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SEMINAR ON THE USES OF SOIL SURVEY AND CLASSIFICATION IN PLANNING AND IMPLEMENTING AGRICULTURAL DEVELOPMENT IN THE TROPICS

ICRISAT - HYDERABAD, INDIA - JANUARY 18 - 23, 1976

SOIL SURVEY INTERPRETATION FOR TECHNOLOGY TRANSFER OPPORTUNITIES AND CAVEATS

The Use of the Soil Survey data to test the wide applicability of the experimental results of the Kenya research stations.

by

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INTRODUCTION

One of the first and most important steps in evaluating the environment is to know the state of the soil through a soil survey. Such a survey indicates the location and extent of each kind of soil and its potentials and limitations for various uses. From the soil map interpretations can be made to show the various alternatives for safe use of a soil and the potential for the production of plants and animals. A standardised programme of soil mapping can especially enable comparison to be made between results gained in different areas of survey. It can also enable extrapolation of the results to similar areas where experiments have not been conducted and thus ensures that the available knowledge is used without unnecessary duplication. The extrapolation of the knowledge is especially important in the developing countries where the resources are still meagre and the borrowing of applicable knowledge from elsewhere can effect a significant saving.

In Kenya, a programme of systematic reconnaissance soil survey based on standardised methodology has been effected. The legend of the soil map is based on local soil grouping but for the purpose of local extrapolation of the results and the interpretation of the soils at international level, the soils are correlated with both the USDA soil classification system and the FAO classification system for the soil map of the world. At national level it is especially of interest to know, for each completed survey, whether the results of experiments conducted at the research stations are applicable in the completed survey areas. The sections below endavour to illustrate such a test with an area in Kenya where a reconnaissance soil survey has recently been completed.

METHOD

A reconnaissance soil sruvey was conducted by Van de Weg and Mbuvi (1975) in an area covering some 320,000 ha and which is depicted in Fig. 1. The soil description terms followed that of FAO, Guidelines for soil description (1967)

and a comprehensive soil analysis was based on the methods recommended in USDA/SCS - Bulletin No. 1. The legend of the map was compiled in line with the local soil grouping but the soils were also classified according to the USDA Seventh Approximation (1967) and the FAO system (1974).

Similarly soils were examined by Mbuvi and Van de Weg (1975) at four agricultural research stations (Embu, Murinduko, Katumani and Kampi ya Mawe) which lie within the vicinity of the reconnaissance soil survey area. Comparison of the soil and climatic conditions of the five areas were made and conclusions drawn.

RESULTS AND DISCUSSION

The reconnaissance soil survey area broadly falls under three ecological zones herein designed as zones III, IV, and V (Woodhead, 1970 and Survey of Kenya, 1970). The area is also occupied with soils which may be classified as USDA Oxic Quartzipsamments - FAO ferralic Arenosol; USDA Lithic Quartzipsamments - FAO ferralic Arenosol, lithic phase; USDA Typic Haplortox - FAO rhodic Ferralsol; USDA Lithic Haplustox - FAO orthic Ferralsol, petroferric phase; USDA Typic Haplustox - FAO orthic Ferralsol; USDA Rhodustalf - FAO eutric Nitosol; USDA Paleustult - FAO dystric Nitosol; USDA Paleustalf - FAO Acri-orthic Ferralsol and Ferral-orthic Acrisol, petroferric phase; USDA Typic Rhodustalf - FAO Ferral-chromic Acrisol; USDA Plinthic Paleustalf - FAO Ferral-ferric Acrisol; USDA Ultic Paleustalf - FAO Ferral-chromic Luvisol; USDA Udic Rhodustalf - FAO chromic Luvisol; USDA Lithic Ustochrept - FAO chromic Cambisol, lithic phase; USDA Typic Pellustert - FAO pellic Vertisol; USDA Lithic Rendoll - FAO orthic Rendzina.

