

PN - AAY - 578
52955 FILE

A NATIONAL AGRICULTURAL RESEARCH SYSTEM FOR LESOTHO

THE MINISTRY OF AGRICULTURE,
MASERU, KINGDOM OF LESOTHO
AND
THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

ELVIN F. FROLIK*

APRIL 1981

*Agricultural Consultant, Formerly Dean, College
of Agriculture, University of Nebraska, Lincoln.

FILE

FOREWARD

The purpose of this study was to "...assess the agricultural research programs underway in Lesotho and provide recommendations for the establishment, management, coordination and operation of a national agricultural research system." The study was made under a Contract, Project No. 698-0135.20 PSI 01, signed by USAID/Lesotho with Elvin F. Frolik, on 17 February, 1981 in Maseru.

The Contract became effective as of that date, with the provision that the work was to be completed o/a 27 March, 1981.

TABLE OF CONTENTS

	Page(s)
I. Terms of Reference	1
II. Current Agricultural Situation in Lesotho and Research Information Available	2
A. General	2
B. Agriculture	2
1. Field Crops	2
2. Livestock	3
3. Range	3
4. Additional Areas	4
5. Retrieving Research Data in Lesotho	4
6. Research Information from Abroad	4
III. Agricultural Research in the Third Five-Year Plan	6
IV. The Roles of Agricultural Research and Education	7
V. Agricultural Research Underway in Lesotho, Together with a Brief Critique	9
A. Cultivated Field Crops	9
B. Horticulture	12
C. Livestock Production and Range Management	13
D. Marketing	13
E. Farm Management	14
F. Rural Sociology	14
G. Soil and Water Conservation	15
VI. Coordination and Who Should Do the Research	16
A. Agencies Doing Research	16
B. The Attitude Prevailing in Lesotho	16
C. The Role of the RD	17
D. Suggestions For Programs of the Other Units	17
VII. Structure of the RD	22
A. Organization Charts	22
B. Explanation of Changes Shown in Figure 2	22
1. Auxiliary Technical Services Section	22
2. Crops Section	28
3. Animal Science and Ecology Section	31
4. Farm Management Section	31
5. Agricultural Engineering Section	31

	Page(s)
VIII. Strengthening and Maximizing the Effectiveness of the Research Division.	32
A. General.	32
B. Staff.	33
C. Lands for Experimental Purposes.	35
D. Operations of Experimental Lands	35
E. Buildings and Improvements	37
F. Equipment.	38
G. Procurement of Equipment and Supplies.	39
H. Budgeting.	39
I. Salaries	40
J. Housing.	40
IX. Lesotho Agricultural Research Council (LARC)	41
X. Quality and Continuity of Research	43
XI. The Role of the FSRP and Related Matters	45
XII. Getting Research Information to Farmers.	48
A. The Technical Division	48
B. General Extension.	48
C. Putting It All Together.	48
XIII. The Payoff	50
XIV. Summary, Conclusions and Recommendations	52
XV. Literature Cited	57
XVI. Appendices	59
A. Acronyms and Abbreviations	59
B. Procedures and Assistance Provided to the Contractor.	61
C. Conferences Held in Lesotho.	64

I. TERMS OF REFERENCE

The "terms of reference" for the Contract entered into between USAID/Lesotho and Elvin F. Frolik on 17 February 1981 were given in the "Scope of Work" as follows:

The purpose of this study is to assess the agricultural research programs underway in Lesotho and provide recommendations for the establishment, management, coordination and operation of a national agricultural research system. More specifically, the study should include the following major areas:

- A. Conduct a comprehensive review of the type, scale, scope and sponsor of ongoing and proposed agricultural research activities in Lesotho.
- B. To provide specific recommendations for the establishment and operation of an effective national agricultural research management system that:
 1. Encompasses the goals and objectives of the agricultural sector as defined by the Ministry of Agriculture;
 2. Facilitates the identification, development and selection of agricultural research policies and priorities;
 3. Provides an effective national organizational structure to direct and coordinate the selection, design, implementation and evaluation of all agricultural research;
 4. Provides appropriate interpretation, documentation, distribution and use of agricultural research findings.
- C. Provide a plan (or optional plans) for the establishment and development of the proposed agricultural research system that considers availability of human and financial resources, and the role and functions of the Research Division of the Ministry of Agriculture.

