REPUBLIC OF ZAMBIA

MINISTRY OF AGRICULTURE

REPORT ON NATIONAL SOIL MAP OF ZAMBIA

SCALE 1: 1000 000

By F. N. MUCHENA

CONSULTANCY REPORT FOR NORAGRIC

AND

SOIL SURVEY UNIT, ZAMBIA.

SEPTEMBER, 1990

Soil Survey Unit
Research Branch
Department of Agriculture
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CONTENTS

PREFACE

This report gives the findings of a consultancy on the National soil map of Zambia, scale 1:1,000,000 which is being compiled and to be published by the Soil Survey Unit (SSU) of the Ministry of Agriculture of the Government of the Republic of Zambia.

The study was carried out during the period 25 th August to 8th September, 1990 at the SSU at Mount Makulu Central Research Station, Chilanga. Preparatory work and the compilation of the final report were carried out in Kenya.

Prior to leaving Lusaka, Zambia a draft Report was handed over to the Soil Survey Unit and NORAGRIC, Lusaka.

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8th September, 1990.

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ACRONYMS

FAO	-	Food and Agriculture Organisation of the United Nations.
GRZ	-	Government of the Republic of Zambia.
NORAD	-	Norwegian Agency for Development
NORAGRIC	-	Norwegian Centre for International Agricultural Development
SADCC	-	Southern Africa Development Coordination Conference.
SSU	-	Soil Survey Unit
UNESCO	-	United Nations Educational, Scientific and Cultural Organization.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The objective of the National Soil Mapping Programme has been to produce an Exploratory Soil Map of Zambia on scale 1:1,000,000 with an interpretative accompanying memoir (report). This inventory will form a basis for national as well as regional agricultural development planning. At the same time it is going to tie in nicely with the Southern Africa Development Coordination Conferences (SADCC) inventory of its resources at a similar scale.

The compilation of the National Soil Map of Zambia is at an advanced stage. A draft National Soil Map has been compiled on the basis of Provincial soil maps on the same scale, with an accompanying draft legend. The objective of the consultancy was to review the legend of the National Soil Map and to correlate the soils occurring in the various mapping units according to the system of FAO-UNESCO (1988) Revised legend for the Soil Map of the World. This task was carried out during a two weeks visit to Zambia from 25th August to 8th September 1990. This period was preceded by a preparatory phase in Kenya.

Recommendations

(a) On Soil Map and Legend

a.1 With the assistance of the consultant a third draft National Soil Map and Legend has been compiled. However a few question marks exist with regard to some mapping units found within the Rift Valley Trough, the Northern Province and the Western Province. It is recommended that the National Mappers check and confirm the relevant information as a matter of urgency before the final soil map and legend are compiled.

a.2 It is recommended that a geological entry be introduced in construction of the legends for the Provincial soil maps.

a.3 In the legend descriptions, drainage condition and effective soil depth should be systematically included for all mapping units.

a.4 The smallest mappable unit in the soil map should not be less than 0.4 cm^2. This corresponds to an area of about 4,000 hectares on the ground at scale of 1:1,000,000.

a.5 The depth class 'moderately shallow' currently being used in all soil maps be changed from 30 - 60 cm to 30 -50 cm in order to coincide with the 50 cm boundary criteria used for lithic or petroferric contact in both the FAO-UNESCO (1988) Revised Legend and the Soil Taxonomy (Soil Survey Staff, 1990).

(b) On Soil correlation

b.1 It is recommended that the FAO-UNESCO Revised Legend be used for soil correlation in the map legends. However both the FAO-UNESCO system and the Soil Taxonomy should be used in classifying the soils in the mapping unit descriptions in the soil reports.

b.2 Since ~~it is~~ only two of the Provincial Soil Reports have been correlated according to the FAO-UNESCO (1988) Revised legend it is recommended that the soils of the other provinces be reclassified according to the Revised Legend.

(c) Mapping unit description

c.1 It is recommended that the soil mapping unit descriptions contained in the memoirs accompanying the Provincial soil maps be simplified as suggested in chapter 3.2.

(d) On Map compilation

d.1 It is the responsibility of the National Mappers to ensure that all information contained in the base maps for the National Soil Map which is not required is deleted in order to enhance the readability of the soil map.

(e) On colour scheme

e.1 It is recommended that the colour scheme to be used for the National Soil Map follow that of the recent FAO (1990) World Soil Resources Map.

(f) On follow-up

f.1 It is recommended that a Technical meeting be organised to discuss the third draft National Soil Map and legend after which the final soil map should be compiled taking into consideration important issues raised during that meeting. Participants should include Provincial soil surveyors, University of Zambia staff and would be users of the soil map.

(g) Concluding Remark

To facilitate the completion of the National soil map of Zambia in accordance with the envisaged time schedule (1991), the soil survey staff will need a lot of support, both moral and financial, from GRZ and NORAD.

ACKNOWLEDGEMENTS

I would like to thank the Soil Survey Unit of the Government of the Republic of Zambia and NORAGRIC for giving me this opportunity to carry out this consultancy. Thanks go to all staff at the Soil Survey Unit and the staff of NORAGRIC and NORAD Lusaka for all support and cooperation during my stay in Zambia. Special mention goes to Messrs L.Chileshe Acting Senior Soil Surveyor, Mr. N.C. Mulenga, National Soil Mapper and Nawa Mukanda Soil Correlator for their assistance during the compilation of the draft soil maps and legends. Their patience and endurance during the long working hours even during weekends is highly appreciated.

My gratitude go to Mr. Calle Hedberg who ensured that all the arrangements for the consultancy were made. Thanks go to C. Lungu and Mrs. Febby M. Malemeno for word processing this report. Acknowledgement also goes to Mr. Winston Njaluka, a driver at the SSU who drove me during the greater part of my stay in Zambia.

Last but not the least I am very grateful to the Director of the Kenya Agricultural Research Institute, Dr. C. G. Ndiritu and the Government of the Republic of Kenya for granting me permission to travel to Zambia.

1. INTRODUCTION

1.1 General

The Soil Survey Unit (SSU) is part of the Research Branch, Department of Agriculture of the Ministry of Agriculture of the Republic of Zambia (GRZ). The SSU started its operations in 1973 with support from the Food and Agriculture Organization (FAO) of the United Nations and the Government of the Kingdom of Norway.

The SSU became a project on 8th December, 1977 on the basis of a contract between GRZ and Norway. The agreement covered a period of six years (1977-1982). However, after evaluation in 1981 and 1985 the project was extended to phase II and III covering the period 1983-1986 and 1987-1991 respectively.

The compilation of a Soil Map of Zambia, scale 1:1,000,000, has been one of the main objectives in setting up a Soil Survey Unit right from the start. The importance of this map was stressed in the first Project Agreement and statements made by the Evaluation Missions in 1981, and 1985.

Early in 1984 a soil surveyor for the National Map was appointed. This marked the start of systematic exploratory soil mapping on a provincial basis. A compilation of the Provincial soil maps (scale 1:1,000,000) will form the basis of the National Soil Map of Zambia on scale 1:1,000,000.

At the time of this consultancy, exploratory soil mapping of seven out of the nine provinces of Zambia had been completed. The compilation of the soil maps of the other two provinces was in progress. On the basis of these soil maps and other previous investigations (at various scales) a first and second draft of the National Soil Map, scale 1:1,000,000 together with the accompanying legends had been prepared. The purpose of this consultancy was therefore to review the legend of this National Soil Map of Zambia (scale 1:1,000,000).

1.2 Scope of Work and Terms of Reference

The consultancy was to be carried out over a period of 3 weeks, entailing in-depth office and if possible fieldwork. A total of 15 work-days were to be provided with at least 10 work-days in Zambia.

The terms of reference of the consultancy (see appendix 1) were to be implemented in close cooperation with the relevant Soil survey Unit staff. At the end of the contract a Report should be submitted to Norwegian Center for International Agricultural Development (NORAGRIC) and the Soil Survey Unit, Zambia.

Briefly the terms of reference covered the following.

1. Review of the structure of the National Soil Map

2. Assist in determining the smallest mappable unit

3. Assist in correlating the FAO-UNESCO soil legend, 1988 version and the Soil Taxonomy.

4. Review all mapping units and the national legend and their classification according to FAO-UNESCO legend, 1988.

5. Suggest format and contents of the National Soil Map memoir/report.

6. Suggest ways of how " associations" or "complexes" or indeed "inclusions" or sub-units shall be represented.

1.3 Procedure of Activities of the Consultant.

Prior to leaving for Zambia, the Consultant studied the contents of two Provincial soil maps and their accompanying memoirs, which had been received on 23rd August, 1990. Other preparatory arrangements such as putting together relevant literature were also made.

The consultant arrived in Lusaka on Saturday, 25th August, 1990. On the same day he had an introductory meeting with Mr. Calle Hedberg, Acting Resident Representative of NORAGRIC, Zambia Branch. On Sunday 26th August, discussions were held with Mr. L. Chileshe, Acting Senior Soil Surveyor, SSU.

On the 27th August in the morning, a visit was paid to the Norwegian Embassy where a brief discussion was held with Mr. Sigurd Bjortuft, NORAD's Senior Agricultural Research Officer. In the same morning a courtesy call was made at the Deputy Director of Agriculture (Research Branch) but unfortunately it was not possible to meet Dr. Munyinda then but an appointment was made to meet him at a later date.