On the other hand, the four research stations may be characterised as follows: Embu station - ecological zone II, soils are USDA Rhodustalf-FAO eutric Nitosol; Murinduko station - ecological zone III, soils are USDA Typic Haplortox - FAO rhodic Ferralsol; Katumani station - ecological zone IVb, soils are USDA Ultic Paleustalf - FAO Ferral-chromic Luvisol and USDA Typic Pellustert - FAO pellic Vertisol; Kampi ya Mawe - ecological zone IVb, soils are USDA Udic Rhodustalf -FAO chromic Luvisol, USDA Ustoxic Paleustult - FAO orthic Acrisol, USDA Ustoxic Haplustult - FAO orthic Acrisol, USDA Udic Paleustoll - FAO luvic Phaeozem, USDA Udic Paleustalf - FAO eutric Nitosol, USDA Oxic Haplustalf - FAO ferric Luvisol, USDA Typic Ustorthent - FAO ferralic Arenosol, and USDA Oxic Quartzipsamment - FAO cambic Arenosol. (see also Appendix I)

The comparison of the soils data and the climatic conditions leads to the conclusion that the extrapolation of the experimental results at Embu Research Station to the reconnaissance survey area will be inappropriate on account of the difference in climate although similar soils occur.

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With regard to the rest of the research stations, the conditions of both soils and climate match very well and the applicability of the experimental results to the reconnaissance survey area is considered appropriate.
Because of the wide occurrance of the soils and climate of the Katumani and Kampi ya Mawe stations in the survey area, it is considered that the experimental results of the former stations may be widely applied in the latter area. This is not true in the case of the Murinduko station whose soils and climate have only a limited occurrance in the survey area.

SUMMARY

A reconnaissance soil survey of an area covering some 320,000 ha was carried out using standardised soil description terms and analytical methods. In order to test the applicability of the results of experiments conducted at far research stations, the latter were also surveyed. A comparison of the results revealed that the results at one of the research stations cannot be extrapolated to the reconnaissance survey area. Of the remaining three research stations, the results at one of them has only a limited application in the survey area. The exercise illustrates how a standardised methodology and soil classification in soil survey can aid the extrapolation of results to similar environmental conditions.

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LOCATION Embu Research Station

TABLE 1

CMS DEPTH	% C	% Sand	% Silt	% Clay	CLAY MINERAL COMPOSITION % kaolinite	Illite	Mont. 14A	m.e.% C.E.C	EXCHANGEABLE BASES m.e.% Ca	Mg	K	Na	E.S.P.	% Base Sat.
A1 0-28	2.20	5	12	73	100	0	0	19.0	9.0	2.4	1.88	0.5	<5	72.6
B21 28-56	0.75	3	16	81	100	0	0	12.0	5.3	2.8	1.8	0.3	<5	85.0
B22 56-112+	0.55	8	12	80	100	0	0	11.4	5.8	1.9	1.80	0.3	<5	85.9

CMS DEPTH	pH 1:1 H_2O	1:1 KCl	1:1 EC mmhos/cm	m.e.% Hp	P ppm	% N
0-28	6.3	5.3	0.15	0	9	0.28
28-56	6.6	5.6	0.16	0	-	0.10
56-112+	6.6	6.2	0.09	0	-	0.08

For % organic matter, multiply % C by 1.73

CEC, NH_4OAc pH 7.0.

Representative profile description for Murinduko Research Station.

Geological formation:		Mount Kenya Phonolite (kenyte)
Local petrography	:	-do-
Physiography	:	volcanic uplands
Relief - macro	:	very gently undulating
Slope gradient	:	1%
Internal drainage	:	well drained.

A	0 - 30 cm	Dark reddish brown (5YR 3/2 moist 5YR 3/4 dry); clay; porous massive to weak sub-angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few, very coarse and common, very fine to fine pores; many fine rocks; lower boundary smooth and diffuse.
B_{21}	30 - 49cm	Dark reddish brown (2.5YR 2.5/4 moist 2.5YR 3/4 dry); clay; porous massive to weak, moderate sub-angular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common, very fine to fine pores; lower boundary clear and smooth.
B_{22}	49 - 110cm+	Dark reddish brown (2.5YR 3/4 moist 2.5YR 3/6 dry); clay; porous massive to weak sub-angular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine pores; no clay cutans.

