REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE — NATIONAL AGRICULTURAL LABORATORIES

# KENYA SOIL SURVEY

## THE SOIL RESOURCES OF THE UPPER KERIO VALLEY

## A PRELIMINARY INVESTIGATION

by

W. Siderius

SITE EVALUATION REPORT

Site Evaluation Report No.D24

Nairobi, Sept. 1975

Kenya Soil Survey
S321/OW/WS - June, 1975

# THE SOIL RESOURCES OF THE UPPER KERIO VALLEY
## A PRELIMINARY INVESTIGATION

b y

W. Siderius

SITE EVALUATION NO. 24

## 1. Introduction

The present exploratory survey was carried out on the request of the Rift Valley Provincial Planning Officer, which was channelled through the Ministry of Agriculture for action by the Kenya Soil Survey. The actual field work in the Kerio Valley, which forms a part of Kenya's medium potential areas, was executed from 4-18th of June 1975. A total of 344.161 ha (825.987 acres) was covered. Apart from 72 soil samples taken for chemical and physical analyses at the National Agricultural Laboratories in Nairobi, also 3 water samples were collected from the Kerio river in order to check its polatebility and suitability for irrigation.
The accompanying "Soil Resources Map of the Upper Kerio Valley" is on scale 1:100.000, and was reduced from the original 1:50.000 topographical sheets, that cover the area. Information from 1:60.000 aerial photography was transferred to the 1:50.000 base map in the office, as part of the preparation prior to the field work.

Intially the survey was to deal only with the possibilities of irrigation in the valley, this was subsequently reformulated in an exercise to gain knowledge about the general conditions of the soils and the land in the valley. Thus more attention was paid to the valley floor and associated terrains , than the bordering steep slopes and hills such as the Tugen Hills proper and the upper part of the Elgeyo escarpment.

The presented data are to be seen as preliminary and a first approximation of the land resources of the valley in general. They may supply the necessary background information for selected, more detailed studies in the future.

## 2. Acknowledgements

The survey party received much valued co-operation from a number of individuals and institutions. Without this help the survey would have been unnecessarily lengthened. They would like to thank in particular the D.C. of the Baringo District, Mr. D.K. Nasieku, the D.O. of the same district Mr. J.R. Ngeno; the Manager of the Baringo Development Training Centre, Mr. A. Hessler and the D.C. of the Marakwet-Elgeyo District Mr. W.O. Muganda.

## 3. Physiography of the survey area

### 3.1. Location and Access

The latitude and longitude for the area are $0^{\circ}15'$ N - $1^{\circ}30'$ N and $35^{\circ}30'$E - $35^{\circ}45'$E. Its western boundary is formed by the upper steep slopes of the Elgeyo Escarpment; the southern boundary is the watershed between the Kerio and the Perkerra river, where the Metkei Forest is located. In the east the lower slopes of the Tugen Hills comprise the boundary, while in the

northwest the divide with the Wei-Wei river is taken, and true North the survey boundary is maintained at 1°30'N.

The area forms part of the Rift Valley system and administratively falls under the jurisdiction of Baringo and Elgeyo-Marakwet districts east and west of the Kerio river. There are however plans to secure a single administration for the whole valley.

The general access in to the area is poor although much was done to improve the situation recently. The use of 4-wheel drive vehicles is recommended for use throughout the valley. The main tracks are the following: Kabernet-Cheblock Bridge-Tambach (resp. 16 + 30 km), a gravel road with steep slopes and sharp bends, except for the flat valley bottom part, which however may be inaccessible in the rainy season; Kabernet-Cheblock Bridge-Kimwarer-Fluorspar Mine (39 km) which is also a gravel track with occasional deep gullies sometimes impassable during the rains even with 4 wheel drive. At Kimwarer this road connects up with a tarred road to Eldoret. A second entrance from the east into the northern part of the valley is formed by the road Marigat-Kito pass-Tot-Sigor. This is a fairly new, well maintained road, motorable throughout the year (Tot-Kito pass: 47 km). From Chebloch there is a track on the east bank of the valley to the South, which is impassable in the rainy seasons, while another track leads north to Kabluk and Barwesa (resp. 28 and 37 km). This track can no longer be followed some miles north of Barwesa and is also impassable during the rains.

On the west side of the valley a track of gravel, sand and murram leads to Tot and further on to Sigor (Kabernet -Tot: 116 km). The going is slow, partly caused by the progressing erosion of the track, making drifts, gullies ets. and therefore difficult to negotiate. In addition there exists a track from Chesoi down into the valley, joining the track Tot-Chebloch. From the Tot bridge is a track leading south on the east side of the valley to Kimonai Mission (27 km), where it ends because of the presence of a lower lava plateau with a considerable scarp (map unit LIb).
A track to Lokori in Turkana branches off 21 km North of Tot from the road to Sigor. No cross section can be made at any part of the valley by car and for detailed surveys cutlines will be necessary.
The land is said to be County Council Trust Land (Ref. no8 &11), its population density is variable from 4-10 per sq. cm. in the lower and northern part of the valley, to 97-193 per sq km on the scarp. Nilo-hamitic and Bantu are the major ethnic groups.

## 3.2. Geology and Parent Material

Information on the hard geology of the area is extracted from the Geological Reports No, 47 and No. 83 respectively by Mason and Gibson (1957) and Walsh (1969).

...../4

The second entrance on the legend is the geology which follows closely the nomenclature of the geological reports. Unfortunately the central area between 0°30'N - 1°00'N and 35°30'-36°00'E has not been covered as yet by a published report and map. Two distinct geological formations are recognised.
1) Archaean rocks of the Basement System, mainly various gneisses and;
2) intermediate and basic igneous rocks of Tertairy age. Ad 1) This formation is exposed on the western side of the valley and forms the so called Elgeyo escarpment. The rocks consist mainly of banded hornblende and biotite gneisses. They follow an almost south-north strike and dip to the east at a 30° angle. The formation has given rise to a striking erosional pattern with very distinct V-shaped secondary valleys. Inclusive in the formation are crystalline limestone and quartzites. Metamorphism of the former may result in fluorspar ($CaF_2$), alteration of the Limestone implies a leaching of colloidal silica under low temperature conditions when $CaCO_3 \rightarrow CaF_2$, while the latter rocks occur regularly at the foot of the escarpment as hills (map unit HF).
Ad 2) The volcanic rocks are from the tertiary and consists of porphyritic olivine basalt, trachyte and phonolite and associated pyroclastic rocks. No central point of outflow could be indicated. It is however anticipated that most of these igneous rocks extruded from various points in the Tugen Hills. The out-flowing magma followed the then existing topography, which resulted in a westwards extension of these flows. The Tertiary rocks occupy the complete east side of the valley and are sometimes exposed up to the Kerio river (map unit LIb) and underly the Quaternary sediments of the valley.
Most probably associated with the volcanic series are sandstones, grits and conglomerates, as exposed in the northern part of the survey area (map unit HS). Their surface area is small when compared with the occurrence of the first two formations.

The parent material for the valley soils originated through weathering of the above named rocks. These weathering products are indicated on the geological map as "torrent wash of the Kerio valley" (Q) and include the Kimwarer and Chebloch sediments as well as the lacustrine deposits of Lake Kamnarok. Their chemical composition is varied and depends firstly on the type of the parent rock(s). Thus the quartzitic component (expressed as $SiO_2$) is mainly derived from the Basement System rocks, predominantly the coarse-grained banded gneisses. This gives rise to somewhat coarser textures on the west side of the valley as compared to the east bank confirming statements made in Ref. No. 1. Hornblende and biotite produce iron and magnesium on weathering, thus providing a source for the reddish colours of the soil. Associated muscovite provides K-Al silicates while Ca and Na may be supplied also, partly through the weathering of the limestone. The biotite gneisses on the whole are kaolinitized, as observed around Kimwarer.

The major part of the valley is underlain by basic igneous rock, expressed as finely grained olivine basalt, in which calcic plagioclase (anorthite $CaCl_2$-$Si_2O_8$) is the main component (about 60%), followed by pyroxenes such as hypersthene and augite. The latter supply Ca, Mg and Fe upon weathering. Olivine constitutes some 10%.

West and south of Kabernet an intermediate igneous rock classified as trachyte is exposed frequently. It is a porphyritic rock in which the ground mass as well as the phenocrysts are mainly composed of alkali feldspar (sanidine, K-Al Silicate), with subordinate amounts of hornblende, biotite and quartz. In the middle and northern part of the valley phonolite is exposed. Although alkali feldspar is again the dominant rock constituent, nepheline (Na-Silicate) is present as phenocrysts, while hornblende and biotite may both occupy some 10%.

The weathering products of the volcanic rocks generally give rise to fine textured soils, with a relatively high persentage of silt; they are of a red colour and may contain appreciable amounts of carbonates and/or salts.

Little salinity and/or alkalinity is expected in the soils derived from the Basement system rocks under the present climatic conditions. However generally this hazard may increase with the climate becoming more arid, in the northern part of the valley.

The supply of plant nutrients from the rocks is expected to be fair. An overall deficiency of nitrogen is anticipated, and confirmed by analysis.

Tectonically the area belongs to the rift system. A major fault is indicated at the base of the escarpment. The contact zone of two different rocks initiated the course of the Kerio river, which subsequently formed the valley in the general direction of the fault or zone of faulting, rock strike and topography.

