5. Medium Altitude Moist Evergreen Forest
6. Medium Altitude Moist Semi-deciduous Forest
7. Swamp Forest

-- The forest types are confined to the udic SMRs (Fig. 2,) where the rainfall is more than about 1500 mm. Even in these areas, there are dry spell which though short, affect growth. Forests in Uganada have suffered a severe toll from indiscriminate deforestation. Langdale-Brown[2] estimated the

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2 The vegetation of Uganda. Memoirs, Dept. of Agriculture, Uganda, unpublished.

extent of the forest cover during different periods as shown in Table 2.

Year	Area Km^2	% Total Land
1900	30,901	12.1
1926	26,277	10.8
1958	11,176	4.6

Table 2. Deforestation in Uganda

A more recent study reported by Global Environmental Monitoring System (GEMS, 1987) of the United Nationas Environment Program, based on satellite imagery (significant areas were masked by cloud cover) also shows this dramatic change in forest cover. The study was made with imagery of 1973 and 1986, and during the 13 year period marked changes, particularly in the Mt. Elgon area, could be observed. There is an urgent need to make a more accurate assessment and, at the same time, develop a massive reforestation program in the country.

8. Forest-Savannah Mosaic
9. Woodland
10. Moist Acacia Savanna
11. Combretum Savanna
12. Butyrospermum Savanna
13. Mixed Savanna
14. Dry Acacia Savanna
16. Thicket
17. Tree and Shrub Steppe
18. Grass Steppe

-- The savanna ecosystems are by far the most extensive and the vegetation types are strongly influenced by the length of the dry season and the soils. The driest area is west of Lake Albert in the Bunyoro region. The thicket vegetation occurs here and characterizes a succession grading towards more desertic types of vegetation. The tree and shrub vegetation types, on the other hand, show the transition from a udic to a ustic SMR and are best expressed on the Vertisols in the Karamoja area. From the Karamoja area and moving westwards into Acholi and Lango, the dry period increases and the vegetation is characterised by the grass steppe type.

19. Swamp

-- The swamps are one of the most fragile resources of Uganda and the largest extent is in the central part of the country, around Lake Kyoga and the banks of Lake Victoria. Water-logged areas also occur at higher elevations (1,500 to 2,000 m) and are characterized by Cyperus papyrus vegetation. Under such environments, acid sulfate soils (Sulfaquents) may be present and detailed soil surveys must be made prior to drainage of these areas.

The weeds occuring in the country have been recorded by Tiley (Jameson, 1970) but there is little documentation of weed succession during land cultivation. In the southern part of the country, there are areas of acid soils, and although *Chromolena odoratum* was not reported by Tiley it has been observed in Rwanda. This is an obnoxious weed and agriculturists must be alert to its invasion. Imperata cylinderica has been reported in Uganda, and this is normally an indication of soil degradation. In the semi arid areas, the occurence and spread of Eleusine africana and Striga asiatica must be monitored. The latter is a parasite living on roots of cereals and can cause considerable crop losses.

4.3. Soils

Much of Uganda is situated on a raised plateau between the Western and Eastern African Rifts. Most of the surfaces are old and may be as old as mid- to end Tertiary. The variety of parent materials, the elevation at which the soils occur and as a result the climatic environment, distinguishes these soils from those on the lowlands of Africa. The Eastern African Plateau is a distinct geomorphological unit and in Fig. 3, is recognized as one of the MLRAs of Africa. Very little detailed information is known about this MLRA and a more detailed study is warranted as it has no equivalent in any other part of the world.

Harrop (in Jameson, 1970) has documented all the information about the soils as was known up to that period and very little additional information has been collated since then. In the current study, detailed soil investigations were conducted around Kampala and this is reported later. As the criteria and terminology employed during the early days are different from those currently used, translating the early information is fraught with difficulties. However, it must also be noted that Uganda serves as a historical source of soils data since some of the earliest and best information on soils of the tropics emerged from here through the works of Milne, Ollier, and others. Milne (1935) developed his

concept of Catena during his work in the East African region. Ollier (1959) crystallized his concepts of 'two-cycle theory of weathering' from his work here and in other parts of Africa.

Harrop (1970) recognized 18 geomorphic units and an attempt will be made here to classify the soils on each of these surfaces according to Soil Taxonomy (Soil Survey Staff, 1975). The task is difficult due to the fact that though the geomorphic units are well described, the soils information is of insufficient detail. As an example, the dominant soil type is described as "Red sandy clay loams, or Dark-red clay loams occasionally laterized". Apart from the color and texture of the soil, little more could be said about their properties and consequently, their classification.

An approximation of the possible soils associated with the different geomorphic units is given below (the reader is referred to Harrop, 1970, for more information on the geomorphic units) and to Tukahirwa (1988) for information on the highlands of Uganda:

1. The upwarped Buganda surface (Ankole and Koki surfaces)
The unit is dissected with elevation ranges from 1,800 m to 2,400 m. The sloping plateaus are underlain by laterite. Due to the high elevation, organic matter is high in the soils except where they have been removed through erosion. The soils are generally Fine-loamy families of Palehumults, Paleustults, and Kandiustox, on the plateaus, and Haplustults and Ustropepts on the steeper slopes. The soils are generally acid, though aluminum toxicity is not expected to be a major limitation.

2. The Buganda surface and its dissected remnants

This unit occurs in two areas in the south; the first is around the town of Masaka and the large area is the surface on which Kampala is located. The surface is dissected and laterite outcrops may be seen along the dissected area. The three experimental stations, the soils of which were studied in detail, are located on this surface and detailed information on the soils is given later. In general, the soils have a high organic carbon content and the dark surface horizons may extend to more than 50 cm deep. The base saturation of the pedons studied is much higher than previously reported for these soils. In fact Harrop states, "they are for the most part acid in reaction". This is an illustration of some of the problems encountered in trying to evaluate the soils based on the older data. With the current data, the soils are Hapludolls, Eutrudox with locally Paleudalfs. The soils,

particularly the Oxisols have a low charge and the nutrient holding capacity of the soil is provided by the organic matter. Consequently, organic matter management becomes crucial to the use of the soils. The soils also fix phosphates and require a liberal supply of phosphates for optimal performance. As a rule of thumb, 10 Kg of P2O5 per percent clay per Ha on an annual basis would suffice for most annual crops. An initial booster dose of about 250 Kg of phosphorous would be very beneficial. Most other nutrients are adequate and the soils have few other adverse problems. Presence of lateritic gravel close to the surface would present problems.

3.Strongly dissected remnants of the Buganda surface

This geomorphic unit forms a border around Unit 2 and is characterized by stronger dissection. In many areas, the laterite is exposed or reworked into the soil, and many of the soils belong to loamy-skeletal families. Because of erosion, soils are shallower with plinthite occuring at depths of less than a meter. The soils are generally Tropohumults, Plinthudults and Hapludalfs.

4. Degraded Buganda surface dominated by a tor landscape

This is a highly dissected area located in central Mubende. Erosion has been extensive, exposing large granitic batholithics. The soils around the tors, are sandy or coarse loamy Hapludults and some Dystropepts. The organic matter content is much less compared to the previous units. Though the soils have an udic SMR, dry spells can have adverse effects on crops due to the sandy textures.

5. Resistant rock features associated with the degraded Buganda surface

The soils are shallow and skeletal and are generally Lithic Dystrochrepts and Hapludults. On the lower slopes, due to accumulation of wash materials, deeper and more loamy soils are found.

6. The Tanganyika surface and its dissected remnants

This surface occupies a large area between Kampala and Masindi in central and north Uganda. The surface is flat to gently undulating. Dissection is more recent giving rise to broad valleys, some of which may be swamps. The soil association is Hapludox, Kandiudox, and Hapludults, and Kandiudults, with coarse to fine loamy textures. Organic matter is slighter lower than on Unit 2 and much of the fertility of the soils

depends on this organic matter. The soils are also highly weathered with few weatherable minerals. Management of these soils requires heavy inputs of fertilizers. Supplementary irrigation is also needed during the short dry spells.

7. The upwarped Tanganyika surface and its dissected remnants.

This unit occupies a large area around the town of Mbarara and has a higher elevation than Unit 6 due to uplift. The soils are characterized by stone-lines and occasionally with plinthite. The soils are reported to be acid and are probably Tropohumults, Haplustults, Kandiustults, and Plinthustults.

8. The upwarped Tanganyika surface in West Nile

The geomorphic unit is located on the Zaire-Uganda border and is an uplifted plateau dipping northwards. The elevation is from 1,500 m in the south falling to 1,200 m in the northern border of Uganda. The Nile flow on the east of this plateau in a fault plane which is the continuation of Lake Albert. The rock is the Basement Complex composed of gneiss and migmatites and the soils developed on this rock ranges in color from dark red to reddish yellow. The soils are essentially Paleudults in the south and Tropudults, Tropohumults, and Kandiudults in the north. Erosion is more extensive in the northern part of the plateau. The soils have a low CEC and have high demands for P and K. Coffee can be grown in the southern part of the plateau but as the moisture stress increases northwards, grazing is perhaps the best use of the soils.

9. Ancient lake sediments overlying the Tanganyika surface

This unit occupies large areas bordering Lake Kyoga. The lake bed and the adjoining swamps have changed in area and shape during the uplift and so the sediments are not uniform but show considerable heterogeniety from place to place. In general, the textures are sandy to loamy and in many places, the soils are highly stratified. The pH of the soils also vary and range from acid to neutral. Although rainfall should be adequate, due to the coarse textures of the soil, moisture stress during parts of the year may be anticipated. The low clay content and relatively low amount of weatherable minerals, also implies low natural fertility. The soils are deficient in P and require most other nutrients.

10. The Karamoja plateau

In the northeastern part of the country, on the Uganda/Kenya border, an escarpment gives way to the Turkana plateau on the Kenyan side. Close to the escarpment is the Karamoja plateau which is undulating in the eastern part and flat in the western part. The western part has flat depressions characterised by the black clays and defining the next geomorphic unit (11). The soils are shallow sandy loams with admixtures of laterites. They are generally Haplustults and Ustochrepts. Climatically, the soils are suitable for cotton but from the soils and general landscape point of view, grazing may be a better proposition. The soils are highly erodible (Fig. 9, 10) and appropriate soil conservation measures must be planned prior to large scale use of the land.

12. Black clays on the Karamoja plateau.

Broad depressions in the plateau characterize the landscape and the soils are an association of black Usterts with Vertic Haplustalfs. Locally some planosols (Albaqualfs) may also be present. Many of the soils are calcareous but calcic horizons have not been reported. Harrop (1970) writes, "poor physical conditions largely offset any benefit from their high nutrient status". For low input agriculture, this problem would still remain but with introduction of low-cost machinery, workability of the soils becomes less of a problem. The long dry season is also a major limitation, but since there are sources of water, particularly in the southern part, irrigation is a viable option. Care has to be taken to provide adequate drainage facilities to reduce salinity build up in these heavy clay soils.

12. The degraded Tanganyika surface

This surface is located around Gulu and continues south-westwards parallel to Lake Albert. The uplifted surface is highly eroded and soils are skeletal or shallow. The major soils are Lithic members of Haplustalfs, Hapludalfs, and some Eutropepts. The land is highly dissected and should be put under forest.

13. The Acholi and other surfaces

This is a large area east of the Albert Nile and west of Gule. The surface is highly eroded, exposing rocks at several places. The surface textures of the soils are sandy to coarse loamy and the soils are Lithic Haplustalfs and Eutropepts. Organic matter enrichment is also poor and so the general fertility of the soils is low. The prevailing dry season also presents

limitations to use of the soil. Under natural vegetation, erosion is low; however, if the soils are cultivated erosivity is high as the rains come in few intense showers.

14. The Rift Valley

This region occupies the eastern part of Lake Albert and continues northwards into the Albert Nile Valley. Close to Lake Albert, the lacustrine deposits give way to red sandy or loamy soils. The area is the driest part of Uganda, particularly around Butiaba, which has a calculated aridic SMR. The dry season is long and moisture stress, accentuated by the low water holding capacity of the soils, is a major limitation. In the valley of the Albert Nile, the loamy soils are interspersed with heavy black clays giving to the classical situation of reddish Haplustalfs with black Vertisols. Some of the Vertisols are poorly drained and may qualify as Aquerts. This area is suitable for a range of crops. With the availability of water for irrigation, it has great potential. This could be one of the priority areas for development.

15. Volcanic mountains and hills and their pediments

This unit occurs in two areas; the larger area is around Mt. Elgon on the Kenyan border and the second area is on the south close to Kabale on the Rwanda border. As a function of elevation, slope, and proximity to the volcanoes, several different soils are anticipated. Close to the volcano and at high elevations, Udands predominate. At lower elevations and gentler slopes, these give way to Eutropepts and Humitropepts. At lower elevations, the soils become redder and Mollisols, Udalfs, and related soils are present. On Mt. Elgon, more recent eruptions have produced lava flows which are rocky or stony and the soils are Lithic Hapludands. These volcanic derived soils would require heavy doses of K and P for good crop performance.

16. Non-volcanic mountains and their pediments

The two main areas are the Ruwebzori range in Toro and the high granite masses in north Karamoja. The latter is related to the uplifted Turkana plateau. The SMR is ustic and so weathering is not intense resulting in shallow soils.

In both areas, organic matter accumulation is induced by the high elevation and low temperatures (the STR is isomesic). At 3,000 m on Ruwenzori, due to the isomesic STR and udic to perudic SMR, peat accumulation takes

SOIL EROSION

Rainfall Erosivity
(Modified Fournier - Index)

Monthly and Annual
Precipitation from
Atlas of Uganda 1967

LEGEND

- Below 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- Above 500

SOURCE: United Nations Environment Programme
Global Environment Monitoring System and
Global Resource Information Database
Map prepared by Soil Conservation Service

Fig. 9. Rainfall erosivity map of Uganda

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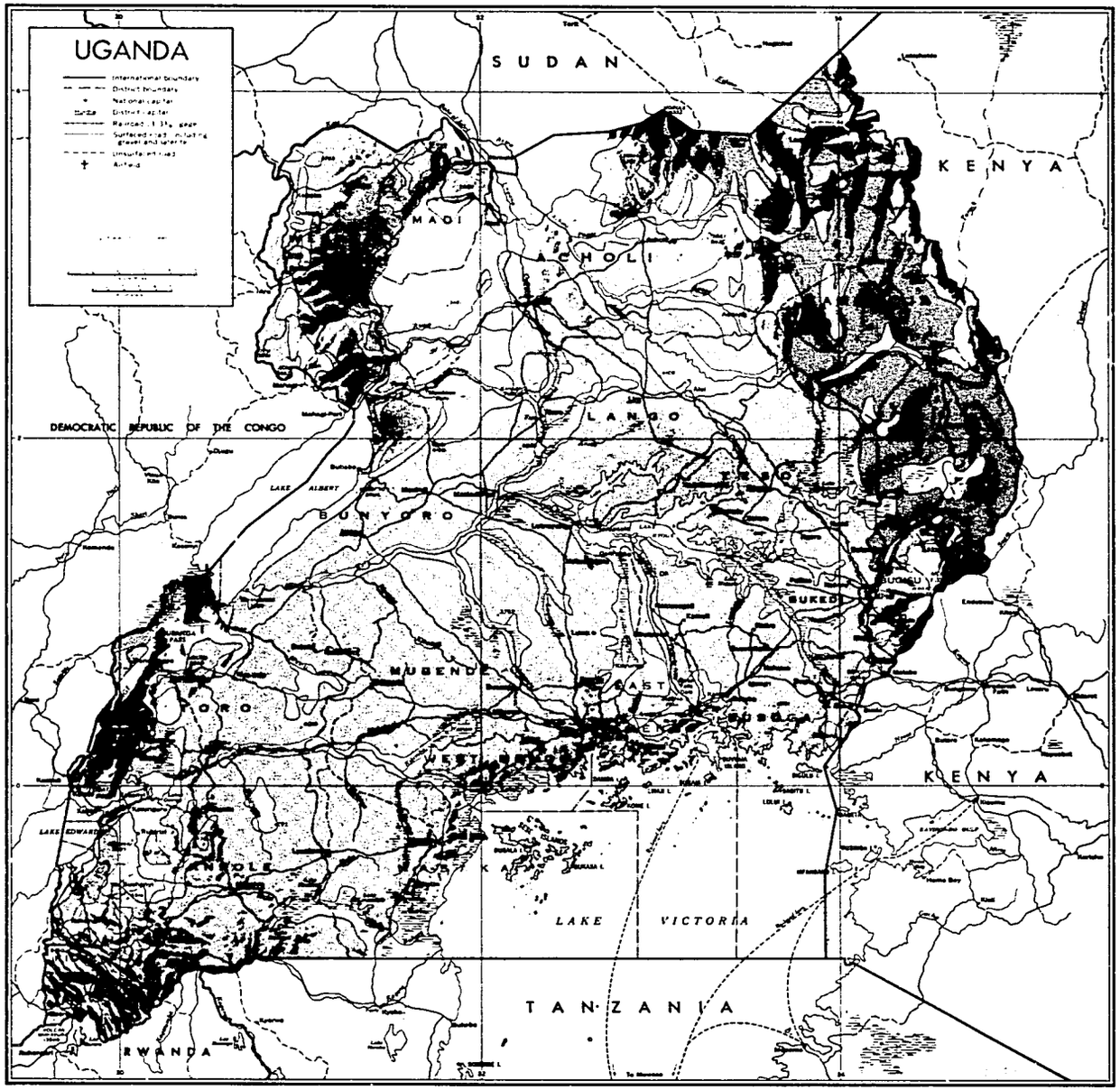

SOIL EROSION

Soil Erodibility

Source of Soil Map:
Atlas of Uganda

LEGEND

- Very Low
- Low
- Medium
- High

SOURCE United Nations Environment Programme
Global Environment Monitoring System
and Global Resource Information Database
Map prepared by Soil Conservation Service

Fig. 10. Soil erodibility map of Uganda

place even on steep slopes. The soils are Troposaprists associated with Haplohumods and Placorthods. At lower elevations, the soils grade to Haplohumults and Tropudults associated with Kandiudults. It would be advisable to keep all the land with the mountain peat under forest. On gentler slopes, tea and coffee are suitable crops but soil conservation is essential. On flatter lands, temperate crops such as potatoes, and horticultural crops may be grown if marketing facilities are developed.

17. Rift escarpments and associated features

This is a narrow band adjoining the Turkana surface on the north east of the country. The land is highly dissected and the soils are shallow and skeletal. The SMR is ustic and under such situations, the land should be under natural vegetation with minimum grazing.

18. Recent alluvial deposits outside the Rift Valley

The Tanganyika surfaces is dissected in many places with the formation of broad alluvial valleys. The textures of the soils depend on the source material. In many places, peat has accumulated or the wet soils have thick organic layers. A range of soils is possible and there is too great a variation to make any generalized statements. Rice cultivation may be recommended in some of the broader valleys but it is advisable to keep the narrow valleys in their natural state as they control the hydrology of the area.

4.4. MLRA Units of Uganda

Based on the assessment of the soil, landscape, climate, vegetation and water resources of the country, the Major Land Resource Areas (MLRAs) of Uganda were established. Fig. 2, shows the distribution of the MLRAs and the following are annotated descriptions of each of the Units:

Unit 1 Kabale Mountains

Physiography and Land Use: This unit consists of steep and very steep hills with incised streams and a number of small and medium sized lakes. Most of the area is in terraced cropland with a predominance of small farms. Cool season crops such as potatoes and cabbage are common and a variety of other vegetables and field crops are grown. Most of this area has native vegetation of grass savanna with some areas of medium altitude moist evergreen forest and thickets.

Elevation and Topography: Elevations range from about 1,830 m to 2,500 m. Residual and colluvial soils are on uplands with alluvium and marshes in lowlands and along streams. The lowlands are nearly level to gently sloping, the uplands are steep and very steep.

Climate: Average annual precipitation is about 1000 mm. Precipitation is relatively evenly distributed throughout the year, with June and July being the driest months. Average annual temperature is 17°C with June and July being the coolest months with an average temperature of 16°C.

Soils: The dominant soils are Haplohumults, Kandiudults and Sombrihumults. These soils are fine textured and have a thermic temperature regime and a udic moisture regime. Narrow ridges of sandstone outcrops are common on some very steep slopes. Hapludands are in a small area in the southern part of the unit, with Umbrepts at the very highest elevations. Areas of Aquepts and Saprists adjoin lakes in the area. Fluvents and Aquepts are on floodplains near streams.

Unit 2 Kabale Foothills

Physiography and Land Use: This unit consists of moderately steep and steep foothills adjoining the Kabale mountains. Most of the area is in cropland and rangeland with many small farms on the less sloping areas. Plantains and a variety of vegetable crops are grown. Steeper slopes are in grass and are used for rangeland. Vegetation is predominantly grass savanna.

Elevation and Topography: Elevations range from about 4800 to 1,830 m. Residual soils with rock outcrops and very stony areas are on steeper slopes in the uplands. Colluvial soils are at the base of hills and in sloping concave areas.

Climate: Average annual precipitation is about 950 mm and is evenly distributed throughout the year except for June and July which are the driest months. Average annual temperature is 19°C with the highest temperature in February and March with an average of 21°C.

Soils: The dominant soils are Kandiudults, Sombrihumults, and Lithic Dystrochrepts. These soils are medium and fine textured and have an isohyperthermic temperature regime and a udic moisture regime. Narrow ridges of sandstone outcrops are common on steep slopes. In the northwest part of the unit, Lithic Dystrochrepts predominate and rock outcrops are more frequent.

Fluvents and Aquepts are common on floodplains along streams.

Unit 3 South Western Rangeland

Physiography and Land Use: This unit consist of sloping and moderately steep areas of grassland broken by hilly and steep areas, especially in the northwestern part. Most of the area is in grassland but steep, hilly areas have limited vegetation or rock outcrops. Some nearly level and depressional areas have seasonal wetness, with mostly Acacia savanna vegetation. Most of the area is grass savanna.

Elevation and Topography: Elevations range from 1,500 m to 2,200 m. Residual soils with rock outcrops and shallow soils are on the steeper uplands. Residual and colluvial soils are on sloping and moderately steep areas.

Climate: Average annual precipitation is 907 mm with distinct dry periods from June through August, and in January and February. The average annual temperature is about 20°C with little fluctuation throughout the year.

Soils: The dominant soils are Kandiustults and Kandiustox in the sloping and moderately steep areas. Lithic Dystrochrepts are dominant in the hilly and steep areas, rock outcrops and very stony areas are common. Wet areas in the northcentral part are Aquepts and Aquents. These soils are medium and fine textured and have an isohyperthermic temperature regime and an ustic moisture regime except the Aquepts and Aquents which have an aquic moisture regime.

Unit 4 Mbarara Rangeland

Physiography and Land Use: This unit consists of sloping, hilly, and very steep areas with wet areas in concave positions and along streams. Most of these areas are in grassland and Acacia though the very steep areas have little vegetation. Most of this unit is used for rangeland. Drainageways, moist foot slopes, and floodplains are used for plantains and local crops. Swampy areas in the depressions are covered with papyrus and other wetland plants. A few of these areas are in small cropland fields. The dominant vegetation is dry Acacia savanna.

Elevation and Topography: Elevations range from 1,400 m to 1,700 m with towns and villages at lower elevations. Shallow, droughty, residual soils are on hills, ridges,

and very steep areas. Deep well drained residual soils are on footslopes and sloping areas. Wet soils and alluvial soils are in gentle depressions and along floodplains.

Climate: Average annual precipitation is 907 mm with distinct dry periods from June through August and again in January and February. The average annual temperature is about 20°C with little variation throughout the year.

Soils: The dominant soils are Kandiustults and Kandiustox in the sloping areas and foothills. Lithic Ustropepts are dominant in hilly and very steep areas and include rocky and very stony areas. Wet areas are commonly Aquents and Aquepts with Fluvents on floodplains near streams. The upland soils have an isohyperthermic temperature regime and an ustic moisture regime, Aquents and Aquepts have an aquic moisture regime.

Unit 5 Wetlands

Physiography and Land Use: This unit consists of lakes, marshes, swamps, and floodplains in small units scattered throughout the country. Vegetated areas have papyrus and other wetlands plants. Only small parts of these areas are used for cropland because of high water table, ponding, and flooding. Drainage systems for water control are impractical or expensive.

Elevation and Topography: Elevation ranges from 600 to 1,200 m mainly because of location in the landscape. Most of the area is nearly level or depressional, and some locations are gently sloping.

Climate: Precipitation ranges from 900 to 1300 mm depending on where the unit is located in the country. These units are wet or ponded much of the time due to run off from uplands. Average annual temperature ranges from 20 to 25°C.

Soils: The dominant soils are Saprists, Aquepts, Aquents, and Fluvents. Depressional areas that are wet or ponded much of the time have Saprists and Aquepts while Aquents and Fluvents are common in floodplains. Textures range from sandy to clayey with an isohyperthermic temperature regime and an aquic moisture regime. The Saprists have a moderately thick or thick layer of peat underlain by mineral soil. An area in the northwest includes Chromusterts and an area south of Lake Albert includes some Halaquepts.

Unit 6 Central Basin

Physiography and Land Use: This large unit consists of lakes, marshes, and flood plains with intricately dissected uplands with numerous drainage ways and small streams. Upland areas are cropped to cotton, plantains, and vegetables. Some portions of this unit have potential for water control structures to improve the agricultural potential, rice and sugarcane are crops that could be considered. Vegetation in the wettest areas is aquatic grassland and herb swamps, with wooded savanna in the drier components.

Elevation and Topography: Elevations range from 1,300 m in the east to 950 m in the west. Residual and colluvial soils are on uplands, alluvial soils on floodplains, and very poorly drained organic and mineral soils in the wettest areas.

Climate: Annual average precipitation is about 1350 mm with a dry period February through April. Average annual temperature ranges from 22 to 25oC with June to September being the coolest months.

Soils: Dominant soils of the uplands are Kandiudults and Kandiustox. These soils are fine textured and have an isohyperthermic temperature regime and udic bordering on ustic, moisture regime. The lowland areas are dominantly Aquepts and Aquents in the nearly level wet areas, saprists in depressional areas, and Fluvents and Aquents on floodplains near streams.

Unit 7 Southwestern Volcanic Mountains

Physiography and Land Use: This unit consists of steep and very steep volcanic mountains in the Ruwenzori range. Some areas have been cleared and are used for the production of coffee or vegetables. Most of the area is forested.

Elevation and Topography: Elevations range from 1,500 to 5,100 m with towns located in the foothills. High elevation organic rich soils are at the highest elevations with residual and colluvial mineral soils at lower elevations.

Climate: Average annual precipitation is about 1500 mm evenly distributed through the year, although the driest month is January. Average annual temperature is 19oC with the coolest months dropping to 18oC.

Soils: Dominant soils at the highest elevations are Umbrepts, Udolls, and Udands. These medium and fine textured soils have an isothermic temperature regime and an udic moisture regime. Soils of the lower elevations are dominated by Hapludalfs and Kandiudalfs and have similar textures, and temperature and moisture regimes.

Unit 8 Southwestern Lakes and Wetlands

Physiography and Land Use: This unit consists of swamps, floodplains, and low foothills near Lake Edward and Lake George. Most of the area is forested but there are small areas of tea and coffee produced in the foothills. Some areas are in native crops and vegetables.

Elevation and Topography: Elevations range 900 to 1,100 m with the highest elevations in the foothills. Soils developed in residuum, colluvium, and volcanic ash are in the foothills. Swamps, marshes, and floodplains are on the lowlands.

Climate: Average annual precipitation is about 800 mm with a dry period in December and January. Average annual temperature is about 19oC with a 1.3oC difference between summer and winter.

Soils: The dominant soils in the upland areas are Hapludands, Eutropepts, and Hapludults. They are medium and fine textured with an isohyperthermic temperature regime and an udic moisture regime. The lowland soils are dominantly Aquepts, Aquents, and Fluvents with small areas of Saprists. The mineral soils have an isohyperthermic temperature regime and aquic moisture regime.

Unit 9 Southwestern Volcanic Foothills

Physiography and Land Use: This unit consists of moderately steep foothills associated with the Ruwenzori mountains. Some areas are cleared and are used for coffee, tea, and vegetable crops. Some areas are covered with medium altitude moist evergreen and semideciduous forest; moist areas are in mixed forest and Savanna.

Elevation and Topography: Elevations range from 4000 to 1,700 m. Soils developed in volcanic ash adjoin the mountain range. Residual and colluvial soils are on nearby hilly areas.

Climate: Average annual precipitation is 1474 mm with a dry period in December and January. Average annual temperature is about 19oC with the winter months about 1oC cooler.

Soils: The dominant soils adjoining the mountains are Hapludands, Eutropepts, and Hapludults. They are medium and fine textured with an isohyperthermic temperature and an udic moisture regime. Near by hilly areas consist of Kandiudults, Kandiudox, and Lithic Dystrochrepts. The Lithic Dystrochrepts are on ridge crests and steep slopes with the Kandiudults and Kandiustox on more gentle slopes.

Unit 10 Northwestern Hills

Physiography and Land Use: This unit consists of a moderately steep, hilly area in the northwestern part of Uganda. Coffee, tobacco, and vegetables are common crops in cultivated areas. Vegetation is mixed Savanna, grass Savanna, and forested Savanna. There is some lowland bamboo and fan palms.

Elevation and Topography: Elevations range from 1,200 to 1,900 m with the highest elevations at the Zaire border sloping east toward the Albert Nile. Shallow residual soils are on ridge tops and hills with residual and colluvial soils on the side slopes of ridges and between hills.

Climate: Average annual precipitation is 1403 mm with a dry period from December to February. The average annual temperature is about 22.5 oC. The warmest period is January through March and the coolest period is June through September.

Soils: The dominant soils on ridges and hills are Lithic Dystrochrepts. Soils on the side slopes of ridges and between hills are Kandiudults and Kandiustox. These medium and fine textured soils have an isohyperthermic temperature regime and an udic moisture regime.

Unit 11 Northwestern Foothills

Physiography and Land Use: This unit consists of rolling and hilly foothills dissected by streams. Cotton is grown in some areas and native vegetables are common. Native vegetation is mixed savanna.

Elevation and Topography: Elevations range from 900 to 1,200 m sloping from West to East. Residual soils are common in uplands and colluvial soils are on

footslopes, concave areas, and associated with drainageways.

Climate: Average annual precipitation is 1322 mm with a distinct dry period from December through March. The average temperature is about 25oC, the warmest month is February with a temperature of 27.1 oC.

Soils: The dominant soils are Kandiustults and Kandiustox in the uplands, with Fluvents, Aquents, and Aquepts along streams and in wet areas. The upland soils have an isohyperthermic temperature regime and an ustic moisture regime. Soils in the lowland areas have an aquic moisture regime.

Unit 12 Northern Hills and Mountains

Physiography and Land Use: This unit consists of steep hills and mountains in the northern part of the country. Most of these areas are covered with Acacia and wooded savanna and are used for extensive grazing.

Elevation and topography: Elevations range from 900 m to 2,000 m. Residual soils are on the top and side slopes of hills and mountains with colluvium on footslopes and associated with drainageways.

Climate: Average annual precipitation is 1262 mm with a distinct dry period from November to March. The driest month is January with 7.1 mm precipitation. The average annual temperature is 24.5 oC with the coolest period from June through September.

Soils: The dominant soils of the mountains are Lithic Ustropepts with Kandiustults and Kandiustox on footslopes and intermountain areas. These soils have medium and fine textures, an isohyperthermic temperature regime and an ustic moisture regime.

Unit 13 Northwestern Mountains

Physiography and Land Use: This unit consists of steep mountains and hills in the Northwestern part of the country. Most of the area is covered with Acacia and grass, and is used for extensive grazing.

Elevation and Topography: Elevations range from 1,500 m to 3,000 m. Residual soils are common in the mountains with colluvium on the foot slopes and associated with streams or drainageways.

Climate: The average annual precipitation is 750 mm with a rainy season from April through August. Average annual temperature is 22.5 oC with a cool period from June through August.

Soils: The dominant soils are Typic Ustropepts and Lithic Ustropepts. Other significant soils are Umbrepts at the highest elevations, Haplustands associated with volcanos and Ustalfs on footslopes. The soils have medium and fine textures, isohyperthermic temperature regimes and ustic moisture regimes.

Unit 14 Northwestern Intermountain Area

Physiography and Land Use: This unit consists of medium to large, gently sloping intermountain valleys. Most of the area is used for grazing. Native vegetation is Acacia tree and shrub steppe vegetation.

Elevation and Topography: Elevations range from 1,100 m to 1,200 m, with an intricate valley and stream pattern generally sloping to the west. Residual soils are on the nearly level and gently sloping broad flats; alluvium on flood plains associated with streams.

Climate: Precipitation is variable in this unit and ranges from 650 to 1075 mm with a distinct dry period from November to February. The average annual temperature is 22.6 oC with the coolest period from June through September.

Soils: The dominant soils are Entic Chromusterts on nearly level areas with Ustropepts, Aquic Ustropepts, and Lithic Ustropepts on sloping or rolling areas associated with the plains. The Chromusterts have clayey textures, an isohyperthermic temperature regime and an ustic moisture regime. The Ustropepts have medium and fine textures and similar temperature and moisture regimes.

Unit 15 Mt Elgon

Physiography and Land Use: This unit consists of steep and very steep soils on Mt. Elgon. Coffee is a common crop at the lower elevations. Native vegetation is high montane grassland, heath, and forest.

Elevation and Topography: Elevations range from 1,500 m to 4,300 m. Residual soils are on uplands with colluvium in concave areas and associated with drainageways.

Climate: The annual precipitation is 1100 mm to 1500 mm with January through March being the driest months. The average annual temperature is 22 oC with a cool period from July through September.

Soils: The dominant soils are Umbrepts, Haplohumults, Udolls, Udands, and Kandiudults. The Umbrepts, Haplohumults, and Udands have been affected by volcanic ash. The soils vary as a function of the elevation. These soils have an isomesic temperature regime and a udic moisture regime.

Unit 16 Eastern Dissected Plains

Physiography and Land Use: This unit consists of gently sloping to rolling uplands dissected by numerous drainageways and flood plains. Much of the uplands is in cotton and vegetable crops. Alluvial soils have limited cropping and most are covered with papyrus and other wetland plants. Uplands are in wooded savanna.

Elevation and Topography: Elevations range from 3500 to 1,200 m sloping from West to East. Residual and colluvial soils are in uplands. Wet soils, mainly alluvium, are in drainageways.

Climate: Average annual precipitation is 1320 mm with January being the driest month. Average annual temperature is about 22 oC with the coolest period from July to September.

Soils: Dominant soils of the uplands are Kandiudults and Kandiudox. Aquents and Aquepts are in wet areas and on floodplains near streams. Upland soils are fine textured with an isohyperthermic temperature regime and an udic moisture regime. Aquents and Aquepts are coarse to fine textured with an aquic moisture regime.

Unit 17 South Western Dry Plains and Hills

Physiography and Land Use: This unit consists of gently sloping and hilly dry plains and low hills with dry Acacia savanna. Most of this area is used as extensive rangeland.

Elevation and Topography: Elevations range from 1,200 m to 1,500 m. Residual soils are on uplands with wet, seasonally ponded areas in depressions.

Climate: Average annual precipitation is 716 mm with a dry period from December through February. Average annual

temperature is about 20 oC with uniform temperature throughout the year.

Soils: Dominant soils are Kandiustults and Kandiustox with some Lithic Ustropepts on ridges and hills. Seasonally wet areas are commonly Aquepts and Aquents. These soils are medium and fine textured with an isohyperthermic temperature regime and an ustic moisture regime except Aquepts that have an aquic moisture regime.

Unit 18 Western Moist Plains and Hills

Physiography and Land Use: This unit consist of moist plains and hills in the western part of the country, most of the area is in rangeland but some areas in the North are in tobacco, cotton, and coffee and other areas are in the small farms. Native vegetation is wooded savanna.

Elevation and Topography: Elevation range from 1,000 m to 1,400 m. Residual soils are common on slopes with colluvium in concave areas and alluvium associated with streams.

Climate: Annual average precipitation is about 1288 mm with a dry period from December through February. The mean annual temperature is 23 oC with the hottest period in January through March.

Soils: Dominant soils are Kandiudults and Kandiudox. These soils have fine textures, an isohyperthermic temperature regimes and an udic moisture regimes. Soils in wet areas and floodplains are Aquents and Aquepts, with an aquic moisture regime.

Unit 19 Northern Moist Plains and Hills

Physiography and Land Use: This large unit consists of nearly level and gently sloping plains with numerous streams and small hills and ridges. Tobacco and cotton are common crops in the area. Native vegetation is woodland or wooded savanna.

Elevation and Topography: Elevations range from 2900 to 1,200 m. Residual soils are on uplands, with colluvium in concave areas and alluvium on floodplains near streams.

Climate: Precipitation ranges from 1109 to 1416 with a dry period from December through February. Average annual

temperature is 23 oC with the warmest period from January through March.

Soils: The dominant soils are Kandiudults and Kandiudox in the uplands with Lithic Dystrochrepts on hilltops and ridges. These soils are medium and fine textured with an an isohyperthermic temperature regime and an udic moisture regime. Aquents and Aquepts are in wet areas and on floodplains near streams. They have an aquic moisture regime.

Unit 20 Aridic Foothills

Physiography and Land Use: This unit is located in the foot hills adjoining Lake Albert. This area is too dry for most crops unless irrigation is used. Native vegetation is deciduous thicket and grass savanna.

Elevation and Topography: Elevations range from 700 m to 1,200 m with the lowest elevations at the lake shore. Residual and colluvial soils are in the uplands and some wet soils adjoin the lake.

Climate: The annual average precipitation is 763 mm with a distinct dry period from December through March. The average annual temperature is 25.5 oC with the hottest period from January through March.

Soils: The dominant soils are Camborthids and Haplorthids in the uplands, and Aquepts and Aquents in the wet areas adjoining Lake Albert. These soils are medium and fine textured with an an isohyperthermic temperature regime and an aridic moisture regime.

Unit 21 South Central Moist Hills and Valleys

Physiography and Land Use: This unit consists of hills and ridges highly dissected by streams and drainageways. Common crops are coffee, tea, cotton, and plantains. Small farms produce a wide variety of vegetables and sugarcane. Native vegetation is woodland with papyrus swamps.

Elevation and Topography: Elevations range from 1,150 m to 1,400 m. Moderately deep residual soils are on hilly crests with very deep residual soils on the side slopes. Alluvial soils are on floodplains and drainageways between hills or ridges.

Climate: Average annual precipitation is 1218 mm with slightly drier periods in June and July and in December

through February. The average annual temperature is 21.5oC. The cool months are June through August.

Soils: The dominant soils are Kandiudults and Kandiustox with a few areas of Kandiudalfs and Hapludalfs. These soils are fine textured and have an isohyperthermic temperature regime and a udic moisture regime. Aquents and Aquepts are on flood plains and in broad drainageways. They are coarse to fine textured and have an aquic moisture regime.

Unit 22 Western Moist Hills and Ridges

Physiography and Land Use: This unit consists of hills and ridges in the western part of the country. This steep and very steep area is predominantly in woodland or medium altitude moist semideciduous forest.

Elevation and Topography: Elevations range from 1,100 m to 1,400 m. Moderately deep residual soils are on crests with very deep residual soils on the side slopes. Alluvial soils are on floodplains and drainageways between hills or ridges.

