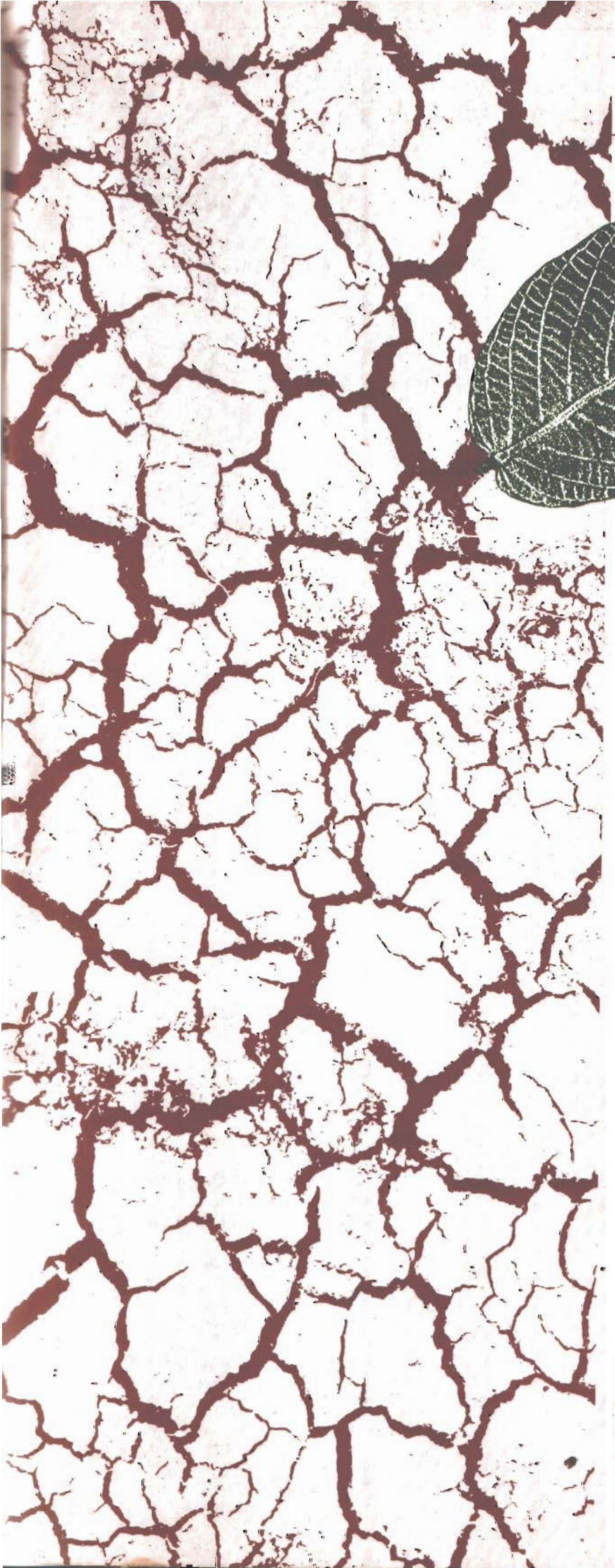

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Review of Soil Surveys (Soil Resource Inventories) in Tanzania

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REVIEW OF SOIL SURVEYS (LAND RESOURCES INVENTORIES) IN TANZANIA.

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CONTENTS

1 EXECUTIVE SUMMARY

Tanzania is a large country with diverse soil and land resources. In order to determine the full production potential of the country, proper identification, characterization and inventorying of these resources are deemed necessary, together with the identification of the factors which are likely to limit production. A review of soil surveys (soil resource inventories) already done in the country is hereby presented.

Tanzania has a history of more than 50 years of collecting basic information on land resources through soil surveys and mapping. These works have been done at different scales and with different objectives. Soil maps have been made for land use planning at national, regional and district levels, for estate and irrigation management projects etc.

The early national soil resource studies prior to 1975 are characterized by their small scale nature and high level of generalization, being based on rather few observations scattered over the country. Moreover, they were done using different criteria. Inevitably, these works cannot be easily correlated and do not have sufficient predictive value. To systematize soil mapping in the country, Soil Survey Section was firmly established in 1972 as part of the Soils and Fertilizer Use Research Programme of the Ministry of Agriculture and was given mandate to organize and execute soil surveys in the country.

The current objectives of soil surveys in Tanzania are three-fold:

(a) Identification, characterization and mapping of the country's land resources at a scale reasonable for land use planning at national level.

(b) Provision of soil survey and land evaluation services required for land use planning at regional, district and farm levels.

(c) Development and elaboration of methods and procedures for soil mapping and land evaluation.

Efforts to meet these objectives have to some extent been frustrated by financial constraints and limited manpower.

Currently there exists a national inventory of soils and agroclimates of modest detail (scale of 1:2,000,000) for the whole country and there are plans to improve on it. About half of the country has been covered by reconnaissance surveys at mapping scales between 1:100,000 and 1:500,000. These scales are however more appropriate for broad land use planning and are not sufficient for land resource management nor for land use planning at the village or farm level. Only about 10,000 square km of land (about 1% of the country's

total area) have been mapped at detailed and semi-detailed scale for village and farm land use planning. In essence it can be said that soil conditions of a great part of the country are still largely unknown.

Very little has been done in terms of basic research into areas that are likely to increase the predictive ability of soil surveys. Handling of basic soil and land data and land evaluation to a very great extent are still been done manually; very little computerization has been done. Moreover, land evaluation is done in qualitative terms and literally no attempt has been done to evaluate land quantitatively.

There is still a big gap between the need for soil surveys and the actual work that has already been done. With the increasing pressure on the land and the consequent land degradation hazards the demand for soil surveys and appropriate land management packages will continue to grow.

To have a rational and an effective utilization of the country's soil and land resources, the government is urged to seriously support efforts of systematically characterizing and mapping these resource by providing the needed funds.

2 INTRODUCTION

Tanzania has a total area of about 945,000 square km and a population of over 24 million. It extends from about 1.5 degrees south of the equator to about 12 degrees south. The country has a wide variety of landforms and climates; and it includes the highest and lowest parts of Africa namely, the summit of Mount Kilimanjaro (about 5900 m a.s.l.) and the floor of Lake Tanganyika (about 358 m b.s.l.). The climate is mainly tropical, but the varying altitudes produce a corresponding range of temperature regimes from tropical to temperate. Rainfall is variable from place to place and is generally lower than might be expected for the altitude.

The distribution of the main land use types and farming (production) systems is determined largely by the agro-climatic and soil conditions. The diverse agro-climates permit the production of a wide range of food and cash crops. The main land use systems range from a nomadic type of pastoralism in the semi-arid, mid-altitude areas in the central parts of the country to high-intensity mixed arable farming in the humid high altitude areas of the northern and southern highlands.

It has long been recognized that in order to determine the full production potential of

the country proper identification, characterization and inventorying of the land resources are needed along with identification of factors limiting production. Tanzania has a long history (more than 50 years) of collecting basic information on land resources through soil survey and mapping. Soil surveys and land evaluation studies have been carried out at a wide range of scales with many different objectives, and soil maps have been produced for land use planning at country, regional and district levels, for establishment of refugee settlements, for the planning of the country's new capital and for estate and irrigation management, just to mention a few.

The objective of this paper is to review the soil survey works already done in the country; to elucidate their evolution over time, their most salient characteristics, their adequacy and impact on development projects, and their future outlook.

Three appendices worth consulting are attached to this paper.

Appendix 1: an annotated bibliography of soil resource studies carried out by the National Soil Service of the Ministry of Agriculture from 1982 to 1993.

Appendix 2: a series of existing maps of soil and related resource inventories.

Appendix 3(a) & 3(b): two diskettes containing 2872 bibliographic entries of publications and studies done in different parts of the country including not only soil surveys but also related subjects like soil fertility and management, geology and forestry.

3 HISTORICAL EVOLUTION OF SOIL SURVEYS IN TANZANIA

Perhaps the earliest pedological study in Tanzania is that by Milne (1936) who made an exploratory soil survey through the part of the country north of the Dar es Salaam to Kigoma railway line. In his narrative of broad soil regions he describes topographic features, soils and vegetation. He notes a strong correlation between soils and vegetation in most of the soil regions. His report includes a narrative of agricultural significance of the soils, a kind of land capability classification. Milne is renowned for introducing the concept of "catena" (repetitive soil-landscape associations determined mostly by changing relief and drainage conditions) for mapping.

After Milne, other workers include Calton (1954), Scott (1963), D'Hoore (1964), Anderson (1967), Baker (1970), Hathout (1972a, b & c), Samki (1977 & 1982) and De Pauw (1983 & 1984). The approaches of these authors differed. Milne tended to take a soil morphological mixed with landscape approach, Scott produced a soil map on the basis of

topography; Anderson's approach was more genetic while Hathout produced a map basically of soil textures and drainage. Other land resource inventories were carried out by Duckworth and Sturtz (1969) in south west, Sheehy and Green (1969) in north east and Hathout (1973a) in south east Tanzania. These studies were not published but were later compiled into soil maps at scales between 1:2,000,000 and 1:2,250,000 (Hathout, 1972b; 1972c, 1973a). They also followed the same approach of using soil textures and drainage for mapping. Attempts were also made to map selected properties such as soil color (Scott, 1963), soil parent material (Baker, 1970), stoniness and drainage (Hathout, 1972a). The Soil Map of the World (FAO-Unesco, 1974) is another important inventory describing soils of Tanzania. Despite its limitations of very small scale (1:5,000,000) and high level of generalization, it is useful for international correlation as the soil taxonomy used for describing soils is one for the whole world.

Apart from land resources inventory studies, some land evaluation studies were also carried out in the early 1970's. Most of these studies were carried out by Hathout in 1972 who compiled, in map form, some land qualities including water availability, water holding capacity and natural soil fertility. In addition to these thematic maps, soil capability maps were compiled by Hathout in 1972 for the whole country as well as for south east, south west, north east and south west Tanzania. These studies were an updated version of the work by Anderson (1967) on potential land use of Tanzania in which the main limitations to cropping were mapped. Conyers (1973) produced a map of broad agro-economic zones of Tanzania in which the zones were characterized in terms of altitudes, main cash crop zones, old and recent settlement areas and livestock habitats. The results of all these studies are presented in the *Soil Atlas of Tanzania* (Hathout (1983).

Up to 1972 soil survey and land evaluation was done by individual scientists in national institutions or by foreign consultant firms. In 1972 soils research was formalized with the appointment of a Coordinator for a *Soils and Fertilizer Use Research Programme* within the Ministry of Agriculture. The programme comprises a soil survey section, a soil fertility and management section and a soil and plant laboratory. From that time the approach to soil survey and land evaluation took on an added dimension. Whereas prior to that time these studies concentrated on broad reconnaissance and exploratory resource inventory, now they include detailed mapping and land evaluation *for specific purposes*. It was also envisaged that under the supervision of the Ministry of Agriculture mapping and characterization of soil

and other land resources would be more systematic and there would be better chances for quality control.

4 OBJECTIVES AND GENERAL CHARACTERISTICS OF SOIL SURVEYS IN TANZANIA

Up to the time when the first land resources inventory map was produced, the distribution of the agricultural resources in Tanzania was largely unknown. Moreover, without such a data base, the agricultural potential of the country could not be estimated correctly. The earlier studies were therefore directed at making available information on the country's land resources and identifying broad economic zones for the production of (cash) crops for industries in Europe. The scales of these studies were mostly of a national magnitude.

By the time the Tanzania National Soils and Fertilizer Use Research Programme was established, such information was largely available and utilized. The major cash crop zones had been established (e.g. cotton in the Lake Victoria areas, coffee and tea in the high altitude areas around the Kilimanjaro and the southern highlands, sisal in the north east, etc). The need for soil surveys for project design and implementation was growing.

The present objectives of soil survey in Tanzania can broadly be summarized as follows:

- Identification, characterization and mapping of the country's land resources at a scale usable for land use planning at national level;
- Provision of soil survey and land evaluation services to farm, district and regional land use planning bodies;
- Development of methods and procedures for soil mapping and the assessment of the suitability of land for relevant production systems.

The general approach to soil survey in Tanzania approximates to the USDA Soil Survey Manual (Soil Survey Staff, 1951) and land evaluation is based on the methodologies developed by FAO (1976 & 1984). Soils are described according to the FAO (1977) guidelines for soil profile description. The official soil classification system adopted is the FAO-Unesco legend for the soil map of the world (FAO-Unesco, 1989) although it is common practice to correlate this to the USDA Soil Taxonomy (Soil Survey Staff, 1975 & 1990). Land evaluation follows the FAO (1976) framework and the detailed guidelines on land

evaluation for rainfed and irrigated agriculture (FAO, 1984 & 1985).

Table 1 summarizes the characteristics of the various soil surveys undertaken in Tanzania. The table shows the types of surveys, the purposes for which those surveys are carried out, the established mapping scales and the general methods.

Although one of the objectives of setting up the Soil Survey Section in the Soils and Fertilizer Research Programme was to carry out a systematic national inventory of land resources, budgetary and manpower limitations have to some degree frustrated this intention (Magoggo, 1992). Hence, the compilation of the national resources map is not progressing due to the said constraints. Moreover, it is apparent that even the more detailed soil survey works being carried out in the country are client-oriented and all costs of studies are met by the clients themselves. Consequently, the clientele is limited and commonly these are government agencies and parastatal organizations, donor-funded development projects and few private farmers.