During the same morning discussions were held with the various soil specialists working at the SSU at Mt. Makulu Central Research Station. Work on the National Soil Map started with an explanation of what had already been done by the National Soil Mappers, Messrs L. chileshe and Nsofwa Charles Mulenga. This was followed-up with a study of all the available provincial soil maps, the accompanying memoirs and the draft legends.

The period Tuesday 28th August to Sunday 2nd September was spent compiling the third draft National Soil Map legend while at the same time a third draft National Soil Map (scale 1:1 million) was coloured depicting all the soil units described in the new legend. Simultaneously the soils occurring in the various mapping units were classified according to the FAO-UNESCO (1988) Revised Legend. This work was carried out in close collaboration with the National Mappers (Messrs Chileshe and Mulenga).

Monday 3rd September was spent on cross-checking the soil mapping units and the legend while some time was spent correcting the typed legend. On the morning of Tuesday 4th September, discussions were held with the Deputy Director of Research Dr. Munyinda who stressed the importance of having the National Soil Map being finalised as soon as possible. Part of the morning was also spent at the Cartographic Section of the Ministry of Agriculture. Discussions were held on the colour scheme for the National Soil Map. In the afternoon, a meeting was held to discuss the draft legend with the Senior Soil Survey Staff of the SSU.

The period Wednesday 5th September to Saturday 8th September was spent on soil classification and compilation of the report. A draft report with recommendations was handed in to the Acting Senior Soil Surveyor before the consultant left for Nairobi on Saturday 8th September at 18.00 hrs. A copy of the report was also made for NORAGRIC.

2. REVIEW OF EXISTING SOIL MAP LEGENDS AND MAPPING UNITS

2.1 Background

The background of the Legend of the Exploratory Soil Map of Zambia and the provincial soil maps on scale 1:1,000,000 is outlined in all memoirs accompanying the provincial soil maps (Ting-Tiang, 1987; Chileshe, 1987, 1988a 1988b, 1989; Chileshe and Mambo, 1990 and Mulenga, 1990). The FAO-UNESCO system used for the legend of the Soil Map of the World (FAO-UNESCO, 1974; FAO-UNESCO, 1988) is used for soil correlation in accordance with the recommendation of the first Meeting of the Eastern African Sub-Committee for Soil Correlation and Land Evaluation held in Nairobi in 1974.

The Revised Legend (FAO-UNESCO, 1988) has only been used for the Exploratory soil maps which have been published after 1989, namely Lusaka Province (Mulenga, 1990), and Central Province (Chileshe and Mambo 1990). The other published reports have used the amended third (FAO, UNESCO, 1985) AND FOURTH DRAFTS (FAO-UNESCO, 1987) of the Revised Legend. In view of this it is recommended that representative soils in the reports for Eastern (chileshe, 1989), Northern (chileshe, 1988), Luapula (chileshe, 1987), Copperbelt (Chileshe 1988) and North-Western (Ting-Tiang, 1987) provinces be reclassified according to the Revised Legend (FAO-UNESCO, 1988) in order to facilitate correlation for the National Soil Map.

2.2 Legend set up

All the Legends for the Provincial soil maps have followed a physiographic approach. The first entry in the legend is physiography. The physiographic units are grouped according to the principles set up by Dalal et al (1985). The second entry is the soil code based on the soil codes used for soil Map of the World (FAO, UNESCO, 1985 and 1988). The code system used in the soil maps is clearly explained in each of the accompanying memoirs.

Although it is recognised in most of the reports that a relationship exists between geology (surface lithology or parent material) and the soils, there is no geological entry in the set up of the soil map legend. As mentioned by Sorensen (1990) geology has an important impact on soil development particularly in the "low rainfall" areas of Zambia. It is therefore recommended that a geological entry be introduced in the soil map Legend as a second entry (see chapter 3.1).

In the description of the various soil mapping units on the legend the drainage condition of the soils and the soil depth are not indicated for all the soil units. It is recommended that this should be systematically indicated for all soil units.

2.3 Map unit characterization

The criteria used in identifying and differentiating the various soil mapping units is clearly explained in all the published memoirs and is based on acceptable standards.

The depth class moderately shallow extends from 30 to 60 cm. However, the boundary criteria for the lithic contact in both the FAO-UNESCO Revised Legend (FAO-UNESCO, 1988) and the Soil Taxonomy (Soil Survey Staff, 1990) is 50 cm. In view of this it is recommended that this depth class (moderately shallow) be changed to coincide with this depth i.e 30 - 50 cm.

2.4 Smallest Mappable unit

The smallest unit which can be represented on the map, referred to as basic map unit, (Vink, 1963) is normally taken as 0.25-1cm ^{2} on the map. The revised US soil survey manual indicates "minimum size delineations" as a roughly square or circular area approximately 6 mm across. Cornell University (1979) consider the basic map unit to be 0.4 cm^2. Considering the latter the smallest mappable unit on the National Soil Map of Zambia scale 1:1,000,000 should be about 4,000 hectares. Areas smaller than this can be mapped as inclusions.

2.5. Soil Correlation

2.5.1 FAO-UNESCO Soil Map of the World Legend

As mentioned in chapter 2.1 the FAO-UNESCO Legend for the Soil Map of the World has been adopted for soil correlation for the Provincial soil maps and the National Soil Map of Zambia. Drafts of the Revised Legend (FAO-UNESCO, 1985 and 1987) have been used to classify soils for the provincial soil maps and memoirs published before 1990. These will have to be re-classified according to the 1988 Revised Legend. While compiling the Legend for the National Soil Map (see chapter 3.1 and appendix 3) the consultant in collaboration with the National Soil Mappers (Messrs Chileshe and Mulenga) classified the soils according to the Revised Legend (FAO-UNESCO, 1988).

Since the Legend of the Soil Map of the World has been and is being used for mapping at scales larger than 1:5,000,000, there is a need for the separation and definition of soil subunits at a third level particularly when mapping at scales 1:1,000,000 or larger. For the Zambian case third level (soil sub-unit) modifiers have been used for both Provincial soil maps and the National Soil Map (see appendix 3). It is however, important to stress that whenever these modifiers are used, they should be clearly defined and systematically applied for correlation in all the soil maps where they may occur.

2.5.2 Soil Taxonomy

Soil Taxonomy has been used in Zambia for soil correlation, particularly in the older publications and in some of the District soil maps, for example Mansa District. However, Soil Taxonomy has not been used for soil correlation for the Provincial soil maps. It is considered useful that for each of the soil mapping unit the equivalent classification according to Soil Taxonomy (Soil Survey Staff, 1990) be shown in the map unit descriptions. As an alternative a table can be prepared for each memoir where the classification of the soils according to the FAO Revised Legend and Soil Taxonomy are shown.

For the National Soil Map of Zambia (scale 1:1,000,000) the author has attempted to present a correlation table (see appendix 4) showing both the FAO Revised Legend (1988) and the Soil Taxonomy (Soil Survey Staff, 1990) equivalents of the various soil units and sub-units identified in the legend which is presented in this report as appendix 3.

It should be noted that for some of the soil units the classification according to Soil Taxonomy is tentative for the following reasons:

1. The author did not have access to descriptions of some of the representative profiles and their analytical data at the time of classification

2. For some of the soil units there is inadequate analytical data

Considering that a substantial number of profile descriptions with analytical data exists for the bulk of the soil units identified in the National Soil Map of Zambia, it is recommended that the Soil Correlators in close collaboration with the National Mappers select representative soil profiles for all these soil units. This data can be stored in a computer and used for the final classification of all the soil units in the National Soil Map of Zambia. The data could also be used for soil correlation of the Provincial soil maps.

3. PROPOSED STRUCTURE FOR THE NATIONAL SOIL MAP.

3.1 Legend

One of the important products of a soil survey is the soil map. The users of soil survey information such as land use planners, agronomists, ecologists, agricultural extension workers etc would therefore expect to get from it a quick insight of the spatial distribution of the main soils, a description of their main features that can be recognized in the field and an indication of their limitations. Bearing this in mind and also taking into account the fact that a soil map should be comprehensive in the sense that it is a basic scientific document that should still be useable many years after its preparation, Sombroek and Van de Weg (1983) have proposed application of " physiognomic-lithomorphic" approach to soil mapping in general and to the presentation of soil map Legends in particular. This approach attempts to visualize the relationship landform-geology-soils. In this methodology the legend reflects landforms at the highest level. There is a subdivision according to (important) differences in geology at the second level, which is followed by the descriptions of the individual soil mapping units. This approach has been used for the Exploratory soil map of Kenya (Sombroek et al, 1982) and a similar approach is recommended for Zambia. In construction of the Legend for the National Soil Map of Zambia (see appendix 3) land forms are taken as the first entry. These are supposed to give the user a preliminary insight into differences of physiography and altitude. The importance of land forms in soil mapping has been stressed by various authors (Soil Survey Staff, 1951, Vink 1963 and 1975, Young, 1976. Sombroek and van de Weg 1983, Sombroek et al, 1982, Dalal-Clayton et al, 1985 and others) The first symbol in the soil map legend represents this.

It should be noted that for the National Soil Map of Zambia, the physiographic units are to a great extent according to those of the Geomorphic Legend (Dalal-Clayton et al, 1985). However, a slight deviation has been made with regard to the Rift Valley Trough and the aggraded plateau. The aggraded plateau has been considered as a sedimentary Plain. The gently undulating land and the terraces within the Rift Valley Trough have also been grouped under sedimentary plains but differentiated from those sedimentary plains influenced by Kalahari sands. The floodplains in the Rift Valley Trough, Plateau and Plains have all been grouped under one physiographic unit since their mode of formation is considered to be the same. The various landforms used and their respective codes are shown in Table 1.