Climate: Average annual precipitation is 1223 mm with dry period from December through February and also June and July. The average annual temperature is 20.5 oC with a mean summer-winter variation of 1.8 oC.

Soils: Dominant soils of the steep ridges and hills are Lithic Dystrochrepts. Kandiudults and Kandiudox are on foot slopes and less steep areas. These soils have medium and fine textures; an isohyperthermic temperature regime and an udic moisture regime.

Unit 23 Northern Dry Plains and Hills

Physiography and Land Use: This unit consists of dry plains and scattered hills with many streams with floodplains. Tobacco and cotton are major crops in addition to small farms, used for vegetable production. Native vegetation is wooded savanna.

Elevation and Topography: Elevations range from 900 m to 1,100 m with the highest elevation on hill tops. Residual soils have developed on gentle slopes with colluvium associated with hills and sloping areas. Alluvium is on floodplains near streams.

Climate: The average annual precipitation is 1262 mm with a dry period from November through March. The average

annual temperature is 24.5 oC, June through September is the coolest part of the year.

Soils: Dominant soils are Kandiustults and Kandiustox with Ustropepts on hills and areas of shallow soils. Aquepts and Aquents are in wet areas and on floodplains. The soils have medium and fine textures with an an isohyperthermic temperature regime and an ustic moisture regime.

5. UTILIZATION OF MLRA INFORMATION

This map (Fig. 2) provides a broad overview of Uganda and can be used for a variety of purposes. It can be used to determine the best areas of cropland in the country, kinds of crops suited to particular regions, provide information for achieving self sufficiency in most crops, indicate areas for production of both field crops and high value crops for export. The map is also useful to evaluate appropriate farming systems technology for sustainable agriculture. Finally, the map also provides guidance in program planning, i.e., needs for more intensive soil surveys in selected areas, laboratory data, and research.

Of primary concern is utilization of this map for cropland development. Those units that have a udic moisture regime have the best and probably, assured distribution of rainfall and where soils and slopes allow, have the best potential for adaptation to cropland development. Unit 21 and 16 represent areas with this potential.

Some areas have a rainy season and a dry season greater than 90 days. These areas have potential for crops that will produce yields during the wet period. Small grains such as sorghum, millet, or wheat have some potential as rainfed crops. Other options to consider are the use of irrigation where water sources can be developed on large tracts, especially where soils and slopes allow. Units 11, 17 and 23 are examples with dry periods and irrigation potential.

Areas with longer dry periods are predominantly in grassland, or mixtures of grass and acacia. Apart from the low rainfall, the amount and distribution is erratic, varying from year to year. For agricultural uses, irrigation is essential to ensure stable production. These areas have potential for rangeland. The best areas appear to be units 2, 3 and 4. Other units have limited potential due to slope, extensive accacia, and limited grass. Renovation and reseeding may not be feasible because of the high cost.

Mountainous areas tend to have cooler temperatures and adequate precipitation. Coffee and tea are commercial crops that can be grown on steeper slopes with appropriate soil conservation practices. Units 7 and 15 are examples of this kind of land use.

Some areas are a complex of moist hills and wet valley floodplains. The uplands have udic moisture regimes and are suited for common crops. The valleys have wet soils and wet flood plains that restrict crop choices. Rice and sugar cane appear to have potential with only small amounts of capital investment. Unit 21 represents this condition.

A large area in the central part of the country has extensive open water, marshes, and wetlands, with lesser amounts of uplands suited for croplands. Open water areas are best suited for fisheries development. Marshes and wetlands appear to be prohibitively expensive to develop into cropland and are best suited for wildlife. Units 5 and 6 are representative.

The northeastern part of country is a diverse area of hills, mountains, and wet clayey valleys. These areas have an ustic soil moisture regime and are suited for rangeland. However the wet clayey soils have potential for cotton and if irrigation is established, would be suitable for sugarcane. Units 12, 13, 14, represent the above conditions.

Regional development needs to be reviewed in relationship to current or planned infrastructure. Areas in the north and southwest have potential for development but transportation presents a problem for shipping large volumes of agricultural products to a market. The MLRA map of Uganda provides an overview of where the greatest agriculture potential is and for the need for improved transportation for agriculture products. Improved transportation to highly productive areas should be considered in relation to improving tourism in Uganda. Uganda has many scenic areas with interesting wildlife. With limited investment, a tourist industry could be developed bringing in significant foreign exchange.

A review of the MLRA map of Uganda indicates the need for more intensive soil surveys in those areas with the greatest potential for agricultural development. Soil maps at a scale of 1:100,000 to 1:250,000 using soil complexes and associations of series are helpful in planning the development of regions or provinces. However, soil surveys at 1:21,500 m or more detailed are necessary for planning development of specific areas for agriculture or relocation of people.

A review of the MLRA map of Uganda and the unit descriptions, especially the soil section will indicate the relative amounts of fertilizer needed for maximizing agricultural potential. Those soils classified as Kandiudox, Udands, or Kandiudults would be expected to fix large amounts of phosphorus. Those soils classified as Udalfs, Udolls, and Vertisols are generally more fertile and have lower requirements for lime and fertilizer.

5.1 Potential Crops

Table 3, lists some of the potential crops that would be related to the soil moisture and temperature regimes in Uganda. For a more rationale selection of crops, it is necessary to consider the soil conditions at the site, and also the socio-economic factors prevailing in the region. In the rural areas, distance to markets and marketing factors are usually as important determinants as the ability to produce and obtain high yields and high qualities.

Udic	Ustic	High Elevation
Vegetables	Sorghum	Coffee
Corn?	Millet	Tea
Soybeans		White potatoes
Plantains/	Rangeland	Vegetables
Bananas		
Potatoes		Wheat
Groundnuts		Barley
Rangeland	Irrigation	
Citrus		
Sunflower	Cotton	
Aquic		
Rice		
Sugarcane		
Pineapple		

Table 3. Crops as a function of soil moisture and temperature regimes

6. DETAILED STUDIES OF SOILS AROUND KAMPALA

6.1. INTRODUCTION

As part of this study, the soils of three agricultural experiment stations were surveyed in detail and representative soils were subjected to detailed characterization. The three stations are:

1. Kawanda Experimental Station
2. Namulonge Experimental Station
3. Kabanyolo Experimental Station

The three stations are located close to Kampala in a radius of about 20 Km. The following is an evaluation of the soils of the stations.

6.11. How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Through traverses across the area the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock, are observed and recorded. Many soil pits were dug to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, it is possible to develop a concept, or model, of how the soil were formed. Thus, during mapping, this model is used to predict, with considerable accuracy, the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, the boundaries between the soils must be established. As only a limited number of soil profiles is studied in detail, these observations, supplemented by an understanding of the soil-

landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and determine the boundaries.

The general characteristics of the soil profiles that were studied and recorded include soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that are employed identify soils. After describing the soils in the survey area and determining their properties, the soils are assigned to taxonomic classes (units). Taxonomic classes are concepts with each class having a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification employed is Soil Taxonomy (Soil Survey STaff, 1975) is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. Subsequent to characterization and classification of the soils, they were compared with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

Soil samples from the survey area were analysed at the laboratories of the Soil Conservation Service of USDA. The data from these analyses and tests, as well as the field-observed characteristics, are employed to interpret the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, one can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but one cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After the significant natural bodies of soil in the survey area are located and identified, the boundaries of these bodies are drawn on aerial photographs and each delineation is identified as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

6.12. Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they have a minimal affect on use and management. These are called nonconstrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

6.13. Detailed Soil Map Units

The map units, discussed later, on the detailed soil maps represent the soils in the survey area. The map unit

descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses.

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named. A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a soil series. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups. A soil complex consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. A soil association is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. An undifferentiated group is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them.

Most map units (table 4) include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soil in the map unit. The included soils are identified in each map unit description. Some small areas of strongly

contrasting soils are identified by a special symbol on the soil maps.

Map unit designation	Corresponding Pedon No.
1B - 3 to 8 percent slopes	008
1C - 8 to 12 percent slopes	002
2B - 3 to 8 percent slopes	003
2C - 8 to 12 percent slopes	
3B - 3 to 8 percent slopes	
3C - 8 to 20 percent slopes	001
4A - 0 to 3 percent slopes	
6A - 0 to 1 percent slopes	006
7B - 3 to 8 percent slopes	009
8C - 8 to 20 percent slopes	
9B - 3 to 8 percent slopes	007
13B - 3 to 8 percent slopes	005
23B - 3 to 8 percent slopes	004
23C - 8 to 15 percent slopes	
23D - 15 to 25 percent slopes	

Table 4. Map units in the survey areas.

6.2 SOIL SURVEY OF KAWANDA AGRICULTURAL RESEARCH STATION

6.21 Introduction

Kawanda Agricultural Research Station is located in south central Uganda about 13 kilometers northwest of Kampala, the capital of Uganda. The research station is in Kyaddonda county, West-Buganda district. Elevation ranges from 1,250 to 1,320 meters above sea level.

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The soils formed in residuum and colluvium from quartzite, gneiss, and schist on side slopes; from laterite (murram) on hilltops; and from alluvium in valleys.

Side slopes of hills are commonly used for cultivated crops. Hill crests are in coffee or are used for farm buildings. Depth to hardened laterite limits the use of these soils. Alluvial flood plains are cultivated in small patches but are not used extensively.

6.22. Soil Map units at Kawanda

The map units identified during the survey are:

1B - 3 to 8 percent slopes

This deep, well drained soil occurs in convex areas below ridge crests on the uplands. Slopes are dominantly 6 percent. The soil developed from schist and phyllite.

The surface layer typically is dark reddish brown, neutral clay loam 28 Cm thick. The subsoil is red neutral, clay loam to a depth of 175 Cm or more.

Included in this map unit are small areas where slopes exceed 8 percent. Also included are areas that are more than 5 percent murram gravel, especially near the adjoining map unit 2.

This soil has moderate fertility. Erosion is a moderate hazzard. The available water capacity is medium. Permeability is moderately rapid. This soil is well suited to cultivated crops. Crop rotation and proper use of crop residue help to reduce erosion. Application of fertilizer based on soil tests helps to improve productivity. Phosphorus fixation can be a problem on this soil.

1C - 8 to 12 percent slopes

This deep, well drained soil occurs in convex areas below ridge crests on uplands. Slopes are dominantly 9 or 10 percent. The soil developed from schist and phyllite.

The surface layer is typically dark reddish brown, neutral clay loam 25 cm thick. The subsoil is red, neutral clay loam to a depth of 175 cm or more.

Included in this map unit are small areas where slopes are less than 8 percent. Also included are small areas that are more than 5 percent murram gravel.

This soil has moderate fertility. Erosion is a severe hazzard. The available water capacity is medium. Permeability is moderately rapid. This soil is well suited to cultivated crops. Conservation practices such as crop rotation and proper use of crop residues help to reduce erosion. The length of time that the soil is bare should be reduced by the use of a cover crop or crop residue mulch. Application of fertilizer based on soil tests helps to maintain productivity. Phosphorus fixation can be a problem on this soil.

2B - 3 to 8 percent slopes

This deep, well drained soil occurs on ridge crests and upper flanks or ridges on uplands. Slopes are dominantly 4 percent. The soil developed from hardened laterite.

The surface layer is typically dark reddish brown, neutral very gravelly loam 40 cm thick. The subsoil is red, neutral extremely gravelly sandy clay loam. Hardened laterite is at a depth of 40 to 152 cm.

Included in this map unit are small areas where hardened laterite is at a depth of less than 100 cm and some areas where hardened laterite is at a depth of more than 152 cm. Areas adjoining map unit 1 have less murram gravel in the profile.

This soil has moderate fertility. Erosion is a slight hazard. The available water capacity is low. Phosphorus fixation may be a problem for some crops. This soil is well suited to perennial crops. Tillage is limited by large areas of murram gravel, and some deep-rooted crops are limited where the soil is shallow over hardened laterite. Perennial crops with ground cover will reduce erosion and improve organic matter levels in the soil. Application of fertilizer based on soil tests improve productivity. Coffee could be an important crop.

2C - 8 to 12 percent slopes

This deep, well drained soil occurs on the flanks of ridges on the uplands. Slopes are dominantly 9 percent. The soil developed from hardened laterite.

The surface layer is typically dark reddish brown, neutral gravelly loam 25 cm thick. The subsoil is red, neutral extremely gravelly sandy clay loam. Hardened laterite is at a depth of 40 to 152 cm.

Included in this map unit are small areas where hardened laterite is at a depth of more than 152 cm.

Areas adjoining map unit 1 have less gravel in the soil and are less sloping.

This soil has moderate fertility. Erosion is a severe hazard. The available water capacity is low. Phosphorus fixation may be a problem for some crops. This soil is best suited to perennial crops such as coffee. Tillage is limited by large amounts of gravel and slope. Shallowness to hardened laterite is a limiting factor for some crops. Perennial crops with ground cover will reduce erosion and improve organic matter levels in the soil. Application of fertilizer based on soil tests improve productivity.

3C - 8 to 20 percent slopes

This deep, well drained soil occurs on the lower flanks of ridges on the uplands. Slopes are dominantly 10 percent. This soil developed from quartzite, granite gneiss, and some schist.

The surface layer typically is dark reddish brown, neutral sandy clay loam 20 cm thick. The subsoil is dark red, neutral clay to a depth of 175 cm or more.

Included in the map unit are gravelly areas where bedrock at a depth of less than 100 cm. In some areas there are a few scattered rock outcrops. Small escarpments are noted by hatch marks on the map. Cobbles and stones occur in small patches. Also included are areas of less than 8 percent slopes.

This soil has moderate fertility. Erosion is a severe hazard. The available water capacity is medium. Permeability is moderately rapid. This soil is suitable for cultivation where slopes are less than 10 percent and shallow rocky areas are infrequent. Conservation practices including the use of crop residue are needed to reduce erosion. Slopes of more than 10 percent should be considered only for pasture or perennial crops. Application of fertilizer based on soil tests help to improve productivity. Phosphorus fixation can be a problem in these soils.

4A - 0 to 3 percent slopes

This deep, poorly drained soil occurs on nearly level flood plains. Slopes are dominantly less than 1 percent. The soil developed in recent sandy alluvium.

The surface layer is typically very dark brown, slightly acid loamy fine sand about 28 cm thick. The subsoil is mottled light brownish gray, stratified

loamy sand, sandy loam, and sandy clay loam to a depth of 152 cm or more.

Included in this map unit are some sloping, moderately well drained and somewhat poorly drained soils on the margins of the map unit.This soil has low fertility, and its available water capacity is low. Flooding and wetness restrict the choice of crops.

This soil is suited to water-tolerant crops or crops that have a short growing season during dry periods. Rice is a potential crop. Drainage outlets may be insufficient for extensive drainage. Control of the water table and use of fertilizer are necessary for many crops.

13B - 3 to 8 percent slopes

This deep, well drained soil occurs on convex flanks and noses of ridges on the uplands. Slopes are dominantly 6 percent. The soil developed from quartzite, granite gneiss, and some schist.

The surface layer typically is dark reddish brown, neutral clay loam 25 cm thick. The subsoil is dark red, neutral clay to a depth of 175 cm or more.

Included in this map unit are small areas where slopes exceed 8 percent. Also included are small areas where the surface is gravelly or stony.

This soil has moderate fertility. Erosion is a severe hazard. The available water capacity is medium. Permeability is moderately rapid. This soil is well suited to cultivated crops. Crop rotation and proper use of crop residue help reduce erosion. Application of fertilizer based on soil tests help to improve productivity. Phosphorus fixation can be a problem on these soils.

6.22. Properties of the major soils of Kawanda

Three pedons (Pedon No. 001, 002 and 003) were sampled for more detailed evaluation. The first two pedons are on convex slopes of 7 and 6% respectively, while the third pedon is on a concave slope of 6%. The site of the soils determine some of the management related properties.

The classification of the soils are as follows:

Pedon No.	Classification
001	Clayey-skeletal, kaolinitic, isothermic, Kandiudalfic Eutrudox
002	Very-fine, kaolinitic isohyperthermic, Kandiudalfic Eutrudox
003	Clayey-skeletal, kaolinitic, isohyperthermic, Oxic Argiudoll

Table 5. Classification of the soils of Kawanda.

Appendix IV gives the profile descriptions and characterization data of the soils. The soils have a significant increase in clay with depth and this is a favourable property as the surface soil has a better workability while the heavier textured subsoil can store more nutrients and water. The low charge of the mineral colloids which are composed essentially of kaolinite, makes the soil potentially poor. However, due to the climatic regime that the soil has, there is considerable organic matter enrichment in the surface soil, which contributes to the nutrient and water holding capacity of the soil. Conservation of the organic matter is an important component of management of these soils because if the organic matter is lost, then the mineral colloid has to support the plants. It would be useful to monitor the organic matter content of forested land on similar soils to determine the extent of soil degradation.

In terms of the pH and cationic composition, the soils do not present any important nutrient problems. There is an adequate supply of calcium and aluminum is not a hazard. Potassium levels are low and potassium fertilization is needed for most agricultural uses. Ammonium sulfate must not be used on these soils as they have a low buffer capacity and can acidify rapidly with adverse effects.

Though the soils are reddish, free iron content is low and the pH in NaF is also not very high which implies that P fixation is not a problem. P fertilization is, however, needed as the soils have no minerals to provide the P. Soil and plant test results could determine levels of P fertilizers needed.

Erosion is not a major problem on such soils. However, some minimum conservation measures must be adopted such as grass edges on fields. As a conservation ethic, farmers must be shown how to use the simple conservation measures.

The soils are suitable for a range of agricultural uses. Similar soils around Kampala could be used for tropical fruits, vegetables, and horticultural purposes. There is also the potential to develop an international market for

these products if transport and marketing facilities could be arranged at Entebbe.

6.3 NAMULONGE EXPERIMENT STATION

6. 31. Introduction

The Namulonge Agricultural Experimental Station is located in south central Uganda about 23 Km north of Kampala. The research station is in the Mosule District. Elevation ranges from 1,200 m to 1,300 m above sea level.

The soils are formed in residuum from quartzite and gneiss on side slopes, from laterite (murram) on some hill tops and alluvium in valleys. The broad tops and side slopes of hills are used for cropland. Where slopes are steep or soils are shallow or rocky, the soils are under natural vegetation. Hill crests underlain by laterite are commonly occupied by buildings. The wet alluvial soils are not used for agriculture.

6.32. Soil Map units at Namulonge

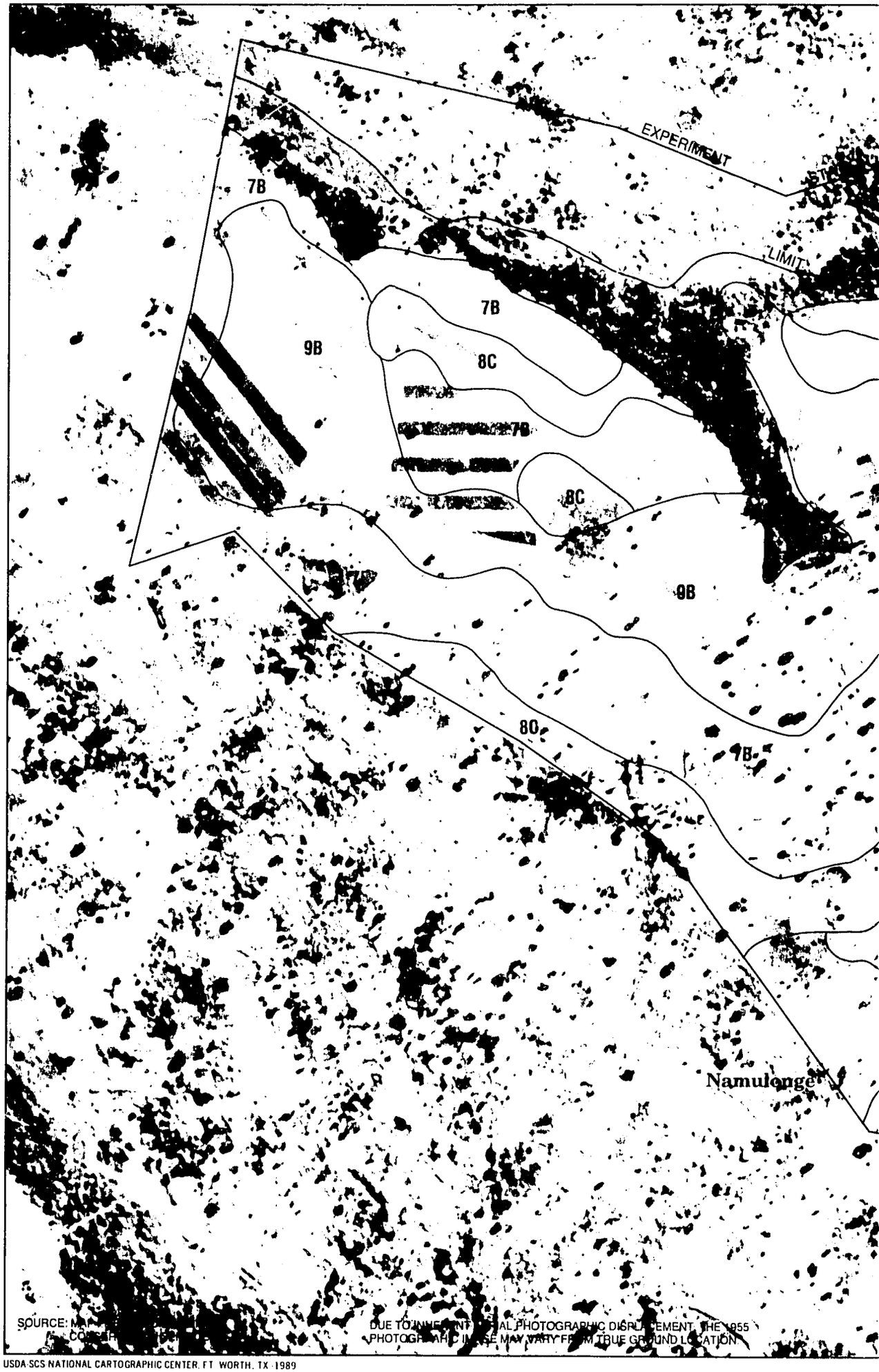
2B - 3 to 8 percent slopes

This deep, well drained soil occurs on ridge crests and upper flanks or ridges on uplands. Slopes are dominantly 4 percent. The soil developed from hardened laterite.

The surface layer is typically dark reddish brown, neutral very gravelly loam 40 cm thick. The subsoil is red, neutral extremely gravelly sandy clay loam. Hardened laterite is at a depth of 40 to 152 cm.

Included in this map unit are small areas where hardened laterite is at a depth of less than 100 cm and some areas where hardened laterite is at a depth of more than 152 cm. Areas adjoining map unit 1 have less murram gravel in the profile.

This soil has moderate fertility. Erosion is a slight hazard. The available water capacity is low. Phosphorus fixation may be a problem for some crops. This soil is well suited to perennial crops. Tillage is limited by large areas of murram gravel, and some deep-rooted crops are limited where the soil is shallow over hardened laterite. Perennial crops with ground cover will reduce erosion and improve organic matter levels in the soil. Application of fertilizer based on



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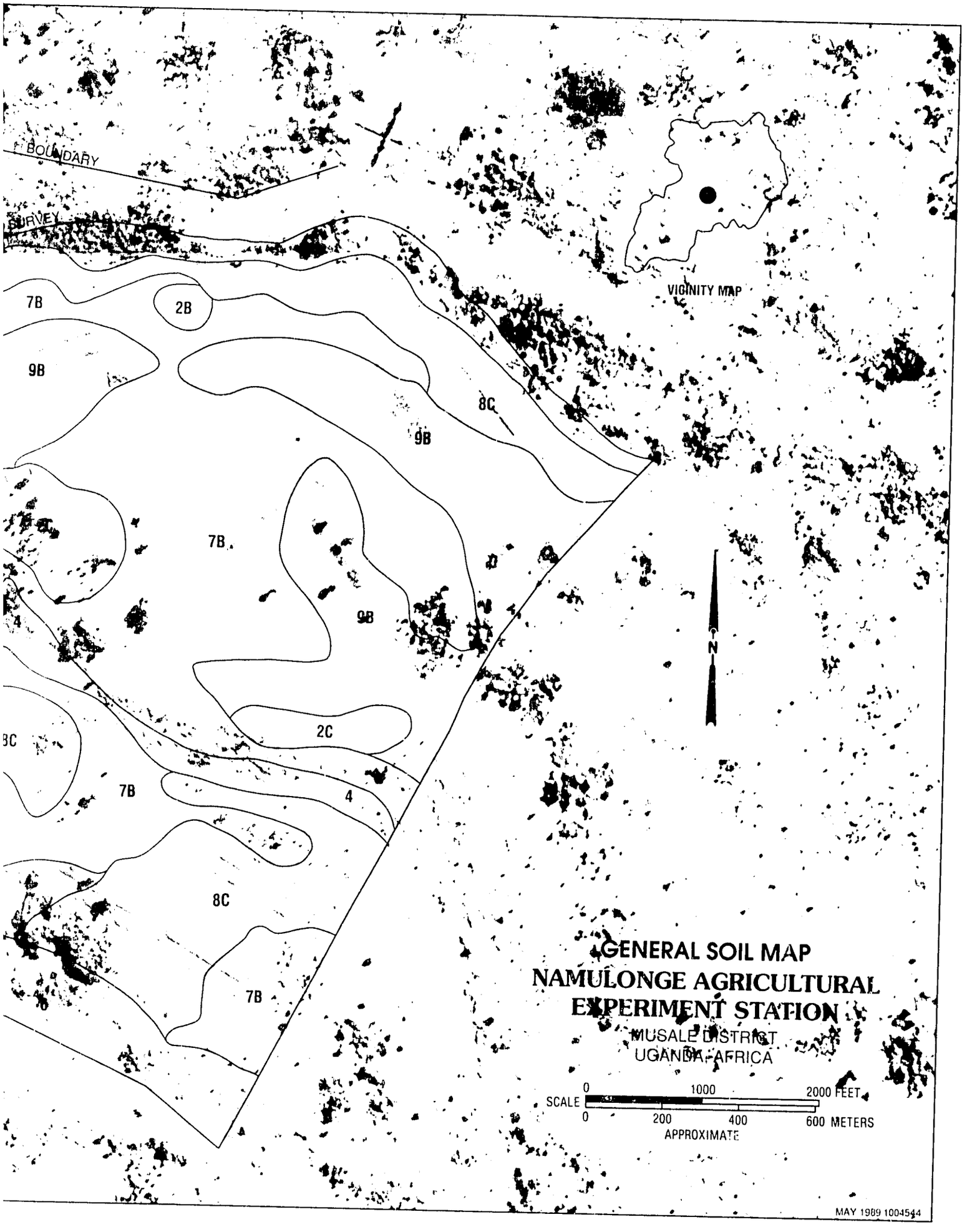
BOUNDARY
SURVEY
VICINITY MAP
7B
2B
9B
8C
9B
7B
9B
2C
7B
4
8C
7B
N
GENERAL SOIL MAP
NAMULONGE AGRICULTURAL
EXPERIMENT STATION
MUSALE DISTRICT
UGANDA-AFRICA
SCALE
0
1000
2000 FEET
0
200
400
600 METERS
APPROXIMATE
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soil tests will improve productivity. Coffee could be an important crop.

2C - 8 to 15 Percent Slopes

These shallow and moderately deep soils occur on the ridge tops in the uplands. Slopes are dominantly 12 percent. These soils have developed in Murram and are underlain by hard laterite.

The surface layer of the shallow soil is reddish brown sandy loam 10 cm thick. The subsoil is very gravelly sandy loam with iron concretions and Murram to a depth of 40 cm. Hardened laterite is at 40 cm. The moderately deep soil typically is a dark reddish brown with extremely gravelly sandy clay loam texture. Hardened laterite is at 100 cm.

Included in this mapping unit are a few small patches of exposed laterite and a few areas where the depth to hardened laterite exceeds 100 cm.

This soil has low fertility and moderate erosion hazard. Available water capacity is low. Permeability is moderate. These soils are unsuited for cultivated crops but better suited to pasture or woodland.

3B - 3 to 8 Percent slopes

This deep well drained soil occurs on convex slopes and noses of ridges in the uplands. Slopes are dominantly 6 percent. These slopes are developed from quartizites, granite gneiss and some schists.

The surface layer is dark reddish brown, neutral, sandy clay loam about 25 cm thick. The subsoil is dark red, neutral clay to a depth of more than 175 cm. Included in this mapping unit are small areas where slopes exceed 8 percent and also, small areas with gravelly or stony surfaces.

This soil has moderate fertility and a moderate erosion hazard. The available water holding capacity is medium. These soils are well suited to cultivated crops. Rotation and proper use of crop residues helps to retard erosion. Application of fertilizers, particularly phosphates, based on soil test results will help to improve productivity. Phosphorous fixation is an important problem in these and related soils.

4A - 0 to 3 percent slopes

This deep, poorly drained soil occurs on nearly level flood plains. Slopes are dominantly less than 1 percent. The soil developed in recent sandy alluvium.

The surface layer is typically very dark brown, slightly acid loamy fine sand about 28 cm thick. The subsoil is mottled light brownish gray, stratified loamy sand, sandy loam, and sandy clay loam to a depth of 152 cm or more.

Included in this map unit are some sloping, moderately well drained and somewhat poorly drained soils on the margins of the map unit. This soil has low fertility, and its available water capacity is low. Flooding and wetness restrict the choice of crops.

This soil is suited to water-tolerant crops or crops that have a short growing season during dry periods. Rice is a potential crop. Drainage outlets may be insufficient for extensive drainage. Control of the water table and use of fertilizer are necessary for many crops.

6A - 0 - 1 percent slopes

This very deep, very poorly drained soil occurs in nearly level flats between ridges. Slopes are less than 1 percent. These soils have developed from sediments washed from the uplands.

The surface layer is dark reddish brown (moist color) and brown (dry color), clay loam, 40 cm thick. The subsoil is grayish brown sandy clay. The substratum is bluish gray sandy clay to a depth of 200 cm.

Included in this mapping unit are gently sloping side slopes with more sand in the solum and some areas with thicker darker surfaces.

This soil has moderate fertility and erosion hazard. Available water holding capacity is medium. Permeability is slow. These wet soils are suited to water tolerant crops. Drainage does not appear feasible on an extensive basis. Suitable outlets for drainage systems are limited. Rice and sugarcane are potential crops where water control system can be developed.

7B - 3 to 8 percent slopes

These very deep and moderately deep soils are on flanks of ridges with gentle slopes. Slopes are dominantly 6 percent. These soils have developed from gneiss.

The surface layer of the very deep soil is dark reddish brown sandy clay loam 15 cm thick. The solum is dark red very gravelly sandy clay loam to a depth of 135 cm. The substratum is red and dark red sandy clay loam with weathered gneiss to a depth of 160 cm. The moderately deep soil is dark reddish brown sandy clay loam 30 cm thick. The subsoil is very gravelly reddish brown and yellowish red sandy clay loam and sandy loam to a depth of 100 cm. Weathered gnesiss occurs below 100 cm.

Included in this mapping unit are small areas of shallow soils and areas where slopes exceed 8 percent, especially along drainageways and swamps.

This soil has moderate fertility and moderate erosion hazard. Available water capacity is medium to low. Permeability is moderate. These soils are suited for cultivated crops. Rotation and the proper use of crop residue help reduce erosion. Applications of fertilizer based on soil test results will help improve productivity. Phosphorus fixation can be a problem in these soils. Rock fragments reduce available water holding capacity and therefore, permanent crops, grassland, or woodland should be considered.

8C 8 to 20 percent slopes

These shallow and moderately deep soils occur on ridge tops and steep side slopes of ridges. Slopes are dominantly 12 percent. These soils are developed from gneiss associated with some quartzite.

The surface layer of the shallow soil is dark reddish brown sandy loam 10 cm thick. The subsoil is dark reddish brown 20 cm thick. Weathered gnesis is at 30 cm. The moderately deep soil is dark reddish brown sandy clay loam 30 cm thick. The subsoil is very gravelly reddish brown and yellowish red sandy clay loam and sandy loam to a depth of 100 cm. Below 100 cm is saprolitic material composed of weathered gneiss.

Included in this mapping unit are small areas with very shallow soils and rock outcrops. Also included are parts of ridges with slopes greater than 20 percent. Small areas with greater than 35 percent rock fragments in the solum are included.

This soil has low fertility and high erosion hazard; available water holding capacity is also low. Permeability is moderately rapid. These soils are unsuited for cultivation and are better suited to pasture or woodland though deeper soils in the area will support coffee.

9B - 3 to 8 Percent Slopes

This very deep well drained soil occurs on the flanks of ridges in the uplands. Slopes are dominantly 6 percent. This soil is developed from granite gneiss.

The surface layer is dark reddish brown and dark red neutral sandy clay loam 36 cm thick. The subsoil is dark red neutral clay loam to a depth of 200 cm or more.

Included in this mapping unit are small areas with slopes of less than 3 percent. Also included are areas with more than 35 percent gravel in the subsoil and bedrock at depths of less than 152 cm. Slopes are greater than 8 percent along drainageways and swamps.

This soil has moderate fertility and erosion hazard. Available water holding capacity is medium. Permeability is moderately rapid. These soils are well suited to cultivated crops. Rotation and the proper use of crop residue help to reduce erosion. Application of fertilizer according to soil test results will help improve productivity. Phosphorus fixation can be a problem in these soils.

23B - 3 to 8 percent slopes

This well drained soil occurs on ridge crests and flanks in the uplands. Slopes are dominantly 6 percent. The soils are derived from gneiss and characteristically, weathered bed-rock ia at 100 to 150 cm.

The surface layer is typically dark reddish brown, neutral, clay loam, about 25 cm thick. The subsoil is slightly acid, clay loam and extends to a depth of more than 110 cm. The substratum is red, extremely gravelly, slightly acid, clay and occurs at depths of 150 cm or more. Included in this mapping unit are small areas with weathered bedrock above 100 cm. Some areas have more than 25 percent rock fragments in the solum.

The soil has moderate fertility and moderate erosion hazard. Subsoil acidity must be monitored. The water holding capacity is medium and permeability is moderately rapid.

The soils are suited for cultivated crops or perennial crops. Rotation and proper use of crop residues will assist in reducing erosion and maintaining fertility. Deep liming with phosphorous application must be investigated.

23C - 8 to 15 percent slope

This deep well drained soil occurs on sloping ridge flanks in the uplands. Slopes are dominantly 9 percent. This soil has developed from geniss. Weathered bedrock is at 100 to 150 cm.

The surface layer is typically dark reddish brown, neutral, clay loam, about 20 to 25 cm thick. The subsoil is red, slightly acid, clay loam to a depth of 110 cm. The substratum is red, extremely gravelly, slightly acid, clay and extends to a depth of more than 150 cm. Included in this mapping unit are areas with weathered gneiss bedrock occuring within 100 cm of the soil surface. Some areas have more than 35 percent rock fragments in the solum and qualify as skeletal families.

This soils has moderate fertility and high erosion hazard. Available water holding capacity is medium and permeability is moderately rapid.

These soils are suited for cultivated or perennial crops. A long rotation and proper use of crop residue will help reduce erosion and maintain fertility. Application of fertilizers, based on soil tests, will improve productivity. Attention must be paid to subsoil acidity and phosphorous.

6.33. Properties of the major soils of Namulonge

Two soils were sampled for detailed characterization:

Pedon No.	Classification
007	Fine, kaolinitic, isohyperthermic, Rhodic Kandiudalf
009	Clayey-skeletal, kaolinitic, isohyperthermic Rhodic Kandidult

Table 6. Classification of the soils of Namulonge.

Pedon 9 is situated on a steeper slope and has more gravel and stones in the soil. The small differences in the slope determines several important soil properties including the skeletal nature of the soil which reduces the effective soil volume. Pedon 7 has a higher organic matter content in the

surface horizons, higher pH and consequently, higher base saturation. Its physiographic position and properties makes Pedon 7 a more suitable soil for most purposes. The charge is largely due to the organic matter, the mineral colloid contributing a very small amount only. As in the soils of Kawanda station, management of organic matter is crucial to sustainable agriculture in these soils.

Pedon 9, has slightly higher aluminum saturation which is still low enough as not to influence crop performance in any significant way. However, supplementary liming will be a good practice on this soil. Although Al is low in the surface horizon of Pedon 9, the subsoil has about 30% aluminum saturation and this would require deep incorporation of lime. Mainitaining soil pH in the range of 5.0 to 5.2 would prevent any aluminum problems. In pedon 7, care has to be taken that the soil is not acidified which can result from erosion and loss of the organic rich surface horizons. Liming the soil will maintain productivity and in htis case, liming would be more as a precautionary measure. Magnesium is low in both the soils and dolomitic limestone, if available, should be used. Potassium is needed for most agricultural uses of the soils. The soils have a high permeability and so leaching losses must be anticipated.

6.4 KABANYOLO EXPERIMENT STATION

6.41 Introduction

The Kabanyolo Agricultural Research Station is located in south central Uganda about 14 Km north of Kampala. The station is in the West Mengo District and has elevations ranging from 1,250 m to 1,320 m above mean sea level.

The soils are formed on residuum and colluvium from quartzites, gneiss and other basement complex rocks. On the side slopes, colluvium enriched with lateritic gravel is common. The broad hill crests and sloping hillsides are used for cropland; steep areas are under coffee. The wet alluvial soils in the valley are not used for agriculture.

6.42. Soil Map units at Kabanyolo

The map units identified during the survey are:

1B - 3 to 8 percent slopes

This deep, well drained soil occurs in convex areas below ridge crests on the uplands. Slopes are dominantly 6 percent. The soil developed from schist and phyllite.

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The surface layer typically is dark reddish brown, neutral clay loam 28 cm thick. The subsoil is red neutral, clay loam to a depth of 175 cm or more.

Included in this map unit are small areas where slopes exceed 8 percent. Also included are areas that are more than 5 percent murram gravel, especially near the adjoining map unit 2.

This soil has moderate fertility. Erosion is a moderate hazard. The available water capacity is medium. Permeability is moderately rapid. This soil is well suited to cultivated crops. Crop rotation and proper use of crop residue help to reduce erosion. Application of fertilizer based on soil tests helps to improve productivity. Phosphorus fixation can be a problem on this soil.

2B - 3 to 8 percent slopes

This deep, well drained soil occurs on ridge crests and upper flanks or ridges on uplands. Slopes are dominantly 4 percent. The soil developed from hardened laterite.

The surface layer is typically dark reddish brown, neutral very gravelly loam 40 cm thick. The subsoil is red, neutral extremely gravelly sandy clay loam. Hardened laterite is at a depth of 40 to 152 cm.

Included in this map unit are small areas where hardened laterite is at a depth of less than 100 cm and some areas where hardened laterite is at a depth of more than 152 cm. Areas adjoining map unit 1 have less murram gravel in the profile.

This soil has moderate fertility. Erosion is a slight hazard. The available water capacity is low. Phosphorus fixation may be a problem for some crops. This soil is well suited to perennial crops. Tillage is limited by large areas of murram gravel, and some deep-rooted crops are limited where the soil is shallow over hardened laterite. Perennial crops with ground cover will reduce erosion and improve organic matter levels in the soil. Application of fertilizer based on soil tests improve productivity. Coffee could be an important crop.

3C - 8 to 20 percent slopes

This deep, well drained soil occurs on the lower flanks of ridges on the uplands. Slopes are dominantly 10 percent. This soil developed from quartzite, granite gneiss, and some schist.