The contractor shall prepare a written report that will include the results of his review and analyses, as well as the specific recommendations concerning the agricultural research management system. The schedule for submission of the report to the Director of USAID/LESOTHO is as follows:

- 20 March, 1981: Draft Report;
- 25 March, 1981: Proposed USAID/GOL Review;
- 30 April, 1981: Completed Final Report.

II. CURRENT AGRICULTURAL SITUATION IN LESOTHO AND RESEARCH INFORMATION AVAILABLE.

A. General

The Kingdom of Lesotho consists of 30,350 square kilometers. Much of the country is mountainous, the elevation ranging from 1400 to 3500 meters. There are 900,000 acres of arable land. Soil erosion is severe. Precipitation averages over 700 mm annually over most of the country (24). However, the amount varies greatly from year to year.

The total population is estimated at 1.2 million, of whom about 200,000 are employed in the R.S.A.

B. Agriculture

There are 187,000 rural households. Farms are small and average farm incomes are very low.

Ruminant livestock, produced largely on range, and field crops constitute the principal agricultural production. Rangeland comprises 70% of the agricultural land. The present production levels of the 3 main components of Lesotho's agriculture, and recommendations for increasing production in the future are as follows:

1. Field Crops

Average yields of the principal crops in Lesotho for the period of 1971-76 were as follows (7, p.VI-2):

<u>Crop</u>	<u>kg/ha</u>
Maize	630
Sorghum	690
Wheat	580
Beans	310
Peas	450

In addition to the fact that yields are extremely low as shown above, 12.6% to 20% of the land in the Thaba-Bosiu Project, for example, was fallowed during 1973-76 (16, p.10). Fallow in Lesotho consists of leaving the land lie idle, i.e. no crop being produced for one entire cropping season. No tillage operations are performed to control weed growth and conserve moisture. The reasons given by farmers for fallowing were: no power, no plows, and lack of seed (16, p.10).

Law (17, p.2) lists the following principal means of increasing crop production:

- a. Timely seedbed preparation
- b. Higher yielding varieties
- c. Proper use of fertilizers--rates and time of application
- d. Proper stands (density)
- e. Possible intercropping

A useful publication is "Cropping Guidelines" which is a product of the MOA (2). It will be updated for 1981.

Fruit and vegetables are grown in Lesotho principally for home consumption. There is no research underway on fruit. Vegetables are grown both as summer and winter crops. Ms. Kotsokoane stated that there is a popular publication on vegetable production, which is now rather old.

2. Livestock

Lesotho has one-half million cattle, and two million sheep and goats (19, p.1). Weaning rates average 50% (19, p.1). Klosterman (18, p.1) states that the solution to the present low returns from livestock lies in balancing livestock numbers with available feed supplies. He states that livestock research has been very limited in Lesotho and that most efforts have been developmental in nature. In summarizing the livestock work done in Lesotho, Klosterman (18, p.2) states that many of the project papers on livestock development efforts outline work planned, and that virtually no information is available regarding degree of adoption by farmers. He urges that the MOA support a few, long term projects rather than large, short term projects (18, p.5).

3. Range

Tiedeman states that much of Lesotho's rangeland is severely overgrazed and in an eroding condition. Communal grazing adds to the complexity of attempts at improvements.

Here again it is found that many of the available papers are long on plans and short on good, hard research data. Much of the research has been terminated before being completed. Tiedeman suggests that range research projects should be carried on for 15 years (19).

There is a guide for range management parallel to "Cropping Guidelines". It was published by the SWCD in 1977 and carries the title "A guide to range site and condition determination. Recommended stocking rates, proper degree of use and principles of range management" (20, p.2).

4. Additional Areas

Wyeth (21) found a paucity of good, hard data on marketing at the farm level in Lesotho. L. Butler (22) stresses the "...need for a careful holistic analyses of the farmers' situation in order to devise appropriate technologies..." Sefeane (23, p.2) made a series of recommendations "...for a quick transfer or dissemination of technology, from research through linkages down to the end users". Ms. Kotsokoane believes that in doing horticultural research the emphasis should be on home consumption, not on exports.