Table 1 Proposed codes for denoting landforms and miscellaneous land types

land form code	Description
M	Mountains and major scarps
H	Hills and minor scarps
He	Hills and faulted scarps of the Rift Valley
F	Footslopes and dissected upper Valleys of the Rift Valley
P	Plateaus
Pu	Flat to gently undulating plateau
Pd	dissected plateau
E	Plains (undifferentiated)
Es	Sedimentary Plains
Et	Older alluvial plains and higher river terraces
Ed	Disseded Plains
A	Floodplains
D	Dambos
Miscellaneous Land Type	
S	Swamps

Note: It is proposed that the landforms are described pragmatically rather than geomorphologically. This should take into account the overall slope, relief intensity, dissection, position in the landscape etc. In the legend presentation the Landform should be arranged from high to low.

The second entry and subsequent symbol in the legend is the geology (surface lithology) or parent material. The geological subdivision is pragmatic, mainly according to the "resistance to weathering" and the "mineral richness of the parent material/rock", always observing the correlation with soil conditions. The codes used for the geological subdivisions in the legend of the National Soil Map of Zambia are shown in Table 2.

The third entry in the legend is the description of the main soil or soils of the individual soil mapping units. A descriptive terminology is used to give a non-soil specialist such as planners, agronomists and extension officers an insight to the features of the soils concerned without confusing them with jargon.

A strict scheme should be followed in all soil descriptions, which refer mainly to the characteristics of the subsoil (usually the B-horizon preferably till a depth of 100 cm or to rock whichever is shallower).

The following information is given in the sequence indicated below:

(a) drainage condition

(b) effective soil depth
(c) colour (moist)
(d) mottling (if present)
(e) consistence (moist)
(f) calcareousness (if present)
(f) salinity, sodicity (if present) acidity (if necessary)
(g) rockiness (if present)
(h) stoniness (if present)
(i) cracking (if present)
(j) texture
(k) nature of the underlying material
(l) soil classification according to the FAO-UNESCO,(1988)

Table 2 PROPOSED CODES TO BE USED FOR DESCRIPTION OF GEOLOGY

Code	Description
G	granites, granodiorites
B	gabbro, dolerite, basalts, amphibolite
L	carbonates and metacarbonates rich in ferromagresian minerals, calcite/dolomitic marble
Q	granitic gneisses, quartzites, meta-quartzites
T	Kundelungu shales schists and silt-stones
U	undifferentiated Basement complex rocks
K	undifferentiated Karroo sediments
A	undifferentiated unconsolidated sediments (colluvium and alluvium)
E	Kalahari sands and other eolian sediments
C	calc-silicates

Additional information on special topsoil or subsoil features or inclusions of soils that differ from the main body in one or more characteristics can be included. For example a description of the epipedon (usually A horizon) may be included when the texture of this horizon differs by two or more classes from the B-horizon, or when clear organic horizons are recognised.

Within the geological subdivision of the legend the sequence of the mapping units is determined by their drainage condition, depth, colour, consistence and texture.

The following guidelines are suggested drainage conditions: the sequence commences with the best drainage condition eg. from excessively drained to very poorly drained. If the drainage condition of a number of mapping units is the same, then their sequence is determined by soil depth: sequence from very deep to very shallow. If drainage and soil depth is the same for a number of soil mapping units then their sequence is determined by soil colour: the red colours are mentioned first followed by brown and grey ones.

In case these four properties are similar the soil consistence is taken as the differentiating parameter:- loose soils are recorded first very firm clays last.

It should be noted that all descriptions are written in full and no abbreviations are used.

Following the codes for landform and parent material (geology) each map unit code has a symbol for the soil according to the FAO-UNESCO (1988) Revised legend for the Soil Map of the World. However, complexes and associations are not given codes for specific soil types but are denoted with symbol C and A respectively.

The mapping unit description is followed by a taxonomic classification of the soils concerned. This is meant to facilitate the soil specialist to correlate the soil unit with soils in different areas and will also ensure the extrapolation of agronomic research data. For the National Soil Map of Zambia FAO-UNESCO (1988) Revised Legend is used for soil correlation in the legend.

In the new legend of the National Soil Map 19 major soil types and 96 mapping units have been identified. This number of mapping units is considered to be reasonable taking into account the area covered and the diversity of parent materials.

3.2 Mapping unit description

In the description of the mapping units contained in the memoirs accompanying the Provincial soil maps the soils are grouped according to the Soil Types and the various units or subunits are described separately starting with a general soil description as outlined in the map legend. This is followed by a description of possible variants or inclusions of other soils which may be found within that mapping unit. This description in some cases may not be easy to read particularly for non-soil scientists. It is therefore recommended that the description should be simplified. The following is suggested.

- Description of the soils as in the map legend (no change)
- Description of the topsoil (all physical and chemical characteristics including the possible range).
- Description of the subsoil (all physical and chemical characteristics including the possible range)
- Description of inclusions within the mapping unit.
- Description of the current land use and vegetation.
- Soil classification (according to both FAO-UNESCO (1988) Revised Legend and the Soil Taxonomy (Soil Survey Staff, 1990)

3.3 Map Compilation

3.3.1 Preparation of the final soil map and the base maps

The issue of map compilation has been addressed substantially by Sorensen (1990). However, some aspects that appertain to the compilation of the final National Soil Map, Scale 1:1,000,000 are worth mentioning.

(a) It is the responsibility of the soil surveyor to ensure that all topographical information that is not needed in the soil map is deleted from the base maps. Information such as trigonometrical stations,huts, cutlines etc should be removed. This is particularly important for readability of the soil map.

(b) The soil surveyors, in this case the National Mappers should check all the connections of the soil boundaries and ensure that they are all connected smoothly and that the final map unit code is indicated in all the units. Although the final drawing of the soil map will be done by the cartographers, the National Mappers should present their draft maps as neatly as possible, preferably in ink and hand coloured.

(c) Before the final National Soil Map is prepared there is a need to check some of the mapping units found within the Rift Valley Trough, the Northern Province and the Western Province. Cross-checking of the soil units delineated on the present draft of the National Soil Map can be carried out by putting together physical and chemical data of representative profiles contained in the various Provincial memoirs and other existing soil reports. The cross-checking of the soil mapping unit descriptions in the soil legend is considered very urgent in order to facilitate finalisation of the draft National Soil Map before the end of October, 1990.

(d) For ease of readability of the soil map, the soil mapping unit code symbols shown in boxes in the legend should be used.

3.3.2 Colour Scheme

It is recommended that the colour scheme to be used for the National Soil Map of Zambia follow that of the recent FAO/1990) World Soil Resources Map. The proposed colour scheme for all the 19 major soil types is shown in Table 3.

It is suggested that the map units are coloured according to the dominant soil unit. Map units having the same dominant soil unit but which differ in their associated soils be separated on the soil map by different symbols. However, where there are soil intergrades, denoted by third level units, intermediate colours close to those of the major soils can be selected.

Table 3 Proposed colour scheme* for the National Soil Map of Zambia, scale 1:1,000,000.

Soil Type	symbol	Colour code** (in %) Black	Yellow	Red	Blue
FLUVISOLS	FL	0	0	0	100
GLEYSOLS	GL	0	0	0	40
REGOSOLS	RG	0	100	10	0
LEPTOSOLS	LP	30	0	0	0
ARENOSOLS	AR	0	100	30	0
VERTISOLS	VR	10	10	50	50
CAMBISOLS	CM	10	100	30	0
SOLONCHAKS	SC	0	0	100	40
SOLONETZ	SN	0	0	70	40
PHAEOZEMS	PH	10	100	40	50
LUVISOLS	LV	10	100	60	0
PLANOSOLS	PL	0	100	0	50
PODZOLS	PZ	0	40	0	20
LIXISOLS	LX	10	100	40	0
ACRISOLS	AC	0	100	40	0
ALISOLS	AL	0	70	50	0
NITISOLS	NT	10	70	100	0
FERRALSOLS	FR	0	70	70	0
HISTOSOLS	HS	50	0	0	0

* Colour scheme similar to that used for the World Soil Resources Map (FAO, 1990)

** Colour code according to Fargguide Europaskalan Liberkartor (1980) colour charts being used by the Cartography section, Ministry of Agriculture, Zambia.

3.3.3. Associations, complexes and inclusions

The following is suggested with regard to presentation of associations, complexes and inclusions in the National Soil Map:-

(a) For soil complexes and soil associations with two components two colours each representative of the major soils constituting the component will have to be selected. It is suggested that the two colours should appear in an alternating pattern of narrow vertical strips.

(b) Soil complexes and associations with more than two components will get only one colour. If is possible cartographic techniques should be applied to make the colour appear with a line pattern.

(c) Soil phases such as rudic, petroferric etc can be shown on the soil map by use of screens.

(d) Major inclusions can be described in the legend, otherwise in general inclusions should be described in the soil mapping unit description in the memoir.

3.3.4 Follow-up

To ensure that the National Soil Map is completed within the time frame outlined in the Workplan contained in Sorensen's report (Sorensen, 1990) the following is suggest as a follow-up:

(1) That the National Mappers complete as a matter of urgency the checking of the current draft National Soil Map in areas outlined under chapter 3.3.1c. Once this is done the final draft map should be circulated to all Provincial soil surveyors together with the legend.