The surface layer typically is dark reddish brown, neutral sandy clay loam 20 cm thick. The subsoil is dark red, neutral clay to a depth of 175 cm or more.

Included in the map unit are gravelly areas where bedrock at a depth of less than 100 cm. In some areas there are a few scattered rock outcrops. Small escarpments are noted by hatch marks on the map. Cobbles and stones occur in small patches. Also included are areas of less than 8 percent slopes.

This soil has moderate fertility. Erosion is a severe hazard. The available water capacity is medium. Permeability is moderately rapid. This soil is suitable for cultivation where slopes are less than 10 percent and shallow rocky areas are infrequent. Conservation practices including the use of crop residue are needed to reduce erosion. Slopes of more than 10 percent should be considered only for pasture or perennial crops. Application of fertilizer based on soil tests help to improve productivity. Phosphorus fixation can be a problem in these soils.

6A - 0 - 1 percent slopes

This very deep, very poorly drained soil occurs in nearly level flats between ridges. Slopes are less than 1 percent. These soils have developed from sediments washed from the uplands.

The surface layer is dark reddish brown (moist color) and brown (dry color), clay loam, 40 cm thick. The subsoil is grayish brown sandy clay. The substratum is bluish gray sandy clay to a depth of 200 cm.

Included in this mapping unit are gently sloping side slopes with more sand in the solum and some areas with thicker darker surfaces.

This soil has moderate fertility and erosion hazard. Available water holding capacity is medium. Permeability is slow. These wet soils are suited to water tolerant crops. Drainage does not appear feasible on an extensive basis. Suitable outlets for drainage systems are limited. Rice and sugarcane are potential crops where water control system can be developed.

13B - 3 to 8 percent slopes

This deep, well drained soil occurs on convex flanks and noses of ridges on the uplands. Slopes are

dominantly 6 percent. The soil developed from quartzite, granite gneiss, and some schist.

The surface layer typically is dark reddish brown, neutral clay loam 25 cm thick. The subsoil is dark red, neutral clay to a depth of 175 cm or more.

Included in this map unit are small areas where slopes exceed 8 percent. Also included are small areas where the surface is gravelly or stony.

This soil has moderate fertility. Erosion is a severe hazard. The available water capacity is medium. Permeability is moderately rapid. This soil is well suited to cultivated crops. Crop rotation and proper use of crop residue help reduce erosion. Application of fertilizer based on soil tests help to improve productivity. Phosphorus fixation can be a problem on these soils.

23D - 15 to 25 Percent Slopes

This deep well drained soil occurs at the base of hills adjoining nearly level valleys. Slopes are dominantly 18 percent. This soil has developed from gneiss. Weathered bedrock is at 100 to 150 cm.

The surface layer is typically dark reddish brown, clay loam with a pH around 7. The subsoil is red, slightly acid, clay loam and extends to a depth of 110 cm, after which it is underlain by weathered gneiss.

Included in this mapping unit are small areas with slopes less than 15 percent. Also included are areas with more than 35 percent rock fragments in the solum. This soil has moderate fertility and high erosion hazard. Available water holding capacity is medium. Permeability is moderately rapid.

These soils are unsuited for cultivated crops because of slope and erosion. Perennial crops such as coffee could be considered. These soils are well suited to pasture and woodland.

6.43. Properties of the major soils of Kabanyolo

Four soils were sampled for detailed characterization:

Pedon No.	Classification
004	Very-fine, kaolinitic, isohyperthermic, Kandiudalfic Eutrudox
005	Fine, kaolinitic, isohyperthermic

	Mollic Kandiudalf
006	Fine-loamy, mixed, isohyperthermic Aeric Tropaquept
008	Very fine, kaolinitic, isohyperthermic Kandiudalfic Eutrudox

Table 7. Classification of the soils of Kabanyolo.

The first two soils are located on the upper slopes and are well drained, while the third pedon (No. 006) is in the valley bottom. This depression soil has an aquic soil moisture regime and at time of sampling, the water table was at about 100 cm. The prominent mottling in the soil indicates that the water table fluctuates during the year.

Pedons 4 and 8 are located on the upper convex slope and both are classified as Oxisol with a relatively thick, organic rich surface horizon. The surface horizons which extend to about 50 cm, have a high CEC and much of this CEC arises from the organic matter. The subsoil, with much lower organic matter has a much lower CEC and indicates the role of organic matter in such soils. Crucial to the management of these soils is the management of organic matter. The surface soil is also well supplied with calcium and the other nutrient cations. pH is slightly on the acid side but aluminum content is negligible. Although liming is not needed on this soil, it would be useful to lime occassionally to prevent acidity build up. The soil will have the capacity to acidify rapidly.

The free iron content of Pedons 4 and 8 is about 4% Fe and this together with the red colors, suggest ability to fix phosphates. About 70 Kg of P_2O_5 per Ha would suffice for most crops and soil tests will establish the correct needs. The soil can store about 8 cm of water per meter and this is adequate in most years. For annual crops, supplementary irrigation in the short dry spells will prevent moisture stress.

Pedon 5 is classified as an Alfisol though for most practical purposes, it is related to the Oxisol. As it is located on a slope, it has received some colluvial additions and this explains the marked clay increase. The organic carbon is much lower and so the surface charge is also lower as compared to the previous soil. Nutrient cations are adequate and well balanced and pH is in the optimal range.

Pedon 6, located in the depression, is a wet soil. The soil material is highly stratified due to erosion additions to the site. Due to the wetness, organic matter is high. The CEC is relatively high, due largely to the organic matter. The soils are in the acid range and even though aluminum is slightly high, it is not critical. However, great care must be taken to prevent further acidification. If sufficient

areas of such soils are available, rice can be considered as a crop. Liming must be an important amendment for rice cultivation.

CONCLUDING REMARKS

Uganda has a range of soil and climatic conditions that permit a wide range of agricultural activity. It has been one of the wealthier countries in the past but the recent turbulent times has created a situation which calls for a complete restructuring, particularly of the infrastructures needed to implement a sustainable and environmentally sound agriculture program. The MFAD project of USAID has already made a tremendous impact in this direction and the Ministry of Agriculture has made significant progress.

Recent reports indicate that there is rampant degradation of the natural resource base. Table 2, presented earlier shows the the degree of deforestation that has taken place. There are no reliable estimates of soil loss and other forms of soil degradation. However, as the mode has been a subsistence form of agriculture in the recent past, one can speculate that soil degradation has been extensive.

What are the short term and long term actions that can be undertaken to bring Uganda back to its past glory. A stability in the political environment will contribute immensely and will enable the targeting of well conceived land development programs. **Institutional strengthening is perhaps the foremost issue and should be considered as the priority activity in any donor funded program.** This is a long term activity but should be persued simultaneously to any short term operational activities. The strengthening is not only of the technicians but also the institutions themselves; Uganda should develop centers of excellence which can collaborate and receive inputs from the international community.

On the short term, one could recommend a whole range of donor supported activities which includes:

1. Developing MLRA maps (1:100,000). This requires the establishment of a national soil survey organization and implementation of a systematic soil survey program.

2. Making and interpreting large scale (Farm level) maps (1:10,000). Extension service to the farmers would require this information.

3. Strengthening soil laboratories through interlaboratory cross-checks, development of analytical methodologies and junior staff training. This is an essential back-stopping service to the national soil survey program.

4. Training on soil survey, soil classification and management of soils. Provide an opportunity for scientists of the region to get together and exchange experience and information.

5. Use and application of geographical information systems (GIS) to store and retrieve resource information. Although the investment is high, the returns are much more cost-effective than the traditional soil survey activities.

6. Land evaluation and a land use database. This monitoring activity is essential to ascertain the progress of the agriculture sector.

7. Utilizing the soil resource information for sustainable agriculture. This must be the motivating force in any agricultural research and development programs.

Table 8, (Eswaran and Virmani, 1990) lists some of the issues, their causes, and required technology in developing countries. The first step is to know the natural resource base. No agricultural development can take place without this information. Following this or simultaneously, the major resource problem affecting most countries -- soil erosion -- can be addressed. This requires acceptance by decision makers of a stewardship and a commitment to soil conservation which involves the establishment of an institutional framework and allocation of necessary funds.

When there is sufficient information on the soil resources of the nation as when a MLRA map is produced, decision makers can develop the philosophy of discriminatory use of soils. This implies the matching of crops to soils and if wisely practised, it would result in a self sufficiency in most agricultural products with a concomitant savings in foreign exchange. This would finally pave the way for putting sustainable agriculture into practise.

Sustainable agriculture cannot be imposed on any country; a country has to graduate to attain this goal and the role of international donors is to help the countries through the tortuous path to sustainable agriculture.

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Table 8. Issues, causes and required technology for land use and sustainable agriculture

Objectives	Major Problems	Primary Causes	Technology Needed	Constraints
1. Knowledge of Natural Resource base	1. Lack of base-line info 2. Lack understanding of relationships 3. Inability to interpret data 4. Need for coordinated data base 5. Need standardization	1. Lack of data 2. Unreliable data quality 3. Lack of monitoring facilities 4. Lack of data base management systems 5. Lack of trained personnel	1. Relational data base & management systems 2. Systems approach to problem identification and solving 3. Cost-effective methods for monitoring 4. Operational labs	1. Institutional framework 2. Trained personnel 3. Adequate funding for research and development 4. Field studies and data generation 5. Quality of data
2. Reduce soil loss	1. Deforestation 2. Off-site damage 3. Lowered water quality 4. Reduced Species Diver. 5. Reduced crop yields 6. Greenhouse effect	1. Shifting cultivation 2. Commerce. timber harves. 3. Steepland cultivation 4. Forest fires 5. Lack of grazing land 6. Lack of fuelwood	1. Sedentary farm. syst. 2. Agroforestry 3. Alley cropping 4. Low-input soil conser. 5. Alternative energy source	1. Socioeconomic 2. Farm size/pattern 3. Production risks 4. Market/income stability 5. Institutional support
3. Discriminatory land use	1. Wet-lands 2. Steep-lands 3. Desertification 4. Soil loss 5. Non-agricultural uses	1. Population stress 2. Overgrazing 3. Land speculation 4. Lack of planning 5. Lack of instit. framework	1. Impr. Cultivars 2. Impr.Soil management 3. Farming systems 4. Land stewardship 5. Conserv. technology	1. Farmer awareness 2. Socioeconomic 3. Lack of extension 4. Lack of applied research 5. Instit. Framework
4. Sustainable agriculture	1. Decline soil fert. 2. Surface soil loss 3. Weeds and pests 4. Decline water quality 5. Changes in soil biota 6. Fluctuations in productivity 7. Degradation of ecosystem	1. Lack of site-specific technology 2. Continuous monocropping 3. Crop residue removal 4. No nutrient replenish. 5. Lack soil/water conservation	1. Soil-specific farming systems 2. Soil bio-technology 3. Water harvesting & other technology 4. Fertilizer management and technology 5. Detailed soil surveys	1. Socioeconomic 2. Absence soils data base 3. Lack of extension serv. 4. Lack of site-specific farming systems packages 5. Lack of other base-line data 6. Institutional framework

APPENDIX I

MAJOR SOIL UNITS IN AFRICA

Albaqualfs
- Typic Albaqualfs
- Aeric Albaqualfs
- Arenic Albaqualfs
- Mollic Albaqualfs
- Ruptic-Vertic Albaqualfs
- Udollic Albaqualfs
- Vertic Albaqualfs

Duraqualfs

Fragiaqualfs
- Typic Fragiaqualfs
- Aeric Fragiaqualfs
- Umbric Fragiaqualfs

Glossaqualfs
- Typic Glossaqualfs
- Aeric Glossaqualfs
- Arenic Glossaqualfs
- Mollic Glossaqualfs

Kandiaqualfs
- Typic Kandiaqualfs
- Aeric Kandiaqualfs
- Aeric Umbric Kandiaqualfs
- Arenic Kandiaqualfs
- Grossarenic Kandiaqualfs
- Plinthic Kandiaqualfs
- Umbric Kandiaqualfs

Natraqualfs
- Typic Natraqualfs
- Albic Natraqualfs
- Albic Glossic Natraqualfs
- Glossic Natraqualfs
- Mollic Natraqualfs

Ochraqualfs
- Typic Ochraqualfs
- Aeric Ochraqualfs
- Aeric Umbric Ochraqualfs
- Andaqueptic Ochraqualfs
- Arenic Ochraqualfs
- Grossarenic Ochraqualfs
- Mollic Ochraqualfs
- Udollic Ochraqualfs
- Umbric Ochraqualfs
- Vertic Ochraqualfs

Plinthaqualfs

Umbraqualfs
- Typic Umbraqualfs
- Arenic Umbraqualfs
- Grossarenic Umbraqualfs

Agrudalfs

Ferrudalfs
- Typic Ferrudalfs
- Aquic Ferrudalfs

Fragiudalfs
- Typic Fragiudalfs
- Albaquic Fragiudalfs
- Aqueptic Fragiudalfs
- Aquic Fragiudalfs
- Glossaquic Fragiudalfs
- Glossic Fragiudalfs
- Mollic Fragiudalfs
- Ochreptic Fragiudalfs
- Umbreptic Fragiudalfs

Fraglossudalfs
- Typic Fraglossudalfs
- Aquic Fraglossudalfs

Glossudalfs
- Typic Glossudalfs
- Aquic Glossudalfs
- Arenic Glossudalfs
- Fragic Glossudalfs
- Haplic Glossudalfs

Hapludalfs
- Typic Hapludalfs
- Albaquic Hapludalfs
- Albaquultic Hapludalfs
- Andeptic Glossoboric Hapludalfs
- Aquic Hapludalfs
- Aquic Arenic Hapludalfs
- Aquic Lithic Hapludalfs
- Aquollic Hapludalfs
- Aquultic Hapludalfs
- Arenic Hapludalfs
- Glossaquic Hapludalfs
- Glossic Hapludalfs
- Glossoboric Hapludalfs
- Lithic Hapludalfs
- Mollic Hapludalfs
- Psammaquentic Hapludalfs
- Psammentic Hapludalfs
- Ultic Hapludalfs
- Vertic Hapludalfs

Kandiudalfs
- Typic Kandiudalfs
- Aquic Kandiudalfs
- Arenic Kandiudalfs
- Arenic Plinthic Kandiudalfs
- Grossarenic Kandiudalfs
- Grossarenic Plinthic Kandiudalfs

Mollic Kandiudalfs
Plinthaquic Kandiudalfs
Plinthic Kandiudalfs
Rhodic Kandiudalfs
Kanhapludalfs
Typic Kanhapludalfs
Aquic Kanhapludalfs
Lithic Kanhapludalfs
Rhodic Kanhapludalfs
Natrudalfs
Typic Natrudalfs
Glossic Natrudalfs
Vertic Natrudalfs
Paleudalfs
Typic Paleudalfs
Albaquic Paleudalfs
Aquic Paleudalfs
Arenic Paleudalfs
Arenic Plinthic Paleudalfs
Glossaquic Paleudalfs
Glossic Paleudalfs
Grossarenic Paleudalfs
Grossarenic Plinthic Paleudalfs
Mollic Paleudalfs
Plinthaquic Paleudalfs
Plinthic Paleudalfs
Psammentic Paleudalfs
Rhodic Paleudalfs
Vertic Paleudalfs
Rhodudalfs
Durustalfs
Haplustalfs
Typic Haplustalfs
Aquic Haplustalfs
Aquic Arenic Haplustalfs
Aquultic Haplustalfs
Arenic Haplustalfs
Arenic Aridic Haplustalfs
Aridic Haplustalfs
Kanhaplic Haplustalfs
Lithic Haplustalfs
Psammentic Haplustalfs
Udic Haplustalfs
Ultic Haplustalfs
Vertic Haplustalfs
Kandiustalfs
Typic Kandiustalfs
Aquic Kandiustalfs
Aquic Arenic Kandiustalfs
Arenic Kandiustalfs
Arenic Aridic Kandiustalfs
Aridic Kandiustalfs
Grossarenic Kandiustalfs
Rhodic Kandiustalfs
Udic Kandiustalfs
Kanhaplustalfs
Typic Kanhaplustalfs
Aquic Kanhaplustalfs
Aridic Kanhaplustalfs
Lithic Kanhaplustalfs
Rhodic Kanhaplustalfs
Udic Kanhaplustalfs
Natrustalfs
Typic Natrustalfs
Aquic Natrustalfs
Aquic Arenic Natrustalfs
Arenic Natrustalfs
Grossarenic Natrustalfs
Mollic Natrustalfs
Petrocalcic Natrustalfs
Salorthidic Natrustalfs
Paleustalfs
Typic Paleustalfs
Aquic Paleustalfs
Aquic Arenic Paleustalfs
Arenic Paleustalfs
Arenic Aridic Paleustalfs
Aridic Paleustalfs
Calciorthidic Paleustalfs
Grossarenic Paleustalfs
Kandic Paleustalfs
Petrocalcic Paleustalfs
Psammentic Paleustalfs
Rhodic Paleustalfs
Udertic Paleustalfs
Udic Paleustalfs
Ultic Paleustalfs
Plinthustalfs
Rhodustalfs
Typic Rhodustalfs
Kandic Rhodustalfs
Lithic Rhodustalfs
Udic Rhodustalfs
Durixeralfs
Typic Durixeralfs
Abruptic Durixeralfs
Abruptic Haplic Durixeralfs
Haplic Durixeralfs
Natric Durixeralfs
Haploxeralfs
Typic Haploxeralfs
Aquic Haploxeralfs
Aquultic Haploxeralfs
Calcic Haploxeralfs
Lithic Haploxeralfs
Lithic Mollic Haploxeralfs
Lithic Ruptic-Xerochreptic
Haploxeralfs

Mollic Haploxeralfs
Natric Haploxeralfs
Psammentic Haploxeralfs
Ultic Haploxeralfs
Vertic Haploxeralfs
Natrixeralfs
Typic Natrixeralfs
Aquic Natrixeralfs
Palexeralfs
Typic Palexeralfs
Aquic Palexeralfs
Calcic Palexeralfs
Mollic Palexeralfs
Natric Palexeralfs
Petrocalcic Palexeralfs
Ultic Palexeralfs
Vertic Palexeralfs
Plinthoxeralfs
Rhodoxeralfs
Typic Rhodoxeralfs
Calcic Rhodoxeralfs
Lithic Rhodoxeralfs
Petrocalcic Rhodoxeralfs

Haplargids
Typic Haplargids
Aquic Haplargids
Arenic Haplargids
Arenic Ustalfic Haplargids
Arenic Ustollic Haplargids
Borollic Haplargids
Borollic Lithic Haplargids
Borollic Vertic Haplargids
Duric Haplargids
Durixerollic Haplargids
Lithic Haplargids
Lithic Ruptic-Entic Xerollic Haplargids
Lithic Ustollic Haplargids
Lithic Xerollic Haplargids
Ustalfic Haplargids
Ustertic Haplargids
Ustollic Haplargids
Vertic Haplargids
Xeralfic Haplargids
Xerertic Haplargids
Xerollic Haplargids
Natrargids
Typic Natrargids
Aquic Natrargids
Borollic Natrargids
Borollic Glossic Natrargids
Duric Natrargids
Durixerollic Natrargids
Glossic Ustollic Natrargids
Haplic Natrargids
Haploxerollic Natrargids
Haplustollic Natrargids
Lithic Natrargids
Lithic Xerollic Natrargids
Ustollic Natrargids
Xerollic Natrargids
Paleargids
Typic Paleargids
Borollic Paleargids
Borollic Vertic Paleargids
Petrocalcic Paleargids
Petrocalcic Ustalfic Paleargids
Petrocalcic Ustollic Paleargids
Petrocalcic Xerollic Paleargids
Ustollic Paleargids
Xeralfic Paleargids
Xerollic Paleargids
Calciorthids
Typic Calciorthids
Aquic Calciorthids
Aquic Duric Calciorthids
Argic Calciorthids
Borollic Calciorthids
Borollic Lithic Calciorthids
Durixerollic Calciorthids
Lithic Calciorthids
Lithic Ustollic Calciorthids
Lithic Xerollic Calciorthids
Ustochreptic Calciorthids
Ustollic Calciorthids
Xerollic Calciorthids
Camborthids
Typic Camborthids
Anthropic Camborthids
Aquic Camborthids
Aquic Duric Camborthids
Borollic Camborthids
Borollic Lithic Camborthids
Borollic Vertic Camborthids
Duric Camborthids
Durixerollic Camborthids
Durixerollic Lithic Camborthids
Fluventic Camborthids
Lithic Camborthids
Lithic Xerollic Camborthids
Natric Camborthids
Ustertic Camborthids
Ustochreptic Camborthids
Ustollic Camborthids
Vertic Camborthids
Xerertic Camborthids
Xerollic Camborthids

Gypsiorthids
- Typic Gypsiorthids
- Calcic Gypsiorthids
- Cambic Gypsiorthids
- Petrogypsic Gypsiorthids

Paleorthids
- Typic Paleorthids
- Aquic Paleorthids
- Ustochreptic Paleorthids
- Ustollic Paleorthids
- Xerollic Paleorthids

Salorthids
- Typic Salorthids
- Aquollic Salorthids

Fluvaquents
- Typic Fluvaquents
- Aeric Fluvaquents
- Aeric Tropic Fluvaquents
- Andaqueptic Fluvaquents
- Humaqueptic Fluvaquents
- Mollic Fluvaquents
- Sulfic Fluvaquents
- Thapto-Histic Fluvaquents
- Thapto-Histic Tropic Fluvaquents
- Tropic Fluvaquents
- Vertic Fluvaquents

Haplaquents
- Typic Haplaquents
- Aeric Haplaquents
- Mollic Haplaquents
- Sulfic Haplaquents

Hydraquents

Psammaquents
- Typic Psammaquents
- Humaqueptic Psammaquents
- Lithic Psammaquents
- Mollic Psammaquents
- Spodic Psammaquents

Sulfaquents
- Typic Sulfaquents

Tropaquents

Torriarents

Udarents
- Alfic Udarents
- Mollic Udarents

Ustarents

Xerarents
- Alfic Xerarents

Torrifluvents
- Typic Torrifluvents
- Anthropic Torrifluvents
- Durorthidic Torrifluvents
- Durorthidic Xeric Torrifluvents
- Ustertic Torrifluvents
- Ustic Torrifluvents
- Vertic Torrifluvents
- Xeric Torrifluvents

Tropofluvents

Udifluvents
- Typic Udifluvents
- Aquic Udifluvents
- Mollic Udifluvents

Ustifluvents
- Typic Ustifluvents
- Aquic Ustifluvents
- Mollic Ustifluvents
- Vertic Ustifluvents

Xerofluvents
- Typic Xerofluvents
- Aquic Xerofluvents
- Aquic Durorthidic Xerofluvents
- Mollic Xerofluvents
- Vertic Xerofluvents

Cryorthents
- Typic Cryorthents
- Alfic Cryorthents
- Alfic Andeptic Cryorthents
- Andeptic Cryorthents
- Aquic Cryorthents
- Lithic Cryorthents
- Pergelic Cryorthents

Torriorthents
- Typic Torriorthents
- Aquic Torriorthents
- Aquic Durorthidic Torriorthents
- Durorthidic Torriorthents
- Durorthidic Xeric Torriorthents
- Lithic Torriorthents
- Lithic Ustic Torriorthents
- Lithic Xeric Torriorthents
- Ustertic Torriorthents
- Ustic Torriorthents
- Vertic Torriorthents
- Xerertic Torriorthents
- Xeric Torriorthents

Troporthents
- Typic Troporthents
- Andeptic Troporthents
- Lithic Troporthents

Udorthents
- Typic Udorthents
- Andeptic Udorthents
- Aquic Udorthents
- Lithic Udorthents
- Vermic Udorthents

Ustorthents
- Typic Ustorthents

Aquic Ustorthents
Lithic Ustorthents
Vermic Ustorthents
Vertic Ustorthents
Xerorthents
Typic Xerorthents
Aquic Xerorthents
Aquic Durorthidic Xerorthents
Durorthidic Xerorthents
Dystric Xerorthents
Lithic Xerorthents
Cryopsamments
Typic Cryopsamments
Alfic Cryopsamments
Aquic Cryopsamments
Lithic Cryopsamments
Pergelic Cryopsamments
Spodic Cryopsamments
Quartzipsamments
Typic Quartzipsamments
Aquic Quartzipsamments
Haplaquodic Quartzipsamments
Lithic Quartzipsamments
Orthoxic Quartzipsamments
Spodic Quartzipsamments
Tropaquodic Quartzipsamments
Ustic Quartzipsamments
Ustoxic Quartzipsamments
Torripsamments
Typic Torripsamments
Durorthidic Xeric Torripsamments
Lithic Torripsamments
Ustic Torripsamments
Xeric Torripsamments
Tropopsamments
Typic Tropopsamments
Aquic Tropopsamments
Lithic Tropopsamments
Udipsamments
Typic Udipsamments
Alfic Udipsamments
Aquic Udipsamments
Lithic Udipsamments
Plaggeptic Udipsamments
Spodic Udipsamments
Ultic Udipsamments
Ustipsamments
Typic Ustipsamments
Alfic Ustipsamments
Aquic Ustipsamments
Lithic Ustipsamments
Xeropsamments
Typic Xeropsamments
Alfic Xeropsamments
Aquic Xeropsamments
Aquic Durorthidic Xeropsamments
Dystric Xeropsamments
Lithic Xeropsamments

Luvifibrists
Medifibrists
Typic Medifibrists
Fluvaquentic Medifibrists
Hemic Medifibrists
Hemic Terric Medifibrists
Hydric Medifibrists
Limnic Medifibrists
Lithic Medifibrists
Sapric Medifibrists
Sapric Terric Medifibrists
Sphagnic Medifibrists
Sphagnic Terric Medifibrists
Terric Medifibrists
Tropofibrists
Typic Tropofibrists
Fluvaquentic Tropofibrists
Hemic Tropofibrists
Hemic Terric Tropofibrists
Hydric Tropofibrists
Limnic Tropofibrists
Lithic Tropofibrists
Sapric Tropofibrists
Sapric Terric Tropofibrists
Terric Tropofibrists
Tropofolists
Typic Tropofolists
Lithic Tropofolists
Luvihemists
Medihemists
Typic Medihemists
Fibric Medihemists
Fibric Terric Medihemists
Fluvaquentic Medihemists
Hydric Medihemists
Limnic Medihemists
Lithic Medihemists
Sapric Medihemists
Sapric Terric Medihemists
Terric Medihemists
Sulfihemists
Typic Sulfihemists
Terric Sulfihemists
Sulfohemists
Typic Sulfohemists.
Tropohemists
Typic Tropohemists
Fibric Tropohemists
Fibric Terric Tropohemists

Fluvaquentic Tropohemists
Hydric Tropohemists
Limnic Tropohemists
Lithic Tropohemists
Sapric Tropohemists
Sapric Terric Tropohemists
Terric Tropohemists
Medisaprists
Typic Medisaprists
Fibric Medisaprists
Fibric Terric Medisaprists
Fluvaquentic Medisaprists
Hemic Medisaprists
Hemic Terric Medisaprists
Limnic Medisaprists
Lithic Medisaprists
Terric Medisaprists
Troposaprists
Typic Troposaprists
Fibric Troposaprists
Fibric Terric Troposaprists
Fluvaquentic Troposaprists
Hemic Troposaprists
Hemic Terric Troposaprists
Limnic Troposaprists
Lithic Troposaprists
Terric Troposaprists

Cryandepts
Typic Cryandepts
Dystric Cryandepts
Dystric Lithic Cryandepts
Entic Cryandepts
Lithic Cryandepts
Dystrandepts
Typic Dystrandepts
Aquic Dystrandepts
Entic Dystrandepts
Hydric Dystrandepts
Hydric Lithic Dystrandepts
Lithic Dystrandepts
Oxic Dystrandepts
Eutrandepts
Typic Eutrandepts
Duric Eutrandepts
Entic Eutrandepts
Lithic Eutrandepts
Udic Eutrandepts
Ustollic Eutrandepts
Xeric Eutrandepts
Hydrandepts
Typic Hydrandepts
Lithic Hydrandepts
Placandepts
Vitrandepts
Typic Vitrandepts
Aquic Vitrandepts
Lithic Vitrandepts
Lithic Mollic Vitrandepts
Lithic Umbric Vitrandepts
Mollic Vitrandepts
Plaggic Vitrandepts
Umbric Vitrandepts
Andaquepts
Typic Andaquepts
Aeric Andaquepts
Aeric Mollic Andaquepts
Haplic Andaquepts
Mollic Andaquepts
Halaquepts
Typic Halaquepts
Aeric Halaquepts
Mollic Halaquepts
Vertic Halaquepts
Haplaquepts
Typic Haplaquepts
Aeric Haplaquepts
Humic Haplaquepts
Lithic Haplaquepts
Mollic Haplaquepts
Sulfic Haplaquepts
Vertic Haplaquepts
Humaquepts
Typic Humaquepts
Cumulic Humaquepts
Fluvaquentic Humaquepts
Histic Humaquepts
Placaquepts
Typic Placaquepts
Histic Placaquepts
Plinthaquepts
Sulfaquepts
Typic Sulfaquepts
Tropaquepts
Typic Tropaquepts
Aeric Tropaquepts
Histic Tropaquepts
Lithic Tropaquepts
Plinthic Tropaquepts
Sulfic Tropaquepts
Vertic Tropaquepts
Dystrochrepts
Typic Dystrochrepts
Andic Dystrochrepts
Aquic Dystrochrepts
Fluvaquentic Dystrochrepts
Fluventic Dystrochrepts

Fluventic Umbric Dystrochrepts
Lithic Dystrochrepts
Lithic Ruptic-Alfic Dystrochrepts
Lithic Ruptic-Ultic Dystrochrepts
Ruptic-Alfic Dystrochrepts
Ruptic-Ultic Dystrochrepts
Umbric Dystrochrepts

Eutrochrepts
Typic Eutrochrepts
Andic Dystric Eutrochrepts
Aquic Eutrochrepts
Aquic Dystric Eutrochrepts
Arenic Eutrochrepts
Dystric Eutrochrepts
Dystric Fluventic Eutrochrepts
Fluvaquentic Eutrochrepts
Fluventic Eutrochrepts
Lithic Eutrochrepts
Lithic Ruptic-Alfic Eutrochrepts
Rendollic Eutrochrepts
Ruptic-Alfic Eutrochrepts
Vertic Eutrochrepts

Ustochrepts
Typic Ustochrepts
Andic Ustochrepts
Aridic Ustochrepts
Fluventic Ustochrepts
Lithic Ustochrepts
Udertic Ustochrepts
Udic Ustochrepts
Vertic Ustochrepts

Xerochrepts
Typic Xerochrepts
Andic Xerochrepts
Aquic Xerochrepts
Aquic Dystric Xerochrepts
Calcixerollic Xerochrepts
Dystric Xerochrepts
Dystric Fluventic Xerochrepts
Dystric Lithic Xerochrepts
Fluventic Xerochrepts
Gypsic Xerochrepts
Lithic Xerochrepts
Lithic Ruptic-Xerorthentic
Xerochrepts
Petrocalcic Xerochrepts
Ruptic-Lithic Xerochrepts
Vertic Xerochrepts

Plaggepts

Dystropepts
Typic Dystropepts
Aquic Dystropepts
Fluventic Dystropepts
Lithic Dystropepts
Oxic Dystropepts
Ustic Dystropepts
Ustoxic Dystropepts
Vertic Dystropepts

Eutropepts
Typic Eutropepts
Andic Eutropepts
Aquic Eutropepts
Fluvaquentic Eutropepts
Fluventic Eutropepts
Lithic Eutropepts
Vertic Eutropepts

Humitropepts
Typic Humitropepts
Andic Humitropepts
Andic Ustic Humitropepts
Fluventic Humitropepts
Lithic Humitropepts
Oxic Humitropepts
Ustic Humitropepts
Ustoxic Humitropepts

Sombritropepts

Ustropepts
Typic Ustropepts
Fluventic Ustropepts
Lithic Ustropepts
Oxic Ustropepts
Vertic Ustropepts

Haplumbrepts
Typic Haplumbrepts
Andic Haplumbrepts
Andaquic Haplumbrepts
Cumulic Haplumbrepts
Entic Haplumbrepts
Fluventic Haplumbrepts
Lithic Haplumbrepts
Pachic Haplumbrepts
Quartzipsammentic Haplumbrepts

Xerumbrepts
Typic Xerumbrepts
Andic Xerumbrepts
Entic Xerumbrepts
Fluventic Xerumbrepts
Lithic Xerumbrepts
Pachic Xerumbrepts

Argialbolls
Typic Argialbolls
Argiaquic Argialbolls
Argiaquic Xeric Argialbolls
Xeric Argialbolls

Natralbolls

Argiaquolls
- Typic Argiaquolls
- Abruptic Argiaquolls
- Arenic Argiaquolls
- Grossarenic Argiaquolls
- Vertic Argiaquolls

Calciaquolls
- Typic Calciaquolls
- Aeric Calciaquolls
- Petrocalcic Calciaquolls

Haplaquolls
- Typic Haplaquolls
- Andaqueptic Haplaquolls
- Cumulic Haplaquolls
- Duric Haplaquolls
- Fluvaquentic Haplaquolls
- Histic Haplaquolls
- Lithic Haplaquolls
- Vertic Haplaquolls

Natraquolls
- Typic Natraquolls

Argiudolls
- Typic Argiudolls
- Aquic Argiudolls
- Lithic Argiudolls
- Oxic Argiudolls
- Psammentic Argiudolls
- Vertic Argiudolls

Hapludolls
- Typic Hapludolls
- Aquic Hapludolls
- Cumulic Hapludolls
- Entic Hapludolls
- Fluvaquentic Hapludolls
- Fluventic Hapludolls
- Lithic Hapludolls
- Vermic Hapludolls
- Vertic Hapludolls

Paleudolls
- Typic Paleudolls
- Aquic Paleudolls

Vermudolls
- Typic Vermudolls
- Entic Vermudolls
- Haplic Vermudolls
- Lithic Vermudolls

Argiustolls
- Typic Argiustolls
- Alfic Lithic Argiustolls
- Aquic Argiustolls
- Aridic Argiustolls
- Boralfic Argiustolls
- Lithic Argiustolls
- Pachic Argiustolls
- Torrertic Argiustolls
- Udertic Argiustolls
- Udic Argiustolls
- Ustalfic Argiustolls
- Vertic Argiustolls

Calciustolls
- Typic Calciustolls
- Aquic Calciustolls
- Aridic Calciustolls
- Lithic Calciustolls
- Lithic Petrocalcic Calciustolls
- Pachic Calciustolls
- Petrocalcic Calciustolls
- Torrertic Calciustolls
- Udertic Calciustolls
- Udic Calciustolls
- Vertic Calciustolls

Haplustolls
- Typic Haplustolls
- Aquic Haplustolls
- Aridic Haplustolls
- Cumulic Haplustolls
- Entic Haplustolls
- Fluvaquentic Haplustolls
- Fluventic Haplustolls
- Lithic Haplustolls
- Lithic Ruptic-Entic Haplustolls
- Oxic Haplustolls
- Pachic Haplustolls
- Ruptic-Lithic Haplustolls
- Salorthidic Haplustolls
- Torrertic Haplustolls
- Torrifluventic Haplustolls
- Torriorthentic Haplustolls
- Torroxic Haplustolls
- Udertic Haplustolls
- Udic Haplustolls
- Udorthentic Haplustolls
- Vertic Haplustolls

Natrustolls
- Typic Natrustolls
- Aridic Natrustolls
- Glossic Natrustolls
- Leptic Natrustolls

Paleustolls
- Typic Paleustolls
- Aquic Paleustolls
- Aridic Paleustolls
- Calcic Paleustolls
- Calciorthidic Paleustolls
- Pachic Paleustolls
- Petrocalcic Paleustolls
- Torrertic Paleustolls
- Udertic Paleustolls

Udic Paleustolls
Vertic Paleustolls
Vermustolls
Typic Vermustolls
Entic Vermustolls
Haplic Vermustolls
Lithic Vermustolls
Pachic Vermustolls
Argixerolls
Typic Argixerolls
Aquic Argixerolls
Aquultic Argixerolls
Aridic Argixerolls
Aridic Calcic Argixerolls
Boralfic Argixerolls
Calcic Argixerolls
Calcic Pachic Argixerolls
Durargidic Argixerolls
Duric Argixerolls
Lithic Argixerolls
Lithic Ultic Argixerolls
Pachic Argixerolls
Pachic Ultic Argixerolls
Ultic Argixerolls
Vertic Argixerolls
Calcixerolls
Typic Calcixerolls
Aquic Calcixerolls
Aridic Calcixerolls
Lithic Calcixerolls
Pachic Calcixerolls
Vermic Calcixerolls
Vertic Calcixerolls
Haploxerolls
Typic Haploxerolls
Aquic Haploxerolls
Aquic Duric Haploxerolls
Aquultic Haploxerolls
Aridic Haploxerolls
Aridic Duric Haploxerolls
Calcic Haploxerolls
Calcic Pachic Haploxerolls
Calciorthidic Haploxerolls
Cumulic Haploxerolls
Cumulic Ultic Haploxerolls
Entic Haploxerolls
Entic Ultic Haploxerolls
Fluvaquentic Haploxerolls
Fluventic Haploxerolls
Lithic Haploxerolls
Lithic Ultic Haploxerolls
Pachic Haploxerolls
Pachic Ultic Haploxerolls
Torrertic Haploxerolls
Torrifluventic Haploxerolls
Torriorthentic Haploxerolls
Torripsammentic Haploxerolls
Ultic Haploxerolls
Vermic Haploxerolls
Vertic Haploxerolls
Natrixerolls
Typic Natrixerolls
Aquic Natrixerolls
Aquic Duric Natrixerolls
Aridic Natrixerolls
Duric Natrixerolls
Palexerolls
Typic Palexerolls
Aridic Palexerolls
Aridic Petrocalcic Palexerolls
Pachic Palexerolls
Petrocalcic Palexerolls
Ultic Palexerolls

Acraquox
Plinthic Acraquox
Aeric Acraquox
Typic Acraquox
Eutraquox
Histic Eutraquox
Plinthic Eutraquox
Aeric Eutraquox
Humic Eutraquox
Typic Eutraquox
Haplaquox
Histic Haplaquox
Plinthic Haplaquox
Aeric Haplaquox
Humic Haplaquox
Typic Haplaquox
Plinthaquox
Aeric Plinthaquox
Typic Plinthaquox
Acroperox
Aquic Petroferric Acroperox
Petroferric Acroperox
Aquic Lithic Acroperox
Lithic Acroperox
Anionic Acroperox
Plinthic Acroperox
Aquic Acroperox
Humic Rhodic Acroperox
Humic Xanthic Acroperox
Humic Acroperox
Rhodic Acroperox
Xanthic Acroperox
Typic Acroperox

Eutroperox
- Aquic Petroferric Eutroperox
- Petroferric Eutroperox
- Aquic Lithic Eutroperox
- Lithic Eutroperox
- Plinthaquic Eutroperox
- Plinthic Eutroperox
- Aquic Eutroperox
- Kandiudalfic Eutroperox
- Umbreptic Eutroperox
- Inceptic Eutroperox
- Humic Rhodic Eutroperox
- Humic Xanthic Eutroperox
- Humic Eutroperox
- Rhodic Eutroperox
- Xanthic Eutroperox
- Typic Eutroperox