Soil classification: FAO rhodic Ferralsol
USDA Typic Haplortox

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LOCATION Murinduko Research Station TABLE

CMS DEPTH	% C	% Sand	% Silt	% Clay	CLAY MINERAL COMPOSITION % kaolinite	Illite	Mont. 14A	m.e.% CEC	EXCHANGEABLE BASES m.e. % CA	Mg	K	Na	E.S.P.	% Base Sat
0-30	1.56	12	5	73	90	10	0	14.4	6.0	2.4	1.13	Tr	-	66.0
49-100	0.40	12	7	81	90	10	0	11.3	4.6	2.1	0.35	Tr	-	62.8

CMS DEPTH	pH 1:1 H_2O	1:1 KCl	1:1 CEC mmhos/cm	m.e.% Hp	P ppm	% N
0-30	5.8	5.6	0.07	0.3	7	0.15
49-110	6.2	5.4	0.04	0.5	0	0.07

For % organic matter, multiply % C by 1.73 CEC, NH_4OAc pH 7.0.

Representative profile description for Katumani Research Station.

Geological formation	:	Quartzo-felspatic gneisses of Basement system
Local petrography	:	-do-
Physiography	:	Uplands
Relief - macro	:	Gently undulating to undulating
Slope gradient	:	3%
Internal drainage	:	Well drained.

A	0 - 15 cm	Dark reddish brown (2.5YR 3/4 moist 2.53/4 dry); clay; weak, fine to medium sub-angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; patchy, thin clay cutans; few, very fine to fine pores; few fine roots; few micas; lower boundary gradual and smooth.
B1	15 - 55 cm	Dark reddish brown (2.5YR 3/4 moist 2.5YR 3/6 dry); clay; massive to weak, fine to medium sub-angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; patchy, thin clay cutans; few, very fine to fine pores; few micas; lower boundary gradual and smooth.
B2	55 - 115cm+	Dark reddish brown (2.5YR 3/4 moist 2.5YR 3/6 dry); clay; massive to weak, coarse, angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common, weak to moderate clay cutans; few, very fine to fine pores; patchy calcium carbonate powdery pockets; few micas

Soil classification: FAO Ferral-chromic Luvisol
USDA Ultic Paleustalf

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L O C A T I O N Katumani Research Station T A B L E

CMS DEPTH	% C	% Sand	% Silt	% Clay	CLAY MINERAL COMPOSITION %			m.e.% C.E.C.	EXCHANGEABLE BASES m.e.%				E.S.P.	% Base Sat.
					kaolinite	Illite	Mont.14A		CA	Mg	K	Na		
0-15	1.12	51	6	43	kaolinite	and illite	are	13.4	6.0	1.3	2.0	0.1	<5	70.1
15-55	-	39	18	43	main	components		12.8	5.4	2.1	0.9	0.3	<5	88.0
55-115+	-	39	20	41				11.5	5.0	2.2	0.85	0.2	<5	72.2

CMS DEPTH	pH 1:1 H_2O	1:1 KCl	1:1 EC mmhos/cm	m.e% Hp	P ppm	% N
0-15	6.0	4.9	0.19	0	15	0.101
15-55	5.8	5.0	0.16	0	-	-
55-115+	8.0	6.8	0.35	0	-	-

For % organic matter, multiply % C by 1.73 CEC, NH_4OAc pH 7.0.

Representative profile description for Kampi ya Mawe Research Station.

Geological formation	:	Basement complex
Local petrography	:	Undifferentiated Basement System gneisses
Physiography	:	Uplands
Relief - macro	:	Gently undulating to undulating
Slope gradient	:	5%
Internal drainage	:	Well drained.

