

# Evaluation Report 3.81

Soil Survey,  
Zambia



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## 1. SUMMARY OF THE MISSION'S FINDINGS

1. Interviews with officials of the Ministry of Agriculture and Water Development, provincial agricultural staff, estate managers, and commercial farmers revealed a high degree of satisfaction and appreciation of the work carried out by the Soil Survey Unit and of its usefulness for agricultural planning.
2. The Soil Survey Unit has operated in Zambia 1973-1981, since 1977 as a project. The area surveyed during this period was 103,277 ha at detailed level, 574,784 ha at semi-detailed level, 1,737,776 ha at reconnaissance level, and 5,461,920 ha at exploratory level. The number of soil reports produced has been 75 (April 1981). Of the 168 surveys completed during the period, 50-60 per cent were used for planning and implementation.
3. During the existence of the Soil Survey Unit, the input of expatriate staff has been 43 person-years, with 18.5 person-years in the pre-project and 24.5 person-years in the project period. This was almost 20 person-years below budgeted figures. Although requested by GRZ, no soil correlator has been recruited.
4. Housing accommodation is a problem for many of the staff and is a major constraint to the recruitment of both expatriate and Zambian staff.
5. Training of Zambian personnel has started by Zambian staff joining courses in Norway, Scotland and Belgium. Both in-service-training and on-the-job-training have been conducted.
6. The financial assistance donated by NORAD, exclusive of salaries for staff, has been approximately Nkr 1 million for the pre-project period and Nkr 5.3 million for the period 1977-1981. The proposed assistance for 1977-1982 has been Nkr 5.5 million. Zambia's contribution to the Soil Survey

Unit's operational expenses, exclusive of salaries, was approximately K 60,000 during the pre-project period. During the period 1977-1981 Zambia has made no contribution to the Unit's operational expenses.

7. Inadequate financial records have been kept on project costs leading to less than desired fiscal control.

8. The addition of a capable administrative officer has greatly reduced the administrative work load of the Soil Survey Unit's professional and technical staff.

9. The Soil Survey Unit is reasonably well equipped with vehicles, camp equipment and other survey equipment. A renewal rate of 2-3 vehicles per year is considered necessary. The Unit's Workshop at Palabana has been adequate. However, shortage of spare parts could be a serious problem for keeping the vehicles on the road in the future. Annual renewal is partly required for camp equipment, as well as for field equipment, air photointerpretation equipment and cartographic equipment.

10. The output of the Soil Survey Unit's laboratory at Mt. Makulu was 1500 samples in 1980. At present there is a certain backlog in delivery of results, for chemical analysis 4-5 months, for texture analysis 2 months. The constraints for chemical analysis have been shortage of trained technical staff, as well as space, and very slow delivery of ordered equipment and chemicals. New equipment ordered has arrived recently, but some units are still on order. On the arrival of the equipment and chemicals, the physical capacity of the laboratory will be 2500 samples per year.

11. There are currently administrative difficulties in the sharing of laboratory facilities with the Soils Advisory Section of The Research Branch, Department of Agriculture.\*

12. Some of the soil chemical analyses, e.g. cation exchange capacity, are not relevant for the very leached and acid soils of the high rainfall areas. Because of the delay in

\*This problem has been solved after the departure of the Evaluation Team.

delivery of equipment and chemicals, the investigation of methods have been delayed. A start has been made by analysing some samples abroad.

13. Soil physical determinations are carried out by the Research Branch. The extent of soil physical work in connection with soil surveys is generally limited. Many soil units have not been analysed with regard to available water capacity, infiltration rate, bulk density, particle density and aggregate stability. The soil physical work has been concentrated on soil surveys for irrigation projects.

14. Soil Survey reports are generally satisfactory, but layout, typing and reproduction might be improved. The limited information on soil and crop management, as well as missing information on yield potential under defined management is due to lack of sufficient research.

15. Soil Survey maps are largely based on airphoto mosaics. Recent work at reconnaissance and semi-detailed level has to a certain extent been transferred from airphotos to 1:50 000 scale topographic maps. The soil units are soil series and these are translated into Land Capability classes. The land classification is rather narrowly defined as it applies only to high technology maize production in the low and medium rainfall areas.

16. Most of the work carried out by the Soil Survey Unit consists of ad hoc surveys requested by Zambian authorities at national and provincial levels, parastatal organizations, commercial farmers and companies. The progress of systematic surveys at reconnaissance level has been slow due to the pressure on the Soil Survey teams in the Provinces to carry out detailed and semi-detailed ad hoc surveys.

17. The Soil Survey Unit is decentralized at provincial level with headquarters at Mt. Makulu. Although the soil surveyors maintain that internal communication would be improved by centralization at Mt. Makulu, the mission feels

that there will be several disadvantages with respect to external communication and advisory work. The present annual soil survey meetings will be expanded to two to three meetings per year from 1981. This, in addition to the recruitment of a soil correlator, will greatly improve internal communication.

18. The co-operation between the soil surveyors and the provincial agricultural staff appears to be good. It was observed that there was an increasing demand for advice from soil surveyors on soil management.

19. There would appear to be greater opportunities for co-operation between the Soil Survey Unit and the Research Branch in regard to using the soil survey findings for research on soil and crop management on major soils. However, it should be noted that the Research Branch has provided every co-operation within its limited budget to assist the Soil Survey Unit in administrative matters.



## 2. RECOMMENDATIONS

1. A Phase II duration of five years, 1982-1986, is considered necessary for the establishment of a National Soil Survey Unit.
2. Negotiations between Norway and Zambia should start as soon as possible to ensure a Phase II of the Soil Survey Project.
3. To realize the basic objective of the Project, the establishment of a National Soil Survey Unit, 2 university graduates, preferably from UNZA, School of Agriculture, and 2 diploma graduates should be recruited annually from 1982. Some mechanism should be established to provide a greater hold by the Ministry on graduates sent abroad for further training.
4. As housing is one major constraint to the recruitment of Zambian staff and the retention of graduates trained abroad, this problem should be taken up with the Ministry of Agriculture and Water Development so that appropriate resources may be allocated for housing during the period 1982-1986.
5. Diploma graduates should have initial training as counterparts and further training abroad. University graduates should also train as counterparts initially, proceed to further studies abroad and complete, if possible, their thesis work in Zambia.
6. A specialist Training Officer should be recruited to work with staff of the Land Use Branch and provide technical expertise to NRDC and agricultural colleges.

7. In order to ensure continuity within the Project and to reduce unproductive learning time of a new Senior Person, the current Senior Soil Surveyor should be encouraged to continue into Phase II until a qualified Zambian can take over. A Senior Zambian should be in place at least two years prior to the end of Phase II and at least one year prior to the Senior Expatriate's departure.

8. Recruitment of the requested Soil Correlator must be accomplished during 1981. The specialist Training Officer referred to in para 6 should be recruited in 1982. A Land Evaluation Officer should be added in 1983. A sufficient number of Soil Surveyors should be recruited.

9. Permanent posts should be established for Soil Survey personnel within the Ministry of Agriculture and Water Development.

10. A data bank for soils information should be established by utilizing soil surveys, soil inspection reports, site evaluations, and other relevant information. The data bank should have several entrances, e.g. type of survey and classification criteria (location, soil series, etc.). This work should be done by experienced soil surveyors.

11. An exploratory soil map of Zambia in scale 1:1 000 000 should be completed by 1984/85. All available sources of information on soils in Zambia should be utilized to attain this objective. Use of LANDSAT information should be investigated. This map should be compiled by experienced soil surveyors.

12. A common legend for a 1:50 000 soil map of Zambia should be established. Previous and future semi-detailed and reconnaissance survey maps should be transferred to 1:50 000 topographic maps. Sufficient simple instruments to do this transfer work must be acquired.

13. Air-photo mosaics constructed from rectified airphotos should be used as soil maps because of the preferences of the users. To achieve rectification suitable equipment ought to be acquired by the Survey Department, Ministry of Lands and National Resources.

14. The land capability classification system should be broadened to other uses and other levels of technology.

15. Research work on crop and soil management of major soils (benchmark soils) should be carried out in co-operation with the Research Branch. The Soil Survey Unit should co-operate with the Soil Productivity Project commencing in Kasama in 1981 and the Zambian Government should work towards similar projects in other regions.

16. The soil laboratory of the Unit should be strengthened to reduce the present backlog of analysis. Procurement of equipment and chemicals must be more timely. Analytical methods suitable for soils of the high rainfall areas must be researched and developed in co-operation with laboratories abroad.

17. In the long run a single strong service laboratory covering soil chemistry, soil physics, soil survey and soils advisory should be considered. However, until a suitable mechanism is established for achieving this, the current Soil Survey Unit's laboratory should be strengthened. Soil physical analysis capabilities should be increased and a Soil Physicist recruited.

18. During the annual soil survey planning meetings sufficient time must be set aside for systematic soil surveys and production of reports and maps.

19. Estimated operational funds in current Kwachas as illustrated in appendix 12 for Phase II of the Soil Survey Project amount to K 2 230 000.

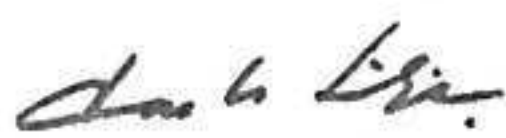
20. Phase II of the project should be accompanied by a more detailed financial control system.

21. Zambian financial assistance to the operation expenses of the Soil Survey Project should be gradually increased from 15 percent in 1983 to 60 percent in 1986.

22. Estimated professional personnel requirements, as illustrated in table 1, chapter 6, for Phase II are 86 person-years, of which 44 are expatriates.


23. A new evaluation should take place in 1984.

Lusaka 10 April 1981

  
B.G. Lilje

  
R.E. Benoit

  
J.B. Mutelo

  
A. Njøs

### 3. OBJECTIVES OF THE EVALUATION

In 1978 a joint Norwegian - Zambian team reviewed the Soil Survey Project in order to ensure the best use was made of the Project and the Norwegian assistance. Among the recommendations put forward by the evaluation team were, that a second review mission should be organized at midterm of the ongoing project to examine the organizational and technical progress made by the Project.

According to that recommendation, a second joint Norwegian - Zambian evaluation team was appointed, consisting of:

- Boo G Lilje - Deputy Provincial Land Surveyor, County Administration, Växjö, Sweden
- Arnor Njøs - Professor, Agricultural University, Ås-NLH, Norway
- J B Mutelo - Assistant Director of Agriculture (Land Use), Department of Agriculture, Ministry of Agriculture and Water Development, Zambia
- R E Benoit - Senior Economist, Planning Unit, Ministry of Agriculture and Water Development, Zambia

The terms of reference of the evaluation team are given in Appendix 1.

The team worked in Zambia from 1981-03-30 to 1981-04-10.

The analysis and conclusions of the team are based on interviews and discussions both within the Ministry of Agriculture and Water Development as well as with a broad spectrum of users of the Soil Survey Unit's products and services. Among those interviewed are:

- 30/3 Mr J H Remba - Principal, Dep. of Agriculture  
Mr W Rettie - Senior Economist, Ditto  
Mr W Harthoorn - Chief Land Use Planning Officer  
Mr T Dahl - Chief Farm Management Officer
- 31/3 Mr A L T M Commissaris - Senior Soil Surveyor  
Mr R J Cheadle - Soil Chemist

	Mr A M Bunyolo	- Soil Physicist
	Dr G Murdoch	- Head Land Resources Services, Booker Agricultural International Ltd
	Mr C Berryman	- Soil Physicist, Booker Agri- cultural International Ltd
	Mr F Kateya	- Acting Permanent Secretary, Min. of Agriculture and Water Dev.m.
1/4	Mr R Malik	- Chief Photogrammetrist, Survey Dep. Ministry of Lands and Natural Resources
	Mr J Bergedalen	- Planning Officer, Lusaka
	Mr J Woods	- Executive Officer, Commercial Farmers Bureau
	Dr I Hurd	- Wheat Coordinator
	Ms R Chungu	- Chief Research Officer, Mt. Makulu
2/4	Mr S Simwynga	- Planning Officer, Mazabuka
	Mr L Holland	- Project Manager, Family Farms Ltd, Magoye
	Mr A Spook	- Acting General Manager, Nakambala Sugar Estate
	Mr M Dabinett	- Manager, Nakambala Sugar Estate
	Mr A Lufwendo	- Manager, Nakambala Sugar Estate
	Mr W Lublinkoff	- Commercial farmer, Mazabuka
	Mr W Barclay	- Contractor, Lusaka
3/4	Mr T Sellström	- Economist, SIDA
	Mr K McPhillips	- Soil Adviser, Mt Makulu
	Mr A J Prior	- Principal Research Officer, Mt Makulu
4/4	Mr M Hummel	- Commercial farmer, Lusaka
	Mr A N Beaumont	- Agricultural Liason Officer, Min. of Agriculture and Water Development
	Mr R Vernon	- Research Officer, Mt Makulu
6/4	Mr L H Syamaboyo	- Provincial Agricultural Officer, Kasama
	Mr J G Vikan	- Soil Surveyor, Kasama
	Mr B Ertzgaard	- Farm Management Officer, Kasama

- Mr J E B Rasmussen - IRDP Coordinator, Kasama  
Mr F Miller - Project Manager, Zambia-Canada  
Wheat Project, Mbala  
Mr D M England - Farm Extension Officer, Ditto  
Mr R W Ferdowsian - Irrigation Officer, Kasama  
Mr H Fäste - Planning Officer, Kasama  
Mr F L Rimmer - Project Development Manager,  
Kateshi Coffee Scheme, Kasama
- 7/4 All soil surveyors and their counterparts during the  
annual Soil Survey Conference at Mpika  
Mr R Davisson - Soil Surveyor, Booker Agri-  
cultural International Ltd
- 8/4 Mr L Sikwaze - Officer in Charge, Kabwe  
Research Station
- 10/4 Mr J E Berntsen - Volunteer, Palabana Workshop

The team visited:

- 2/4 Family Farms Ltd, Magoye, Nakambala Sugar Estate and  
W Lublinkoff, Mazabuka  
4/4 M Hummel, Lusaka  
6/4 Provincial Headquarters, Kasama and Kateshi Coffee Scheme  
7/4 The Annual Soil Survey Conference at Mpika  
8/4 Provincial Headquarters, Kabwe and Kabwe Research Station

The team has also studied soil survey reports and other papers connected with the terms of reference.