It was also foreseen that experiences gained through the execution of soil surveys in the country would permit the formulation of guidelines and procedures for soil survey and land evaluation. The guidelines are essential not only as reference documents for the soil survey staff but also as standards for outside organizations which carry out soil surveys in the country. These guidelines are currently in preparation although with a slow progress owing partly to financial constraints.

5 STATUS OF SOIL SURVEYS AND RELATED STUDIES IN TANZANIA

Routine soil survey and land evaluation

Identification, characterization and mapping of the soils of Tanzania has been done at 1:2 million scale. The latest of these soil maps have been produced by Samki (1982) and De Pauw (1983). Concurrently with and deriving from these soil maps agroecological zones (AEZ) maps at 1:2 million have been published by the same authors. These documents are basically compilations of existing information at larger scale. Based on these documents fertilizer recommendations have been improved from the blanket type to broad AEZ-specific.

TABLE 1: Characteristics of soil surveys in Tanzania (from Magoggo, 1992)

TYPE OF SURVEY	PURPOSE	MAP SCALE	KINDS OF MAPPING UNITS	GENERAL METHODS
Exploratory (national soil resources inventory)	Establishing major soil regions for agricultural planning and research at national level, international soil correlation and data exchange	1:2,000,000 1:1,000,000	(Physiographic units enclosing) associations	Deductions from natural resources maps, specifically geologic maps; (re-)interpretation of existing soil maps and field data; study of satellite imagery using small-scale topographic maps as auxiliary information (1:2,000,000): Study of satellite imagery, aerial photo interpretation, soil observations at selected sites throughout the country and laboratory analysis of soil profiles (1:1,000,000)
Reconnaissance (land resources inventory of regions and 2districts)	Systematic inventory of land resources with multi-purpose land evaluation for regional planning and project location (pre-feasibility)	1:250,000 1:100,000 (Some surveys have been done at 1:500,000 scale)	Associations and complexes, consociations	Aerial photo interpretation and study of satellite imagery; extensive field observations; laboratory analysis of selected profiles; development of land evaluation keys for land suitability assessment
Semi-detailed	General purpose (e.g. high potential areas) and special purpose (e.g. project feasibility studies, development of a particular land use)	1:50,000 1:20,000	Consociations and associations, some complexes	Aerial photo interpretation; intensive field observations; limited field testing (irrigation surveys); laboratory analysis of selected profiles and composite samples; development of land evaluation keys for land suitability assessment

Detailed	Special purpose (e.g. farm, estate and project development and planning, characterization of trial sites, irrigation lay-out and planning)	1:10,000 1:5,000	Consociations and some complexes	Very intensive field observations; relatively little emphasis on aerial photo interpretation; field testing (irrigation surveys); laboratory analysis of soil profiles and composite samples; development of land evaluation keys for land suitability assessment
Site evaluation	Special purpose (e.g. soil fertility appraisal, salinity assessment, project identification)	Variable	Physiographic units enclosing major soils or soil associations	Aerial photo interpretation; extensive field observations (rapid soil inventory); rapid laboratory testing; rapid reporting

Larger scale mapping of a number of regions and districts has been done at scales between 1:100,000 to 1:500,000. About half the country has been covered in this way (see figure 1). Examples of this type of resource inventories include the regional surveys of Kilimanjaro (Iseki, 1977), Mbeya (King, 1982), Tabora (Acres, 1983; Corker, 1982 & 1983; Mitchell, 1982 & 1984), Tanga (Agrar und Hydrotechnik, 1976 a & b) and Rukwa (King et al., 1979; Rombulow-Pearce, 1980). In most of these studies suitability of land for relevant land use systems and recommendations for sustained use of the land have been made. Currently three district soil surveys are on-going in Morogoro, Mbulu and Maswa Districts.

A wide range of areas has been covered in terms of detailed soil survey and land evaluation studies of farms, estates, irrigation schemes and village areas. These project areas are scattered throughout the country and their total areal extent is about 10,000 sq. km. (Magoggo, 1992; Kilasara et al., 1993) which is negligible taking into consideration the size of the country. These studies, however, may have the biggest impact since they are used directly to solve production constraints or for project design and development.

Areal distribution of soil types in Tanzania

Currently it is not possible to give accurate figures on the areal distribution of the various soil types in Tanzania because of the existing rather meagre soil information at national level and the small scale nature of the existing national soil resource inventories.

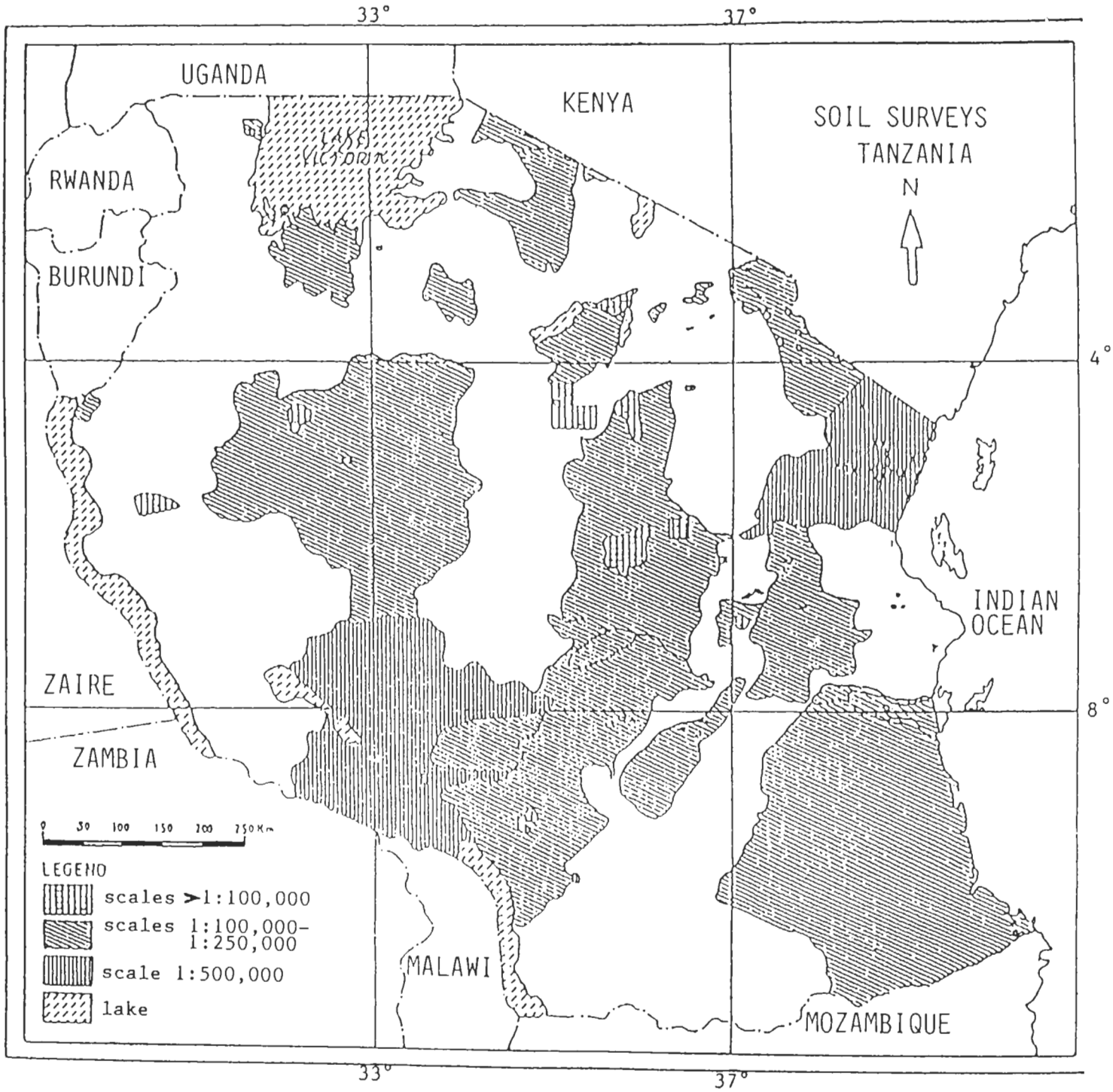

Figure 1. Areas covered by soil surveys in Tanzania (from Magoggo, 1992)

However, just for the sake of appreciation, an attempt has been made here to give rough estimation of the areal distribution of the soil types (according to the FAO-Unesco, 1974 classification) using the "Soils, Physiography and Agroecological Zones Maps" of De Pauw (1984) as the most recent and comprehensive national soil resource inventory. The area data given for the mapping units is used together with the information on the proportions of the different dominant soil units to estimate the total area of the soil types. Table 2 presents the estimated areas and corresponding % proportions of the soil types in order of decreasing magnitude. From this table it can be seen that the most important soil types in terms of areal extent include Cambisols, Ferralsols, Vertisols, Xerosols, Lithosols, Nitosols, Gleysols, Arenosols, Luvisols, Fluvisols, Planosols, Phaeozems, Solonchaks and Andosols. Other soil types which also exist in the country but in smaller extents are Chernozems, Histosols, Solonetz and Regosols.

Developments in basic research

Moisture availability and the management of soil water is considered one of the biggest constraints to crop production in Tanzania. A great deal of effort has been put into modelling this land quality. A method of growing season analysis based on the FAO (1983) methodology for agro-ecological zones has been developed and tried in reconnaissance surveys in Geita and Sengerema Districts (De Pauw, 1982) and Dodoma Capital City District (De Pauw, Magoggo and Niemeyer, 1983).

A soil information system (*SISTAN*) has been set up with facilities for rapid data base query and information output (Magoggo, 1992). The system is also used to generate parts of soil survey reports (profile descriptions and analytical data).

A modest start has been made in computerization and automation of land evaluation. The Automated Land Evaluation System - *ALES* (Rossiter and Van Wambeke, 1989) and the Land Evaluation Computer System - *LECS* (Wood and Dent, 1983 a & b) have been used in the land evaluation of a sample area in Kilosa District (Kimaro, 1989; Kimaro and Kips, 1991; Kimaro and Msanya, 1993). Recently Sokoine University of Agriculture in collaboration with the National Soil Service of the Ministry of Agriculture started studies geared towards developing a computerized land evaluation system for Tanzania (Land Use

and Land Evaluation Systems Research Project, 1993). In the field of cartography a modest start is being made with using scribing techniques and map contact-screening using a vacuum frame (Magoggo, 1992).

Table 2. Areal extent of different soil types in Tanzania (derived from De Pauw, 1984)

Soil type	Area mill. ha	% propo-rtion	Soil type	Area mill. ha	% propo-rtion
Cambisols	23.3	28.2	Fluvisols	2.9	3.5
Ferralsols	12.5	15.1	Planosols	2.4	2.9
Vertisols	7.2	8.7	Phaeozems	1.7	2.1
Xerosols	5.9	7.1	Solonchaks	1.3	1.6
Lithosols	5.6	6.8	Andosols	1.3	1.6
Nitosols	4.8	5.8	Chernozems	0.9	1.1
Gleysols	4.7	5.7	Histosols	0.5	0.6
Arenosols	4.0	4.8	Solonetz	0.4	0.5
Luvisols	3.2	3.9	Regosols	0.06	0.07

6 ADEQUACY AND IMPACT OF SOIL SURVEYS IN TANZANIA

As pointed out earlier, the selection of areas for the major cash crops (agro-economic zones) at country level was done on the basis of the earlier soil surveys. Due to the interests of the government in those days, very little work was done in identifying land potential for indigenous land use types. Efforts in this direction are very recent, having been started in the late 1970s.

There is still no adequate information on land resources at the farm or project level for most of the country.

As far as adequacy of soil resource inventories is concerned, it has been noted from world-wide studies that many soil surveyors do not monitor the utility and adequacy of the

documents they produce (Msanya, 1987; Msanya et al., 1987 & 1993) to see if they are useful to the users. In Tanzania the trend is almost the same. There is still to be established a routine of follow-up activities to determine how effective the results of soil surveys (particularly those aimed at solving problems at farm or project level) and to use this feed-back in the design of future soil surveys. For some surveys effective contacts exist between the surveyors and the client of the study from the initial planning to and after the delivery of the results. In other cases, however, such contacts are very minimal, either due to distance or other reasons. The formulation of a formal system of follow-ups and after-care activities should be given priority.

The above notwithstanding, there are documented examples of successful implement-ation of land use plans based on soil surveys such as the one for refugee settlement in Mishamo, Mpanda District (Bomans, De Pauw and Espinosa, 1981), which at the time of the soil survey in 1979 was a jungle full of wildlife, but is currently an exemplary village settlement featuring high on the national scale in terms of production of crops such as groundnuts.

In the area of irrigation soil surveys, follow-up and feed-back during the project implementation stage (after delivery of the results of the surveys) has generally been poor, with the exception of recent surveys for irrigation rehabilitation in the Kilimanjaro area (Kips and Ndondi, 1990; Kips and Ngailo, 1990). Experience in Tanzania is that irrigation projects frequently are faced with increasing soil-related difficulties after some years of operation. This is therefore an area where follow-ups would be most appropriate.