A1	0 - 15 cm	Dark reddish brown (5YR 3/4 moist, 5YR 4/4 dry), coarse sandy loam; weak, very fine and fine sub-angular blocky structure; loose when dry, friable when moist, non sticky and non plastic when wet; many, very fine and fine pores, common medium pores; some termite channels; many medium and coarse roots; lower boundary clear and smooth.
AB	15 - 27 cm	Dark reddish brown (5YR 3/4 moist, 5YR 5/6 dry), coarse sandy clay loam; porous massive breaking to some weak, fine and medium sub-angular blocks; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few coarse pores, many very fine and fine pores, common medium pores; krotovina, 3-4 cm diameter; common fine and medium roots; lower boundary gradual and smooth.
B21	27 - 84 cm	Dark red (2.5 YR 3/6 moist, 2.5YR 5/6 - 5/8 dry), sandy clay loam; porous massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; many very fine pores, common fine pores; common fine and medium roots; lower boundary diffuse and smooth,
B22	84 - 130 cm	Dark red (2.5YR 3/6 moist, 2.5YR 4/6 - 5/6 dry), sandy clay; porous massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine pores; common fine roots; lower boundary gradual and smooth.
B3	130 - 160cm+	Dark red (2.5YR 3/6 moist, 2.5YR 5/6 dry), gravelly clay; porous massive; slightly hard when dry, very friable when moist, slightly sticky and plastic when wet; common very fine and fine pores; many fine sub-angular and angular quartz gravels; common fine roots.

Soil classification: FAO orthic Acrisol, USDA Ustoxic Paleustult.

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L O C A T I O N   Kampi ya Mawe Research Station   T A B L E

CMS DEPTH	% C	% Sand	% Silt	% Clay	CLAY MINERAL COMPOSITION % Kaolinite	Illite	Mont.14A	m.e.% C.E.C NH_4OAC pH 7.0	EXCHANGEABLE BASES m.e. % Ca	Mg	K	Na	% Base Sat.
0-15	0.35	72	8	20	-	-	-	4.2	1.8	0.4	0.50	0.20	69
15-17	0.26	68	8	24	-	-	-	4.0	1.6	0.1	0.08	0.05	46
27-84	0.15	56	12	32	-	-	-	3.7	2.0	0.2	0.28	0.10	70
84-130	0.26	54	8	38	-	-	-	4.2	2.0	0.2	0.25	0.20	63
130-160+	0.24	48	12	40	-	-	-	4.6	2.0	0.3	0.28	0.21	61

CMS DEPTH	pH 1:1 H_2O	1:1 KCl	1:1 EC mmhos/cm	AVAILABLE NUTRIENTS m.e.% K	Ca	Mg	P ppm	% N	C/N
0-15	5.9	4.4	0.10	0.37	1.8	0.7	11	0.04	-
15-27	5.6	4.3	0.08	0.31	1.6	0.7	4	0.04	-
27-84	5.7	3.9	0.08	-	-	-	-	-	-
84-130	5.3	3.9	0.08	-	-	-	-	-	-
130-160+	5.7	3.8	0.08	-	-	-	-	-	-

For % organic matter, multiply % C by 1.73

Representative profile description for the reconnaissance survey area

Geological formation	:	Basement system rocks (Precambrian)
Local petrography	:	Undifferentiated banded gneisses
Physiography	:	Uplands
Relief - macro	:	Gently undulating
Slope gradient	:	4%
Internal drainage	:	Well drained

A1	0 - 23	Dark reddish brown (5YR 3/3 moist, 5YR 3/4 dry); sandy clay; moderate, medium to coarse sub-angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common, fine pores; many, fine to medium, few coarse roots; insect holes; lower boundary gradual and smooth.
AB	23 - 38 cm	Dark reddish brown (5YR 3/3 moist, 5YR 4/4 dry); sandy clay; moderate, medium to coarse, sub-angular blocky structure; hard when dry, friable when moist, sticky and slightly plastic when wet; few, fine pores; many fine, few medium, roots; lower boundary gradual and smooth.
B1	38 - 60 cm	Dark reddish brown (5YR 3/4 moist, 5YR dry); sandy clay; moderate, medium to coarse, sub-angular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few, fine pores; common fine roots; lower boundary gradual and smooth.
B21	60 - 103cm	Yellowish red (5YR 4/8 moist, 5YR 5/8 dry); clay to sandy clay; moderate, medium to coarse, sub-angular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common, very fine pores; common fine roots; lower boundary diffuse and smooth.
B22	103 - 175cm+	Yellowish red (5YR 4/8 moist, 5YR 5/8 dry); clay; moderate, fine to coarse, sub-angular blocky structure; slightly hard when dry, friable when moist, non-sticky and non-plastic when wet; common, very fine to fine pores; common, fine roots.