### 3.3. Topography and landforms

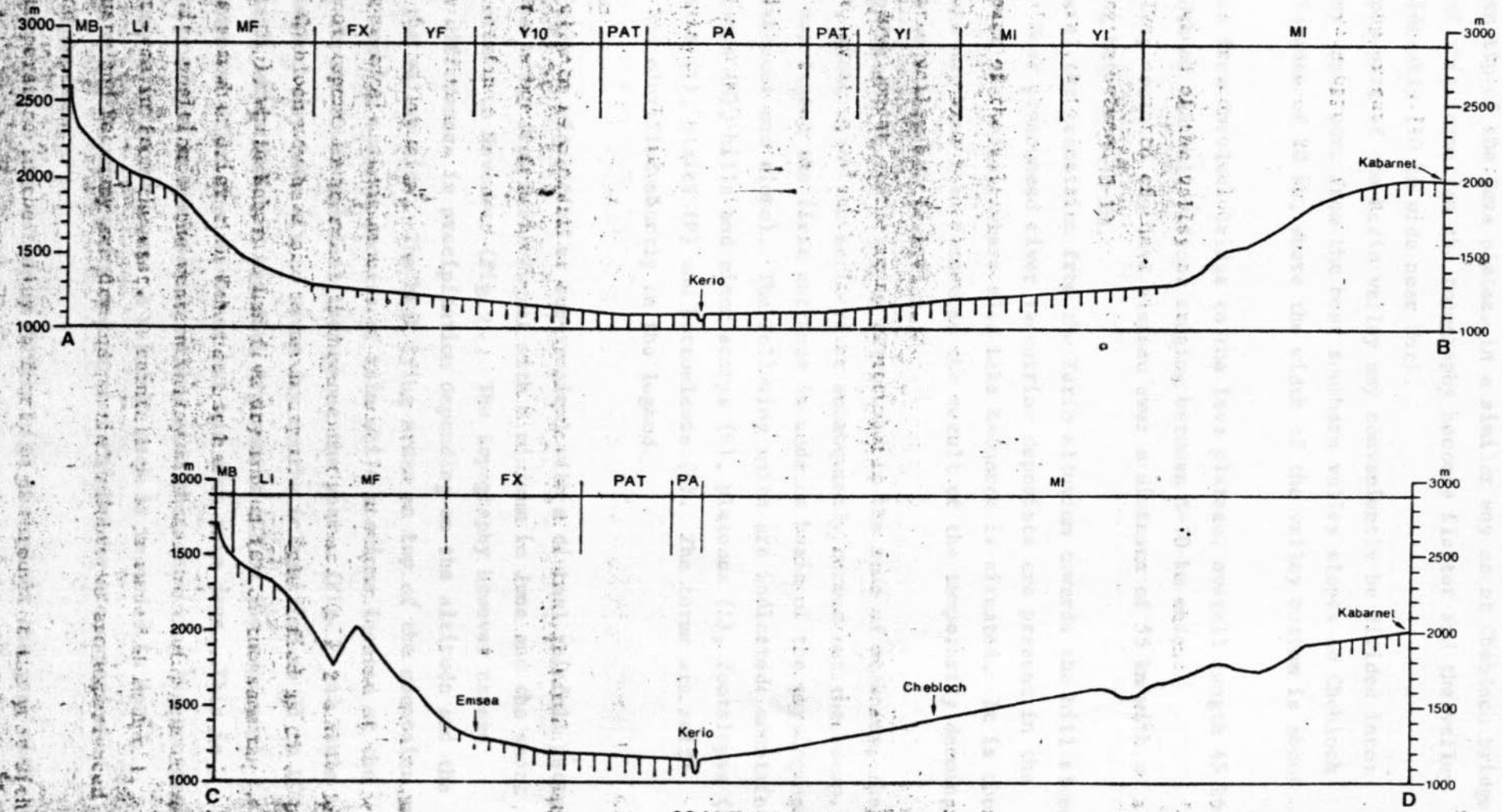
The contrasting geological formations, the varied tectonic history combined with the climate caused the development of large differences in relief and induced a strongly erosional topography. Outstanding features are the Elgeyo Escarpment rising up to 1500 m above the valley floor to the top of the scarp on the west side of the valley; while on the east side the Tugen Hills rise to similar beights having a slightly more subdued topography (fig. 1)

Large relief differences also occur in the southern part of the valley, where rocks of the Basement and the volcanic formations meet.

Towards the north the valley widens, but 10 km North of Kabulwa a large flow of trachytic phonolitic lava (map unit IIb) causes a narrow passage way for the Kerio river.

..../6

**Fig.1 CROSS–SECTIONS OF UPPER KERIO VALLEY**



Its flow must have been superimposed, as the river breaks through the most southern tip of the lava plateau in a similar way as at Chebloch bridge. Northwards of this formation the topography becomes flatter and the valley widens considerably (10 km wide near Tot).

The upper part of the Kerio valley may conveniently be divided into:

a) the very upper part from the most southern valley slopes to Chebloch Bridge, a distance of 20 km, where the width of the valley bottom is about 1-2 km;

b) the area from Chebloch Bridge to the lava plateau, overall length 45 km with the width of the valley floor ranging between 5-10 km and;

c) the valley north of the lava plateau over a distance of 55 km with a width varying between 3-10 km.

In general the transition from the Kerio alluvium towards the hill slope is gradual. Most pronounced river lacustrine deposists are present in the central part of the valley, where also Lake Kamnarok is situated. It is thought that this lake may have been formed as the result of the temporarily damming of the Kerio valley by the lava flow.

The development of the scarp is attrubuted to the zone of weakness, the Elgeyo fault, along which the Kerio river subsequently carved out the scarp.

On the map legend the first entrance is made on basis of the physiography (relief differences and slope). The following units are indicated: mountains and major scarps (M), hills and minor scarps (H), plateaus (L), footslopes (F), piedmont plains (Y), plains (P) and bottomlands (B). The terms are self-explanatory and clarified shortly on the legend.

### 3.4. Climate

The climate is classified as sub-tropical with a diurnal rainfall pattern. The long rains occur from April-August with a minimum in June and the short rains are confined to November (Fig. 2). The topography however causes considerable differences in precipitation depending on the altitude and the exposure of the valley side. The high lying areas on top of the mountains and upper slopes receive maximum amounts of rain while stations located at the valley floor report lower rainfall throughout the year. (Fig. 2 and Table 1).

Thus Chebloch may have six to seven dry months (classified as C5 on DOS 1:250.000 map), while Kabernet has five dry months (C3 on the same map). Tambach is somewhat drier than Kabernet but has more rain days. This is caused by its position on the western valley side thus receiving the convertive rains that come in from the east. A rainfall peak is recorded in April, while January and February are dry and partial rainbreaks are experienced in June and September.

The temperature in the valley is fairly high throughout the year with annual maxima ranging from 26-34°C and annual minima from 14-22°C. It varies according to altitude, and accordingly the valley bottom area is warmer

...../7

throughout the year than the associated slopes, the scarp and mountaneous areas (Ref's 4, 5 and 8).

The resulting evaporation is lowest during the rainy season(s) and is then estimated to be between 150-175 mm per month, while during the remaining part of the year the evaporation (Eo-Penman) is estimated to be between 175-200 mm monthly (Woodhead, 1968).

Table 1a - Rainfall for selected stations in mm

| Station | J | F | M | A | M | J | J | A | S | O | N | D | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kabernet DC | 25 | 42 | 68 | 180 | 155 | 149 | 222 | 245 | 83 | 45 | 66 | 57 | 1337 |
| Tambach DC | 33 | 46 | 88 | 188 | 173 | 103 | 134 | 125 | 65 | 76 | 93 | 73 | 1197 |
| Chebloch-Agr. | 21 | 32 | 59 | 135 | 129 | 82 | 117 | 132 | 53 | 46 | 92 | 39 | 937 |
| Lomut | 22 | 37 | 53 | 112 | 122 | 101 | 132 | 112 | 50 | 45 | 65 | 42 | 893 |

Table 1b Evaporation (Eo Penman) and Estimated Evaporatransipiration ( = 2/3 Eo) for maize in mm

| | J | F | M | A | M | J | J | A | S | O | N | D | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eo | 190 | 190 | 190 | 165 | 165 | 165 | 165 | 165 | 190 | 190 | 165 | 165 | 2105 |
| Et (maize) | 127 | 127 | 127 | 110 | 110 | 110 | 110 | 110 | 127 | 127 | 110 | 110 | 1405 |

Number of raindays

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kabernet DC | 3 | 4 | 7 | 15 | 14 | 12 | 16 | 17 | 9 | 8 | 9 | 6 | 120 |
| Tambach DC | 4 | 5 | 8 | 16 | 16 | 12 | 16 | 14 | 9 | 17 | 13 | 7 | 131 |
| Chebloch-Agr. | 2 | 4 | 7 | 8 | 18 | 2 | 6 | 6 | 4 | 4 | 6 | 3 | 70 |
| Lomut | 4 | 9 | 6 | 2 | 16 | 0 | 9 | 6 | 6 | 11 | 11 | 1 | 81 |

Station particulars

Kabernet DC - 30 year record (1931-1969), altitude 2043 m, 0°30'N-35°45'E, No. 89.35/20

Tambach DC - 30 year record (1931-1969), altitude 1829 m, 0°36'N-35°32'E, No. 89.35/14

Chebloch Agr. 19 year record (1940-1969), altitude 1219 m, 0°26'N-35°40'E, No. 89.35/93

Lomut - 14 year record (1945-1959), altitude 947m, 1°25'N-35°33'E

A rainday is a day on which 0.25 mm or more rain is recorded (Ref. no. 5). After 1962 it was redefined as a day on which 1.0 mm or more vain is recorded.

The stations Kabernet and Tambach are thought fairly representative of the higher areas in the valley, respectively on the east and the west side. The Chebloch station may approach the situation as exists in the lower valley regions in the southern part. Lomut is situated just west of the northern

...../8

part of the survey area and is the taken to indicate the climatic conditions for the lower parts in that region.

It is anticipated that measurable differences in climate exist between the southern and northern part of the valley. The available data indicate that climatic conditions become more severe going northwards, as is expressed by a decrease in rainfall, an increase in the unreliability of the rainfall, an increase in temperature and evaporation. This change in climate becomes apparent through different vegetative growth in the area north of the lava flow (see section 3.5).

The available moisture to support rain-fed arable farming may be calculated as follows. The growing season is defined from April to August, whilst field preparation is scheduled in March and harvesting during October and November.

Expected rainfall in the five months long growing season as compared to the total annual rainfall is:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lomut | total annual rainfall: | 893 mm | | long rains: | 579 mm |
| Chebloch- | " | " | " : | 937 mm | | " | " : | 595 mm |
| Kabernet- | " | " | " : | 1337 mm | | " | " : | 949 mm |
| Tambach- | " | " | " : | 1197 mm | | " | " : | 723 mm |

In addition the short rains contribute favourably to the soil moisture situation, while land in lower topographic positions benefit from lateral drainage of the hill slopes, thus improving their moisture balance.