7 THE FUTURE OF SOIL SURVEYS IN TANZANIA

Due to the increased pressure on land and the consequent land degradation hazards, the need for appropriate land management packages is increasing. It is likely that the land users will become more and more the *direct* recipients of the results of soil survey. For this reason the pressure on development of land evaluation is going to be on development of quantitative models for estimating crop performance, optimal planting dates, etc. Side by side with this there will be a growing need for integration of soil management studies in order to jointly develop land management packages aimed at improving the sustainability of land utilization types.

Although the country is only covered at 1:2 million scale and there are efforts to

produce a national map at 1:1 million scale, the costs of soil surveys are such that studies that are not aimed at specific agricultural or development projects will receive less and less attention. Besides, developments in technologies such as remote sensing and geographic information systems allow for generation of such information from existing data bases. The one problem is that a lot of work still has to be done on centralizing and correlating the available data and then developing appropriate software for generating the information.

There is a lot of scope, however, for semi-detailed and detailed reconnaissance soil surveys. These studies will provide land resources information at sufficient detail to be used at project level. So far, only a small part of the country is covered by soil surveys of good quality at these scales.

For the rational and effective utilization of the country's soil and land resources, the government will have to commit itself to support systematic characterization and mapping of these resources by providing the needed funds.

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APPENDIX 1. ANNOTATED BIBLIOGRAPHY OF NSS PUBLICATIONS FROM 1992-1993.

The bibliography gives titles, authors and abstracts of the technical reports produced by the National Soil Service of the Ministry of Agriculture.

The reports are categorized as follows:

I Soil and Land Resources Inventories of Regions and Districts

R Reconnaissance Soil Surveys

D Detailed and Semi-detailed Soil Surveys

S Site Evaluations and Soil Appraisal Studies

F Soil Fertility Studies

M Miscellaneous Publications

These documents can be obtained from the office of the NSS at Mlingano, Tanga. The postal address is:

The National Soil Service, Agricultural Research Institute, Mlingano, P.O. Box 5088, Tanga, TANZANIA.

They can also be consulted at the libraries of the Ministry of Agriculture (Headquarters) in Dar es Salaam and the Sokoine University of Agriculture in Morogoro.

I SOIL AND LAND RESOURCES INVENTORIES OF REGIONS AND DISTRICTS

I 1
1982
Soil Survey Report of Geita and Sengerema Districts.
De Pauw, E.F. and E.J. Espinosa.
197 pp. with maps in separate volume.

The study concerns a reconnaissance soil survey of the Geita and Sengerema Districts, Mwanza Region, at a scale of 1:250,000. The survey area covers 9,800 square km and consists of hills, upland plains and lowland plains. Soils very widely. Drought stress, low inherent fertility and erosion hazard are the major limitations for agricultural development. The suitability of the lands is assessed for cotton, maize, millet and sorghum. About 20% of the area is covered by lowland plains with poor drainage. Part of these lands are suitable for wetland rice cultivation.

I 2
1983
Soil Survey Report of Dodoma Capital City.
De Pauw, E.F.
127 pp. with maps in a separate volume.

A semi-detailed soil survey of Dodoma Capital City District, at a scale of 1:50,000. The area covers approx 2,500 square km. The report includes a soil, land use and soil erosion map. The greater part of the area is an upland plain of low relief. Soils vary widely but generally are of low to very low nutrient status due to poor inherent fertility and widespread erosion. Lack of soil moisture is the major constraint and the area is considered marginal for rainfed agriculture. Lands with prospects for improvement are confined to small valleys and footslopes.

R RECONNAISSANCE SOIL SURVEYS

R 1
1986 Reconnaissance Land and Soil Resources Survey for the Selection of Suitable Land for Tea in the Southern Highlands.
Van Kekem, A.J. and J.K.W. Niemeyer.
55 pp.; separate folder with maps.

The study concerns a reconnaissance soil and land resources survey at 1:50,000 scale of the Kidabaga (14,500 ha) and Usokami (16,400 ha) areas in Iringa District, and of the Ihanu area (3,400 ha) in Mufindi District. The suitability of the land units is assessed for estate and small-holder types of tea cultivation. The best suitable areas for the development of a nucleus tea estate are indicated.

R 2
1987 Soils of the Wattle Areas in Njombe District and Their Potential for Alternative Crops.
Van Kekem, A.J. and G.W. van Barneveld.
46 pp. with map.

A reconnaissance soil survey at 1:40,000 scale of TANWAT plantations, covering 17,000 ha in the Njombe District (Iringa Region). The study includes a soil fertility evaluation and an assessment of the effects of many years of continuous cropping (wattle, maize, wheat and triticale) on the chemical and physical soil conditions. For diversification purposes, the suitability is assessed for tea, coffee, sweet potatoes and eucalyptus trees as alternative crops.

R 3
1987 Soils and Their Potential for Agricultural Development at Ndolela, Songea District.
Kimaro, D.N. and A.J. van Kekem.
32 pp. with map.

The study concerns a reconnaissance soil survey at 1:25,000 scale of 2,000 ha near Mahanje, Songea District (Ruvuma). Particular attention is paid to the suitability of the lands for mechanized maize cultivation but as the possibilities for this type of cultivation are limited, the lands are also assessed for coffee, tea, tobacco and small-scale farming systems.

R 4
1987 Soils of Kikwetu Estate and their Potential for Sisal and Alternative crops.
Kimaro, D.N. and A.J. van Kekem.
36 pp. with map.

This reconnaissance soil survey at 1:40,000 scale covers 5,500 ha of Kikwetu Estate, Lindi District (Lindi Region). The study was carried out for the rehabilitation of the estate. The suitability of the lands is assessed for sisal, citrus, pineapple and cashew. The study also includes an inventory of the infestation with 'Kaptura' sisal.

D DETAILED AND SEMI-DETAILED SOIL SURVEYS

D 1
1980
Soil Survey Report of Ulyankulu Refugee Settlement.
Hof, J., E.J. Espinosa and J.P. Magoggo.
75 pp. with maps.

A 1:50,000 scale soil survey of 54,200 ha, Urambo District, Tabora Region. The suitability of the area is assessed for the cultivation of upland crops (maize, millet, sorghum, groundnuts and cassava) and for the production of firewood and charcoal.

D 2
1981
Soil survey Report of Mishamo Refugee Settlement
Bomans, E., J.P. Magoggo and E. de Pauw.
79 pp. with maps.

A 1:50,000 scale soil survey covering 112,800 ha in Mpanda District, Rukwa Region. The suitability of the area is assessed for crop production and settlement of refugees. Approx 54% of the surveyed area is suitable for sustained cultivation of a wide range of upland crops.

D 3
1983
Soil Survey Report of Selected Areas in the Mkata Plain; Kilangali, Mvumi and Mgongola Proposed Village Irrigation Schemes.
Magoggo, J.P.
101 pp. with maps.

A 1:10,000 scale soil survey of 3 farms in Morogoro Region, in total covering approx. 1640 ha. The soils of the farms are mainly cracking clays. The suitability of the lands for irrigated rice cultivation is assessed and the major part is found suitable.

D 4
1983
Soil Survey Report of Matipwili village irrigation scheme.
Magoggo, J.P.
38 pp. with map.

A 1:10,000 scale soil survey of the Matipwili village irrigation scheme in Bagamoyo District, Coast Region. The scheme covers 500 ha. In spite of a moderate degree of soil salinity and sodicity most of the area is found suitable forirrigated wetland rice cultivation.

D 5
1986
Soils and Land Suitability for Irrigated Rice Cultivation of the Mkindo Village Irrigation Scheme.
Mugogo, S.E. and G.W. van Barneveld.
51 pp. with map.

A 1:5,000 scale soil survey of the Mkindo irrigation scheme in Morogoro Rural District. The scheme covers 115 ha. The suitability of the lands is evaluated for semi-mechanised and non-mechanised forms of irrigated rice-based cropping systems.

D 6
1986
Soils of Kwamtili Estate and their Suitability for Cultivation of Cocoa and Coconut.
Niemeyer, J.K.W. and G.W. van Barneveld.
72 pp. with map.

A 1:5,000 scale soil survey of the Kwamtili Cocoa Estate, Korogwe District, Tanga Region. The area covers 4,600 ha. Based on detailed water-balance studies for each soil unit, the suitability for cocoa and coconut was evaluated.

D 7 Soils and Land Suitability for Irrigated Agriculture of the
1987 Kitivo Village Irrigation Scheme.
Mugogo, S.E., J.K.W. Niemeyer and G.W. van Barneveld.
52 pp. with maps.

A 1:10,000 scale soil survey of the Kitivo Irrigation Scheme, Lushoto District, Tanga Region. The area covers 1,521 ha. A survey based on the interpretation of aerial photographs (taken in 1978) and field work carried out in 1981/82 and in 1986/87. The study indicates the fitness of the lands for irrigated rice and maize/beans cropping systems.

D 8 Soils of Kigombe Estate and their Suitability for Sisal.
1987 Brom, A.J.M.
47 pp. with map.

A 1:30,000 scale semi-detailed soil survey of Kigombe Sisal Estate, Pangani District, Tanga Region. The area covers 3,918 ha. The study includes a suitability evaluation for hybrid sisal cultivation.

D 9 Soils of the Naberera Farms; Their Suitability and Management
1987 Requirements for the Cultivation of Seedbeans, Wheat and Barley.
Brom, A.J.M., F. van der Wal, J.D.J. Mbogoni and P.H. Silayo. 41 pp. with map.

A 1:25,000 scale semi-detailed soil survey of the Naberera farms, Kiteto District, Arusha Region. The area covers 4,815 ha. The suitability of the lands is indicated for the cultivation of seedbeans, wheat and barley. Recommendations are given for proper soil and water management, including practices to control erosion and conserve water.

D 10 Soils of the Simba Farms; Their Suitability and Management
1987 Requirements for the Cultivation of Seedbeans, Wheat and Barley.
Brom, A.J.M., F. van der Wal, J.D.J. Mbogoni, and P.H. Silayo.
49 pp. with map.

A 1:25,000 scale semi-detailed soil survey of the Simba farms, Hai District, Kilimanjaro Region. The area covers 2,430 ha. The suitability of the lands is indicated for the cultivation of seedbeans, wheat and barley. The soil, water and crop management requirements are discussed.

D 11 Soils of the Lolkisale Farms; Their Suitability and
1987 Management Requirements for the Cultivation of Seedbeans, Wheat and Barley.
Brom, A.J.M., F. van der Wal, J.D.J. Mbogoni and P.H. Silayo. 48 pp. with map.

A 1:25,000 scale semi-detailed soil survey of the Lolkisale Farms, Masai District, Arusha Region. The area covers 2,500 ha. approx. The suitability of the lands is indicated for the cultivation of seedbeans, wheat and barley. Proper soil and water conservation, tillage and crop management practices are proposed, aimed at maintaining favourable soil conditions.

D 12 Soils of the Umoja Farms and Fil Estates (Arumeru District,
1988 Arusha Region) and Their Suitability for Seedbeans.
Brom, A.J.M., F. van der Wal, J.D.J. Mbogoni and P.H. Silayo. 34 pp. with map.

A 1:25,000 scale semi-detailed soil survey of Umoja and part of Fil Estates, covering 1,500 ha. The Estates are located on a flat sedimentary plain built up of volcanic sediments. The suitability of the lands for irrigated beans is discussed and management recommendations are given. Soil salinity and sodicity

are the main constraints to crop cultivation.

D 13 Soils of Mwera Estate and Their Potential for Hybrid Sisal
1988 Cultivation.
Cleveringa, S.M. and A.E. Hartemink.
60 pp. with map.

A 1:20,000 scale semi-detailed soil survey/of Mwera Sisal Estate, Pangani District, Tanga Region. The Estate covers 8,200 ha gross and is situated on the coastal plain with the majority of the soils developed on coral limestone. The soils are classified for replanting with hybrid sisal. Proper soil and crop management practices are discussed.

D 14 Soils of Kwamdulu Estate and Their Potential for Hybrid Sisal
1988 Cultivation.
Cleveringa, S.M. and A.E. Hartemink.
54 pp. with map.

The report presents the results of a 1:20,000 scale soil survey of Kwamdulu Estate, Korogwe District, Tanga Region. The Estate covers 4,460 ha gross and is situated on an undulating peneplain. Soils are mainly red-ferrallitic with low inherent fertility. Several cycles of sisal cultivation have lead to depletion and exhaustion. Particular attention is paid to the use and management of soils with high (toxic) levels of exchangeable aluminium.

D 15 Soils of Pongwe Estate and Their Potential for Hybrid Sisal
1988 Cultivation.
Cleveringa, S.M. and A.E. Hartemink.
55 pp. with map.

A 1:20,000 scale soil survey of Pongwe Sisal Estate, Tanga District. The Estate covers 3,685 ha and is situated on the coastal plain. The soils are developed in sediments covering Jurassic limestone. The depth to limestone and the type of sediment are important aspects determining the suitability of the soils for sisal cultivation.

D 16 Soils of Tungi Estate and Their Potential for Hybrid Sisal
1988 Cultivation.
Mbogoni, J.D.J. and P.H. Silayo.
38 pp. with map.