Soil classification: FAO orthic Ferralsol, USDA Typic Haplustox. ..../13

L O C A T I O N Reconnaissance survey area. T A B L E LAB. NO. 781-785/73

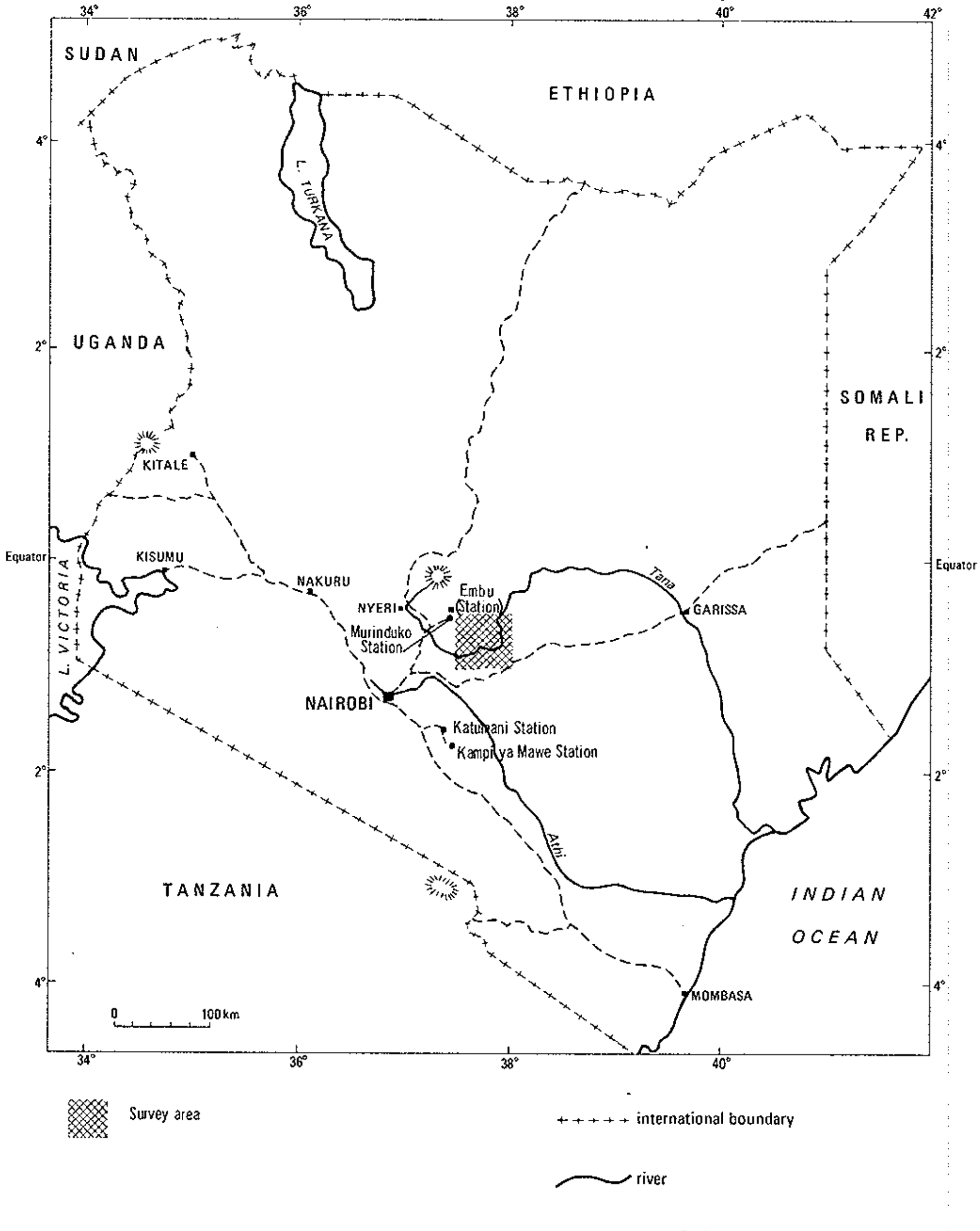
PIT NO.