Haploperox
- Aquic Petroferric Haploperox
- Petroferric Haploperox
- Aquic Lithic Haploperox
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- Plinthaquic Haploperox
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Kandiperox
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- Petroferric Kandiperox
- Aquic Lithic Kandiperox
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- Plinthaquic Kandiperox
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- Andic Kandiperox
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- Humic Xanthic Kandiperox
- Humic Kandiperox
- Rhodic Kandiperox
- Xanthic Kandiperox
- Typic Kandiperox

Sombriperox
- Petroferric Sombriperox
- Lithic Sombriperox
- Humic Sombriperox
- Typic Sombriperox

Acrotorrox
- Petroferric Acrotorrox
- Lithic Acrotorrox
- Typic Acrotorrox

Eutrotorrox
- Petroferric Eutrotorrox
- Lithic Eutrotorrox
- Typic Eutrotorrox

Haplotorrox
- Petroferric Haplotorrox
- Lithic Haplotorrox
- Typic Haplotorrox

Acrudox
- Aquic Petroferric Acrudox
- Petroferric Acrudox
- Aquic Lithic Acrudox
- Lithic Acrudox
- Aquic Anionic Acrudox
- Anionic Acrudox
- Plinthic Acrudox
- Aquic Acrudox
- Eutric Acrudox
- Humic Rhodic Acrudox
- Humic Xanthic Acrudox
- Humic Acrudox
- Rhodic Acrudox
- Xanthic Acrudox
- Typic Acrudox

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- Aquic Petroferric Eutrudox
- Petroferric Eutrudox
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- Plinthaquic Eutrudox
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- Aquic Eutrudox
- Kandiudalfic Eutrudox
- Umbreptic Eutrudox
- Inceptic Eutrudox
- Humic Rhodic Eutrudox
- Humic Xanthic Eutrudox
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Sombriudox
Petroferric Sombriudox
Lithic Sombriudox
Humic Sombriudox
Typic Sombriudox

Acrustox
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Petroferric Acrustox
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Aquic Anionic Acrustox
Anionic Acrustox
Plinthic Acrustox
Aquic Acrustox
Eutric Acrustox
Humic Rhodic Acrustox
Humic Xanthic Acrustox
Humic Acrustox
Rhodic Acrustox
Xanthic Acrustox
Typic Acrustox

Eutrustox
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Petroferric Eutrustox
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Plinthic Eutrustox
Aquic Eutrustox
Kandiustalfic Eutrustox
Umbreptic Eutrustox
Inceptic Eutrustox
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Humic Xanthic Eutrustox
Humic Eutrustox
Rhodic Eutrustox
Xanthic Eutrustox
Typic Eutrustox

Haplustox
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Petroferric Haplustox
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Plinthic Haplustox
Aqueptic Haplustox
Aquic Haplustox
Inceptic Haplustox
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Humic Xanthic Haplustox
Humic Haplustox
Rhodic Haplustox
Xanthic Haplustox
Typic Haplustox

Kandiustox
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Petroferric Kandiustox
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Plinthaquic Kandiustox
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Aquic Kandiustox
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Humic Xanthic Kandiustox
Humic Kandiustox
Rhodic Kandiustox
Xanthic Kandiustox
Typic Kandiustox

Sombriustox
Petroferric Sombriustox
Lithic Sombriustox
Humic Sombriustox
Typic Sombriustox

Haplaquods
Typic Haplaquods
Aeric Haplaquods
Alfic Haplaquods
Alfic Arenic Haplaquods
Arenic Haplaquods
Arenic Ultic Haplaquods
Entic Haplaquods
Ferrudalfic Haplaquods
Grossarenic Haplaquods
Lithic Haplaquods
Placic Haplaquods
Ultic Haplaquods

Placaquods
- Typic Placaquods

Sideraquods
- Typic Sideraquods
- Alfic Sideraquods
- Entic Sideraquods

Tropaquods
- Typic Tropaquods
- Aeric Tropaquods
- Aeric Arenic Tropaquods
- Aeric Grossarenic Tropaquods
- Entic Tropaquods
- Histic Tropaquods
- Histic Lithic Tropaquods
- Ultic Tropaquods

Ferrods

Cryohumods
- Typic Cryohumods
- Haplic Cryohumods
- Lithic Cryohumods
- Pergelic Cryohumods

Haplohumods
- Typic Haplohumods
- Arenic Haplohumods
- Arenic Ultic Haplohumods
- Entic Haplohumods
- Ferrudalfic Haplohumods
- Grossarenic Entic Haplohumods
- Lithic Haplohumods
- Orthic Haplohumods
- Plaggeptic Haplohumods
- Ultic Haplohumods
- Xeric Haplohumods

Placohumods
- Typic Placohumods
- Cryic Placohumods

Tropohumods

Haplorthods
- Typic Haplorthods
- Alfic Haplorthods
- Aqualfic Haplorthods
- Aquentic Haplorthods
- Aquic Haplorthods
- Duric Haplorthods
- Entic Haplorthods
- Entic Lithic Haplorthods
- Humic Haplorthods
- Lithic Haplorthods
- Ultic Haplorthods

Placorthods

Troporthods

Albaquults
- Typic Albaquults
- Aeric Albaquults

Fragiaquults
- Typic Fragiaquults
- Aeric Fragiaquults
- Plinthic Fragiaquults
- Plinthudic Fragiaquults

Kandiaquults
- Typic Kandiaquults
- Acric Kandiaquults
- Aeric Kandiaquults
- Arenic Kandiaquults
- Arenic Plinthic Kandiaquults
- Arenic Umbric Kandiaquults
- Grossarenic Kandiaquults
- Plinthic Kandiaquults
- Umbric Kandiaquults

Kanhaplaquults
- Typic Kanhaplaquults
- Aeric Kanhaplaquults
- Aeric Umbric Kanhaplaquults
- Andic Kanhaplaquults
- Plinthic Kanhaplaquults
- Umbric Kanhaplaquults

Ochraquults
- Typic Ochraquults
- Aeric Ochraquults
- Arenic Ochraquults

Paleaquults
- Typic Paleaquults
- Aeric Paleaquults
- Arenic Paleaquults
- Arenic Plinthic Paleaquults
- Arenic Umbric Paleaquults
- Grossarenic Paleaquults
- Plinthic Paleaquults
- Umbric Paleaquults

Plinthaquults
- Typic Plinthaquults
- Kandic Plinthaquults

Umbraquults
- Typic Umbraquults

Haplohumults
- Typic Haplohumults
- Andeptic Haplohumults
- Aquic Haplohumults
- Plinthic Haplohumults
- Ustic Haplohumults
- Xeric Haplohumults

Kandihumults
- Typic Kandihumults
- Andic Kandihumults
- Andic Epiaquic Kandihumults
- Andic Ustic Kandihumults

Anthropic Kandihumults
Epiaquic Kandihumults
Plinthic Kandihumults
Ustic Kandihumults
Kanhaplohumults
Typic Kanhaplohumults
Andic Kanhaplohumults
Andic Ustic Kanhaplohumults
Anthropic Kanhaplohumults
Aquic Kanhaplohumults
Epiaquic Kanhaplohumults
Lithic Kanhaplohumults
Ustic Kanhaplohumults
Palehumults
Typic Palehumults
Andeptic Palehumults
Aquic Palehumults
Plinthic Palehumults
Ustic Palehumults
Xeric Palehumults
Plinthohumults
Sombrihumults
Hapludults
Typic Hapludults
Aquic Hapludults
Arenic Hapludults
Humic Hapludults
Lithic Hapludults
Ochreptic Hapludults
Psammentic Hapludults
Ruptic-Lithic-Entic Hapludults
Vertic Hapludults
Kandiudults
Typic Kandiudults
Acric Kandiudults
Acric Plinthic Kandiudults
Andaquic Kandiudults
Andic Kandiudults
Aquic Kandiudults
Aquic Arenic Kandiudults
Arenic Kandiudults
Arenic Plinthaquic Kandiudults
Arenic Plinthic Kandiudults
Arenic Rhodic Kandiudults
Epiaquic Kandiudults
Grossarenic Kandiudults
Grossarenic Plinthic Kandiudults
Plinthaquic Kandiudults
Plinthic Kandiudults
Rhodic Kandiudults
Sombric Kandiudults
Kanhapludults
Typic Kanhapludults
Acric Kanhapludults
Andic Kanhapludults
Aquic Kanhapludults
Arenic Kanhapludults
Arenic Plinthic Kanhapludults
Epiaquic Kanhapludults
Lithic Kanhapludults
Plinthaquic Kanhapludults
Plinthic Kanhapludults
Rhodic Kanhapludults
Paleudults
Typic Paleudults
Aquic Paleudults
Aquic Arenic Paleudults
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Arenic Plinthaquic Paleudults
Arenic Plinthic Paleudults
Arenic Rhodic Paleudults
Fragiaquic Paleudults
Fragic Paleudults
Grossarenic Paleudults
Grossarenic Plinthic Paleudu
Plinthaquic Paleudults
Plinthic Paleudults
Psammaquentic Paleudults
Psammentic Paleudults
Rhodic Paleudults
Spodic Paleudults
Plinthudults
Rhodudults
Typic Rhodudults
Haplustults
Typic Haplustults
Aquic Haplustults
Arenic Haplustults
Epiaquic Haplustults
Kanhaplic Haplustults
Lithic Haplustults
Petroferric Haplustults
Plinthic Haplustults
Kandiustults
Typic Kandiustults
Acric Kandiustults
Andic Kandiustults
Andic Udic Kandiustults
Aquic Kandiustults
Arenic Kandiustults
Arenic Plinthic Kandiust
Aridic Kandiustults
Plinthic Kandiustults
Rhodic Kandiustults
Udic Kandiustults
Kanhaplustults
Typic Kanhaplustults
Acric Kanhaplustults

Andic Kanhaplustults
Andic Udic Kanhaplustults
Aquic Kanhaplustults
Arenic Kanhaplustults
Aridic Kanhaplustults
Epiaquic Kanhaplustults
Lithic Kanhaplustults
Plinthic Kanhaplustults
Rhodic Kanhaplustults
Udic Kanhaplustults
Paleustults
Plinthustults
Rhodustults
Typic Rhodustults
Haploxerults
Typic Haploxerults
Lithic Haploxerults
Ruptic-Lithic-Xerochreptic
Haploxerults
Palexerults

Torrerts
Typic Torrerts
Mollic Torrerts
Paleustollic Torrerts
Chromuderts
Typic Chromuderts
Aquentic Chromuderts
Aquic Chromuderts
Entic Chromuderts
Pelluderts
Typic Pelluderts
Entic Pelluderts
Chromusterts
Typic Chromusterts
Entic Chromusterts
Paleustollic Chromusterts
Udic Chromusterts
Udorthentic Chromusterts
Pellusterts
Typic Pellusterts
Entic Pellusterts
Udic Pellusterts
Udorthentic Pellusterts
Chromoxererts
Typic Chromoxererts
Aquic Chromoxererts
Entic Chromoxererts
Palexerollic Chromoxererts
Pelloxererts
Typic Pelloxererts
Chromic Pelloxererts
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APPENDIX II

SOIL MOISTURE AND TEMPERATURE REGIMES OF UGANDA

Station:ARUA Country:UGANDA Latit: 3 1 N
Elevation: 1280 Longit: 30 55 E

Annual rainfall 1403 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	19.0	47.0	85.1	137.9	148.1	130.0	150.9	191.0	167.9	181.1	102.1	42.9
monthly air temperatures (Celcius)	24.1	24.6	24.3	23.3	22.7	21.9	21.2	21.3	21.8	22.4	22.9	23.2
monthly evapotranspiration (Thornthwaite), mm.	109.5	104.6	111.6	96.8	93.4	82.1	77.8	78.3	80.9	89.8	92.5	99.0

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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                1************15**************30

JAN   333333333333333333333333333332
FEB   222222222222222222222222222222
MAR   222222222222222222222222222222
APR   222222222222222333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	76	284	0	76	284	360	360	0	29

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:BUKALASA Country:UGANDA Latit: 0 55 N
Elevation: 1127 Longit: 31 46 E

Annual rainfall 1182 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	25.9	46.0	91.9	175.0	138.9	53.1	79.0	129.0	122.9	156.0	101.1	63.0
monthly air temperatures (Celcius)	23.6	23.6	23.6	23.1	22.6	22.1	21.7	21.8	22.2	22.7	22.9	23.0
monthly evapotranspiration (Thornthwaite), mm.	103.1	93.8	103.1	94.6	92.5	84.0	82.5	84.2	85.7	93.1	92.8	96.8

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333222222222222222222
MAR  222222222222222333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section			Highest number of consecutive days that the MCS is				
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	32	328	0	32	328	360	360	0	45

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station: BUTIABA Country: UGANDA Latit: 1 50 N
Elevation: 621 Longit: 31 20 E

Annual rainfall 763 mm
Temperature regime: Isohyperthermic Moisture regime: Aridic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	11.9	31.0	55.9	101.1	96.0	55.1	68.1	86.1	74.9	84.1	71.9	26.9
monthly air temperatures (Celcius)	26.1	26.5	26.5	25.9	25.7	25.3	24.8	24.5	25.1	25.5	25.6	25.7
monthly evapotranspiration (Thornthwaite), mm.	133.2	126.9	140.4	125.6	126.5	115.7	111.3	107.1	113.1	122.8	121.0	126.5

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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      1************15**************30

JAN   111111111111111111111111111111
FEB   111111111111111111111111111111
MAR   111111111111111222222222111111
APR   111111111111111222222222222222
MAY   222222222211111222222222222222
JUN   222222211111111222222222221111
JUL   111111111111111222222222222222
AUG   222111111111111222222222222222
SEP   222222222111111222222222222222
OCT   222211111111111222222222222222
NOV   222221111111111222222222222222
DEC   211111111111111111111111111111
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
196	164	0	196	164	0	25	25	15	0

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Aridic

Station:FORT PORTAL Country:UGANDA Latit: 0 40 N
Elevation: 1539 Longit: 30 17 E

Annual rainfall 1479 mm
Temperature regime: Isothermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	35.1	71.9	133.1	184.9	144.0	82.0	59.9	117.1	191.0	214.9	166.1	79.0
monthly air temperatures (Celcius)	19.1	19.6	19.7	19.7	19.4	18.8	18.4	18.7	18.7	18.9	19.1	19.0
monthly evapotranspiration (Thornthwaite), mm.	72.9	69.4	77.6	75.4	75.0	68.7	67.5	69.9	67.9	71.2	70.8	72.0

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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      1************15**************30

JAN   333333333333333333333333333333
FEB   333333333333333333333333333333
MAR   333333333333333333333333333333
APR   333333333333333333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
```

Number of cumulative days that the moisture control section			Highest number of consecutive days that the MCS is				
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:ENTEBBE Country:UGANDA Latit: 0 3 N
Elevation: 1146 Longit: 32 27 E

Annual rainfall 1574 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	79.0	85.0	170.0	278.0	279.0	113.0	73.0	84.0	77.0	84.0	137.0	115.0
monthly air temperatures (Celcius)	22.0	22.0	22.0	22.0	22.0	21.0	21.0	21.0	21.0	22.0	22.0	22.0
monthly evapotranspiration (Thornthwaite), mm.	89.4	80.8	89.4	86.8	89.4	77.5	79.8	79.8	77.5	89.4	86.8	89.4

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:GULU Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1540 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	16.0	48.0	91.0	176.0	185.0	137.0	164.0	253.0	178.0	157.0	88.0	47.0
monthly air temperatures (Celcius)	24.0	25.0	25.0	24.0	23.0	22.0	22.0	22.0	22.0	23.0	23.0	23.0
monthly evapotranspiration (Thornthwaite), mm.	107.3	108.6	120.2	104.2	95.4	81.9	84.4	84.4	81.9	95.4	92.7	95.4

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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      1************15**************30

JAN   333333333333333333333333333333
FEB   222222222222222222222222222222
MAR   222222222222222222222222222222
APR   222222222222222333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	75	285	0	75	285	360	360	0	30

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:HOIMA Country:UGANDA Latit: 1 26 N
Elevation: 1158 Longit: 31 22 E

Annual rainfall 1436 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	30.0	69.1	119.1	169.9	147.1	87.1	103.1	150.9	181.1	179.1	134.1	65.0
monthly air temperatures (Celcius)	23.7	24.3	24.1	22.9	22.5	22.1	21.5	21.6	21.7	22.0	22.6	22.7
monthly evapotranspiration (Thornthwaite), mm.	105.3	101.2	109.9	93.0	91.5	84.8	81.1	82.2	80.9	86.2	90.0	93.9

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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                1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:KABALE Country:UGANDA Latit: 1 15 N
Elevation: 1871 Longit: 29 59 E

Annual rainfall 987 mm
Temperature regime: Isothermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	61.0	91.0	116.0	136.0	93.0	26.0	20.0	54.0	94.0	97.0	107.0	92.0
monthly air temperatures (Celcius)	17.0	17.0	17.0	17.0	17.0	16.0	16.0	17.0	17.0	17.0	17.0	17.0
monthly evapotranspiration (Thornthwaite), mm.	66.0	59.6	66.0	64.1	66.0	57.8	59.5	66.0	64.1	66.0	64.1	66.0

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:KAWANDA AG. ST. Country:UGANDA Latit: 0 25 N
Elevation: 1196 Longit: 32 32 E

Annual rainfall 1218 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	54.0	75.0	119.0	167.0	129.0	69.0	57.0	105.0	104.0	121.0	135.0	83.0
monthly air temperatures (Celcius)	22.1	22.3	22.4	22.0	21.5	20.9	20.4	20.8	21.2	21.7	21.8	21.7
monthly evapotranspiration (Thornthwaite), mm.	90.7	83.8	93.7	87.1	84.9	76.9	74.7	78.3	79.6	86.8	85.2	86.8

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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      1************15**************30

JAN   333333333333333333333333333333
FEB   333333333333333333333333333333
MAR   333333333333333333333333333333
APR   333333333333333333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:KITGUM Country:UGANDA Latit: 3 17 N
Elevation: 914 Longit: 32 53 E

Annual rainfall 1262 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	7.1	27.9	78.0	134.9	175.0	144.0	170.9	180.1	129.0	114.0	68.1	33.0
monthly air temperatures (Celcius)	25.5	26.5	26.4	25.3	24.4	23.8	23.2	22.9	23.6	24.0	24.3	24.3
monthly evapotranspiration (Thornthwaite), mm.	125.1	126.9	139.2	118.2	108.9	97.8	93.5	89.4	95.6	103.6	104.3	107.4

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333322222222222222222222222
FEB  222222211111111111111111111111
MAR  111111111111111222222222222222
APR  111111111111111222222222222222
MAY  222222222222222333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
53	75	232	53	75	232	292	292	0	7

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:lira Country:uganda Latit: 2 17 N
Elevation: 1372 Longit: 32 56 E

Annual rainfall 1416 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	27.9	36.1	91.9	165.1	182.1	122.9	135.9	228.1	164.1	145.0	77.0	39.9
monthly air temperatures (Celcius)	24.6	25.1	24.9	23.8	22.9	22.5	21.7	21.9	22.5	22.9	23.3	23.5
monthly evapotranspiration (Thornthwaite), mm.	114.8	109.8	118.5	101.3	93.7	86.8	81.0	82.7	86.8	93.7	95.4	100.9

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333332222
FEB  222222222222222222222222222222
MAR  222222222222211222222222222222
APR  222222222222222333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
2	77	281	2	77	281	358	358	0	26

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:masaka Country:uganda Latit: 0 20 S
Elevation: 1313 Longit: 31 44 E

Annual rainfall 1083 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	52.1	61.0	115.1	178.1	166.9	46.0	36.1	52.1	88.9	101.1	97.0	88.9
monthly air temperatures (Celcius)	21.8	22.0	21.6	21.1	20.5	20.4	20.1	20.4	20.8	21.2	21.1	20.9
monthly evapotranspiration (Thornthwaite), mm.	90.0	82.7	87.2	80.2	77.6	74.4	73.7	76.7	78.3	83.7	80.4	81.7

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:MASINDI Country:UGANDA Latit: 1 41 N
Elevation: 1146 Longit: 31 43 E

Annual rainfall 1288 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	29.0	56.0	103.0	157.0	145.0	99.0	112.0	138.0	143.0	144.0	118.0	44.0
monthly air temperatures (Celcius)	24.0	24.0	24.0	23.0	23.0	22.0	22.0	22.0	22.0	23.0	23.0	23.0
monthly evapotranspiration (Thornthwaite), mm.	108.0	97.6	108.0	93.4	96.2	82.8	85.3	85.3	82.8	96.2	93.4	96.2

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333322222222333333333333333
MAR  222222222222222333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	23	337	0	23	337	360	360	0	45

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:MBALE Country:UGANDA Latit: 1 6 N
Elevation: 1226 Longit: 34 11 E

Annual rainfall 1145 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	25.9	50.0	94.0	162.1	141.0	122.9	115.1	135.9	109.0	85.1	62.0	41.9
monthly air temperatures (Celcius)	23.9	24.1	23.9	23.1	22.4	22.1	21.7	21.7	21.9	22.3	22.9	23.1
monthly evapotranspiration (Thornthwaite), mm.	107.0	99.1	107.0	95.1	89.9	84.5	83.0	83.0	82.2	88.8	92.7	97.9

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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          1************15**************30

JAN       333333333333333333333322222222
FEB       222222222222222222222222222222
MAR       222222222222222222222222222222
APR       222222222222222333333333333333
MAY       333333333333333333333333333333
JUN       333333333333333333333333333333
JUL       333333333333333333333333333333
AUG       333333333333333333333333333333
SEP       333333333333333333333333333333
OCT       333333333333333333333333333333
NOV       333333333333333333333333333333
DEC       333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	83	277	0	83	277	360	360	0	22

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:MBARARA Country:UGANDA Latit: 0 37 N
Elevation: 1432 Longit: 30 39 E

Annual rainfall 907 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	43.9	62.0	97.0	121.9	81.0	25.9	21.1	61.0	97.0	105.9	113.0	77.0
monthly air temperatures (Celcius)	20.8	21.1	21.9	20.5	20.2	20.1	20.1	20.7	20.5	20.4	20.2	20.1
monthly evapotranspiration (Thornthwaite), mm.	81.6	76.4	91.6	76.9	76.8	73.6	75.8	81.1	76.9	78.2	74.5	75.8

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is				
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:MOYO Country:UGANDA
Elevation: 1036

Latit: 3 41 N
Longit: 31 44 E

Annual rainfall 1322 mm
Temperature regime: Isohyperthermic

Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	15.0	29.0	63.0	125.0	156.0	129.0	167.9	200.9	175.0	148.1	85.1	27.9
monthly air temperatures (Celcius)	26.8	27.1	26.9	22.2	23.9	23.4	22.3	22.4	22.9	23.7	24.4	25.3
monthly evapotranspiration (Thornthwaite), mm.	140.4	131.1	140.4	80.1	102.8	93.6	83.1	85.0	88.3	99.9	107.1	122.1

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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        1************15**************30

JAN     333333332222222222222222222222
FEB     222222111111111111111111111111
MAR     111111111111111222222222221111
APR     111111111111111222222222222222
MAY     222222222222222333333333333333
JUN     333333333333333333333333333333
JUL     333333333333333333333333333333
AUG     333333333333333333333333333333
SEP     333333333333333333333333333333
OCT     333333333333333333333333333333
NOV     333333333333333333333333333333
DEC     333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
58	69	233	58	69	233	291	291	0	8

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:MOROTO Country:UGANDA Latit: 2 33 N
Elevation: 1347 Longit: 34 36 E

Annual rainfall 894 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	9.0	31.0	74.0	124.0	150.0	90.0	136.0	107.0	51.0	48.0	49.0	25.0
monthly air temperatures (Celcius)	24.0	24.0	23.0	23.0	22.0	21.0	21.0	21.0	22.0	22.0	23.0	23.0
monthly evapotranspiration (Thornthwaite), mm.	109.0	98.6	97.6	94.8	87.0	74.8	77.1	77.1	84.5	87.0	94.8	97.6

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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      1************15**************30

JAN   222222222222222222222222211111
FEB   111111111111111111111111111111
MAR   111111111111111222222222222222
APR   222222222222222222222222222222
MAY   222222222222222333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333322222222222222222
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
50	102	208	50	102	208	310	310	0	0

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:MOROTO Country:UGANDA Latit: 2 33 N
Elevation: 1524 Longit: 34 36 E

Annual rainfall 887 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	7.9	30.0	73.9	122.9	149.1	89.9	135.9	105.9	51.1	47.0	49.0	24.9
monthly air temperatures (Celcius)	23.3	23.9	23.7	22.8	21.7	21.3	21.2	21.1	22.1	22.1	22.3	22.7
monthly evapotranspiration (Thornthwaite), mm.	100.9	97.5	106.0	92.6	84.4	77.7	79.5	78.4	85.8	88.3	87.5	94.8

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  222222222222222222222222222211
FEB  111111111111111111111111111111
MAR  111111111111111222222222222222
APR  222222222222211222222222222222
MAY  222222222222222333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333222222222
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
49	95	216	49	95	216	283	283	0	0

*

Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:MUBENDE Country:UGANDA Latit: 0 35 N
Elevation: 1553 Longit: 31 22 E

Annual rainfall 1223 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	38.1	58.9	104.9	150.1	104.9	61.0	58.9	125.0	145.0	159.0	144.0	72.9
monthly air temperatures (Celcius)	21.5	21.5	21.1	20.3	19.9	20.1	19.9	19.7	19.8	20.0	20.3	20.3
monthly evapotranspiration (Thornthwaite), mm.	88.6	80.1	85.1	75.6	74.6	74.3	74.6	73.3	71.6	75.6	75.6	77.9

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:NAMULONGE CRS Country:UGANDA Latit: 0 32 N
Elevation: 1148 Longit: 32 37 E

Annual rainfall 1296 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	58.0	70.0	135.0	208.0	131.0	69.0	61.0	86.0	108.0	138.0	143.0	89.0
monthly air temperatures (Celcius)	22.0	22.3	22.4	22.0	21.2	21.3	20.8	21.2	21.6	22.0	22.0	21.7
monthly evapotranspiration (Thornthwaite), mm.	89.3	83.4	93.3	86.7	81.5	80.1	77.8	81.5	82.9	89.3	86.7	86.3

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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          1************15**************30

JAN       333333333333333333333333333333
FEB       333333333333333333333333333333
MAR       333333333333333333333333333333
APR       333333333333333333333333333333
MAY       333333333333333333333333333333
JUN       333333333333333333333333333333
JUL       333333333333333333333333333333
AUG       333333333333333333333333333333
SEP       333333333333333333333333333333
OCT       333333333333333333333333333333
NOV       333333333333333333333333333333
DEC       333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:SERERE Country:UGANDA Latit: 1 31 N
Elevation: 1097 Longit: 33 27 E

Annual rainfall 1371 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	22.1	53.1	99.1	206.0	192.0	105.9	116.1	166.9	143.0	115.1	97.0	55.1
monthly air temperatures (Celcius)	25.9	25.6	24.8	23.8	23.4	23.1	22.4	22.8	23.4	24.1	24.3	24.6
monthly evapotranspiration (Thornthwaite), mm.	131.7	114.5	116.4	100.0	97.4	91.2	86.1	90.0	94.6	105.9	105.6	112.5

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333322222222
FEB  222222222222222222222222222222
MAR  222222222222111222222222222222
APR  222222222222222333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
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Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
3	80	277	3	80	277	357	357	0	22

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:SOROTI Country:UGANDA Latit: 1 43 N
Elevation: 1127 Longit: 33 37 E

Annual rainfall 1311 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	20.1	47.0	72.9	182.9	192.0	125.0	117.1	184.9	142.0	116.1	72.9	38.1
monthly air temperatures (Celcius)	25.5	25.9	25.7	24.4	23.5	23.1	22.5	22.6	23.3	24.1	24.5	24.7
monthly evapotranspiration (Thornthwaite), mm.	125.7	118.9	129.0	106.7	98.3	90.8	86.2	87.5	92.7	106.2	108.2	114.5

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333322222222222222222222222
FEB  222222222222111111111111111111
MAR  111111111111111222222222222222
APR  222211111111111333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
44	54	262	44	54	262	297	297	0	15

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:TORORO Country:UGANDA Latit: 0 42 N
Elevation: 1233 Longit: 34 10 E

Annual rainfall 1475 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	53.1	57.1	137.9	223.0	263.9	103.1	100.1	119.9	104.9	119.9	103.1	79.0
monthly air temperatures (Celcius)	23.3	23.7	23.6	22.9	22.3	21.7	21.5	21.5	22.0	22.5	22.6	22.6
monthly evapotranspiration (Thornthwaite), mm.	100.5	95.4	104.3	93.4	89.6	81.4	81.6	81.6	84.2	91.9	90.4	93.1

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

APPENDIX III

SOIL MOISTURE AND TEMPERATURE REGIMES

FOR A TEN YEAR PERIOD, GULU, UGANDA

Station:GULU 51 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1519 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	24.0	31.0	132.0	188.0	102.0	104.0	209.0	119.0	36.0	168.0	264.0	141.0
monthly air temperatures (Celcius)	24.1	24.1	24.5	22.9	22.6	22.3	21.4	22.1	22.8	23.1	22.5	22.1
monthly evapotranspiration (Thornthwaite), mm.	109.3	98.8	114.2	92.4	91.9	86.0	79.3	86.5	91.4	97.4	88.1	86.5

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  332222222222222333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	13	347	0	13	347	360	360	0	62

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

Station:GULU 52 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1543 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	1.0	16.0	127.0	183.0	145.0	123.0	151.0	205.0	257.0	263.0	67.0	5.0
monthly air temperatures (Celcius)	23.8	23.9	23.9	22.9	22.7	22.3	21.7	21.6	21.9	22.6	22.9	24.6
monthly evapotranspiration (Thornthwaite), mm.	105.6	96.5	106.8	92.4	92.9	86.0	82.2	81.2	81.9	91.8	92.4	115.4

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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                1************15**************30

JAN   333332222222222222222222222222
FEB   222222222111111111111111111111
MAR   111111111111111222222222222222
APR   222222222222222333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
36	64	260	36	64	260	324	324	0	15

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:GULU 53 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1378 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	22.0	8.0	47.0	137.0	158.0	159.0	156.0	210.0	83.0	249.0	132.0	17.0
monthly air temperatures (Celcius)	24.7	25.7	24.1	23.2	22.3	21.6	21.9	22.6	23.0	22.9	22.9	23.4
monthly evapotranspiration (Thornthwaite), mm.	116.2	117.2	108.5	94.8	87.5	77.8	83.2	90.8	92.6	94.2	91.5	100.0

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1***********15**************30

JAN  333333333333333333333322222222
FEB  222222222222222222222222111111
MAR  111111111111111111111111111111
APR  111111111111111222222222222222
MAY  222222222222222333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
51	62	247	51	62	247	309	309	0	22

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:GULU 54 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1518 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	5.0	15.0	82.0	199.0	237.0	118.0	157.0	296.0	184.0	130.0	32.0	63.0
monthly air temperatures (Celcius)	23.8	25.4	25.5	23.0	22.5	22.0	21.2	21.3	22.0	22.4	23.6	23.2
monthly evapotranspiration (Thornthwaite), mm.	105.3	113.7	127.1	93.2	90.3	82.5	76.8	77.8	82.5	89.3	99.9	98.2

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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     1************15**************30

JAN  333333333333333222222222222222
FEB  222222222222222222222111111111
MAR  111111111111111222222222222222
APR  222222222222222333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
24	65	271	24	65	271	336	336	0	16

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:GULU 55 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1629 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	55.0	0.0	55.0	143.0	180.0	91.0	217.0	272.0	284.0	168.0	59.0	105.0
monthly air temperatures (Celcius)	24.2	24.2	24.9	23.7	22.8	22.4	21.6	21.2	21.7	22.7	22.7	23.0
monthly evapotranspiration (Thornthwaite), mm.	110.4	99.8	119.2	101.3	93.9	86.9	81.1	77.1	79.7	92.8	90.1	96.2

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

```
      1************15**************30

JAN   333333333333333333333333333333
FEB   333333333333333333333333322222
MAR   222222222222222222222222222222
APR   222222222222222333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	50	310	0	50	310	360	360	0	55

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:GULU 56 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1563 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	7.0	55.0	105.0	287.0	204.0	138.0	52.0	313.0	129.0	181.0	37.0	55.0
monthly air temperatures (Celcius)	22.5	23.0	24.4	22.8	22.5	21.8	20.8	21.5	22.2	22.4	23.1	22.9
monthly evapotranspiration (Thornthwaite), mm.	92.0	88.1	113.7	92.5	92.0	82.3	74.9	81.7	86.3	90.9	95.7	96.3

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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      1************15**************30

JAN   333333333333333333333332222222
FEB   222222222222222333333333333333
MAR   332222222222222333333333333333
APR   333333333333333333333333333333
MAY   333333333333333333333333333333
JUN   333333333333333333333333333333
JUL   333333333333333333333333333333
AUG   333333333333333333333333333333
SEP   333333333333333333333333333333
OCT   333333333333333333333333333333
NOV   333333333333333333333333333333
DEC   333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	35	325	0	35	325	360	360	0	45

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:GULU 57 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1505 mm
Temperature regime: Isohyperthermi Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	44.0	5.0	108.0	319.0	207.0	104.0	120.0	144.0	139.0	160.0	122.0	33.0
monthly air temperatures (Celcius)	23.5	24.0	23.5	23.1	22.7	22.7	22.1	22.2	23.1	23.4	23.4	23.8
monthly evapotranspiration (Thornthwaite), mm.	101.4	97.1	101.4	93.9	92.2	89.5	85.6	86.7	93.9	100.2	97.3	105.0

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

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        1************15**************30

JAN     333333333333333333333333333333
FEB     333332222222222222222222222222
MAR     222222222222222333333333333333
APR     333333333333333333333333333333
MAY     333333333333333333333333333333
JUN     333333333333333333333333333333
JUL     333333333333333333333333333333
AUG     333333333333333333333333333333
SEP     333333333333333333333333333333
OCT     333333333333333333333333333333
NOV     333333333333333333333333333333
DEC     333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	40	320	0	40	320	360	360	0	45

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Dry Tropudic

Station:GULU 59 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1368 mm
Temperature regime: Isohyperthermic Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	10.0	32.0	138.0	136.0	221.0	124.0	82.0	192.0	211.0	115.0	105.0	2.0
monthly air temperatures (Celcius)	24.6	24.8	24.6	24.2	23.3	22.8	22.0	22.1	22.5	22.7	23.0	23.8
monthly evapotranspiration (Thornthwaite), mm.	114.5	105.9	114.5	106.2	98.3	89.8	83.6	84.7	86.5	91.4	92.1	104.4

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

```
     1************15**************30

JAN  333333333322222222222222222222
FEB  222222222222222222222211111111
MAR  111111111111111222222222222222
APR  222222222222222333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
23	72	265	23	72	265	337	337	0	15

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Udic Tropustic

Station:GULU 60 Country:UGANDA Latit: 2 45 N
Elevation: 1109 Longit: 32 20 E

Annual rainfall 1772 mm
Temperature regime: Isohyperthermic Moisture regime: Udic

SOIL CLIMATIC REGIME ACCORDING TO NEWHALL COMPUTATION
(soil temp.=air temp.+2.5 C; amplit. reduced by 1/3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
monthly rainfall (mm)	46.0	122.0	136.0	201.0	173.0	66.0	171.0	341.0	213.0	154.0	76.0	73.0
monthly air temperatures (Celcius)	24.4	24.8	24.6	23.7	22.8	22.3	21.6	21.7	22.3	22.6	23.1	24.5
monthly evapotranspiration (Thornthwaite), mm.	112.3	106.2	114.9	100.6	93.0	84.9	80.1	81.1	84.9	90.8	93.7	113.6

MOISTURE CALENDAR
1 = dry ; 2 = m/d ; 3 = moist