5. Retrieving Research Data in Lesotho

Many of the data, accumulated in the past in Lesotho, at least some of which should be helpful in making recommendations for improving farm practices, are not available at the RD. It is stated that over the years often the only copies of data were sent to the Headquarters of the MOA, without copies being retained by the researchers. It is suggested therefore that arrangements be made with the PS and DPS-Technical to have a careful and thorough search made of the old files to see if some of these data from previous years' experimenting could be retrieved, summarized, and utilized in making recommendations to farmers.

6. Research Information From Abroad

There is a wealth of agricultural research information available to Lesotho from abroad. Much of the information can be obtained in scientific journals and other publications. The latest research findings are typically presented at within-country, regional and international meetings. Most such meetings are open to everyone, and proceedings (at least abstracts) are commonly published. Also, scientists

are usually generous in providing reprints of their publications.

Virtually every country having an agricultural sector of economic importance has an agricultural research program underway. In addition there are regional and international centers, usually concentrating on one or a few segments of agricultural research. An example of the former is SARWEIN. CGIAR is supporting 13 international centers, of which CIMMYT is an example. These centers are important sources of information, materials and assistance.

Lesotho participates in SARWEIN, which is headed up at the Small Grain Centre, Bethlehem, South Africa. It is very fortunate that this excellent regional wheat program which has as its aim "...the stimulation of wheat production in the Southern African sub-continent" (26, ;,0), is headquartered so close to Lesotho. There is also cooperation by Lesotho researchers with CIMMYT, IBYAN, INTSOY, and the Pioneer Hybrid Seed Company in the R.S.A.

Still other sources of information on research underway abroad are CRIS for the United States and CARIS, under the sponsorship of FAO, for many other countries.

Much of the available research information and materials (such as improved germ plasm) secured from abroad require only a limited amount of adaptive research under Lesotho conditions to be utilized here. Generally speaking, and especially with respect to crop and range production, the closer the research has been done to where the findings will be utilized, the more valuable it is. This underscores the potential value of the extensive agricultural research programs underway in the R.S.A. to Lesotho. Research findings in other nearby African countries can also be utilized.

III. AGRICULTURAL RESEARCH IN THE THIRD FIVE-YEAR PLAN

- A. In the Third Five-Year Plan of the GOL the following objectives are listed for agricultural research (15, p.314):
1. Conduct farmer-oriented research
 2. Include areas of agricultural research in addition to agronomic research
 3. Integrate and direct all agricultural research activities and to train research personnel
 4. Coordinate all research activities to avoid duplication
- B. Some of the specific areas of agricultural research to be addressed are:
1. Irrigation for self-sufficiency in vegetables
 2. Winter vegetable production, including intercropping and post-harvest techniques
 3. Varieties and fertilization of winter fodder crops
 4. Grazing experiments, along with introduction of improved grasses and legumes, and use of fodder crops
 5. Cultivation machinery--crop residue management, rotations, and weed control
 6. Control of field and storage pests and diseases:
 - a. Screening chemicals
 - b. Obviate disease outbreaks in certified seed
 7. Weeds and weed control
 8. Livestock improvement--animal health, feeding and management
 9. Conservation research

The above presentation shows that considerable emphasis is being placed on agricultural research by the GOL. It follows that maximizing results from expenditures for agricultural research, and getting the findings of these efforts utilized by farmers to the greatest degree possible, are essential in reaching the objectives of the programs outlined in the Third Five-Year Plan.

IV. THE ROLES OF AGRICULTURAL RESEARCH AND EDUCATION

A. Basic Components

The role of publicly-supported, mission-oriented, agricultural research is to develop statistically-sound data, other useful information, and materials (such as improved germ plasm), and to put these findings and materials into a directly usable form by farmers and/or by the delivery system. The adoption of the information and materials by farmers will lead to improvements through higher yields and improved quality of agricultural commodities; and to greater efficiency in production and marketing. The end result is a higher net cash income; a greater amount of and more nutritious food for home consumption; a higher standard of living; and ultimately a better quality of life. And all of the above must be done without damaging the ecological environment--hopefully actually improving it.