(2) A Technical meeting be held to discuss the final draft soil map and legend. Comments and suggestions considered important can be incorporated and thereafter the map and legend are finalised. If need be the National Mapper can come to Kenya and discuss the final draft soil map and legend with the Consultant and the staff of the Kenya Soil Survey before handing it over to the Cartographers. Cartographic details can also be discussed during this meeting.

It should however be noted that the above suggestions should be implemented in such a way that they do not disrupt the planned schedule of producing the National Soil Map.

4. NATIONAL SOIL MAP MEMOIR/REPORT

4.1 Contents of Soil Survey Reports

Apart from actual presentation of the technical data in a soil survey report there are a number of requirements that should be met:-

(1) The first requirements are those which make the reports look more attractive so that they are more easily opened and looked into. Thus the report must (a) look attractive and (b) be useful to the readers. The soil survey report must be useful for the different kind of report readers.

(2) A second set of requirements are those that make people like to read the reports and collect for their own purposes whatever technical information is given. Therefore the contents of a soil survey report should take into account the needs and interests of various users.

For example

(a) some readers are mainly policy makers and are not primarily interested in the technical part of the report, but mainly in conclusions and recommendations.
(b) others are primarily interested in the technical data about the soils separated eg with respect to the actual profile characteristics
(b) other specialists however want to learn something about the soils, the history of the soils.

From the above it is apparent that the contents of a soil survey report/memoir should take into account the interests of potential users.

4.2 Format and content of the National Soil Map.

A comprehensive account of the possible contents of the Report accompanying the National Soil Map of Zambia is given in Sorensen's (1990) report pages 11 and Appendix VI. I concur with most of his observations. A possible format and content is presented in appendix 5.

5. CONCLUSIONS

5.1 The objective of the National Soil Map Programme to produce an exploratory Soil Map of Zambia on Scale of 1 : 1,000,000 is about to be achieved. The compilation of the National Soil Map is at an advanced stage. A draft map has been compiled on the basis of provincial soil maps on the same scale. A third draft legend for the National Soil Map has also been compiled with the help of the consultant.

5.2 In order to ensure that the National Soil map and the accompanying memoir is completed by 1991, the National Soil Mappers in close collaboration with Soil Correlator and Land Evaluator should endeavour to have the final draft soil map completed by December 1990. Meanwhile work should start on gathering the necessary information on the soil memoir.

To facilitate the completion of the National Soil Map, it is imperative that the Soil Survey Unit staff be given both moral and financial support.

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Many other soil survey reports and soil maps which are not cited in the text were consulted but are not included in the list of References.

Appendix 1. TERMS OF REFERENCE

CONSULTANCY ON THE NATIONAL SOIL MAP OF ZAMBIA

(scale 1:1,000,000)

The objective of this Programme has been to produce a Soil Map of Zambia at 1:1 Million scale with an interpretative accompanying memoir. This inventory will form a basis for national as well as regional agricultural development planning. At the same time it is going to tie in nicely with SADCC's inventory of its soil resources at a similar scale. On a province by province basis the four high rainfall provinces have their maps and reports ready with Eastern, Central, Lusaka and Southern Provinces having maps and draft reports ready while Western Province draft map is ready.

The consultancy, to be carried out over a period of 3 weeks shall entail in-depth office and possible fieldwork. It shall include a preparatory phase of 3-5 days in which the consultant shall study the already published memoirs, draft legend, outline of reports etc before setting off for Zambia.

In order to benefit fully from the consultancy, the consultant shall:

1. Review the structure of the legend, its background, set up and map unit characterization.

2. Assist in determining the smallest mappable unit.

3. Assist in correlating the FAO-UNESCO soil Legend, 1988 version, and re-defining the Zambia specific third unit levels with Soil Taxonomy.

4. Review all the mapping units and the national legend as they would appear on the final map and their classification (as per latest FAO-UNESCO legend)

5. Suggest format and contents of the National Soil Map memoir/report.

6. Suggest ways of how "associations" or"complexes" or indeed "inclusions" or sub-units shall be presented.

7. Submit draft recommendations before leaving Zambia and a final report within one (1) month from the date of departing Zambia.

Appendix 2. ITINERARY OF THE CONSULTANT.

Date/Time		
23-8-90 and 24-8-90	Receipt of Reports from Zambia in Nairobi	Study of the soil maps and Reports
25-8-90 17.00-21.00hrs	Arrival Lusaka Mr. Calle Hedberg	Briefing and Signing of the Contract
26-8-90 10.00-17.00hrs	Lusaka Mt. Makulu Mr. L. Chileshe	Briefing on the National Soil Map
27-8-90 9.00-10.00hrs	NORAD, Lusaka Mr. Chileshe Mr. Sigurd Bjortuft	Introduction of the consultant.
10.00-11.00hrs	Ministry of Agriculture	Introduction of the consultant
11.30-17.00hrs	Mt. Makulu Res. St. National Mappers L. Chileshe and N.C. Mulenga	Introduction and discussions with soil survey staff study of the soil maps and legends
28-8-90 7.15-18.00hrs	Mt. Makulu Res. St.	Compilation of the soil map and Legend, soil classification
30-8-90 7.30-19.00hrs	Mt. Makulu Res. St.	Continuation with compilation of the soil map and Legend, Soil classification
31-8-90 7.30-19.00hrs	Mt. Makulu Res. St.	Compilation of the map and legend, soil classification
1-9-90 8.00-18.00hrs	Mt. Makulu Res. St.	Compilation of map legend, soil classification
2-9-90 9.00-17.00hrs	Mt. Makulu Res. St.	Continuation with the above work
3-9-90 7.30-8.30hrs	Mt. Makulu Res. St.	Checking of the draft soil map legend

		continuation with colouring of the soil map
4-9-90 7.30-8.30hrs	Mt. Makulu Res. St.	Checking of the soil legend
9.00-11.00hrs	Dr. Munyinda Ministry of Agriculture	Briefing on Progress of the National Soil Map
10.00-12.00hrs	Cartography section Ministry of Agriculture Mr. M.H. Chakwira Mr. G.K. Mambwe Mr. Ndabandaba	Discussions on the colour scheme for the National Soil Map.
14.00-18.00hrs	Mt. Makulu Res. St. Messrs Nawa Mukanda Julius P. Daka Brian Chirwa Ronald Msoni Daniel Banda L. Chileshe Nsofwa C. Mulenga	Discussion of the 3rd Draft Legend of the National Soil Map and the revised soil map
5-9-90 7.30-21.00hrs	Mt. Makulu Res. St.	Finalisation of the soil legend soil correlation FAO-UNESCO (1988) and Soil Taxonomy
6-9-90 7.30-18.00hrs	Mt. Makulu Res. St.	Compilation of the Report.
7-9-90 7.30-18.00hrs	Mt. Makulu Res. St.	Continuation with compilation of the Report and Draft Recommendation.
8-9-90 7.30-13.00Hrs	Lusaka/Mt. Makulu Research Station	Finalisation of report. Hand in Draft Report and Recommendations
16.00-18.00hrs	Lusaka Airport	Leave for Nairobi.

Appendix 3

NATIONAL SOIL MAP OF ZAMBIA
SCALE 1:1,000,000

LEGEND

	M	**MOUNTAINS AND MAJOR SCARPS (slopes predominantly over 30%.)**
	MQ	**Soils developed on granitic gneisses**
M	MQLPd	well drained, shallow to moderately shallow, dark brown friable, rocky, coarse loamy to fine loamy soils (**eutric LEPTOSOLS**, rudic phase; with **lithic LEPTOSOLS**)
	H	**HILLS AND MINOR SCARPS (slopes predominantly over 16%)**
	HQ	**Soils developed on granitic gneisses, quartzites and pelites**
H1	HQLPd	well drained, shallow to moderately shallow, yellowish brown to yellowish red, friable, fine loamy soils; in places gravelly fine loamy to clayey (**dystric LEPTOSOLS**)
H2	HQA	association of: - well drained, moderately deep to deep, brown, friable fine loamy soils with a loamy sand to sandy loam topsoil (**dystric REGOSOLS**) - Quartzitic rock outcrops
	HT	**Soils developed on Kundelungu shales and siltstones.**
H3	HTA	association of: -well drained, very deep, yellowish red to strong brown, friable clayey soils (**chromi-haplic FERRALSOLS**). - well drained, shallow to moderately shallow, yellowish red to yellowish brown, fine loamy soils (**dystric LEPTOSOLS**)
	HU	**Soils developed on undifferentiated Basement Complex rocks**
H4	HUA	association of: - well drained, shallow to moderately shallow, brown to dark brown, friable, coarse to fine loamy soils (**dystric LEPTOSOLS**) - well drained, deep to very deep, red to strong brown, friable, fine loamy to clayey soils (**chromi-haplic LIXISOLS**)
	He	**HILLS AND FAULTED SCARPS OF THE RIFT VALLEY (variable slopes)**
	HeQ	**Soils developed on granitic gneisses.**