```
     1************15**************30

JAN  333333333333333333333333333333
FEB  333333333333333333333333333333
MAR  333333333333333333333333333333
APR  333333333333333333333333333333
MAY  333333333333333333333333333333
JUN  333333333333333333333333333333
JUL  333333333333333333333333333333
AUG  333333333333333333333333333333
SEP  333333333333333333333333333333
OCT  333333333333333333333333333333
NOV  333333333333333333333333333333
DEC  333333333333333333333333333333
```

Number of cumulative days that the moisture control section						Highest number of consecutive days that the MCS is			
During one year is			When soil temp is above 5 deg. C			Moist in some parts		Dry after summer solstice	Moist after winter solstice
DRY	M/D	MOIST	DRY	M/D	MOIST	YEAR	T>8		
0	0	360	0	0	360	360	360	0	120

*
Computed by BASIC program NSM, November 1986
Tentative subdivision: Typic Udic

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 1 KAWANDA EXPERIMENTAL STATION

Soils Series: Kawanda Unit 3
NSSL ID#: 88P0402
Soil Survey #: S87-FN- -001
Location: Kaswanda Experiment Station
Latitude: 00-25-00-N
Longitude: 032-32-02-E
Classification: Clayey-skeletal, kaolinitic, isohyperthermic Kandiudalfic Eutrudox
Physiography: Hillside or mountainside in hills
Geomorphic Position: backslope sideslope
Microrelief: on middle third of component
Slope Characteristics: 7% convex southeast facing
Elevation: 1189 m MSL
Precipitation: 116 cm - Udic Moisture Regime.
Permeability: Moderately rapid
Soil Temperature: Ann: 24 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland
Stoniness: 0
Erosion: Moderate
Runoff: Slow
Particle Size Control Section: 24 to 74 cm
Parent Material: solid rock from quartzite material
Diagnostic Horizons: 0 to 24 cm Ochric, 24 to 175 cm Placic
Described By: D. Goss, D. Yost, Eriabu Sseniwanyo
Date: 09/87
Notes: This site is below the soil from Murram. The profile contained Murran fragments from 24-122 cm. Most of the Murram fragments were from 24-80 cm. The structure on these horizons was controlled by the rock fragments.

Ap1--0 to 13 cm; dark reddish brown (2.5YR 3/4) moist clay loam; dark reddish brown (5YR 3/4) dry; moderate fine and medium subangular blocky structure; very hard, friable, very sticky, plastic; few coarse and many fine roots throughout; few very fine vesicular and tubular pores; neutral (pH=6.8); 5 percent pebbles igneous rocks; clear wavy boundary. Rock fragments are quartzite.
88P2060

Ap2--13 to 24 cm; dark reddish brown (2.5YR 3/4) moist clay loam; dark reddish brown (5YR 3/4) dry; moderate coarse angular blocky structure; extremely hard, firm, very sticky, plastic; many fine roots throughout; few very fine vesicular and tubular pores; neutral (pH=6.8); 10 percent pebbles igneous rocks; abrupt wavy boundary. This is almost massive. Rock fragments are quartzite.
88P2061

Bt1--24 to 47 cm; red (10R 4/6) moist clay; dark red (2.5YR 3/6) dry; moderate fine and medium subangular blocky structure parting to moderate medium subangular blocky; very hard, firm, very sticky, plastic; few very fine roots throughout; few very fine interstitial pores; continuous faint clay films on faces of peds; common medium rounded iron concretions and common medium irregular ironstone nodules; neutral (pH=7.0); 50 percent pebbles igneous rocks; clear wavy boundary. Structure dominated by gravel and Murram. Organic stains on ped faces. The rock fragments contain black sand grains.
88P2062

Bt2--47 to 80 cm; red (10R 4/6) moist clay; red (2.5YR 4/6) dry; moderate fine and medium angular blocky structure ; hard, friable, very sticky, plastic; few very fine roots

throughout; few very fine interstitial pores; discontinuous faint clay films on faces of peds; common medium irregular ironstone nodules; neutral (pH=7.0); 50 percent pebbles igneous rocks, 10 percent cobbles igneous rocks; gradual wavy boundary. Structure is dominated by gravel and Murram. Few black sand grains, less than above. Rock fragments are quartzite.
88P2063

Bt3--80 to 122 cm; red (2.5YR 4/6) moist clay; red (2.5YR 4/6) dry; moderate fine and medium subangular blocky structure ; hard, friable, sticky, plastic; few very fine roots throughout; common very fine interstitial and tubular pores; patchy faint clay films on faces of peds; common fine irregular ironstone nodules; neutral (pH=7.0); 35 percent pebbles; gradual wavy boundary. Structure still has been influenced by rock fragments.
88P2064

Bt4--122 to 150 cm; red (2.5YR 4/6) moist sandy clay loam; red (2.5YR 4/6) dry; very few to few red (10R 5/8) mottles;moderate fine and medium angular blocky parting to weak very fine platy structure; friable, sticky, slightly plastic; very few very fine roots throughout; common very fine interstitial and tubular pores; patchy prominent clay films on faces of peds and in pores; neutral (pH=7.0); 15 percent pebbles; gradual irregular boundary. Gravel is very soft quartzite, few black sand grains. Structure not as controlled by gravel.
88P2065

Bt5--150 to 175 cm; red (2.5YR 4/6) moist sandy clay loam; red (2.5YR 4/6) dry; very few to few red (10R 5/8) mottles; moderate fine and medium angular blocky structure; friable, sticky, slightly plastic; very few very fine roots throughout; common very fine interstitial and tubular pores; patchy faint clay films on faces of peds; 70 percent pebbles. Lots of quartz rock, deeper excavation impossible with tools available.
88P2066

S88FN-910-001

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KAWANDA UNIT 3 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
REVISED TO : ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC KANDIUDALFIC EUTRUDOX

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 402, SAMPLES 88P2060-2067
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	FINE LT .0002	CO3 LT .002	(- -CLAY- -) FINE .002 -.02	COARSE .02 -.05	(- - - - - -SILT- -) VF .05 -.10	F .10 -.25	(- - - - - -SAND- - - - - -) M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) 2 -5	5 -20	- - - - WEIGHT - - - - 20 -75	.1- 75	(>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2060S	0- 13	AP1	40.8	13.6	45.6	23.6		7.2	6.4	9.9	19.1	10.3	4.6	1.7	1	1	--	37	2
88P2061S	13- 24	AP2	39.9	13.5	46.6	23.4		7.2	6.3	10.0	18.9	10.7	4.4	2.6	1	1	--	38	2
88P2062S	24- 47	BT1	65.1	6.6	28.3	43.3		2.7	3.9	6.4	10.4	5.3	2.7	3.5	16	24	--	53	40
88P2063S	47- 80	BT2	61.7	7.0	31.3	41.1		2.9	4.1	5.5	8.9	5.4	4.5	7.0	21	30	5	67	56
88P2064S	80-122	BT3	63.2	7.4	29.4	40.9		3.3	4.1	5.5	8.5	4.3	4.5	6.6	17	27	1	58	45
88P2065S	122-150	BT4	62.7	12.1	25.2	33.7		6.7	5.4	6.2	7.9	4.1	3.0	4.0	18	7	--	39	25
88P2066S	150-175	BT5	54.6	14.5	30.9	28.1		8.8	5.7	6.3	7.0	4.7	5.1	7.8	17	28	--	59	45
88P2067S	180-193		45.1	15.2	39.7	22.6		9.8	5.4	5.7	6.9	6.5	8.7	11.9	26	29	--	70	55

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT	OF <2MM -->					PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 13	2.44	0.195			3.3	0.4	0.2	0.34	0.35	38	19		1.43	1.57	0.031			22.5	14.4	0.11
13- 24	2.06	0.164			3.2	0.3	0.2	0.35	0.35				1.49	1.63	0.030			21.1	13.9	0.11
24- 47	0.62	0.081			4.3	0.5	0.1	0.14	0.30				1.36	1.45	0.016			28.4	19.3	0.09
47- 80	0.47				4.1	0.4	0.1	0.14	0.30	52	26		1.28	1.38	0.015			32.1	18.8	0.11
80-122	0.32				4.2	0.4	TR	0.12	0.31				1.69	1.81	0.015			16.8	19.6	
122-150	0.18				4.6	0.4	TR	0.13	0.33				1.39	1.44	0.010			29.0	20.9	0.10
150-175	0.11				4.6	0.4	TR	0.14	0.35				1.46	1.52	0.009			26.0	19.0	0.07
180-193	0.10				4.1	0.3	TR	0.12	0.36										16.1	

AVERAGES, DEPTH 24- 74: PCT CLAY 63 PCT .1-75MM 61

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-001
SAMPLED AS : KAWANDA UNIT 3 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 402, SAMPLE 88P2060-2067

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	(- NH4OAC EXTRACTABLE BASES -)							(- - - -CEC - - -)				-BASE	SAT-	CO3 AS	RES.		COND.	(- - - -PH - - -)		
	<- - - - - - - - - - -MEQ / 100 G - - - - - - - - - - ->										<- - - - -PCT - - - ->									
0- 13	5.8	2.0	0.1	0.2	8.1	11.1	TR	19.2	14.0			42	58					8.6	4.7	5.0
13- 24	5.8	1.9	0.1	0.1	7.9	10.9	--	18.8	14.0			42	56					8.7	4.8	5.4
24- 47	4.1	1.6	0.1	0.1	5.9	7.8	TR	13.7	9.2			43	64					9.3	5.0	5.5
47- 80	3.7	1.3	0.1	TR	5.1	7.2	--	12.3	8.4			41	61					9.4	5.1	5.7
80-122	3.2	1.0	0.1	TR	4.3	7.3	0.1	11.6	7.8	4.4	2	37	55					9.5	4.9	5.5
122-150	3.7	0.6	0.1	--	4.4	6.3		10.7	7.9			41	56					9.5	5.1	5.8
150-175	3.7	0.5	0.1	--	4.3	5.3		9.6	7.5			45	57					9.5	5.3	6.0
180-193	3.6	0.6	0.2	0.1	4.5	3.7		8.2	5.5			55	82					9.5	5.6	6.0

DEPTH (CM)	C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI PCT FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	(- - - -SPODIC HORIZON CRITERIA - - - - -)						
	(- -NA PYROPHOSPHATE EXTRACTABLE- -)						
	<- PCT OF <2MM->			(- -DIVIDED BY- -)			
0- 13		0.3	0.1	0.1			
13- 24		0.3	0.1	0.1			
24- 47		0.2	0.1	0.1			
47- 80		0.1	0.1				
80-122		--	TR				
122-150		--	TR				
150-175		--	TR				
180-193		--	TR				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-001

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KAWANDA UNIT 3 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 402, SAMPLES 88P2060-2067
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1-BAR 4B1a	-11- 2-BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - - PIPETTE - - ><- HYDROMETER - > CLAY <- - - 3A1c	-14- SILT	-15- SAND	-16- CLAY	-17- SILT SML	-18- SAND	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T	o f < 2	m m ->	<- P P	M ->	< - - - - - - - - - - P E R C E N T							o f	< 2 m m - - - - - - - - - - - -					>< PCT>
88P2060	1	0.05	0.43	0.03	0.16																
88P2061	2	0.06	0.47	0.04	0.19																
88P2062	3	0.04	0.37	0.04	0.16																
88P2063	4	0.05	0.49	0.04	0.17																
88P2064	5	0.05	0.43	0.04	0.15																
88P2065	6	0.03	0.39	0.05	0.14																
88P2066	7	0.02	0.29	0.05	0.11																
88P2067	8	0.02	0.23	0.06	0.07																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-001
SAMPLED AS : KAWANDA UNIT 3 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 402, SAMPLE 88P2060-2067

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY 7A2i peak size	X-RAY 7A3b peak size	X-RAY 7A4b peak size	DTA	TGA	SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		CLAY MINERALOGY (<.002mm)			THERMAL		ELEMENTAL Percent							EGME RETN 7D2 mg/g	INTERPRETATION
88P2061	TCLY	KK 5	HE 2	MI 2	GE 2			25.0	9.4			1.1			
88P2063	TCLY	KK 5	HE 2	MI 2	GE 2			28.0	10.0			0.9			
88P2064	TCLY	KK 5	HE 2	MI 1	GE 2			27.0	9.0			0.8			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite MI mica GE goethite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 2 KAWANDA EXPERIMENTAL STATION

Soils Series: Kawanda Unit 1
NSSL ID#: 88P0403
Soil Survey #: S87-FN- -002
Location:
Latitude: 00-24-48-N
Longitude: 032-32-02-E
Classification: Very-fine, kaolinitic, isohyperthermic Kandiudalfic Eutrudox
Physiography: Hillside or mountainside in hills
Geomorphic Position: backslope crested hills
Microrelief: on upper third of component
Slope: 6% convex east facing
Elevation: 1181 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Permeability: Moderately rapid
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland
Stoniness: 0
Erosion or Deposition: Moderate
Runoff: Slow
Particle Size Control Section: 25 to 75 cm
Parent Material:
Diagnostic Horizons: 0 to 13 cm Ochric, 13 to 200 cm Placic
Described By: D. Goss, D. Yost, J. Tur ihairwe, E. Ssendiwanyo
Date: 09/87
Notes: This site was in a sugar cane patch. The soil was deep and well drained. The appearance of cutans was strong when moist, but the distinctness decreased on drying. Auger length was not sufficent to reach the parent material.

Ap1--0 to 13 cm; dark reddish brown (2.5YR 3/4) moist clay loam; dark reddish brown (5YR 3/4) dry; moderate medium subangular blocky structure parting to weak medium granular; hard, friable, slightly sticky, slightly plastic; many very fine roots throughout; few very fine vesicular and tubular pores; neutral (pH=6.5); clear wavy boundary. Some incusion of red Bt by termites.
88P2068

A&B--13 to 25 cm; dark red (10R 3/6) moist clay; dark reddish brown (2.5YR 3/4) and red (10R 4/6) dry; moderate fine and medium angular blocky structure; very hard, friable, sticky, plastic; many very fine roots throughout; few fine tubular and few very fine tubular pores; discontinuous distinct organic coats on faces of peds and discontinuous distinct clay films on faces of peds; neutral (pH=6.8); clear wavy boundary. Less than 5% small pebbles. Colors blend when moist. Some Murram of Ap1. Common termites.
88P2069

Bt1--25 to 54 cm; dark red (10R 3/6) moist clay; red (10R 4/6) and dark red (10R 3/6) dry; moderate medium and coarse angular blocky structure parting to strong fine granular structure; very hard, friable, very sticky, plastic; common very fine roots throughout; common very fine interstitial and tubular pores; patchy distinct red (10R 4/6) organic coats on faces of peds and patchy distinct clay films on faces of peds; neutral (pH=6.8); gradual wavy boundary. Less than 5% pebbles. Some organic stains on ped faces.
88P2070

Bt2--54 to 86 cm; red (10R 4/6) moist clay; red (10R 4/6) dry; moderate medium and coarse angular blocky structure parting to moderate fine granular; very hard, friable, very

sticky, plastic; common very fine roots throughout; common very fine interstitial and tubular pores; patchy faint clay films on faces of peds; neutral (pH = 6.8); diffuse wavy boundary. Less than 5% pebbles. White termites, many to common.
88P2071

Bt3--86 to 112 cm; red (10R 4/6) moist clay; red (2.5YR 4/6) dry; moderate medium and coarse angular blocky structure parting to moderate fine granular; friable, sticky, plastic; common very fine roots throughout; few fine tubular and common very fine interstitial and tubular pores; patchy faint clay films on faces of peds; neutral (pH = 6.8); diffuse wavy boundary. Less than 5% pebbles. Termites absent. Very few organic stains on faces.
88P2072

Bt4--112 to 150 cm; red (2.5YR 4/6) moist clay; red (2.5YR 5/6) dry; moderate coarse platy structure parting to moderate medium angular blocky; very friable, sticky, plastic; many very fine roots throughout; common fine tubular and common very fine interstitial and tubular pores; patchy faint clay films on faces of peds; neutral (pH = 6.8); diffuse wavy boundary. Less than 5% pebbles. No termites. Very few organic stains, less than above.
88P2073

Bt5--150 to 195 cm; red (2.5YR 4/6) moist clay; red (2.5YR 4/6) dry; moderate medium subangular blocky structure parting to moderate fine and medium granular; very friable, sticky, plastic; few very fine roots throughout; common fine tubular and common fine interstitial and tubular pores; patchy faint clay films on faces of peds; neutral (pH = 7.0). Less than 5% pebbles. Many manganese stains on ped faces and what may be weathered Murram pieces.
88P2074

S88FN-910-002

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KAWANDA UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF
REVISED TO : ; VERY-FINE, KAOLINITIC, ISOHYPERTHERMIC KANDIUDALFIC EUTRUDOX

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 403, SAMPLES 88P2068-2075
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	FINE LT .0002	CO3 LT .002	(- -CLAY- -) FINE .002 -.02	COARSE .02 -.05	(- - - - SILT- -) VF .05 -.10	F .10 -.25	(- - - - -SAND- - - - - -) M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) 2 -5	5 -20	WEIGHT - - - - 20 -75	.1- 75	(>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2068S	0- 13	AP	49.8	12.4	37.8	26.7		5.8	6.6	7.7	15.5	9.3	3.7	1.6	--	--	--	30	--
88P2069S	13- 25	A&B	65.3	8.0	26.7	40.5		2.4	5.6	5.7	10.7	6.7	2.7	0.9	--	--	--	21	--
88P2070S	25- 54	BT1	66.5	7.8	25.7	42.9		2.6	5.2	5.3	9.9	6.1	2.8	1.6	--	--	--	20	--
88P2071S	54- 86	BT2	69.7	6.5	23.8	44.8		1.4	5.1	5.2	9.5	5.7	2.4	1.0	TR	--	--	19	--
88P2072S	86-112	BT3	69.4	7.4	23.2	43.9		2.0	5.4	4.9	9.5	5.1	2.5	1.2	--	--	--	18	--
88P2073S	112-150	BT4	69.8	6.4	23.8	39.9		1.4	5.0	5.5	8.9	4.7	2.4	2.3	TR	--	--	18	TR
88P2074S	150-195	BT5	71.6	7.6	20.8	37.5		2.3	5.3	5.3	7.9	3.7	2.2	1.7	1	--	--	16	1
88P2075S	196-231		70.6	8.2	21.2	34.4		2.9	5.3	5.6	8.0	3.9	2.0	1.7	1	TR	--	16	1

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A <- PERCENT	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A OF	MN 6D2A <2MM -->	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1 PCT	PI 4F <0.4MM	(- BULK DENSITY -) FIELD MOIST 4A3A <- -	1/3 BAR 4A1D G/CC	OVEN DRY 4A1H - - ->	COLE WHOLE SOIL 4D1 CM/CM	(- - -WATER CONTENT - -) FIELD MOIST 4B4 <- -	1/10 BAR 4B1C -PCT OF	1/3 BAR 4B1C <2MM	15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 13	2.21	0.170			3.8	0.4	0.2	0.25	0.35	44	20		1.11	1.21	0.029			22.8	17.2	0.06
13- 25	0.73	0.082			4.0	0.4	0.1	0.11	0.31				1.44	1.53	0.020			26.1	20.2	0.09
25- 54	0.44	0.058			4.8	0.5	0.1	0.10	0.31				1.43	1.52	0.021			27.2	20.4	0.10
54- 86	0.31				4.3	0.4	0.1	0.09	0.30	50	26		1.40	1.47	0.016			26.9	20.8	0.09
86-112	0.28				4.3	0.4	0.1	0.10	0.30				1.37	1.43	0.014			25.9	20.6	0.07
112-150	0.25				4.1	0.4	TR	0.09	0.29				1.32	1.40	0.020			27.1	19.9	0.10
150-195	0.15				4.3	0.4	0.1	0.08	0.30					1.22					21.7	
196-231	0.19				4.2	0.4	0.1	0.08	0.30										21.4	

AVERAGES, DEPTH 25- 75: PCT CLAY 68 PCT .1-75MM 20

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-002
SAMPLED AS : KAWANDA UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 403, SAMPLE 88P2068-2075

PRINT DATE 01/19/90

DEPTH (CM)	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID- ITY 6H5A	-7-- EXTR AL 6G9b	-8-- (- - - -CEC - - -) SUM CATS 5A3A	-9-- NH4- OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
	<- - - - - - - - - - -				-MEQ /	100 G	- - -	- - - - - - - - -		- ->	<- - - -		-PCT	- - - ->						
0- 13	4.4	1.5	0.1	0.2	6.2	12.6	0.2	18.8	12.5	6.4	3	33	50					8.9	4.7	5.1
13- 25	3.0	1.0	0.1	TR	4.1	8.0	0.1	12.1	7.4	4.2	2	34	55					9.3	4.8	5.4
25- 54	2.5	0.8	0.1	--	3.4	7.5	0.1	10.9	6.4	3.5	3	31	53					9.4	5.0	5.4
54- 86	2.2	0.7	0.1	--	3.0	7.3	--	10.3	6.5			29	46					9.5	4.9	5.4
86-112	2.2	0.7	0.1	--	3.0	7.2		10.2	6.7			29	45					9.5	5.0	5.7
112-150	2.2	0.4	0.1	--	2.7	6.6	TR	9.3	6.5			29	42					9.6	5.1	5.5
150-195	2.6	0.3	0.1	--	3.0	6.2		9.2	5.5			33	55					9.6	5.4	5.6
196-231	2.6	0.3	0.2	0.1	3.2	6.0		9.2	5.3			35	60					9.6	5.4	5.6

DEPTH (CM)	(- - - -SPODIC HORIZON CRITERIA - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	<- PCT OF <2MM->			(- -DIVIDED BY- -)			
0- 13		0.4	0.1	0.1			
13- 25		0.1	0.1				
25- 54		--	TR				
54- 86		TR	0.1	TR	--		
86-112		TR	TR				
112-150		--	TR				
150-195		--	TR				
196-231		--	0.1	TR	--		

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-002

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KAWANDA UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 403, SAMPLES 88P2068-2075
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

		-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		ACID OPT DEN	OXALATE FE	EXTRACTION SI	AL	PHOSPHOUS RET	CIT-ACID	KCL MN	TOTAL C	(- -WATER 0.06 BAR	1- BAR	CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 2- BAR	15 BAR	<- - PIPETTE - - >< - HYDROMETER - > CLAY	SILT	SAND	CLAY	SILT	SAND	MIN SOIL CONT	AGGRT STABL <5mm
SAMPLE NO.	HZ NO	8J	6C9a	6V2	6G12	6S4	6S5	6D3	6A2d	4B1c	4B1a	4B1a	4B2b	<- - - 3A1c	- - -><- - - SML				- - ->	8F1	4G1
			<- P C T	o f < 2 m m -><- P P M						-><- - - - - - - - - - - P E R C E N T											o f < 2 m m - - - - - - - - - - - ><PCT>
88P2068	1	0.06	0.30	0.03	9.19																
88P2069	2	0.04	0.44	0.05	0.17																
88P2070	3	0.03	0.49	0.06	0.17																
88P2071	4	0.03	0.51	0.05	0.20																
88P2072	5	0.03	0.47	0.04	0.14																
88P2073	6	0.03	0.49	0.04	0.18																
88P2074	7	0.02	0.39	0.04	0.13																
88P2075	8	0.02	0.39	0.05	0.12																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-002
SAMPLED AS : KAWANDA UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 403, SAMPLE 88P2068-2075

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY 7A2i peak size			THERMAL DTA	THERMAL TGA	CLAY MINERALOGY (<.002mm) Percent SiO2	AL2O3	Fe2O3	ELEMENTAL Percent MgO	CaO	K2O	Na2O	EGME RETN 7D2 <mg/g>	INTERPRETATION
88P2068	TCLY	KK 5	HE 2	GE 1				25.0	9.7			0.3			
88P2071	TCLY	KK 5	GE 2	HE 2				28.0	10.3			0.3			
88P2074	TCLY	KK 5	GE 2	HE 2	MI 1			29.0	10.4			0.3			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite GE goethite MI mica

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 4 KABANYOLO EXPERIMENTAL STATION

Soils Series: Kawanda Unit 2
NSSL ID#: 88P0404
Soil Survey #: S87-FN- -003
Location:
Latitude: 00-24-52-N
Longitude: 032-31-58-E
Classification: Clayey-skeletal, kaolinitic, isohyperthermic Oxic Argiudoll
Physiography: Hillside or mountainside in hills
Geomorphic Position: backslope crested hills
Slope: 5% concave
Elevation: 1204 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately slow
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland
Stoniness: 0
Erosion : Runoff:
Parent Material:
Diagnostic Horizons: 0 to 30 cm Mollic, 30 to 97 cm Placic
Described By: D. Goss, D. Yost, J. Tumuhairwe, E. Ssenbiwanyo
Date: 09/87
Notes: This soil is apparently from Murram, or a broken latterite. In some areas hard latterite was observed at the surface. This site has hard latterites at 97 cm. The local soil scientist said the Murram frags. became soft on wetting.

Ap1--0 to 10 cm; dark reddish brown (5YR 3/2) moist loam; dark brown (7.5YR 3/2) dry; moderate medium and fine subangular blocky structure parting to moderate very fine granular; slightly hard, friable, slightly sticky, slightly plastic; many very fine and many fine roots throughout; many very fine interstitial pores; neutral (pH = 7.0); 25 percent cobbles ironstone; clear wavy boundary. Rock fragments and Murram control structure.
88P2076

Ap2--10 to 18 cm; dark reddish brown (5YR 3/2) moist loam; brown to dark brown (7.5YR 4/2) dry; moderate medium subangular blocky structure parting to moderate very fine granular; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots throughout; many fine interstitial and tubular pores; neutral (pH = 7.0); 25 percent cobbles ironstone; clear wavy boundary. Roots, many and matted between Ap2 and Ap3. Rock fragments as above, also control structure.
88P2077

Ap3--18 to 30 cm; dark reddish brown (5YR 3/2) moist clay loam; brown to dark brown (7.5YR 4/2) dry; moderate fine subangular blocky structure parting to moderate very fine granular; hard, friable, sticky, plastic; common very fine roots throughout; many fine interstitial and tubular pores; slightly acid (pH = 6.0); 40 percent cobbles ironstone; clear wavy boundary. Rocks fragments as above.
88P2078

Bt1--30 to 64 cm; red (2.5YR 4/6) moist clay; moderate medium angular blocky structure; very hard, firm, sticky, plastic; few very fine roots; few very fine discontinuous

tubular pores; patchy faint clay films on faces of peds; few iron concretions; neutral (pH = 7.0); 70 percent cobbles ironstone; clear wavy boundary. Rocks control structure. Clay skins are thick in some pores between Murram.
88P2079

Bt2--64 to 97 cm; red (2.5YR 4/6) moist clay; moderate medium angular blocky structure; very hard, very firm, slightly sticky, plastic; few very fine roots throughout; few very fine discontinuous tubular pores; patchy faint clay films on faces of peds; few iron concretions; neutral (pH = 7.0); 80 percent cobbles ironstone; abrupt wavy boundary. Rock fragments are Murram and control structure.
88P2080

Cr--97 to 102 cm; .

S88FN-910-003

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KAWANDA UNIT 2 ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANHAPLUDALF
REVISED TO : ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC OXIC ARGIUDOLL

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 404, SAMPLES 88P2076-2080
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- TOTAL FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS(MM) 2 -5	-14- COARSE FRACTIONS(MM) 5 -20	-15- COARSE FRACTIONS(MM) 20 -75	-16- COARSE FRACTIONS(MM) .1- 75	-17- >2MM WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2076S	0- 10	AP1	32.3	16.3	51.4	15.7		7.5	8.8	8.5	21.3	14.2	5.4	2.0	5	15	--	54	20
88P2077S	10- 18	AP2	32.8	14.7	52.5	12.2		8.8	5.9	9.0	20.7	13.6	6.2	3.0	5	16	--	55	21
88P2078S	18- 30	AP3	32.2	12.7	55.1	12.5		7.1	5.6	8.5	20.7	14.5	5.6	5.8	11	38	1	73	50
88P2079S	30- 64	BT1	52.1	8.1	39.8	29.6		3.5	4.6	6.2	11.1	7.6	6.3	8.6	17	56	--	82	73
88P2080S	64- 97	BT2	53.8	11.7	34.5	29.8		6.7	5.0	4.9	6.3	4.9	6.2	12.2	14	48	9	80	71

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	DITH-CIT EXTRACTABLE AL 6G7A	DITH-CIT EXTRACTABLE MN 6D2A	CEC 8D1	RATIO/CLAY 15 BAR 8D1	ATTERBERG LIMITS LL 4F1	ATTERBERG LIMITS PI 4F	BULK DENSITY FIELD MOIST BAR 4A3A	BULK DENSITY 1/3 BAR 4A1D	BULK DENSITY OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1C	WATER CONTENT 1/3 BAR 4B1C	WATER CONTENT 15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT OF <2MM -->						PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 10	4.06	0.349			2.4	0.3	0.2	0.67	0.46	43	15		1.12	1.26	0.036			30.3	15.0	0.15
10- 18	4.29	0.351			2.3	0.3	0.2	0.67	0.42				1.16	1.28	0.030			29.9	13.9	0.17
18- 30	3.31	0.266			2.6	0.3	0.2	0.53	0.42				1.38	1.56	0.027			20.7	13.4	0.07
30- 64	0.72	0.080			4.4	0.4	TR	0.16	0.32				1.26	1.40	0.015			45.9	16.9	0.16
64- 97	0.34	0.053			4.6	0.4	TR	0.12	0.35	43	20		2.02	2.12	0.006			12.7	18.9	

AVERAGES, DEPTH 30- 80: PCT CLAY 53 PCT .1-75MM 81

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-003
SAMPLED AS : KAWANDA UNIT 2 ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANHAPLUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 4G4, SAMPLE 88P2076-2080

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- (- - - -CEC - - -) SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
	<- - - - - - - - - - - -MEQ / 100 G							- - - - - - - - - - ->			<- - - - -PCT - - - ->									
0- 10	16.6	5.2	0.1	4.1	26.0	4.9		30.9	21.7			84	100					9.0	6.5	6.7
10- 18	19.1	5.4	0.1	4.2	28.8	4.7		33.5	21.9			86	100					9.1	6.7	6.9
18- 30	10.4	3.2	0.1	1.9	15.6	8.0		23.6	17.0			66	92					8.7	5.7	6.1
30- 64	4.5	1.0	0.1	0.8	6.4	6.1		12.5	8.1			51	79					9.2	5.4	6.1
64- 97	3.3	1.0	0.1	0.7	5.1	4.6		9.7	6.5			53	78					9.4	5.9	6.5

DEPTH (CM)	(- - - -SPODIC HORIZON CRITERIA - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	<- PCT OF <2MM->			(- -DIVIDED BY- -)			
0- 10		0.2	0.3	0.2	TR		
10- 18		0.3	0.3	0.2			
18- 30		0.3	0.4	0.2			
30- 64		0.3	0.1	0.1			
64- 97		TR	TR				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-003

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : KAWANDA UNIT 2 ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANHAPLUDALF

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 404, SAMPLES 88P2076-2080
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

		-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		ACID	OXALATE	EXTRACTION		PHOSPHOUS		KCL	TOTAL	(- -WATER		CONTENT- -)(- - - - WATER DISPERSIBLE - - - -)								MIN	AGGRT
		OPT DEN	FE	SI	AL		CIT-	MN	C	0.06	1-	2-	15	<- - PIPETTE - - >< - HYDROMETER - >						SOIL	STABL
SAMPLE	HZ	8J	6C9a	6V2	6G12	RET 6S4	ACID 6S5	6D3	6A2d	BAR 4B1c	BAR 4B1a	BAR 4B1a	BAR 4B2b	CLAY	SILT	SAND	CLAY	SILT	SAND	CONT	<5mm
NO.	NO		<- P C T	o f	< 2	m m ->	<- P P M	->	< - - - - - - - - - - - - P E R C E N T					<- - -	3A1c	- - ->	<- - -	SML	- - ->	8F1	4G1
															of	< 2 m m - - - - - - - - - - - - >< PCT>					
88P2076	1	0.07	0.26	0.07	0.25																
88P2077	2	0.06	0.25	0.07	0.22																
88P2078	3	0.05	0.25	0.03	0.17																
88P2079	4	0.03	0.23	0.07	0.13																
88P2080	5	0.02	0.13	0.04	0.10																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-003
SAMPLED AS : KAWANDA UNIT 2 ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANHAPLUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 404, SAMPLE 88P2076-2080

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY peak size 7A2i	X-RAY peak size 7A3b	X-RAY peak size 7A4b	DTA	TGA	SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		CLAY MINERALOGY (<.002mm)			THERMAL		ELEMENTAL Percent								
										7C3					
88P2077	TCLY	KK 5 GE 1 MI 1						20.0	7.4			1.1			
88P2080	TCLY	KK 5 GE 2 HE 2 MI 1						28.0	9.3			0.3			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite GE goethite MI mica HE hematite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 3 KAWANDA EXPERIMENTAL STATION

Soil Series: Kabanyolo Unit 23
NSSL ID#: 88P0405
Soil Survey #: S87-FN-910-004
Location:Kabanyolo University Farm, Uganda
Latitude: 00-27-42-N
Longitude: 032-36-26-E
Classification: Very-fine, kaolinitic, isohyperthermic Kandiudalfic Eutrudox
Physiography: Hillside or mountainside in hills
Geomorphic Position: backslope crested hills
Slope: 6% plane west facing
Elevation: 1189 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately rapid
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland-Coffee
Stoniness: 0
Erosion:
Runoff:
Particle Size Control Section: 23 to 73 cm
Parent Material: solid rock from metamorphic rock
Diagnostic Horizons: 0 to 23 cm Mollic, 23 to 124 cm Kandic
Described By: D. Goss, D. Yost, E. Ssendiwanyo, J. Tumuhairwe
Date: 09/87
Notes: The parent material of current soil is coluvium of gneiss and some Murram. Located in coffee west of housing.

Ap1--0 to 10 cm; dark reddish brown (2.5YR 3/4) moist clay loam; dark reddish brown (5YR 3/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky, plastic; many very fine and many fine roots; few very fine interstitial and tubular and few fine interstitial and tubular pores; 60 percent pebbles ironstone; clear wavy boundary. Rock fragments of quartzite, weathered gneiss and Murram.
88P2081

Ap2--10 to 23 cm; dark reddish brown (2.5YR 3/4) moist clay loam; strong medium and coarse angular blocky; hard, firm, sticky, plastic; many fine and common very fine roots; common fine interstitial and tubular and common medium tubular pores; 10 percent pebbles ironstone; clear wavy boundary. Rock fragments as above.
88P2082

Bt1--23 to 47 cm; dark red (2.5YR 3/6) and red (2.5YR 4/6) moist clay loam; dark red (2.5YR 3/6) dry; moderate fine and medium angular blocky structure; hard, firm, very sticky, plastic; many very fine roots; common fine interstitial and tubular pores; patchy faint clay films on faces of peds; 15 percent pebbles ironstone; clear wavy boundary. Rock fragments as above. Ped faces have argillans stained with organic matter.
88P2083

Bt2--47 to 66 cm; dark red (2.5YR 3/6) and red (2.5YR 4/6) moist clay loam; dark red (2.5YR 3/6) dry; weak coarse prismatic structure parting to strong fine and medium angular blocky structure; hard, firm, very sticky, plastic; many very fine roots; few medium

continuous tubular and common fine interstitial and tubular pores; continuous distinct clay films on faces of peds; 10 percent pebbles ironstone; clear wavy boundary. Ped faces, particularly prismatic have argillans stained with OM.
88P2084

Bt3--66 to 89 cm; red (2.5YR 4/6) moist clay loam; red (2.5YR 4/6) dry; moderate fine and medium angular blocky structure parting to strong very fine granular; slightly hard, very friable, sticky, plastic; many very fine roots; common fine continuous tubular and few medium continuous tubular pores; patchy faint clay films on faces of peds; neutral (pH=6.5); 10 percent pebbles ironstone; clear wavy boundary.