The team received a minute from the P A O, Copperbelt, appendix 13.

The team wishes to express thanks to all who have contributed. Special thanks are due to Mr A L T M Commissaris for all information provided during the visit of the evaluation team. Thanks also to Gunilla Kassir, who typed the draft report.

## 4. THE PROJECT

### 4.1 Background

Soil surveys had before 1970 been carried out on an occasional basis by people with different backgrounds and within various Ministries and organizations. These surveys resulted largely in soil/vegetation maps with indicative trees, soil colour and texture being the most important criteria. An attempt in classifying soils was made during the FAO Kafue Basin Soil Survey and was continued by Yager, who later joined the Soil Section of the Land Use Services Division. Yager also initiated the soil series concept and described and established 20 soil series using the USDA system. But the main aim within the agricultural sector during these years was to establish the land capability.

In 1971, FAO agreed to provide a Senior Scientist to head a soils team. A bi-lateral request of two Soil Surveyors was directed to NORAD. The number requested was influenced in part by the difficulty of housing more than two Soil Surveyors at Mt. Makulu and in part by the fact that there were only two Soil Surveyor posts in the Land Use Services establishment.

Further consultations regarding the Soil Survey Team took place in January 1972. The NORAD Mission supported Norwegian assistance and a team consisting of one Senior Soil Surveyor, the team leader, and two Soil Surveyors was organized.

In addition to technical assistance through the provision of expert services, financial assistance covering running costs and equipment was provided, although this was not intended at the beginning. In October 1976 an official request of financial support was put forward and resulted in a formal Agreement between the two countries. The agreement, see appendix 2, was signed on the 8th of Desember 1977 for a period of six years (1977 - 1982) with a total allocation above expatriate personnel of Nkr 5,500,000.- (about K 850,000.-).



#### 4.2 Objectives of the Project

The main function of the Project, according to the agreement, were to be:

- a) to assist Planning Officers in classifying and mapping land suitable for Agricultural Development
- b) to carry out soil surveys particularly where intensive agriculture or the provision of irrigation are under consideration
- c) to carry out a more systematic soil and land capability survey so as to allow a more comprehensive assessment of Zambia's soil resources to be made use of as a basis for national, provincial and economic planning
- d) to advise agricultural staff on matters relating to soil distribution, properties and behaviour.

For further details, see appendix 2.

#### 4.3 Progress 1973 - 1978

The strengthening of the Soil Survey Unit was implemented during the first months of 1973. Right from the start the team faced problems. NORAD had difficulties in recruiting qualified soil surveyors, which affected the rate of progress. The Government of the Republic of Zambia (GRZ) was unable to provide the necessary material support such as transport, equipment and subsistence allowances, for an efficient running of the day to day operations of the Soil Survey. To solve the problems of operational difficulties, NORAD met costs of about Nkr 300, 000. (about K 47, 000) per year.

In spite of the difficulties the soil survey team contributed to the development in Zambia, as well as to the building up of an appropriate soil survey and land capability system.

During these years the personnel contribution consisted of 4-8 expatriates. These expatriates, mainly soil surveyors, were posted in Lusaka (Mt. Makulu) and in various provincial capitals.

On account of a great demand for ad hoc surveys and limited resources, systematic soil and land capability surveys were not carried out to such an extent as was originally intended.

A special laboratory was established in 1975. The laboratory was equipped for particle size analysis, extractions for exchangeable cations, for determination of organic carbon and soil acidity.

#### 4.4 Evaluation 1978

In view of the increasing involvement in strengthening of the Soil Survey Unit, NORAD, in agreement with GRZ, decided to review the project in detail to ensure the best possible future use of the assistance. A five-member joint mission carried out the evaluation.

For conclusions and recommendations of the mission, see appendix 3 and 4.

#### 4.5 Purpose of the project

The general policies of agricultural development for the period 1979 - 1983 are given in the Third National Development Plan (TNDP).

To fulfil these objectives it is essential to have a thorough knowledge of the soil resources to be used for agricultural production. This basic knowledge is acquired from a soil survey.

The soil survey accompanied by physical and chemical analysis together with known results of research work, forms the base of mapping soil units, classifying the soil and the land and establishing the most economic sustained use of the land. This knowledge can be used in land use planning but is essential even for soil, crop and farm management. It is important that the information of soil surveys is utilized by the research and extension staff to form the base of

advice to farmers.

In appendix 5 the objectives of the Project are given together with the means necessary to achieve these objectives.

## 5. ACCOMPLISHMENT

### 5.1 Tasks

The Soil Survey Unit carries out soil surveys at different levels of intensity. The Unit receives requests for soil surveys from various Ministries, parastatal bodies, companies and private farmers. The requests are annually discussed in the Provinces and plans are drawn up for the surveys of the forthcoming year according to priorities given by the provincial authorities and the resources of the provincial soil survey team.

The soil surveys carried out during 1973 - 1980 are shown in appendix 6 and 7 and on appended map. The surveys can be summarized:

Province	Surveyed area in hectares			
	Detailed and Intensive	Semidetailed	Reconnaissance	Exploratory
Northern	15,027	38,495	165,000	300,000
Luapula	4,469	62,400	217,000	-
Copperbelt	5,550	103,415	30,000	20,000
North-Western	-	15,003	-	5,004,700
Central	32,113	61,135	642,871	83,220
Lusaka	8,432	350	11,000	-
Eastern	10,414	146,807	67,000	34,000
Western	19,436	86,000	262,000	-
Southern	7,836	61,179	342,905	20,000
Total	103,277	574,784	1,737,776	5,461,920
No of surveys	54	68	37	9
Scale	1:10000-1:30000	1:20000-1:60000	1:50000-1:500000	<1:250000

The table shows that about 78,800 km<sup>2</sup> or about 10 per cent of Zambia's surface area has been subject to one of the 168 soil surveys carried out from 1973 to 1980. The size of the areas surveyed range from 13 to 5 mill. hectares.

No considerable backlog exists as to requested surveys. The normal time span from request to report is about one year, provided there is no back/log in analysis or map construction..

## 5.2 Staff

The Soil Survey Unit relies on the Land Use Branch establishment, containing one senior soil surveyor and two soil surveyors. Expatriate personnel are engaged in addition to the establishment positions. Of the local staff, 25 per cent are paid daily by using NORAD donated funds.

Since 1977, four graduates from the University (UNZA) and ten diploma graduates from National Resources Development College (NRDC) have been recruited.

The staff positions of the Soil Survey Unit since 1977 are shown in appendix 8.

The graduates from UNZA and NRDC work with the Unit as counterparts for respectively at least one or two years before they go abroad for further training. So far one soil surveyor is undertaking a M.Sc. course in Soil Science in Aberdeen, Scotland since 1979, while two in August 1980 went to a similar course in Aas, Norway, all on NORAD scholarships. Three NRDC graduates left in October 1980 for Gent, Belgium, to attend a specialisation course in Soil Science. On-the-job-training courses have been conducted for both soil survey and planning staff.

## 5.3 Funds

The Agreement states that Norway shall make available to Zambia on a grant basis terms an amount up to and not exceeding Nkr 5,500,000 (about K 869,000 exchange rate used Nkr 6.33 = K 1,00).

It has been difficult to determine the amount so far spent through the grant as inadequate financial records have been kept in Zambia on projects costs. Therefore the following figures may be inaccurate.

<u>Expenditure</u>	<u>Nkr</u>	<u>Kwacha</u>
Expenditure in Norway	1,319,235	208,410
Expenditure in Zambia	<u>2,523,556</u>	<u>398,666</u>
Subtotal	3,842,791	607,076
Estimated expenditure 1981		
in Zambia	1,253,340	198,000
in Norway	<u>202,560</u>	<u>32,000</u>
Subtotal	<u>1,455,900</u>	<u>230,000</u>
Total	5,298,691	837,076
Remaining for 1982	<u>201,309</u>	<u>31,924</u>
Grant	5,500,000	869,000

It has not been possible to divide the figures according to the schedule in the agreement.

The break down of expenditure in Zambia is shown in appendix 9.

It takes something between 7 to 12 months, when purchasing from abroad, from the request till the goods are received. To speed up local purchases, each soil surveyor holds an accountable advance of K 1000 with NORAD. This advance is used to buy spare parts etc. from suppliers, who do not accept Local Purchase Orders. This system works well.

Up to 1979, NORAD reimbursed Zambia for expenditure encountered by the Unit, while for 1980 payment has been made in advance. In order to speed up the purchasing procedure a new system will be introduced as from 1981. Ministry of Agriculture will present a request for funds. This request will be in two parts, one of the funds to be transferred from NORAD to Ministry of Finance for payment in Zambian currency and one for the amount in foreign currency. The latter amount is

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transferred to Bank of Zambia account in the Central Bank of Norway, Oslo. For local purchases the same procedures as used up to now will be continued. This system has been used by SIDA for one year and has worked to the satisfaction of both parties. The system is thought to speed up procurement of purchases.

#### 5.4 Equipment

The Soil Survey Unit is generally well equipped. Through the NORAD Grant the Unit has been able to purchase sufficient landrovers. The number of vehicles is shown in appendix 10. Since the end of 1980, the workshop at Palabana has been adequate. However, shortage of spare parts could in the future hamper the possibilities of keeping the vehicles on the road.

Other instruments and equipment purchased through the NORAD Grant are shown in appendix 11.

Complaints have legitimately been put forward concerning the administrative restraints and the time span from request to delivery of equipment. These problems have especially affected the laboratory. Equipment ordered more than one year ago has not yet been received. This is hampering the work of the Unit, especially the completion of reports, as a result of the long waiting period for results of chemical analysis. The situation of laboratory equipment is also shown in appendix 11.

#### 5.5 Housing

Office accomodation is adequate.

Working and storage space remains unsatisfactory for the laboratory. Additional space within the Soils Advisory Unit has been made available and permission is given for a three

room store to be built nearby. The work has started but progress has for various reasons been slow. However, it is expected that the Unit will occupy these new premises before the middle of 1981.

Housing accomodation is a problem for many of the staff. Some of them have not been allocated a house for one to two years after their appointment. The situation has worsened as the Unit is dependent on Research Branch accomodation, who themselves have problems in this respect.



## 6. ADMINISTRATIVE ASPECTS

According to NORAD personnel and Zambian staff the co-operation between NORAD and GRZ is satisfactory. The same applies to the co-operation between the Soil Survey Unit staff and NORAD/GRZ.

There is a substantial amount of co-operation among technical and professional staff between the Soil Survey Unit and Land Use Planning Section in production of maps, air photo interpretation and ecological analysis in areas which are soil surveyed. This work forms the basis for integrated land resources and water management planning strategies for large farms, settlement schemes and other agricultural development projects.

The Extension Services has a pool of Agronomists, Farm Management, Horticultural and Agricultural Engineering Experts, whose advice is taken into account when recommending farm development after initial soil survey have been done. At times the soil surveyor is given advance information for crop - livestock suitability of an area to be soil surveyed.

The matter of centralization of the Unit has been discussed widely. Advantages with centralization are:

- the soil surveyors will not feel as isolated as they do nowadays
- the problems with typing etc for reports could easily be solved
- better and quicker knowledge of new inventories
- improved communication between the officers.

But centralization also has disadvantages such as:

- longer distances to working areas, which means longer absences from the families
- poorer communications with planning and extension staff

- longer distances to customers, which will obstruct advisory service
- higher expenditure
- probably less effective in terms of agricultural development

On the whole a decentralized organisation is preferable. Some of the advantages with a centralized organisation might be achieved by improved communication between the officers. Thus regular meetings, at least twice a year, should be held to discuss technical and practical matters. A regular circulation of relevant scientific journals should be initiated.

There seems to be no need to change the project set-up or to propose other changes.

In order to ensure continuity into the next phase of this project the senior soil surveyor should be approached about the possibility of extending his contract until a suitable Zambian replacement can be found. A senior Zambian should head the unit for a minimum of one year and hopefully for at least 2 years prior to the end of phase II of this project.

## 7. FUTURE PROJECT ACTIVITIES

### 7.1 Objectives

The first Soil Survey Evaluation Mission listed as the basic longterm objective "the establishment of a viable national Soil Survey Unit, able to work independently of any foreign assistance". The present Mission considers this to be the main objective. The Mission considers the following medium term objectives important during the remaining part of this project-period and a Phase II of the project:

- a) To collect and systematize all known soils information i.e. soil survey maps, soil profiles descriptions, soil analyses, and other observations relevant to this subject to create a soil data bank.
- b) To establish a Soil Map of Zambia in scale 1:1 000 000.
- c) To correlate mapping units and establish a legend for a 1:50 000 map series, and where applicable, for the 1:250 000 map series.
- d) To develop land suitability, crop suitability and soil management suitability ratings for different levels of economy and technology, as well as for different uses of land.
- e) To classify mapping units according to international systems, e.g. the FAO-UNESCO soil classification system.

### 7.2 Staff

It is felt that the present provincial organisation, although not entirely satisfactory, has worked reasonably well. A regional organisation with soil surveyors at Mt. Makulu, Mongu, Ndola, Kasama and Chipata, and technical officers in all provinces is a possible compromise between a centralised and a provincial organisation.

According to the project outline the Soil Survey Unit should be brought up to a level, where there would be soil surveyors in most of the provinces. The 1978 mission arrived at the

conclusions that there should be 8 Zambian and 8 expatriate soil surveyors, as well as 8 Zambian land use planning officers. At Mt. Makulu there were to be one Zambian and one expatriate senior soil surveyor, one Zambian and one expatriate soil surveyor, one Zambian and one expatriate soil correlator, one Zambian and one expatriate land evaluation officer, as well as one soil physicist on the Research Branch.