A 1:25,000 scale soil survey of Tungi sisal estate in Morogoro District covering approximately 2,180 ha. Soils in the southern part of the estate are deep and ferrallitic-clayey, in the northern part they are less deep and more sandy. A suitability assessment for hybrid sisal cultivation is given as well as soil management recommendations for sisal cultivation.

D 17 Soils of Kwafungo Estate and Their Suitability for Selected
1989 Fruit Crops and Hybrid Sisal Cultivation.
Kips, Ph.A., J.D.J. Mbogoni and P.M. Ndondi.
87 pp. with map.

A 1:20,000 scale soil survey of Kwafungo Estate, 2,330 ha, in Muheza District, Tanga Region. The estate is situated on a dissected peneplain. Soils are mainly red ferrallitic clays with low fertility status and low water holding capacities. The suitability of the lands is assessed for the cultivation of pineapple, citrus, mango, passion fruit and hybrid sisal. Special attention is given to soil water balance calculations. Recommendations are given on the proper use and management of the soils.

D 18 Soils of Gunyoda Village and Their Agricultural Potential.
1989 Brom, A.J.M.
23 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Gunyoda village, Mbulu District, Arusha Region. The area covers about 5,500 ha. The suitability of the area is assessed for cropland and for extensive grazing. 37% of the area is suitable for mechanized cultivation. For extensive grazing 40% of the area is suitable. 20% of the area is not suitable for either purpose. A set of recommendations is given for sustainable land use.

D 19 Soils of Kansay Village and Their Agricultural Potential.
1989 Magoggo, J.P.
26 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Kansay village, Mbulu District, Arusha Region. The area covers about 4,800 ha. The suitability of the area is assessed for cropland and for extensive grazing. 29% of the village area is suitable for cropland and 43% is rated as suitable for extensive grazing. 54% of the area is not suitable for either purpose. A set of recommendations is given for sustainable land use.

D 20 Soils of Kilima Tembo Village and Their Agricultural
1989 Potential.
Van der Wal, F.
30 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Kilima Tembo village, Mbulu District, Arusha Region. The area covers about 2,400 ha. The suitability of the area is assessed for cropland, extensive grazing and afforestation. Of the total village area 46% is considered to be suitable for mechanized cultivation. For extensive grazing 73% of the total area is suitable. For afforestation 61% is suitable. 20% of the area is not suitable for any of the three land utilization types. A set of recommendations is given for sustainable land use.

D 21 Soils of Kambi ya Simba Village and Their Agricultural
1989 Potential.
Shaka, J.M.
31 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Kambi ya Simba village, Mbulu District, Arusha Region. The area covers about 4,000 ha. The suitability of the area is assessed for mechanized cultivation, extensive grazing and afforestation. 56% of the total village area is suitable for mechanized cultivation. For extensive grazing 69% of the area is suitable. For afforestation 81% of the area is suitable. 18% of the total village area is not suitable for any one of these three land uses. A set of recommendations is given for sustainable land use.

D 22 Soils of Chemchem Village and Their Agricultural Potential
1990 Magoggo, J.P.
30 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Chemchem village, Mbulu District, Arusha Region. The area covers about 4,035 ha. The suitability of the area is assessed for mechanized cultivation and extensive grazing. 25% of the total village area is suitable for cultivation. For extensive grazing 65% of the total area is suitable. Approximately 35% of the total village area is not suitable or only marginally suitable for any of these two land uses. A set of recommendations is given for sustainable land use.

D 23 Soils of Giekurum/Arusha Village and Their Agricultural
1990 Potential.
Brom, A.J.M.
27 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Giekurum/Arusha village, Mbulu District, Arusha Region. The area covers about 2,020 ha. The suitability of the lands is assessed for mechanized cultivation and extensive grazing. 56% of the area is suitable for mechanized cultivation. For extensive grazing 59% is assessed as suitable. 22% of the area is not suitable for cultivation nor extensive grazing. A set of recommendations is given for sustainable land use.

D 24 Soils of Bashay Village and Their Agricultural Potential.
1990 Brom, A.J.M.
26 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Bashay village, Mbulu District, Arusha Region. The area covers about 3,470 ha. The suitability of the area is assessed for mechanized cultivation and extensive grazing. 46% of the area is suitable for both mechanized cultivation and for extensive grazing. The remaining part of the area (54%) is not suitable for either land use. A set of recommendations is given for sustainable land use.

D 25 Soils of Endalah Village and Their Agricultural Potential
1990 Van der Wal, F.
31 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Endalah village, Mbulu District, Arusha Region. The area covers about 6,620 ha. The suitability of the area is assessed for mechanized cultivation and extensive grazing. 23% of the area is suitable for cultivation or for extensive grazing. 51% of the area is not suitable for either purpose. A set of recommendations is given for sustainable land use.

D 26 Soils of Endamarariek Village and Their Agricultural
1990 Potential.
Van der Wal, F.
32 pp. with map.

A 1:20,000 scale semi-detailed soil survey of Endamarariek village, Mbulu District, Arusha Region. The area covers about 5,620 ha. The suitability of the area is assessed for mechanized cultivation and for extensive grazing. 42% of the area is suitable for mechanized cultivation. For extensive grazing 48% is suitable. 12% of the area is not suitable for either purpose. A set of recommendations is given for sustainable land use.

D 27 Soils of Mang'ola Village and Their Agricultural
1992 Potential.
in press Kaitaba, E.G.
32 pp. with map

A 1:20,000 scale semi-detailed soil survey of Mang'ola Village, Mbulu District, Arusha Region. This arid, depositional area along Lake Eyasi covers about 9,475 ha. The suitability of the area is assessed for irrigated cultivation of onions and maize, and for extensive grazing. 67% of the village area is irrigable with gravity irrigation methods. Of this 30% is suitable for irrigated onions and 4% is suitable for irrigated maize. Major limiting factors are soil sodicity and drainage conditions. 53% of the irrigable soils is suitable for extensive grazing. 29% of the total village area is not suitable for any of the three land uses. A set of recommendations is given for sustainable land use.

D 28 Soils and Land Suitability for Irrigated Agriculture of Musa
1990 Mijanga and Kikafu Chini Irrigation Schemes (Hai District, Kilimanjaro Region).
Kips, Ph.A. and P.M. Ndondi.
99 pp. with 2 maps.

A 1:5,000 scale detailed soil survey of two village irrigation schemes covering about 1,315 ha in Hai District, Kilimanjaro Region. The schemes are situated on the volcanic plain of Mount Kilimanjaro. Soils are mainly well drained, dark brown Cambisols with a wide range in texture and with varying depth to brittle tuff and gravel layers. The soils have moderate fertility levels, the extent of sodic soils being limited (about 275 ha). Most soils have relatively rapid infiltration rates, posing a constraint to water distribution at field level. About 95% of the lands are rated as suitable for irrigated rice, whereas 85% are rated suitable for irrigated maize and beans. Ample recommendations are given on proper soil and water management.

D 29 Soils and Land Suitability for Irrigated Agriculture of Musa
1990 Rundugai Irrigation Scheme (Hai District, Kilimanjaro Region).
Kips, Ph.A. and J.A. Ngailo.
85 pp. with map.

A 1:5,000 scale detailed soil survey of a village irrigation scheme covering 2,570 ha in Hai District, Kilimanjaro Region. The scheme is situated partly on a fluvio-volcanic plain and partly on an adjacent lahar plain. Soils on the fluvio-volcanic plain have impeded drainage and are shallow over brittle tuff and gravel layers. Most of these soils are sodic. Soils of the lahar plain are well drained and mostly non-sodic, but stony and gravelly. 56% of the lands are rated as suitable for irrigated rice. 47% of the lands are rated as suitable for maize and beans. Ample recommendations are given on proper soil and water management.

D 30 Soils of Ukiriguru Agricultural Research Institute.
1990 Magoggo, J.P. and J.D.J. Mbogoni
24 pp. with map.

A 1:5,000 scale semi-detailed soil survey of Ukiriguru Agricultural Research Institute, Kwimba District, Mwanza Region. The area covers some 500 ha. It is within the steppe landscape of Sukumaland characterised by rocky hills and inselbergs with long footslopes to mbuga. The major soils of the institute are very deep, well drained, dark brown sands and loamy sands on the middle footslope. Soil depth becomes shallower upslope to Ukiriguru hill. Drainage becomes increasingly impeded downslope. In the mbuga the soils are poorly drained, cracking, black calcareous clays.

D 31 Soils and Land Use Potential of Kabirizi Village (Bukoba
1991 District, Tanzania).
Vlot, J.E. and D.N. Kimaro.
70 pp. with map.

A 1:25,000 scale semi-detailed soil survey of Kabirizi Village in Bukoba District, Kagera Region. The area covers 1,380 ha. The village is situated on an elongated hill standing out above the surrounding plain. Soils are shallow on the steep upper slopes and increase in depth downslope. Soil properties are further related to the use of the land as so-called 'kibanja' or 'rweya'. The land suitability evaluation indicates that about 30% of the lands are suitable for the 'kibanja' type of land use. The rest of the area is unsuitable for crop cultivation but has a potential for extensive grazing. An analysis of the nutrient cycling in the kibanja shows that this traditional system is environmentally sound (sustainable) and should be adhered to.

D 32 Soils of Mikindani Estate (Mtwara Region) and Their
1991 Suitability for Cashew, Mango, Lime, Hybrid Sisal and Teak Cultivation.
Ngailo, J.A. and Ph.A. Kips.
65 pp. with map.

A 1:25,000 scale semi-detailed soil survey of Mikindani Estate, 4,285 ha, in Mtwara District, Mtwara Region. The estate is situated on an uplifted coastal plain of low relief. Soils are generally deep and red in colour. Based on texture (clayey or loamy) and pH (acidic or non-acidic) four soil groups are identified. Soil fertility is overall poor. The available water capacity of the soils is relatively low. With the long dry season at the locality, moisture stress is the most important constraint to crop production. About 95% of the lands are suitable for cashew, mango and lime. About 60% of the lands are rated as suitable for hybrid sisal. The estate lands are not suitable for teak. Recommendations are given on the proper management of the soils.

D 33 Soils and Land Use Potential of Ruhunga Village (Bukoba
1992 District, Tanzania).
in press Vlot, J.E.
62 pp. with map.

A 1:25,000 scale semi-detailed soil survey of Ruhunga Village in Bukoba District, Kagera Region. The area covers 2,080 ha. The village is situated on series of elongated hills standing out above the surrounding plain. Soils are shallow on the steep upper slopes and increase in depth downslope. Soil properties are further related to the use of the land as so-called 'kibanja' or 'rweya'. The land suitability evaluation indicates that only 9% of the lands are suitable for the 'kibanja' type of land use. Limited available water capacity, low fertility and the erosion hazard of the soils are the main constraints. The rest of the area is unsuitable for crop cultivation but has a potential for extensive grazing.

D 34 Soils and Land Use Potential of Buturage Village (Bukoba
1991 District, Tanzania).
Kimaro, D.N. and J.W. Kabushemera.
77 pp. with map.

A 1:25,000 scale semi-detailed soil survey of Buturage Village in Bukoba District, Kagera Region. The area covers 1,675 ha. The village is situated on an elongated hill standing out above the surrounding swampy plain. Soils are shallow on the steep upper slopes and increase in depth downslope. Soil properties are further related to the use of the land as so-called 'kibanja' or 'rweya'. The land suitability evaluation indicates that about 35% of the lands are suitable for the 'kibanja' type of land use. Limited available water capacity and the low fertility of the soils are the main constraints. The rest of the area is unsuitable for crop cultivation but has a potential for extensive grazing.

S SITE EVALUATIONS AND SOIL APPRAISAL STUDIES

S 1
1986
Soils of Kwamkoro and Bulwa Tea Estate.
Nzabayanga, S., D.N. Kimaro and A.J. van Kekem.
20 pp. with map.

Report of a site evaluation of Kwamkoro and Bulwa Tea Estates (approx. 1,000 ha) in the East Usambara Mountains, Tanga Region. The environmental and soil conditions are described and discussed. Particular attention is paid to the soil fertility status in relation to the cultivation of tea.

S 2
1986
Soils and Their Productivity and Management at Namuai Estate, West Kilimanjaro.
Kimaro, D.N. and A.J. van Kekem.
25 pp. with map.

Report of a study into the factors responsible for the observed decline in soil productivity at Namuai Estate (810 ha). The findings are that continuous monocropping has lead to a decrease in organic matter levels, limited biological activity and deterioration of the soil structure. Appropriate management practices are discussed to restore the production capacity.

S 3
1986
Soil Fertility Status Ngombezi Sisal Estates, Korogwe.
Kiwambo, B.J. and Z.A. Mmari.
12 pp.

Report on the fertility status of soils in selected blocks in Ngombezi Sisal Estates, Korogwe (Tanga Region). The blocks were being considered for replanting with sisal.

S 4
1986
Soils of Amboni Estate and Their Potential for Sisal Growing.
Van Kekem, A.J. and D.N. Kimaro.
23 pp.

Report of a study of the soil conditions of selected areas at Amboni estate, Tanga Region (1,100 ha) to assess the factors which contribute to the observed decline in yield levels. Continuous cultivation of sisal resulted in considerable degradation of the soil fertility status.