H5	HeQLPe	excessively drained to well drained, shallow to moderately shallow, dark brown to yellowish brown, friable, stony, gravelly, coarse to fine loamy soils (**eutric LEPTOSOLS**; rudic phase; with **lithic LEPTOSOLS**).
	F	**FOOTSLOPES AND DISSECTED UPPER VALLEYS OF THE RIFT VALLEY (slopes 2-8%)**
	FK	**Soils developed on colluvium derived from undifferentiated Karroo sediments**
F	FKAR1	well drained, deep to very deep, red to yellowish red, loose to very friable, coarse loamy soils, in places shallow, rocky and stony (**luvic ARENOSOLS**; with **dystric** and **lithic LEPTOSOLS**)
	P	**PLATEAU**
	Pu	**flat to gently undulating (slopes 0-5%)**
	PuU	**Soils developed on undifferentiated Basement complex rocks (mainly granitic gneisses)**
Pu1	$PuULXh_1$	well drained, very deep, dark red to red, friable, fine loamy to clayey soils (**rhodi-haplic LIXISOLS**)
Pu2	$PuULXh_2$	well drained, very deep, strong brown to red, friable, fine loamy to clayey soils; in places abruptly underlying a thick pale brown to white loamy sand to sandy loam topsoil (**chromi-hapli LIXISOLS**)
Pu3	PuUACh	well drained, deep to very deep, yellowish red to strong brown, friable, fine loamy to clayey soils; with inclusions (20%) of moderately well drained to imperfectly drained, deep to moderately shallow, gravelly clayey soils. (**chromi-haplic ACRISOLS**; with **pisi-haplic** and **gleyi-haplic ACRISOLS**, partly skeletic phase; **dystric LEPTOSOLS**)
Pu4	PuUACp	well drained to moderately well drained, very deep, brownish yellow to pale brown, friable, fine loamy to clayey soils with a thick sandy loam to loamy sand topsoil (**plinthic ACRISOLS**)
Pu5	$PuUA_1$	association of: - soils of unit PuULXh1 - moderately well drained to imperfectly drained, very deep, pale brown to brownish yellow, loose to very friable, coarse loamy soils (**luvic ARENOSOLS**)
Pu6	$PuUA_2$	association of: - soils of unit PuULXh1 - poorly drained to imperfectly drained, very deep, brown, slightly firm clayey soils (**dystric** and **eutric GLEYSOLS**)

Pu7	$PuUA_3$	association of: - soils of unit PuUACh - soils of unit PuTFRh1
Pu8	$PuUA_4$	association of: - soils of unit PuUACh - very poorly drained, light brown to light yellowish brown, loose to very friable, coarse loamy soils; in places with a humic topsoil (**dystric GLEYSOLS**)
	PuA	**Soils developed on undifferentiated unconsolidated sediments (colluvium and alluvium).**
Pu9	PuAA	association of: - well drained to moderately well drained, deep, strong brown, friable clayey soils with a humic topsoil (**chromi -haplic ALISOLS**) -well drained, moderately deep to very deep, yellowish red to strong brown, friable, fine loamy to clayey soils (**chromi-haplic ACRISOLS**)
	PuB	**soils developed on basic rocks rich in ferro-magnesian minerals (gabbros,dolerites, amphibolites)**
Pu10	PuBLXh1	well drained, very deep, dark red to dark reddish brown, friable clayey soils with a humic topsoil (**rhodi-haplic LIXISOLS**)
Pu11	PuBNTr	well drained, very deep, dark red, friable clayey soils (**rhodic NITISOLS**)
	PuL	**soils developed on carbonates and meta-carbonates**
Pu12	PuLLVh	well drained, very deep, dark red to dark reddish brown, friable to slightly firm, clayey soils with a humic topsoil (**rhodi-haplic LUVISOLS**)
Pu13	PuLNTr	well drained, very deep, red to dark reddish brown, friable clayey soils with a humic topsoil (**rhodic NITISOLS**)
Pu14	PuLPHh	moderately well drained, very deep, dark grayish brown to grayish brown, friable, fine loamy soils with a humic topsoil (**haplic PHAEOZEMS**).
Pu15	$PuLPHl_1$	well drained, very deep, dark red to dark reddish brown, friable clayey soils with a humic topsoil (**rhodi-luvic PHAEOZEMS**)

Pu16	$PuLPHl_2$	well drained, very deep, dark reddish brown, friable, fine clayey soils with a humic topsoil (**niti-luvic PHAEOZEMS**)
Pu17	PuLFRr	well drained, very deep, dark red to red, friable clayey soils with a humic topsoil and frequent oxidic gravels in the subsoil (**rhodic FERRALSOLS**)
Pu18	PuLFRx	well drained to moderately well drained, very deep, yellowish brown, friable clayey soils (**xanthic FERRALSOLS**)
Pu19	PuLLPe	moderately well drained to imperfectly drained, shallow, dark brown to yellowish brown, coarse to fine loamy soils (**eutric LEPTOSOLS**)
	PuC	**Soils developed on calc-silicate schists**
Pu20	PuCLXf	well drained, very deep, yellowish red, friable, fine loamy to clayey soils, (**ferric LIXISOLS**)
Pu21	PuCLVx	well drained, moderately deep to deep, dark red, friable, fine loamy to clayey soils (**chromic LUVISOLS**(?))
Pu22	PuCA	association of: - soils of unit PuCLVx - poorly drained, very deep, very dark grey, firm, neutral to mildly alkaline, cracking, fine clayey soils; in places calcareous (**eutric VERTISOLS** and **calcari -eutric VERTISOLS**)
	PuT	**Soils developed on Kundelungu shales, schists and siltstones.**
Pu23	$PuTFRh_1$	well drained, very deep, strong brown to yellowish red, friable, gravelly clayey soils with a high silt/clay ratio; in places overlying pisoferric material (**chromi-haplic FERRALSOLS**)
Pu24	$PuTFRh_2$	well drained, deep to very deep, yellowish red, friable, very gravelly clayey soils with a high silt /clay ratio (**chromi- haplic FERRALSOLS**, skeletic phase)
Pu25	PuTACg	moderately well drained to imperfectly drained, very deep, light yellowish brown to pale brown, friable, fine loamy to clayey soils; in places shallow over ironstone (**gleyic ACRISOLS**; with **dystric LEPTOSOLS**)

Pu26	PuTRGd	moderately well drained, very deep, brown to very pale brown, friable, fine loamy to clayey soils; in places imperfectly drained (**dystric REGOSOLS**)
Pu27	PuTLPd	moderately well drained to imperfectly drained, moderately shallow, brown to yellowish brown, friable clayey to fine loamy soils over ironstone with high silt/clay ratio; in many places with outcrops of ironstone (**dystric LEPTOSOLS**, petroferric phase; with **lithic LEPTOSOLS**)
Pu28	PuTA	association of: - well drained, very deep, yellowish red to strong brown, friable clayey soils (**chromi-haplic FERRALSOLS**) - well drained, shallow to moderately shallow, yellowish red to yellowish brown, gravelly, fine loamy soils; common isolated ridges; in places with ironstone outcrops (**dystric LEPTOSOLS**, skeletic phase, with **lithic LEPTOSOLS**)
	PuQ	**Soils developed on quartzites and metaquartzites.**
Pu29	PuQACh	well drained, moderately deep to deep, yellowish red to strong brown, friable, gravelly, fine loamy soils (**pisi-haplic ACRISOLS**, skeletic phase)
Pu30	PuQARo	well drained, very deep, red to reddish brown, loose to very friable, coarse loamy soils (**ferralic ARENOSOLS**)
	PuG	**Soils developed on granites**
Pu31	PuGALh	well drained, moderately deep to deep, red to strong brown, friable, gravelly, fine loamy to clayey soils (**chromi-haplic ALISOLS**, partly skeletic phase)
Pu32	PuGC	complex of: - well drained, shallow to moderately shallow, dark brown to dark yellowish brown, rocky, fine loamy to clayey soils (**eutric and dystric LEPTOSOLS**, rudic phase) - well drained, deep to very deep, dark brown to strong brown, friable, fine loamy to clayey soils (**haplic ACRISOLS**)
	Pd	**Dissected plateau (slopes 5-16%)**
	PdT	**Soils developed on Kundelungu shales, schists and siltstones**

Pd1	PdTCMo	well drained, moderately deep to very deep, yellowish red to strong brown, friable, gravelly clayey soils; in places moderately shallow (**chromi-ferralic CAMBISOLS**, with **dystric LEPTOSOLS**, skeletic phase)
	PdB	**Soils developed on colluvium derived from basic rocks rich in ferromagnesian minerals**
Pd2	PdBCMx	well drained to moderately well drained, moderately deep to deep, red to strong brown, friable, gravelly, fine loamy to clayey soils (**chromic** and **eutric CAMBISOLS**, skeletic phase)
	PdQ	**Soils developed on granitic gneisses and quartzites.**
Pd3	PdQA	association of: - well drained, moderately deep to deep, yellowish brown to dark brown, friable, fine loamy to clayey soils (chromi -haplic ACRISOLS) - well drained, shallow to moderately shallow, dark brown, friable, fine loamy soils; in places rocky (**dystric** and **lithic LEPTOSOLS**).
Pd4	PdQC1	complex of: excessively drained to well drained, shallow to moderately shallow, dark brown to yellowish brown, friable, coarse to fine loamy soils (**eutric LEPTOSOLS**) - well drained, moderately deep to deep, red, friable, fine loamy to clayey soils (**chromic CAMBISOLS**)
Pd5	PdQC2	complex of: - well drained, very deep, red to strong brown, friable, fine loamy to clayey soils (**chromi-haplic ACRISOLS**) - well drained, moderately deep to deep, yellowish red to strong brown, gravelly fine loamy soils (**pisi-haplic ACRISOLS**, skeletic phase)
	PdU	**Soils developed on undifferentiated Basement complex rocks**
Pd6	$PdUA_1$	association of: - well drained, shallow to moderately shallow, dark brown, friable, fine loamy to clayey soils with humic topsoil (**eutric LEPTOSOLS**) - moderately well drained, deep to very deep, red to strong brown, friable, fine loamy to clayey soils (**chromi-haplic LIXISOLS**)
Pd7	$PdUA_2$	association of: - well drained, moderately deep to deep, yellowish red, friable clayey soils with a high silt/clay ratio (**chromic LUVISOLS**) - well drained, shallow to moderately deep, dark brown to strong brown, friable, rocky, stony, gravelly, fine loamy and clayey soils (**dystric LEPTOSOLS**, partly rudic phase)