The present mission considers that there may be many constraints as to a further building up of the Soil Survey Unit. NORAD has experienced considerable difficulties in recruiting the present number of expatriate personnel. Further, the number of Zambian professional staff is far below expectations.

The build-up of soil survey staff in the provinces should be based on Zambian staff after 1982, with a slow phasing out of expatriate assistance. At Mt. Makulu a recruitment of specialist officers is necessary. First of all, the requested soil correlator should be recruited in 1981. A soil survey training officer should be recruited to assist in the staff development. One of the provincial soil surveyors might be transferred to this position. He would assist in training Zambian graduates for posts as planning officers and give courses at the NRDC and the Colleges of Agriculture. In 1983 a land evaluation officer should be recruited to work out land evaluation and land classification. The research of the Soil Productivity Unit in Kasama might be a valuable co-operator for land evaluation in the high rainfall areas.

Two of the experienced provincial soil surveyors might be transferred to Mt. Makulu for building up a soil data bank and for completion of a Soil Map of Zambia. The gradual development of Zambian professional staff is a major objective of the Soil Survey Project. The experience so far seems to indicate that a fast build-up of Zambian professional staff is unlikely. In the Land Survey Department, Ministry of Lands and Resources, only one graduate stayed in government service out of six graduates recruited. It is believed that

two new professional Zambian staff members per year is a reasonable, but slightly optimistic expectation.

The normal staff development procedure would be to recruit university graduates and diploma graduates, train them in provincial teams for one to two years, send them abroad for further training, the university graduates for M.Sc. programmes, partly abroad, partly in Zambia, the diploma graduates to Ghent or Enschede. The vacancies should be filled with new candidates, who would be ready to go abroad on return of the previous candidates a.s.o.

The constraints to this development are many. At present, only three posts are established in the Government service for soil survey, viz. 2 posts for soil surveyors and one for senior soil surveyor. The output at the University of Zambia, School of Agriculture is a limiting factor. The number of students in each year at the School of Agriculture is for 1981:

<u>Curriculum</u>	<u>1st year</u>	<u>2nd year</u>	<u>3rd year</u>	<u>4th year</u>
4 year	21	32	46	25
5 year	25	16	-	-

The earliest possible M.Sc. programme is supposed to start 1983, depending on UNZA staff and support from overseas. The Department of Geography, which, in the near future may be transferred from the School of Education to the School of Natural Sciences, is ready to start up an M.Sc. programme for Land Resources.

The students majoring in geography have a limited amount of soil science and almost no agriculture included in their curriculum. In the long run it would therefore seem reasonable to base the recruitment for professional staff on the School of Agriculture.

The NORAD Soil Science Course at the Agricultural University of Norway might contribute towards a build-up of professional

Zambian staff, provided UNZA agrees to supervise the research and thesis work towards an M.Sc. degree at UNZA.

The problems concerning this arrangement have earlier been discussed with the staff of the Departments of Soils and Geography, as well as with the Deputy Vice-chancellor. The conclusion was that UNZA is going to discuss possibilities of treating this case as an exemption and thereby find ways and means of supervising the thesis work.

A staff development sheet is shown in table 1.

Table 1. Actual and proposed staff at professional and NRDC level for the period 1980 - 1985.

Provinces/Mt Makulu	1980		1981		1982		1983		1984		1985		1986	
	Z	E	Z	E	Z	E	Z	E	Z	E	Z	E	Z	E
<u>Provinces</u>														
Soil Surveyor	1	4	1	4	3	4	4	4	5	2	5	2	6	-
NRDC	2		5		6		7		8		8		8	
<u>Mt Makulu</u>														
Senr. Soil Surveyor	-	1	-	1	-	1	1	1	1	1	1	1	1	-
Soil Surveyor	-	1	-	$\frac{1}{2}$	-	1	-	1	1	2	2	1	1	1
Soil Chemist	-	$\frac{1}{2}$	-	1	-	1	1	1	1	1	1	1	1	-
Soil Correlator	-	-	-	-	-	1	-	1	-	1	-	1	-	1
Land Evaluator	-	-	-	-	-	-	-	1	-	1	-	1	1	1
Training Officer	-	-	-	-	-	1	-	1	-	1	1	1	1	-
Soil physicist						1		1	1	1	1	1	1	1
NRDC	-		1		1		1		1		1		2	
<u>Sum Professional</u>	1	6 $\frac{1}{2}$	1	6 $\frac{1}{2}$	3	10	6	11	9	10	11	9	12	4
<u>Sum NRDC</u>	2		6		7		8		9		9		10	

Z = Zambian      E = Expatriate

Zambian professionals = UNZA graduates

The total sum of person-years during the four years 1982 - 1985 will amount to 29 professional (Z), 41 professional (E) and 33 NRDC. It remains to be seen if it is possible to fill the three new specialist posts, viz. soil correlator, land evaluator, training officer, soil physicist as scheduled.

The soil physicist might serve both the Research Branch and the Soil Survey Unit. It must be up to the Government to decide on the proper placement of this specialist. If this specialist is recruited through NORAD, the Soil Survey Unit would be most appropriate.

Table 2 shows a provisional schedule of recruitment.

Table 2. Staff recruitment sheet

Staff	1981	1982	1983	1984	1985	1986
<u>Expatriate</u>						
Senr. Soil Surveyor		1		1		
Soil Surveyor	2	3	2	2	1	
Soil Correlator		1		1		1
Training Officer		1		1		
Soil Chemist						
Land Evaluator			1		1	
Soil physicist		1		1		1
<u>Zambian</u>						
UNZA	1	2	2	2	2	2
NRDC		2	2	2	2	2

The uncertainty is great with regard to recruitment of Zambian staff. Training abroad and loss of trained staff to parastatal and private enterprises seem to require some overrecruitment. On the other hand housing problems may render this overrecruitment impossible.

### 7.3 Laboratory, vehicles, equipment

#### 7.3.1 Laboratory facilities

It is expected that the new Atomic Absorption Spectrophotometer (AAS) will be operative by the end of 1981. This will greatly increase the soil laboratory's capacity of determining macro-nutrients and micro-nutrients as well as aluminium. During 1980 the backlog of chemical analyses

was up to one year due to the breakdown of equipment. At present the backlog of chemical analyses is about 4-5 months, while the texture analyses are only 2 months behind. It should be aimed at reducing the waiting time to 6 weeks.

The Mission considers that each piece of equipment, especially the expensive units like the AAS should be operated by one technician only, under the supervision of one professional officer. Under the present circumstances it would seem reasonable that the Soil Survey Unit takes the responsibility for the AAS, but that analytical work may be done for other sections, if time allows.

However, in the long run, it would seem appropriate to work towards a combined Service Laboratory at Mt. Makulu. This laboratory could serve the Soil Survey Unit, as well as the Research Branch and an expanding Advisory Service, and include the Chemistry Section. It would be necessary to recruit a highly qualified Senior Soil Chemist to supervise this laboratory.

At present there are a limited number of soil physical investigations carried out by the soil physicist of the Research Branch. As detailed surveys for irrigation agriculture are in great demand, soil physical measurements, e.g. infiltration capacity, hydraulic conductivity and available water capacity should be expanded. A soil physicist should therefore be recruited. Even in the ordinary soil survey work soil physical investigations should be included.

### 7.3.2 Vehicles

A gradual replacement of old Land Rovers and Land Cruisers will be expected. However, the good maintenance offered by the workshop at Palabana may prolong the life of the Soil Survey Unit' vehicles. A purchase of 2-3 Land Rovers/Land Cruisers per year is expected. - According to the volunteer at the Palabana work-shop the supply of spare parts in the country is diminishing very quickly. Without



accounts abroad purchase of spare parts may be in great difficulty.

### 7.3.3 Field equipment

The Soil Survey Unit is at present well supplied with field equipment, but renewal of augers, compasses, inclinometers and other equipment is necessary. This applies also to camping equipment.

## 7.4 Technical matters

### 7.4.1 Soil Survey methods

Improvement of soil survey methods may be possible. Use of special aerial photographs, e.g. infrared film, and in special cases Landsat images, ought to be investigated. It is felt, however, that the thorough ground work, which has been so typical for this soil survey unit, is a safe method for all detailed and semidetailed surveys. For the reconnaissance surveys which require highly trained and experienced surveyors, all the knowledge collected during the history of the Soil Survey Unit should be applied together with modern methods of landscape evaluation.

### 7.4.2 Laboratory analysis

The immediate need concerning soil analysis may be discussed separately for chemical and physical analyses.

#### a) Chemical analysis

The present method of determining cation exchange capacity (CEC), which is basically a measure of nutrient storage capacity of the soil with regard to cations, is unsatisfactory for the acid soils. Analysis carried out at the Agricultural University of Norway (personal communication from G. Semb) on samples from high rainfall areas in Zambia, have shown that the CEC at the pH of the soil is much less than the CEC according to  $\text{NH}_4\text{-Ac}$  at pH 7. Further, the aluminium saturation of this "net exchange complex" in some cases is excessively high, showing the risk of aluminium toxicity. This method, based on KCl extraction, should be

tried out as soon as possible. The method would be useful for assessing the fertility limitation of acid soils.

Analytical determinations useful to the classification of the soils according to the FAO or Soil Taxonomy (USDA) systems should be expanded.

Micronutrient determinations are presently scarce, but ought to be expanded for characterization of soils as well as for advisory work concerning soil management. The Soil Productivity Project will be starting up at Kasama in 1981. It would seem appropriate to co-operate with that project on shipment of samples to be analysed at the Agricultural University of Norway. This would be helpful for complicated determinations, as well as for checking of new methods.

#### b) Physical analysis

Particle size analysis ought to be carried out, both with water as the dispersing agent, as well as with Na-pyrophosphate or other dispersing agents. Especially for irrigation surveys it would be useful with the water dispersion method. The pipette method should be introduced. Further, more work should be done to characterize the physical properties of soils, viz. available water capacity, infiltration rate, bulk density, particle density. Aggregate stability vs. falling drops might be of help to characterize the erodibility of soils. An expansion of physical analyses would not be possible without staff development.

Clay mineralogy determinations might be carried out at specialized laboratories abroad.

#### c) Organization

The output of the laboratory was 1500 samples in 1980. When ordered equipment and chemicals are ready for use, its capacity would increase to 2500 samples per year.

More space is now being made available through an arrange-

ment with the Soils Advisory Laboratory, Research Branch. If this arrangement works out the present housing problem will be solved.

#### 7.4.3 Soil Maps

Soil Survey maps are drawn on air photo mosaics, more or less rectified, traced onto paper or photocopied from mosaics. In some cases they are drawn on the 1:50 000 topographical maps, which are basemaps covering the greater part of the country.

It is felt that each Provincial Soil Surveyor should make a 1:1 000 000 map of his own province of broad soil units, e.g. according to the FAO-UNESCO system, and that these maps should be compiled to a soil map of Zambia.

Further, the soil maps available should be transferred to 1:50 000 base maps with a common legend. This work would have to be conducted by a soil correlator.

The various air photo mosaics cannot be joined together. As it is important that all soil surveys carried out in the past and in the future are stored in a similar way, the information should be transferred the 1:50 000 topographic map. As the photo mosaics being used are unrectified, the use of a simple photogrammetric instrument is needed. Instruments are available at the Photogrammetric Section, Survey Department. A sketchmaster is used by the Soil Survey Unit. Investigations should be conducted to find alternative and simple instruments.

It has been suggested that the Survey Department purchases a rectifying instrument. When this has been done, rectified air photos should be used when economical.

Most planning officers are in favour of aerial photocopies to orient themselves in the field. A suitable production procedure should be investigated in co-operation with the

Department of Surveys under the Ministry of Lands and Natural Resources. Map construction should be carried out in Lusaka.

In some cases land capability units are printed on the soil series maps. If different land uses are described this would be impossible and there would have to be one map for each type of land use, viz. commercial maize farming, small scale farming, rice cultivation, etc. Another solution is to draw a feature separation on the topographic map containing only series number, thereby the map may be used for various purposes and in various scales.

#### 7.4.4 Soil Survey Reports

The soil survey reports are standardized and have shown little development since the previous evaluation mission. The soil surveyors are normally short of time with regard to report writing, caused mostly by delays in soil analytical results.

A radical change cannot be expected as long as the work load is so heavy. However, some improvements with regard to layout, typing, and reproduction might be possible. Sufficient time must be set aside during the annual planning meetings for report writing. Training of typists and use of electric type writers are two possibilities of improving the graphic standards. A photo-copying machine should be acquired at Mt. Makulu.

As long as no land evaluation officers have joined the team, crop suitability seems to be an important chapter of the report.

#### 7.4.5 Soil classification and correlation

It is of great importance to recruit a soil correlator. A proper soil classification and correlation depends on sufficient analyses. Some of these analyses, especially mineralogy analyses may still be missing. However, if the soil correlation work is not started up at this stage it will get completely out of hand.

To transfer the present soil maps to a common scale of 1:50 000, a common legend would be required. It is not possible to do the job without a clear description of soil series with given range of variation. Classification in an international system, e.g. the FAO system would greatly facilitate the use of gained experience from other parts of the world concerning soil management and cropping systems.

#### 7.4.6 Land evaluation

In Zambia the land evaluation system used at present was developed from the CONEX ("Conservation and Extension") system in the old federation. This system was basically built on the USDA-SCS Land Capability Classification. The land is classified according to the most intensive use, which will not decrease its potential. Erosion hazard is a major consideration in the definition of "the most intensive use". The main division according to land uses is arable, grazing and unsuitable land, with subclasses for texture. The system was improved in 1974 by the introduction of limitations (wetness, topography, rocks, stones, effective soil depth, etc.). Fertility has also been introduced as a limitation, although the present method of determining the cation exchange capacity has made this limitation inaccurate. The major land use implied in the system is rainfed, large scale mechanized maize production with the use of fertilizers. It is important to develop this system further, for different levels of management and technology. This should be done under the supervision of a qualified land evaluation officer.