S 5
1987
Soil Conditions and Agricultural Development Potential of Mikere Farms.
Niemeyer, J.K.W. and G.W. van Barneveld.
26 pp. with map.

Report of a site evaluation of Mikere Farms (2,000 ha), Kisarawe District, Coast Region. The environmental and soil conditions are described and interpreted in terms of suitability for coconut, citrus, cashew and pineapple.

S 6
1987
Soil Conditions and Agricultural Development Potential of Visiga Farm.
Niemeyer, J.K.W., Z.A. Mmari and G.W. van Barneveld.
12 pp.

Report of a site evaluation of Visiga Farm (20 ha), Bagamoyo District, Coast Region. The soil conditions are described and the soil fertility status is assessed in view of developing the farm for coconut, citrus, mango and banana cultivation.

S 7 Soil Conditions and Agricultural Production Potential for
1988 Selected Rainfed Crops of UFC Kikongo Farm.
Kips, Ph.A., J.D.J. Mbogoni and J.A. Ngailo.
66 pp. with map.

Report of a study of the soil conditions at Kikongo Farm (550 ha), near Mlandizi, Kibaha District, Coast Region, and appraisal of the agricultural potential. The soils are evaluated for the rainfed cultivation of maize, sorghum, rice, green gram, pigeon pea, cowpea, cassava, sunflower, coconut, citrus and pineapple.

S 8 Soils of the Agricultural Research Institute TARO
1988 Naliendele.
Ngatunga, E.L.N.
15 pp. with map.

Report of a characterization of the soils at ARI TARO-Naliendele (850 ha), near Mtwara town, Mtwara Region. The soils are derived from sandstone; they are deep sandy loams with loamy sand topsoils. The fertility of the soils is low, decreasing considerably under continuous cropping. Suitable management practices are discussed.

S 9 Soil Conditions and Agricultural Production Potential for
1988 Selected Fruit Crops of Chrismill Farm.
Kips, Ph.A., J.D.J. Mbogoni and J.A. Ngailo.
33 pp. with map.

Report of a site evaluation of Chrismill farm (625 ha), near Mlandizi, Kibaha District, Coast Region. The suitability of the farm lands is assessed for the rainfed cultivation of pineapple, citrus (especially grapefruit) and passion fruit. The lands are moderately suitable for passion fruit and pineapple and marginally suitable for grapefruit.

S 10 Soils of Laki Laki Estate and Their Suitability for
1988 Seedbeans.
Brom A.J.M., J.M. Shaka and F. van der Wal.
21 pp.

Report of a site evaluation of Laki Laki Estate (400 ha), Arusha District, Arusha Region. The soils are assessed for the cultivation of seedbeans. Recommendations are given on appropriate soil, crop and water management practices.

S 11 Soil Conditions and Agricultural Production Potential for
1988 Selected Annual Crops of the proposed Mkongo-Rusende Farm.
Kips, Ph.A., J.D.J. Mbogoni and J.A. Ngailo.
26 pp. with map.

Report of a study of the soil conditions at the proposed Mkongo-Rusende Farm (2,000 ha), near Utete, Rufiji District, Coast Region, and appraisal of the lands for wetland rice cultivation, sorghum and cotton. The area is located on the floodplain of the lower Rufiji river. The main constraint to economic agricultural production is the serious flood hazard. Flood protection works are proposed, but should be part of an overall masterplan for the lower Rufiji valley. The soils are fertile and the area as such offers good possibilities for irrigation.

S 12 Towards Sustainable Land Use in the East Usambara Mountains.
1989 Van Kekem, A.J. and J.D.J. Mbogoni (eds).
18 pp.

Report of a site evaluation of 2 villages in the East Usambara Mountains, Tanga Region. Particular attention is given to soil erosion and fertility aspects. Once the nutrient cycle is broken through deforestation, the soils become chemically very poor. Recommendations for sustainable cropping and agroforestry systems were given.

S 13 Soil Conditions and Agricultural Production Potential for
1989 Hybrid Sisal and Selected Fruit Crops of Bombwera Estate.
Mbogoni, J.D.J., P.M. Ndondi and Ph.A. Kips.
34 pp. with map.

Report of a site evaluation of an old sisal estate (2,320 ha) in Muheza District, Tanga Region, within the framework of a sisal rehabilitation and crop diversification programme. The environmental and soil conditions are described and the lands evaluated for the cultivation of hybrid sisal, pineapple and citrus.

S 14 Soil Conditions and Agricultural Production Potential for
1990 Hybrid Sisal and Selected Fruit Crops of Kwamgwe Estate.
Ngailo, J.A., P.M. Ndondi and Ph.A. Kips.
34 pp. with map.

Report of a site evaluation of an old sisal estate (1,480 ha) in Handeni District, Tanga Region, within the framework of a sisal rehabilitation and crop diversification programme. The environmental and soil conditions are described and discussed. The lands are appraised for hybrid sisal cultivation and for the cultivation of fruit crops, particularly pineapple and citrus.

S 15 Soil Conditions and Agricultural Production Potential for
1990 Hybrid Sisal and Selected Fruit Crops of Kwashemshi Estate.
Ngailo, J.A., Ph.A. Kips and P.M. Ndondi.
33 pp. with map.

Report of a site evaluation of an old sisal estate (1,500 ha) in Korogwe District, Tanga Region, within the framework of a sisal rehabilitation and crop diversification programme.. Kwashemshi estate is located on a low land surface in between the East and West Usambara Mountains. The environmental and soil conditions are described and interpreted in terms of suitability for hybrid sisal, pineapple and citrus cultivation.

S 16 Soil Fertility Appraisal of Kisangata Farm (Kilosa District,
1990 Tanzania).
Floor, J. and F.B.S. Kaihura.
19 pp.

This report presents the result of a soil fertility appraisal of Kisangata Estate covering 5,700 ha in Kilosa District, Morogoro Region. The estate is situated on the transition of the footslope of the Ukaguru Hills and the Mkata alluvial plain. The best soils for sisal and maize cultivation are the footslope soils and those of the bordering river terrace. The best soils for tobacco are the light textured soils of the alluvial plain. Ample recommendations are given on the conservation and fertility management of the soils.

S 17 Soil Fertility Appraisal of Karimi Tea Estates (Amani, Muheza
1992 District, Tanzania).
in press Floor, J., E.I. Kimambo and J.P. Magoggo.
50 pp.

A soil appraisal of three Karimi Tea Estates in the East Usambara Mountains, based on soil and leaf analyses. The estates are Monga, Maramba and Derema. The total area covered is 880 ha. Soils are fairly uniform. They are strongly acid, deep, well drained, yellowish red and red clays with relatively thick sandy clay topsoils that are rich in organic matter. The results of the leaf analysis show that nitrogen and phosphorus are either deficient or just sufficient in most samples. Soil moisture balances are calculated and show no serious moisture deficit for tea in most years. Results of the study are translated into soil management terms including soil moisture and fertility management.

S 18 Soil Fertility Appraisal of Mahonda Sugar Estate, Zanzibar,
1990 Tanzania.
Floor, J., E.I. Kimambo and S.T. Ikerra.
13 pp.

This report summarizes the findings of a study on the soil fertility status of two farms of Mahonda Sugercane Estate, covering 2,260 ha in northern Zanzibar. The report describes four main soil types in the estate and evaluates their suitability for sugarcane cultivation. It concludes that almost the entire Farm 2 (468 ha) is unsuitable or only marginally suitable for sugarcane. The main limitations of the soils are susceptibility to drought and low nutrient status. A detailed design for fertilizer experiments is presented to arrive at appropriate fertilizer recommendations per soil type.

S 19 Soil Conditions and Land Suitability for Irrigated
1991 Agriculture of Kitere Scheme (Mtwara Region).
Kips, Ph.A. and R.K. Kimaro.
34 pp. with map.

Report on a land appraisal of an irrigation scheme (1,200 ha) in an inland alluvial plain in Mtwara Region. The dominant soils are slightly sodic and non-saline Vertisols. The assessment indicates that the lands are moderately suitable for irrigated rice-based cropping systems (rice, sorghum, millet, cowpea). The biggest concern requiring adequate attention is the drainability of the lands.

S 20 Soil Appraisal of Four Village Irrigation Schemes in Mwanga
1992 District, Kilimanjaro Region (Kileo, Kirya, Mvureni and Kigonigoni Schemes).
Banzi. F.M., Ph.A. Kips, D.N. Kimaro and J.D.J. Mbogoni.
72 pp. with maps.

The report describes the soil conditions in four traditional irrigation schemes in Mwanga District and evaluates the lands for irrigated agriculture (maize and/or wetland rice). Kileo scheme (315 ha) is on a the volcanic plain at the foot of Mount Kilimanjaro and has a good potential, in spite of the dominantly strongly sodic soils. Kirya scheme (400 ha) is on the floodplain of the Pangani river with dominantly extremely sodic soils, and has a low potential. Mvureni scheme (1,100 ha) is situated for the greater part on the footslope of the North Pare Mountains with non-sodic, non-saline colluvial soils. This part of the scheme has a good potential. The part of the scheme located in the bordering lake plain is characterized by saline-sodic soils and has a low potential. Kigonigoni scheme has the same setting and potentials as Mvureni scheme.

S 21
1992
in press

Soil Appraisal in Relation to Wilt Disorder of Coconut at Selem, Bambi, Kidichi and Kitope Farms, Zanzibar, Tanzania. Kiwambo, B.J. and F.M. Banzi. 20 pp.

Report on an investigation to see if the massive wilting of certain hybrid coconut varieties on Zanzibar is related to adverse soil conditions. The report describes the soils in four farms: Selem Seed Farm, Kidichi and Bambi Trial Farms and Kitope Farm. The total area is some 100 ha. Field characteristics of soils in affected and non-affected blocks do not differ and also soil laboratory analyses do not point to any direct soil-related cause to the wilt disorder.

M1 MISCELLANEOUS PUBLICATIONS

M 1
1985
Field Tour Guide, Kilimanjaro Region.
East African Soil Science Society Meeting, 1985.
Van Barneveld, G.W.
20 pp.

A guide to a one-day field trip on the lower south-eastern slopes of Mount Kilimanjaro during the Fifth Annual General Meeting of the Soil Science Society of East Africa. The guide describes the soils in the area in relation to their position on the mountain slope. The four major soil types of the toposequence are described in detail.

M 3
1986
Land Resources and Agricultural Development Potentials of Selected Areas in Tanzania.
Barneveld, G.W. van.
20 pp.

The land resources and agricultural development potentials of nine regions of Tanzania are briefly described in terms of physiography, soils, land suitability for crop production and dependable growing seasons. The areas concerned are: Bukoba, Karagwe and Muleba Districts (Kagera Region); Geita and Sengerema Districts (Mwanza Region); Maswa District (Shinyanga Region); Mbulu and Hanang Districts (Arusha Region); Kondoa District (Dodoma Region); Morogoro Rural District (Morogoro Region); Mbozi District (Mbeya Region); and Songea District (Ruvuma Region).

M 8
1988
The Potential for Hybrid Sisal Cultivation of Four Amboni Estates (Tanga Region); A Summary Report.
Hartemink, A. and G.W. van Barneveld.
31 pp. with maps.

The report summarizes the results of the soil surveys of Mwera, Kigombe, Kwamdulu and Pongwe Sisal Estates of the Amboni Group, carried out in 1987. The soils are compared and described in terms of suitable or unsuitable for sisal. Particular attention is paid to soil degradation under continuous sisal cultivation. The causes of yield decline experienced are discussed. Recommendations are given for proper soil and fertility management practices.

M 12
1990
Field Excursion Guide to Mbulu District, Tanzania; for the Soil Science Society of East Africa, Tenth Annual General Meeting, Arusha, December 1990.
Brom, A.J.M., J.P. Magoggo and F. van der Wal
19 pp.

This report is an excursion guide prepared for the participants of the 10th Annual General Meeting of the Soil Science Society of East Africa. It describes the landscapes and soils in the northern part of Mbulu District, Arusha Region, and presents some of the land-related problems experienced by the land users. Next to this the guide provides detailed information on the soils and soil management aspects in Chemchem, Kambi ya Simba and Bashay villages.