CMS DEPTH	% C	% Sand	% Silt	% Clay	CLAY MINERAL COMPOSITION % kaolinite	Illite	Mont.14A	m.e.% C.E.C NH_4OAC pH 7.0	EXCHANGEABLE BASES m.e.% Ca	Mg	K	Na	% Base Sat
0-23	0.71	62	6	32	-	-	-	10.7	2.8	2.6	0.5	0.1	56.0
23-38	-	52	8	40	-	-	-	8.9	1.8	1.7	0.4	tr	43.8
38-60	-	52	8	40	-	-	-	7.4	0.9	1.0	0.2	tr	28.4
60-103	-	44	8	48	Predominant	5-10	Trace	7.6	0.6	1.6	0.1	tr	30.3
103-175+	-	32	12	56	-	-	-	8.0	0.5	1.4	0.1	tr	25.0

CMS DEPTH	pH 1:1 H_2O	1:1 KCl	1:1 EC mmhos/cm.	m.e. % Hp	SiO_2/Al_2O_3	SiO_2/R_2O_3	% Fe_2O_3	AVAILABLE NUTRIENTS m.e.% K	Ca	Mg	P ppm	% N	C/N	% Ca CO_3	Bulk Density	% W/V Avail. Moist.	% W/V Moisture 1/3 Atm	15Atm
0-23	6.2	5.9	0.04	0	-	-	-	0.44	1.2	1.6	4	0.08	8.9	0	1.35	5.9	17.8	11.9
23-38	5.4	4.5	0.03	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-
38-60	5.3	4.4	0.02	0	-	-	-	-	-	-	-	-	-	0	1.15	6.4	20.6	14.2
60-103	5.1	4.2	0.03	0	1.6	1.5	5.9	-	-	-	-	-	-	0	-	-	-	-
103-175+	5.4	5.0	0.02	0	-	-	-	-	-	-	-	-	-	0	1.08	11.9	23.8	11.9

For % organic matter, multiply % C by 1.73

Fig. 1 Location of the Research Stations and Reconnaissance survey area



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SEMINAR ON THE USES OF SOIL SURVEY AND CLASSIFICATION IN PLANNING AND IMPLEMENTING AGRICULTURAL DEVELOPMENT IN THE TROPICS

ICRISAT - HYDERABAD, INDIA - JANUARY 18 - 23, 1976

Use of Soil Survey Data in land use planning. Soil survey for land use planning in Kenya

by

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Climate may generally be considered as the most important physical factor in determining the location of agricultural development but the soil is certainly the next most important consideration.

Land use maps based on essential soil survey data, assist the economic planner to determine a rational economic balance between the conflicting demands of Agriculture, Forestry, Ranching, Wildlife and Urban development. Even more the planning of soil conservation measures, drainage, irrigation, extension of trials on the use of fertilizers and other forms of land reclamation require a knowledge of soils and their distribution.

In Kenya, reconnaissance soil surveys are conducted in order to provide basic physical data for regional planning and development programmes. The work involved is treated in four steps which concern: the mapping of the soils; the identification and definition of land utilization types; the interpretation of the soil units for various uses; and the relative comparison of the land utilization types in terms of economic and sociological conditions. The first step once accomplished may not need to be reviewed for a long time but the rest of the steps require continual reviewing since they are dependent on contemporary conditions. The following sections briefly discuss the four steps.

The mapping of the soils

For the reconnaissance soil mapping, much use is made of aerial photographs which enable one to distinguish the main landscape units and to delineate further what are likely to become the mapping units on the soil map. The photo-interpretation is followed by field work during which the actual soils of the photo-interpretation units are investigated. The final reconnaissance soil map then indicates soil units which in more detailed surveys could still be sub-divided. In many cases the final map will depict soil units that represent associations or complexes rather than single soil units.

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Since in Kenya the reconnaissance soil mapping is conducted at scales of 1:100,000 and 1:250,000 the soil associations and complexes are kept to a satisfactory minimum.