Much more research should be carried out with soil and crop management systems on well defined, important, soil series to establish their potential under defined management levels. However, under the present circumstances the Research Branch may not have the necessary resources to do this research. A start can be made in the Northern Province with the introduction of the Soil Productivity Project.

Until further work is done on the land evaluation, crop suitability ratings seem as important as land capability classification. Both ratings are of interest to the planning officer. The present irrigability classification seems to work reasonably well, but should be improved.

#### 7.4.7 Soil Data Bank

At present (April 1981) 75 soil survey reports have been published since 1967, out of which 35 between 1973 and 1976, and 32 between 1977 and to date. Furthermore some 93 surveys have been carried out without a published report.

These surveys and reports contain a substantial amount of soils information. In addition there are some major surveys, like the Copperbelt survey (Wilson 1956), the Kafue Basin survey (FAO/SF 1968), the reconnaissance assessment of the Northern and Luapula Provinces (Mansfield et al. 1976) and Trapnell's survey of soils, vegetation and agricultural systems (1957). Verboom (1970) published an ecological survey of Western Province, and Ballantyne (1958) a preliminary soil map of the whole country.

There are numerous reports from inspection tours to different parts of the country, often given as additions to monthly reports.

The total amount of information on soils is so great, that it should be collected, systematized and stored in such a form that it could be considered a soil data bank. The register should have different entries based on classification and stratification criteria.

This data bank should be developed in co-operation with the soil correlation officer.

One of the advantages inherent in such a system would be the easy checking of possible earlier surveys or other soils information of a given area.

Where cadastral surveys have been carried out or farm numbers have been allocated, soils information might also be stored according to "cadastral" units. Where such information is not available, one of the entries would be the grid system.

### 7.5 Funds

The agreement between Norway and Zambia ends in 1982 or when the stipulated Grant is consumed. As shown in chapter 4 not more than about Nkr 200 000 (K30 000) remains at the beginning of 1982.

The mission has tried to estimate necessary funds for operation expenses during the period 1982-1986. The estimates are calculated in the monetary value of 1981, see appendix 12.

The estimates include

- recurrent expenditures including maintenance and running of vehicles, chemicals, stationaries, photographs, literature, subsistence allowances, labour expenses and sundries, and
- procurement of vehicles, caravans and camping equipment, necessary scientific and work equipment for the soil survey work, office and laboratory equipment and facilities.

The operational expenses for the Unit are about Nkr 2 500 000 (K450 000) yearly. The total expenditure during 1982-86 is estimated in 1981 monetary value to Nkr 14 000 000 (K 2 230 000).

To be able to control the expenditure, a detailed financial control system should be introduced. It is essential to separate recurrent expenditure from procurement of equipment.

Zambia is not in a financial position to take over the running of the Unit immediately. It is therefore essential

that financial support is continued. However, it is important that Zambia as soon as possible begin to take part in the running of the Unit. As it is impossible to start this programme next year, Zambia's contribution should start in 1983.

At the end of 1986, the staff of the Unit should be about 60% Zambianized. It seems suitable that Zambia meets the same percentage of the funds needed. Thus Zambia's contribution should be gradually increased from 15 per cent in 1983 to 60 per cent in 1986.



8. FOLLOW-UP OF RECOMMENDATIONS OF THE 1978 EVALUATION MISSION

Recommendations

National staff at all levels be appointed to the project as a matter of urgency, the recruitment possibilities which are likely to be available in the next few years from NRDC college should be carefully considered, facilities should be granted to graduates for training abroad and upgrading at professional level of the best officers.

A concrete establishment be made available for the appointment of National staff in accordance with Article II paragraph 3 of the Agreement regarding the Soil Survey Unit.

Teaching of soil science in the NRDC college be further strengthened by inclusion of a course on soil survey, soil classification and land evaluation in the curriculum of the agriculture section of the college and that bilateral assistance be requested for the purpose.

Young graduates from the Agricultural University at Aas be recruited as associate experts to work in the provinces under

Implementations

4 UNZA and 10 NRDC have been recruited, no recruitment list has been drawn up, housing is still a major problem and prevents recruitment, 3 UNZA and 3 NRDC graduates are training abroad, no upgrading of officers has occurred.

No posts have been established. Professional and technical staff is employed on the Land Use Planning establishment while junior staff is seconded from Land Use Planning.

Nothing has been done.

The soil surveyor, Northern Province, was recruited according to this recommendation.

the direct supervision of an experienced soil surveyor after a short training period in Norway.

Soil correlation and characterization of field survey methods be actively pursued and that an expatriate soil correlator be recruited as a first priority for this purpose.

Land evaluation methodology be further improved in line with the FAO "Framework for Land Evaluation" and standardized at country level, and that an expatriate land evaluation specialist be recruited as a second priority for this purpose.

Soil Management properties of main representative soils be further investigated through an expanded field experimental programme carried out by the Soil Research Station at Mt. Makulu in collaboration with the land evaluation specialist and soil correlator of the project.

The laboratory facilities at the Soil Survey Unit Laboratory at Mt. Makulu Research Station be further strengthened to cope with an increased number and kinds of analysis; such strengt-

Request has been handed over to NORAD, who has faced difficulties in recruiting a qualified soil scientist.

No request from GRZ.

Not implemented, but a soil productivity project operated by the Agricultural University of Norway to start at Kasama 1981.

Laboratory equipment has been ordered, the atomic absorption spectrophotometer has arrived and is to be mounted in the near future. Most

hening will require additional room-space, equipment and national staff. Because of the dust from Chilanga Cement Plant carried by winds in the direction of Mt. Makulu station it may be difficult to avoid contamination of soil samples in the laboratory. It may therefore be better to have specialized analysis done in another laboratory such as at Kabwe Station.

Some analytical methods giving unreliable results be further investigated and improved.

A soil physics section be established within the soil survey laboratory at Mt. Makulu Research Station.

Studies on micronutrients deficiencies and toxicities be initiated and additional equipment and supplies required for such studies be provided.

Exchange of experiences on analytical methods and results be organized with the soil laboratory of the Agricultural University of Norway.

An experienced senior technical officer with administrative experience be recruited to deal with the administration

units, as well as chemicals ordered, have not arrived. Building operations and renovation of space in Soils Advisory Laboratory have started.

Almost nothing has been done.

Not implemented.

No studies except at the Agricultural University, Norway. Equipment purchased.

Partly implemented.

An administrator has recently been attached to the Soil Survey Unit although not as technical

of the Unit. This post should be part of the national establishment and filled by a qualified Zambian.

A petty cash system be requested. If this system is not approved or does not work satisfactory, NORAD should be prepared to establish a working-capital-fund.

officer and not in an establishment position.

Implemented as every expatriate soil surveyor has got a personal NORAD loan to be used as a revolving fund.

## TERMS OF REFERENCE

for an evaluation of the Soil Survey Unit - hereinafter referred to as the Unit - under the Ministry of Agriculture and Water Development, Zambia.

1. BACKGROUND.

With the basic objective to establish a viable national soil survey unit, NORAD has provided technical assistance to the Soil Survey Unit, Ministry of Agriculture and Water Development in Zambia since 1972 and financial assistance since 1977.

The present agreement expires at the end of 1982.

A first evaluation of the project took place in May 1978. It was then recommended that a second evaluation should take place in 2-3 years time.

2. PARTICIPANTS AND MODE OF WORK

The evaluation will be carried out by a joint Norwegian-Zambian team.

NORAD has appointed as members of the evaluation team (professional background in brackets):

Boo G. Lilje (cartography), leader of the team,  
Arnor Njøs (soil science).

Two other members of the team will be appointed by Zambia.

The work will include a review of all relevant documents as well as talks and interviews with officials and employees of the Unit. Investigations shall be carried out at the Unit's headquarters at Mt. Makulu and at least one Provincial Branch.

The evaluation team shall carry out its fieldwork in Zambia from the 30th of March to the 10th of April 1981.

### 3. TASKS OF THE EVALUATION TEAM.

#### 3.1 General.

The team shall:

3.1.1 Describe the present state of the Project and review achievements in relation to: the basic objective as stated above, the project description in the agreement between Norway and Zambia regarding Norwegian financial assistance to the Soil Survey Unit in Zambia, documents regarding the request for technical assistance from 1971 and the recommendations of the evaluation of 1978 as approved by NORAD and Zambian authorities.

3.1.2 Assess the progress since the last evaluation and the achievements in relation to the input of personnel and equipment.

#### 3.2 Fulfillment of obligations.

The team shall:

Assess to what extent Norway and Zambia have fulfilled their obligations such as

- i providing qualified expatriate soil surveyors and training of Zambian counterparts,
- ii providing counterparts for NORAD personnel and posts within the Zambian civil service for such counterparts,
- iii nominating candidates and providing fellowships to young Zambian agriculture graduates within the soil science related to the tasks of the Soil Survey Unit,

- iv providing necessary material support such as transport, equipment and subsistence for an efficient running of the day to day operations of the Soil Survey Unit.

### 3.3 Priorities and standard of work.

The team shall:

- 3.3.1 Consider the specific objectives of the Unit and the order of priorities given to various types of surveying in view of the requirements of rural development,
- 3.3.2 assess the standard of work of the Unit in relation to the requirements of the users, viz. the degree of survey intensity and survey methods applied,
- 3.3.3 assess the standard of soil surveying:
  - soil sampling, laboratory testing and soil correlation,
  - the content and layout of soil mapping reports,
- 3.3.4 assess the adequacy of cartographic methods and the standard of the presentation of maps.

### 3.4 Impact.

The team shall:

- 3.4.1 Assess to what extent the Unit's findings are being used (by farmers, planning, research and extension staff), or to what extent adequate experimental work on soil management properties is being undertaken on the basis of the Unit's findings,
- 3.4.2 assess any other impact the activities of the Unit might have.

### 3.5 Recommendations.

The team shall:

Make recommendations for the future project activities. Hereunder, the team shall give specific consideration to the objective of achieving take-over of the Unit by Zambian staff. Thus the team shall

- i if necessary, suggest ways to increase the present efforts to train and educate Zambians in soil science and other subjects relevant to the Unit's work,
- ii work out a staff development programme with a time-phased implementation schedule,
- iii assess the need for a follow-up after the expiry of the present agreement.

### 4. REPORTING

A report in English comprising all findings and recommendations shall be submitted to the Ministry of Agriculture and Water Development, Zambia and to NORAD within one month after the completion of the fieldwork. A draft report with final recommendations shall be worked out and agreed upon by the participants before the team is dissolved.

Oslo, den 9.mars 1981.

  
Nils Vogt  
Assistant  
Director  
General



A G R E E M E N T

between

THE GOVERNMENT OF THE KINGDOM OF NORWAY

and

THE GOVERNMENT OF THE REPUBLIC OF ZAMBIA

regarding

Norwegian financial assistance to  
the Soil Survey Unit in Zambia

- - - - -

The Government of the Kingdom of Norway (hereinafter referred to as "Norway") and the Government of the Republic of Zambia (hereinafter referred to as "Zambia"), desiring to continue their co-operation in promoting economic and social development in Zambia and thereby strengthen the friendly relations that exist between Norway and Zambia,

in pursuance of the Agreement between the Government of the Kingdom of Norway and the Government of the Republic of Zambia regarding Economic and Technical Co-operation, dated 20th February 1976,

and with reference to the provisions therein relating to Specific Agreements,

have reached the following understanding which shall constitute a Specific Agreement:

Article I  
Contributions and Obligations of Norway

1. Norway shall, subject to Parliamentary appropriations, make available to Zambia on grant terms an amount up to and not exceeding N.kr. 5 500 000 (Norwegian kroner five-millionfivehundredthousand) (hereinafter referred to as the "Grant") to be used exclusively for purchasing of equipment and supplies and for the financing of running costs of the established Soil Survey Unit in Zambia (hereinafter referred to as the "Project") in accordance with the provisions contained in the Schedule to this Agreement.

2. Norway shall make all efforts to meet requests towards providing

- a) expatriate personnel to assist in the implementation of the Project,
- b) fellowships to young Zambian agriculture graduates within soil science related to the tasks of the Soil Survey Unit.

The costs connected therewith, shall be covered by Norway over and above the Grant.

The status and privileges for the expatriate personnel serving under this Agreement shall be as defined in the Agreement between the Government of the Kingdom of Norway and the Government of the Republic of Zambia regarding Economic and Technical Co-operation, dated 20th of February 1976.

3. Norway shall present to Zambia reports and financial statements on the expenditures incurred by Norway in connection with the purchase of equipment and supplies.

## Article II

### Contributions and Obligations of Zambia

Zambia shall:

1. have the overall responsibility for the administration and implementation of the Project as described in the Schedule to this Agreement, and to this end do their utmost to secure a successful implementation of the Project;
2. cover all expenses that may be required over and above the Grant with the exception of costs related to Article I, para 2 above;
3. provide necessary local personnel and pay their salaries and related costs. Expenditures related to the use of casual labourers in the field, shall, however, be covered by the Grant, c.p. Schedule para 1 b);
4. promptly inform Norway of any condition that interferes with the successful accomplishment of the purpose of the Grant;
5. submit to Norway
  - a) for approval:  
  
Lists of equipment to be procured;
  - b) for information:  
  
Time schedules for the expenditure of the Grant.

## Article III

### Disbursement - Reports

Zambia shall submit to Norway:

- a) Annual applications for reimbursement from the Grant. Each application shall contain a statement of expenditures incurred in the preceding year. The applications shall be forwarded by the Ministry of Economic and Technical Co-operation.

Evidence of the person or persons who are authorized to sign the applications together with the authenticated specimen signature of each such person shall be attached to the first application for reimbursement.

