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KENYA SOIL SURVEY

DETAILED SOIL SURVEY OF THE KAMAMI FARM
(KIKUYU DIVISION, KIAMBU DISTRICT)

by
P.T. Gicheru

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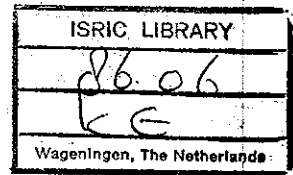
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Kenya Soil Survey
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1. INTRODUCTION

Following the request of the owner of the farm received through the Director, National Agricultural Laboratories (NAL), a detailed soil survey of Kamami farm was carried out to evaluate the suitability of the soils for the growth of various crops. The farm is approximately 4ha in size.

Fieldwork was carried out from 18/2/85 to 20/2/85 in collaboration with B.G.M. Muriithi of Kenya Soil Survey.

2. ENVIRONMENT

2.1 Location and communication

The survey area is situated in Kikuyu Division of Kiambu District. The farm is located at Muguga Forest Jet Scheme, 25km NW of Nairobi. The area is well served by a good network of roads which can be used throughout the year.

2.2 Climate

The nearest rainfall station to the survey area is KARI Muguga, station No. 91.36121 at an altitude of 2096 metres. The station has rainfall data for 19 years from 1951 to 1970 (EAMD, 1975).

The mean annual rainfall in the survey area is about 995mm. The distribution is bimodal with the long rains occurring in the months of March, April and May and the short rains occurring in the months of October, November and December.

2.3 Geology, physiography and hydrology

The whole survey area is covered by the Limuru trachytes and quartz trachytes (Saggerson, 1961 and 1967).

The survey area lies within ^{one} physiographic unit. This is the Block faulted upland. Most of the area is rolling to hilly (slopes 10-28%) while the rest of the area is gently undulating (slopes 2-3%). The area has no drainage channels. For planning groundwater a borehole has been established in the farm.

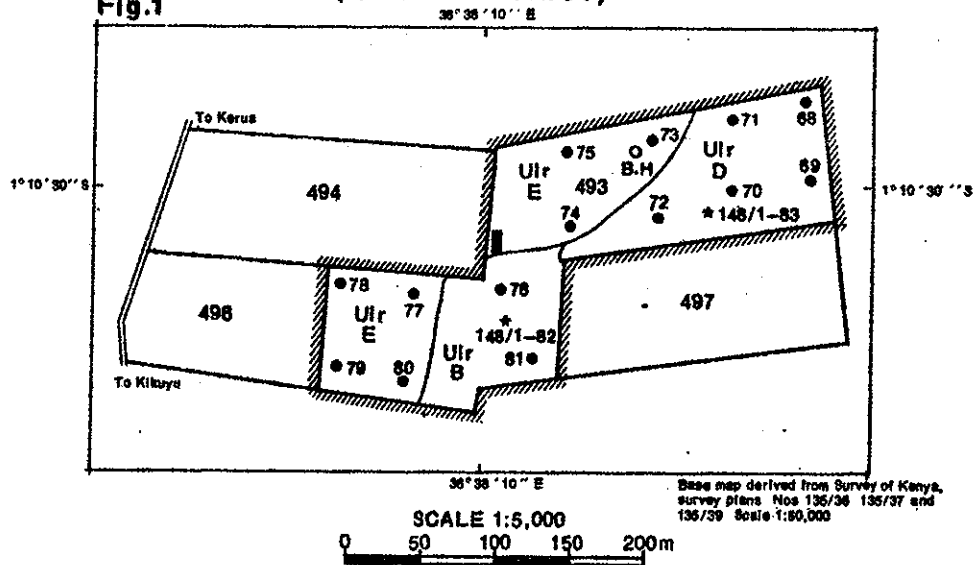
2.4 Vegetation and present land use

Most of the farm is covered by Kikuyu grass (2.5ha). The rest of the farm is planted with maize and nappier grass. Formerly, the survey area was covered by a natural forest.

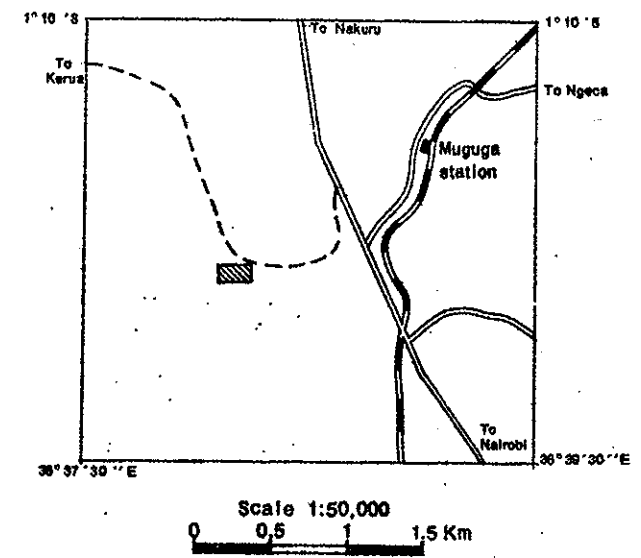
DETAILED SOIL MAP OF KAMAMI FARM

(KIAMBU DISTRICT)