E **Plains (aggraded Plateau) (slopes 0-3%)**

Es **Sedimentary Plains**

EsE **Soils developed on eolian deposits (Kalahari sands)**

Es1	EsEARa	excessively drained, very deep, brown to pale brown, loose sandy soils (albic **ARENOSOLS**)
Es2	EsEARoa	excessively drained, very deep, pale brown, to very pale brown, loose sandy soils (albi-ferralic **ARENOSOLS**)
Es3	EsEARor	excessively drained, very deep, dark red, loose sandy soils (rhodi-ferralic **ARENOSOLS**)
Es4	EsEARo	Somewhat excessively drained, very deep, very pale brown to yellowish brown, loose to very friable, sandy soils (ferralic **ARENOSOLS**)
Es5	EsEPZc	Somewhat excessively drained, very deep, very dark grey to dark yellowish brown, loose sandy soils; common, pan dambos (cambic **PODZOLS**; with mollic **GLEYSOLS** and fibric **HISTOSOLS**)
Es6	EsEACh	Somewhat excessively drained, very deep, yellowish brown to yellowish red, very friable, coarse loamy soils (chromi -haplic **ACRISOLS**)
Es7	EsEARg	imperfectly drained, very deep, pale brown to very pale brown, loose to very friable sandy soils; in places yellowish brown (gleyic **ARENOSOLS**)
Es8	$EsEA_1$	association of: - soils of unit EsEARo - soils of unit EsEACh
Es9	$EsEA_2$	association of: - soils of unit EsEACh - soils of unit PuUACh
Es10	$EsEA_3$	association of: - soils of unit EsEACh - moderately well drained to imperfectly drained, very deep, friable, fine loamy to clayey soils (gleyic **ACRISOLS**)
Es11	$EsEA_4$	association of: - soils of unit EsEARoa - soils of unit EsEARg

Es12	$EsEA_5$	association of: - soils of unit EsEARg - poorly drained, very deep, very dark grey, friable, fine loamy to clayey soils with a humic topsoil (**umbric GLEYSOLS**)
Es13	$EsEA_6$	association of: - somewhat excessively drained, very deep, very dark brown, loose sandy soils (**spodi-ferralic ARENOSOLS**) - excessively drained, very deep, very dark grey, loose sandy soils with acid humic topsoil (**ferralic ARENOSOLS**)
Es14	$EsEA_7$	association of: - soils of unit EsEARoa - moderately well drained to imperfectly drained, very deep, dark grayish brown to very pale brown, loose sandy soils (**gleyic PODZOLS**)
Es15	EsEC	complex of: - soils of unit EsEARoa - somewhat excessively drained, very deep, very dark brown, loose sandy soils; in places with a spodic deeper subsoil (**spodi-ferralic ARENOSOLS** with **carbic PODZOLS**)
	Ed	**Dissected Plains**
	EdB	**Soils developed on basalts**
Ed	EdBC	complex of: - well drained, shallow, reddish brown to dark brown, friable, stony, clayey soils (**eutric LEPTOSOLS**) - moderately well drained to well drained, strong brown to dark reddish brown, friable to firm, clayey soils with high silt/clay ratio (**haplic SOLONETZ**)
	Et	**Older alluvial plains and higher river terraces in the Rift Valley Trough (slopes 0 - 2%)**
	EtK	**Soils developed on alluvium derived from undifferentiated Karroo sediments**
Et1	EtKLVx	well drained, very deep, reddish brown to dark yellowish brown, slightly firm, clayey soils with a humic topsoil (**chromic LUVISOLS**)
Et2	EtKSNk	imperfectly to somewhat poorly drained, deep, dark brown to brown, firm, strongly sodic clayey soils with high silt/clay ratio (**calcic SOLONETZ**)

Et3	$EtKA_1$	association of: - well drained, shallow to moderately shallow, dark brown to strong brown, loose to friable, coarse to fine loamy soils (**dystric LEPTOSOLS**) - well drained, very deep, reddish brown to dark yellowish brown, friable clayey soils (**chromi-haplic LUVISOLS**)
Et4	$EtKA_2$	association of: - poorly drained, deep, dark brown, firm, cracking, fine clayey soils (**eutric VERTISOLS**) - well drained, very deep, yellowish red, friable to firm, fine loamy soils with a humic topsoil (**chromi-haplic PHAEOZEMS**)
Et5	$EtKA_3$	association of: - well drained, moderately shallow to deep, yellowish red, friable clayey soils (**chromic CAMBISOLS**) - well drained, shallow to moderately shallow, dark brown to brown, friable, fine loamy to clayey soils (**eutric LEPTOSOLS**)
Et6	$EtKC_1$	complex of: - imperfectly drained to poorly drained, very deep, very dark grayish brown, firm, calcareous, cracking clayey soils (**calcic VERTISOLS**) - moderately well drained, very deep, dark reddish brown, slightly firm, calcareous fine clayey soils; in places cracking (**calcari-haplic LUVISOLS**; with **vertic LUVISOLS**)
Et7	$EtKC_2$	complex of: - imperfectly drained, very deep, dark grayish brown, to yellowish brown, friable, stratified clayey soils (**eutric FLUVISOLS**) - moderately well drained to well drained, very deep, yellowish brown to dark yellowish brown, firm, calcareous clayey soils (**calcic LUVISOLS**)
Et8	$EtKC_3$	complex of: - imperfectly drained, olive brown to brown, firm, sodic clayey soils (**haplic SOLONETZ**) - well drained, very deep, yellowish red to strong brown, friable to slightly firm, clayey soils; in places cracking (**chromi-haplic LUVISOLS**; with **eutric VERTISOLS**)

A **FLOODPLAINS**

AA **Soils developed on undifferentiated alluvial sediments**

A1	AAGLd	poorly drained, very deep, light brown to light yellowish brown, loose to very friable, coarse loamy soils; in places with a humic topsoil (**dystric GLEYSOLS**)
A2	AAARg	imperfectly drained to poorly drained, very deep, dark brown to dark yellowish brown, friable, coarse loamy soils (**gleyic ARENOSOLS**)
A3	AAGLu	poorly drained, very deep, light brownish grey to grayish brown, loose, coarse loamy to fine loamy soils; in places fine clayey soils with a mucky topsoil (**umbric GLEYSOLS**; with **terric HISTOSOLS**)
A4	AAGLdu	poorly drained, very deep, grayish brown, friable to firm, fine loamy to clayey soils; in places with humic topsoil (**fluvi-dystric GLEYSOLS**; with **umbric GLEYSOLS**)
A5	AAVRe	poorly drained, very deep, very dark grey, very firm, calcareous, cracking fine clay soils (**eutric VERTISOLS**; with **calcic** and **dystric VERTISOLS**)
A6	AAPLe	imperfectly drained to poorly drained, very deep, dark grey, firm, clayey to fine clayey soils abruptly underlying a sandy loam to silty clay loam topsoil (**eutric PLANOSOLS**(?))
A7	AAFLe	very poorly drained, very deep, light brownish grey, very friable, stratified, fine to coarse loamy soils with a humic topsoil (**eutric FLUVISOLS**; with **gleyic ARENOSOLS**)
A8	AAA_1	association of: - poorly drained, very deep, grayish brown to dark olive grey, firm, calcareous, cracking, fine clayey soils; 60% (**calcic VERTISOLS**; with **eutric VERTISOLS**) - well drained to moderately well drained, deep, dark yellowish brown to strong brown, very friable, fine clayey soils with a humic topsoil (**haplic ALISOLS**)
A9	AAA_2	association of: - soils of unit AAVRe (60%) - soils of unit EsEARo (40%)

A10	AAA_3	association of: - moderately well drained to imperfectly drained, shallow to moderately deep, grayish brown to brown, friable clayey soils; in places with outcrops of ironstone (**dystric REGOSOLS**; with **dystric LEPTOSOLS**) - poorly drained, very deep, very dark grey, firm, cracking fine clayey soils (**calcic VERTISOLS**)
A11	AAC_1	complex of: - imperfectly drained, very deep, grayish brown to light grey, loose sandy soils; in places with 20 - 60 cm peaty and mucky topsoils (**greyic ARENOSOLS**; with **terric HISTOSOLS**) - imperfectly drained to poorly drained, very deep, dark grey to grayish brown, friable to firm, clayey soils abruptly underlying a sandy loam to loam topsoil (**eutric PLANOSOLS**) - poorly drained, very deep, very dark grayish brown, loose, sandy soils with a humic topsoil (**umbric GLEYSOLS**) - poorly drained, very deep, black to dark brown, very firm calcareous, cracking, fine clayey soils (**calcic VERTISOLS**)
A12	AAC_2	complex of: - moderately well drained to imperfectly drained, moderately shallow, brown to yellowish brown, friable, fine loamy to clayey soils over ironstone (**dystric LEPTOSOLS**, petroferric phase) - poorly drained, very deep, light olive brown, very friable, clayey soils (**eutric GLEYSOLS**).
A13	AAC_3	complex of: - soils of unit AAVRe - poorly drained, very deep, grayish brown firm clayey soils with a humic topsoil (**verti-mollic GLEYSOLS**)
	AK	**soils developed on alluvium derived from undifferentiated Karroo sediments**
A14	AKFLe	imperfectly drained, to poorly drained, very deep, dark yellowish brown to dark brown, friable to firm, stratified, fine loamy to clayey soils; in places coarse loamy (**eutric FLUVISOLS**)