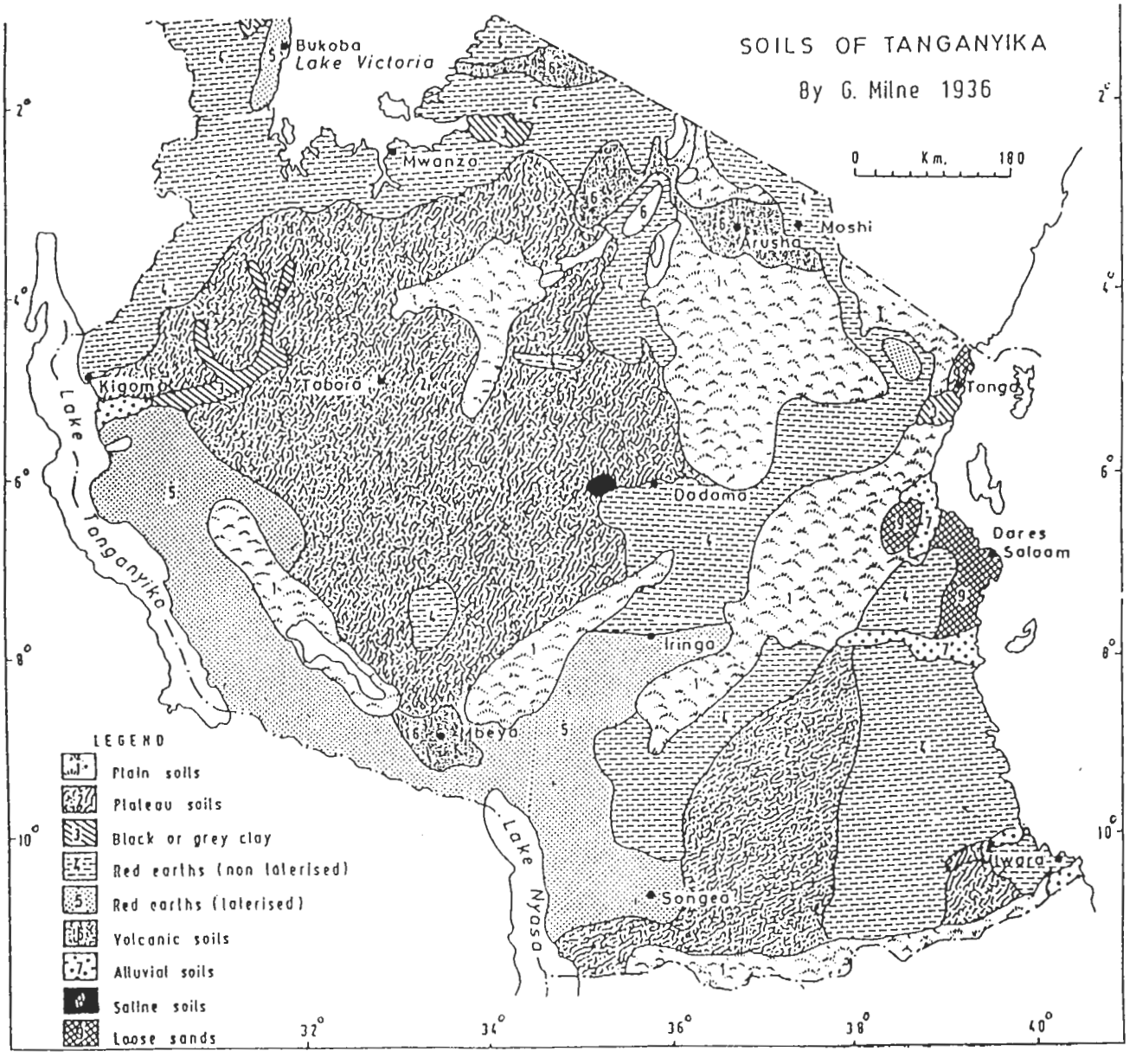
M 18 Soil Characterization of Trial Sites in the Western Cotton
1992 Growing Area.
in press Magoggo, J.P. and J.D.J. Mbogoni
35 pp.

In this report the soils of the cotton trial sites in the regions of Mwanza, Kagera, Mara, Shinyanga and Tabora (Western Cotton Growing Area) are characterized. Profile descriptions, classifications and analytical data are presented of a total of 27 sites. The majority of the sites lie at an altitude between 1080 and 1355 m. The parent rock in the northern parts is granitic, in the south some soils are formed in lacustrine sediments. The soils are shallow to deep, brownish in colour, and light to medium textured.

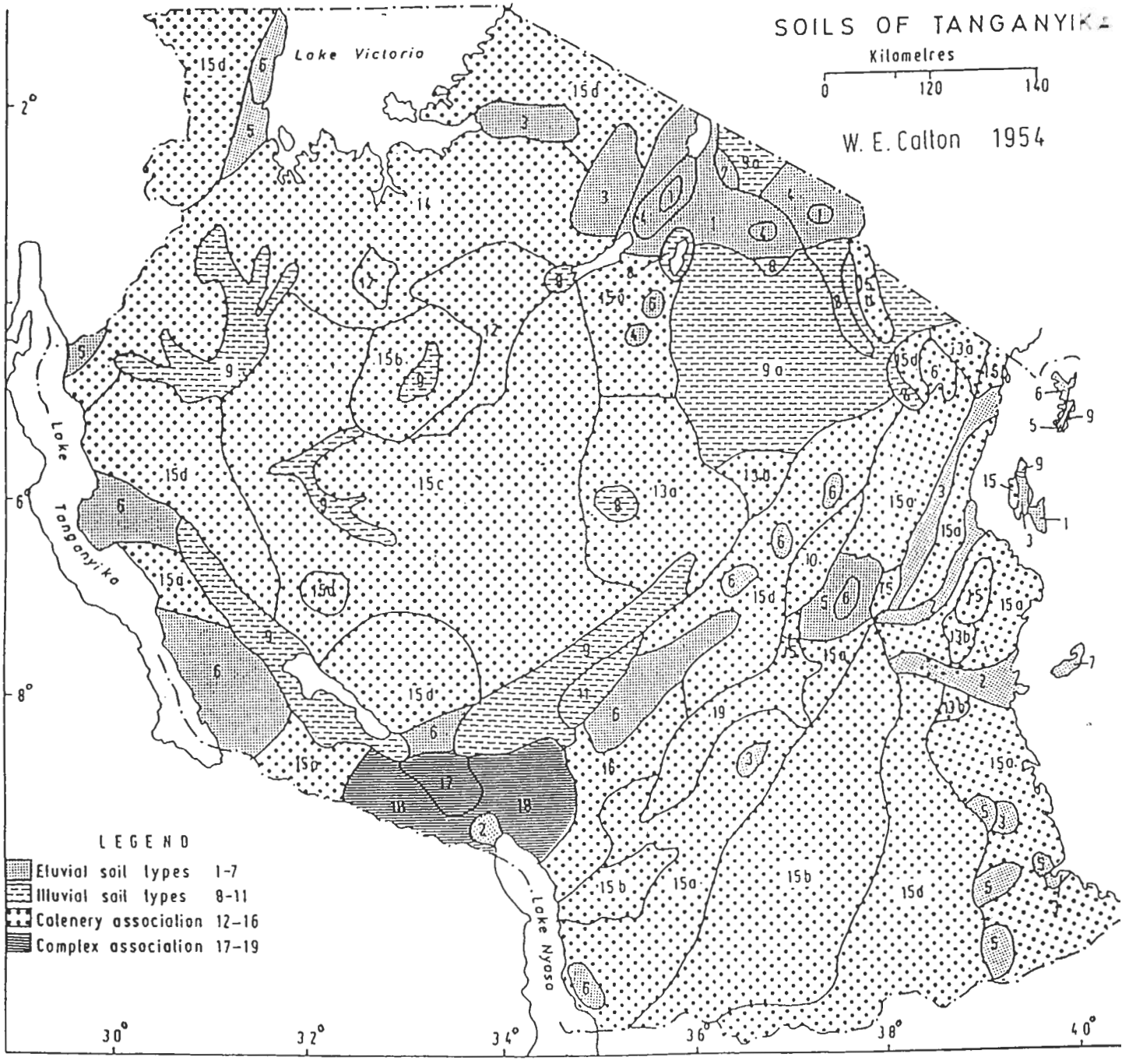
APPENDIX 2. EXISTING MAPS OF NATIONAL SOIL AND RELATED RESOURCE INVENTORIES.

This appendix contains 9 maps representing different national soil and related resource inventories which were made during the period 1936 - 1972. These maps have been extracted from the **Soil Atlas of Tanzania** (Hathout, 1983).