The reconnaissance soil maps produced are therefore considered to provide sufficient information and the right kind of basis for research and interpretation for land use planning. The legend of such maps as for instance found in Van de Weg and Mbuvi (1975) is compiled on the basis of a combined morphometric and physiographic approach. In this approach, the soils are first separated on the basis of physiography, followed by geology and then morphology. Although the entries into the legend are in descriptive terms for the comprehension of the non soil scientists, attempt is made to correlate the soil units with various international systems of soil classification.

The identification and definition of the land utilization types

An important aspect of the soil survey is to interpret the soil map for various possible uses. This implies the identification and definition of what is termed "land utilization types" which are relevant to the survey area. It is done on the basis of factors such as produce, capital intensity, labour intensity, farm power, farm size, standard of technical know how etc. A typical example of the definition of land utilization types may be found in Luning (1973). It is only on the basis of such well defined and well analysed land utilization types that a piece of land can be evaluated and rated.

The land evaluation in Kenya recognises several major land utilization types which include: small holder rainfed arable mixed farming; large scale arable farming; small and large scale irrigation; extensive range management; development of plantation forest; management of wildlife; and development of recreation facilities.

The interpretation of the soil units for various uses.

The completion of the soil map and definition of land utilization types are only the first steps in soil survey for land use planning. Further work must be done to relate the soil units to the defined use and management level. By direct visual observation and by means of other tests the properties of the land which include topography, stoniness and rockiness, the natural vegetation present, the climate, the erosion hazard and actual state of erosion are determined. All these determine the suitability of land for the defined use.

In order to be of practical value the land suitability has to be expressed in a rating. So as to arrive at this rating, the relevant individual "land qualities" (defined as the quality of the land which has direct bearing on its use possibilities) are first rated.

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The detailed treatment of such land qualities may be found in Van de Weg and Mbuvi (1975) but they include moisture availability, nutrients availability, resistance to erosion, possibility of the use of agricultural implements, receptivity of the soil as seedbed, presence or hazard of waterlogging and depth of soil.

The relative comparison of the value of various land utilization types

After the interpretative maps become available they are then subjected to the policy decision about what sort of land utilization types should be encouraged and in what parts of the area under consideration. It is at this stage that sociological and economic considerations come into play. Sociological and economic policies at country level dictate the direction that the development eventually takes. The physical data however make a rational choice possible.

S U M M A R Y

The use of soil survey data for land use planning is viewed to involved four essential steps. The first step is the production of a soil map to be followed by the identification and definition of the land utilization types. The next step is the linking of the soil units with the land utilization types through the production of interpretive maps. The final step is then to subject the interpretive maps to the economic and sociological analysis in order to arrive at the course that development may take. The prevailing economic and sociological policies in a country will be the main factor to direct the eventual direction of development.

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~~Dumanski~~
Sombroek

REPORT ON THE PARTICIPATION IN

A SEMINAR AT HYDERABAD, INDIA: 18TH - 25TH JANUARY, 1976

Nyandat

The Seminar took place in Hyderabad, India from 18 - 25th January, 1976. The period 23 - 25th was spent on Field excursion to research stations and farms. The topic of the seminar was "Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics". It was aimed at providing opportunities for programme planners and soil scientists from tropical countries to report, discuss and learn about the practical usefulness of soil classification in:

1. Interrelating research studies on soil, water and crop management to each other and to similar work in other tropical areas.
2. Land use planning and regulation
3. Planning and implementation of agricultural development for food production.

Some 87 people from 31 countries of the world participated with most of the countries being represented by a planner and a soil scientist. I represented Kenya as a soil scientist. I represented Kenya as a soil scientist while F.M. Kinoti M'Mugambi of the Land and Farm Management Division participated as a planner.

SESSIONS

For the presentation purpose , the proceedings were divided into seven sessions namely: Opening Plenary; Modern Soil Classification Fundamentals; Soil Survey Interpretation for Technology Transfer; Use of Soils data in Land Use Planning; Use of soils data in Regional and National development; Expanding the Soils Research Network; Soil and Water Management in rainfed agriculture; and Planners session. There were also three discussion groups which met separately at the same time to discuss the ~~same~~ topics. The topics for discussions were: "Soils information needed for planning" and "Soils Information available for planning".