Reimbursement shall be effected upon Norway's approval of the applications;

- b) semi-annual progress reports;
- c) audited accounts in respect of the Project within one year after the end of each Zambian fiscal year.

#### Article IV

##### Co-operation - Representation

1. Norway and Zambia shall co-operate fully to ensure that the purpose of the Grant is accomplished. To that end, each Party shall furnish the other with all such information as it shall reasonably request pertaining to the Project.
2. In matters relating to the implementation of this Agreement the Norwegian Agency for International Development (NORAD) and the Ministry of Economic and Technical Co-operation shall be competent authorities to represent Norway and Zambia respectively.

#### Article V

##### Disputes - Entry into Force - Termination

1. If any dispute arises relating to the implementation or interpretation of this Agreement, there shall be mutual

consultations between the Parties with a view to secure a successful implementation of the Project.

2. This Agreement shall enter into force on the date of its signature and shall remain valid until the date both Parties have fulfilled all obligations arising from it. Whether these obligations shall be regarded as fulfilled will be ascertained after prior consultations between the Parties.

3. Notwithstanding the preceding paragraph, both Parties shall be entitled to terminate this Agreement by giving six months' written notice to the other.

In witness whereof, the undersigned, being duly authorized thereto by their respective Governments, have signed the present Agreement in two originals in the English language.

Done in

this

8/12

day of

1977.

For the Government of  
the Kingdom of Norway

For the Government of  
the Republic of Zambia



## Schedule

The Project is based upon the official request from the Ministry of Economic and Technical Co-operation of 28th October 1976 and the draft background paper on Soil Survey Unit Project attached to the request.

### Project description

I. The Project shall comprise extension and operation for an estimated six year project period 1977-1982 of the established Soil Survey Unit, which is part of the Land Use Section of the Department of Agriculture.

The Grant shall be utilized as follows:

- a) Procurement of vehicles, camping wagons and equipment and necessary scientific and work equipment for soil survey work, as well as office and laboratory equipment and facilities to an amount not exceeding N.kr. 2 200 000 (Norwegian kroner twomilliontwohundredthousand).
- b) Covering recurrent expenditures including maintenance and running of vehicles, chemicals, stationaries, photographs, literature, subsistence allowance, kilometer allowance, labour expenses and sundries to an amount not exceeding N.kr. 3 300 000 (Norwegian kroner threemillionthreehundredthousand).
- c) On request from Zambia part of the Grant may be utilized for delivery of goods as mentioned under a) and b) through NORAD.

II. The main functions of the Project shall be:

- a) To assist Planning Officers in classifying and mapping land suitable for Agricultural Development.
- b) To carry out Soil Surveys particularly where intensive agriculture or the provision of irrigation are under consideration.
- c) To carry out a more systematic soil and land capability survey so as to allow a more comprehensive assessment of Zambia's soil resources to be made use of as basis for national, provincial and local economic planning.
- d) To advise agricultural staff on matters relating to soil distribution, properties and behaviour.

III. The organizational set-up of the Project

Members of the Soil Survey Unit are responsible both technically and administratively to the Assistant Director of Agriculture (Land Use).

The Headquarters of the Soil Survey Unit are currently at Mount Makulu Research Station, Chilanga, where office laboratory and drawing office accomodation is available.

In addition to the Team Leader/Soil Surveyor, one Soil Analystist, and one Laboratory Technician should work at Headquarters.

In each Province there should be one Soil Surveyor in charge of 1-2 field teams.

The field teams will possibly consist of one Technical Officer, two Agricultural Assistants and other supporting staff.



Conclusions and Recommendations.

Conclusions

At the end of the project review the mission reached the following conclusions:

- 1= The basic long term objective of the project should be the establishment of a national Soil Survey and Land Evaluation Unit which should progressively take over the responsibility of the work. This basic objective is implied but is not specifically spelled out in the Agreement between the Government of Norway and Zambia regarding assistance to the Soil Survey
- 2= For this purpose, National staff at all levels should be progressively appointed to the project and receive adequate in-service and abroad training. The possibility of recruiting university graduates being rather remote, the National Resources Development College (NRDC) offers the best source of technical staff. Inclusion of a course on soil survey and land classification in the soil curriculum of the College is suggested and bilateral assistance may be requested for the purpose.
- 3= In view of the above difficulties in recruiting national staff a long term technical and financial assistance to the project is justified. The six year grant offered by NORAD under the Agreement for purchasing equipment and supplies and financing the running costs of the project is amply sufficient for purpose and its duration allows for long term planning of project implementation, work programme and staff training.
- 4= In the present setup, a serious weakness of the project is lack of sufficient close and frequent contacts between the provincial soil surveyors and project headquarters; as a result the standardization of field work at country level cannot be fully achieved. This situation could be considerably improved by the assignment to the project headquarters of a soil correlator and a land evaluation specialist who would visit regularly the provincial teams for sufficient periods of time and ensure the standardization of work in their respective fields of specialization.
- 5= A reconnaissance soil map of the country is required for general land use planning at country level. Such map could be compiled without significant additional expenditure by the

the information collected during their field trips and the soil maps produced by the provincial team.

- 6= Additional experimental research is required for characterization of management properties, crop rotations and average yields of main representative soil series as basic input to land evaluation and land use planning both at regional and levels. This programme should be carried out by a research officer attached to the soil research section of Mount Makulu Research Station in collaboration with the soil correlator and the land evaluation specialist of the project.
- 7= In view of a foreseeable increase of the number and kind of soil analyses, the present soil survey laboratory facilities available at Mount Makulu will become insufficient. Two possibilities of expansion of laboratory facilities may be considered: either making use of existing and little used laboratory facilities in provincial experiment stations such as Kabwe station, or strengthening the existing central laboratory at Mount Makulu Research Station. This latter solution is technically preferable, for facility of supervision and standardization of methods and results. The strengthening of the laboratory would require additional room space, some specialized equipment and technical staff (2 technical officers, two laboratory assistants and two laboratory attendants).
- 8= Some analytical methods such as determination of cation exchange capacity give unreliable results. Further investigation is required for improvement of the method.
- 9= Determination of physical characteristics of established soil series is being made on a limited number of samples by the laboratory of the soil research section at Mount Makulu station. This laboratory cannot meet the needs of the soil survey unit and a soil physics section will have to be established within the soil survey laboratory.
- 10= Determination of micronutrients should be carried out specially on strongly weathered soils where deficiencies or toxicities due to the lack or excess of microelements are frequent and cause heavy damages to certain crops. For this purpose some specialized equipment such as an atomic absorption spectrophotometer will be necessary.

11= The accuracy and regular control of analytical results will benefit greatly by exchange of samples, results and experience with another soil laboratory. The soil laboratory of the Agricultural Univeristy at As may be suggested for such exchange.



RECOMMENDATIONS



Considering the present situation and the medium and long term objectives of the project, the Mission recommends that:

- 1= National staff at all levels be appointed to the project as a matter of urgency; the recruitment possibilities which are likely to be available in the next few years from the NRDC college should be carefully considered, facilities should be granted to graduates for training abroad and upgrading at professional level of the best officers.
- 2= A concrete establishment be made available for the appointment of National staff in accordance with Article II-paragraph 3 of the Agreement regarding the Soil Survey Unit.
- 3= Teaching of soil science in the NRDC college be further strengthened by inclusion of a course on soil survey, soil classification and land evaluation in the curriculum of the agriculture section of the college and that bilateral assistance be requested for the purpose.
- 4= Young graduates from the Agricultural University at As, be recruited as associate experts to work in the provinces under the direct supervision of an experienced soil surveyor, after a short training period in Norway.
- 5= Soil correlation and characterization of established and provisional soil series and standardization of field survey methods be actively pursued, and that an expatriate soil correlator be recruited as a first priority for this purpose.
- 6= Land evaluation methodology be further improved in line with the FAO "Framework for Land Evaluation" and standardized at country level; and that an expatriate land evaluation specialist be recruited as a second priority for this purpose.
- 7= Soil Management properties of main representative soils be further investigated through an expanded field experimental programme carried out by the Soil Research Station at Mount Makulu in collaboration with the land evaluation specialist and soil correlator of the project.

- 8= The laboratory facilities at soil survey Unit<sup>laboratory</sup> at Mount Makulu Research Station be further strengthened to cope with an increase number and kinds of analyses; such strengthening will require additional room-space, equipment and national staff. Because of the dust from the Chilanga Cement Plant carried by winds in the direction of Mount Makulu station, it may be difficult to avoid contamination of soil samples and in the laboratory. It may therefore be better to have specialized analyses done in another laboratory such as in Kabwe station.
- 9= Some analytical methods giving unreliable results be further investigated and improved.
- 10= A soil physics section be established within the soil survey laboratory at Mount Makulu Research Station.
- 11= Studies on micronutrients deficiencies and toxicities be initiated and additional equipment and supplies required for such studies be provided.
- 12= Exchange of experiences on analytical methods and results be organized with the soil laboratory of the Agricultural University of Norway.
- 13= A second review mission be organized at midterm of the ongoing project i.e., in roughly 2½ to 3 years time, to examine the organizational and technical progress made by the project.

- 14= An experienced senior technical officer with administrative experience be recruited to deal with the administration of the Unit. This post should be a part of the national establishment and filled by a qualified Zambian.
- 15= A petty cash system be requested. If this system is not approved or does not work satisfactory NORAD should be prepared to establish a working-capital-fund.

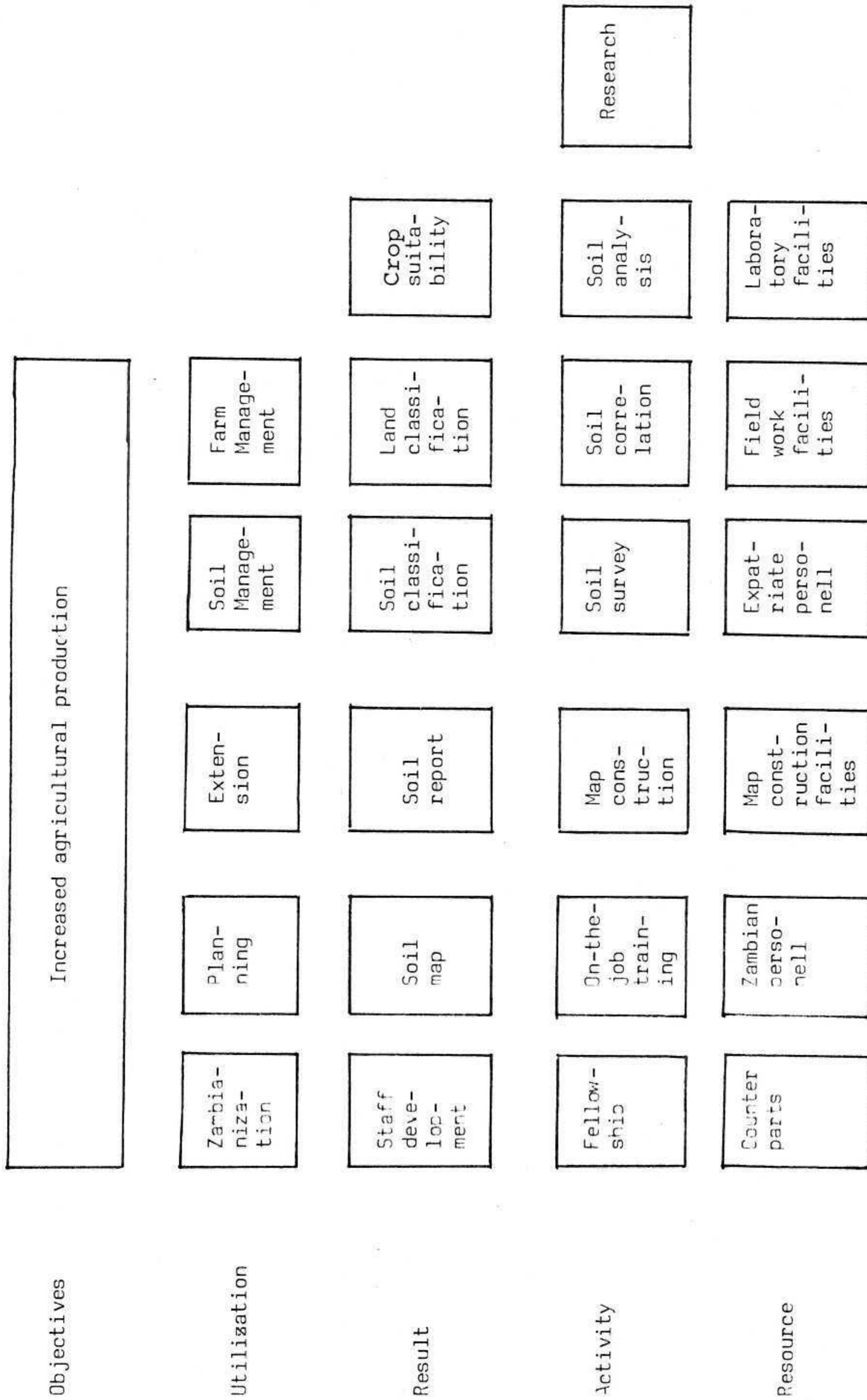
Lusaka, 11 May 1978.