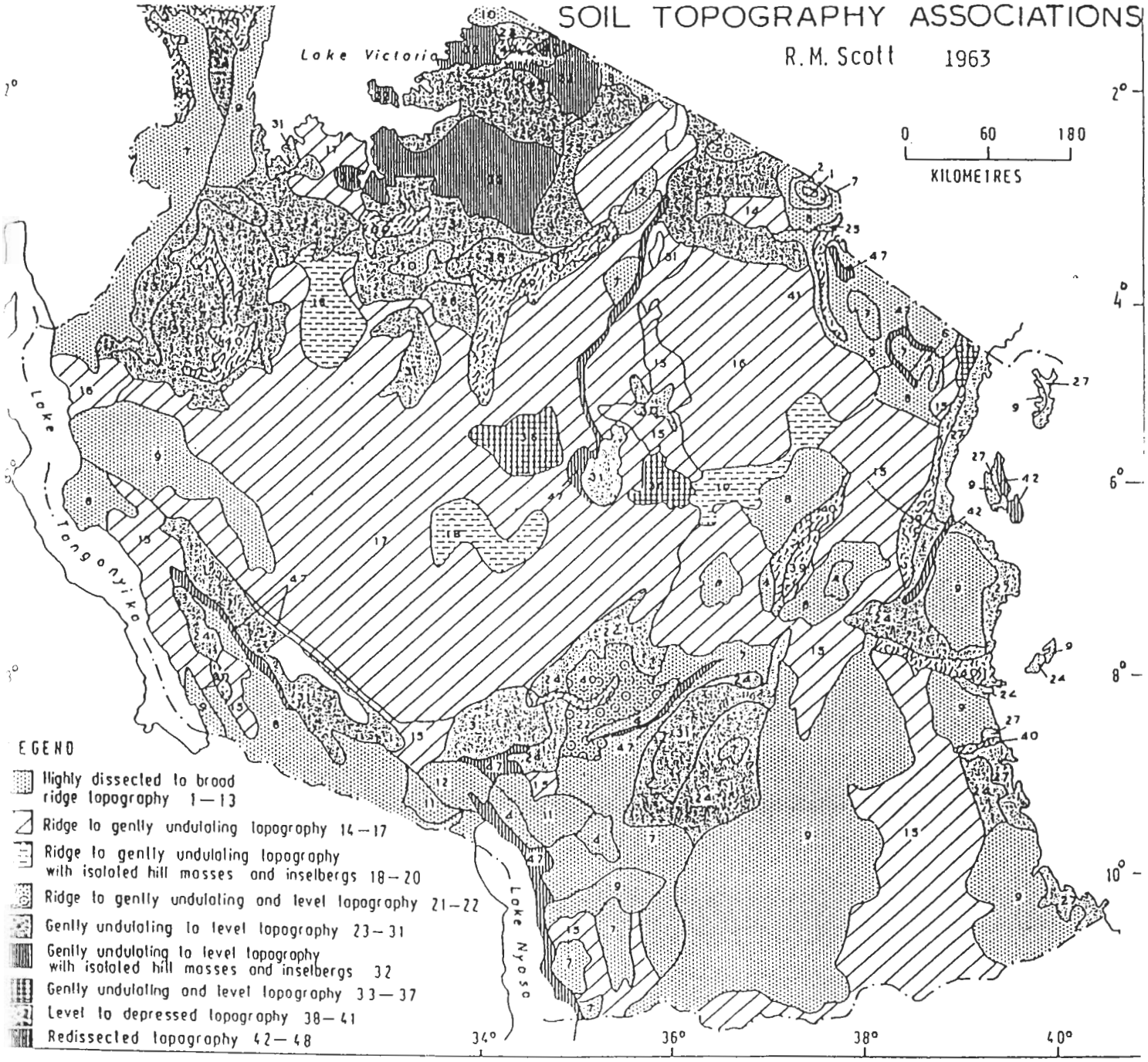
Map 1



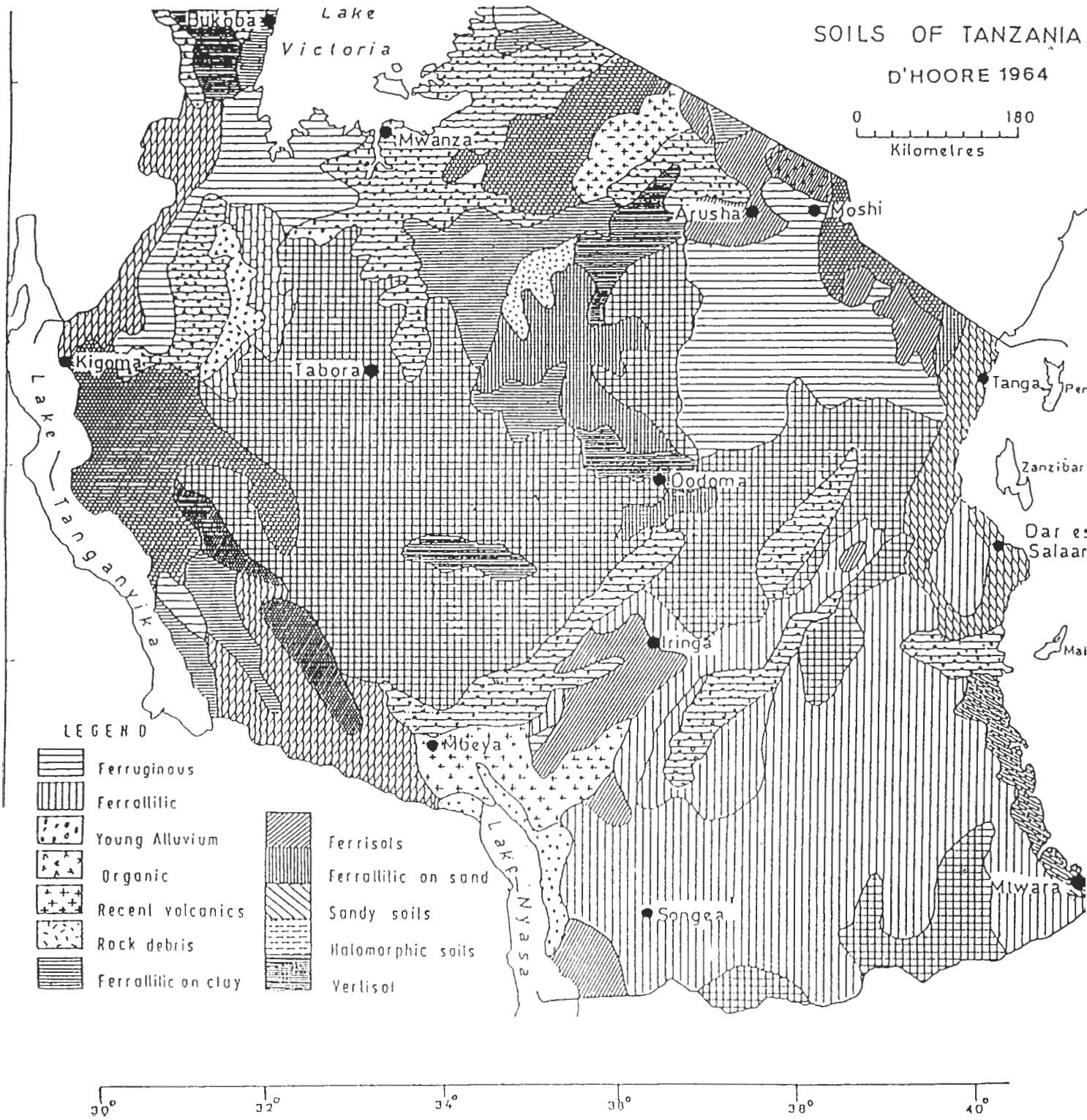
Map 2


SOILS OF TANGANYIKA
Kilometres
0 120 140
W. E. Collon 1954
Lake Victoria
Lake Tanganyika
Lake Nyasa
LEGEND
Eluvial soil types 1-7
Illuvial soil types 8-11
Colenery association 12-16
Complex association 17-19
2°
6°
8°
30°
32°
34°
36°
38°
40°

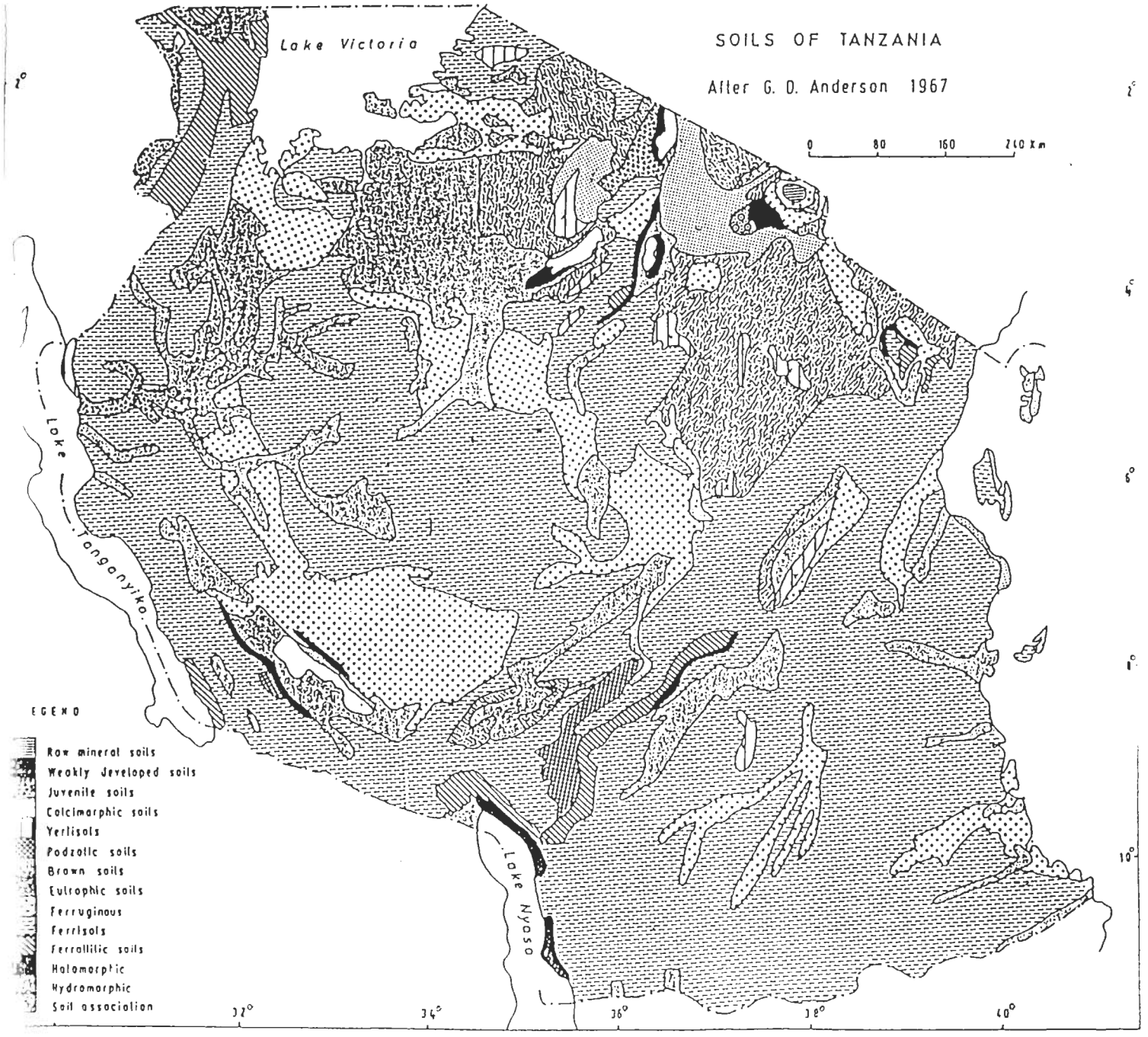
lap 3


SOIL TOPOGRAPHY ASSOCIATIONS
R.M. Scott 1963
Lake Victoria
0 60 180
KILOMETRES
Lake Tanganyika
Lake Nyasa
EGEND
Highly dissected to broad ridge topography 1—13
Ridge to gently undulating topography 14—17
Ridge to gently undulating topography with isolated hill masses and inselbergs 18—20
Ridge to gently undulating and level topography 21—22
Gently undulating to level topography 23—31
Gently undulating to level topography with isolated hill masses and inselbergs 32
Gently undulating and level topography 33—37
Level to depressed topography 38—41
Redissected topography 42—48
34°
36°
38°
40°

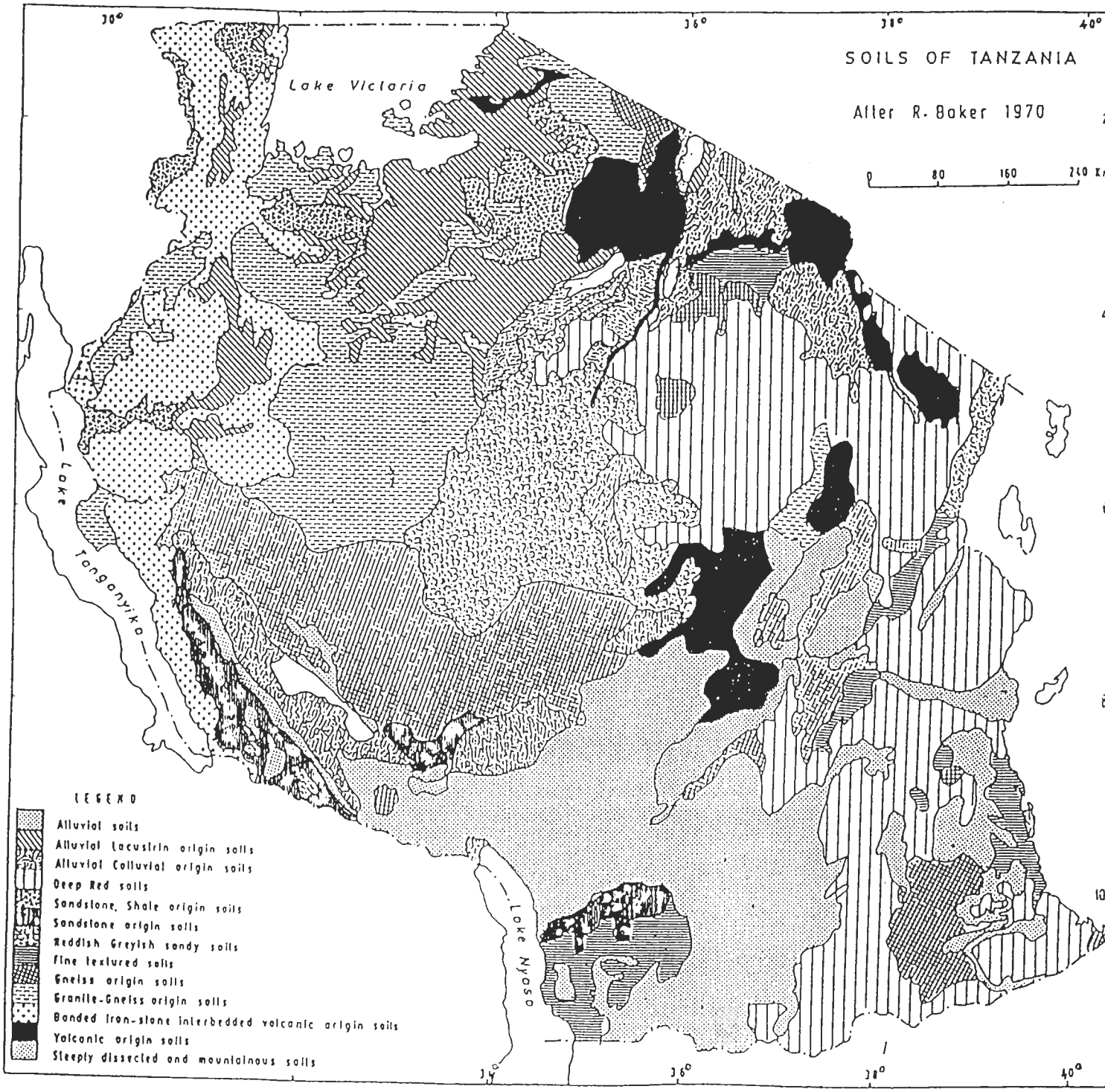
Map 4


SOILS OF TANZANIA
D'HOORE 1964
0
180
Kilometres
Lake
Victoria
Bukoba
Mwanza
Arusha
Moshi
Kigoma
Tabora
Tanga
Zanzibar
Dodoma
Iringa
Mbeya
Songea
Mtwara
Lake Tanganyika
Lake Nyasa
LEGEND
Ferruginous
Ferrallitic
Young Alluvium
Organic
Recent volcanics
Rock debris
Ferrallitic on clay
Ferrisols
Ferrallitic on sand
Sandy soils
Halomorphic soils
Vertisol
30°
32°
34°
36°
38°
40°