Fig.1



LOCATION MAP



LEGEND

U BLOCK FAULTED UPLANDS (slopes 2-28%)
UI Soils developed on intermediate igneous rocks

Uir well drained, extremely deep; dark reddish brown firm clay (humic NITISOLS*)

*all soils are extremely deep (> 180 cm)

The names between brackets reflect the soil classification according to the 1974 FAO/ UNESCO legend for their "Soil Map of the World". Terms marked with * are Kenyan concept

KEY

- Uir soil mapping code
- B slope class code
- slope class boundary
- 70 augerhole observation, with reference number
- *148/1-82 profile pit observation, with reference number
- 1 cm² 0.25 ha
- railways
- road
- - - track
- 497 plot number and boundary
- o B.H. bore hole
- building
- /// survey area boundary
- ▨ surveyed area

KEY TO SLOPE CLASSES

slope %	slope class code	name of the macrorelief
0-2	A	flat to very gently undulating
2-5	B	gently undulating
5-8	C	undulating
8-16	D	rolling
16-30	E	hilly

SOIL SURVEY AND MAP PREPARATION (1985)

soil survey and map compilation.....P.T. Gicheru and B.M. Murlithi
 map correlation.....V.W.P. van Engelen
 cartography.....L.H. Mikiel

3. WORKING METHODS

3.1 Office methods

Prior to fieldwork, data on geology and previous work done on soil were collected. In addition, one topographic map sheet 148/1 by the Survey of Kenya at scale 1:50,000 and survey plans numbers 135/36, 135/37 and 135/39 at scale 1:5,000 were used for preparation of a base map.

3.2 Field methods

Most of the fieldwork was executed by the routine augering. Augerhole observations were done in grid system of 50 x 50m. Most augerings were made to a depth of 160cm. A total of 14 augerhole observations and 2 profile pit observations were made and described. The soils were described according to the standards of Kenya Soil Survey which are based on the "Guidelines for the soil profile description (FAO, 1977)". Each horizon in the profile pit was described and sampled for analysis in the laboratory.

Composite topsoil samples (0-30cm) were taken at various sites around the profile pit for analysis according to mass analysis method for soil fertility evaluation.

3.3 Laboratory methods

Analysis was carried out at the National Agricultural Laboratories, Nairobi. The methods are described briefly below. For details refer to Hinga et al (1980).

Before any analysis was done, all samples were air dried, crushed and sieved through a 2mm sieve.

Survey analysis

Texture	: hydrometer method
pH-H ₂ O	: 1:2:5 soil-water suspension
pH-KCl	: 1:2:5 soil-salt suspension
EC	: 1:2:5 soil-water suspension
Org. C%	: Walkley and Black method on A horizon soils
N%	: semi-micro Kjeldahl method on A-horizon soils only
Exchangeable cations	: successive leaching of the soil by 1N ammonium acetate pH (7.0). Determination of Na, K and Ca by flame-photometer/atomic absorption.

CEC : After the leaching the samples for exchangeable cations, the samples were successively leached with alcohol (95%) sodium acetate (pH 8.2) and 1N ammonium acetate (pH 7.0). The CEC was determined by measuring the Na concentration in the last leachate with a flame-photometer.

Mass analysis for available nutrients (on A horizon only)

Extraction of soil by shaking for 1 hour with 1:5 ratio 0.1N HCl/0.025N H_2SO_4 . Ca, K and Na were determined by EEL-flamephotometer after anion resin treatment for Ca. Both Mg and Mn were determined colorimetrically. P was determined by vanadomolybdophosphoric yellow colorimetrically.

4. SOILS

4.1 Description of the soil mapping unit

4.1.1 Systematics and nomenclature

The mapping unit on the soil map in fig. 1 is indicated by a code. The first entry on the map legend is the physiography which is denoted by U for uplands. The second entry is the parent material denoted by I for intermediate igneous rocks, r indicates the reddish colour of the soil.

4.1.2 Soils of the uplands

Mapping unit UIr

Extent	: 4ha
Parent material	: Trachyte
Physiography	: uplands
Macro relief	: approximately 1ha of this unit has a gently undulating relief (slopes 2-3%) and approximately 1ha of this unit has a rolling relief (slopes 8-16%) and the rest has a hilly relief (slopes 16-30%)
Erosion susceptibility:	very high
Land use	: Kikuyu grass, maize and nappier grass
Drainage	: well drained
Soils, general	: This unit consists of strongly weathered, extremely deep, dark reddish brown, firm clay soils. They have an ABC sequence of horizons with clear to gradual transitions. Clay cutans are present in B-horizon. The

Table 1. cont'd.