Agricultural research must be accompanied by a delivery system, for the improved practices/materials are of no value if they are permitted to merely remain on the shelves of the research offices and laboratories. And so rather universally, Extension organizations have been established to get the research information/materials to the farmers in a way that will lead to adoption. The education or final step in getting improved practices to be adopted by farmers can break down principally in either one of two places, as follows: 1) failure of successful transfer of knowledge/materials from researchers to their primary receiving audience, i.e. the Extension subject matter specialist; and 2) failure of the Extension organization to in turn transfer the products of research to farmers in ways which will lead to adoption.

The reasons why a Research/Extension system may not be effective or at least not be as productive as it should be, are many and include the following:

1. The research component failing to adequately carry out its mission as a result of:
 - a. Lack of an adequate number of qualified personnel
 - b. Failure to review and utilize available knowledge

- c. Inadequate research facilities
 - d. Insufficient operational funds
 - e. Poorly chosen fields of research; including a failure to understand the problems and needs of farmers
 - f. Inferior research procedures
 - g. Failure to properly analyze and interpret data
 - h. Failure to publish research findings promptly and in a form that can be understood and readily put to use by the primary receiving audience--the Extension workers and even farmers, directly
2. The Education (Extension) component failing to successfully carry out its responsibilities because of one or more of the following:
- a. The staff lacks in numbers or capabilities, or both
 - b. Failure to properly utilize effective tools such as demonstrational plantings on farms
 - c. Failure to understand farmers and their problems
 - d. Lack of effectively converting research information into forms understandable by farmers
 - e. Insufficient operational funds, sometimes expressed through inadequate or no transport facilities
 - f. A poorly structured and administered organization
 - g. Failure to keep current on agricultural developments, due to lack of dialogue with researchers, not inspecting experiments that are underway, and failure to read pertinent scientific literature.
 - h. Overlooking the infrastructure necessary for farm progress
 - i. Failure to assist in helping farmers to procure inputs such as good quality seed of improved varieties
 - j. Plain lethargy

V. AGRICULTURAL RESEARCH UNDERWAY IN LESOTHO TOGETHER WITH A BRIEF CRITIQUE.

Research here is defined as an endeavor to develop information or materials, through experiments, which are designed so that the results can be analyzed statistically and tests can be applied to measure the significance of differences obtained. Replication and randomization are indispensable components of agricultural experimentation.

The term "research" is commonly misused. For example, utilizing a "package" of recommended inputs on a 1/2 ha plot of maize, while growing another 1/2 ha plot alongside in the traditional manner, may have great value. Yield comparisons and observations will generally reveal major differences. However, a single such comparison does not constitute research, since a statistical measure of differences obtained is not possible. However, utilizing a group of such plantings, with the farms selected at random and considering each farm as a replication, does permit a statistical analysis for the area involved and a measure of significance of differences obtained.

An attempt has been made to identify and tabulate the research (as defined above) studies underway in Lesotho, which are as follows:

A. Cultivated Field Crops

The 1980-81 cultivated field crop experiments are listed in Table 1, which shows the Division or Agency doing the work and location (Station if applicable) where the experiments are being conducted.

It will be noted that the RD is concentrating heavily on variety tests, with some work on inter-cropping, and still less on time-of-planting, fertilizer applications, and other tests. The CD is conducting fertilizer tests on wheat.

It is suggested that in view of the fact that the RD is conducting a fairly large number of variety tests and relatively few fertilizer tests, and the CD is conducting only fertilizer tests, the two could be combined into single experiments where