The probability of receiving 600 mm or more rain during the long rains is 90% for Kabernet and 75% for Tambach; while the probability (Pr) of more or equal the precipitation of 500 mm is 70% for the Chebloch area and 65% for Lomut station (see also chapter 5).

If the evapotranspiration for maize is estimated at 2/3 of the Eo, than it totals 1405 mm annually. From April to August the Eo varies between 750 and 875 mm; the Et during these months for maize is calculated as 500 to 600 mm. One cropping season appears therefore perfectly feasible.

In terms of the USDA Soil Taxonomy the soil moisture regime may be classified as Ustic, meaning there is limited moisture, but it is present at a time when conditions are suitable for plant growth. The soil temperature regime in the valley is tentatively classified as Hyperthermic, it being more than 22°C, while the difference between mean summer and mean winter soil temperatures at 50 cm is estimated to be more than 5°C. The soil temperature is considered favourable for the germination and vegetative growth, especially in the lower parts of the valley, but may be on the low side on the higher areas during the long rains. In these areas it may classify as Thermic.

.../9

## 3.5 Vegetation

The distribution of plant species and over-all physiognomy of the vegetation follows fairly closely the physiography and moisture conditions. According to reference no's 2&3 complemented with recent information, the following types of vegetation may be distinguished:

a) in the swamps (map unit S)- undifferentiated grassland and clump grassland with Acacia fistula.

b) on the valley floor ( map units PA, PAT, PAL) -riverine woodland of Acacia tortilis and Boscia albitrunca, in the northern part with a thicket of A. tortilis. The undergrowth of grasses, herbs and legumes is fair and should be good under undisturbed conditions.

c) on the piedmont plain (map units Y) low woodland of Acacia spp. and Commiphora spp. with occasional thicket and variable undergrowth of grasses and herbs.

d) on the lava plateau (LIb)- Acacia mixtures of bushland and thicket mainly of A. tortilis and Capparidaceae.

e) on the footslopes at the southern end of the valley (map unit FX)- woodland of Combretum spp. with evergreen bush and woodland, Combretum with sparse Dodonaea

f) on the west steep valley slope (map unit MF)-Acacia brevispica and A. tortilis in association with Terminali and A.evergreens, while on the proper scarp a mixture occurs of Ulvaria with Dodonaea.

g) on the eastern fringe of the valley (map unit MI)- mixed bushland of Combretum with sparse Dodonaea and Acacia with Terminalia and Albiza. The amount of undergrowth is variable and is described as fair to poor in the southern part of the valley, but is considered fair to good in the central region. In this area a good grass cover of annuals and some perennials such as Cenchrus cilarius and Chloris roxburghiana. may be encounted, together with herbs.

To the north the undergrowth is variable, partly caused by climatic and soil conditions, partly as a result of overgrazing.

In general the woody vegetation is well developed, but height and density decrease to the north.

Human influence is detectable by the cutting and burning of the natural vegetation; and even more so by the uncontrolled number of goats and sheep of which especially the latter have a desctructive influence on the vegetation and its regrowth. This is especially obvious in populated areas where the delicate ecological balance is easily disturbed:

3.6. Hydrology

The main perennial stream is the Kerio river, in some sections also called Endo. It is fed by a number of tributaries of which the most important ones are in the southern part: the Kimwarer, the Mong, the Mkorwa and the Kipsay. The Torch, and Barwesa rivers are the tributaries in the central part and the Arror, Embamin, Tilingwa and Kapcherertytin in the northern part. The overall drainage system is directed northwards and forms part of the Lake Turkana basin of the northern Rift Valley.

Although no flow may be detected at the surface during the drier months of the year the Kerio is reported to contain water at shallow depth and wells are dug for animal and human water supply. Few data are available on the amount of water that is available during the year. The water flow for the Kerio and Arror rivers as given by the WHO (1973- Ref. No. 19) indicate low annual discharge of respectively 5.4 and 2.2 cusec. (Table 2). This may restrain the development of large irrigation schemes.

Table 2. Discharge data of the Kerio and Arror Rivers

| Site | Catchment area in sq. km | Mean annual report | | 95% duration runoff | |
|---|---|---|---|---|---|
| | | $m^3$/sec. | l/sec/sq.km | $m^3$/sec. | l/sec/sq.km |
| Arror (2C5) | 185 | 2.23 | 12.1 | 0.89 | 4.8 |
| Kerio (2C7) | 893 | 5.37 | 6.01 | 0.074 | 0.083 |

Some of the mountain streams of the Elgeyo escarpment are reported to be perennial, such as the one causing the Torok waterfall. Although the total discharge of these affluents may be little, their water could be used to more advantage than at present. In addition to the construction of (low) weirs, stock dams may provide a means of storing water in the drier season. As is shown, the major contribution to streamflow in the Kerio river is caused by runoff in the southern part of the catchment area. Extremely high floods do occasionally occur as for example in 1963 when the valley was flooded over a width of 600 m at Chebloch Bridge, This however is rare and floods, if occurring, are commonly restricted to the flood-plain (map unit PA and PAT).

Analyses of Kerio water samples taken at three different places during the first half of June 1975 indicate the following composition (Table 3).

Table 3 - Composition of Kerio River-Lake Water

| Location | meq/litre Na | K | Ca | Mg | Sum | $CO_3$/$HCO_3$ | Cl | Sum |
|---|---|---|---|---|---|---|---|---|
| Chebloch Bridge | 0.57 | 0.10 | 0.44 | 0.14 | 1.25 | 0.80 | 0.61 | 1.41 |
| Lake Kamnarok(E-bank) | 0.46 | 0.15 | 0.58 | 0.16 | 1.35 | 0.98 | 0.36 | 1.34 |

| Location | pH | EC mmhos/cm | SAR | RSC | TDS | Fluoride (in ppm) | Heavy min. |
|---|---|---|---|---|---|---|---|
| Chebloch Bridge | 7.2 | 112 | 1,14 | 0,50 | 769 | 1.0 | 0.001 |
| Lake Kamarok (E-bank) | 7.4 | 124 | 0.62 | 0.24 | 298 | 0.8 | 0.001 |
| Tot Bridge | 7.9 | 158 | 0.69 | 0.48 | 1857 | 1.2 | 0.001 |

The overall classification of the water is neutral to slightly alkaline, it contains a fair amount of mineral matter. The water is drinkable; the fluoride content is far below the generally accepted upper limit (=5.0 ppm). For irrigation purposes the water is classified as C1S1, meaning a low sodium hazard and low conductivity. In addition the RSC (residual sodium carbonate) value is far below values held to be critical towards plant growth.

The TDS (total dissolved sediment) data give an indication of the augmenting amount of solid material being washed into the river water down streams giving the water a brownish colour.

Careful management of the watershed is thus called on to prevent any further erosion, which would cause thousands of tons of valuable topsoil material to be drained away in the river. These aspects need further appreciation when dam building is considered.

Because of rock differences and variations in soil cover the permeability of the ground to enrich the groundwater aquafer is variable. The expected depth of static water level is between 50-100m, but may be shallower (less than 50 m) in the northwest (WHO, 1973). -Ref. No 18). Bicarbonate ground waters are to be anticipated.

In the northern areas the occurrence of saline ground water is a possibility.

The hydrological aspects of the Kerio valley deserve a more detailed study to come to a better use of the available water based on more information.

## 3.7 Conclusion

The physiography of the area has hampered full development of its resources. This is enhanced by difficult access and possible adverse climatic and health conditions. Although malaria does occur in the lower parts of the valley, the occurrence of tsetse fly was rare at the time of the field studies. This however may be true only during the period of June.

At present the environmental conditions should not prevent the better utilization of large stretches of land that occupy the lower slopes and the alluvia.

The annual rainfall is sufficient to support one crop while in addition river water may be used to supplement crop growth through irrigation, and provide water for lifestock.

## 4. Description of Mapping Units

### 4.1. General

This description follows closely the map units as described on the map legend. The major entrances are the physiography and the geology, followed by a concise indication of the major soils of each unit. It will be noted that inclusions are not mentioned in the map legend; these will be described shortly in the paragraphs below. These soil inclusions may take up 20% of a map unit.

### 4.2. Unit description

#### 4.2.1. Soils of the Mountains and Major scarps (M)

-MF- This land comprises the mountaineous sloping west side of the Kerio Valley and includes what is indicated on the various topomaps as the "Elgeyo Escarpment". Commonly the slopes are between 25-35° (45-70%). Dominant rocks are banded hornblende-biotite gneisses of the Basement system, but locally quartzites and crystalline limestone also occur. The main vegetation is a Acacia woodland in many areas degradat to shrub or scarp vegetation (Ref. nos 3b 13). Soil development is limited; lithosols are common in association with bedrock exposure, in addition soils are gravelly and/or stony. Soil material is mainly dark reddish brown sandy loam to sandy clay loam, well drained, friable and slightly acid to neutral. The lands are susceptible to erosion, as is obvious from the many V-shaped gullies, which are partly induced by the strike and dip of the parent rock.

In this unit somewhat deeper soils may be encountered on steep slopes. These are occasionally cultivated by means of simple terraces. The erosion hazard remains however considerable.

Present Land use: Some arable rainfed farming of food crops is carried out. Maize, and cassava are the major crops. Cultivated plots, are very small (0.1 ha). Where water is available from the escarpment some small scale garden irrigation may be carried out by gravity flow; in this case bananas are grown.

There is some grazing for livestock.

Land use alternatives: The cultivation of the steep mountain slopes should be discontinued to minimize the erosion of the catchment area of the Kerio. Some mountain streams may be suitable to dam and create additional water supply for human and animal use. No arable cropping or grazing is recommended for this unit, as better lands are available at a lower topographic position.