88P2085

Bt4--89 to 124 cm; red (2.5YR 4/8) moist sandy clay loam; red (2.5YR 4/8) dry; strong very fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine roots; common fine continuous tubular pores; 10 percent pebbles ironstone; abrupt wavy boundary.
88P2086

2C/B--124 to 160 cm; red (2.5YR 4/6) moist clay; strong very fine granular structure; sticky, plastic; 60 percent cobbles ironstone. Gravel is gneiss and Murram, content of each could not be determined. Gneiss well weathered.
88P2087

S88FN-910-C04

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KABANYOLO UNIT 2 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
REVISED TO : ; VERY-FINE, KAOLINITIC, ISOHYPERTHERMIC KANDIUDALFIC EUTRUDOX

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 405, SAMPLES 88P2081-2087
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- CLAY LT .002	-2-- SILT .002 -.05	-3-- SAND .05 -2	-4-- FINE LT .0002	-5-- CO3 LT .002	-6-- FINE .002 -.02	-7-- COARSE .02 -.05	-8-- VF .05 -.10	-9-- F .10 -.25	-10- M .25 -.50	-11- C .5 -1	-12- VC 1 -2	-13- 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- WT PCT OF WHOLE SOIL
			(- - -TOTAL - - -)				(- -CLAY- -)	(- -SILT- -)		(- - - - - -SAND- - - - - -)					(-COARSE FRACTIONS(MM)-)(>2MM)				
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2081S	0- 10	AP1	54.2	11.6	34.2	27.9		7.2	4.4	6.2	14.0	9.0	3.4	1.6	1	1	--	29	2
88P2082S	10- 23	AP2	52.0	12.1	35.9	24.8		7.6	4.5	6.8	14.8	8.6	3.2	2.5	1	1	--	31	2
88P2083S	23- 47	BT1	71.3	4.9	23.8	41.4		2.2	2.7	4.6	10.1	5.6	1.9	1.6	2	1	--	22	3
88P2084S	47- 66	BT2	71.5	5.6	22.9	40.9		2.1	3.5	3.9	9.8	5.8	1.9	1.5	2	2	--	22	4
88P2085S	66- 89	BT3	70.6	5.2	24.2	42.2		1.9	3.3	4.7	10.4	6.0	1.9	1.2	2	2	--	23	4
88P2086S	89-124	BT4	70.0	5.5	24.5	36.3		2.5	3.0	4.5	9.5	5.3	2.3	2.9	5	2	--	26	7
88P2087S	124-160	2C/B	63.0	11.6	25.4	4.9		5.9	5.7	5.4	7.9	4.7	3.1	4.3	17	38	--	64	55

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT	OF <2MM -->					PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 10	3.06	0.283			4.0	0.4	0.2	0.32	0.35	45	21		1.24	1.38	0.036			25.3	18.7	0.08
10- 23	1.82	0.136			4.3	0.4	0.2	0.25	0.31				1.48	1.60	0.026			23.8	16.2	0.11
23- 47	0.67	0.078			4.2	0.4	0.1	0.10	0.26				1.44	1.55	0.024			25.9	19.9	0.09
47- 66	0.50	0.065			4.6	0.5	0.1	0.09	0.28	45	23		1.41	1.49	0.018			25.7	20.0	0.08
66- 89	0.35	0.059			4.5	0.5	0.1	0.08	0.28				1.32	1.40	0.019			26.9	19.7	0.09
89-124	0.35	0.052			4.9	0.5	0.1	0.07	0.29				1.27	1.32	0.012			26.9	20.4	0.08
124-160	0.32	0.043			4.2	0.4	TR	0.08	0.32										19.9	

AVERAGES, DEPTH 23- 73: PCT CLAY 71 PCT .1-75MM 22

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-004
SAMPLED AS : KABANYOLO UNIT 2 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 405, SAMPLE 88P2081-2087

PRINT DATE 01/19/90

DEPTH (CM)	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- (- - - -CEC - - -) SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
	<- - - - - - - - - - -MEQ / 100 G							- - - - - - - - - - ->			<- - - - -PCT			- - - ->						
0- 10	7.4	2.2	0.1	1.0	10.7	14.3	0.1	25.0	17.2	10.8	1	43	62					8.4	4.7	4.8
10- 23	5.5	1.4	0.1	0.8	7.8	11.2	0.1	19.0	12.9	7.9	1	41	60					8.8	4.8	5.4
23- 47	2.1	1.1	0.1	0.2	3.5	8.9	0.3	12.4	6.9	3.8	8	28	51					9.1	4.6	5.1
47- 66	1.7	0.9	0.1	0.5	3.2	8.6	0.2	11.8	6.2	3.4	6	27	52					8.8	4.6	5.1
66- 89	1.2	0.6	0.1	0.6	2.5	7.3	0.2	9.8	5.6	2.7	7	26	45					9.0	4.7	5.2
89-124	1.3	0.4	0.1	0.4	2.2	7.6	0.2	9.8	5.2	2.4	8	22	42					9.2	4.8	5.3
124-160	1.1	0.4	0.1	0.3	1.9	6.9	0.3	8.8	4.9	2.2	14	22	39					9.2	4.7	5.2

DEPTH (CM)	(- - - -SPODIC HORIZON CRITERIA - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	<- PCT OF <2MM->			(- -DIVIDED BY- -)			
0- 10		0.3	0.1	0.1	--		
10- 23		0.2	0.1	0.1			
23- 47		0.1	0.1				
47- 66		TR	TR				
66- 89		TR	TR				
89-124		--	0.1	TR	--		
124-160		--	TR				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-004

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KABANYOLO UNIT 2 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 405, SAMPLES 88P2081-2087
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER 0.06 BAR 4B1c	-10- 1- BAR 4B1a	-11- CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 2- BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - PIPETTE - - ><- HYDROMETER - > CLAY <- - -	-14- SILT 3A1c - - ->	-15- SAND	-16- CLAY <- - -	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m ->				<- P P M ->			< - - - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - - - >											< PCT>
88P2081	1	0.08	0.19	0.02	0.17																
88P2082	2	0.05	0.29	0.03	0.23																
88P2083	3	0.07	0.50	0.06	0.19																
88P2084	4	0.06	0.64	0.07	0.20																
88P2085	5	0.04	0.55	0.06	0.17																
88P2086	6	0.05	0.59	0.07	0.21																
88P2087	7	0.04	0.42	0.06	0.18																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-004
SAMPLED AS : KABANYOLO UNIT 2 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 405, SAMPLE 88P2081-2087

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY peak size			THERMAL DTA	THERMAL TGA	ELEMENTAL SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		7A2i	7A3b	7A4b			7C3								
		CLAY MINERALOGY (<.002mm)					ELEMENTAL Percent							mg/g	
88P2082	TCLY	KK 5	HE 2	GE 2				26.0	11.3			0.3			
88P2084	TCLY	KK 5	HE 2	GE 2				28.0	11.3			0.2			
88P2085	TCLY	KK 5	HE 2	GE 2				29.0	11.4			0.2			
88P2087	TCLY	KK 5	HE 2	GE 2				29.0	11.3			0.2			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite GE goethite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 5 KABANYOLO EXPERIMENTAL STATION

Soil Series: Kabanyolo Unit 13
NSSL ID#: 88P0406
Soil Survey #:S87-FN-910-005
Print Date: 11/02/89
Location:Kabanyolo University farm, Uganda
Latitude: 00-28-02-N
Longitude: 032-37-02-E
Classification: Fine, kaolinitic, isohyperthermic Mollic Kandiudalf
Physiography: Hillside or mountainside in hills
Geomorphic Position: shoulder crested hills
Slope: 4% convex east facing
Elevation: 1195 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately rapid
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland-Unplanted
Stoniness:
Erosion : Moderate
Runoff: Slow
Particle Size Control Section: 17 to 67 cm
Parent Material: solid rock from metamorphic material
Diagnostic Horizons: 0 to 17 cm Ochric, 17 to 137 cm Kandic
Described By: D. Goss, D. Yost, E. Ssendiwanyo, J. Tumuhairwe
Date: 09/87
Notes: The clay increases to the Bt2 and decreases thereafter. This soil was located to the East of the solhum on a ridge. This was new land for Kanbanyolo.

Ap1--0 to 17 cm; dark reddish brown (5YR 3/3) moist clay loam; reddish brown (5YR 4/3) dry; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky, plastic; many very fine roots throughout; common very fine tubular pores; 5 percent pebbles quartzite; abrupt wavy boundary. Some areas approaching massive. Quartzite rock fragments in all horizons.
88P2088

Bt1--17 to 35 cm; red (2.5YR 4/6) ped interior and dark reddish brown (2.5YR 3/4) ped exterior moist clay loam; dark yellowish brown (10YR 3/6) and dark reddish brown (2.5YR 3/4) dry; strong coarse angular blocky structure parting to moderate fine and medium angular blocky structure; hard, firm, slightly sticky, plastic; common fine roots; few fine tubular pores; continuous prominent clay films on faces of peds; 5 percent pebbles ironstone; clear wavy boundary. Quartzite rock fragments.
88P2089

Bt2--35 to 56 cm; red (2.5YR 4/6) and dark reddish brown (2.5YR 3/4) moist clay loam; dark red (2.5YR 3/6) and red (2.5YR 4/6) dry; moderate coarse prismatic structure parting to moderate fine and medium angular blocky; very hard, firm, slightly sticky, plastic; few fine roots; few fine continuous tubular pores; continuous prominent clay films on faces of peds; 5 percent pebbles ironstone; clear wavy boundary.
88P2090

Bt3--56 to 90 cm; red (2.5YR 4/6) and dark reddish brown (2.5YR 3/4) moist clay loam; red (2.5YR 4/6) dry; moderate coarse prismatic structure parting to moderate medium angular blocky; hard, friable, slightly sticky, plastic; common very fine roots; few

fine continuous tubular pores; discontinuous prominent clay films on faces of peds; 5 percent pebbles ironstone; clear wavy boundary. The (2.5YR 3/4) organic stained cutans are less abundant than in the previous horizons.
88P2091

Bt4--90 to 110 cm; (10R 4/8) and dark reddish brown (2.5YR 3/4) moist clay loam; red (2.5YR 4/6) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky, plastic; few very fine roots; few very fine continuous tubular and common fine continuous tubular pores; patchy distinct clay films on faces of peds; 10 percent pebbles ironstone; abrupt wavy boundary. Organic coatings continue to decrease.
88P2092

C--110 to 132 cm; dark red (10R 3/6) moist clay loam; dark red (2.5YR 3/6) dry; weak fine and medium subangular blocky structure parting to moderate very fine granular; soft, very friable, slightly sticky, plastic; few very fine continuous tubular pores; patchy faint clay films on faces of peds; 30 percent pebbles ironstone; abrupt wavy boundary. Clay content less than above.
88P2093

Cr--132 to 142 cm; .

S88FN-910-005

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : KABANYOLO UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
REVISED TO : ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 406, SAMPLES 88P2088-2094
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002 <-	SILT .002 -.05	SAND .05 -2	FINE LT .0002	CO3 LT .002	(- -CLAY- -) FINE .002 -.02	(- -SILT- -) COARSE .02 -.05	VF .05 -.10	F .10 -.25	M .25 -.50	C .5 -1	VC 1 -2	(- - - - -SAND- - - - - -) 2 -5	5 -20	(-COARSE FRACTIONS(MM)-) 20 -75	.1- 75	(>2MM) WT PCT OF WHOLE SOIL
			- - - - - - - - - - - - PCT OF <2MM						(3A1) - - - - - - - - - - - - - - ->						<- PCT OF <75MM(3B1)->		
88P2088S	0- 17	AP1	31.6	14.9	53.5	14.0		8.2	6.7	9.6	19.9	13.7	6.8	3.5	1	2	--	46	3
88P2089S	17- 35	BT1	57.3	10.0	32.7	32.0		4.6	5.4	6.3	11.1	7.9	4.2	3.2	TR	--	--	26	TR
88P2090S	35- 56	BT2	59.0	10.0	31.0	32.1		4.9	5.1	5.7	10.7	7.6	4.2	2.8	TR	--	--	25	--
88P2091S	56- 90	BT3	61.4	10.0	28.6	34.3		5.0	5.0	5.9	10.2	6.8	3.5	2.2	TR	--	--	23	TR
88P2092S	90-110	BT4	61.6	10.9	27.5	34.8		5.6	5.3	5.4	9.4	6.0	3.6	3.1	1	TR	--	23	1
88P2093S	110-132	BT5	62.5	10.1	27.4	38.8		4.7	5.4	5.6	9.5	6.1	3.2	3.0	1	--	--	23	1
88P2094S	155-175		57.3	14.4	28.3	32.2		8.5	5.9	6.7	8.3	4.8	4.2	4.3	7	1	--	28	8

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A <-	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B PERCENT	AL 6G7A OF	MN 6D2A <2MM -->	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1 PCT	PI 4F <0.4MM	(- BULK DENSITY -) FIELD MOIST 4A3A <-	1/3 BAR 4A1D G/CC	OVEN DRY 4A1H - ->	COLE WHOLE SOIL 4D1 CM/CM	(- - -WATER CONTENT - -) FIELD MOIST 4B4 <-	1/10 BAR 4B1C -PCT OF	1/3 BAR 4B1C <2MM	15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 17	1.28	0.095			2.8	0.2	0.2	0.27	0.35	28	13		1.65	1.74	0.018			17.9	11.2	0.11
17- 35	0.56	0.069			3.8	0.3	0.1	0.12	0.31				1.51	1.61	0.022			23.0	17.7	0.08
35- 56	0.34	0.052			3.9	0.4	0.1	0.10	0.31	47	24		1.51	1.61	0.022			23.5	18.1	0.08
56- 90	0.26				4.1	0.4	0.1	0.09	0.30				1.50	1.60	0.022			23.4	18.6	0.07
90-110	0.24				4.4	0.4	0.1	0.09	0.30				1.48	1.55	0.015			24.1	18.7	0.08
110-132	0.23				4.1	0.4	0.1	0.09	0.32	46	18		1.36	1.44	0.019			24.0	20.1	0.05
155-175	0.14				3.8	0.3	TR	0.08	0.33										18.8	

AVERAGES, DEPTH 17- 67: PCT CLAY 59 PCT .1-75MM 25

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-005
SAMPLED AS : KABANYOLO UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 406, SAMPLE 88P2088-2094

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	<- NH4OAC EXTRACTABLE BASES ->					ACID-	EXTR	<- CEC ->			AL	BASE	SAT-	CO3 AS	RES.		COND.	PH		
	<- -MEQ / 100 G ->										<- -PCT ->									
0- 17	5.3	1.4	0.1	0.4	7.2	5.9		13.1	8.4			55	86					8.3	5.4	6.0
17- 35	3.1	1.5	0.1	0.3	5.0	6.1		11.1	6.7			45	75					8.7	5.3	5.8
35- 56	2.1	1.4	0.1	0.3	3.9	6.1		10.0	5.9			39	66					8.8	5.1	5.6
56- 90	1.9	1.3	0.1	0.4	3.7	6.4		10.1	5.8			37	64					9.0	5.1	5.7
90-110	1.9	1.1	0.1	0.4	3.5	6.4	--	9.9	5.8			35	60					9.0	5.1	5.5
110-132	1.9	1.1	0.1	0.4	3.5	6.8		10.3	5.7			34	61					9.0	5.1	5.7
155-175	1.9	1.0	0.1	0.3	3.3	5.2		8.5	4.8			39	69					9.1	5.4	5.9

DEPTH (CM)	SPODIC HORIZON CRITERIA: C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI PCT FE+AL	FE+AL/AL+C PCT CLAY	INDEX OF ACCUM PCT CLAY
	<- PCT OF <2MM->					
0- 17		0.1	0.1	0.1		
17- 35		TR	TR			
35- 56		--	TR			
56- 90		--	TR			
90-110		--	TR			
110-132		--	TR			
155-175		--	TR			

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-005

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : KABANYOLO UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 406, SAMPLES 88P2088-2094
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1-BAR 4B1a	-11- 2-BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - - PIPETTE - - ><- HYDROMETER - > CLAY <- - -	-14- SILT 3A1c	-15- SAND - - ->	-16- CLAY <- - -	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m ->			<- P P M ->				< - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - - - >											< PCT>
88P2088	1	0.04	0.34	0.07	0.14																
88P2089	2	0.04	0.41	0.06	0.11																
88P2090	3	0.04	0.43	0.05	0.10																
88P2091	4	0.03	0.37	0.05	0.12																
88P2092	5	0.03	0.36	0.05	0.11																
88P2093	6	0.03	0.27	0.04	0.11																
88P2094	7	0.05	0.15	0.05	0.08																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-005
SAMPLED AS : KABANYOLO UNIT 1 ; FINE, KAOLINITIC, ISOHYPERTHERMIC MOLLIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 406, SAMPLE 88P2088-2094

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY 7A2i peak size					THERMAL DTA 7A3b Percent	TGA 7A4b Percent	ELEMENTAL SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME 7C3 mg/g	INTERPRETATION 7D2
88P2088	TCLY	KK 5	HE 2	GE 2						25.0	9.7			0.5			
88P2090	TCLY	KK 5	HE 2	GE 2	MI 1	VR 1				28.9	10.0			0.3			
88P2093	TCLY	KK 5	HE 2	GE 2						28.0	9.9			0.3			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite GE goethite MI mica VR vermiculite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 6 KABANYOLO EXPERIMENTAL STATION

Soils Series: Kabanyolo Unit 6
NSSL ID#: 88P0407
Soil Survey #: S87-FN-910-006
Location:Kabanyolo University farm, Uganda
Latitude: 00-28-10-N
Longitude: 032-36-48-E
Classification: Fine-loamy, mixed, isohyperthermic Aeric Tropaquept
Physiography: in hills
Geomorphic Position: toeslope sideslope
Slope: 1% convex east facing
Elevation: 1158 m MSL
Precipitation: 116 cm - Aquic Moisture Regime
Water Table Depth: 2.2 meters
Permeability: Moderately slow
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Poorly drained
Land Use: Wetlands
Stoniness: 0
Erosion:
Runoff:
Particle Size Control Section: 61 to 101 cm
Parent Material: alluvium from mixed-igneous & metamorphic material
Diagnostic Horizons: 0 to 61 cm Umbric, 61 to 155 cm Cambic
Described By: D. Goss, D. Yost, J. Tumuharie
Date: 09/87
Notes: This site was on a slight slope at the edge of a swamp. The material is alluvial but a stone line occured at the bottom of the pit.

A1--0 to 18 cm; dark reddish brown (5YR 3/2) moist sandy clay loam; brown (7.5YR 5/2) dry; moderate fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; many fine and many coarse roots throughout; many fine and medium tubular pores; gradual wavy boundary.
88P2095

A2--18 to 38 cm; dark reddish brown (5YR 3/2) moist clay loam; brown (7.5YR 5/2) dry; many medium distinct dark red (2.5YR 3/6) mottles; weak coarse platy structure parting to moderate medium angular blocky; friable, slightly sticky, slightly plastic; many very fine and many medium roots throughout; common fine and medium tubular pores; clear wavy boundary.
88P2096

A/Bt--38 to 61 cm; 40% dark brown (7.5YR 3/2) and 60% very dark brown (10YR 2/2) moist clay loam; brownish yellow (10YR 6/8) and light gray to gray (10YR 6/1) dry; many medium distinct red (2.5YR 4/8) mottles; weak coarse prismatic structure parting to moderate coarse platy; hard, friable, sticky, plastic; common fine and common very fine roots throughout; common fine and medium tubular pores; patchy faint clay films on faces of peds; clear wavy boundary.
88P2097

Bt1--61 to 80 cm; dark grayish brown (10YR 4/2) moist sandy clay; light gray to gray (10YR 6/1) dry; common medium prominent red (2.5YR 5/8) and common medium prominent red (2.5YR 4/8) mottles; moderate coarse prismatic structure parting to

moderate coarse; platy friable, slightly sticky, plastic; few fine roots between peds; few fine tubular pores; patchy faint clay films on faces of peds; clear wavy boundary.
88P2098

Bt2--80 to 109 cm; grayish brown (10YR 5/2) moist sandy clay; light gray to gray (10YR 6/1) dry; common medium prominent red (2.5YR 4/6) mottles; moderate coarse platy structure parting to moderate medium angular blocky; friable, slightly sticky, plastic; few fine roots between peds; few fine tubular pores; patchy distinct clay films on faces of peds; clear wavy boundary.
88P2099

Bt3--109 to 155 cm; gray (10YR 5/1) moist sandy clay; light gray (10YR 7/1) dry; few coarse prominent red (2.5YR 4/6) and many coarse distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; friable, sticky, plastic; few fine roots between peds; few fine tubular pores; patchy distinct clay films on faces of peds; clear wavy boundary.
88P2100

C--155 to 205 cm; bluish gray (5B 5/1) moist sandy clay; bluish gray (5B 6/1) dry; few fine prominent yellowish brown (10YR 5/6) mottles; friable, sticky, plastic; patchy distinct clay films on faces of peds. Stone line at 90 to 200 cm.
88P2101

S88FN-910-006

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KABANYOLO UNIT 6 ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC MOLLIC OCHRAQUALF
REVISED TO : ; FINE-LOAMY, MIXED, ISOHYPERTHERMIC AERIC TROPAQUEPT

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 407, SAMPLES 88P2095-2101
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	FINE LT .0002	CO3 LT .002	(- -CLAY- -) FINE .002 -.02	COARSE .02 -.05	(- - - - - -SILT- -) VF .05 -.10	F .10 -.25	(- - - - - -SAND- - - - - -) M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) 2 -5	5 -20	- - - - WEIGHT - - - - 20 -75	.1- 75	(>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2095S	0- 18	A1	32.4	17.1	50.5	18.8		9.9	7.2	9.7	21.5	13.7	4.1	1.5	TR	TR	--	41	--
88P2096S	18- 38	A2	40.2	16.7	43.1	24.3		9.9	6.8	8.5	17.2	11.3	4.0	2.1	TR	--	--	35	--
88P2097S	38- 61	A/BT	31.0	20.1	48.9	17.1		11.9	8.2	9.3	20.4	12.9	4.6	1.7	TR	--	--	40	--
88P2098S	61- 80	BT1	25.7	17.5	56.8	15.9		9.3	8.2	10.1	23.3	16.1	6.4	0.9	--	--	--	47	--
88P2099S	80-109	BT2	33.1	16.1	50.8	21.3		8.5	7.6	10.3	20.7	13.7	4.6	1.5	TR	--	--	40	--
88P2100S	109-155	BT3	42.6	13.0	44.4	28.4		6.8	6.2	8.2	18.1	10.7	5.2	2.2	1	--	--	37	1
88P2101S	155-205	C	37.5	14.8	47.7	24.7		7.9	6.9	8.9	19.1	12.9	5.0	1.8	1	--	--	39	1

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT	OF <2MM -->					PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 18	1.86	0.135			2.5	0.2	0.1	0.36	0.45	37	17		1.30	1.37	0.018			22.7	14.6	0.11
18- 38	1.74	0.111			3.0	0.3	TR	0.30	0.43				1.28	1.38	0.025			26.0	17.2	0.11
38- 61	1.56	0.092			2.4	0.1	TR	0.40	0.49				1.66	1.75	0.018			18.4	15.1	0.05
61- 80	0.30				1.1	0.1	--	0.24	0.39	24	13		1.64	1.75	0.022			19.2	9.9	0.15
80-109	0.22				1.7	0.1	--	0.21	0.38				1.65	1.78	0.026			19.3	12.7	0.11
109-155	0.19				0.3	TR	--	0.19	0.35				1.73	1.87	0.026			16.8	15.0	0.03
155-205	0.12				2.2	0.1	TR	0.19	0.38	36	24		1.61	1.77	0.032			19.8	14.1	0.09

AVERAGES, DEPTH 38- 88: PCT CLAY 29 PCT .1-75MM 42

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-006
SAMPLED AS : KABANYOLO UNIT 6 ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC MOLLIC OCHRAQUALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 407, SAMPLE 88P2095-2101

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	<- - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - -PCT - - - ->									
0- 18	3.2	1.0	0.1	0.2	4.5	13.0	0.8	17.5	11.5	5.3	15	26	39							
18- 38	3.1	0.9	0.1	0.1	4.2	15.4	1.5	19.6	12.0	5.7	26	21	35					8.3	4.3	4.7
38- 61	3.7	1.3	0.2	TR	5.2	13.2	0.6	18.4	12.5	5.8	10	28	42					9.0	4.2	4.8
61- 80	2.3	1.4	0.2	0.1	4.0	4.4	0.2	8.4	6.1	4.2	5	48	66					8.5	4.3	5.2
80-109	2.8	1.9	0.2	0.1	5.0	4.9	0.2	9.9	7.0	5.2	4	51	71					8.8	4.2	5.1
109-155	4.3	2.0	0.4	0.1	6.8	5.1	0.2	11.9	8.1	7.0	3	57	84					8.8	4.2	5.1
155-205	3.1	1.7	0.2	0.1	5.1	5.6	0.3	10.7	7.2	5.4	6	48	71					8.6	4.1	4.5
																		8.8	4.2	4.9

(- - - -SPODIC HORIZON CRITERIA - - - - -)

DEPTH (CM)	(- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	(- -DIVIDED BY- -) FE+AL DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	<- PCT OF <2MM->						
0- 18		0.4	0.1	0.2			
18- 38		0.5	0.1	0.2			
38- 61		0.4	0.1	0.2			
61- 80		0.1	TR	0.1	--		
80-109		0.1	--	0.1	--		
109-155		0.1	TR	0.3	--		
155-205		TR	TR				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-006

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : KABANYOLO UNIT 6 ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC MOLLIC OCHRAQUALF

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SKSS UGANDA
- PEDON 88P 407, SAMPLES 88P2095-2101
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1-BAR 4B1a	-11- 2-BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - PIPETTE - - ><- HYDROMETER - > CLAY <- - - 3A1c	-14- SILT - - ->	-15- SAND	-16- CLAY	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
		<- P C T o f < 2 m m -><- P P M -><- - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - ><PCT>																			
88P2095	1	0.09	0.74	0.04	0.13																
88P2096	2	0.11	0.94	0.06	0.20																
88P2097	3	0.12	1.30	0.09	0.11																
88P2098	4	0.04	0.32	0.04	0.03																
88P2099	5	0.04	0.35	0.06	0.02																
88P2100	6	0.02	0.18	0.02	0.03																
88P2101	7	0.02	0.24	0.10	0.02																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-006
SAMPLED AS : KABANYOLO UNIT 6 ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC MOLLIC OCHRAQUALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 407, SAMPLE 88P2095-2101

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		CLAY MINERALOGY (<.002mm)																			
		X-RAY						THERMAL					ELEMENTAL							EGME	INTER
								DTA		TGA		SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O		RETN	PRETA
		7A2i						7A3b		7A4b					7C3					7D2	TION
		peak size						Percent					Percent							mg/g	
88P2095	TCLY	KK 5	HE 2	GE 2	VR 1	MI 1							24.0	8.3			0.3				
88P2098	TCLY	KK 5	MT 3	GE 1	MI 1								24.0	7.1			0.4				
88P2101	TCLY	KK 5	MT 3	GE 2	HE 1	MI 1							25.0	8.9			0.3				

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite GE goethite VR vermiculite MI mica MT montmorill

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 7 NAMULONGE EXPERIMENTAL STATION

Soils Series: Namulonge Deep Red
NSSL ID#: 88P0408
Soil Survey #: S87-FN-910-007
Location:Namulonge Experiment Station, Uganda
Latitude: 00-31-36-N
Longitude: 032-38-38-E
Classification: Fine, kaolinitic, isohyperthermic Rhodic Kandiudalf
Geomorphic Position: backslope crested hills
Slope: 6% convex north facing
Elevation: 1128 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately rapid
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland
Stoniness: 0
Erosion:
Runoff:
Parent Material: solid rock from mixed-igneous & metamorphic material
Diagnostic Horizons: 0 to 15 cm Mollic, 36 to 200 cm Argillic
Described By: D. Goss, D. Yost, E. Ssendiwandyo, J. Tumuhairwe
Date: 09/87
Notes: Old soybean field north of Headquarters.

Ap1--0 to 15 cm; dark reddish brown (5YR 3/3) moist sandy clay loam; reddish brown (5YR 4/4) dry; moderate fine and medium subangular blocky structure parting to moderate fine granular; very hard, friable, slightly sticky, plastic; many very fine and many fine roots throughout; many fine discontinuous tubular pores; abrupt wavy boundary.
88P2102

Ap2--15 to 36 cm; dark reddish brown (5YR 3/4) moist sandy clay loam; dark reddish brown (2.5YR 2/4) dry; weak coarse prismatic parting to moderate coarse angular blocky structure; very hard, friable, slightly sticky, plastic; many very fine roots throughout; many fine discontinuous tubular pores; discontinuous faint organic coats on faces of peds; abrupt wavy boundary. Organic stains on ped faces. Some B material with moist color of (2.5YR 3/6).
88P2103

Bt1--36 to 56 cm; dark yellowish brown (10YR 3/6) and dark yellowish brown (10YR 3/4) moist clay loam; red (2.5YR 4/6) and dark reddish brown (2.5YR 3/4) dry; moderate coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, friable, sticky, plastic; many very fine roots between peds; common medium discontinuous tubular and many fine tubular pores; continuous distinct clay films on faces of peds; 5 percent pebbles ironstone; gradual wavy boundary. Cutans stained with organic mottles.
88P2104

Bt2--56 to 79 cm; dark red (10R 3/6) and dusky red (10R 3/2) moist clay loam; dark red (2.5YR 3/6) and red (2.5YR 4/6) dry; moderate coarse prismatic structure parting to moderate medium and coarse angular blocky; very hard, friable, sticky, plastic; common very fine roots between peds; few fine and medium tubular and few very fine tubular pores; continuous distinct clay films on faces of peds; 5 percent pebbles ironstone; clear wavy boundary. Cutans stained with organic matter.
88P2105

Bt3--79 to 100 cm; dark red (10R 3/6) moist clay loam; dark red (10R 3/6) dry; moderate coarse prismatic structure parting to moderate fine and medium angular blocky structure; hard, friable, sticky, plastic; few very fine roots between peds; common fine and medium continuous tubular pores; continuous distinct clay films on faces of peds; 15 percent pebbles ironstone; clear wavy boundary. (10R 3/3) organic stains on a few of the cutans.
88P2106

Bt4--100 to 130 cm; dark red (10R 3/6) and red (10R 4/6) moist clay loam; dark red (10R 3/6) dry; weak fine and medium angular blocky structure; hard, friable, slightly sticky, plastic; very few very fine roots between peds; common fine and medium continuous tubular pores; patchy distinct clay films on faces of peds; 20 percent pebbles ironstone; gradual wavy boundary. Clay skins also on rounded quartzite gravel.
88P2107

Bt5--113 to 200 cm; dark red (10R 3/6) moist clay; red (10R 4/6) and dark red (10R 3/6) dry; strong fine and medium angular blocky structure; slightly hard, friable, slightly sticky, plastic; few fine and medium continuous tubular pores; continuous distinct clay films on faces of peds; neutral (pH=6.8); 20 percent pebbles ironstone. The gravel is of quartzite. Clay skins also on fine gravel.
88P2108

S88FN-910-007

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : NAMULONGE DEEP R ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF
REVISED TO : ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 408, SAMPLES 88P2102-2110
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS(MM) WEIGHT 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- (>2MM) WT PCT OF WHOLE SOIL
			<- PCT OF <2MM (3A1) ->												<- PCT OF <75MM(3B1)->				
88P2102S	0- 15	AP1	28.5	18.5	53.0	14.7		10.6	7.9	10.1	17.8	12.3	7.3	5.5	1	1	--	44	2
88P2103S	15- 36	AP2	31.5	18.1	50.4	14.5		10.7	7.4	9.4	17.2	11.6	6.8	5.4	1	1	--	42	2
88P2104S	36- 56	BT1	46.5	15.2	38.3	30.4		9.0	6.2	7.1	13.0	8.7	5.5	4.0	TR	--	--	31	TR
88P2105S	56- 79	BT2	51.5	13.5	35.0	34.0		7.4	6.1	6.5	11.2	7.6	5.2	4.5	1	TR	--	29	1
88P2106S	79-100	BT3	54.5	12.1	33.4	37.7		6.8	5.4	6.0	9.9	6.8	4.8	5.9	6	3	--	34	9
88P2107S	100-130	BT4	55.5	13.1	31.4	37.6		7.7	5.4	4.9	7.9	5.6	5.0	8.0	12	8	--	41	20
88P2108S	130-200	BT5	54.7	18.3	27.0	32.8		13.0	5.3	5.2	6.9	2.7	3.7	8.5	12	--	--	31	12
88P2109S	178-203		53.1	14.6	32.3	35.4		9.8	4.8	5.6	7.1	5.2	5.9	8.5	5	TR	--	30	5
88P2110S	203-229		56.6	13.7	29.7	34.2		8.5	5.2	5.8	6.2	4.0	5.2	8.5	4	--	--	27	4

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	RATIO/CLAY 15 BAR 8D1	ATTERBERG LIMITS LL 4F1 PCT	PI 4F <0.4MM	BULK DENSITY FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1 CM/CM	WATER CONTENT FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1 CM/CM
				<- PERCENT	OF <2MM -->							<- G/CC - ->				<- -PCT OF <2MM - ->				
0- 15	1.79	0.137			2.7	0.2	0.2	0.39	0.43	32	13		1.42	1.51	0.021			18.7	12.2	0.09
15- 36	1.39	0.104			2.8	0.2	0.2	0.35	0.43				1.68	1.77	0.017			18.3	13.4	0.08
36- 56	0.47	0.065			3.9	0.3	0.1	0.16	0.36				1.59	1.70	0.023			20.1	16.7	0.05
56- 79	0.38				2.6	0.2	0.1	0.13	0.34	48	27		1.53	1.63	0.021			22.1	17.4	0.07
79-100	0.34				3.7	0.3	0.1	0.13	0.34				1.46	1.56	0.021			23.5	18.5	0.07
100-130	0.31				3.7	0.2	TR	0.12	0.35				1.52	1.59	0.013			23.3	19.5	0.05
130-200	0.15				4.3	0.3	TR	0.13	0.35				1.49	1.62	0.026			22.7	19.2	0.05
178-203	0.20				3.9	0.3	TR	0.12	0.34										18.2	
203-229	0.15				3.1	0.2	TR	0.11	0.34										19.3	

AVERAGES, DEPTH 36- 86: PCT CLAY 50 PCT .1-75MM 31

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-007
SAMPLED AS : NAMULONGE DEEP R ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 408, SAMPLE 88P2102-2110

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH CACL2 .01M 8C1F 1:2	-19- PH H2O 8C1F 1:1	-20-
	<- - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - ->										<- - - - -PCT - - - ->									
0- 15	7.6	1.5	TR	1.1	10.2	6.2		16.4	11.1			62	92					5.4	5.9	
15- 36	7.3	1.6	--	0.9	9.8	5.0		14.8	10.9			66	90					5.6	6.2	
36- 56	3.8	1.6	TR	0.7	6.1	4.7		10.8	7.4			56	82					5.6	6.1	
56- 79	2.8	1.8	TR	0.6	5.2	5.1		10.3	6.7			50	78					5.5	6.0	
79-100	2.7	1.7	TR	0.5	4.9	5.4		10.3	7.3			48	67					5.4	5.8	
100-130	2.7	1.5	0.1	0.6	4.9	5.4		10.3	6.5			48	75					5.5	5.9	
130-200	2.9	1.4	0.1	0.9	5.3	5.2		10.5	7.2			50	74					5.7	6.2	
178-203	2.0	0.8	0.2	0.2	3.2	6.9	0.4	10.1	6.5	3.6	11	32	49					4.5	5.2	
203-229	1.9	0.8	0.2	0.2	3.1	6.7	0.5	9.8	6.4	3.6	14	32	48					4.5	5.1	

DEPTH (CM)	C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	(- - - -SPODIC HORIZON CRITERIA - - - - -)						
	(- -NA PYROPHOSPHATE EXTRACTABLE- -)						
				(- -DIVIDED BY- -)			
	<- PCT OF <2MM->						
0- 15		0.2	0.3	0.2			
15- 36		0.1	0.1	0.1			
36- 56		0.1	TR	TR	--		
56- 79		TR	TR				
79-100		--	TR				
100-130		--	TR				
130-200		TR	TR				
178-203		TR	TR				
203-229		TR	TR				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-007

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : NAMULONGE DEEP R ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 408, SAMPLES 88P2102-2110
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- EXTRACTION AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- PHOSPHOUS CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1- BAR 4B1a	-11- 2- BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - PIPETTE - - ><- HYDROMETER - > CLAY <- - - 3A1c	-14- SILT - - ->	-15- SAND	-16- CLAY	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m -><- P P M -><- - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - - ><PCT>																		
88P2102	1	0.04	0.27	0.06	0.11																