TABLE 1. SUMMARY OF CULTIVATED FIELD CROP EXPERIMENTS PLANTED IN LESOTHO 1980-81^{1/}

AGENCY & LOCATION	Variety Trials										Time of Planting	Spacing/ Plants per Ha	Intercropping	Fertilizer Tests				Miscellaneous	Total	
	Maize	Sorghum	Wheat	Beans	Peas	Sunflower	Grass	Triticale	Cereal	Forage				Pasture	Soybeans	Maize	Wheat			Lucerne
Research Division (including FSRP)																				
Main Station	3	1	4	1		1	1	1	1	1	1	Flax	Maize/Soybeans Sorghum/Soybeans	1		1		Selection for Resistance to Bean Blight	22	
Ratau	1																		1	
Matsieng	3																		3	
Machache	2		1				1						Maize/Soybeans Sorghum/Soybeans						6	
Mafeteng	1	1	3										Maize/Soybeans Sorghum/Soybeans					Bean Insects	8	
Tsakholo Farmer Fields (Irrigated)			1																1	
Leribe	1		2																3	
T.Y. or Berea	2	1																	3	
Libbing Farmers Fields/ (Mokhotlong District)P _{2/}			1									Wheat, Barley, Maize						Wet Land Forage	5	
Nyakosoba (Maseru District)2/									1	1			F. Sorghum/Cowpeas ^{3/}						3	
Mokhotlong Research Station			1	1			1	1				Wheat, Maize Cowpeas	Flax	Maize/Soybeans F. Sorghum/Cowpeas ^{2/}					10	
Molomong Farmers Field P _{2/}	1						1											Misc. Forage adaptation	3	
Siloe (Mohales Hoek District)P _{2/}										1			F. Sorghum/Cowpeas G. "/Cowpeas ^{4/}			1		Annual use peren- nial fodder	5	
Crops Division (FAO) Farmers Fields															7				7	
TTRDP (CIDA)	6	6	1	1		1		3	1			Maize			7	2	1	Maize Cutworm Test	21	
TOTAL	13	10	19	2	2	1	1	4	4	3	2	7			1	7	2	1	6	101

1/ Based on information secured primarily from Dr. Alvin Law, Research Division and FSRP; Mr. David Beckerman and Dr. Michael Pratt, Thaba-Tseka District Rural Development Project; and Mr. Michael Leyretz, FAO and Crops Division.

2/ P = Prototype Area for FSRP

3/ F. Sorghum = Fodder Sorghum

4/ G. Sorghum = Grain Sorghum

the same crops are involved. A factorial design could be used to include both types of treatments. A split block design would probably be best from the standpoint of also using the plots for demonstrations.

TTRDP is doing largely variety tests of various crops for grain and fodder, with one time-of-planting test on maize and one maize/cutworm test.

The fact needs to be emphasized that Table 1 lists experiments planted rather than successfully completed. Some total failures and other experiments of questionable value were noted in field observations. These were due to such factors as poor farming, very uneven soil productivity, inadequate or no follow-up by the researchers involved, unsatisfactory stands, frost damage and too many weeds. Bird damage will reduce the value of some of the experiments. Sperling (25) found in making field inspections in late March that only one of the five CIMMYT maize variety trials is good enough to merit harvesting for yield comparisons.

It would be well (after the 1980-81 crop season is completed) for someone to make a tabulation of the number of experiments successfully completed, based on usable data presented in written reports. It would be well to review the coefficients of variability, and finally to tabulate the percentage of experiments successfully completed.

Such obviously important areas of research as seedbed preparation, methods of planting, cropping practices (rotations), value of "fallow" and how it should be handled, control of weeds, and most diseases and insects are receiving little attention, researchwise.

There is no plant breeding underway except for some limited selection in maize at Thaba Tseka. At this stage there probably should be little plant breeding underway. Variety testing along with some limited selection in fairly heterogenous material is probably adequate for the time being. Special attention should

be given to making breeder's seed available of newly recommended varieties to the Seed Section.

Seed for many of the variety tests is secured from CIMMYT (maize and sorghum), SARWEIN (wheat and triticale), IBYAN (beans), INTSOY (soybean), and Pioneer Hybrid Seed Co. (maize). Running variety tests with the selection of varieties, planting plans being provided, assembling and packeting of seed, and analysis of results being made by outside agencies facilitates getting the research job done. But such procedure may not result in the most meaningful research being conducted. There needs to be an identification of the most pressing farm needs, with experiments established to meet those needs. In maize production, do farmers need to know the best hybrid (Pioneer provides seed of hybrids) or the best open pollinated variety (CIMMYT includes only such populations), or should there now be tests including a combination of a few of the best hybrids and open pollinated varieties (determined on the basis of previous tests) to help farmers make their selections? And what about important production inputs that are being largely omitted in the maize experiments?