-MB- Most of this land is situated on the southeast slopes of the valley and is underlain by olivine basalt. It has steep slopes and the vegetation consists mainly of Combretum spp. with Dodonaea and Terminalia spp. Undergrowth is poor and lacking in certain areas. Sheets erosion is prominent in many parts, while seasonal streams may be incised several meters in the soil and rock

...../13

material. Their tributaries often take the appearance of gullies. Soils are very shallow, dark reddish brown to dusky red in colour (2.5YR 3/4 - 3/6) clay loams, well drained and friable. Occasional deeper soils may be encountered and these may be cultivated.

On the west side of the valley this unit is represented by the almost vertical scarp of the olivine basalt, the latter recognized by the columnar rock structure. There is none to a very thin soil cover and vegetation is practically absent, apart from mosses and some grasses.

Present land use: most of the land is used for grazing while in some pockets rainfed agriculture is practised. Terracing of the land is a necessity to prevent erosion from getting a hold on the precious topsoil.

Land Use Alternative(s): none, grazing and cutting of the vegetation should be discouraged as much as possible to save the watershed from degradation. Some streams may be suitable for damming as a way to improve the water situation.

-MI- This unit occupies most of the eastern side of the valley. Slopes are steep and rugged with only occasional flatter areas. This unit forms part of the Tugen Hills, which are fully expressed in the east. The vegetation is the same as for MB and the geology is described as trachyte, occasional phonolite. The soils are also very shallow, well drained, dark reddish brown (5YR - 2.5YR 3/4) clay loam. In some places they may be deeper and support rainfed and occasional irrigated cultivation as practised near Kabernet. Exposures of the bedrock and stoniness are common features in this unit.

Present land use: some grazing and cultivation of deeper soils. A few small dams are constructed

Land Use Alternative(s): The possiblility of dams should be investigated to supplement the present water supply. Grazing and cultivation of the soils should be kept to a minimum to safeguard this side of the valley against erosion, which is already severe in some areas.

4.2.2. Soils of the Hills and Minor Scarps (H)

-HF- This map unit comprises isolated hills that occur mainly in the western side of the valley at the flank of the Elgeyo Escarpment. The geology consists of resistant gneisses and quartzites. The vegetation cover is varied. Soil development is limited: shallow dark (reddish) brown (in 7.5YR and 5YR hues ) sandy loams and sandy clay loams dominate the scene. Occasionally deeper soils may be encountered over small areas.

Present land use: this is limited to extensive grazing, mainly by goats. No other forms of cultivation occur.

Land Use Alternative(s) none; extensive grazing is the only use for these lands, but should be practised with care to prevent accelerated erosion.

...../14

-HB- Lands in this unit are hilly with slopes up to 30% and with common rock exposures and stoniness. The geology is a porphyritic olivine basalt, whose weathering products account for the friable, dark reddish brown (in the 2.5YR and 5YR hue) clay loam soils, which however are of shallow to very shallow depth. Deeper soils are sometimes encountered over small areas.

Present land use: these lands are used for extensive grazing, arable cultivation being restricted to the deeper soils that occasionally occur.
Land Use alternative(s): none, this land is only suitable for extensive grazing. The possibility of damming may be considered for some seasonal rivers.

-HI- This land occurs also on the eastern valley side and is underlain by trachytes, an igneous rock of a slightly higher silica content than the phonolites. Slopes are steep, erosion is severe in many places and soils are slightly developed. Well drained very shallow dark reddish brown (5YR & 2.5YR hue) clay loams are common; they may be deeper in some places. The vegetation is a shrubland with poor undergrowth.

Present land use: as for HB
Land use alternative(s): as for HB

-HS- Land of this nature occurs in the very northern part of the upper Kerio Valley where it is underlain by grits of Mesosoic origin. The soils are very shallow but in places moderately deep sandy clay loams, of a dark brown to dark reddish brown colour (7.5YR & 5YR hue) occur. Shrubland of various Acacia species is dominant, the semi-arid environment not favouring forest development. The grass cover is fair over limited areas.
Present land use: extensive grazing and wild-life
Land use alternative(s): none, apart from improvement of the grazing conditions.

### 4.2.4. Soils of the Plateaus (L)

-LI- These lands commonly occur at an altitude of 2000 m or higher on the west slope of the Kerio Valley. They comprise of undulating to fairly flat terrain which is underlain by lava (Ref, No's 13 & 16). They may be a few hundred meters to a kilometer wide and seem to occur quite frequently as broad steps or benches along the scarps of the rift valley system. The vegetation is described as Acacia mixed woodland with Dodonaea or Uvaria and/or Dodonaea-Combretum woodland. The soils are said to consist of well-drained, deep dark reddish brown (5YR 3/4) clay loam, underlain by a dark red 2.5YR 3/6) friable clay. Weathered lava is found at 150+ cm.

..../15

Present land use: large areas have been cleared and are farmed under rainfed conditions. Annual rainfall is higher than at the lower sites (see fig. 2) and also more reliable. This leads to a better chance for good yields. Maize, often intercropped with peas, is the main crop. Most population centres, such as Tambach are situated on these lands,

Land use alternative(s): improved farming techniques may induce higher yields, while in certain areas irrigated farming can be practised, if a supplementory supply of water is made available. Most of the better land is however already taken into cultivation and the risk exists that less suitable areas may be taken into use. These will include terrain with steeper slopes and less favourable soil conditions. These latter areas are best left under forest.

-LIb- This unit is limited to the eastern side of the valley and comprises a large low plateau on trachyte. The presence of this land causes a considerable narrowing of the valley and forms a natural boundary between the northern section and the southern section. Lands may be fairly flat to undulating with slopes up to 8%, while rock exposures and boulders/stones are common. The vegetation is a thicket of mainly Acacia species, with variable but in general poor grass cover. The soils are well drained, shallow to moderately deep, dark reddish brown clay loams (5YR 3/4), occasionally redder and sandier.

Present land use: extensive grazing and wildlife

Land use alternative(s): none, but ranching conditions can be improved.

Soils Developed on the Footslopes (F)

-FX- The soil parent material consists of colluvium derived from gneisses rich in ferromagnesian minerals and basalt. The relief is undulating with slopes between 3-8%, surface stoniness is common, while occasionally rock is encountered. Rubble land is included in this unit. The vegetation is usually woodland with fair undergrowth. The soils are well drained, dark reddish brown (in the 5YR and 2.5YR hue) sandy clay loams, mainly moderately deep, although soil depth varies considerably over short distances. Stones may be encountered and can account for the impenetrability of the soil with a hand auger, often however below this layer weathered soil material occurs. This map unit is confined to the western and southern side of the valley, and includes some eroded land in the very upper part of the valley as well as two large alluvial fans which have maintained their shape clearly and are indicated with symbol YF(Al1.Fan).

Present land use: extensive grazing and occasional rainfed arable cultivation of maize and cassava, mainly in small shambas(fields).

..../16

Land use alternative(s): depending on the outcome of more detailed surveys regarding the total acreage of suitable land it is anticipated that much of this land unit may be put to a better use. It will however be necessary that adequate steps be taken to counteract erosion, as the soils are susceptible to this destructive process. The cutting of trees at random and at liberty should therefore be prevented while also the numbers of lifestock should be controlled.

-FI- This unit is confined to the eastern side of the valley where trachyte is the parent material. The vegetation is shrubland to open woodland and slopes are between 3 and 8%. Boulders and stones are common. Most soils are shallow to moderately deep, dark red (2.5YR 3/6) clay loams, friable. The soil reaction is medium acid; of the major plant nutrients, nitrogen is insufficient while also calcium is lacking. In several parts of this unit severe soil erosion is encountered.

Present land use: extensive grazing and some arable on the deeper soils.

Land use alternative(s): grazing should be discouraged, cropping is possible but contour ploughing, bench terraces, effective mulching etc. are a necessity to produce and sustain reasonable yields, without losing the soil through erosion.

-FR- These soils are developed from colluvium derived from grits and occur in the northern part of the survey area. The vegetation is Acacia shrubland with variable undergrowth of grasses. The soils are well grained, shallow to moderately deep, dark brown sandy clay to sandy clay loams. The moist consistence is friable; the soils may be calcareous and slightly alkali. Soil erosion is pronounced in some parts.

Present land use: extensive grazing, wild-life.

Land use alternative(s): none, apart for improvement of the range conditions.

### 4.2.5. Soils Developed on the Piedmont Plains (Y)

-YF- These lands occur in undulating positions with slopes between 5 and 8%. They carry a woodland vegetation of Acacia spp. and Boscia albitrunca and have fair to good undergrowth of grasses and herbs under natural conditions. At present considerable areas of this land are being eroded, resulting in a degradation of the environment, including a decline in the growth of grasses, and herbs. The soil parent material is mainly derived from the weathering products of banded hornblende and biotite gneisses but there may be some admixture of material from basic igneous origin (olivine basalt). The dominant soil is a deep, well drained, dark reddish brown (5YR 3/2 and 2.5YR 3/2) sandy loam till about 20 cm, overlying sandy clay loam with weak structural

...../17

development of similar colour; and of friable occasionally firm consistence in moist conditions. The natural soil fertility is moderate; the pH ranges from strongly acid to neutral the topsoil is commonly acid. Nitrogen is generally not present in sufficient amounts to warrant continuous optimum plant growth. The water holding capacity of this soil is considered good and the workability favourable. The soil material is susceptible to erosion and farming techniques should be geared to safeguarding the land from erosion. Included in this unit is a dark red (2.5YR 3/6) sandy clay loam over a sandy clay with similar properties as described above. This soil may be calcareous in the subsoil with a moderately alkaline pH, while also a somewhat browner soil (7.5YR 3/2) sandy loam over sandy clay loam may be encountered. The transition from this unit to the escarpment is often very sharp and narrow. Stones, boulders and occasional rock outcrops occur on the boundary but have little impact on the soil conditions of unit YF.

Present land use: Some areas have been cultivated to produce crops under rain-fed conditions, while around TOt intensive gravity irrigation is practised. Little or no fertiliser is applied but yields seem to be reasonable. Main crops are maize, cassava, peas and bananas.

Land use alternative(s): under careful management it is considered that this unit has more potential than is at present being utilized. Large stretches of land can be cultivated under rainfed conditions, while in some areas additional water supply can be obtained from the affluents of the Elgeyo escarpment. Additional information may also show the good response of livestock to be ranched on this unit. However the livestock should not be allowed to roam freely about in uncontrolled large numbers thus damaging crops and ruining the natural vegetation.