 G. Sumb. 

 S. S. Sumb.









LIST OF SOIL SURVEYS 1973-1980

No	Soil Survey Area	Province	Detailed ha	Semidetailed ha	Reconnaissance ha	Explanatory ha	Remarks
8	Katamba Valley Research Station	Western	153				P I
9	Secheke Research Station	Western	3144				P I
10	Nakambala Sugar 2nd Extension	Southern	935				P I
12	Sasare block	Eastern		5225			I
13	Nakambala 3rd Extension	Southern		1500			P I
14	Zamic Chisamba Farm	Central	5870		13500		P I
15	Mungu River Area	Lusaka	4378				P I
16	Pemba Village	Eastern	300				P I
17	Kalunsa Area	Central			35800		P I
18	Kabwe Research Station	Central	543				P I
19	Msekera Research Station	Eastern	400				P I
20	Mochipapa Research Station	Southern	480				P I
21	Mukonchi East Block	Central			19031	8220	-
22	Mkushi West	Central			46300		P I
23	Kalichero	Eastern			35000		P I
24	Big Concession	Central			97000		P
25	Nakambala 4th Extension	Southern		1448			P I
27	Masumba Res. Station	Eastern	250				
28	Chipangali West	Eastern		15000			
29	Chinjara Ranch	Eastern		5400			
30	State Land Chipata North	Eastern		3000			P I
31	DuneIn Estates	Eastern		3000			P I

P = Planned

I = Implemented

No	Soil Survey Area	Province	Detailed ha	Semidetailed ha	Reconnaissance ha	Explanatory ha	Remark
33	Mutale-Kabundi	Central			26700		
34	Mwinuna East Extension	Copperbelt		30000			
35	Big Concession NW	Central			45000		
36	Mpusu-Kaporosa	Central			84800		
37	Parts of Mkushi District	Central		27100	124200		P
38	Chifwesa groundnut Sch.	Northern	800				
39	Nondo Settlement Sch.	Northern	1880				
40	Lubu Valley Settl.Sch.	Northern		4000			
41	Misamfu Research St	Northern	400				P I
42	Mambwe I D Z area	Northern			95000		P I
43	Munkonge T B Z area	Northern		2100			
44	Luena Proposed 2nd Sugar Estate	Luapula			137000		
45	Luena Proposed 2nd Sugar Estate	Luapula		62400			P
46	Magoye Research Station	Southern	653				P I
47	Mwinilunga Solwezi Distr.	North Western			5000 000		used
48	Nakambala 5th Ext	Southern	4179				P I
49	Katito Wheat Scheme	Northern	-	3905			P I
50	Senga Hill Area	Northern			60000 ?		P I
51	Chief Muchinda area	Central			164000		
52	Chief Kafinda area	Central				75000	used
53	Mpongwe Block 1-II	Copperbelt		35225			P I
54	Nyangombi Settlement	North Western		4518			P I
58	Jivundu Settlement	North Western		2585			P I

No	Soil Survey Area	Province	Detailed ha	Semidetalled ha	Reconnaissance ha	Explanatory ha	Remarks
56	Kateshi Coffee Scheme	Northern	2440				P I
57	Musakanya's Estate	Northern		5600			
58	Mbala State Ranch N-Part	Northern		10890			P
59	8 proposed Rice Schemes	Northern/ Luapula	8939				P
60	Mushwishi Rural Res. Center	Central		2100	10040		P I
61	Chibote Farms Ltd	Central					P I
62	Chambashi Estates	Central		16200			P I
63	Sikaleta-Nanzhila	Southern			243870		
64	Mushwala Settl. Sch	Western	15680				P I
65	Lukulu-Watopa area	Western			46000		
66	Kalabo for wheat	Western			95000		
67	Chief Muchinda	Central					N A
68	Mpika Dairy Settl Sch	Northern	845				P I
69	Lukulu N Stateland block	Northern			30000		P I
70	Bonanza Farm No 2061	Lusaka	1274				P I
71	Chanyanya Kafue Flats	Lusaka			11000		
72	Zambezi Ranching Corpora- tion	Southern	576	7631			P I
73	Chief Chitina Area	Central					
74	Kashim Farm	Central	1350				P I
75	Munkumpu	Copperbelt	2500	24000			P

Soil Survey Area	Province	Detailed ha	Semidetailed ha	Reconnaissance ha	Exploratory ha	Remarks
Lusito Settlement	Southern	13				P
Presidents Lodge	Lusaka		350			
Mwonboshi Farm 1455	Central			800		P
Karubwe Farm 2029	Central	1100				
Kalola-Chisamba	Central	21200				P I
Batoka Ranch	Southern			12000		
Kayuni Ranch	Southern			5000		
Naluama Ranch	Southern			1200		I
Harmony Ranch	Southern		3900			P I
Zimba Hills	Southern		25000			
Farm 3332	Central		930			P I
1020	Central		250			P I
1543	Central		1300			P I
1445	Central		2025			P I
3204	Central		1730			P I
Mumbalashi/Lunsemfwa	Central		5800			
Katamba	Central		2700			
Farm 3394	Central		900			P I
Nkolonga	Central			4300		
ZNS Camp Mumbwa	Central		6500			P I
Farm 1446	Central	1000				P I
ZNS Airport Farm	Lusaka	1580				P I
Lundwe's Farm	Southern			980		P I
Kabuyu	Southern				20000	
Chitandika	Eastern				34000	

Soil Survey Area	Province	Detailed ha	Semidetailed ha	Reconnaissance ha	Exploratory ha	Remarks
Farm D80/Re and D27/Re	Eastern		2300			P I
Mwami Farms	Eastern		5300			P I
D24/Re	Eastern		1270			I
Jumbo 952, 953	Eastern		1420			P I
Ngwata Estates	Eastern		600			P
Chipangali Farms	Eastern		600			P
Lumesi	Eastern		62750			
Mtonga Farms	Eastern	100	1225			
Gonda Barracks	Eastern	412				P I
Farm D/27	Eastern		1225			
Kapoya Farm	Eastern	37				P I
Kabwe Urban	Central			100000		N A
Farms 1672-73	Central			2800		P I
Nyama Farms	Central		9800			P I
Farm 1826	Central	1050				P I
Farm D 38/Re	Eastern	81				I
D 102/Re	Eastern	668				I
D 25/D	Eastern	610				I
D 35/Re	Eastern		1024			I
D 79	Eastern	650				I
D 223	Eastern	410				I
Luambwa Rural R C	Eastern		6551			I
Chanje area	Eastern		1657			I
Chasefa area	Eastern		3205			I
Magodi area	Eastern		16548			I

Soil Survey Area	Province	Detailed ha	Semidetailed ha	Reconnaissance ha	Exploratory ha	Remarks
Chitandika	Eastern		3652			I
Uningi Pans	Northern	250				P I
Lunzua	Northern					N A
Npongwe Hospital	Copperbelt	400				
Chitafu Farm	Copperbelt	400				
Ndola Rural Council	Copperbelt	1200				
Nkungwa Settl. Scheme	Southern		10000			P I
Chembo South	Copperbelt		1935			
Chembo West	Copperbelt		720			
Luanshya West	Copperbelt		2600			
Luongo area	Copperbelt		2000			
Fisenge area	Copperbelt		380			
Kamurendo	Copperbelt		1370			
Various farm surveys	Copperbelt	700				
Nyanphande Extension	Eastern		4455			P I
Farm D80/E	Eastern	542				I
D25/N	Eastern	300				I
D25/B	Eastern	410				I
Mr Tembo Farm	Eastern	3868				I
Simonga Wheat Scheme	Southern	1000				
Kafubu Dam-W	Copperbelt		5185			
Mpongwe Pilot Farm	Copperbelt	350				P I
Zambia Council for Handicapped	North Western		360			P I
Rural Council Kansonge	North Western		2040			



Soil Survey Area	Province	Detailed ha	Semidetailed ha	Reconnaissance ha	Exploratory ha	Remark
Mutanda Mission	North Western				4700	
Ngosa	Copperbelt				20000	N A
Naluama+Mugota Ranches	Southern			2500		P I
Kayuni Ranch	Southern			5850		I
Farm D/179	Eastern		1400			
Chama Rice Schemes	Eastern	1026				P I
Ntirizi	Eastern			32000		P
Kaoma F T C	Western	459				P I
Kalumwanga area	Western			121000		
Changufu's Farm	Northern	1800				P I
Lingalonga Farm	Northern	2142				
Chikoli State Ranch	Southern		8700			P I
Kalomo F T C	Southern		1000			
Siachitema area	Southern			60000		P
Kalomo P F A	Southern		2000			
Farm D 36 sub.17	Eastern	350				I
Kahare area	Western		86000			N A
Kambilombilo	Copperbelt			30000		P
Chafukuma	North Western		5500			P I
Mbala State Ranch South	Northern		12000			P
Kayambi-Makasa	Northern				200000	P I
Mpika Statefarm	Northern			20000		(P)
Luwingo Statefarm	Northern			20000		(P)
Luapula IRDP	Luapula			80000		
Kafue flats	Lusaka	1200				



- 1 -

SOIL SURVEY REPORTS

- |     |   |      |
|-----|---|------|
| 1*  | Detailed soil survey and irrigability classification of the Chalibana area, Zambia.<br>T.U.Yager, C.A.Lee and G.A.Perfect | 1967 |
| 2.  | Detailed soil survey of the Copperbelt Regional Research Station, Mufulira.<br>T.U.Yager, C.A.Lee and G.A.Perfect.        | 1968 |
| 3.  | Detailed soil survey of the Luapula Regional Research Station, Mansa.<br>T.U.Yager, C.A.Lee and G.A.Perfect.              | 1968 |
| 4*  | Detailed soil survey of Mount Makulu Central Research Station.<br>C.A.Lee.  | 1968 |
| 5*  | Moisture characteristics of Zambia soils.<br>A.H.Maclean.   | 1970 |
| 6.  | Soil profile descriptions and analytical data for some soils of Zambia, 1968-69.<br>Soil Survey staff, Mount Makulu.      | 1970 |
| 7.  | Detailed soil survey of New Kaoma Tobacco Scheme.<br>H.B.Mumba.   | 1971 |
| 8.  | Detailed soil survey of Kataba Valley Research Substation, Western Province.<br>H.Brammer and D.B.Clayton.                | 1973 |
| 9.  | Detailed soil survey of Seshelhe Research Substation, Western Province.<br>H.Brammer and D.B.Clayton.                     | 1973 |
| 10. | Detailed soil survey, Nakambala Sugar Estate, Proposed second extension.<br>H.Brammer and D.B.Clayton.                    | 1973 |
| 11. | Soils of Zambia, 1971-1973.<br>H.Brammer.   | 1973 |
| 12. | Semi-detailed soil survey, Sasare Block, Proposed refugee settlement.<br>A.Commissaris.                                   | 1973 |

\*The following reports were issued under duplicated numbers.

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|----|--|------|
| 1. | Detailed soil survey of the Nakambala Sugar Estates, first extension.<br>H.B.Mumba.            | 1971 |
| 4. | Detailed soil survey of Farris 171a and 172a, Upper Kaleya Settlement Extension.<br>H.B.Mumba. | 1971 |
| 5. | Detailed soil survey of Heales Estate.<br>H.B.Mumba.   | 1971 |

13. Detailed soil survey, Nakambala Sugar Estates, proposed extension 3 (Farms 554A, 554B, 554Rem, 1342, 1343, 1343Rem).  
A. Njøs. 1974
14. Detailed soil survey, ZAMIC Chisamba Farms (Mtendere, Nsadsu, Penyaonse Blocks).  
D. B. Clayton. 1974
15. Detailed soil survey, Mungu River Area (Farms 41a, 42a, 1320a, 1329a).  
D. B. Clayton. 1974
16. Detailed soil survey, Pemba Village.  
A. L. T. N. Commissaris. 1974
17. Reconnaissance soil survey, Kalunsa, area.  
O. Haugboen. 1974
18. Detailed soil survey, Kabwe Regional Research Station.  
O. Haugboen. 1974
19. Detailed soil survey, Msekera Regional Research Station.  
A. L. T. N. Commissaris. 1974
20. Detailed soil survey, Mochipapa Regional Research Station.  
J. C. Schmidt and A. Njøs. 1974
21. Reconnaissance soil survey, Mukonchi East Block.  
D. B. Clayton. 1974
22. Reconnaissance soil survey, Mkushi West.  
O. Haugboen. 1974
23. Reconnaissance soil survey, Kalichero Area.  
A. L. T. N. Commissaris. 1974
24. Reconnaissance soil survey, Big Concession.  
O. Haugboen. 1974
25. Semi-detailed soil survey, Nakambala Sugar Estates, Extension 4 (Farms 553A, 553 Rem, 555).  
A. Njøs. 1974
26. Land Capability: Land Use Planning Guide, Chapter 2. 1974
27. Detailed soil survey of Masumba Research Substation.  
A. Commissaris. 1975
28. Semi-detailed soil survey of Chipangali West.  
A. Commissaris. 1975
29. Semi-detailed soil survey of Chinjala Ranch.  
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30. Semi-detailed soil survey of selected areas for Chipangali Quarter Re-organisation Scheme.  
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31. Detailed soil survey of Dunelm Estates.  
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32. The Sandveldt Soils of Central Province.  
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33. Reconnaissance soil survey of the Mutale-Kabundi  
area, Central Province.  
By R. Sørensen. 1976
34. Detailed reconnaissance soil survey, Iwiana  
East Extension, Copperbelt Province.  
By A. Commissaris. 1976
35. Reconnaissance soil survey, Big Consession, North-  
Western Part, Central Province.  
By A. Commissaris. 1976
36. Detailed reconnaissance soil survey, Mpusu-Kaperosa  
area, Central Province.  
By Rolf Sørensen. 1976
37. Reconnaissance soil survey, Parts of the Ikushi  
District, Central Province.  
By Rolf Sørensen. 1976
38. Detailed soil survey of the Chifwesa Groundnuts  
Scheme, Northern Province.  
By L.A. Van Sleen. 1976
39. Detailed soil survey of the NONDO Settlement Scheme,  
Northern Province.  
By L.A. Van Sleen. 1976
40. Detailed soil survey of the Labu Valley with  
settlement scheme, Northern Province.  
By L.A. Van Sleen. 1976
41. Detailed soil survey of the Misanfu Regional Research  
Station, Northern Province.  
By L.A. Van Sleen. 1976
42. Detailed reconnaissance soil survey of the Nambe  
I.D.E. area, Northern Province.  
By L.A. Van Sleen. 1976
43. Semi-detailed soil survey of the Munkongo T.B.E.  
area, Northern Province.  
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44. Reconnaissance soil survey of the proposed second  
Sugar Estate Luena area, Luapula Province.  
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45. Semi-detailed soil survey of the proposed second  
Sugar Estate Luena area, Luapula Province.  
By A. Commissaris. 1977