Chemical results

pH	5.4	6.3	6.4	5.9	4.3	5.3
Na me%	0.24	0.40	0.25	0.25	0.14	0.15
K me%	1.16	1.11	1.50	1.28	1.72	0.92
Ca me%	2.0	2.6	6.0	3.0	<u>0.2</u>	<u>0.8</u>
Mg me%	2.4	2.8	3.5	3.4	1.4	2.2
Mn me%	(2.88)	(3.12)	(3.32)	(3.56)	1.36	(2.72)
P ppm	9	Trace	Trace	Trace	Trace	12
N %	0.38	0.35	0.50	0.37	0.22	0.40
C %	3.14	2.27	3.14	2.76	1.17	3.11
Hp me%	-	-	-	-	-	-

These soils are moderately acid. Available potash is adequate while calcium and magnesium varies from low to adequate. Phosphorus is low. The organic carbon % is high.

5. CONCLUSIONS AND RECOMMENDATIONS

1. The soils of Kamami farm are well drained, deep with good physical properties for commonly grown crops.
2. The fertility status of these soils are generally good but can be improved. In areas where the soils are acid, it is recommended that agricultural lime should be applied as a base dressing along with superphosphates. It is also recommended that nitrogen may be applied in the form of calcium ammonium nitrate (CAN) which may be alternated with ammonium sulphate nitrate (ASN) every few years.

Following is the recommended requirements for the specific crops to be grown in the farm:-

a) Bana grass

Apply 75kg/ha of Triple superphosphate (TSP) when planting. Top-dress with 100-150kg/ha of calcium ammonium nitrate (CAN) in three split applications per year. Top dressing should be done after every cutting or grazing.

b) Vegetables (cabbages, tomatoes and spinach)

Apply 1-2 handfuls (10g) of triple superphosphate (TSP) per hole when planting. Top dress with one teaspoonful of calcium ammonium nitrate (CAN) per plant when cabbages and tomatoes are 20 to 25cm high, respectively. Spinach is top dressed after 3 weeks of planting.

c) Maize

Apply 100kg/ha of triple superphosphate (TSP) when planting. Top-dress with 150kg/ha of calcium ammonium nitrate when the plants are just about knee high.

d) Beans

Apply 200kg/ha of triple superphosphate (TSP) when planting.

e) Potato veins

These are usually not fertilized, but due to very low phosphorus levels apply about 100-200kg/ha of triple superphosphate (TSP) when planting.

f) Papaya

Apply one debe of manure, three tablespoonfuls of triple superphosphate and two tablespoonfuls of calcium ammonium nitrate (CAN) when planting. Top-dress with 200g of calcium ammonium nitrate (CAN) per plant per year.

g) Pears

Mix one debe of manure and 200g of triple superphosphate (TSP) with top-soil from each planting hole. Add 500g of calcium ammonium nitrate (CAN) per tree (when the plants are about to flower) per year.

h) Avocadoes

Avocadoes require 2 debes of manure and 120g of triple superphosphate (TSP) in each planting hole. Thereafter apply amounts of fertilizers as shown below.

<u>Age (yrs)</u>	<u>CAN (g)</u>	<u>TSP (g)</u>	<u>Muriate of potash</u>
1-3	120	220	-
4-5	220	450	-
6-7	450	650	220
8-9	650	650	450

REFERENCES

- E.A.M.D., 1975. Climatological statistics for East Africa Part 1 EAMD, Nairobi.
- FAO, 1977, Guidelines for soil profile descriptions, FAO, Rome.
- Hinga, G., C.M. Njihia and F.N. Muchena, 1980. Physical and chemical methods of soil analysis. Ministry of Agriculture, National Agricultural Laboratories, Nairobi.
- Saggerson, E.P., 1961 and 1967. Geological map of Nairobi area.

LABORATORY DATA OF PROFILE DESCRIPTION No. 1.