·YFe- This unit occurs normally in a somewhat lower topographical position than unit YF. It is very similar to YF but shows moderate to severe gully erosion, with individual gullies 2-3 m wide and several meters deep, sheet erosion also occurs. Undergrowth is totally lacking in many places. A main component of this land is also the dark brown (7.5YR 3/2) sandy loam over sandy clay loam that is calcareous in the subsoil, with a moderately alkaline soil reaction. N, P and K are deficient.

resent land use: some cultivation and extensive grazing

and use alternative(s): offers similar possibilities as unit yf , but hould be managed with even more care.

...../18

-YI- This land is confi ned to the eastern side of the valley, where the geology consists of trachyte, although some admixture with weathering products of the olivine basalt may be present. The land is gently undulating (slopes 2-8% and is under an open woodland vegetation of Acacia spp. and Boscia albitrunca, with variable undergrowth. In some areas strong gully erosion is evident, but its occurrence is rather localised. The dominant soil is a deep, well drained, dark red (2.5YR 3/6 - dark reddish brown, (2.5YR 3/4) (sandy) loam overlying a clay loam. The soil consistence when moist is friable; structural development is poor. The soil reaction is strongly to slightly acid (pH 4.4.-6.4), with a mean pH of 5.7 in the topsoil. The chemical fertility is considered low. Apart from nitrogen also phosphorus is below required level, while the calcium level is on the low side. Physical properties of the soils are favourable with good water holding capacity, easy workability and good infiltration of rainwater.

This unit may include a deep, well drained, dark brown (7.5YR 3/2)(sandy) clay loam over (sandy) clay with free lime in the subsoil and a moderate alkaline soil reaction. This soil usually occurs in somewhat lower topographic position and is associated with the units Y10 and Y20.

Present land use: large stretches of land in this unit have been cleared from the original vegetation and put under cultivation. Apart from food crops, the cash crop cotton, was introduced three years ago. This crop is especially cultivated around the Barwesa area and appears to thrive well. More farmers have taken up the cultivation of cotton to supplement their income.

Land use alternative(s): it is anticipated that more land in this unit can be farmed, even more economically than at present. As shifting cultivation practices will become irrelevant because of population pressure and subsequent land shortage, more emphasis will have to be put on the intensive cultivation of the same area. This will require an even better use of the land with attention paid to timed weeding and mulching practises, to store water and nutrients for the crops specified.

-Y10- The soils in this unit have been developed on alluvium derived from gneisses rich in ferromagnesium minerals, such as hornblende and biotite, and basalt. They occur in gently undulating position (slopes 2-5%) and carry a woodland vegetation of Acacia spp and Boscia albitrunca. Undergrowth is fair with herbs and grasses among which occur several perennials. The main soils are

1) a deep, well drained dark brown (7.5YR 3/2) to dark reddish brown (5YR 3/2) (sandy) clay loam with a slightly acid to neutral soil reaction friable consistence, and good physical properties,

..../19

2) a deep,well drained,dark brown (7.5YR3/2)-(sandy) loam overlying a clay loam; this soil is calcareous with a neutral to mildly alkaline soil reaction. Both soils lack sufficient nitrogen and occasionally phosphorus, however they are expected to respond well to fertilizer application. In some areas soil erosion has limited the effective use of the land for cultivation practices.

Present land use: rainfed arable mainly for maize, cassava. peas and occasionally cotton;intensive grazing has led to overgrazing in some areas.

Land use alternatives: the majority of this land can be utilized better and some large areas have not been farmed at all.The soils are expected to respond well under fair management and produce sustained reasonable yields.In the northern part of the area,where rainfall is less and more unreliable,ranching may be a valuable proposition for the best land use. If water is available from nearby streams,irrigation may be practised.It is doubtful however if this method can serve a large acreage, as the amount of water is limited.Damming for livestock may be considered.

-Y20- This unit occurs in association with Y10 and its features are very similar to the former unit.The main soil is a deep,well drained,dark brown (7.5YR3/2) to dark greyish brown (10YR3/2) loam over a clay loam. The soil reaction is moderately alkaline in the subsoil,where free lime may be encountered.The topsoil has a pH of 6.9.The soil consistence is friable to firm in some cases,while they are slightly hard when dry.This may cause a limited amount of water to inf ltrate into the soil initially.These soils are deficient in nitrogen.

Present land use: as for Y10

Land use alternatives: as for Y10

-Y30- Land of this nature was encountered in the northwestern part of the valley,where it is derived from the same parent material as Y10 and Y20. The vegetation is open woodland of Acacia with sparse undergrowth;slopes are between 5-8%;occasionally 2%.The most common soil is a deep,well drained, dark brown (7.5YR3/2-3/4) sandy clay,firm moist.Mica is common in the subsoil giving rise to silty clay loam textures.Gully erosion is prominent,with gullies 1-2 m wide and up to 3 m deep.Structural development is weak,physical properties are good.The pH of the topsoil is neutral but usually increases with depth.Nitrogen and phosphorus are commonly deficient.The soils are saltfree.

Present land use:extensive grazing,which has led to soil erosion in some parts.. This was caused by overgrazing and thereby causing destruction of the vegetation.

Land use alternative(s):under the present climate the unit is best utilized for extensive grazing,using alternative grazing grounds.

.../20

Soils Developed on the Alluvial and Lacustrine Plains (P)

-PA- Land of this unit occurs in flat to very gently undulating positions (slopes 0-2%) and is derived from mixed alluvial deposists such as encountered in the major flood-plains of the Kerio river and its tributaries. This material originated from the surrounding eroding bedrock and contains therefore the gneissic component of the Basement System as well as the basic components contributed by the basalts and trachytic rock of mainly Tertiary age.

The vegetation consists of riverine woodland, alternating with thicket of mainly Acacia species. A, fistula is an evident indicator species for poorly drained sites. Textural variations in the soils are considerable and due to changes in the conditions for sedimentation of the solid sediment load from the river water.

In this map unit are also included the actual river beds of the Kerio river and its affluents, These are mainly sandy, occasionally loamy, and commonly yield water in the dry season, when no surface flow is visible. The river may be incised 7-10m in its youngest flood-plain.

The major soils are:

1) deep, well drained, dark brown (7.5YR 3/2)(sandy) loam, structureless, friable and of reasonable nutrient level and 2) a deep, poorly drained, black to very dark grey (10YR 2/1 or 3/1) cracking clay, with a prismatic to subangular blocky structure becoming massive with depth (vertisols). The soil consistence is firm when moist and very sticky and plastic when wet. They are considered fertile but have poor workability. Depending on the source of the parent material these soils may be calcareous, usually from 60 cm downwards. Soft $CaCO_3$ mycelium is common while with depth $CaCO_3$ concretions occur. The pH of samples (PA comp. in table 5) taken from the recent streambed indicate mildly alkaline conditions, while nutrient levels are sufficient apart for nitrogen. The soil pH may be mildly alkaline, but salt free.

3) A deep, moderately well-drained, greyish brown (10YR 3/2 clay loam, often calcareous, with a neutral to slightly alkaline soil reaction. It commonly occurs in association with the soils of the lower piedmont plain, such as units Y10 or Y20.

Present land use: appreciable areas of this unit are cultivated for rainfed crop production, maize being the dominant crop. Furthermore livestock graze on the lands.

Land use alternative(s): there is still a large area not fully utilized at present, while also the ranging aspects need to be looked into more carefully. Possibly, small-scale irrigation may be feasible.

..../21

The soils may experience flooding once every year for a variable period. Depending on the duration and time of flooding rice could be cultivated on the Vertisols.

-PA- This land is similar to the above described PA, and differs mainly in a slightly higher topographical position on a possible terrace, as well as in the inclusion of a well drained, deep, dark reddish brown (5YR 3/2) friable loam. A risk of flooding exists every 5 - 10 years for a varied period of time.

Present land use: as for PA

Land use alternative(s): as for PA

-PAL- This unit occupies a large area in the central part of the valley. It occurs on flat to very gently sloping topography (slopes 0-2%) and is situated in an intermediate position between the flood-plain proper and the lower piedmont plains. The parent material is believed to be a mixture of alluvium and lacustrine deposits, laid down during a period that Lake Kamnarok had a larger extension. The vegetation is a homogeneous Acacia woodland with an usually dense undergrowth of smaller woody species, grasses and herbs. Dominant soil is a deep, well drained to moderately well drained, dark brown (7.6 YR 3/2 sometimes 5YR 3/2) clay loam over clay. The soil consistence is friable, occasionally firm when moist, while a subangular blocky structure may be present in the topsoil; the subsoil has no appreciable structural development. The soil reaction is neutral to slightly acid (pH 6.2-7.1), while the nutrient level is fairly good with mainly nitrogen lacking in sufficient amounts to sustain continuous high yields.

Present land use: occasional small plots are cultivated under rainfed conditions; furthermore uncontrolled grazing takes place. A large part of the area is used by wild-life, among which are "big game", such as elephant, rhine, buffalo, hippo and various antelope.

Land use alternative(s): extension of the arable cropping is feasible together with ranging. In addition irrigation possibilities should be looked into. The area around lake Kamnarok could be set aside as game park, apart from game many birds can be observed in beautiful scenery.

## 2.7. Soils developed on the Bottomlands (B)

-BLa- Land in this unit comprises the lower areas between the lava flows (unit La). It has flat to gently undulating topography. The soil parent material is mainly derived from volcanic rock (trachyte and olivine basalt), but may have some admicture of more acid components towards the Molo river and in the northern part of the survey area. The vegetation is an Acacia thicket with dense riverine woodland along the drainage channels.

The transition to the lava flows is often very gradual but may be more evident in cases of riverine incisions. Soils developed on this colluvium alluvium are moderately deep to deep, well drained to moderately well drained, dark brown (7.5YR 3/2) sandy clay loam underlain by a sandy clay. The subsoils and sometimes the topsoil are calcareous with often $CaCO_3$ occurring in concretionary form with depth. The soil reaction is moderately to strongly alkaline (pH 8.7-9.0). Soils lack sufficient amounts of nitrogen and phosphorus, while potassium level is on the low side. Salinity may occur in the subsoil.

