



REPUBLIC OF KENYA

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MINISTRY OF AGRICULTURE—NATIONAL AGRICULTURAL LABORATORIES

## KENYA SOIL SURVEY

A PRELIMINARY EVALUATION OF THE SOIL CONDITIONS  
OF THE EXPERIMENTAL AREA OF THE  
MACHANGA SOIL CONSERVATION STATION  
(EMBU DISTRICT)

by  
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## 1. Introduction

On request of the University of Nairobi, Department of Agronomy, the Kenya Soil Survey realised a site evaluation on the experimental area for beans on the Machanga Soil Conservation Station in Machanga (Embu). Special attention was paid to the irrigation suitability of the mentioned area.

The fieldwork was executed by Messrs. J.M. Kibe and A. Weeda during a visit to the area on 8th and 9th December, 1983.

## 2. General description of the area

### 2.1. Location

The Machanga Soil Conservation Station is located several kilometres NW of the Kamburu dam site on the road to Kiritiri (Embu district). The approximate coordinates of the area are  $0^{\circ}48'S$  and  $37^{\circ}40'E$  at an altitude of roughly 1100 metres above sea level. Within the station the area selected for experimentation with beans is situated 1 km SW of the offices and has an approximate extension of 10 ha.

### 2.2. Climate

According to the KSS agroclimatic zone map of Kenya (Sombroek et al, 1982) the area of the station is located in zone IV-2, with average yearly rainfall between 600-1100 mm and average annual temperatures of  $22-24^{\circ}C$ .

For the station Machanga (No. 90.37104) some climatic data, based on an observation period of 13 years upto 1971, are given in table 1.

Table 1. Rainfall (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
35	25	102	161	85	6	3	4	24	85	213	89
Average annual rainfall 830 mm.											

Table 2. Rainfall (in mm) and water requirements ( $2/3 E_o$ ) in mm during long and short rains, (Braun, 1977):

long rains			short rains		
rain (Mar-May)	$2/3 E_o$ (Apr-Jun)	P $2/3^*$	rain (Oct-Dec)	$2/3 E_o$ (Nov-Jan)	P $2/3^*$
348	287	37	387	363	54

\* P $2/3$  = P( $r < 2/3 E_o$ ) = probability that rainfall is less than  $2/3 E_o$  (water requirement) in %.

As for the growing seasons the indicated rainfall is low and not very reliable, the difficulties with rainfed agriculture are clear from this point of view.

### 2.3. Geology and geomorphology

The following generalized description on geology and geomorphology can be given. Most of the area consists of Precambrian quartz rich rocks of the Basement System, built up by a wide variety of granitoid gneisses and schists with some mixtures of other rocks through the formation of migmatites. The area is located on the strongly dissected peneplain (sub-Miocene?).

### 2.4. Vegetation and land use

The uncleared part of the station has a (wooded) bushland as natural vegetation cover although human influence is clearly visible: use as rangeland. Also charcoal burning is generally practised. The experimental area has recently been cleared with machinery for the planned purposes of bean growing.

### 2.5. Hydrology

The area is draining to the Lake Kamburu. No permanent surface water source is present inside the area belonging to the station.

## 3. Soils

### Field method

After a general view of the surroundings of the area, augerhole observations were made to approximately 1.20m at intervals of 100m along parallel lines, 100m apart, orientated NW-SE over the terrain of the experimental area. Additionally, water samples were taken from Lake Kamburu and the Thiba river, the two possible surface water sources for irrigation (pumping).

### Description of soil units

Two soil units can be distinguished. Both soils are developed in the Uplands on Basement System rocks, predominantly granitoid gneisses.

- Unit 1     UQr  
           A     Slopes dominantly less than 1%, well drained, deep soils with a topsoil (0-40cm) of dark reddish brown to reddish brown (5YR 3/3-4/4) loamy sand with subsoil of red to dark red (2.5YR 3/6-4/8) - sometimes dark brown (7.5YR 4/4) to strong brown (7.5YR 4/6) - loamy sand to sandy loam.
- Unit 2     UQrp  
           C     Slopes dominantly 5-6%, well drained, moderately deep soils with a topsoil (0-30cm) of dark reddish brown (5YR 3/2-3/4) to dark brown (10YR 4/3) loamy sand with subsoil of red (2.5YR 4/6) to strong brown (7.5YR 5/6) loamy sand to sandy loam with red mottles (10R 4/6), underlain by gravelly loamy sand (upto 70% gravel) or stones. Sometimes upto the grade of a gravelly or stony phase.

The transition between the two units is sharply marked by the change in slope class.

The units UQr and UQrp correspond greatly with the units BQ1 and BQ1p of the report of the Kindaruma area (van de Weg, R.F. and J.P. Mbuvi, 1975).

Other characteristics of these soils mentioned in the Kindaruma report are:

- a) the soils in general are slightly to moderately susceptible to sealing
- b) have a moderate susceptibility for rain splash due to the loose structure of the sandy topsoil
- c) have high infiltration rates
- d) are easily workable
- e) are chemically poor, although the level of K and Ca might be moderately acceptable (depends also on the requirements of the agricultural use)
- f) have a soil moisture storage capacity (between pF 2.3 and 3.7) of 6-8% vol, which can be considered as low.