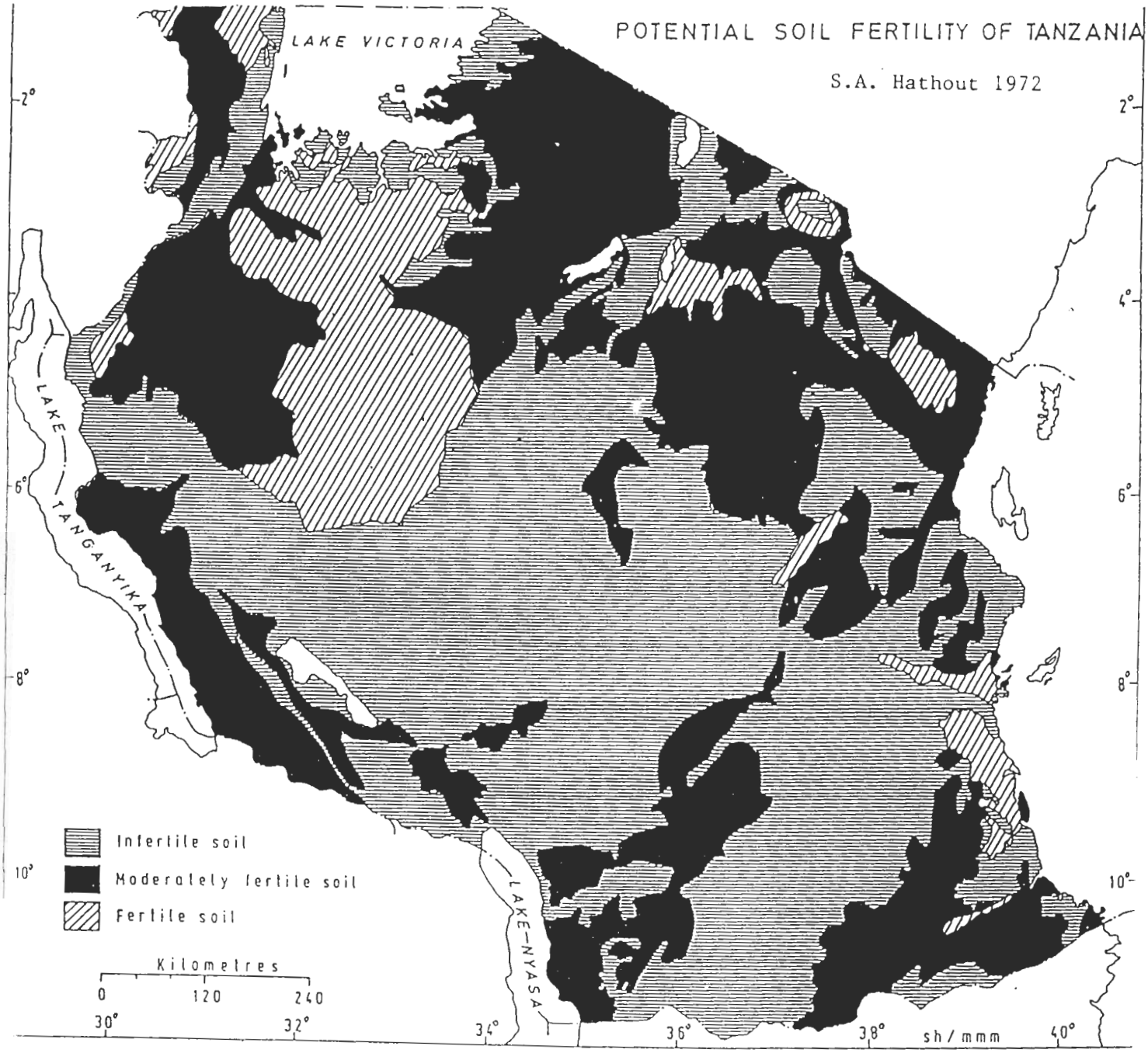
Map 5


SOILS OF TANZANIA
After G. D. Anderson 1967
0 80 160 240 Km
Lake Victoria
Lake Tanganyika
Lake Nyasa
EGEND
Raw mineral soils
Weakly developed soils
Juvenile soils
Calcimorphic soils
Yerlisols
Podzolic soils
Brown soils
Eutrophic soils
Ferruginous
Ferrisols
Ferrallitic soils
Halomorphic
Hydromorphic
Soil association
32°
34°
36°
38°
40°

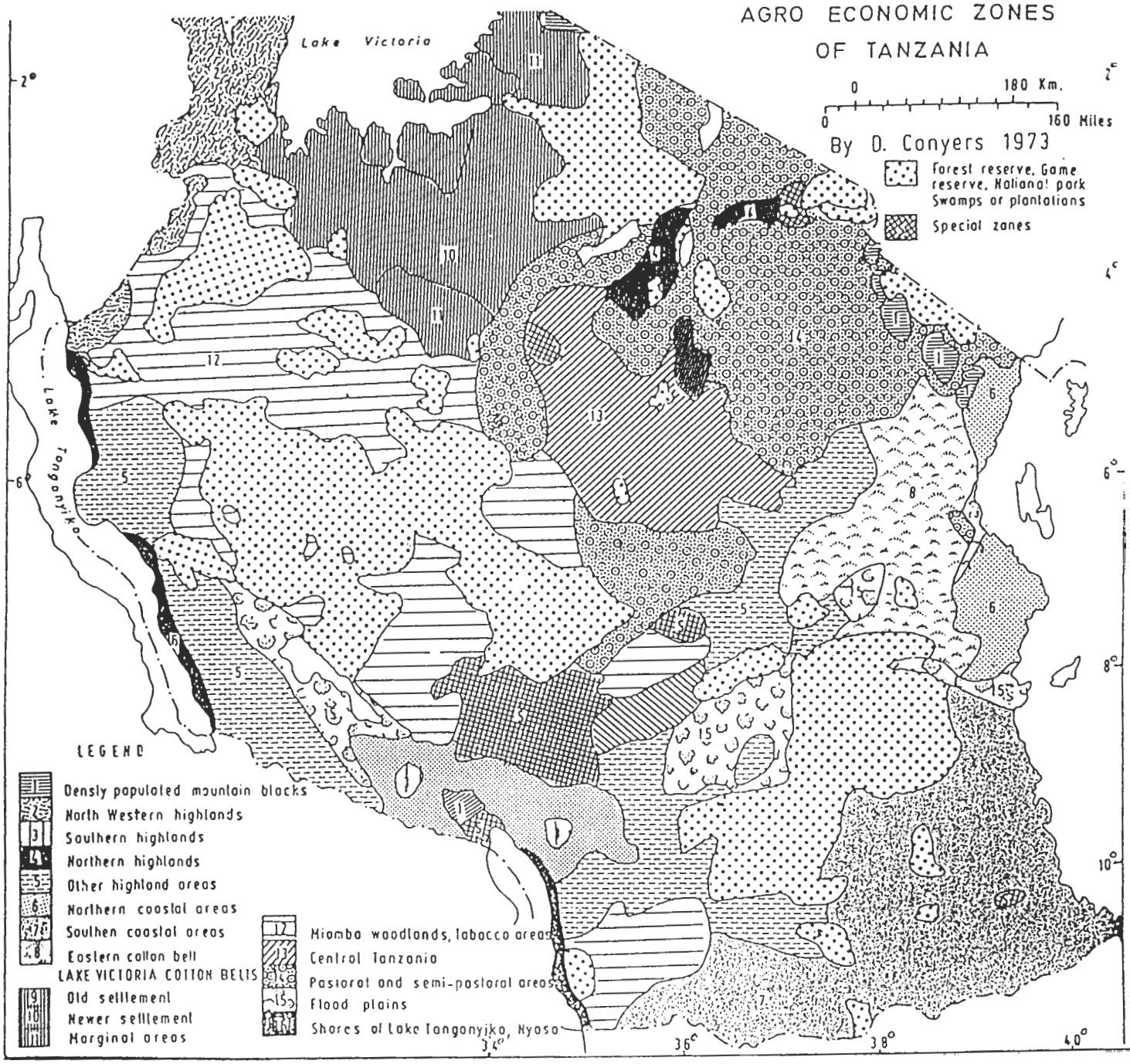
Map 6


SOILS OF TANZANIA
After R. Baker 1970
0 80 160 240 Km
Lake Victoria
Lake Tanganyika
Lake Nyasa
30°
36°
38°
40°
LEGEND
Alluvial soils
Alluvial Lacustrin origin soils
Alluvial Colluvial origin soils
Deep Red soils
Sandstone, Shale origin soils
Sandstone origin soils
Reddish Greyish sandy soils
Fine textured soils
Gneiss origin soils
Granite-Gneiss origin soils
Banded iron-stone interbedded volcanic origin soils
Volcanic origin soils
Steeply dissected and mountainous soils

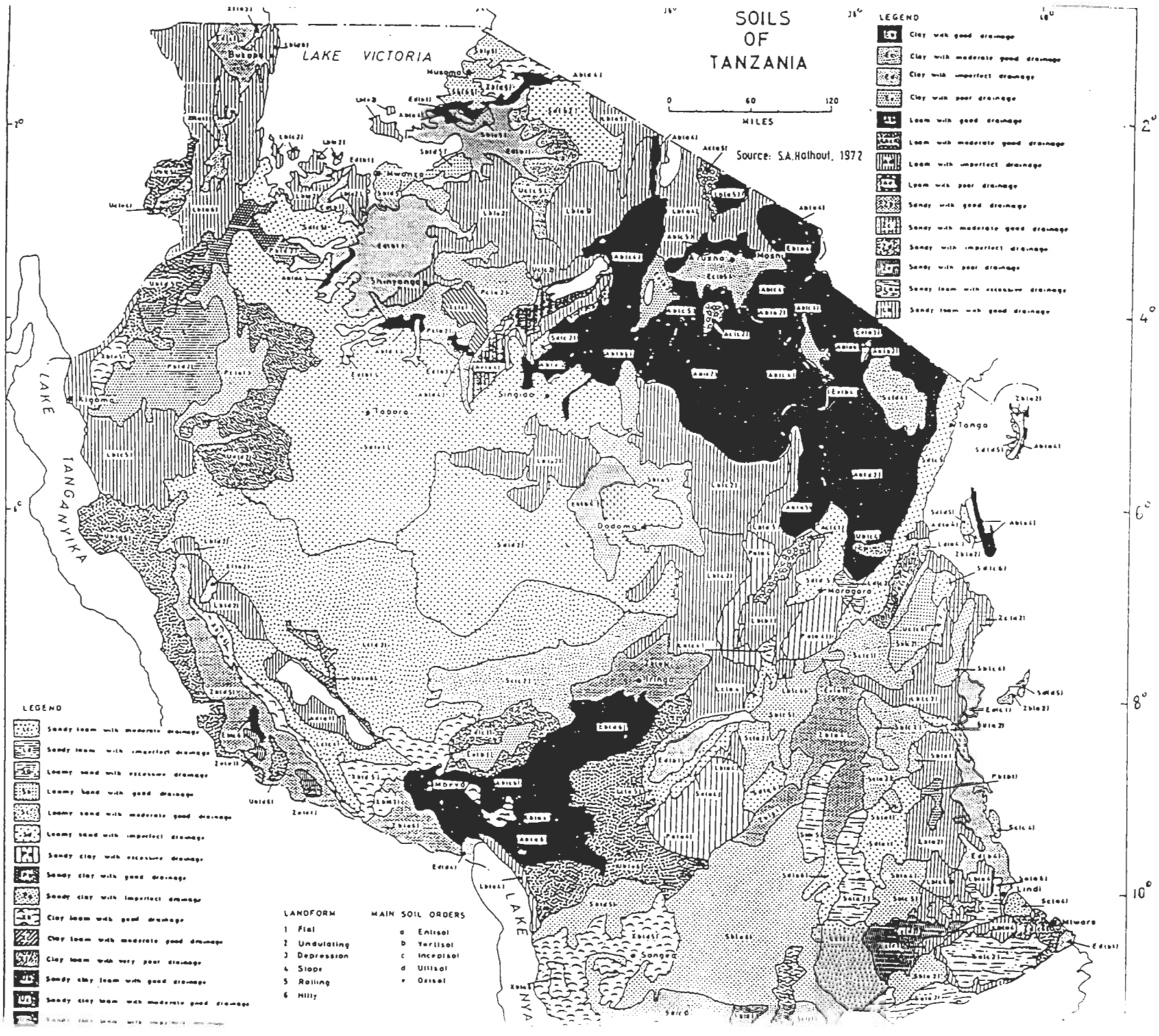
Map 7


POTENTIAL SOIL FERTILITY OF TANZANIA
S.A. Hathout 1972
LAKE VICTORIA
LAKE TANGANYIKA
LAKE NYASA
Infertile soil
Moderately fertile soil
Fertile soil
Kilometres
0
120
240
2°
4°
6°
8°
10°
30°
32°
34°
36°
38°
40°
sh / mmm

Map 8


AGRO ECONOMIC ZONES
OF TANZANIA
By D. Conyers 1973
0 180 Km.
0 160 Miles
Forest reserve, Game reserve, National park Swamps or plantations
Special zones
Lake Victoria
Lake Tanganyika
LEGEND
Densly populated mountain blocks
North Western highlands
Southern highlands
Northern highlands
Other highland areas
Northern coastal areas
Southen coastal areas
Eastern cotton belt
LAKE VICTORIA COTTON BELTS
Old settlement
Newer settlement
Marginal areas
Miombo woodlands, tobacco areas
Central Tanzania
Pastoral and semi-pastoral areas
Flood plains
Shores of Lake Tanganyika, Nyasa
2°
4°
6°
8°
10°
34°
36°
38°
40°

Map 9


SOILS OF TANZANIA
Source: S.A. Halhout, 1972
0 60 120
MILES
LAKE VICTORIA
LAKE TANGANYIKA
LAKE NYASA
LEGEND
Clay with good drainage
Clay with moderate good drainage
Clay with imperfect drainage
Clay with poor drainage
Loam with good drainage
Loam with moderate good drainage
Loam with imperfect drainage
Loam with poor drainage
Sandy with good drainage
Sandy with moderate good drainage
Sandy with imperfect drainage
Sandy with poor drainage
Sandy loam with excessive drainage
Sandy loam with good drainage
LEGEND
Sandy loam with moderate drainage
Sandy loam with imperfect drainage
Loamy sand with excessive drainage
Loamy sand with good drainage
Loamy sand with moderate good drainage
Loamy sand with imperfect drainage
Sandy clay with excessive drainage
Sandy clay with good drainage
Sandy clay with imperfect drainage
Clay loam with good drainage
Clay loam with moderate good drainage
Clay loam with very poor drainage
Sandy clay loam with good drainage
Sandy clay loam with moderate good drainage
LANDFORM
1 Flat
2 Undulating
3 Depression
4 Slope
5 Rolling
6 Hilly
MAIN SOIL ORDERS
a Entisol
b Vertisol
c Inceptisol
d Ultisol
e Oxisol
Bukoba
Musoma
Mwanza
Shinyanga
Kigoma
Tabora
Singida
Dodoma
Iringa
Mbeya
Morogoro
Tanga
Songea
Mtwara
Lindi