Present land use: extensive grazing with some rainfed cultivation

Land use alternative(s): improvement of the land for range, depending on the availability of water.

-B- A distinct depressional area occurs in the north of the survey area and is indicated as such on the map. The topography is flat to almost flat, with a very slight slope to the southeast. The parent material is thought to be colluvium and alluvium from the nearby gneissic hills with volcanic components. The vegetation is an open bushland with a dense undergrowth of grasses and herbs. The dominant soil is a deep, poorly drained, very dark grey (10YR 3/1) cracking clay. The natural fertility is moderate with mainly nitrogen lacking. The workability of this soil depends much on the right amount of moisture. In addition the soils are subject to ponding for varying duration. The soil reaction is moderately to strongly alkaline (pH 8.3-8.5) while $CaCO_3$ concretions are encountered from 20 cm onwards. The subsoil may be slightly saline. On the fringes of this unit the terrain slopes up slightly and the soils may be somewhat browner in the subsoil (10YR 4/2), In addition they may contain more fine gravel and/or coarse sand, the latter derived from the grit exposure to the east.

Present land use: extensive grazing

Land use alternative(s): grazing - none

4.2.8. Miscellaneous Units

-S- Perennial swamp encountered in association with the present flood-plain mainly in the southern and central part of the area.

-La- Lava flow from mainly trachyte and commonly encountered in the north-eastern part of the area. Rock outcrops and surface stoniness are common. They occur in flat to almost flat position and carry a vegetation of Acacia thicket. The soils are mainly shallow to moderately deep, dark brown (7.5YR 3/2) clay loam, often with appreciable amounts of coarse sand gravel. The pH is moderate to strongly alkaline (7.0-8.5); free carbonates are common. The soils may be slightly saline.

...../23

Land use: extensive grazing

e alternative(s): controlled grazing with low stock densities.

d Evaluation Aspects

. Present Land Use

d resources of the valley are at present utilized in the following

ole rainfed farming, including small scale irrigation, b) rearing of
ck, c) mining, d) wildlife and e) fishing.

mber of reports deal with the situation (Ref. No's. I, 14) inclusive
land tenure system and grazing rights.
is felt therefore not relevant to expand further on this subject,
an make the following remarks.

Rainfed arable farming includes mainly small plots of 01-1.0 acre
re maize, cassava, rainfed groundnut, millet, peas. Where irrigation
tised bananas are also grown. Recently rainfed cotton was introduced
h crop in the Barwesa region, under co-operative management. Its
ion looks promising. Bee-keeping is practised on a limited scale.
rearing of livestock provides cash, meat and milk but is to a large
een as an expression of wealth. Especially large herds of goats
p roam about in the valley doing more harm than good to the natural
ent, while little is gained by the keeping of too large a flock.
s not common in the valley, but those present seem to thrive well.
t clear whether the presence of tsetse has had an influence on the
f cattle as few tsetse were seen. However it may be that tsetse will
with increasing amount of cattle. Cattle are strongly recommended
ts and sheep, to prevent situations such as seen nowadays in the NE
district. Alternate grazing grounds are a necessity.

ng is concentrated in the SW part of the valley, where open cast mining
spar ($CaF_2$) is undertaken. For the valley as a whole this enterprise
ost capital earning and it is intended to be extended to northern parts
alley. The envisaged construction of a railway will undoubtly lead
r access of the valley and so make also her agricultural products
ily available for surrounding markets.

game is concentrated around Lake Kamnarok. The present wildlife has
commercialised, although there are plans to look into the possibi-
a Game Park around the lake. Poaching concentrates on leopard skins
hant tusks. Poisoned arrows and spears are used to guarantee silent

main fish producing areas are concentrated around the lake and the
streams. Fluctuation in fish production is directly related to

..../24

variations in water level due to seasonal rainfall. Tilapia is the most common species of fish in these waters. At present the scope of this industry is limited due to restricted possibilities of marketing and because the local inhabitants are not accustomed to easting fish.

The area as a whole offers good possibilities for mixed farming as well as mining and some wildlife. The major strategy towards satisfying development should be directed to good communications, involving the construction of all-weather roads on both sides of the Kerio with improved access to the central part of the valley.With regard to irrigation in previous reports (Ref. no. 1, 10, 14) a number of locations are mentioned, notably: Endo, Sambirir, Arror, Irony and Soy. Most of the irrigated land occurs within map unit YF. The total acreage available does not depend so much on the suitable land as well as the amount of water available and the terrain commandability. Prospects for irrigation downstream of the survey area are dealt with in references 15 and 17 (Vleeshouwer & Watts respectively).

## 5.2. Current Land Suitability

The actual physical suitability of the land such as encountered at present in the valley is dealt with below. As it concerns a preliminary examination, the land classification will be kept in simple terms and will not dwell upon the economic aspects of crop cultivation under improved conditions of management and transport. Preliminary remarks on the land potential of the various map units are already made in chapter 4.
The land classification includes the suitability for irrigation, but this is based on the quality/quantity of the land only, while the aspect of sufficient water will have to be looked into in greater detail. Nevertheless areas which are suitable for this type of farming will be indicated.

The map units are qualitatively evaluated for the use of 1) arable rain-fed farming, 2) irrigation and 3) range. Four levels of generalization are used I = highly suitable, II = moderately suitable, II = marginal suitable and IV = unsuitable. The kind of limitation and the positive aspects of the land in question are dealt with in the next paragraphs. The results are summarized in Table 5.

map unit MF : this land on the whole is not suitable for arable farming and irrigation because of soil limitations (soil depth) and topography (steep slopes). The land may be grazed under careful management but is considered marginally suitable for that use. Suitability code for arable farming-irrigation and range is IV - IV - III. Where deeper soil occurs in flatter position and/or water is available for irrigation the suitability of the land is upgraded to moderately suitable: II-II-II. The latter only if pastures are considered.

map unit MB : Suitability as for MF: IV-IV-III, in case of deeper soils on more favourable topographic positions: II-II-II. It is anticipated that cultivation in the mountainous area is undertaken with the knowledge of contour ploughing contour banks and various soil conservation techniques.

map unit MI : Land suitability as for the previous two units, thus IV-IV-III. When deeper soil and flatter topography is encountered the classification may be II-II-II.

map unit HF : Suitability code IV-IV-III
map unit HB : " " IV-IV-III
map unit HI : " " IV-IV-III
map unit HS : " " IV-IV-III

map unit LI : The soils are considered highly suitable for irrigation but the climate may be a limiting factor in view of low temperatures in the winter. If water is available irrigation is feasible. Suitability: II-II-II.

map unit LIb : Major limitations to the use of this land are soil depth, with associated rock outcrops and stones. Best use may be extensive ranching. Suitability coded as IV-IV-III.

map unit FX : Under proper management lands of this unit may be suitable for arable farming and where water is available may support irrigated crops. As for range, watershed protection is of utmost importance and soil conservation measures are therefore of prime consideration. The land is considered moderately suitable for arable farming (II), as well as irrigation (II) and ranching (II). Deep soils in this unit must be selected for the above mentioned land uses.

map unit FI : This map unit faces similar limitations as FX but even more severe. Arable cropping and ranching is not recommended, except for the inclusions of deeper soils in the flatter positions. Rating: IV-IV-III.

map unit FR : In addition to soil limitations the climate (poor rainfall) has an advese influence on arable cropping while also irrigation is not thought feasible because of land conditions. Extensive ranching is seen as the best land utilization type. Code: IV-IV-III.

map unit YF : Soils in this unit are generally well suited to agricultural use; because of its steep slopes, careful management is required. Its occurrence bear the escarpment may cause some stoniness and rock outcrops to be present.

map unit BLa : Soil physical and chemical properties are marginal more than were experienced in the southern part of the Upper Valley Suitability rating is III-III-II . Moreover the climate is drier.

map unit B : These soils are alkaline and saline in addition to having poor workability and a drier climate. They are best used for extensive grazing. The rating is thus: IV-IV-II.

map unit S : unsuited for the mentioned land use practices, but may act as a source of water for animal, plants and human consumption.

map unit La : Chemical properties are not favourable (alkalinity/ salinity hazard), stones and gravel besides limited soil depthare present in many places. These lands are best kept under extensive grazing. The rating is thus as follows: IV-IV-II.

Table 5 - Current Suitability for the various map unit

| map unit | limitations | current suitability | surface area (in ha.) | improvement possible and/ or recommended |
|---|---|---|---|---|
| MF | soil physical, topo-graphy (slope) | IV-IV-III | 43.430 | no |
| MB | (depth stoniness, rocks | IV-IV-III | 1.250 | no |
| MI | -do- | IV-IV-III | 15.800 | no |
| HF | -do- | IV-IV-III | /00 | no |
| HB | -do- | IV-IV-III | 7.950 | no |
| HI | -do- | IV-IV-III | 395 | no |
| HS | -do- | IV-IV-III | 4.505 | no |
| LI | climate (temperature) | II-II-II | 17.100 | yes |
| LIb | soil depth, stoniness, rockoutcrop | IV-IV-II | 11.720 | no |
| FX | soil depth, topogra-phy, rockoutcrop | II-II-II | 11.934 | Yes |
| FI | soil depth, topo-graphy | IV-IV-III | 9.540 | Yes |
| FR | climate,(rainfall) soil depth | IV-IV-III | 3.690 | no |
| YF | soil physical, topo-graphy | II-II-II | 21.250 | yes |
| YFe | erosion | III-III-III | 9.240 | yes |

...../28

| map unit | limitations | current suitability | surface area (in ha.) | improvement possible and/or recommended |
|---|---|---|---|---|
| YI | none | I-I-II | 13.900 | Yes |
| Y10 | alkalinity | II-II-II | 38.660 | Yes |
| Y20 | -do- | II-II-II | 39.530 | Yes |
| Y30 | climate (rainfall), soil erosion | III-III-II | 4.519 | Yes |
| PA | flooding | II-II-II | 43.173 | Yes |
| PAT | -do- | II-II-II | 1.850 | Yes |
| PAL | climate (rainfall) | II-II-I | 5.040 | Yes |
| BLa | soil physical and chemical | IV-IV-II | 18.010 | no |
| B | alkalinity/salinity, workability; limited rainfall | IV-IV-II | 1.060 | no |
| S | waterlogging | | (100) | Yes |
| La | soil chemical and physical | IV-IV-III | 20.215 | no |
| | | total | 344.161 (825.987 acres) | |

Total acreage highly and moderately suitable for arable rain-fed or irrigated farming (classes I & II) .192.437. ha ( 461.849 acres)
Total marginally suitable for arable rainfed/or irrigation (class III) 13.759.ha (x) Total unsuitability for arable rainfed or irrigation (class IV) .137.965..ha(331.116) If only ranching is considered than the following acreages apply:
highly and moderately suitable .216.026.... ha ( 518.462 acres):Class I&II
marginally suitable .128.135 ha (..307.524.... acres) : Class III

(x) 33.022 acres . Calculated as 1 ha equals 2:4 acres.