B. Horticulture

There appears to be no research presently underway on fruit crops in Lesotho.

There is vegetable research being conducted in the RD. Ms. Kotsokoane is doing variety trials under irrigation on cabbage, asparagus and tomatoes at the Main-Station; and on cabbage, tomatoes and onions for seed at Tsakholo. She has studies underway on intercropping of maize and tomatoes. She is doing considerable research on seedling production and stand establishment.

Dr. B. N. Ndimande planted an experiment to compare cabbage varieties for resistance to the disease black rot, but the planting was ruined by insects.

C. Livestock Production and Range Management

The livestock production research currently being done in Lesotho is under the direction of Dr. Earle Klosterman, FSRP. The objective of the program is to determine the advantage of feeding oxen with fodder and protein/mineral supplement for two or three winter months. Progress here would alleviate the problem of the oxen being so weak when spring work should be started that the work has to be postponed until the grass grows sufficiently to provide strength-giving nutrients for the oxen.

Dr. James Tiedeman^{1/}, and his colleagues in keeping with the FSRP philosophy of involving farmers in the research process, are attempting to establish a "wagon wheel" and a "village ranch" experiment. The former consists of dividing a village grazing area into 9 parts and grazing them systematically. No fences will be built--herd boys will provide the necessary control. Permanent transects will be established. The second approach, "village ranch", consists of proper stocking and management on an entire village basis. Tiedeman is also doing work on restoration following burning, restoration on abandoned fields, and control of the brush plant, Chrysocoma. Tiedeman's graduate student has established 9 exclosures in Lesotho.

Mr. David Beckman is trying some control measures with Chrysocoma, also. He is conducting a planted pasture experiment with 9 entries, clipping the forage to simulate grazing. Attempts to establish control grazing areas and overseeding have so far resulted largely in failures in the TTRDP.

D. Marketing

Marketing research is underway by three agencies, namely at the RD through the FSRP, at TTRDP, and at the Planning Division.

^{1/} For further details on this program see Roche's Consultant Report (13, p.13).

Dr. Peter Wyeth, FSRP, is concentrating on the following problems at the farm level: 1) procurement of inputs, 2) the often too great distances for marketing, and 3) the way local markets operate.

Mr. Brian Wilson at TTRDP reported that so far his time has been spent largely in getting acquainted with the marketing system. Past research has consisted principally of subjective observations.

Mrs. A. M. Morojele stated that the Planning Division is doing some marketing research which she feels is necessary for forecasting and other segments of the planning process.

E. Farm Management

Dr. Joel C. Plath and his colleagues are conducting a survey with 118 farmers in the FSRP prototype areas. The purpose is to arrive at a thorough understanding of and quantify as far as possible the farming systems. It is hoped that this study will also result in recommendations on varieties, production practices and management.

Dr. Fred Winch reported that BASP had made a baseline survey of 250 households in Block I. It was found that the top 10% of the farmers have significantly higher crop production than the 250 as a whole, even though the former farms are only slightly larger than the average of the 250. The higher production is due largely to better farming practices.

The Bureau of Statistics of the Ministry of Finance is also doing farm management research, according to Dr. Joel Plath. They started making their surveys in 1977-78 but to date have not issued a report of their findings.

F. Rural Sociology

Dr. Lorna Butler stated that the terms of reference for her assignment provide for analyzing social data and conducting surveys which will assist the FSRP in solving production problems. She is also placing emphasis on training colleagues.

G. Soil and Water Conservation

1. The SWCD reported that they are setting up a project with the Ministry responsible for hydrology and the NUL Department of Geography to check rainfall and run-off in catchments (Mr. Scherer).

Mr. Lepele also stated that the Division must do research on each new soil they come up with in their classification process.

2. Mr. Wally Fausch of the SWCD, and Dr. Alvin Law and Dr. Joel C. Plath, RD, FSRP, are cooperating with two farmers in the Maseru area in testing no-till maize production. This radical departure from traditional farming in Lesotho is the type of research that could conceivably lead to a real "break-through" in Lesotho farming. The implications of being able to adopt the system are obvious, especially with respect to the fact that presently plowing in the spring is typically delayed until there is sufficient grass growth to strengthen the oxen.