The seminar was opened by the India Minister of State for Agriculture and Irrigation (Honourable Shri Shah Nawaz Khan) and the sessions were presided over by various Chairmen. I presided over the session on "Use of Soils data in land use planning". Reports by the groups were strikingly similar.

Several conclusions emerged from the sessions as following:

1. Besides the soil suitability maps, planners need information on cropping combinations, crop performance or crop ecology, alternative land uses, water resource, energy and climatic data. The information should be quantified iterms of acreages available and economic productivity (with cost/benefit calculations)

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2. Pedological data should be separated from interpretations needed by planners. Further more soil survey should be followed by research so that results of experiments are superimposed on soils before passing them to the extension workers and the users.

3. Interpretation for use and management should be stated as simply as possible but accurately. Even reconnaissance scale soil surveys can be used in the small scale farmer situation - as a means of giving guidelines to field extension workers in regard to crop types, animal enterprises etc.

4. Soil surveyors should be involved in planning at an early stage to avoid a time constraint bearing in mind that the number of soil surveyors available is generally small. Interaction and consultation should take place right at the project formulation stage and the dialogue be maintained throughout upto the Project execution stage.

5. Soil scientists need to bridge the communication gap with other disciplines. They should work with other specialists, extensionists and planners rather than work in isolation. There is a special need for co-operation between the plant breeders and soil scientists so that the latter could indicate to the former the special problem soil areas that need a particular kind of focus in the genetic manipulation of crop variables.

6. Consideration should not only be given to the horizontal transfer of technology to other subject matter specialists but also to vertical transfer of technology to the small scale farmer in the tropics. It was the opinion of the participants that for the dissemination of information to the farmer it was necessary to have a subject matter specialist who is <u>trained</u> in soil interpretation and extension work in agriculture to interpret the soil reports produced by the soil surveyor. The material produced by the subject matter specialist is then to be passed to the extension agents to disseminate to the individual farmers. It should further more be feasible to train extension workers in simple techniques of soil survey and physical and economic planning for the individual small farmer or co-operative groups of small farmers.

7. Soil surveyors should be exposed to orientation and familiarisation courses.in planning. Planners and development economists in turn should be exposed to soil survey and classification and their field application in actual development.

8. Since development and not planning is the ultimate goal, consideration should be given to means available to execute a plan and the economic, social, political and cultural implications of a land use plan. Basic requirements of a land user including a farmer are inputs and credit.
These are the realities the land user is faced with in implementing recommendations. The implication is that there are different levels of management. It may be necessary to convince the financers to put in their inputs in areas which have this problem.

FIELD EXCURSION

Some 740 km of field tour was made from Hyderabad city in the North through Raichur, Hospet and Bellary to Bangalore city in the south. This is a region where the annual rainfall is variable (range 375 - 859 mm) with frequent prolonged droughts and sufficient rainfall occurs only once every three to four years.

Intensive irrigation and dryland farming are practiced. The area visited included 4 Dryland farming research stations, 1 irrigation research station, 1 soil conservation Research Training and Demonstration Centre, 1 State Farm for Seed Production, 1 Soil Survey and Correlation Centre.

The soils in the region are predominantly the cracking black soils. Also occurring is appreciable proportion of rather shallow red soils. Irrigation mainly for padi rice is practiced on the black soils whereas drought resistant crops are grown on the red soils using dryland farming system. Crops cultivated under dryland farming are common crops in Kenya and include sorghum, millet, cotton, sunflower, sufflower pegion peas, castor, peanut and red gram. Methods for water conservation and use figure prominently in both dryland farming and irrigation research. Also the breeding of locally adapted crop varieties and tests on appropriate crop rotation rank high in the research priority.

The impressive and successful small-holder farming in this region of adverse envrionmental conditions amply illustrates the value of practically oriented agricultural research. Incidentally, most of the agricultural research in India is, by Act of Parliament, the responsibility of the Agricultural Universities. The Government agencies concentrate on extension service. The agricultural extension service is headed by trained agronomists and this greatly facilitates the flow of the results of agricultural experiments to the farmers.

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SEMINAR ON

USES OF SOIL SURVEY AND CLASSIFFICATION IN PLANNING AND IMPLEMENTING AGRICULTURAL DEVELOPMENT IN THE TROPICS

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