## 6. Conclusions

The exploratory survey of the Upper Kerio Valley yield the following conclusive points.

Firstly the full development of the area is hampered because of the topography and climatic conditions. Successful development of the region can only be obtained by proper access into the area by road, rail and air.

Secondly the soil parent material in general is sufficiently rich over large acreages to sustain a good vegetation cover, climate permitting.

This implies that cultivation of food crops with or without grazing is possible especially in the most upper part of the valley.

Thirdly it appears that although the acreage of rocky, stony and steeply sloping land is considerable the land of the piedmont plain and the alluvial plains (symbols Y and P respectively) offer substantial possibilities for agricultural development.

...../29

Fourthly the climate, as far as can be assessed at present and with upto date information, is favourable enough to allow for the cultivation of one rainfed crop of cash and/or food crop per season. In the northern part of the survey area emphasis should be on ranching rather than on rainfed arable. In addition there is more scope for the construction of small dams and weirs in the affluents from the Elgeyo Escarpment and the Tugen Hills. Thus irrigation and the rearing of livestock may be improved.

Fifthly the soils' productivity under natural conditions can decrease considerably through overgrazing and uncontrolled cutting and burning of the vegetation resulting in erosion and depletion of the soil nutrients. In some areas, especially around centres of population, this is already evident.

As the ecological balance is disturbed in some areas, all must be done to prevent further deterioration of the Kerio catchment area.

The alkalinity/salinity hazard is negligible to absent in most soils of the footslopes and piedmont plains, but may occur in depressional soils. Detailed soil investigations are necessary in selected areas for agricultural development.

## 7. Recommendations

In view of a co-ordinated development of the Upper Kerio Valley the following recommendations are suggested. They embrace short term as well as long term objectives; some of which have been voiced before (Ref. no. 1, 6 & 14).

1) It is recommended that a "co-ordinating committee" deals with the development of the Upper Kerio Valley as a whole and particularly co-ordinates the activities in the agricultural field.

2) The construction of good all-weather roads on both sides of the Kerio river is a first condition for opening up the area and to provide access to markets outside the valley proper.

3) The construction of a railway line should likewise be of service to the people of the valley.

4) To start forthwith with the installation of automatic rainfall recorders, thermometers and evaporation pans to gain more climatic information.

5) A hydrological survey should be undertaken to assess in detail the amount of water available for irrigation and human and animal use. Detailed soil-land surveys can then be planned accordingly.

6) The construction of small dams and weirs (stock dams) should be looked into as a way to improve the water situation in general.

7) The breeding and production of cattle should be looked into, especially with regard to the presence of tsetse fly.

...../30

of the environment, particularly of the lower valley regions, on the physical well-being of its inhabitants should be studied.

9) The use of the mountains, hills and major and minor scarps as grazing grounds should be discouraged, so as to allow rehabilitation of the slopes possible through re-afforestation, and thus providing proper watershed protection.

10) The keeping of goats is to be kept to a minimum and their grazing areas should be checked continuously by local authorities, to prevent the development of badland areas as seen in northeastern Baringo.

11) The use of alkaline and/or saline soils is not recommended other than for extensive grazing.

12) In the southern part of the valley, rainfed arable farming can be encouraged, while in the northern part extensive grazing combined with irrigation on a small scale offers the best possibilities.

13) The cultivation of rice, especially on the dark, cracking clays in the eastern part of the valley is proposed.

14) The introduction of new crops (citrus, mango, sunflower, soya bean and groundnuts) and intensification of the cultivation of already existing crops (cotton, bananas, maize, cassava etc.) is feasible when suitable markets can be reached easily (see 2).

15) Farming techniques should be geared as much as possible to the conservation of the land and should include practices to 1) store the maximum amount of moisture by mulching and the right time of land preparation (viz. one month before the long rains-March), employ contour ploughing and construction of bench terraces on (steeply) sloping land and 3 ) fence agricultural fields or pastures.

16) Large and fairly homogeneous stretches of land such as units "Y" may be used for large holdings that can be farmed with machinery on a co-operative basis.

17) Wildlife preservation may be promoted by setting aside an area around Lake Kamnarok as a Game Reserve or National Park.

18) The promotion of bee-keeping and fish industry should be looked into.

19) The waste waters from the fluorspar mine are to be checked continuously to prevent contamination of the river waters with fluorides, thus

## 8. Summary

This report deals with an explora
Valley carried out by the KSS during t

A total area of 344.161 ha (=
The various land forms and associated
1:100.000 map.

The physiography of the survey ar
while the mapping units are described
is then evaluated for rainfed arable,
a four classed rating system.

This is followed by a summary and
list of literature references is inclu
classification and laboratory data.

## 8. Summary

This report deals with an exploratory soil survey of the upper Kerio Valley carried out by the KSS during the first half of June 1975.

A total area of 344.161 ha (= 825.987 acres) has been surveyed. The various land forms and associated soils are indicated on the accompaning 1:100.000 map.

The physiography of the survey area is discussed in some detail, while the mapping units are described as elaborate as possible. The land is then evaluated for rainfed arable, irrigation and range according to a four classed rating system.

This is followed by a summary and a paragraph on recommendations. A list of literature references is included as well as an appendix with soil classification and laboratory data.

16 ) USDA
1970
Selected chapters from the unedited text of the soil Taxonomy.
USDA, Washington D.C. December 1970

17) Vleeshouwer, J.J.
Michieka, D.O.
1974
Suitability of the Soils and Waters of the flood-plain of the Kerio River Northeast of Lokori.
Kenya Soil Survey; Site Evaluation Report No. 17, October 1974.

18) Walsh, J.
1969
Geology of The Eldama Ravine-Kabernet Area. Geological Survey of Kenya, Report No. 83

19) Watts, D.
1962
Turkana Rehabilitation Irrigation Reconnaissance
Hydraulic Branch M.O.W. and C.
December 1962

20) WHO
1973
Groundwater Resources in Kenya.
Report No. 76, Brazzaville, June 1973.

21) -do-
Surface Water Resources in Kenya.
Report No. 16, Brazzaville, June 1973

22) Woodhead, T.
1968
Studies of Potential Evaporation in Kenya. Min. of Nat. Res.; Water Dev. Dept.; Rep. of Kenya E.A.A.F.R.O. Nairobi, February 1968.

Appendix I

Soil Classification

According to the soils information as given in the National Atlas of Kenya (1970) two major grouping of soils are recognized in the survey area:

1) in the valley: alluvium and recent lacustrine deposists; old river sediments as well as those now being added to the flood-plain; and lake deposists of geologically recent origin, without developed morphology other than a humic surface horizon.

2a) east valley: slope — shallow stony soils with rock outcrops, variously developed soils which have been subjected to geological and recent accelerated erosion and lost their original characteristics

2b) west valley: slope — -do- in addition to steepslopes and escarpments.

On the FAO/Unesco 1973 edition of the Soil Map of the World (sheet VI-3 Africa) the majority of the soils in the area are indicated as I Rbc= Lithosols and Regosols, rolling to hilly and steeply dissected mountains.

Small areas, presumably around Lake Kamarok, are indicated as Humic Gleysols (Gh) in level to undulating position.

Both description contain elements of truth, but may be improved upon in view of the recent soil information. According to the FAO criteria for their Soil Map legend the following tentative classification of the soils is suggested.

- Soils of the Mountains and Major Scarps: Lithosols occur and soils with an ochric A horizon only (Regosols) or underlain by a cambic B horizon (Cambisols).
- Soils of the Hills and Minor Scarps: main soils in this unit compare with those of the previous one; Lithosols, Regosols and Cambisols.
- Soils of the Plateaus: on the high plateau (map unit LI) and ochric or umbric A may be recognized overlying an argillic B with presumebly a base saturation of less than 50% (Acrisols). With inclusions of other soils that have argillic B horizons or that are transitional. Soils of the low plateau are similar to the ones in the more hilly regions, viz.: Lithosols and Cambisols with Regosols.
- Soils of the Footslopes are considered to have an ochric epipedon overlying in most cases a cambic B (Cambisols), but inclusion of Lithosols, Regosols and soils with Argillic B horizons may occur.

...../35

- Soils of the Piedmont Plains are fairly well developed having an ochric topsoil horizon overlying an argillic B. In case of unit YI an oxic horizon may be considered, placing these soils in the Ferralsol group. Inclusions of Cambisols may also occur.

- Soils of the Bottomlands have an ochric A and are often calcareous in the subsoil. In case of unit BLa cambic B horizons are thought of, while in case of map unit BA Pellic Vertisols are the dominant soil group.

- Soils of the Plains are mainly developed on various alluvia. Profile development is varied. Some will classify as Fluvisols, while the dark cracking clays are Vertisols. In addition the occurrence of Cambisols is not excluded.

In unit S the occurrence of Histosols is likely. Map unit La comprises mainly Regosols and Lithosols.

...../36

Appendix II

Soil analytical data arranged per map unit.

