H.M.H. Braun

REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE—NATIONAL AGRICULTURAL LABORATORIES

KENYA SOIL SURVEY

AN ASSESSMENT OF THE IRRIGATION SUITABILITY OF THE KANDIS DAM AREA

(NEAR ONGATA RONGAI, KAJIADO DISTRICT)

by

H. M. H. Braun

SITE EVALUATION REPORT No. 57, JUNE 1981

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Kenya Soil Survey.

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1. INTRODUCTION

At the request of the Irrigation and Drainage Branch of the Ministry of Agriculture an assessment was made of the soil conditions in the area south of the concrete dam which is under construction in the Kandis river. Together with various officers of the Irrigation and Drainage Branch the area south of the dam was inspected on 28/5/1981. The area to the north of the dam was investigated on 6/6/1981.

2 GENERAL INFORMATION

Location and storage of the dam: The dam is situated at coordinates 9845.0 North and 246.7 East (latitude $1^{o}24'$S, longitude $36^{o}44'$ E) on the Kandis river, just downstream of its confluence with the Nol Chora river. The dam site is approximately one kilometre south of the Magadi Road between the villages Ongata Rongai (also written as Langata Rongai and Angata Rongai) and Kiserian. The location can be found on the 1:50,000 topographical map with sheet no. 148/3 (Ngong). According to drawings present at the damsite the dam will store approximately 70,000 m^3 of water. At the time of the visit the dam was overflowing.

Location of the survey area: The area surveyed has the dam as its centre. Somewhat arbitrarily the Magadi Road and the Kiserian River were chosen as the north and south boundaries of the surveyed area (see fig.1).

Climate: There are no climatic stations in the immediate vicinity of the damsite. The nearest rainfall stations are Ndigo Farm, some 4 kilometres to the north-east and Quarry Lane which is located 6 kilometres north-west of the damsite. Stations of interest which are farther away are Ngong, Magadi Water Works and Athi River Railway Station at 10, 9 and 27 kilometres distance respectively. Some relevant climatic data are given in table 1 below.

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Table 1: Climatic data.

station	number	name	lat S	long E	Alt(ft)	T(°C)	E_o(mm)	nr of years
1.	91.36096	Ndigo Farm	1.22	36.45	5850	19	1784	37
2.	138	Quarry Lane	1.22	36.43	5700	19	1801	21
3.	055	Magadi Water Works	1.26	36.41	6100	18	1757	21
4.	013	Ngong D.C.	1.22	36.49	6700	17	1692	63
5.	026	Athi River R.S.	1.27	36.58	5700	19	1801	59

R A I N F A L L (in mm).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	dec	Year	r/E_o
1.	48	40	78	181	149	34	14	20	19	49	99	83	814	46%
2.	69	51	72	204	188	35	19	21	23	61	133	82	958	52
3.	38	40	93	178	129	50	13	19	17	35	71	73	756	43
4.	44	54	95	191	148	36	14	20	23	44	91	63	823	49
5.	28	37	90	153	72	23	6	8	10	35	85	49	596	32

(data from KMD, 1977; Woodhead 1968; Mungai and Braun, in prep.)

For the region of the damsite the rainfall has been estimated by calculating the weighted average based on distance of the five stations given above. An estimate of the monthly evapotranspiration was calculated with Woodhead's (1968) altitude equation (x2/3) and a distribution derived from various stations in E.A.M.D. (1975). These data are given in table 2. below.

Table 2. Rainfall (r) and potential evapotranspiration (ET) estimates for the damsite.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
r	50	45	82	186	150	36	15	19	20	48	101	76	828
ET	132	120	120	96	84	72	60	72	108	120	96	120	1200

It can be seen from table 2 that the average rainfall in the period March - June (long rains) exceeds the potential evaporatranspiration in the period April - July (growing season) by 142mm (i.e. 454 - 312). In all other months and also during the period October - December (short rains) the average rainfall is less than the potential evapotranspiration (i.e. October - Dec. rainfall 225, November - January ET 336, a deficit of 111mm).

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Without going into further details of rainfall probabilities the data indicate that the long rains can be expected to provide enough rainfall for seasonal crop production in most years, while the short rains can only be rarely expected to provide enough rainfall for seasonal crops.