46. Detailed soil survey of Magoye Regional Research Station, Southern Province.  
By V.R. Chinene. 1977
47. Rapid reconnaissance soil survey of the Iwinilunga and Selwezi Districts, N.W. Province.  
By P. Heilmann. 1977
48. Detailed soil survey of the Makambala Extensions area, Southern Province.  
By A. Commissaris and J. Storror. 1978
49. Detailed soil survey of the Katito proposed wheat scheme, bala, Northern Province.  
By J. Slordal and B. Nyendwa. 1978
50. Detailed reconnaissance soil survey of the Senga Hill area, Northern Province.  
By B. Nyendwa. 1978
51. Reconnaissance soil survey of Chief Muchinka's area, Serenje District, Central Province.  
By P. Woods. 1978
52. Rapid reconnaissance soil survey of the Chief Kafinda's area, Serenje District, Central Province.  
By P. Woods. 1978
53. Semi-detailed soil survey of the Mpongo Block I and II GRZ/EEC irrigated wheat scheme, Copperbelt Province.  
By P. Heilmann. 1978
54. Semi-detailed soil survey of Nyangombi settlement scheme, North-Western Province.  
By P. Heilmann. 1978
55. Semi-detailed soil survey of Jivundu settlement scheme, North-Eastern Province.  
By P. Heilmann. 1978
56. Detailed soil survey of Kateshi Tucom Coffee Estate, Northern Province.  
By J. Slordal. 1978
57. Semi-detailed soil survey of Mr. Lusakanya's Estate, Northern Province.  
By J. Slordal. 1978
58. Semi-detailed soil survey of Mbala State Ranch, Northern Part, Northern Province.  
By J. Slordal. 1978
59. Detailed soil survey of eight proposed rice schemes, Northern and Luapula Provinces.  
By J. Slordal. 1978

60. Reconnaissance/semi-detailed soil survey of Muswishi Rural Reconstruction Centre, Central Province.  
By P.Woode. 1978
61. Semi-detailed soil survey of Chibote Farms Ltd. Farms no 5571 and 5189, Central Province.  
By P.Woode and R.Mwenda. 1979
62. Semi-detailed soil survey of Chambashi Estate, Central Province.  
By P.Woode and J.Storrø. 1979
63. Reconnaissance soil survey of Sikaleta - Nanzhila area, Southern Province.  
By O.Wennerby. 1980
64. Detailed soil survey of the Mushwala area, Kaoma District, Western Province.  
By C.Offergelt. 1980
65. Reconnaissance soil survey of the Lukulu-Watopa area, Lukulu District, Western Province.  
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66. Reconnaissance soil survey of parts of Kalabo District for wheat growing, Western Province.  
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67. Reconnaissance soil survey of part of Chief Muchinda area, Serenje District, Central Province.  
By P.R.Woode. 1980
68. Detailed soil survey of Mpika dairy settlement scheme, Mpika District, Northern Province.  
By I.Malima. 1980
69. Semi-detailed soil survey of Lukulu North proposed stateland block, Lasama District, Northern Province.  
By I.Malima. 1980
70. Detailed soil survey of Farm no 2061, Lusaka Province.  
By V.R.Chinene. 1980
71. Reconnaissance and partly detailed soil survey of Chanyanya, Kafue Flats, Central Province.  
By A.Commissaris and J.Storrø. 1980
72. Reconnaissance and partly detailed soil survey of Zambezi Ranching Corporation, Mazabuka District, Southern Province.  
By J.Storrø. 1980
73. Reconnaissance soil survey of Chief Chitina area, Mkushi District, Central Province.  
By R.Mwenda and J.Storrø. 1980

74. Detailed soil survey of Mashima Farm of Chibete Holdings Ltd., Lusaka Province.  
By J. Vikan. 1980
75. Semi-detailed and detailed soil survey of Munkumpu proposed irrigation scheme, Copperbelt Province.  
By G.K. Hennerann. 1980



SOIL SURVEY UNIT STAFF 1977 - 1980

Position	1977							1978							1979							1980						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Senior Soil Surveyor	1							1						1							1							
Soil Surveyor	1	1	1	1				1	1	2	2	1	1	1	1	2	2	1	1	1	1	2	2	1				
Soil Chemist																				1								
Technical Officer				1				1	1	1	1	1	1	1	1	1	1	1	1		2	1	2					
Agricultural Assistant	2	1	6	2	1	1		2	6	2	2	2	1	4	5	3	2	1		2	3	2	1	1	1	1		
Laboratory Assistant	1																			1								
Laboratory Attendant	2							2												2								
Compassman						3	1			3	1			1	3	1				1	1	1						
CDE								3			1			3						3								
Driver	1	1		1			1	1	1	1	1	1	1	1	1	2	1	1		1	1	1	1	1	1	1		
Laboratory Technician	1																											
Agricultural Demonst.	1							1						1						1	1							

1. Mt Makulu
2. Central Province
3. Copperbelt
4. Northern and Luapula
5. Western
6. Southern
7. Eastern



LOCAL EXPENDITURE 1973 - 1981

Item	Expenditure							Estimated expenditure 1981	
	1973	1974	1975	1976	1977	1978	1979		1980
• Maintenance and running costs of vehicles							55 524	66 515	35 000
• Night and Km allowances							18 692	27 281	10 000
• Camping and survey equipment							20 018	2 258	15 000
• Office equipment							4 637	453	8 000
• Casual fieldlabourers							14 154	19 736	3 000
• Laboratory equipment and chemicals							10 955	40 993	35 000
• Stationaries and photographs							3 495	4 493	7 000
• Literatur							312		2 000
• Repair of caravans							842		
• Purchase of vehicles									5 000
• Running costs of provincial soil surveys									30 000
Sundries							2 082	2 503	3 000
AL	No record	15 000	31 000	10 000	30 000	73 722	130 712	164 232	198 000



TRANSPORT

<u>GRZ no.</u>	<u>Type</u>	<u>Year</u>	<u>Condition</u>	<u>Station</u>
130 X	Toyota Vinyl Toyp, LWB	1980	Excellent	Mt. Makulu
715 W	Toyota Hardtop LWB	1980	Dito	Ndola
714 W	Dito	1980	Dito	Mongu
260 W	Toyota, Station Wagon	1980	Dito	Mt. Makulu
309 V	Landrover, pick- up	1979	Good	Gwembe
825 S	Toyota SWB, hard- top	1979	Dito	Kasama
824 S	Dito	1979	Dito	Mt. Makulu
600 S	Landrover, pick- up	1979	Dito	Kasama
184 S	Landrover station- wagon	1978	Dito	Mt. Makulu
872 R	Landrover	1977	Engine overhaul	Workshop
873 R	Dito	1977	Good-fair	Kabwe
597 R	Dito	1977	Engine overhaul	Workshop
768 N	Landrover station- wagon	1975	Good	Ndola
769 N	Landrover pick- up	1975	Off the road	Workshop
995 N	Dito	1975	Dito	Choma
560 L	Dito	1974	Dito	Mt. Makulu
561 L	Dito	1974	Fair	Chipata
566 D	Landrover station- wagon	1971	Poor	Magoye



INSTRUMENTS AND EQUIPMENT PURCHASED FROM NORAD 1973 - 1980.

<u>Item</u>	Year
4 Typewriters	1973
1 Tetramatic conductivity meter	1978
1 Metrohm pH meter	1978
1 Facit calculator	1978
1 Corning flame photometer	1978
1 Kjeltac distilling digestion system	1978
1 Metrohm multi burette	1978
1 Tecator distilling/digestion system	1981
1 Varian atomic absorption	1981
1 Gallenkamp oven (locally obtained)	1980
10 Stills + connector and cable	1981
2 Tetramatic electrodes	1980
Various cartographic materials e g chemicals scribing materials, film etc	1980
Various chemicals	
8 Landsat color imageries	1979
4 Topcon mirrorstereoscopes	1979
15 Soil color chart books	1979
10 Munsell soil color charts	1979
25 FAO guidelines for profile description	1979
70 Soil augers	1978
15 Compasses	1981
Clinometers	1980
8 Cyclometers	1979
8 Curvimeters	1979
30 books	1979

Laboratory equipmentAvailable

1 flame photometer
1 distillation unit
1 conductivity meter
1 pH meter
1 water bath
1 sand bath

Ordered

- 1 AAS distillation unit (has arrived)
- 1 water stills
- 1 spectrophotometer
- 1 water bath
- 1 pH meter
- 1 electronic balances



ITEM	1980 <sup>1)</sup>	1981	1982	1983	1984	1985	1986
1 Maintenance and running costs of vehicles	66,515	60,000	70,000	90,000	90,000	90,000	90,000
2 Night and Km allowance	27,281	70,000 <sup>3)</sup>	100,000	110,000	120,000	130,000	140,000
3 Camping and Survey Equipment	2,258	15,000	20,000	20,000	25,000	25,000	25,000
4 Office equipment	453	8,000	10,000	10,000	10,000	10,000	10,000
5 Casual fieldlabourer	19,736	30,000 <sup>4)</sup>	40,000	45,000	50,000	50,000	50,000
6 Laboratory equipment and chemicals	40,993	60,000	60,000	70,000	70,000	70,000	70,000
7 Stationary and photographs	4,493	7,000	10,000	10,000	10,000	10,000	10,000
8 Litterature	312	15,000 <sup>5)</sup>	10,000	10,000	10,000	10,000	10,000
9 Repair of caravans	842	2,000	2,000	2,000	2,000	2,000	2,000
10 Purchase of vehicles		50,000	75,000	50,000	75,000	50,000	75,000
11 Running costs of Provincial teams <sup>2)</sup>		-	-	-	-	-	-
12 Sundries	2,503	5,000	5,000	5,000	5,000	5,000	5,000
TOTAL K	164,232	322,000	402,000	422,000	467,000	452,000	487,000

- 1) Not included in 1980 expenditure and items purchased by NORAD Oslo such as 4 vehicles, chemicals, laboratory equipment, books etc
- 2) Expenditure for running costs of Provincial Teams is summarized under other items
- 3) These allowances were increased in dec.1980 tremendously (prof. and techn. officers doubled and 5 times increased for drivers and CD's)
- 4) Wages increased by 50% in Dec. 1980
- 5) This includes bringing up to date books at the Soil section at Mt Makulu library.
- 6) Building of houses for counterpart staff has not been included.





REPUBLIC OF ZAMBIA

DEPARTMENT OF AGRICULTURE

PROVINCIAL AGRICULTURAL OFFICER  
COPPERBELT PROVINCE  
P.O. BOX 232  
NDOLA

3rd April, 1981.

To: The Norad Soil Survey Evaluation Mission.

Dear Sirs,

COMMENTS FOR YOUR CONSIDERATION

1. The Copperbelt Province, being a new agricultural area, has a lot of work that involves the soil survey unit. Because agriculture is being expanded, we anticipate this activity to continue for several years. In order to achieve a certain amount of self sufficiency in the production of foodstuffs and exportable commodities the soil survey unit will have to have a corresponding establishment to this volume of work.
2. The work done so far by the soil survey unit in the Province has proved of great benefit. The increase in the production of agricultural commodities over the past 3 or 4 years can be attributed to the programme of the Unit.
3. In view of the shortage of professional Zambian Soil Surveyors it is imperative for the Province in particular, and the country generally, to continue the Norad project.
4. The rate at which Zambian Soil Surveyors are being trained could be increased by proper training courses both within Zambia (ie. at UNZA, NRDC, etc) and abroad.
5. Although I am satisfied with the performance of the soil survey unit in the Province, I am, however, concerned about the sharing of services with the North Western Province. This tends to slow down our programme & delay expansion, so that our targets are not being achieved as rapidly as we should like.
6. With these views in mind I would request the Government of the Republic of Zambia to continue the Norad soil survey project.
7. I wish the evaluation Mission success in its deliberations.

  
D.E. Kajimo

PROVINCIAL AGRICULTURAL OFFICER



# THE REPUBLIC OF ZAMBIA

Scale 1:1,500,000 or 23.67 miles to 1 inch



City	<b>LUSAKA</b>	Aerodromes	+	ALTIMUDE TINTS	
Principal Town	• Livingstone	Roads		Miles	Feet
Town	• Mwanlunga	Trunk Routes	—————	2 1/2	1000
Village		Main	—————	1 1/2	500
Boundaries		Secondary or District	—————	3/4	500
International	.....	Other Roads and Tracks	.....	1/2	1000
Provincial	- - - - -	Railways	—————	1/2	1000
National Parks or Game Reserves		Spot Heights in Feet		300	1000
				200	1000
				100	1000

The representation on this map of a road or track is not evidence of its height or width.

THIS MAP MUST NOT BE CONSIDERED AN AUTHORITY ON THE DELIMITATION OF INTERNATIONAL BOUNDARIES.