Table 6: Mean values and range of some chemical data per map unit*

| unit | pH-H2O topsoil mean | pH-H2O topsoil range | 1:2½ top & sub soil mean | 1:2½ top & sub soil range | ECe 1:2½ topsoil mean | ECe 1:2½ topsoil range | whole soil mean | whole soil range |
|---|---|---|---|---|---|---|---|---|
| comp. | 7.8 | 7.7-7.8 | n.a, | | 0.15 | 0.09-0.21 | n.a. | |
| | 7.3 | 6.8-8.1 | 7.4 | 6.8-8.1 | 0.19 | 0.06-0.35 | 0.22 | 0.06-0.50 |
| | 7.1 | n.a. | 6.7 | 6.2-7.1 | 0.35 | n.a. | 0.35 | n.a. |
| | 8.7 | n.a. | 8.8 | 8.7-9.0 | 0.85 | n.a. | 1.77 | 0.85-1.50 |
| | 8.3 | n.a. | 8.4 | 8.3-8.5 | 0.35 | n.a. | 0.80 | 0.35-1.20 |
| | 5.7 | 5.1-6.4 | 5.5 | 4.4-6.4 | 0.12 | 0.08-0.15 | 0.15 | 0.06-0.25 |
| | 6.2 | 4.8-6.7 | 6.3 | 4.8-7.1 | 0.15 | 0.06-0.28 | 0.13 | 0.04-0.28 |
| | 6.9 | 6.6-7.2 | 7.0 | 6.2-8.0 | 0.19 | 0.05-0.16 | 0.25 | 0.05-0.35 |
| | 6.9 | 6.6-7.2 | 7.6 | 6.6-8.4 | 0.08 | 0.07-0.40 | 0.33 | 0.05-0.65 |
| | 8.1 | n.a. | 8.1 | n.a. | 0.29 | n.a. | 0.32 | 0.29-0.35 |
| | 7.3 | 6.8-7.8 | 7.9 | 6.8-8.5 | 0.21 | 0.18-0.24 | 0.98 | 0.18-1.85 |

| unit | Na mean | Na range | K mean | K range | Ca mean | Ca range | Mg in meq/100 g soil mean | Mg range topsoils only |
|---|---|---|---|---|---|---|---|---|
| comp. | 0.74 | 0.72-0.76 | 0.57 | 0.50-0.64 | 14.4 | 12.0-16.8 | 2.9 | 2.6-3.2 |
| | 0.38 | 0.27-0.52 | 1.47 | 0.70-2.80 | 10.1 | 5.2-16.0 | 3.5 | 1.4-5.8 |
| | 0.48 | n.a. | 0.82 | n.a. | 12.6 | n.a. | 4.4 | n.a. |
| | 5.30 | n.a. | 0.21 | n.a. | 40.0 | n.a. | 1.7 | n.a. |
| | 1.85 | n.a. | 0.50 | n.a. | 24.0 | n.a. | 7.6 | n.a. |
| | 0.28 | 0.15-0.37 | 0.85 | 0.70-1.00 | 2.7 | 1.2-5.2 | 2.1 | 1.7-2.6 |
| | 0.21 | 0.12-0.39 | 0.63 | 0.36-0.90 | 3.8 | 1.2-5.6 | 3.0 | 2.0-4.4 |
| | 0.38 | 0.14-1.08 | 1.06 | 0.36-1.74 | 5.2 | 3.4-7.6 | 2.9 | 1.1-5.4 |
| | 0.59 | 0.27-1.02 | 0.61 | 0.30-0.90 | 7.1 | 4.8-9.6 | 2.5 | 1.7-3.5 |
| | 0.52 | n.a. | 0.14 | n.a. | 42.0 | n.a. | 5.4 | n.a. |
| | 1.95 | 0.34-4.50 | 0.97 | 0.50-1.38 | 12.0 | 4.8-22.0 | 2.9 | 2.2-3.4 |

| unit | Mn mean | Mn range | P mean | P range | %N total mean | %N total range | %C in meq/100g soil mean | %C range topsoils only |
|---|---|---|---|---|---|---|---|---|
| comp. | 0.87 | 0.66-1.08 | 173 | 132-214 | 0.04 | 0.02-0.06 | 0.38 | 0. 26-0.050 |
| | 0.76 | 0.61-0.88 | 165 | 50-240 | 0.07 | 0.02-0.12 | 0.53 | 0.21-0.84 |
| | 0.86 | n.a. | 71 | n.a. | 0.07 | n.a. | 0.58 | n.a. |
| | 0.02 | n.a. | 8 | n.a. | 0.09 | n.a. | 0.92 | n.a. |
| | 0.64 | n.a. | 24 | n.a. | 0.06 | n.a. | 0.64 | n.a. |
| | 0.91 | 0.80-1.13 | 9 | 7-11 | 0.07 | 0.06-0.09 | 0.54 | 0.48-0.58 |
| | 0.54 | 0.35-0.66 | 91 | 39-166 | 0.06 | 0.03-0.08 | 0.54 | 0.38-0.68 |

) complete soil analyses on a number of samples is still awaited.

) Na, K, Ca, Mg, Mn and P analyses are done according to Mehlich fertility analyses.

| mp unit | Mn mean | Mn range | P mean | P range | %N total mean | %N total range | %C mean | %C range |
|---|---|---|---|---|---|---|---|---|
| 10 | 0.75 | 0.28-1.16 | 82 | 30-170 | 0.08 | 0.03-0.10 | 0.71 | 0.24-1.48 |
| 20 | 0.49 | 0.27-0.55 | 84 | 14-212 | 0.07 | 0.06-0.08 | 0.56 | 0.45-0.66 |
| 30 | 0.33 | n.a. | 16 | n.a. | 0.04 | n.a. | 0.40 | n.a. |
| a | 1.07 | 0.61-1.38 | 40 | 28-57 | 0.07 | 0.06-0,08 | 0.69 | 0.57-0.80 |

in meq/100g soi
topsoil only

n.a. = not applicable in case of one sample or equal values

## Appendix III List of Site Evaluation Reports

| Number | Author(s) | Title | Date of issue |
|---|---|---|---|
| 1 | R.F. van de Weg and W.G.Sombroek | Report of a site evaluation of cat clay hazards in the Yala swamp-Western Kenya | June 1972 |
| 2 | R.F.van de Weg | Report of a site evaluation trip to Lake Kenyatta Cotton Scheme-Lamu District | June 1972 |
| 3 | H.M.H. Braun and S.M. Wokabi | Irrigation suitability of the Olkeramatian Experiment Area | Dec. 1972 |
| 4 | H.F. Gelens and G. Ngari | Report of a site evaluation of the proposed location of Alupe substation | Jan. 1973 |
| 5 | N.N. Nyandat | A reconnaissance survey of arable land in the area East of Meru town | April 1973 |
| 6 | H.M.H. Braun and N.N. Nyandat | Report of a visit to the experiment area of the Ishiara irrigation scheme | Dec. 1972 |
| 7 | W.G. Sombroek, J.J. Vleeshouwer and S.M. Wokabi | Report of a site evaluation of irrigation suitability of the soils and waters of the Merti Area- Isiolo District | Jan. 1973 |
| 8 | H.F. Gelens G. Ngari | Report of a site evaluation for a proposed irrigation project at Kunati-Meru District | March 1973 |
| 9 | N.N. Nyandat and R.A. Leyder | A preliminary survey of the utilization of Nairobi sewage effluent for irrigation | August 1973 |
| 10 | W.G. Sombroek, H.M.H. Braun and J.M. Kibe | A preliminary evaluation of the irrigation suitability of the soils in he Mandera-Ramu Area-North-Eastern Province | Sept. 1973 |
| 11 | H.M.H. Braun and H.W. Okwaro | Drainage problems of planosolic soils in the Bonet Area | April 1974 |
| 12 | J.J. Vleeshouwer and J.P. Mbuvi | A preliminary evaluation of the irrigation suitability of the soils and the waters of Katilo irrigation scheme-Turkana Distr. | Sept. 1974 |
| 13 | J.J. Vleeshouwer and J.M. Kibe | Suitability as sports grounds of some sites on the terrains of the Kiambu Institute of Science and Technology | August 1973 |
| 14 | W.G. Sombroek, J.P. Mbuvi, J.M. Kibe and H.W. Okwaro | A preliminary evaluation of the irrigation suitability of the lands in the middle- lower Tana valley (Mbalambala-Garissa-Bura) | March 1974 |

Appendix III cont'd

| Number | Author(s) | Title | Date of issue |
|---|---|---|---|
| 15 | W.G. Sombroek, J.P. Mbuvi and H.W. Okwaro | A preliminaryévaluation of the irrigation suitablity of the lands in the pre-delta Tana flood-plain | Dec. 1973 |
| 16 | J.P.Mbuvi, R.F. van de Weg and H.M.H. Braun | A preliminary evaluation of the soils of NW-Machakos District | July 1974 |
| 17 | J.J. Vleeshouwer and D.O.Michieka | Irrigation suitability of the soils and waters of the flood-plain of the Kerio river NE of Lokori-Turkana District | Oct, 1974 |
| 18 | J.P. Mbuvi | A preliminary ev aluation on the suitability of the area of Busia District for sugar cane development | Oct. 1975 |
| 19 | J.P. Mbuvi and R.F. van de Weg | A preliminary evaluation of the soils around Nyangoma mission-Bondo Division | Dec. 1974 |
| 20 | H. Bonarius and P.N. Njoroge | A preliminary evaluation of the irrigation suitability of lands in the Kanjoo Area'Meru District | Oct. 1974 |
| 21 | W.G. Sombroek, J.P. Mbuvi and R.A. Leyder | Preliminary evaluation of the soil conditions on the East bank of the lower Tana (Bura-East Area) for large scale irrigation development (&addendum) | June 1975 |
| 22 | H. Bonarius | Preliminary assessment of irrigation development in the Marsabit Area | April 1975 |
| 23 | S.M. Wokabi, W.G. Sombroek and J.P. Mbuvi | Evaluation of Tana delta soils for large scale irrigation development | Nov. 1975 |
| 24 | W. Siderius | Soil resources of the upper Kerio valley-a preliminary investigation | Sept. 1975 |
| 25 | J.P Mbuvi and R.F. van de Weg | Some preliminary notes on the soils of Katumani, Kampi Ya Mawe, Embu and Murinduko Agricultural Research Stations | June 1975 |