Observation no: 148/1-82 Mapping unit: Uir Soil classification: humic NITISOL

Laboratory no.	/85	1240	1241	1242	1243		
Horizon		Ap	Bt1	Bt2	Bt3		
Depth (cm)		0-12	12-34	34-84	84-150		
pH-H ₂ O (1: 2.5v/v)		5.8	6.2	4.5	4.5		
pH-KCl 1:2.5 "		4.9	5.5	3.9	4.0		
EC (mmho/cm) "		0.09	0.15	0.11	0.11		
CaCO ₃ (%)							
CaSO ₄ (%)							
C (%)		3.54	4.11	1.11	0.51		
N (%)							
C/N							
CEC (me/100g), pH 8.2		26.5	32.0	22.0	19.0		
CEC " " pH 7.0							
Exch. Ca (me/100g)		9.6	7.6	1.4	0.6		
" Mg "		2.0	4.2	1.0	1.40		
" K "		2.46	2.96	1.14	0.68		
" Na "		1.00	1.24	0.72	0.60		
Sum of cations		15.06	16.0	4.26	3.28		
Base sat. %, pH 8.2		57	50	19	17		
" " %, pH 7.0							
ESP at pH 8.2		3.8	3.9	3.3	3.2		
<u>Texture (limited pretreatment)</u>							
Gravel % (>2.0mm)							
Sand % (2.0-0.05mm)		18	20	14	16		
Silt % (0.05-0.002mm)		34	28	18	12		
Clay % (0.002-0mm)		48	52	68	72		
Texture class		C	C	C	C		
<u>Fertility aspects</u>		0 - 30 cm			Laboratory no. 1248/85		
<u>General</u>		<u>Available nutrients</u>					
pH-H ₂ O (1: v/v)	5.4	Na (me/100g)	0.24	Mn (me/100g)	(2.88)		
Exch. acidity (me/100g)		K "	1.16	P (ppm)	9		
C %	3.14	Ca "	2.0	P-Olsen (ppm)			
N %	0.38	Mg "	2.4				
<u>Remarks:</u>							

PROFILE DESCRIPTION No. 1General site information

Mapping unit : UIr
 Soil classification : humic NITISOL*
 Agroclimatic zone : II-5
 Observation no./date: 148/1-82; Kiambu District; 20/2/85
 Parent material : Limuru Trachyte
 Physiography : Uplands.
 Relief, macro : gently undulating
 Land use : grazing
 Groundwater level : very deep
 Slope gradient : 2%
 Drainage class : well drained

Profile description

Ap 0-12cm dark red (7.5YR 3/2 moist); clay; moderate, medium subangular blocky structure; friable when moist, sticky and plastic when wet; thin patchy clay cutans; many micro pores; many very fine, few fine roots; pH 5.8; clear and irregular transition to: lab. no. 1240/85

Bt₁ 12-34cm dark reddish brown (7.5YR 3/2 moist); clay; moderate coarse subangular to angular blocky structure; friable when moist, sticky and plastic when wet; thick, continuous clay cutans; few macro, many micro pores; many very fine, few fine few coarse roots; pH 6.2; gradual and smooth transition to: lab. no. 1241/85

Bt₂ 34-84cm dark reddish brown (2.5YR 2.5/4 moist); clay; strong coarse angular blocky structure; friable when moist, sticky and plastic when wet; thick, continuous clay cutans; few macro, many micro pores; few fine, few coarse roots; pH 4.5; clear and wavy transition to: lab. no. 1242/85

Bt₃ 84-150+cm dark reddish brown (2.5YR 2.5/4 moist); clay; strong coarse angular blocky structure; friable when moist, sticky and plastic when wet; thick continuous clay cutans; many micro pores; very few fine roots; pH 4.5
 lab. no. 1243/85

PROFILE DESCRIPTION No. 2General site information

Mapping unit : Uir
 Soil classification : humic NITISOL*
 Agroclimatic zone : II-5
 Observation No./date: 148/1-83; Kiambu District; 20/2/85
 Parent material : Limuru trachyte
 Physiography : uplands
 Relief, macro : rolling
 Land use : grazing
 Groundwaterlevel : very deep
 Slope gradient : 10%
 Drainage class : well drained

Profile description

- Ap 0-16cm dark brown (7.5YR 3/2 moist); clay; weak fine subangular blocky structure; friable when moist, sticky and plastic when wet; many macro pores; many very fine, few fine roots; pH 5.8 clear and smooth transition to:
 (lab. no. 1244/85)
- Bt₁ 16-55cm dark reddish brown (7.5YR 3/2 moist); clay; moderate, medium angular blocky structure; friable when moist, sticky and plastic when wet; thick patchy clay cutans; few macro, many micro pores; very few fine, common fine roots; pH 5.6; gradual and smooth transition to:
 (lab. no. 1245/85)
- Bt₂ 55-92cm dark reddish brown (5YR 3/3 moist); clay; moderate, medium angular blocky structure; friable when moist, sticky and plastic when wet; thick continuous clay cutans; many micro pores; very few fine roots; pH 5.7; clear and smooth transition to:
 (lab. no. 1246/85)
- Bt₃ 92-150+cm dark reddish brown (2.5YR 2.5/4 moist); clay; strong, medium angular blocky structure; very firm when moist, sticky and plastic when wet; thick continuous clay cutans; few macro, many micro pores; very few fine roots; pH 5.4
 (lab. no. 1247/85)