The map with the soil units (figure 1) is a preliminary map as no exact location of the boundaries of the experimental area within the station was available.

#### 4. Water quality for irrigation

The area itself does not have superficial water sources, alternative sources from Thiba river or Lake Kamburu might be used through pumping. The quality of the water of these sources is shown by the results of the analysis of samples taken (appendix 1).

5. Conclusions

The soils are of a sandy texture with low organic matter content, resulting in a low water holding capacity. Taking also the local micro-topography into account, it will have to be concluded that sprinkler is the only technically feasible irrigation method to be applied on the flatter topography in the NW of the area.

The soils on the slope towards the South will not be recommended to be used because of slope, erosion hazard, limited rooting zone and as well by difficulties in workability due to the amounts of stones in several places. Quality of irrigation water from the Thiba river or Lake Kamburu is good for the normal agricultural uses.

6. References

Braun, H.M.H. The reliability of the rainy seasons in Machakos and Kitui districts. Report no. M12, Kenya Soil Survey, Nairobi. 1977

FAO-UNESCO, Soil Map of the World, Vol. I - Legend. Unesco, Paris. 1974

van de Weg, R.F. Soils of the Kindaruma area. Report No. R1, Kenya Soil and J.P. Mbuvi, Survey, Nairobi. 1975

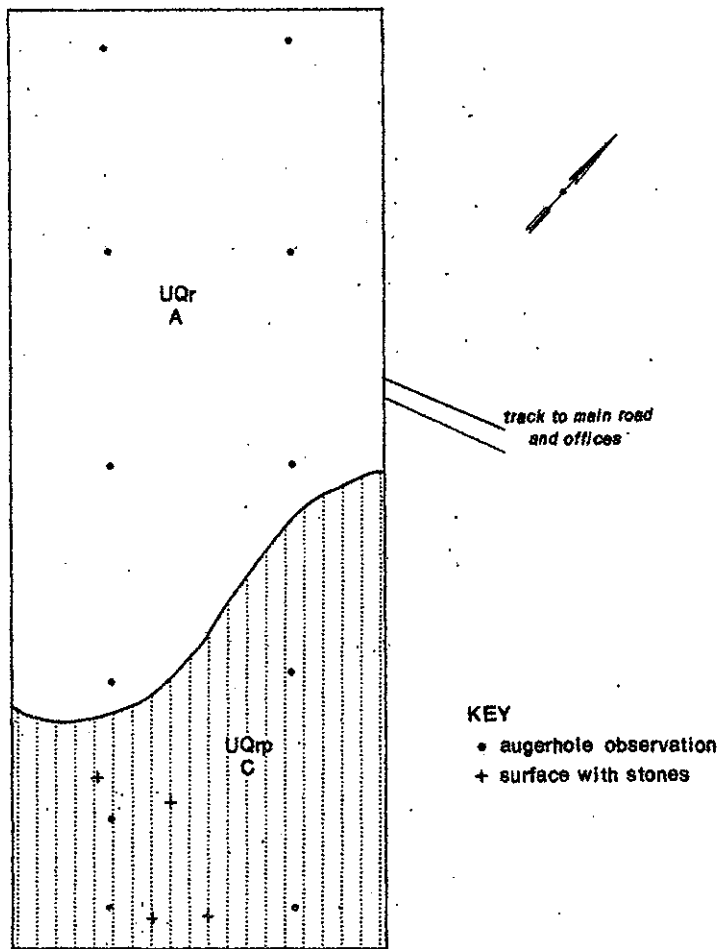
Appendix 1. Water quality of paddy fields and irrigation water.

Analysis of water samples taken in 1983.

	Thiba river	Lake Kamburu
Lab. no. .../83	8678	8679
pH	7.2	7.5
Conductivity microhm/cm	96	90
Sodium me/l	0.61	0.57
Potassium me/l	0.04	0.05
Calcium me/l	0.20	0.30
Magnesium me/l	0.40	0.10
Carbonates me/l	nil	0.19
Bicarbonates me/l	0.94	0.77
Chlorides me/l	0.30	0.35
Sulphate me/l	0.023	0.02
SAR	1.11	1.27



Fig. 1 Preliminary soil map of the experimental area of the Machanga Soil Conservation Station




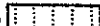
LEGEND\*

SCALE 1:4,000 (approx)

U UPLANDS

UQ Soils developed on quartz rich Basement System rocks; predominantly granitoid gneisses

UQr  well drained, deep, red to dark red, loamy sand to sandy loam, with 0 to 40 cm topsoil of loamy sand (slopes 0-1%)

UQrp  well drained, moderately deep, mottled, red to strong brown loamy sand to sandy loam, with 0 to 30 cm topsoil of loamy sand; underlain by gravelly loamy sand or stones (slopes 5-7%)

\*slope classes A: slopes 0-2% flat to very gently undulating  
C slopes 5-8% undulating

Drawing No. 84005

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