88P2103	2	0.05	0.35	0.05	0.15																
88P2104	3	0.03	0.31	0.08	0.10																
88P2105	4	0.04	0.44	0.07	0.11																
88P2106	5	0.05	0.60	0.07	0.15																
88P2107	6	0.05	0.58	0.08	0.16																
88P2108	7	0.04	0.58	0.08	0.16																
88P2109	8	0.04	0.43	0.08	0.14																
88P2110	9	0.03	0.45	0.07	0.13																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-007 PRINT DATE 01/19/90
SAMPLED AS : NAHULONGE DEEP R ; FINE, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 408, SAMPLE 88P2102-2110

SAMPLE NUMBER	FRACTION	X-RAY peak size				THERMAL DTA	TGA	SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		CLAY MINERALOGY (<.002mm)						ELEMENTAL Percent								
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
88P2103	TCLY	KK 5	HE 2	GE 1	MI 1							25.0	10.3			0.7				
88P2105	TCLY	KK 5	HE 2	GE 1	MI 1							27.0	9.6			0.5				
88P2108	TCLY	KK 5	HE 2	GE 1	MI 1							28.0	10.2			0.5				
88P2110	TCLY	KK 5	HE 2	GE 1	MI 1							28.0	10.0			0.4				

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite GE goethite MI mica

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 8 KABANYOLO EXPERIMENTAL STATION

Soils Series: Kabanyolo Unit 1
NSSL ID#: 88P0409
Soil Survey #: S87-FN-910-008
Location:Kabanyolo University farm, Uganda
Latitude: 00-28-00-M
Longitude: 032-36-36-E
Classification: Very-fine, kaolinitic, isohyperthermic Kandiudalfic Eutrudox
Geomorphic Position: backslope crested hills
Slope: 4% convex
Elevation: 1186 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately rapid
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland-Tilled field
Stoniness: 0
Erosion:
Runoff:
Particle Size Control Section: 38 to 88 cm
Parent Material: solid rock from mixed-igneous & metamorphic material
Diagnostic Horizons: 0 to 38 cm Ochric, 38 to 200 cm Kandic
Described By: D. Goss, D. Yost, E. Ssendiwanyo, J. Tumuhairwe
Date: 09/87
Notes: South housing. Location of experimental field for IBSNAT.

Ap1--0 to 15 cm; dark reddish brown (5YR 3/3) moist clay loam; weak medium and coarse subangular blocky structure parting to moderate very fine granular; hard, friable, sticky, plastic; common fine roots; few very fine interstitial pores; clear wavy boundary.
88P2111

Ap2--15 to 38 cm; dark reddish brown (5YR 3/3) moist clay loam; dry; weak medium and coarse subangular blocky structure parting to moderate very fine granular; hard, friable, sticky, plastic; many fine roots; common fine continuous tubular and few medium continuous tubular pores; abrupt wavy boundary.
88P2112

Bt1--38 to 63 cm; dark red (2.5YR 3/6) moist clay dark red (2.5YR 3/6) dry; moderate medium subangular blocky structure parting to moderate fine angular blocky; very hard, friable, sticky, plastic; common very fine roots; common fine continuous tubular and few medium continuous tubular pores; many patchy distinct manganese or iron-manganese coats on faces of peds and many patchy distinct clay films on faces of peds; 7 percent pebbles ironstone; clear wavy boundary. Stains may not be manganese.
88P2113

Bt2--63 to 86 cm; dark red (2.5YR 3/6) moist clay; red (2.5YR 4/6) dry; weak coarse prismatic structure parting to weak coarse angular blocky parting to moderate fine angular blocky; very hard, friable, very sticky, plastic; common very fine roots; few very fine tubular and few medium tubular pores; many patchy faint manganese or iron-manganese coats on faces of peds and many patchy faint clay films on faces of peds; gradual wavy boundary. Stains may not be manganese.
88P2114

Bt3--86 to 120 cm; red (2.5YR 4/6) moist clay; red (2.5YR 4/6) dry; weak medium angular blocky structure parting to moderate fine angular blocky; very hard, friable, very sticky, plastic; few very fine roots; few very fine tubular and few medium continuous tubular pores; many patchy faint manganese or iron-manganese coats on faces of peds and many patchy faint clay films on faces of peds; 10 percent pebbles ironstone; clear wavy boundary. Manganese stains much less than above.
88P2115

Bt4--120 to 160 cm; red (2.5YR 4/6) moist clay; red (2.5YR 4/8) dry; moderate medium angular blocky structure parting to moderate fine granular; slightly hard, very friable, sticky, plastic; few fine continuous tubular pores; patchy faint clay films on faces of peds; 10 percent pebbles ironstone; diffuse wavy boundary.
88P2116

Bt5--160 to 200 cm; red (2.5YR 4/6) moist clay loam; red (2.5YR 4/6) dry; moderate medium subangular blocky structure parting to moderate fine granular; hard, very friable, slightly sticky, plastic; few fine continuous tubular pores; patchy faint clay films on faces of peds; 5 percent pebbles ironstone.
88P2117

S88FN-910-008

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : KABANYOLO UNIT 1 ; FINE, ISOHYPERTHERMIC RHODIC KANDIUALF
REVISED TO : ; VERY-FINE, KAOLINITIC, ISOHYPERTHERMIC KANDIUDALFIC EUTRUDOX

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 409, SAMPLES 88P2111-2119
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- TOTAL FINE LT .0002	-5-- CLAY- CO3 LT .002	-6-- SILT- FINE .002 -.02	-7-- SILT- COARSE .02 -.05	-8-- SAND- VF .05 -.10	-9-- SAND- F .10 -.25	-10- SAND- M .25 -.50	-11- SAND- C .5 -1	-12- SAND- VC 1 -2	-13- COARSE FRACTIONS(MM) WEIGHT 2 -5	-14- COARSE FRACTIONS(MM) WEIGHT 5 -20	-15- COARSE FRACTIONS(MM) WEIGHT 20 -75	-16- COARSE FRACTIONS(MM) WEIGHT .1- 75	-17- (>2MM) WT PCT OF WHOLE SOIL
			<- PCT OF <2MM (3A1)												<- PCT OF <75MM(3B1)->				
88P2111S	0- 15	AP1	45.6	16.1	38.3	22.3		10.1	6.0	7.2	15.3	10.4	3.9	1.5	2	1	--	33	3
88P2112S	15- 38	AP2	48.2	14.4	37.4	25.0		8.8	5.6	7.1	15.0	10.2	3.6	1.5	TR	TR	--	30	TR
88P2113S	38- 63	BT1	63.0	12.5	24.5	33.1		7.7	4.8	5.0	9.6	6.1	2.8	1.0	TR	TR	--	19	--
88P2114S	63- 86	BT2	65.0	11.9	23.1	33.3		8.1	3.8	5.1	9.0	5.6	2.3	1.1	1	--	--	19	1
88P2115S	86-120	BT3	65.4	12.4	22.2	32.8		8.1	4.3	4.7	8.6	5.3	2.3	1.3	TR	--	--	17	TR
88P2116S	120-160	BT4	65.0	12.8	22.2	37.5		8.8	4.0	4.8	8.8	5.4	2.1	1.1	TR	TR	--	17	--
88P2117S	160-200	BT5	66.5	11.7	21.8	32.6		8.0	3.7	5.1	8.5	4.7	2.3	1.2	1	TR	--	18	1
88P2118S	216-244		64.9	13.2	21.9	29.3		9.7	3.5	5.4	8.3	4.5	2.1	1.6	3	TR	--	19	3
88P2119S	244-274		66.6	12.2	21.2	28.8		8.3	3.9	4.8	7.9	4.3	2.3	1.9	1	--	--	17	1

DEPTH (CM)	-18- ORGN C 6A1C PCT	-19- TOTAL N 6B3A <2MM	-20- EXTR P 6S3 PPM	-21- TOTAL S 6R3A	-22- DITH-CIT EXTRACTABLE FE 6C2B	-23- DITH-CIT EXTRACTABLE AL 6G7A	-24- DITH-CIT EXTRACTABLE MN 6D2A	-25- CEC 8D1	-26- RATIO/CLAY 15 BAR 8D1	-27- ATTERBERG LIMITS LL 4F1	-28- ATTERBERG LIMITS PI 4F	-29- BULK DENSITY FIELD MOIST 4A3A	-30- BULK DENSITY 1/3 BAR 4A1D	-31- BULK DENSITY OVEN DRY 4A1H	-32- COLE WHOLE SOIL 4D1	-33- WATER CONTENT FIELD MOIST 4B4	-34- WATER CONTENT 1/10 BAR 4B1C	-35- WATER CONTENT 1/3 BAR 4B1C	-36- WATER CONTENT 15 BAR 4B2a	-37- WRD WHOLE SOIL 4C1
	PCT	<2MM	PPM	<- PERCENT OF <2MM -->						PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 15	2.14	0.156			2.5	0.3	0.3	0.30	0.37	41	20		1.44	1.55	0.024			21.8	16.7	0.07
15- 38	1.87	0.138			2.4	0.2	--	0.26	0.33				1.47	1.58	0.024			20.7	15.9	0.07
38- 63	0.48	0.064			5.3	0.5	0.2	0.10	0.31				1.49	1.58	0.020			24.2	19.4	0.07
63- 86	0.32				4.6	0.4	0.1	0.10	0.30	49	27			1.19					19.5	
86-120	0.24				4.5	0.4	0.1	0.09	0.30				1.44	1.51	0.016			24.5	19.8	0.07
120-160	0.17				4.6	0.4	0.1	0.09	0.30					1.21					19.5	
160-200	0.15				4.3	0.4	0.1	0.09	0.30				1.38	1.45	0.016			24.1	19.7	0.06
216-244	0.16				3.7	0.3	0.1	0.10	0.30										19.6	
244-274	0.21				2.4	0.2	0.1	0.09	0.30										20.3	

AVERAGES, DEPTH 38- 88: PCT CLAY 64 PCT .1-75MM 19

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-008
SAMPLED AS : KABANYOLO UNIT 1 ; FINE, ISOHYPERTHERMIC RHODIC KANDIUALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 409, SAMPLE 88P2111-2119

PRINT DATE 01/19/90

DEPTH (CM)	-1- CA 5B5A 6N2E	-2- MG 5B5A 6O2D	-3- NA 5B5A 6P2B	-4- K 5B5A 6Q2B	-5- SUM BASES	-6- ACID-ITY 6H5A	-7- EXTR AL 6G9b	-8- SUM CATS 5A3A	-9- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC	- - -)		AL	-BASE	SAT-	CO3 AS	RES.		COND.	(- - - -PH	- - -)	
	<- - - - - - - - - - -MEQ / 100 G - - - - - - - - - - ->										<- - - - -PCT - - - ->									
0- 15	4.8	1.1	0.2	0.1	6.2	14.0	0.8	20.2	13.6	7.0	11	31	46					9.0	4.3	4.7
15- 38	3.7	0.6	0.2	0.1	4.6	14.8	1.6	19.4	12.7	6.2	26	24	36					9.0	4.2	4.6
38- 63	2.9	0.6	0.2	--	3.7	7.9	0.2	11.6	6.5	3.9	5	32	57					9.4	4.7	5.1
63- 86	2.7	0.9	0.1	--	3.7	7.0	--	10.7	6.3			35	59					9.6	5.1	5.5
86-120	2.4	0.9	0.2	--	3.5	5.6		9.1	5.9			38	59					9.7	5.4	5.6
120-160	2.7	0.6	0.2	--	3.5	5.0		8.5	6.1			41	57					9.4	5.6	5.8
160-200	3.1	0.4	0.2	--	3.7	5.2		8.9	5.9			42	63					9.4	5.8	5.9
216-244	3.2	0.3	0.2	0.1	3.8	4.5		8.3	6.4			46	59					9.4	6.0	6.5
244-274	3.4	0.2	0.2	0.1	3.9	4.3		8.2	6.1			48	64					9.4	6.1	6.4

DEPTH (CM)	(- - - -SPODIC HORIZON CRITERIA - - - - -)						
	(- -NA PYROPHOSPHATE EXTRACTABLE- -)						INDEX
	C	FE	AL	FE+AL	FE+AL	AL+C	OF
				(- -DIVIDED BY- -)			ACCUM
	6A4A	6C8A	6G10	DI-CI	PCT	PCT	
	<- PCT OF <2MM->			FE+AL	CLAY	CLAY	
0- 15		0.3	0.1	0.1			
15- 38		0.3	0.1	0.2			
38- 63		TR	TR				
63- 86		TR	--				
86-120		TR	--				
120-160		--	--				
160-200		--	--				
216-244		--	--				
244-274		TR	TR				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-008

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : KABANYOLO UNIT 1 ; FINE, ISOHYPERTHERMIC RHODIC KANDIUALF

PRINT DATE 01/19/90

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 409, SAMPLES 88P2111-2119
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- EXTRACTION AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- PHOSPHOUS CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1-BAR 4B1a	-11- 2-BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - - PIPETTE - - ><- HYDROMETER - > CLAY <- - - 3A1c	-14- SILT - - ->	-15- SAND	-16- CLAY <- - - SML	-17- SILT - - ->	-18- SAND	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m -><- P P M -><- - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - - ><PCT>																		
88P2111	1	0.08	0.63	0.07	0.31																
88P2112	2	0.07	0.57	0.06	0.28																
88P2113	3	0.05	0.60	0.07	0.16																
88P2114	4	0.05	0.47	0.05	0.14																
88P2115	5	0.05	0.61	0.06	0.15																
88P2116	6	0.05	0.69	0.07	0.16																
88P2117	7	0.06	0.77	0.08	0.20																
88P2118	8	0.05	0.63	0.06	0.19																
88P2119	9	0.05	0.63	0.07	0.18																

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 9 NAMULONGE EXPERIMENTAL STATION

Soils Series: Namulonge
NSSL ID#: 88P0410
Soil Survey #: S87-FN-910-009
Location:
Latitude: 00-31-44-N
Longitude: 032-38-38-E
Classification: Clayey-skeletal, kaolinitic, isohyperthermic Rhodic Kandiudult
Geomorphic Position: backslope crested hills
Slope: 11% convex north facing
Elevation: 1122 m MSL
Precipitation: cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately slow
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Well drained
Land Use: Cropland
Stoniness: 0
Erosion:
Runoff:
Particle Size Control Section: 30 to 80 cm
Parent Material: solid rock from metamorphic material
Diagnostic Horizons: 0 to 15 cm Umbric, 30 to 137 cm Argillic
Described By: D. Goss, D. Yost, J. Tumuhairwe, E. Ssendiwanyo
Date: 09/87
Notes: Located in unused field north of headquarters.

Ap--0 to 15 cm; dark reddish brown (5YR 3/2) moist sandy clay loam; reddish brown (5YR 4/3) dry; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky, slightly plastic; many fine and many very fine roots throughout; common very fine interstitial pores; 25 percent cobbles ironstone; abrupt wavy boundary.
88P2120

A/B--15 to 30 cm: 50% dark red (2.5YR 3/6) and 50% dark reddish brown (2.5YR 2/4) moist very gravelly clay loam; red (2.5YR 4/6) and dark reddish brown (2.5YR 3/4) dry; moderate fine and medium angular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine and common fine roots throughout; few very fine interstitial and few very fine tubular pores; 70 percent pebbles ironstone; abrupt wavy boundary. Gravel tends to control schist (1 to 2 1/2 inches). Quartzite and gneiss rock fragments.
88P2121

Bt1--30 to 53 cm; dark red (10R 3/6) moist very gravelly clay loam; dark red (10R 3/6) dry; moderate fine angular blocky structure; hard, friable, sticky, plastic; few very fine roots throughout; few very fine tubular pores; patchy distinct clay films on faces of peds; 50 percent pebbles ironstone; gradual wavy boundary. Fine and coarse gravel rock fragments. Cutans on rock fragments.
88P2122

Bt2--53 to 81 cm; dark red (10R 3/6) moist very gravelly clay loam; dark red (2.5YR 3/6) dry; moderate medium angular blocky structure; hard, friable, sticky, plastic; few very

fine roots throughout; few very fine tubular pores; continuous distinct clay films on faces of peds; 35 percent pebbles ironstone; gradual wavy boundary. Irregular rock fragments content from 20-45 percent. Cutans on rock fragments.
88P2123

Bt3--81 to 137 cm; dark red (10R 3/6) moist very gravelly sandy clay loam; weak fine and medium angular blocky structure; hard, friable, sticky, plastic; few very fine tubular pores; continuous distinct clay films on faces of peds; 25 percent pebbles ironstone; gradual wavy boundary. 1/2 to 3/4 rock fragments. Cutans on rock fragments. Clay skins more prominent than above.
88P2124

B/Ct--137 to 163 cm; 40% red (10R 4/8) and 60% dark red (10R 3/6) moist gravelly sandy clay loam; weak medium subangular blocky structure; patchy distinct clay films on faces of peds; 15 percent pebbles ironstone. Weathering gneiss with cutans in cracks. The gneiss is very soft. Some rock structure remaining.
88P2125

S88FN-910-009

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : NAMULONGE GRAVEL ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC TYPIC KANHAPLUDALF
REVISED TO : ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC RHODIC KANDIUDULT

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 410, SAMPLES 88P2120-2126
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- TOTAL FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS(MM) WEIGHT 2 -5	-14- COARSE FRACTIONS(MM) WEIGHT 5 -20	-15- COARSE FRACTIONS(MM) WEIGHT 20 -75	-16- COARSE FRACTIONS(MM) WEIGHT .1- 75	-17- (>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2120S	0- 10	AP	29.0	15.6	55.4	16.2		8.5	7.1	8.5	19.5	12.6	7.3	7.5	3	1	--	49	4
88P2121S	10- 30	A/B	36.0	11.6	52.4	23.0		6.2	5.4	6.2	13.1	8.6	9.3	15.2	16	16	19	74	51
88P2122S	30- 53	BT1	51.1	10.6	38.3	33.8		5.3	5.3	5.7	9.3	6.3	7.1	9.9	17	19	--	57	36
88P2123S	53- 81	BT2	58.2	10.1	31.7	37.2		5.3	4.8	5.3	6.8	4.2	5.1	10.3	10	2	--	35	12
88P2124S	81-137	BT3	62.7	10.5	26.8	41.8		5.2	5.3	4.7	6.9	4.1	3.9	7.2	12	9	3	41	24
88P2125S	137-163	B/CT	54.4	20.0	25.6	36.9		6.7	13.3	3.6	5.5	4.2	5.1	7.2	6	TR	--	27	6
88P2126S	201-229														6	TR	--		6

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A <- PERCENT	DITH-CIT EXTRACTABLE FE 6C2B OF	AL 6G7A <2MM -->	MN 6D2A	CEC 8D1	RATIO/CLAY 15 BAR 8D1	ATTERBERG LIMITS LL 4F1 PCT	PI 4F <0.4MM	BULK DENSITY FIELD MOIST 4A3A <- -	1/3 BAR 4A1D G/CC	OVEN DRY 4A1H - - ->	COLE WHOLE SOIL 4D1 CM/CM	WATER CONTENT FIELD MOIST 4B4 <- -	1/10 BAR 4B1C -PCT OF	1/3 BAR 4B1C <2MM	15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 10	1.86	0.135			2.3	0.3	0.1	0.38	0.37	35	16			1.18					10.7	
10- 30	0.84	0.073			2.6	0.2	0.1	0.21	0.34					1.18					12.1	
30- 53	0.63				3.1	0.3	TR	0.17	0.32	50	29		1.40	1.51	0.020			24.0	16.6	0.08
53- 81	0.45				4.1	0.3	TR	0.14	0.32				1.44	1.52	0.017			24.9	18.5	0.09
81-137	0.27				3.6	0.2	TR	0.14	0.31				1.40	1.47	0.014			25.9	19.5	0.08
137-163	0.24				3.5	0.3	TR	0.13	0.35	50	29		1.40	1.47	0.016			26.2	18.8	0.10
201-229	0.09				4.5	0.2	TR			46	22								18.2	

AVERAGES, DEPTH 30- 80: PCT CLAY 55 PCT .1-75MM 45

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-009
SAMPLED AS : NAMULONGE GRAVEL ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC TYPIC KANHAPLUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 410, SAMPLE 88P2120-2126

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17-	-18- COND. MMHOS /CM 8I	-19- PH NAF 8C1D	-20- PH CACL2 .01M 8C1F 1:2	PH H2O 8C1F 1:1
	(- NH4OAC EXTRACTABLE BASES -)							(- - - -CEC - - -)				-BASE SAT-		CO3 AS	RES.			COND.	(- - - -PH - - -)		
	<- - - - - - - - - - -MEQ / 100 G - - - - - - - - - - ->										<- - - - -PCT - - - ->										
0- 10	3.2	1.2	0.1	0.3	4.8	9.7	0.2	14.5	11.0	5.0	4	33	44						8.6	4.6	5.3
10- 30	1.4	0.6	0.1	--	2.1	8.2	1.0	10.3	7.7	3.1	32	20	27						8.7	4.2	5.0
30- 53	1.4	0.6	0.1	--	2.1	8.7	1.2	10.8	8.5	3.3	36	19	25						8.9	4.2	4.9
53- 81	1.7	0.7	0.1	--	2.5	8.5	1.0	11.0	7.9	3.5	29	23	32						9.0	4.4	5.1
81-137	2.3	0.8	0.1	--	3.2	8.0	0.7	11.2	8.6	3.9	18	29	37						9.0	4.4	5.2
137-163	1.9	0.7	0.1	--	2.7	7.5	0.5	10.2	7.0	3.2	16	26	39						8.9	4.5	5.3
201-229	2.5	1.2	0.2	0.8	4.7	4.4		9.1	6.5			52	72						9.2	6.0	6.4

DEPTH (CM)	C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	(- - - -SPODIC HORIZON CRITERIA - - - - -)						
	(- -HA PYROPHOSPHATE EXTRACTABLE- -)						
				(- -DIVIDED BY- -)			
	<- PCT OF <2MM->						
0- 10		0.3	0.2	0.2	TR		
10- 30		0.4	0.1	0.2			
30- 53		0.2	0.1	0.1			
53- 81		TR	TR				
81-137		--	TR				
137-163		--	TR				
201-229		--	--				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-009

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : NAMULONGE GRAVEL ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC TYPIC KANHAPLUDALF

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 410, SAMPLES 88P2120-2126
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OXALATE EXTRACTION OPT DEN 8J	-2-- FE 6C9a	-3-- SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1- BAR 4B1a	-11- 2- BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - PIPETTE - - ><- HYDROMETER - > CLAY <- - - 3A1c	-14- SILT - - ->	-15- SAND	-16- CLAY	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m -><- P P M -><- - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - ><PCT>																		
88P2120	1	0.07	0.46	0.06	0.21																
88P2121	2	0.05	0.42	0.02	0.14																
88P2122	3	0.05	0.36	0.04	0.18																
88P2123	4	0.05	0.44	0.05	0.21																
88P2124	5	0.05	0.53	0.07	0.18																
88P2125	6	0.04	0.39	0.06	0.14																
88P2126	7	0.03	0.44	0.08	0.10																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-009
SAMPLED AS : NAMULONGE GRAVEL ; CLAYEY-SKELETAL, KAOLINITIC, ISOHYPERTHERMIC TYPIC KANHAPLUDALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 410, SAMPLE 88P2120-2126

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY peak size				THERMAL DTA	TGA	ELEMENTAL SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		CLAY MINERALOGY (<.002mm)						Percent							<mg/g>	
88P2120	TCLY	KK 5	HE 2	GE 1	MI 1				24.0	9.4			0.6			
88P2122	TCLY	KK 5	HE 2	GE 1	MI 1				27.0	9.7			0.4			
88P2125	TCLY	KK 5	HE 2	GE 1					28.0	9.0			0.3			
88P2126	TCLY	KK 5	HE 2	GE 1					29.0	10.2			0.5			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite GE goethite MI mica

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 10 ADDITIONAL PEDON SAMPLED IN THE VICINITY OF KAMPALA

(Not included in the report)

Soils Series: Kasule
NSSL ID#: 88P0411
Soil Survey #: S87-FN- -010
Location:
Latitude: 00-24-36-N
Longitude: 032-33-42-E
Classification: Fine-loamy, isohyperthermic Typic Paleudult
Physiography: Playa or alluvial flat in hills
Geomorphic Position: footslope sideslope
Microrelief:
Slope: 2% plane west facing
Elevation: 1173 m MSL
Precipitation: 116 cm - Udic Moisture Regime
Water Table Depth: 0
Permeability: Moderately rapid
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage: Moderately well drained
Land Use: Cropland
Stoniness: 0
Erosion:
Runoff:
Parent Material:
Diagnostic Horizons: 0 to 37 cm Umbric, 37 to 51 cm Albic, 51 to 150 cm Placic
Described By: D. Goss, N. Smeck, J. Tumuhairwe
Date: 09/87

Ap--0 to 20 cm; very dark gray (10YR 3/1) moist sandy loam; dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable, nonsticky, nonplastic; many fine roots throughout; clear smooth boundary.
88P2127

A1--20 to 37 cm; very dark gray (10YR 3/1) moist sandy loam; gray (10YR 5/1) dry; slightly hard, friable, nonsticky, nonplastic; common fine and few very fine roots throughout; gradual smooth boundary.
88P2128

E--37 to 51 cm; brown (10YR 5/3) moist fine sandy loam; grayish brown (10YR 5/2) dry; strong medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine and few very fine roots throughout; clear smooth boundary. Worm coats of (10YR 3/1), many and about 2 mm in diameter. This is probably an E.
88P2129

Bt1--51 to 76 cm; yellowish brown (10YR 5/6) moist sandy clay loam; strong medium subangular blocky structure; very hard, firm, slightly sticky, plastic; few very fine roots throughout; patchy distinct brown to dark brown (10YR 4/3) coats on faces of peds; gradual smooth boundary. Common (10YR 3/1) worm casts.
88P2130

Bt2--76 to 98 cm; yellowish brown (10YR 5/6) moist clay loam; strong coarse subangular blocky structure; extremely hard, firm, slightly sticky, plastic; few very fine roots throughout; patchy distinct brown to dark brown (10YR 4/3) coats on horizontal faces of peds and patchy distinct brown to dark brown (10YR 4/3) coats on vertical faces of peds; gradual smooth boundary. Few (10YR 3/1) worm casts.
88P2131

Bt3--98 to 119 cm; yellowish brown (10YR 5/6) moist clay loam; few fine prominent yellowish red (5YR 4/6) mottles; strong medium subangular blocky structure; extremely hard, firm, sticky, plastic; few very fine roots throughout; continuous distinct yellowish brown (10YR 5/6) coats on vertical faces of peds; gradual smooth boundary. Mottles surrounding worm casts. 30% (10YR 4/1) worm casts 2 to 5 mm in diameter.
88P2132

Bt4--119 to 136 cm; yellowish brown (10YR 5/6) moist clay; few medium distinct light gray to gray (10YR 6/1) and few fine prominent yellowish red (5YR 4/6) mottles; strong medium prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky, plastic; few very fine roots throughout; continuous distinct yellowish brown (10YR 5/6) coats on vertical faces of peds; few fine rounded soft masses of iron; gradual smooth boundary. 25% (10YR 4/1) worm casts 2 to 4 mm in diameter.
88P2133

Bt5--136 to 150 cm; yellowish brown (10YR 5/6) moist clay loam; many medium prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; strong medium prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky, plastic; few very fine roots throughout; continuous distinct light brownish gray (10YR 6/2) coats on faces of peds; few fine rounded soft masses of iron; gradual smooth boundary. Gray coatings on about 25%. 10% (10YR 4/1) worm casts 2 mm in diameter.
88P2134

B/C--150 to 160 cm; yellowish brown (10YR 5/6) moist clay loam; many fine prominent yellowish red (5YR 4/6) mottles; strong medium subangular blocky structure; hard, friable, sticky, plastic; continuous distinct light gray to gray (10YR 6/1) coats on faces of peds. Gray coatings are about 60%.
88P2135

S88FN-910-010

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KASULE ; FINE-LOAMY, ISOHYPERTHERMIC MOLLIC OCHRAQUALF
REVISED TO : ; FINE-LOAMY, ISOHYPERTHERMIC TYPIC PALEUDULT

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 411, SAMPLES 88P2127-2135
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	FINE LT .0002	(- -CLAY- -) CO3 LT .002	(- -SILT- -) FINE .002 -.02	COARSE .02 -.05	(- - - - - -SAND- - - - - -) VF .05 -.10	F .10 -.25	M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) 2 -5	5 -20	20 -75	(>2MM) .1- 75	WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2127S	0- 20	AP	14.5	13.9	71.6	7.0		5.7	8.2	15.6	35.3	15.6	4.2	0.9	--	--	--	56	--
88P2128S	20- 37	A1	14.4	13.4	72.2	7.0		5.6	7.8	15.1	36.7	15.2	4.3	0.9	TR	--	--	57	--
88P2129S	37- 51	E	14.4	12.6	73.0	6.3		5.2	7.4	15.7	36.2	15.3	4.4	1.4	TR	TR	--	57	TR
88P2130S	51- 76	Bt1	26.6	11.7	61.7	14.2		5.1	6.6	13.0	30.9	13.1	3.7	1.0	--	--	--	49	--
88P2131S	76- 98	BT2	30.6	11.6	57.8	16.4		5.2	6.4	13.9	28.4	11.8	3.0	0.7	TR	--	--	44	--
88P2132S	98-119	BT3	34.5	11.6	53.9	18.4		5.1	6.5	12.3	26.8	10.9	2.6	1.3	TR	--	--	42	--
88P2133S	119-136	BT4	35.4	11.6	53.0	20.7		5.6	6.0	12.5	25.8	10.0	2.9	1.8	1	TR	--	41	1
88P2134S	136-150	BT5	32.5	11.7	55.8	18.8		5.7	6.0	10.9	24.0	11.0	4.7	5.2	4	--	--	47	4
88P2135S	150-160	B/C	32.9	11.4	55.7	18.7		5.0	6.4	11.7	23.9	11.4	4.6	4.1	2	TR	--	45	2

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT	OF <2MM -->					PCT	<0.4MM	<- - G/CC	- - ->		CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
0- 20	1.39	0.100			0.7	0.1	TR	0.55	0.45	24	6		1.21	1.26	0.014			18.9	6.5	0.15
20- 37	0.90	0.056			0.8	0.1	TR	0.42	0.42					1.20					6.0	
37- 51	0.52	0.036			0.9	0.1	TR	0.30	0.38				1.49	1.55	0.013			15.8	5.5	0.15
51- 76	0.41	0.038			1.8	0.2	--	0.19	0.38	28	14		1.62	1.69	0.014			15.8	10.0	0.09
76- 98	0.41				2.0	0.2	--	0.18	0.37				1.59	1.68	0.019			18.7	11.2	0.12
98-119	0.44				2.2	0.2	TR	0.17	0.37				1.57	1.69	0.025			19.8	12.9	0.11
119-136	0.33				2.5	0.2	--	0.17	0.37	33	17		1.63	1.72	0.018			18.2	13.2	0.08
136-150	0.25				3.7	0.3	--	0.17	0.39				1.64	1.73	0.018			17.9	12.6	0.08
150-160	0.20				2.3	0.2	--	0.16	0.40				1.64	1.72	0.016			17.4	13.1	0.07

AVERAGES, DEPTH 51- 81: PCT CLAY 27 PCT .1-75MM 48

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-010
SAMPLED AS : KASULE ; FINE-LOAMY, ISOHYPERTHERMIC MOLLIC OCHRAQUALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 411, SAMPLE 88P2127-2135

PRINT DATE 01/19/90

DEPTH (CM)	-1- CA 5B5A	-2- MG 5B5A	-3- NA 5B5A	-4- K 5B5A	-5- SUM BASES	-6- ACIDITY 6H5A	-7- EXTRAL 6G9b	-8- SUM CATS 5A3A	-9- CEC NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE	SAT-	CO3 AS	RES.		COND.	(- - - -PH - - -)		
	<- - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - ->										<- - - - -PCT - - - ->									
0- 20	2.7	0.8	0.1	0.1	3.7	8.9	0.5	12.6	8.0	4.2	12	29	46					7.9	4.2	4.5
20- 37	0.9	0.2	0.1	--	1.2	7.8	1.4	9.0	6.1	2.6	54	13	20					8.4	3.9	4.5
37- 51	0.6	0.1	0.1	--	0.8	4.8	1.2	5.6	4.3	2.0	60	14	19					8.4	3.9	4.5
51- 76	0.9	0.5	0.1	--	1.5	5.6	1.4	7.1	5.0	2.9	48	21	30					8.5	4.0	4.6
76- 98	1.5	0.7	TR	--	2.2	5.8	0.9	8.0	5.6	3.1	29	27	39					8.9	4.1	4.6
98-119	2.4	1.1	--	--	3.5	5.5	0.4	9.0	6.0	3.9	10	39	58					8.8	4.3	4.8
119-136	2.4	1.1	--	--	3.5	5.5	0.5	9.0	5.9	4.0	13	39	59					8.7	4.2	4.8
136-150	1.8	1.0	--	--	2.8	5.7	0.4	8.5	5.6	3.2	13	33	50					8.8	4.3	4.9
150-160	1.5	0.9	--	--	2.4	5.3	0.6	7.7	5.1	3.0	20	31	47					8.9	4.2	4.9

DEPTH (CM)	C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	(- - - -SPODIC HORIZON CRITERIA - - - - -)						
	(- -NA PYROPHOSPHATE EXTRACTABLE- -)						
	<- PCT OF <2MM->			(- -DIVIDED BY- -)			
0- 20		0.3	0.3	0.8			
20- 37		0.3	0.2	0.6			
37- 51		0.2	0.3	0.5			
51- 76		0.3	TR	0.2			
76- 98		0.4	0.1	0.2			
98-119		0.4	0.1	0.2			
119-136		0.3	TR	0.1			
136-150		0.3	TR	0.1			
150-160		0.1	TR	TR	--		

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-010

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : KASULE ; FINE-LOAMY, ISOHYPERTHERMIC MOLLIC OCHRAQUALF

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 411, SAMPLES 88P2127-2135
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- EXTRACTION AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- PHOSPHOUS CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1- BAR 4B1a	-11- 2- BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - - PIPETTE - - ><- HYDROMETER - > CLAY <- - -	-14- SILT 3A1c	-15- SAND - - ->	-16- CLAY <- - -	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m ->			<- P P M ->			< - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - - - >											< PCT>
88P2127	1	0.05	0.16	0.02	0.08																
88P2128	2	0.04	0.16	0.02	0.10																
88P2129	3	0.05	0.15	TR	0.07																
88P2130	4	0.03	0.11	0.02	0.09																
88P2131	5	0.03	0.20	0.04	0.11																
88P2132	6	0.04	0.31	0.04	0.09																
88P2133	7	0.03	0.35	0.06	0.08																
88P2134	8	0.03	0.32	0.03	0.09																
88P2135	9	0.03	0.27	0.03	0.08																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-010
SAMPLED AS : KASULE ; FINE-LOAMY, ISOHYPERTHERMIC MOLLIC OCHRAQUALF
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 411, SAMPLE 88P2127-2135

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	X-RAY peak size				THERMAL DTA	THERMAL TGA	ELEMENTAL SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		7A2i	7A3b	7A4b	7C3	Percent	Percent								<mg/g>	
88P2128	TCLY	KK 4	MI 3	CR 1	GE 1				21.0	8.1			2.8			
88P2130	TCLY	KK 5	MI 3	GE 2	HE 1				24.0	8.9			2.6			
88P2133	TCLY	KK 5	MI 3	GE 2	HE 1				26.0	9.9			2.7			
88P2135	TCLY	KK 5	MI 3	GE 2	HE 1				25.0	10.0			2.7			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite MI mica CR cristobalite GE goethite HE hematite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 11 ADDITIONAL PEDON SAMPLED IN THE VICINITY OF KAMPALA

(Not included in the report)

Soils Series: Mabira Forest
NSSL ID#: 88P0412
Soil Survey #: S87-FN- -011
Location:
Classification: Very-fine, kaolinitic, isohyperthermic Kandiudalfic Eutrudox
Geomorphic Position: backslope sideslope
Slope: 2% plane northwest facing
Elevation: m MSL
Precipitation: cm - Udic Moisture Regime
Soil Temperature: Ann: 25 Summ: 23 Win: 26
Drainage:
Land Use:
Stoniness:
Erosion:
Runoff:
Parent Material:
Diagnostic Horizons: 0 to 18 cm Mollic, 30 to 110 cm Placic
Described By: N. Smeck, D. Goss, J. Zake
Date: 09/87
Notes: In mabira forest at picnic area.

A--0 to 18 cm; dusky red (2.5YR 3/2) moist silty clay loam; moderate medium subangular blocky structure parting to moderate medium granular; friable, slightly sticky, plastic; common very fine and few medium roots throughout; clear smooth boundary.
88P2136

Bt1--18 to 30 cm; dark reddish brown (2.5YR 3/4) moist clay; moderate medium subangular blocky structure; friable, sticky, plastic; many medium and coarse roots throughout and common very fine roots throughout; continuous faint dark reddish brown (2.5YR 3/4) coats on faces of peds; clear smooth boundary. Coatings are difficult to differeniate in color from ped interiors.
88P2137

Bt2--30 to 52 cm; dark reddish brown (2.5YR 3/4) moist clay; moderate medium angular blocky structure; friable, sticky, very plastic; common medium and few very fine roots throughout; continuous faint dark reddish brown (2.5YR 3/4) coats on faces of peds; gradual smooth boundary.
88P2138

Bt3--52 to 84 cm; dusky red (10R 3/3) moist clay; strong medium prismatic structure parting to moderate medium subangular blocky; firm, sticky, very plastic; common medium and few very fine roots throughout.
88P2139

Bt4--84 to 110 cm; clay.
88P2140

S88FN-910-011

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : MABIRA FOREST ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC RHODIC EUTRODOX
REVISED TO : ; VERY-FINE, KAOLINITIC, ISOHYPERTHERMIC KANDIUDALFIC EUTRUDOX

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 412, SAMPLES 88P2136-2140
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	FINE LT .0002	CO3 LT .002	(- -CLAY- -) FINE .002 -.02	COARSE .02 -.05	(- - - - -SILT- -) VF .05 -.10	F .10 -.25	(- - - - -SAND- - - - - -) M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) 2 -5	- - - - WEIGHT - - - - 5 -20	20 -75	.1- 75	(>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