Users noting errors or omissions on this map should notify the Assistant Surveyor General (Mapping) P. O. Box R. W. 397 Lusaka





Lualaba

Kolwezi

Jadotville

Lake Retenuc

Kungu Mountains



Katito wheat Rep. No. 4

Nchelenge State Farm

Luena sugar estate Rep. No. 45

Luwingu State Farm

Chakaba Rep. No. 59

Kasaba Rep. No. 59

Chama Lufimba Rep. No. 59

N O R T H



**Katito wheat scheme**  
Rep. No. 49

**Mambwe I.D.Z area**  
Rep. No. 42

**Mbala state ranch**  
Rep. No. 58

**Senga Hill**  
Rep. No. 42

**Nondo settl. scheme**  
Rep. No. 39

**Katashi coffee scheme**  
Rep. No. 56

**Misamfu research station**  
Rep. No. 41

**Musakanya's estate**  
Rep. No. 57

**Rep. No. 59**  
**Rep. No. 59**  
**Rep. No. 59**

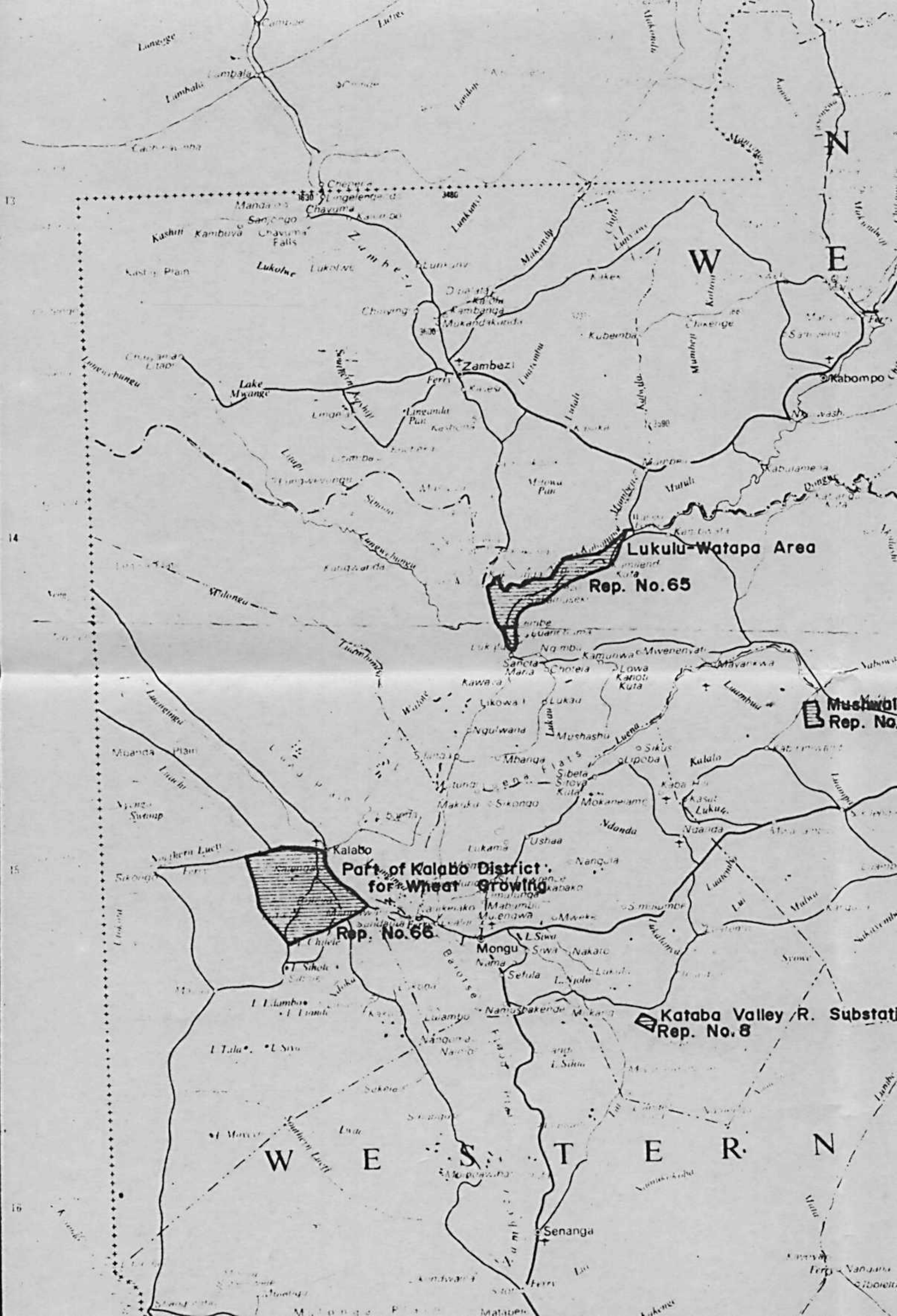
**Nashinga**  
Chinsali

**Lubu Valley**  
Rep. No. 40

**Chifwesa**  
Rep. No. 38

**T H E R N**



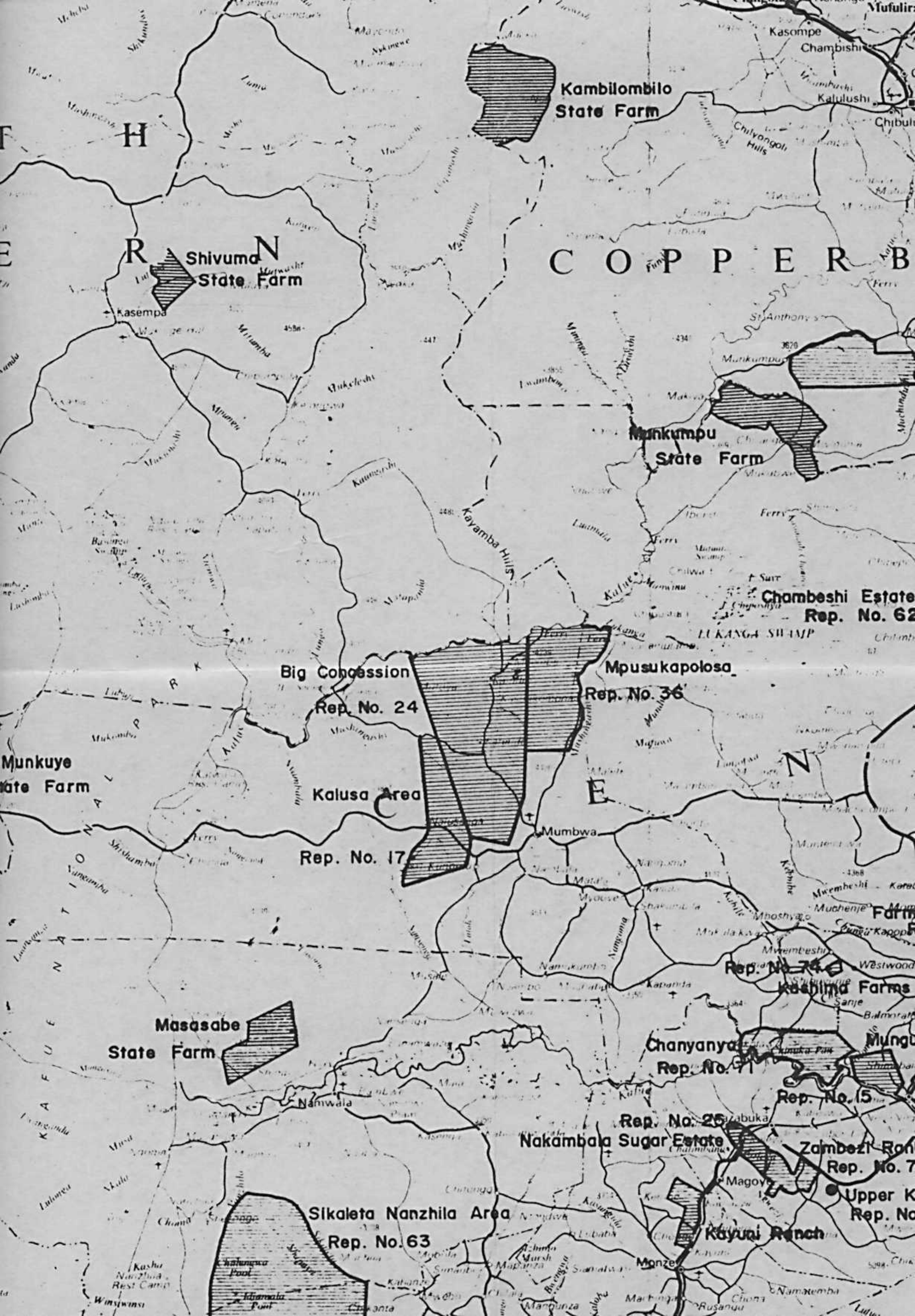


13  
W E

14  
**Lukulu-Watapa Area**  
Rep. No. 65

15  
**Part of Kalabo District for Wheat Growing**  
Rep. No. 66

16  
**Kataba Valley R. Substation**  
Rep. No. 8  
W E S T E R N



**Kambilombilo State Farm**

**Shivuma State Farm**

**C O P P E R B E L T**

**Mankumpu State Farm**

**Big Concession  
Rep. No. 24**

**Mpusukapolosa  
Rep. No. 36**

**Chambeshi Estate  
Rep. No. 62**

**Munkuye State Farm**

**Kalusa Area**

**Rep. No. 17**

**Masasabe State Farm**

**Rep. No. 74**

**Chanyanya  
Rep. No. 71**

**Rep. No. 25  
Nakambala Sugar Estate**

**Rep. No. 15**

**Sikaleta Nanzhila Area  
Rep. No. 63**

**Zambezi Ranch  
Rep. No. 7**

**Kayuni Ranch**

**Upper K  
Rep. No.**



Rep. No. 51  
Chief Muchira

Lukulu Soil Survey

Mutale Kapandi

Rep. No. 33

LUANGWA VALLEY  
GAME RESERVE (SOUTH)

Serenje

Rep. No. 37  
Chief Chitina's Area

Rep. No. 37

(4)

Mkushi

(3)

(2)

Rep. No. 37

Rep. No. 22

Parts of Mkushi District  
Rep. No. 37

(1)

N.N.S.S.  
Extantion

Mtrizi  
State Farm

R  
Station

No. 60  
swishi R.R. Center

E S C A R P M E N T

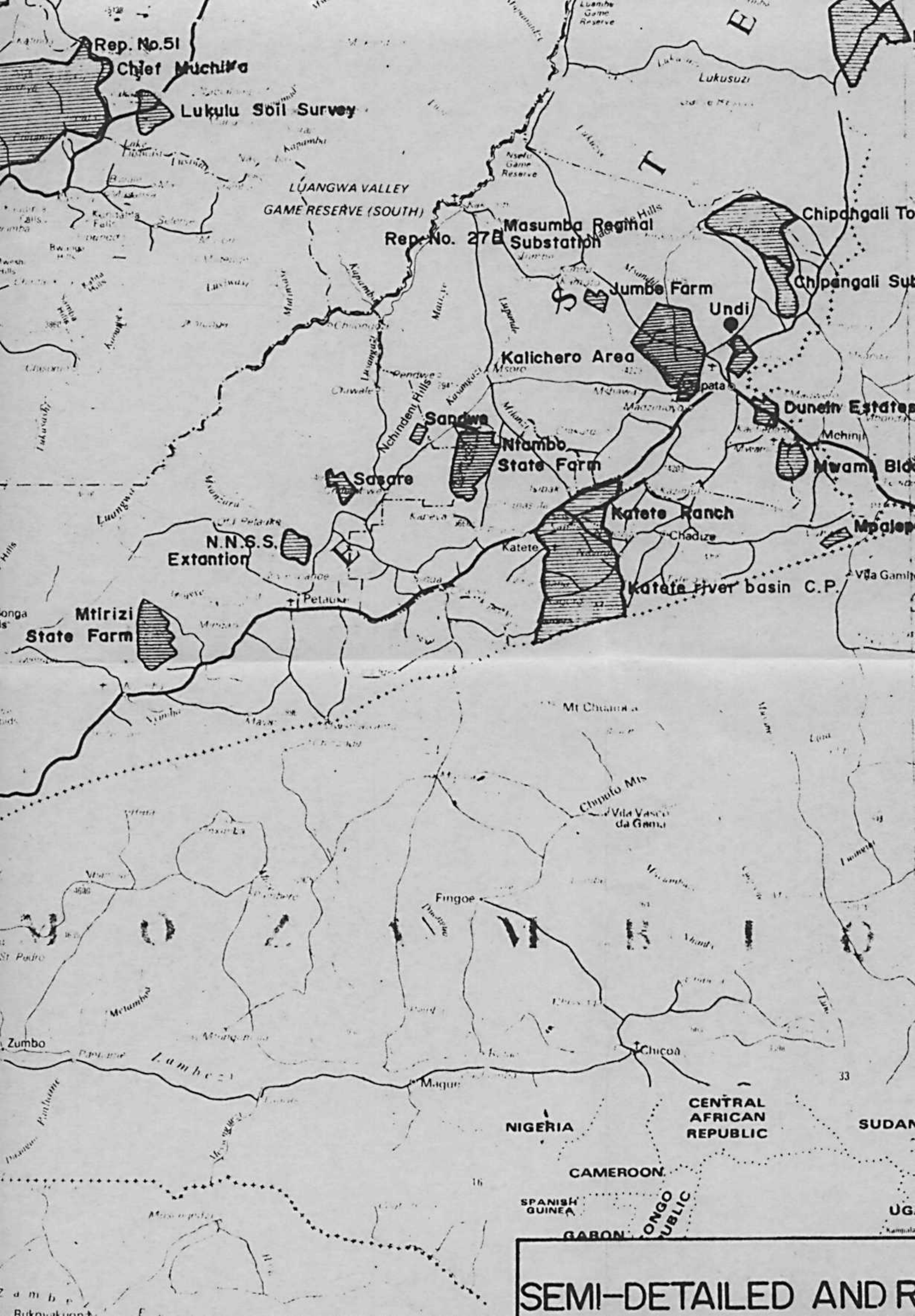
/Chongwe, Rep. No. 14

akantapa  
te Farm

Zumbo

Fera

Z a m b e z i  
Bukwakuona



Rep. No. 51

Chief Muchira

Lukulu Soil Survey

LUANGWA VALLEY  
GAME RESERVE (SOUTH)

Rep. No. 27B

Masumba Regional  
Substation

Jumbe Farm

Undi

Kalichero Area

Sandwa

Nfambo  
State Farm

Sasore

Katete Ranch

N.N.S.S.  
Extantion

Katete River basin C.P.

Mfirizi  
State Farm

NIGERIA

CENTRAL  
AFRICAN  
REPUBLIC

CAMEROON

SPANISH  
GUINEA

GABON

CONGO  
PUBLIC

SEMI-DETAILED AND R