The annual rainfall/evaporation ratio of the damsite is 828/1800 = 0.46 or 46% which places the site in agroclimatic zone IV. The area does not belong to the Arid and Semi-arid lands (zones V and VI) which have a ratio of less than 40%.

Vegetation and land use: According to field observations the natural vegetation of the plains and uplands (see fig.1) consists of grasslands with scattered shrubs. Among the grasses Themeda triandra and Setaria sphacelata are the most common ones; the dominant shrubs are Acacia drepanolobium and Acacia seyal. The valley sides (units VVC1 and VVC2 of fig.1) are covered with bushed and wooded grassland.

Probably up to quite recently the land use has been grazing only. At present there is in some places extensive cultivation of seasonal crops like maize and beans, particularly in the area south of the Kandis river. In the area north of the river many houses have been or are being built but there is little cultivation of seasonal crops.

Crop performance: Crop performance was found to be related to micro-topography. Areas where the soil was only slightly higher than the surroundings showed a distinctly better crop growth, while slight depressions showed a substantially worse crop growth than average conditions. These differences in crop growth seem to be largerly due to differences in drainage conditions. Improvement of crop performance may be expected from cultivation on cambered beds. If any irrigation is planned then it should be accompanied by a proper drainage layout.

3. SOILS INFORMATION

Previous work on soils was carried out by Touber (1978) who mapped the Athi - Kapiti plains at a scale of 1:250,000. Most of the area near Kandis dam forms part of two complexes with imperfectly drained, shallow to deep soils.

During the first field visit the soils just south of the Kandis dam were investigated and described in six augerings at 100m intervals on a transect at right angles to the river. At one of these sites a soil pit was excavated and described the next day. A week later four more augers and one profile pit were described in the area north of the river. The locations of the observations are indicated in fig.1.

After interpretation of aerial photographs and field data a photo-interpretation map with legend was prepared (fig.1)

pH and electrical conductivity: Some measurements were carried out in unit PV1p. The pH of a 1:5 soil - water suspension varies from 6.3 to 7.0 in the topsoil and from 7.2 to 7.6 in the subsoil. The electrical conductivity varies from 0.04 to 0.13mmho/cm in the topsoil and 0.15 to 0.25mmho/cm in the subsoil. Both the pH and the EC values are normal. It is not expected that any of the other soil units will have substantially different pH or EC values: i.e. all soils are non-sodic and non-saline.

Soil Fertility: From unit PV1p four topsoil samples were collected for fertility analysis. The results will be added to the report at a later stage. It is expected that the soils are reasonably fertile, although nitrogen and phosphate fertilisers will have to be used to obtain good yields under rainfed or irrigated conditions.

Topography: From the contours on the topomap it is estimated that the level of the plains on both sides of the dam is 25 - 30m above the dam level.

As indicated in the legend of fig.1 the slopes vary from 0-30%. The plains units (P) are nearly flat. The units mapped as minor valleys (VVC1, VVC2) have a decreasing slope percentage from the bottom of the valley to the plains or uplands. As mentioned under "crop performance" small differences in height have a pronounced effect on crop growth.

Drainage: All the soils investigated are either imperfectly or poorly drained. This drainage condition is inferred from the occurence of mottles in the soil. The pit in unit PV3p showed mottles from the surface downwards; the pit in unit PV1p had mottling starting at 35cm depth.

All areas except the valleys and unit PV3p consist of heavy clays which have low or very low hydraulic conductivity. It seems likely that the underlying rock strata are impervious. As crop performance shows, cambered beds may improve growing conditions under rainfed conditions. It seems unlikely that the soils of units similar to PV1p can be drained properly for irrigated crop cultivation.

Workability: The topsoils of the heavy clay units like PV1p have a poor workability. When dry these soils are hard, when wet they are very sticky and plastic. They have a narrow moisture range between the upper and lower tillage limit and they have a wide moisture range between field capacity and the upper tillage limit. As a result of these characteristics these soils can hardly ever be worked under optimum moisture conditions to obtain proper tilth.

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Suitability for irrigation: From what has been reported on the various soils in previous paragraphs it is clear that none of the soil units are thought to offer good prospects for irrigation in general. For horticultural crops the picture is even more dim.

An estimate of the degree to which various land qualities limit the irrigation suitability of the various soil units and the resulting irrigation suitability evaluation are given in table 3. None of the soil units are considered highly or moderately suitable for irrigation; units PV1p, UV1p, UV2p and VVC2 are marginal and PV2P, PV3P and VVC1 are unsuitable.