	D	**DAMBOS**
	DA	**Soils developed on undifferentiated unconsolidated sediments (colluvium and alluvium)**
D1	DAGLd	very poorly drained, light brown to light yellowish brown, loose to very friable, coarse loamy soils; in places with a humic topsoil (**dystric GLEYSOLS**)
D2	DAGLu	poorly drained to very poorly drained, very deep, grayish brown to grey, slightly firm, fine loamy to clayey soils with a humic topsoil (**umbric GLEYSOLS**)
D3	DASCg	imperfectly drained to poorly drained, very deep, dark bluish grey, mottled, slightly firm, saline and sodic, clayey soils (**gleyic SOLONCHAKS**)
D4	DAHSf	very poorly drained, very deep, black clayey soils with 50 - 80 cm of weakly decomposed organic materials (**fibric HISTOSOLS**)
D5	DAHSs	very poorly drained, light olive brown to dark grayish brown, very deep, fine loamy to clayey soils with a 20 - 40 cm mucky topsoil; in places with unripe clay (**terric HISTOSOLS**)
D6	DAVRe	poorly drained, very deep, very dark grey, firm, cracking clayey soils with a humic topsoil (**calcari-eutric VERTISOLS**)
D7	DAPLd	imperfectly drained to poorly drained, very deep, very dark grayish brown to light brownish grey, firm, clayey soils with a high silt/clay ratio abruptly underlying a sandy loam to silt clay loam topsoil (**verti-dystric PLANOSOLS** with **mollic** and **eutric PLANOSOLS**)
D8	DAA_1	association of: - soils of unit PuUACh - soils of unit AAGLu
D9	DAC_1	complex of poorly drained, very deep, grayish brown to light brownish grey, friable clayey soils with high silt/clay ratio and a humic topsoil (**mollic GLEYSOLS** and **eutric GLEYSOLS**)
D10	DAC_2	complex of: - very poorly drained, very deep, black, partly decomposed to decomposed peat overlying coarse sandy to fine loamy soils (**fibric HISTOSOLS**) - poorly drained, very deep, very dark grayish brown, loose sandy soils with a humic topsoil (**umbric** and **dystric GLEYSOLS**)

D11	DAC_3	complex of: - soils of unit $PuLPHl_2$ - soils of unit **AAVRe**
	S	**SWAMPS**
S1	SHSf	very poorly drained, very deep, dark grey, firm, fine loamy to clayey soils with 10 - 15 cm of undecomposed organic materials; permanent swamps (**fibric HISTOSOLS**; with **dystric GLEYSOLS** and **terric HISTOSOLS**)

Appendix 4. SOIL CORRELATION ACCORDING TO FAO-UNESCO 1988) REVISED LEGEND AND SOIL TAXONOMY

Soil mapping Unit	FAO-UNESCO (1988)	SOIL TAXONOMY (SOIL SURVEY STAFF, 1990)
MQLPd	eutric LEPTOSOLS Lithic LEPTOSOLS	Lithic EUTROPEPTS
HQLPd	dystric LEPTOSOLS	Lithic DYSTROPEPTS
HQA	dystric REGOSOLS	Typic USTORTHENTS
HTA	chromi-haplic FERRALSOLS dystric LEPTOSOLS	Typic KANDIUSTOX (?) Lithic DYSTROPEPTS or Lithic USTORTHENTS
HUA	dystric LEPPTOSOLS chromi-haplic LIXISOLS	Lithic DYSTROPEPTS Typic KANHAPLUSTALFS (?)
HeQLPe	eutric LEPTOSOLS lithic LEPTOSOLS	Lithic EUTROPEPTS
FKAR1	luvic ARENOSOLS dystric and Lithic LEPTTOSOLS	Ustoxic QUARTZI-PSAMMENTS
PuULXh1	rhodi-haplic LIXISOLS	Rhodic KANHAPLUSTALFS
PuULXh2	chromi-haplic LIXISOLS	Typic KANHAPLUSTALFS
PuUACh	chromi-haplic ACRISOLS pisi-haplic ACRISOLS gleyi-haplic ACRISOLS dystric LEPTOSOLS	Typic KANHAPLUSTALFS " Epiaquic KANHAPLUSTULTS Lithic KANHAPLUSTULTS
PuUACp	Plinthic ACRISOLS	Plinthic KANHAPLUSTULTS
PuUA1	rhodi-haplic LIXISOLS Luvic ARENOSOLS	Rhodic KANHAPLUSTALFS Ustoxic QUARTZIP-SAMMENTS
PuUA2	rhodi-haplic LIXISOLS dystric GLEYSOLS eutric GLEYSOLS	Rhodic KANHAPLUSTALFS Typic TROPAQUEPTS (?) TROPAQUENTS (?)
PuUA3	chromi-haplic ACRISOLS chromi-haplic FERRALSOLS	Typic KANHAPLUSTULTS Typic KANDIUSTOX (?)

PuA4	dystric GLEYSOLS chrom-haplic ACRISOLS	TROPAQUENTS ? Typic KANHAPLUSTULTS
PuAA	chromi-haplic ALISOLS chromi-haplic ACRISOLS	Typic HAPLUSTULTS Typic KANHAPLUSTULTS
PuUBLXh1	rhodi-haplic LIXISOLS	Rhodic KANHAPLUSTALFS
PuBNTr	rhodic NITISOLS	Kandic PALEUSTALFS (?) Rhodic PALEUSTALFTS
PuLLVh	rhodic-haplic LUVISOLS	Typic RHODUSTALFS
PuLNTr	rhodic NITISOLS	Kandic PALEUSTALFS (?) Rhodic PALEUSTALFTS
PuLPHh	haplic PHAEOZEMS	oxic HAPLUSTOLLS ?
PuLPHl1	rhodi-luvic PHAEOZEMS	Typic ARGIUSTOLLS
PuLPHl2	niti -luvic PHAEOZEMS	Typic ARGIUSTOLLS
PuLFRr	rhodic FERRALSOLS	Rhodic KANDIUSTOX Rhodic EUTRUSTOX (?)
PuLFRx	xanthic FERRALSOLS	xanthic HAPLUSTOX
PuLLPe	eutric LEPTOSOLS	Lithic EUTROPEPTS
PuCLXf	ferric LIXISOLS	Typic KANHAPLUSTALFS
PuCLVx	chromic LUVISOLS	Typic RHODUSTALFS (?)
PuCA	chromic LUVISOLS eutric VERTISOLS	Typic RHODUSTALFS Typic PELLUSTERTS
PuTFRh1	chromi-haplic FERRALSOLS	Typic HAPLUSTOX
PuTFRh2	chromi-haplic FERRALSOLS	Petroferric HAPLUSTOX (?) Typic HAPLUSTOX (?)
PuTACg	gleyic ACRISOLS dystric LEPTOSOLS	Aquic KANHAPLUSTULTS Lithic KANHAPLUSTULTS
PuTRGd	dystric REGOSOLS	Typic USTORTHENTS
PuTLXd	dystric LEPTOSOLS Lithic LEPTOSOLS	Lithic DYSTROPEPTS Petroferric DYSTROPEPTS
PuTA	chromi-haplic FERRALSOLS	Typic HAPLUSTOX

	dystric LEPTOSOLS	Lithic DYSTROPEPTS
PuQACh	pisi-haplic ACRISOLS	Typic KANHAPLUSTULTS
PuQARo	ferralic ARENOSOLS	Ustic QUARTZIPSAMMENTS
PuGALh	chromi-haplic ALISOLS	Typic RHODUSTULTS Typic HAPLUSTULTS
PuGC	eutric LEPTOSOLS	Lithic EUTROPEPTS Lithic DYSTROPEPTS
	dystric LEPTOSOLS	Lithic KANHAPLUSTULTS
	haplic ACRISOLS	Typic KANHAPLUSTULTS
PdTCMo	chromi-ferralic CAMBISOLS	Ustoxic DYSTROPEPTS
	dystric LEPTOSOLS	Lithic DYSTROPEPTS
PdBCMx	chromic CAMBISOLS	Typic EUTROPEPTS
	eutric CAMBISOLS	Typic EUTROPEPTS
PdQC1	eutric LEPTOSOLS	Lithic EUTROPEPTS
	chromic CAMBISOLS	Typic EUTROPEPTS
PdQC2	chromi-haplic ACRISOLS	Typic KANHAPLUSTULTS
	pisi-haplic ACRISOLS	Typic KANHAPLUSTULTS
PdQA	chromi-haplic ACRISOLS	Typic KANHAPLUSTULTS
	dystric LEPTOSOLS	Lithic KANHAPLUSTULTS
	Lithic LEPTOSOLS	" "
PdUA1	eutric LEPTOSOLS	Lithic USTROPEPTS
	chromi-haplic LIXISOLS	Typic KANHAPLUSTALFS
PdUA2	chromic LUVISOLS	Typic PALEUSTALFS
	dystric LEPTOSOLS	Lithic DYSTROPEPTS
EsEARa	albic ARENOSOLS	spodic QUARTZIPSAMMENTS
EsEARoa	albic ferralic ARENOSOLS	spodic QUARTZIPSAMMENTS
EsEARo	ferralic ARENOSOLS	ustic- QUARTZIPSAMMENTS
EsEPZc	carbic PODZOLS	Typic TROPOHUMODS
	mollic GLEYSOLS	Mollic TROPAQUENTS
	fibric HISTOSOLS	Typic TROPOFIBRISTS
EsEACh	chromi-haplic ACRISOLS	Typic KANHAPLUSTULTS
EsEARg	gleyic ARENOSOLS	Typic PSAMMAQUENTS
EsEA1	ferralic ARENOSOLS	ustic QUARTZIPSAMMENTS
	chromi-haplic ACRISOLS	Typic KANHAPLUSTULTS