88P2136S	0- 18	A	51.1	34.8	14.1	24.0		19.2	15.6	7.5	3.7	1.5	1.0	0.4	1	--	--	8	1
88P2137S	18- 30	BT1	57.2	30.3	12.5	27.1		16.7	13.6	6.9	3.1	1.1	0.6	0.8	TR	TR	--	6	--
88P2138S	30- 52	BT2	66.8	23.2	10.0	35.8		12.8	10.4	5.4	2.4	1.1	0.6	0.5	--	TR	--	5	TR
88P2139S	52- 84	BT3	71.6	20.2	8.2	42.4		11.0	9.2	4.3	1.9	0.8	0.6	0.6	TR	TR	--	4	TR
88P2140S	84-110	BT4	71.0	20.9	8.1	39.9		11.3	9.6	4.3	2.0	0.7	0.5	0.6	TR	--	--	4	--

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT OF <2MM -->						PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 18	2.98	0.272			4.8	0.3	0.3	0.39	0.40	51	24								20.3	
18- 30	1.08	0.122			4.0	0.2	0.2	0.18	0.35										20.1	
30- 52	0.83				4.4	0.2	0.2	0.15	0.34	54	31		1.33	1.49	0.039			29.5	22.6	0.09
52- 84	0.63				5.5	0.2	0.1	0.13	0.34				1.33	1.49	0.039			31.7	24.3	0.10
84-110	0.37				5.0	0.2	0.1	0.12	0.33										23.2	

AVERAGES, DEPTH 18- 68: PCT CLAY 66 PCT .1-75MM 5

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-011
SAMPLED AS : MABIRA FOREST ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC RHODIC EUTRODOX
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 412, SAMPLE 88P2136-2140

PRINT DATE 01/19/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	(- NH4OAC EXTRACTABLE BASES -) <- - - - - - - - - -MEQ /					ACID-ITY	EXTR AL	(- - - -CEC - - -)			AL SAT	-BASE SUM	SAT- NH4 OAC	CO3 AS CACO3	RES. OHMS		COND.	(- - - -PH - - -)		
						100 G - - - - - - - - - - - ->					<- - - - -PCT - - - ->									
0- 18	13.1	1.8	--	0.3	15.2	12.8	--	28.0	20.0			54	76					8.4	5.1	5.3
18- 30	6.8	1.3	--	0.1	8.2	8.2		16.4	10.5			50	78					8.8	5.3	5.6
30- 52	6.1	1.6	--	0.1	7.8	7.4		15.2	9.8			51	80					9.0	5.6	6.0
52- 84	5.9	1.6	--	0.1	7.6	6.9		14.5	9.2			52	83					9.3	5.9	6.3
84-110	4.9	1.5	--	0.1	6.5	10.3		16.8	8.3			39	78					9.4	6.0	6.3

DEPTH (CM)	C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI PCT FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM
	(- - - -SPODIC HORIZON CRITERIA - - - - - -)						
	(- -NA PYROPHOSPHATE EXTRACTABLE- -)						
	<- PCT OF <2MM->			(- -DIVIDED BY- -)			
0- 18		0.3	0.1	0.1			
18- 30		0.1	TR	TR	--		
30- 52		0.1	--	TR	--		
52- 84		TR	TR				
84-110		TR	--				

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-011

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/19/90

SAMPLED AS : MABIRA FOREST ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC RHODIC EUTRODOX

NSSL - PROJECT 88P 80, SMSS UGANDA
- PEDON 88P 412, SAMPLES 88P2136-2140
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER 0.06 BAR 4B1c	-10- 1- BAR 4B1a	-11- CONTENT- -)(- - - - WATER 2- BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - PIPETTE - - ><- HYDROMETER - > CLAY <- - -	-14- SILT 3A1c - - ->	-15- SAND	-16- CLAY	-17- DISPERSIBLE - - - -) SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
		<- P C T o f < 2 m m -><- P P M -><- - - - - - - - - - - P E R C E N T o f < 2 m m - - - - - - - - - - - -><PCT>																			
88P2136	1	0.08	0.61	0.05	0.17																
88P2137	2	0.06	0.75	0.06	0.11																
88P2138	3	0.07	0.99	0.08	0.15																
88P2139	4	0.06	0.91	0.10	0.16																
88P2140	5	0.08	1.17	0.08	0.19																

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-011
SAMPLED AS : MABIRA FOREST ; CLAYEY, KAOLINITIC, ISOHYPERTHERMIC RHODIC EUTRODOX
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 412, SAMPLE 88P2136-2140

PRINT DATE 01/19/90

SAMPLE NUMBER	FRACTION	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		CLAY MINERALOGY (<.002mm)																			
		X-RAY						THERMAL					ELEMENTAL							EGME	INTER
		7A2i						7A3b		7A4b					7C3					RETN	PRETA
		peak size						Percent							Percent					7D2	TION
																				<mg/g>	
88P2136	TCLY	KK 5	HE 2	MI 2	GE 2								23.0	15.7			0.9				
88P2138	TCLY	KK 5	HE 2	MI 2	GE 2								24.0	17.2			0.7				

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite HE hematite MI mica GE goethite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 12 ADDITIONAL PEDON SAMPLED IN THE KABALE EXPERIMENTAL STATION

(Not included in the report)

Soils Series: Not Designated
NSSL ID#: 88P0975
Soil Survey # S88-FN-910-001
Location: Kachwekano Experiment Station; Kabale, Uganda.
Classification: clayey, oxidic, isomesic Typic Palehumults
Physiography: Hillside in Piedmonts
Geomorphic Position: on upper third, shoulder of a side slope
Micorrelief: terracettes
Slope Characteristics: 002% northeast facing plane
Elevation: 2364 m MSL
Precipitation: udic moisture regime
Hydraulic Conductivity: high
Air Temperature: Ann 13 C Sum 14 C Win 12 C
Soil Temperature: Ann 14 C Sum 15 C Win 13 C
Drainage Class: well drained
Land Use: pasture land and native pasture
Stoniness: 0
Erosion: slight
Particle Size Control Section: 25 to 100 cm
Runoff: very slow
Parent Material: local colluvium from sandstone material over volcanic ash from material
Diagnostic Horizons: 0 to 30 cm ochric
Described By: D. Yost and D. Adam.
Date: 03/88
Notes: Vegetation: pasture - grass, legume, clover.

Ap--0 to 30 cm; dark yellowish brown (10YR 3/4) silt loam; moderate fine subangular blocky structure; friable; many fine roots throughout; common very fine tubular, and many vesicular pores; slightly acid (pH 6.2); 10% pebbles; abrupt wavy boundary.
88P5310

Bt1--30 to 60 cm; yellowish red (5YR 4/6) clay; weak coarse platy structure parting to moderate fine angular blocky parting to weak very coarse prismatic; firm, moderately sticky, moderately plastic; common fine roots between peds; common fine tubular pores; common distinct patchy clay films on faces of peds, and many faint; slightly acid (pH 6.0); 05% pebbles; clear wavy boundary.
88P5311

2BAb--60 to 101 cm; yellowish red (5YR 4/6), and dark reddish brown (5YR 3/4) clay; moderate fine and medium subangular blocky structure parting to ; friable, moderately sticky, moderately plastic; few fine roots throughout; common fine vesicular pores; common faint patchy clay films on faces of peds, and ; moderately acid (pH 5.6); 05% pebbles; gradual wavy boundary.
88P5312

2ABb--101 to 149 cm; dark reddish brown (5YR 3/4), and yellowish red (5YR 5/6) silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, moderately plastic; few fine roots; common fine tubular, and vesicular pores; soil nodules present; few faint patchy clay films on faces of peds, and common distinct discontinuous coats throughout; moderately acid (pH 5.8); 05% pebbles; gradual wavy boundary.
88P5313

3Bbt--149 to 185 cm; yellowish red (5YR 5/8), and yellowish red (5YR 4/6) clay; weak coarse platy structure parting to moderate medium subangular blocky; friable, moderately sticky, moderately plastic; common medium vesicular pores; many prominent continuous clay films on faces of peds; moderately acid (pH 5.6); 05% pebbles.
88P5314

S88FN-910-001

*** P R I M A R Y   C H A R A C T E R I Z A T I O N   D A T A ***
(UGANDA)

PRINT DATE 01/17/90

SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC HUMIC HAPLUDULT
REVISED TO : ; CLAYEY, OXIDIC, ISOMESIC TYPIC PALEHUMULT

NSSL - PROJECT 88P 179, SMSS UGANDA
- PEDON 88P 975, SAMPLES 88P5310-5314
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-4-- (- - -TOTAL CLAY LT .002	-5-- SILT .002 -.05	-6-- SAND .05 -2 - - -)	-7-- (- -CLAY- FINE LT .0002	-8-- CO3 LT .002 -)	-9-- (- -SILT- FINE .002 -.02	-10- COARSE .02 -.05 -)	-11- (- - - -SAND- VF .05 -.10	-12- F .10 -.25	-13- M .25 -.50	-14- C .5 -1	-15- VC 1 -2 - - -)	-16- (-COARSE FRACTIONS(MM)-) WEIGHT 2 -5	-17- 5 -20	-18- 20 -75	-19- .1- 75	-20- (>2MM) WT PCT OF WHOLE SOIL
			<- - - - - - - - - - - - -	PCT OF <2MM	(3A1)	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- ->	<- PCT OF	<75MM(3B1)->			
88P5310S	0- 30	AP	46.9	19.8	33.3	15.8		16.0	3.8	4.7	9.9	9.7	6.1	2.9	1	4	--	32	5
88P5311S	30- 61	BT1	72.2	10.9	16.9	40.5		9.4	1.5	2.7	5.3	4.7	2.9	1.3	--	--	--	14	--
88P5312S	61-102	2BAB	70.2	11.3	18.5	39.5		8.5	2.8	2.9	5.0	4.9	3.3	2.4	TR	TR	--	16	TR
88P5313S	102-150	2ABB	69.8	9.4	20.8	34.7		7.1	2.3	3.1	6.0	5.6	3.3	2.8	TR	TR	--	18	TR
88P5314S	150-186	3BAB	73.7	8.3	18.C	35.3		6.3	2.0	2.8	4.9	4.2	3.2	2.9	1	TR	--	16	1

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
				<- PERCENT	OF <2MM -->					PCT <0.4MM		<- - G/CC	- - ->		CM/CM	<- - -PCT OF <2MM	- ->			CM/CM
0- 30	3.43				4.9	0.7		0.48	0.39	50	18		1.25	1.38	0.033			26.6	18.2	0.10
30- 61	1.35				6.3	1.0		0.20	0.32	43	16		1.32	1.45	0.032			30.6	22.9	0.10
61-102	1.46				5.8	1.0		0.25	0.33				1.21	1.35	0.037			32.0	23.4	0.10
102-150	1.34				6.0	1.1		0.23	0.32	41	14		1.28	1.37	0.023			27.9	22.4	0.07
150-186	0.80				5.9	1.0		0.13	0.31				1.30	1.37	0.018			26.8	22.5	0.06

AVERAGES, DEPTH 30- 61: PCT CLAY 72 PCT .1-75MM 14

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-001
SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC HUMIC HAPLUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 975, SAMPLE 88P5310-5314

PRINT DATE 01/17/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9b	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A9B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT-NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	<- NH4OAC EXTRACTABLE BASES ->					ACID-	EXTR	<- CEC			AL	BASE	SAT-	CO3 AS	RES.		COND.	PH		
	<-				-MEQ /	100 G	->				<-		-PCT	->						
0- 30	11.8	2.6	--	1.0	15.4	16.6		32.0	22.4			48	69					8.6	5.2	5.6
30- 61	2.8	1.6	--	0.4	4.8	21.1	2.3	25.9	14.6	7.1	32	19	33					9.2	4.3	5.0
61-102	1.0	0.8	--	0.2	2.0	25.3	4.9	27.3	17.7	6.9	71	7	11					9.3	4.0	4.6
102-150	0.4	0.4	--	0.2	1.0	25.1	5.2	26.1	16.1	6.2	84	4	6					9.4	3.9	5.2
150-186	0.2	0.3	--	0.3	0.8	17.1	3.7	17.9	9.6	4.5	82	4	8					9.0	3.8	4.2

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-001

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC HUMIC HAPLUDULT

PRINT DATE 01/17/90

NSSL - PROJECT 88P 179, SMSS UGANDA
- PEDON 88P 975, SAMPLES 88P5310-5314
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

		-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		ACID	OXALATE	EXTRACTION		PHOSPHOUS		KCL	TOTAL	(- -WATER		CONTENT- -)(- - - - WATER DISPERSIBLE - - - -)								MIN	AGGRT
		OPT	FE	SI	AL		CIT-	MN	C	0.06	1-	2-	15	<- - PIPETTE - - >< - HYDROMETER - >						SOIL	STABL
		DEN				RET	ACID			BAR	BAR	BAR	BAR	CLAY	SILT	SAND	CLAY	SILT	SAND	CONT	<5mm
SAMPLE	HZ	8J	6C9a	6V2	6G12	6S4	6S5	6D3	6A2d	4B1c	4B1a	4B1a	4B2b	<- - -	3A1c	- - ->	<- - -	SML	- - ->	8F1	4G1
NO.	NO		<- P C T	o f	< 2 m m	->	<- P P	M ->	< - - -	- - -	- - -	- - -	P E R	C E N	T	o f	< 2 m m	- - -	- - -	- - -	>< PCT>
88P5310	1																				
88P5311	2							0.1													88
88P5312	3							0.1													
88P5313	4							0.0													
88P5314	5							0.0													

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-001
SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC HUMIC HAPLUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 975, SAMPLE 88P5310-5314

PRINT DATE 01/17/90

SAMPLE NUMBER	FRACTION	X-RAY 7A2i	X-RAY peak size	DTA 7A3b	TGA 7A4b	THERMAL Percent	SiO2	Al2O3	Fe2O3	MgO	CaO	K2O	Na2O	ELEMENTAL 7C3 Percent	EGME RETN 7D2 <mg/g>	INTERPRETATION
88P5310	TCLY	KK 4	GE 2	HE 2	MI 1			23.0	14.3			0.8				
88P5311	TCLY	KK 3	GE 2	HE 2	MI 1			27.0	14.3			0.4				
88P5313	TCLY	KK 3	GE 2	HE 2	MI 1			27.0	14.3			0.5				

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite GE goethite HE hematite MI mica

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

S88FN-910-001

*** S U P P L E M E N T A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/17/90

SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC HUMIC HAPLUDULT
REVISED TO : ; CLAYEY, OXIDIC, ISOMESIC TYPIC PALEHUMULT

NSSL - PROJECT 88P 179,
- PEDON 88P 975, SAMPLES 88P5310-5314
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	PERCENTAGE PASSING 3	2	3/2	1	3/4	3/8	4	10	40	200	PSD 20	5	2	CUMULATIVE CURVE FRACTIONS(<76MM) USDA 1.	.5	LESS .25	THAN .10	.05	DIAMETERS(MM) AT 60	50	10	ATTER-BERG LL	PI	GRADATION UNI-FMTY CU	CUR-VTUR CC
			<-----INCHES----->						<-NUMBER->				<-MICRONS->			<--------MM-------->					<--PERCENTILE-->			<-PCT>			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
88P5310S	0- 12	AP	100	100	100	100	100	98	96	95	84	66	60	51	45	92	86	77	68	63	0.02	0.005	--	50	18	63.5	0.1
88P5311S	12- 24	BT1	100	100	100	100	100	100	100	100	95	85	82	76	72	99	96	91	86	83	--	0.001	--	43	16	4.9	0.7
88P5312S	24- 40	2BAB	100	100	100	100	100	100	100	100	93	83	79	74	70	98	94	89	84	81	--	0.001	--			5.2	0.7
88P5313S	40- 59	2ABB	100	100	100	100	100	100	100	100	92	81	77	73	70	97	94	88	82	79	--	0.001	--	41	14	5.2	0.7
88P5314S	59- 73	3BAB	100	100	100	100	100	100	100	99	92	83	79	75	73	96	93	89	84	81	--	0.001	--			4.8	0.7

DEPTH (IN.)	(WEIGHT PER UNIT VOLUME G/CC) (VOID RATIOS) WHOLE SOIL >2	250-UP	250-75	75-2	75-20	20-5	5-2	<2	<75 MM FRACTION 75-2	75-20	20-5	5-2	<2	WHOLE SOIL 1/3 BAR SOIL SURVEY	OVEN-DRY	MOIST	SATURATED ENGINEERING	<2 MM FRACTION 1/3 BAR SOIL SURVEY	15 BAR	OVEN-DRY	MOIST	SATURATED ENGINEERING	AT 1/3 BAR WHOLE SOIL	<2 MM
	<------PCT OF WHOLE SOIL----->								<--PCT OF <75 MM->															
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0- 12	5	--	--	5	--	4	1	95	5	--	4	1	95		1.28	1.41	1.60	1.80	1.25	1.29	1.38	1.58	1.78	1.07	1.12
12- 24	--	--	--	--	--	--	--	100	--	--	--	--	100		1.32	1.45	1.73	1.82	1.32	1.36	1.45	1.72	1.82	1.01	1.01
24- 40	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		1.21	1.35	1.60	1.75	1.21	1.25	1.35	1.60	1.75	1.19	1.19
40- 59	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		1.28	1.37	1.64	1.80	1.28	1.30	1.37	1.64	1.80	1.07	1.07
59- 73	1	--	--	1	--	TR	1	99	1	--	TR	1	99		1.31	1.38	1.66	1.82	1.30	1.31	1.37	1.65	1.81	1.02	1.04

*** S U P P L E M E N T A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-001
SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC HUMIC HAPLUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 975, SAMPLE 88P5310-5314

PRINT DATE 01/17/90

DEPTH (IN.)	(VOLUME FRACTIONS)(C/)(RATIOS TO CLAY)(LINEAR EXTENSIBILITY)(WRD)																							
	----WHOLE SOIL (MM)								AT 1/3 BAR--- (/N)						<2 MM FRACTION					WHOLE SOIL		--<2 MM--		WHOLE	<2
	>2 -UP	250 -75	250 -20	75 -2	75 -5	20 -2	5 <2	2-.05	.05-.002	LT .002	PORES D	F	RAT -10	FINE CLAY	---CEC-- SUM CATS	NH4-OAC	15 BAR H2O	LE 1/3 BAR	<-1/3 BAR TO 15 BAR	OVEN -DRY	(PCT)---> 15 BAR	OVEN -DRY	SOIL <--IN/IN->	MM
	<----------PCT OF WHOLE SOIL---------->																							
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0- 12	2	--	--	2	--	2	1	98	15	9	22	20	32		0.34	0.68	0.48	0.39	0.073	1.3	3.3	1.1	3.4	0.10	0.11
12- 24	--	--	--	--	--	--	--	100	8	5	36	9	41		0.56	0.36	0.20	0.32	0.044	0.8	3.2	1.0	3.2	0.10	0.10
24- 40	TR	--	--	--	--	TR	TR	100	8	5	32	15	39		0.56	0.39	0.25	0.33	0.053	1.1	3.7	1.1	3.7	0.10	0.10
40- 59	TR	--	--	--	--	TR	TR	100	10	5	34	16	36		0.50	0.37	0.23	0.32	0.033	0.5	2.3	0.5	2.3	0.07	0.07
59- 73	1	--	--	1	--	TR	1	99	9	4	36	16	35		0.48	0.24	0.13	0.31	0.024	0.3	1.8	0.3	1.8	0.06	0.06

DEPTH (IN.)	(WEIGHT FRACTIONS - CLAY FREE)(-TEXTURE--)(--PSDA(MM)---)(PH)(-ELECTRICAL)(CUMULT. AMOUNTS)																							
	--WHOLE SOIL--						---<2 MM FRACTION----								(DETERMINED IN	BY	SAND 2-	SILT .05-	CLAY LT	CA- CL2	RES- IST.	CON- DUCT.	SALT MG/	IN. OF H2O
	>2 -2	75 -2	20 -.05	2- .05	.05- .002	LT .002	------SANDS------- VC	C	M	F	VF	SILTS C	F	CL AY	FIELD	PSDA	.05	.002	.002	.01M	OHMS	MMHOS	KG	1/3 BAR TO 15BAR AIRDRY
	PCT OF >2MM+SAND+SILT>						(------PCT OF SAND+SILT------)								(--<2 MM-)		(--PCT OF .2MM-)			(- - - - <2 MM- - - -)				(WHL SOIL)
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0- 12	9	9	9	57	34	80	5	11	18	19	9	7	30	88	SIL	C	33.3	19.8	46.9	5.2					
12- 24				61	39	260	5	10	17	19	10	5	34	260	C	C	16.9	10.9	72.2	4.3					
24- 40				62	38	236	8	11	16	17	10	9	29	236	C	C	18.5	11.3	70.2	4.0					
40- 59				69	31	231	9	11	19	20	10	8	24	231	SICL	C	20.8	9.4	69.8	3.9					
59- 73	4	4	4	66	30	270	11	12	16	19	11	8	24	280	C	C	18.0	8.3	73.7	3.8					

APPENDIX IV

DESCRIPTIONS AND CHARACTERIZATION DATA OF THE STUDIED SOILS

PEDON 13 ADDITIONAL PEDON SAMPLED IN THE KABALE EXPERIMENTAL STATION

(Not included in the report)

Soils Series: Not Designated
NSSL ID#: 88P0976
Soil Survey # S88-FN-910-002
Location: Kachwekano Experiment Station; Kabale, Uganda.
Classification: clayey, oxidic, isomesic Typic Palehumult
Physiography: Mountainside in Hills
Geomorphic Position: on upper third, shoulder of a head slope
Micorrelief: terracettes, < 20 cm, linear
Slope Characteristics: 012% northeast facing plane
Elevation: 2448 m MSL
Precipitation: udic moisture regime
Hydraulic Conductivity: high
Air Temperature: Ann 13 C Sum 14 C Win 12 C
Soil Temperature: Ann 14 C Sum 15 C Win 13 C
Drainage Class: well drained
Land Use: cropland
Stoniness: 0
Erosion: slight
Particle Size Control Section: 20 to 50 cm
Runoff: slow
Parent Material: local colluvium from sandstone material over volcanic ash
Diagnostic Horizons: 0 to 20 cm ochric, 20 to 50 cm argillic
Described By: D. Yost and D. Adam.
Date: 03/88
Notes: potato field (Irish)

Ap--0 to 20 cm; dark reddish brown (5YR 3/3) silt loam; moderate fine granular structure; very friable, non sticky; many fine roots throughout; many fine tubular pores; slightly acid (pH 6.2); 05% pebbles; abrupt wavy boundary.
88P5315

Bt--20 to 50 cm; dark reddish brown (2.5YR 3/4) silty clay; weak fine angular blocky structure; friable, slightly sticky, slightly plastic; common fine roots throughout; common very fine vesicular and tubular pores; clay skins observed with 20x; many distinct patchy clay films on faces of peds; moderately acid (pH 5.8); 05% pebbles; gradual wavy boundary.
88P5316

Ab--50 to 78 cm; dark reddish brown (5YR 3/4) silty clay; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots throughout and few medium roots throughout; few fine vesicular pores; many distinct patchy clay films on faces of peds; moderately acid (pH 5.6); 05% pebbles; gradual wavy boundary.
88P5317

Ab2--78 to 99 cm; dark reddish brown (5YR 3/3) sandy clay loam; moderate fine angular blocky structure parting to moderate medium angular blocky; friable, slightly sticky, slightly plastic; few fine roots throughout; few fine vesicular pores; firm soil nodules, 2mm-1cm; few faint patchy clay films on faces of peds, and common distinct discontinuous coats throughout; moderately acid (pH 5.8); 05% pebbles; clear wavy boundary.
88P5318

2Ab--99 to 119 cm; dark reddish brown (5YR 3/3), and red (2.5YR 4/6) silty clay loam; weak medium subangular blocky structure; very friable, slightly sticky, slightly plastic; common fine roots throughout; few fine vesicular, and pores; firm soil nodules, 2mm-1cm; many distinct patchy coats throughout; moderately acid (pH 5.6); 05% pebbles; clear wavy boundary.
88P5319

3Ab2--119 to 160 cm; dark reddish brown (5YR 3/4), and yellowish red (5YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm, moderately sticky, moderately plastic; few fine roots throughout; few fine vesicular and tubular, and tubular pores; many firm soil nodules; 2mm-1cm; few distinct patchy coats throughout; moderately acid (pH 5.6); 05% pebbles; abrupt wavy boundary.
88P5320

3Bt--160 to 190 cm; red (2.5YR 4/6), and reddish brown (5YR 4/4) silty clay; weak medium subangular blocky structure; friable, very sticky, moderately plastic; few fine roots throughout; few medium tubular, and vesicular pores; rock fragments weathered; many distinct patchy clay films on faces of peds, and coats throughout; moderately acid (pH 5.4); 10% pebbles.
88P5321

S88FN-910-002

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC TYPIC HAPLUDULT
REVISED TO : ; CLAYEY, OXIDIC, ISOMESIC TYPIC PALEHUMULT

PRINT DATE 01/17/90

NSSL - PROJECT 88P 179, SMSS UGANDA
- PEDON 88P 976, SAMPLES 88P5315-5321
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (CM)	HORIZON	-1-- CLAY LT .002	-2-- SILT .002 -.05	-3-- SAND .05 -2	-4-- FINE LT .0002	-5-- CO3 LT .002	-6-- FINE .002 -.02	-7-- COARSE .02 -.05	-8-- VF .05 -.10	-9-- F .10 -.25	-10- M .25 -.50	-11- C .5 -1	-12- VC 1 -2	-13- 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- WT PCT OF WHOLE SOIL
			(- - -TOTAL - - -)				(- -CLAY- -)	(- -SILT- -)		(- - - - - -SAND- - - - - -)				(-COARSE FRACTIONS(MM)-)(>2MM)					
			<- - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - - ->											<- PCT OF <75MM(3B1)->					
88P5315S	0- 20	AP	50.5	17.6	31.9	17.3		13.0	4.6	4.4	10.9	10.3	4.5	1.8	1	2	--	30	3
88P5316S	20- 51	BT	63.9	11.8	24.3	33.3		8.7	3.1	3.4	8.3	8.3	3.2	1.1	--	--	1	22	1
88P5317S	51- 80	AB	65.8	11.4	22.8	39.4		8.1	3.3	2.9	8.0	7.8	3.0	1.1	--	TR	--	20	--
88P5318S	80- 99	AB2	64.5	12.0	23.5	38.0		8.2	3.8	3.1	8.4	7.8	3.0	1.2	--	TR	--	20	--
88P5319S	99-119	2AB	62.8	12.3	24.9	35.4		8.4	4.0	2.5	8.4	9.2	3.5	1.3	TR	TR	--	22	--
88P5320S	119-159	3AB2	63.1	11.6	25.3	35.3		7.6	4.0	3.5	8.7	8.4	3.3	1.4	TR	TR	--	22	--
88P5321S	159-190	3BT	60.4	18.7	20.9	39.4		7.9	10.8	2.8	6.9	6.4	2.9	1.9	TR	1	--	19	1

DEPTH (CM)	ORGN C 6A1C PCT	TOTAL N 6B3A <2MM	EXTR P 6S3 PPM	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2a	WRD WHOLE SOIL 4C1
	PCT			<- PERCENT	OF <2MM -->					PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
0- 20	4.36				5.5	0.9		0.42	0.38	50	19		1.09	1.20	0.032			27.5	19.4	0.09
20- 51	1.64				6.7	1.0		0.23	0.31				1.34	1.45	0.027			27.0	19.5	0.10
51- 80	1.53				7.3	1.1		0.23	0.31				1.28	1.40	0.030			28.1	20.2	0.10
80- 99	1.60				7.1	1.1		0.27	0.32				1.25	1.37	0.031			28.2	20.6	0.10
99-119	1.52				7.1	1.1		0.25	0.32	40	3		1.29	1.38	0.023			27.2	20.1	0.09
119-159	1.13				7.0	1.1		0.20	0.31				1.29	1.35	0.015			25.9	19.4	0.08
159-190	0.86				7.6	1.1		0.17	0.33	40	16		1.44	1.52	0.018			24.8	19.7	0.07

AVERAGES, DEPTH 20- 51: PCT CLAY 64 PCT .1-75MM 21

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-002
SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC TYPIC HAPLUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 976, SAMPLE 88P5315-5321

PRINT DATE 01/17/90

DEPTH (CM)	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6Q2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID- ITY 6H5A	-7-- EXTR AL 6G9b	-8-- SUM CATS 5A3A	-9-- CEC NH4- OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
	(- NH4OAC EXTRACTABLE BASES -)																			
	<- - - - - - - - - - -				-MEQ /	100 G	- - -	- - -	- - -	- ->	<- - - -	-PCT	- - -	- ->						
0- 20	7.9	4.2	--	1.6	13.7	19.8	TR	33.5	21.0			41	65					8.6	4.9	5.2
20- 51	1.1	1.1	--	1.1	3.3	22.6	3.1	25.9	14.9	6.4	48	13	22					9.0	4.1	4.8
51- 80	0.4	0.4	--	0.9	1.7	27.3	4.9	29.0	15.3	6.6	74	6	11					9.1	3.9	5.5
80- 99	0.1	0.2	--	1.2	1.5	31.7	5.4	33.2	17.7	6.9	78	5	8					9.3	3.9	5.4
99-119	0.1	0.1	--	1.0	1.2	28.7	5.2	29.9	15.8	6.4	81	4	8					9.3	3.9	5.3
119-159	0.1	0.1	--	0.8	1.0	22.5	4.4	23.5	12.5	5.4	81	4	8					9.1	3.8	4.8
159-190	0.1	0.1	--	0.8	1.0	19.5	4.0	20.5	10.1	5.0	80	5	10					8.9	3.8	4.8

ANALYSES: S= ALL ON SIEVED <2MM BASIS

S88FN-910-002

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/17/90

SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC TYPIC HAPLUDULT

NSSL - PROJECT 88P 179, SMSS UGANDA
- PEDON 88P 976, SAMPLES 88P5315-5321
- GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	HZ NO	-1-- ACID OPT DEN 8J	-2-- OXALATE FE 6C9a	-3-- EXTRACTION SI 6V2	-4-- AL 6G12	-5-- PHOSPHOUS RET 6S4	-6-- CIT-ACID 6S5	-7-- KCL MN 6D3	-8-- TOTAL C 6A2d	-9-- (- -WATER CONTENT- -)(- - - - WATER DISPERSIBLE - - - -) 0.06 BAR 4B1c	-10- 1-BAR 4B1a	-11- 2-BAR 4B1a	-12- 15 BAR 4B2b	-13- <- - - PIPETTE - - ><- HYDROMETER - > CLAY <- - - 3A1c	-14- SILT - - ->	-15- SAND	-16- CLAY	-17- SILT SML	-18- SAND - - ->	-19- MIN SOIL CONT 8F1	-20- AGGRT STABL <5mm 4G1
			<- P C T o f < 2 m m ->				<- P P M ->		< - - - - - - - - - - - P E R C E N T						o f < 2 m m - - - - - - - - - -						>< PCT>
88P5315	1							0.9													72
88P5316	2							0.1													
88P5317	3							0.0													
88P5318	4							0.0													
88P5319	5							0.0													
88P5320	6							0.0													
88P5321	7							0.0													

*** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-002
SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC TYPIC HAPLUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 976, SAMPLE 88P5315-5321

PRINT DATE 01/17/90

SAMPLE NUMBER	FRACTION	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		CLAY MINERALOGY (<.002mm)																			
		X-RAY						THERMAL					ELEMENTAL								
		7A2i						7A3b		7A4b			SiO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETN 7D2	INTERPRETATION
		peak size						Percent					Percent							mg/g	
88P5315	TCLY	KK 4	GE 2	MI 2	HE 2									23.0	14.3			1.0			
88P5316	TCLY	KK 4	GE 2	HE 2	MI 2									27.0	15.7			0.8			
88P5319	TCLY	KK 3	GE 2	HE 2	MI 1									32.0	20.0			0.8			
88P5321	TCLY	KK 3	GE 2	HE 2	MI 1									28.0	17.2			0.8			

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL INTERPRETATION:

KK kaolinite GE goethite MI mica HE hematite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON MINERALOGY
BASED ON SAND/SILT:
BASED ON CLAY:
FAMILY MINERALOGY:
COMMENTS:

S88FN-910-002

*** S U P P L E M E N T A R Y C H A R A C T E R I Z A T I O N D A T A ***
(UGANDA)

PRINT DATE 01/17/90

SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC TYPIC HAPLUDULT
REVISED TO : ; CLAYEY, OXIDIC, ISOMESIC TYPIC PALEHUMULT

NSSL - PROJECT 88P 179,
- PEDON 88P 976, SAMPLES 88P5315-5321
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FROM USDA FRACTION SIZES)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN.)	HORIZON	ENGINEERING PERCENTAGE PASSING SIEVE <-----INCHES----->						<-NUMBER->				PSDA <-MICRONS->			CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN <--------MM-------->					DIAMETERS(MM) AT <--PERCENTILE-->			ATTERBERG <-PCT>		GRADATION	
			3	2	3/2	1	3/4	3/8	4	10	40	200	20	5	2	1.	.5	.25	.10	.05	60	50	10	LL	PI	UNIFMTY CU	CURVTUR CC
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
88P5315S	0- 8	AP	100	100	100	100	100	99	98	97	88	68	62	54	49	95	91	81	70	66	0.02	0.002	--	50	19	46.7	0.1
88P5316S	8- 20	BT	100	100	100	99	99	99	99	99	93	77	72	67	63	98	95	87	78	75	--	0.001	--			6.2	0.7
88P5317S	20- 31	AB	100	100	100	100	100	100	100	100	94	79	74	69	66	99	96	88	80	77	--	0.001	--			5.8	0.7
88P5318S	31- 39	AB2	100	100	100	100	100	100	100	100	94	78	73	68	65	99	96	88	80	76	--	0.001	--			6.0	0.7
88P5319S	39- 47	2AB	100	100	100	100	100	100	100	100	93	77	71	66	63	99	95	86	78	75	--	0.001	--	40	3	6.3	0.7
88P5320S	47- 62	3AB2	100	100	100	100	100	100	100	100	93	77	71	66	63	99	95	87	78	75	--	0.001	--			6.2	0.7
88P5321S	62- 75	3BT	100	100	100	100	100	100	99	99	93	80	68	63	60	97	94	88	81	78	--	0.001	--	40	16	7.2	0.6

DEPTH (IN.)	(WHOLE SOIL (MM)- >2 -UP <------PCT OF WHOLE SOIL----->								<75 MM FRACTION-- 75 -2 <--PCT OF <75 MM->						WEIGHT PER UNIT VOLUME G/CC) SOIL SURVEY ENGINEERING 1/3 BAR	OVEN -DRY	MOIST	SATUR -ATED	<2 MM FRACTION-- SOIL SURVEY-- 1/3 BAR	15 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	(VOID) --RATIOS-- AT 1/3 WHOLE SOIL	BAR <2 MM
	250	250	75	75	20	5		75	75	20	5															
	75	75	-2	-20	-5	-2	<2	-2	-20	-5	-2	<2														
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
0- 8	3	--	--	3	--	2	1	97	3	--	2	1	97		1.10	1.21	1.40	1.69	1.09	1.13	1.29	1.39	1.68	1.41	1.43	
8- 20	1	--	--	1	1	--	--	99	1	1	--	--	99		1.35	1.46	1.71	1.84	1.34	1.37	1.45	1.70	1.83	0.96	0.98	
20- 31	TR	--	--	--	--	TR	--	100	--	--	TR	--	100		1.28	1.40	1.64	1.80	1.28	1.32	1.40	1.64	1.80	1.07	1.07	
31- 39	--	--	--	--	--	--	--	100	--	--	--	--	100		1.25	1.37	1.60	1.78	1.25	1.28	1.37	1.60	1.78	1.12	1.12	
39- 47	--	--	--	--	--	--	--	100	--	--	--	--	100		1.29	1.38	1.64	1.80	1.29	1.32	1.38	1.64	1.80	1.05	1.05	
47- 62	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		1.29	1.35	1.63	1.80	1.29	1.31	1.35	1.62	1.80	1.05	1.05	
62- 75	1	--	--	1	--	1	TR	99	1	--	1	TR	99		1.45	1.53	1.81	1.90	1.44	1.46	1.52	1.80	1.90	0.83	0.84	

*** S U P P L E M E N T A R Y C H A R A C T E R I Z A T I O N D A T A ***

S88FN-910-002
SAMPLED AS : NOT DESIGNATED ; FINE, MIXED, MESIC TYPIC HAPLUDULT
NATIONAL SOIL SURVEY LABORATORY ; PEDON 88P 976, SAMPLE 88P5315-5321

PRINT DATE 01/17/90

DEPTH (IN.)	(VOLUME FRACTIONS) >2 -UP (51)	250 -75 (52)	250 -75 (53)	75 -2 (54)	75 -20 (55)	20 -5 (56)	5 -2 (57)	<2 (58)	2-.05 (59)	.05-.002 (60)	LT .002 (61)	PORES D (62)	PORES F (63)	RAT -IO (64)	FINE CLAY (65)	CEC SUM CATS (66)	CEC NH4-OAC (67)	15 BAR H2O (68)	LE 1/3 BAR (69)	WHOLE SOIL <-1/3 BAR TO 15 BAR (70)	WHOLE SOIL OVEN-DRY (71)	<2 MM (PCT) 15 BAR (72)	<2 MM OVEN-DRY (73)	WHOLE SOIL <--IN/ (74)	<2 MM IN-> (75)
0- 8	1	--	--	1	--	1	1	99	13	7	20	28	30		0.34	0.66	0.42	0.38	0.065	0.9	3.2	1.2	3.3	0.09	0.09
8- 20	1	--	--	1	1	--	--	99	12	6	32	13	36		0.52	0.41	0.23	0.31	0.042	0.7	2.6	0.7	2.7	0.10	0.10
20- 31	TR	--	--	--	--	TR	--	100	11	6	32	16	36		0.60	0.44	0.23	0.31	0.046	1.0	3.0	1.0	3.0	0.10	0.10
31- 39	--	--	--	--	--	--	--	100	11	6	30	18	35		0.59	0.51	0.27	0.32	0.048	1.1	3.1	0.8	3.1	0.10	0.10
39- 47	--	--	--	--	--	--	--	100	12	6	30	16	35		0.56	0.48	0.25	0.32	0.037	0.8	2.3	0.8	2.3	0.09	0.09
47- 62	TR	--	--	--	--	TR	TR	100	12	6	30	17	34		0.56	0.37	0.20	0.31	0.024	0.5	1.5	0.5	1.5	0.08	0.08
62- 75	1	--	--	1	--	1	TR	99	11	10	33	9	36		0.65	0.34	0.17	0.33	0.030	0.5	1.8	0.5	1.8	0.07	0.07

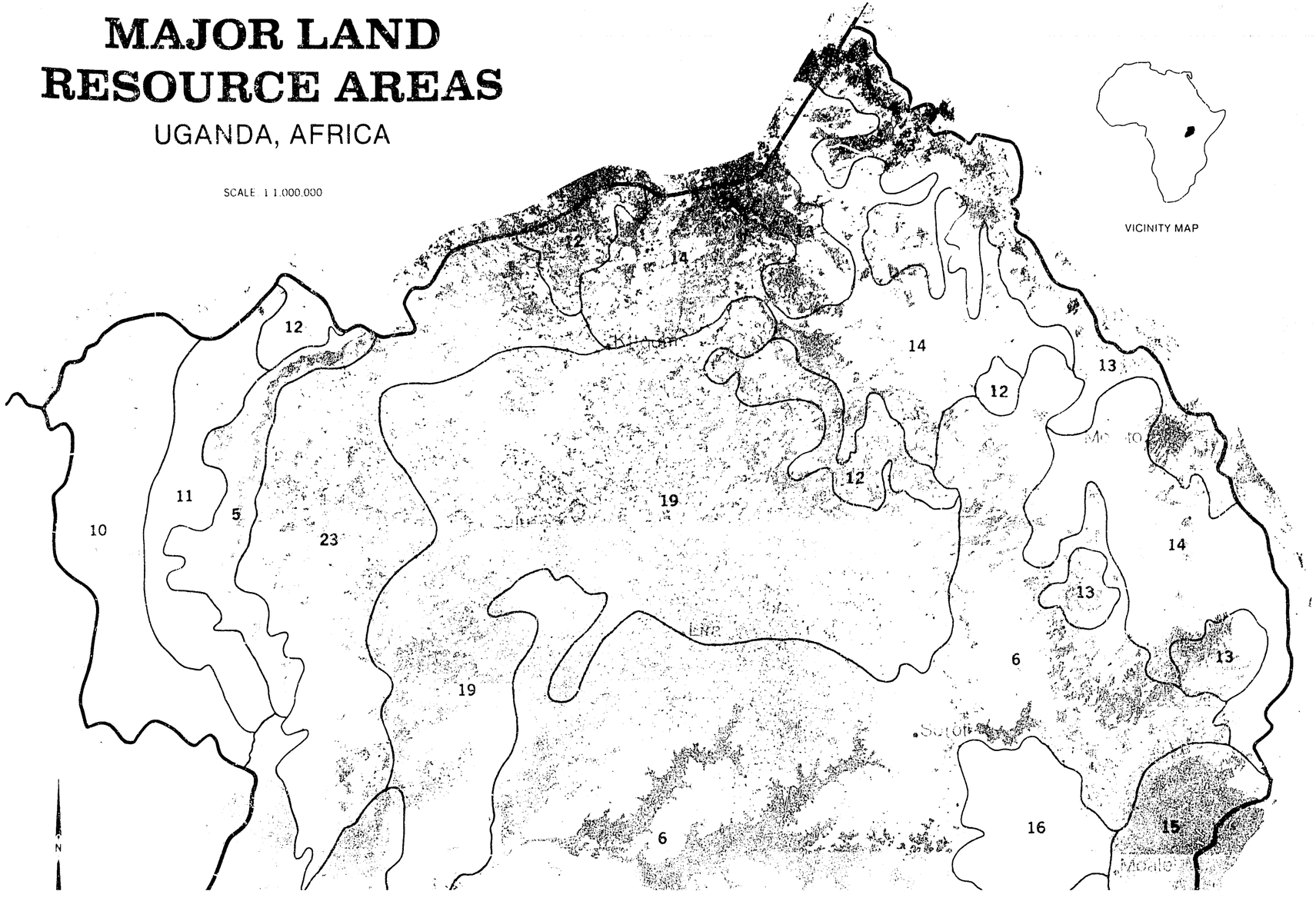
DEPTH (IN.)	(WEIGHT FRACTIONS) >2 -2 (76)	75 -2 (77)	20 -2 (78)	2-.05 (79)	.05-.002 (80)	LT .002 (81)	VC (82)	C (83)	M (84)	F (85)	VF (86)	C (87)	F (88)	CL AY (89)	TEXTURE DETERMINED IN FIELD (90)	BY PSDA (91)	SAND 2-.05 (92)	SILT .05-.002 (93)	CLAY .002 LT (94)	CACL2 .01M (95)	RESIST. OHMS (96)	CONDUCT. MMHOS (97)	SALT MG/KG (98)	1/3 BAR TO 15BAR AIRDRY (WHL SOIL) (99)	(100)
0- 8	6	6	6	61	33	96	4	9	21	22	9	9	26	102	SIL	C	31.9	17.6	50.5	4.9					
8- 20	3	3		66	32	172	3	9	23	23	9	9	24	177	SIC	C	24.3	11.8	63.9	4.1					
20- 31				67	33	192	3	9	23	23	8	10	24	192	SIC	C	22.8	11.4	65.8	3.9					
31- 39				66	34	182	3	8	22	24	9	11	23	182	SCL	C	23.5	12.0	64.5	3.9					
39- 47				67	33	169	3	9	25	23	7	11	23	169	SICL	C	24.9	12.3	62.8	3.9					
47- 62				69	31	171	4	9	23	24	9	11	21	171	SICL	C	25.3	11.6	63.1	3.8					
62- 75	2	2	2	51	46	149	5	7	16	17	7	27	20	153	SIC	C	20.9	18.7	60.4	3.8					

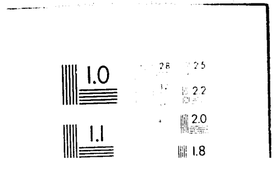
☆U.S. Government Printing Office: 1990 — 762-319

MAJOR LAND RESOURCE AREAS

UGANDA, AFRICA

SCALE 1:1,000,000





1.25 1.4 1.6

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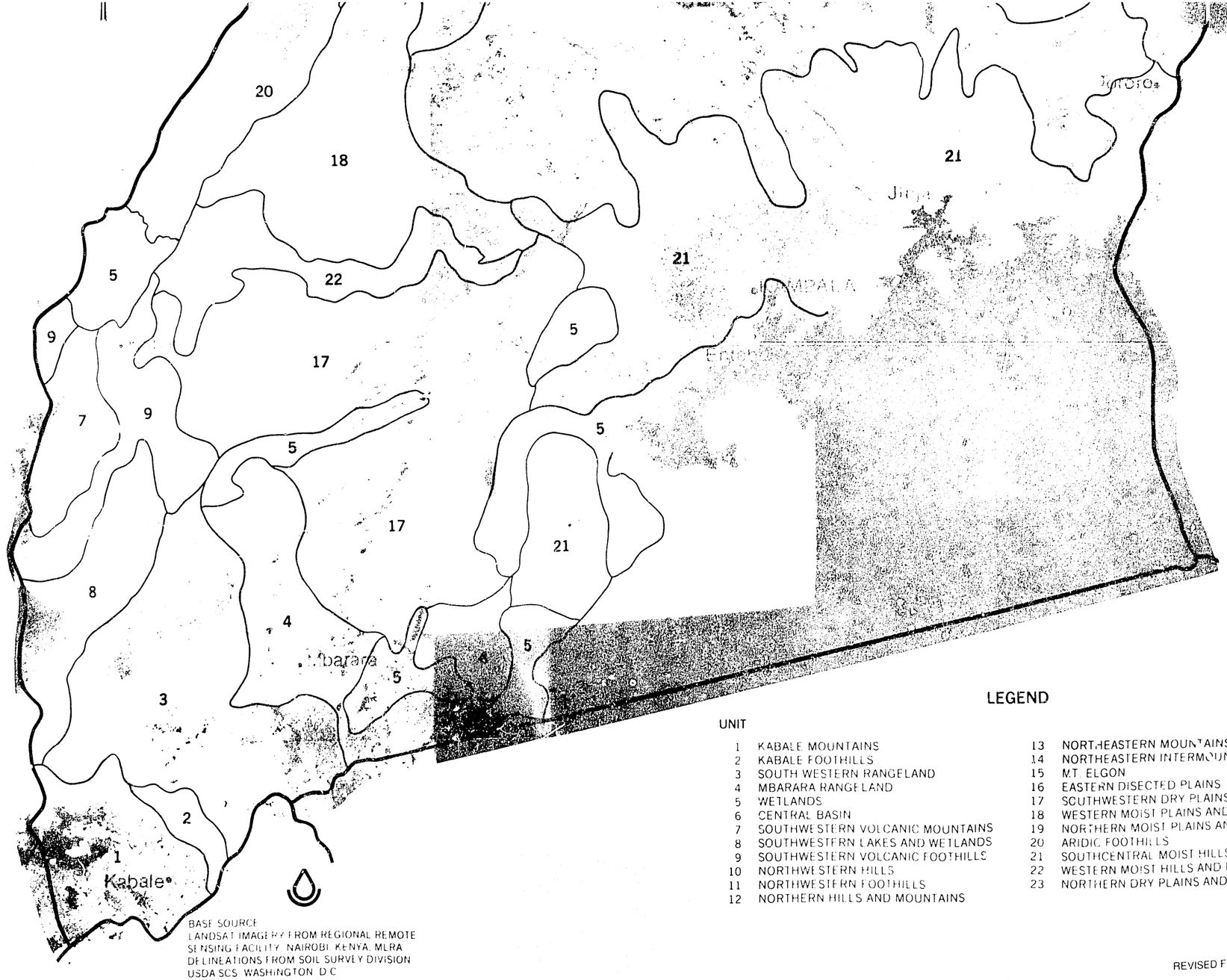

BASE SOURCE
LANDSAT IMAGERY FROM REGIONAL REMOTE SENSING FACILITY, NAIROBI, KENYA, MLRA DELINEATIONS FROM SOIL SURVEY DIVISION USDA SCS, WASHINGTON, D.C.

LEGEND

UNIT

1 KABALE MOUNTAINS
2 KABALE FOOTHILLS
3 SOUTH WESTERN RANGELAND
4 MBARARA RANGELAND
5 WETLANDS
6 CENTRAL BASIN
7 SOUTHWESTERN VOLCANIC MOUNTAINS
8 SOUTHWESTERN LAKES AND WETLANDS
9 SOUTHWESTERN VOLCANIC FOOTHILLS
10 NORTHWESTERN HILLS
11 NORTHWESTERN FOOTHILLS
12 NORTHERN HILLS AND MOUNTAINS
13 NORTHEASTERN MOUNTAINS
14 NORTHEASTERN INTERMOUNTAIN AREA
15 MT. ELGON
16 EASTERN DISECTED PLAINS
17 SOUTHWESTERN DRY PLAINS AND HILLS
18 WESTERN MOIST PLAINS AND HILLS
19 NORTHERN MOIST PLAINS AND HILLS
20 ARIDIC FOOTHILLS
21 SOUTHCENTRAL MOIST HILLS AND VALLEYS
22 WESTERN MOIST HILLS AND RIDGES
23 NORTHERN DRY PLAINS AND HILLS

REVISED FEBRUARY 1989 1004249