Table 3: Estimated irrigation suitability and limiting land qualities of the soil units.

		limiting land qualities				
soil unit	suitability for irrigation	soil depth	stoniness/ rockiness	topography (slope)	workability	drainability
PV1p	marginal	x	-	-	xx	xx
PV2P	unsuitable	xx	-	-	xx	xxx
PV3P	"	xxx	?	-	x ( )	xxx
UV1p	mariginal	x	-	x (1)	xx	xx
UV2p	"	x	-	x (1)	xx	xx
VVC1	unsuitable	xx	xx	xxx	?	?
VVC2	marginal (?)	x	x	x (1)	?	?

- no limiting
x slight limitation
xx moderate limitation
xxx strong limitation
(1) x for overhead irrigation
xx/xxx for surface irrigation

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4. SUMMARY

The soils in the vicinity of the Kandis dam were investigated for assessing their suitability for irrigated agriculture. None of the soil units is considered highly or moderately suitable for irrigation and the best units are at most marginally suitable for irrigation. The major limitations for irrigation are:

shallowness (units PV2P, PV3P, VVC1)
drainability (PV1p, PV2P, PV3P, UV1p, UV2p)
workability (PV1p, PV2P, UV1p, UV2p)
slope (VVC1)
stoniness/rockiness (VVC1)

The soils south of the Kandis river (except the steep valley slopes) appear moderately suitable for rainfed cultivation of seasonal crops provided that the surface drainage conditions are improved and fertilizers are supplied. The soils north of the river are unsuitable for agriculture because they are shallow.

5. REFERENCES

E.A.M.D., 1975: Climatological statistics in East Africa; part 1 Kenya; East African Meteorological Department, Nairobi.

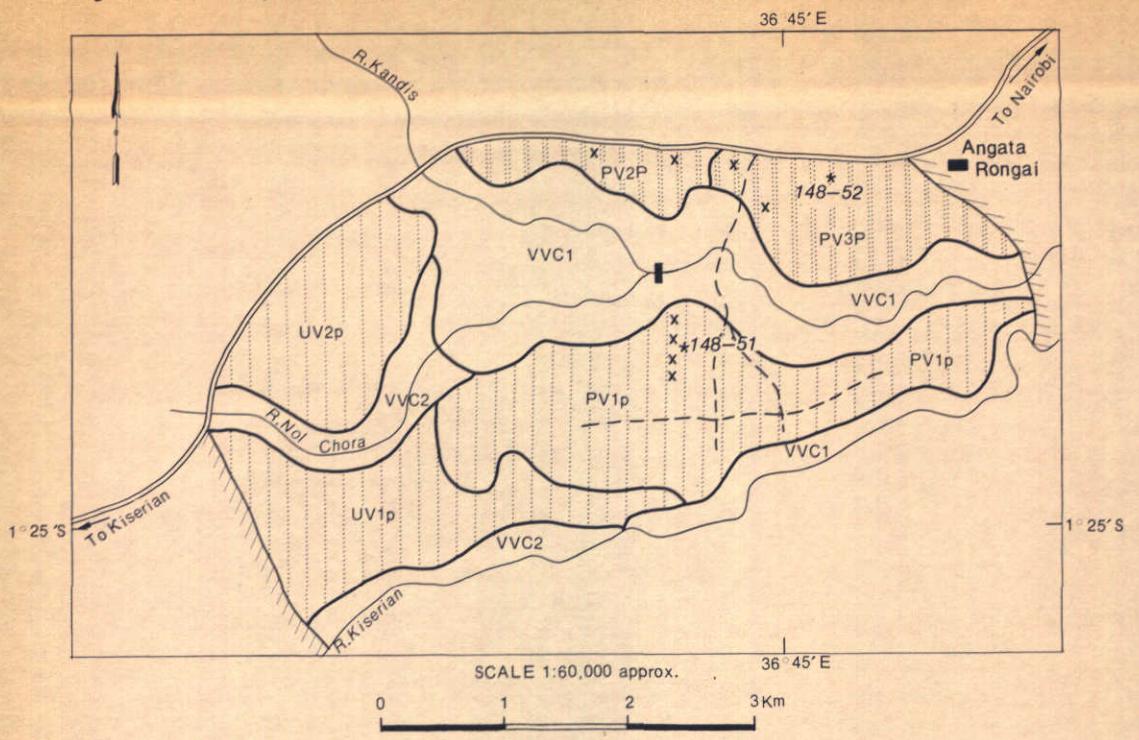
K.M.D., 1977: Summary of rainfall in Kenya for the year 1973, Kenya Meteorological Department, Nairobi.