EsEA2	chromi-haplic ACRISOLS	Typic KANHAPLUSTULTS
	pisi-haplic ACRISOLS	Typic KANHAPLUSTULTS
	gley-haplic ACRISOLS	Epiaquic KANHAPLUSTULTS
	dystric LEPTOSOLS	Lithic KANHAPLUSTULTS
EsEA3	albic ferralic ARENOSOLS	spodic QUARTZIPSAMMENTS
	gleyic ARENOSOLS	Typic PSAMMAQUENTS
EsEA4	albic ferralic ARENOSOLS	spodic QUARTZIPSAMMENTS
	gleyic ARENOSOLS	Typic PSAMMAQUENTS
EsEA5	gleyic ARENOSOLS	Typic PSAMMAQUENTS
	umbric GLEYSOLS	- TROPAQUENTS.
EsEA6	spodi-ferralic ARENOSOLS	spodic QUARTZIPSAMMENTS
	ferralic ARENOSOLS	ustic QUARTZIPSAMMENTS
EsEC	spodi-ferralic ARENOSOLS	spodic QUARTZIPSAMMENTS
	carbic PODZOLS	Typic TROPOHUMODS
EdBC	eutric LEPTOSOLS	Lithic EUTROPEPTS
	haplic SOLONETZ	Typic NATRUSTALFS
EtKLVx	chromic LUVISOLS	Typic PALEUSTALFS
EtKSNk	calcic SOLONETZ	Typic NATRUSTALFS
EtKA1	dystric LEPTOSOLS	Lithic DYSTROPEPTS
	chromi-haplic LUVISOLS	Typic PALEUSTALFS
EtKA2	eutric VERTISOLS	Typic CHROMUSTERTS
	chromi-haplic PHAEOZEMS	Typic ARGIUSTOLLS
EtKA3	chromic CAMBISOLS	Typic EUTROPEPTS
	eutric LEPTOSOLS	Lithic EUTROPEPTS
EtKC1	calcic VERTISOLS	Typic CHROMUSTERTS
	calcari-haplic LUVISOLS	Typic PALEUSTALFS
EtKC2	eutric FLUVISOLS	TROPOFLUVENTS
	calcic LUVISOLS	Calciorthidic PALEUSTALFS
EtKC3	haplic SOLONETZ	Typic NATRUSTALFS
	chromi-haplic LUVISOLS	Typic PALEUSTALFS
	eutric VERTISOLS	Typic CHROMUSTERTS.
AAGLd	dystric GLEYSOLS	- TROPAQUENTS

AAARg	gleyic ARENOSOLS	Typic PSAMMAQUENTS
AAGLu	umbric GLEYSOLS	TROPAQUENTS
	terric HISTOSOLS	Terric TROPOSAPRISTS
AAGLdu	fluvi-dystric GLEYSOLS	Fluvic TROPAQUENTS
	umbric GLEYSOLS	- TROPAQUENTS
AAVRe	eutric VERTISOLS	Typic CHROMUSTERTS
	calcic VERTISOLS	" "
	dystric VERTISOLS	" "
AAPLe	eutric PLANOSOLS	Typic ALBAQUALFS
AAFle	eutric FLUVISOLS	- TROPOFLUVENTS
	gleyic ARENOSOLS	Typic PSAMMAQUENTS
AAA1	calcic VERTISOLS	Typic PELLUSTERTS
	eutric VERTISOLS	Typic PELLUSTERTS
	haplic ALISOLS	Typic HAPLUSTULTS
AAA2	eutric VERTISOLS	Typic CHROMUSTERTS
	calcic VERTISOLS	Typic CHROMUSTERTS
	ferralic ARENOSOLS	ustic QUARTZIPSAMMENTS
AAA3	dystric REGOSOLS	Typic USTORTHENTS
	dystric LEPTOSOLS	Lithic KANHAPLUSTULTS
	calcic VERTISOLS	Typic CHROMUSTERTS
AAC1	greyic ARENOSOLS	Typic PSAMMAQUENTS
	terric HISTOSOLS	Terric TROPOSAPRISTS
	eutric PLANOSOLS	Typic ALBAQUALFS
	umbric GLEYSOLS	Typic TROPAQUENTS
	calcic VERTISOLS	Typic CHROMUSTERTS
AAC2	dystric LEPTOSOLS	Lithic DYSTROPEPTS
	eutric GLEYSOLS	- TROPAQUENTS
AAC3	verti-mollic GLEYSOLS	Vertic/mollic TROPAQUENTS
	eutric VERTISOLS	Typic CHROMUSTERTS
	calcic VERTISOLS	" "
DAGLd	DYSTRIC GLEYSOLS	Typic PSAMMAQUENTS
DAGLu	umbric GLEYSOLS	Typic TROPAQUENTS
DASCg	gleyic SOLONCHAKS	Typic NATRAQUALFS(?)
DAHSf	fibric HISTOSOLS	Typic TROPOFIBBRISTS
DAHSs	terric HISTOSOLS	Terric TROPOSAPRISTS
DAVRe	calcari-eutric VERTISOLS	Typic CHROMUSTERTS
DAPLd	verti-dystric PLANOSOLS	Ruptic-Vertic ALBAQUALFS
	mollic PLANOSOLS	mollic ALBAQUALFS
	eutric PLANOSOLS	Typic ALBAQUALFS

DAA1	chromi-haplic ACRISOLS	Typic KANHAPLUSTULTS
	gleyi-haplic ACRISOLS	Epiaquic KANHAPLUSTULTS
	umbric GLEYSOLS	Typic TROPAQUENTS
	terric HISTOSOLS	Terric TROPOSAPRISTS
DAC1	mollic GLEYSOLS	Mollic TROPAQUENTS.
	eutric GLEYSOLS	Typic TROPAQUENTS
DAC2	fibric HISTOSOLS	Typic TROPOFIBRISTS
	umbric GLEYSOLS	Typic PSAMMAQUENTS
	dystric GLEYSOLS	Typic PSAMMAQUENTS
DAC3	niti-luvic PHAEOZEMS	Typic ARGIUSTOLLS
	eutric VERTISOLS	Typic CHROMUSTERTS
	calci VERTISOLS	" "
	dystric VERTISOLS	" "
SHSf	fibric HISTOSOLS	Typic TROPOFIBRISTS
	terric HISTOSOLS	Terric TROPOSAPRISTS
	dystric GLEYSOLS	Typic TROPAQUENTS

Appendix 5. SUGGESTED TABLE OF CONTENTS FOR THE MEMOIR/REPORT OF THE NATIONAL SOIL MAP

FOREWORD (by Permanent Secretary Ministry of Agriculture)

SUMMARY(content intended for the busy administrator who may be vitally interested in learning how the broad findings of the National Soil Map can affect his development planning).

1. INTRODUCTION (background information)

2. THE ENVIRONMENT (brief account only)
2.1 Location, population and communications
2.2 Climate (rainfall, temperature, evaporation, Agro-climatic zones,length of growing season etc)
2.3 Physiography (geology, geomorphology, relief surface drainage and erosion)
2.4 Vegetation and present land use (include human activity).

3. METHODS (EXPLORATORY SOIL MAP OF ZAMBIA)
3.1 Map compilation (indicate sources of information used in compiling the National Soil Map and the fieldwork carried out)
3.2 Legend Composition (explain how the legend has been constructed and the symbols used).
3.3 Soil classification (give summary of the soil classification systems used, soil units identified - first level, second level and third level terminologies, and phases).

3.4 The legend (a brief account of the descriptive terminology used and how to read the map and legend).

4. THE SOILS

4.1 Previous national maps
4.2 General properties of the soils
4.3 Description of soil mapping units (very briefly).

5. LAND EVALUATION
(A brief account of the methodology should be given)
5.1 Suitability for Rainfed Agriculture
5.2 Suitability for Irrigated Agriculture.
(on a national scale; Digitization of the Soil Map the Agro-climatic zone map would be a useful basis for Land Evaluation)

6. REFERENCES

APPENDICES: Thematic map showing all sources of information used for compilation of the National soil map. (measure of reliability)
: Thematic map on Agro-climatic Zones of Zambia.
: Thematic map on Geomorphology of Zambia.