Mungai, D.N and Braun H.M.H, (in prep): Average monthly and annual rainfall of Kenya Stations. Misc. paper M16, Kenya Soil Survey.

Touber, L., 1978: Soil map of the Athi - Kapiti plains; Kenya Soil Survey, Nairobi.

Woodhead, T., 1968: Studies of Potential evaporation in Kenya. East African Agriculture and Forestry Research Organisation, Nairobi.

Fig. 1 Photo – interpretation map of the area near the Kandis dam



LEGEND

P PLAINS (slopes 0–2%)

PV Soils developed on various volcanic rocks (phonolites and tuffs)

PV1p imperfectly drained, moderately deep to deep, very dark grey to dark grey, firm, non-calcareous, non-saline, non-sodic, cracking clay (pellic Vertisols)

PV2P soils similar to PV1p but shallow

PV3P poorly drained, shallow, dark reddish grey, friable clay loam; with abundant iron-manganese concretions at 15–30cm depth

U UPLANDS (slopes 2–8%)

UV Soils developed on various volcanic rocks (phonolites and tuffs)

UV1p soils similar to PV1p, but slope 2–5%

UV2p soils similar to PV1p, but slope 2–8%

V MINOR VALLEYS (slopes 2–30%)

VV Soils developed on various volcanic rocks (phonolites and tuffs)

VVC1 complex of shallow and deep soils; with rock outcrops; slopes 8–30%

VVC2 complex of shallow and deep soils; slopes 2–8%

KEY TO DEPTH CLASSES

thickness soil in cm	symbol over rock	name
0-50	P	shallow
50-80	p	moderately deep
80-120		deep
more than 120		very deep

KEY

soil boundary
*148–51 observation pit
x augerhole observation
road
track
river
dam
boundary of survey area

Prepared and drawn by Kenya Soil Survey June, 1981
Drawing No. 81022

SOIL TEST REPORT

INWARD REF.: Inf, 1 Sheet of 29.5.81

OUR REF.:

DATE SAMPLE RECEIVED: 5.6.81

DATE SAMPLE REPORTED: 31.8.81

SAMPLE/S SENT BY: Kenya Soil Survey
N.A.L, Box 14733, Nairobi.
(Attention of Mr. Braun)

NATIONAL AGRICULTURAL LABORATORIES,
DEPARTMENT OF AGRICULTURE,
P.O. BOX 14733,
NAIROBI.

FROM (PLACE): Kandisi Dam
Rift Valley Province

Field Designation..	$148/_3$-46	$148/_3$-49	$148/_3$-50	$148/_3$-51					
Lab. No. .. 81..	5894	5895	5896	5897					
Depth ..Cm..	0-30	0-30	0-30	0-30					
Colour									

Chemical Test Results

pH	6.3	5.8	5.7	5.6					
Na m. e. % ..	0.32	0.57	0.62	0.46					
K m. e. % ..	0.68	0.45	0.46	0.65					
Ca m. e. % ..	30.0	16.1	16.3	16.9					
Mg m. e. % ..	9.0	9.6	8.6	9.6					
Mn m. e. % ..	0.84	1.19	1.08	1.02					
P. p. p. m. ..	13	13	11	10					
N %									
C %	1.92	1.34	1.34	1.74					
Hp m. e. % ..	-	-	-	-					

(Toxicities Bracketed) Deficiencies Underlined

REMARKS:

The above results show that these soils are moderately acidic. The basic plant nutrients are supplied in excess that may cause toxicity problems as Ca and Mg are concerned. On the other side, these soils are deficient in P and N, but sufficiently supplied with K, Na and Mn.

In view of the above remarks, it is recommended that phosphate fertilizers in form of diammonium phosphate should be added to these soils to improve phosphorus status 60 Kg/acre P_2O_5 and 3-5 tons of organic manure or FYM/acre to improve the soil status and the supply of Nitrogen to plants.