VI. COORDINATION AND WHO SHOULD DO THE RESEARCH

A. Agencies Doing Research

Agricultural research underway in Lesotho has been summarized in Section VI of this Report. A list of agencies presently doing agricultural research in Lesotho (as far as the Contractor has been able to determine) is as follows:

<u>Names</u>	<u>Types of Research</u>
RD (including FSRP)	(1) Crops including fertilizers (2) Animal science (3) Range management (4) Farm management (farmer surveys) (5) Rural sociology (farmer surveys) (6) Marketing at the farm level (7) Economic value of indigenous plants
Crops Division (FAO)	(1) Fertilizers
SWCD	(1) Rainfall and runoff in catchments* (2) On new soil classes (3) Forestry
TTDRDP	(1) Range management (2) Food grain production (3) Fooder production (4) Marketing of livestock
Planning Division	(1) Marketing
BASP	(1) Ninety 1/2 acre plots or farms "package" recommendation inputs on maize and sorghum (2) Baseline survey on farms
Bureau of Statistics, Ministry of Finance	(1) Farm management (surveys) (2) Baseline survey of 250 households

*In cooperation with Hydrology, GOL, and Department of Geography, NUL.

B. The Attitude Prevailing in Lesotho

In the numerous conferences held with Basotho in the course of the present study, the following conclusions concerning research were rather generally expressed:

1. The RD should do most of the agricultural research
2. The RD presently is weak and is contributing relatively little to the fund of agricultural knowledge, in fact, in various areas, nothing
3. A future goal should be to involve the Faculty of the LAC as much as possible in research

There appeared, however, to be more interest among some of the

donors in pursuing the programs they are involved in than in overall coordination of research efforts.

With the attitude prevailing among the Lesotho Nationals, the outlook for agricultural research, organizationally, can be characterized as encouraging.

C. The Role of the RD

A portion of the answer to Lesotho's problems, weaknesses, and lack of coordination in agricultural research is obvious--greatly strengthen the RD, posthaste. The methods suggested to get this done are outlined in Section IX.

Generally speaking, as necessary capabilities are developed in the RD, newly undertaken farm research should be assigned to that Division.

The RD should also serve as the repository for all agricultural research data and reports. Therefore, copies of such materials covering research findings of other units of the MOA should be filed promptly and on a regular basis with the RD.

D. Suggestions for Programs of the Other Units

With reference to the other units now doing research or who should be doing research in the future, the following suggestions are offered:

1. Crops Division (including FAO)

In its partial role of disseminating subject matter, the CD is conducting and should conduct field demonstrations. So designing these plantings that they can be utilized also to generate research information is both understandable and commendable. It is suggested in Section VI that RD, now concentrating heavily on variety testing and CD, presently conducting fertilizer tests, pool their efforts where possible into combined factorial experiments. This would automatically bring about coordination. In addition, other field data generated by the CD should be immediately shared with the RD. This needs to be done in order to get all research assembled and published through a single

unified channel. There would be no question of coordination if LARC operates as is being recommended in this report (see Section X).

2. SWCD

The highly specialized types of limited research now being conducted in the SWCD had probably best remain there, for the following reasons:

a. Rainfall and runoff in catchments

Only the SWCD presently has staff knowledgeable in this area. These persons are in the field on a day-to-day basis working with the various phases of runoff and yield of water from catchments. They are involved in action (operations) programs where judgments on these factors must be made. They cannot wait for qualified staff to come on board at the RD--they need the informations now. It would be short-sighted to deny the SWCD the right to obtain such much-needed data in their day-to-day operations.

b. New Soils

The Soil Section needs to do research so as to characterize any new soil, so classified. The SWCD includes the only knowledgeable staff in this area. Such research had therefore best remain in this Division, at least for the foreseeable future.

c. Woodlot Project

The Woodlot Project has great need of research findings on seedling establishment in the nurseries and survival under field conditions. The staff must also be able to evaluate species for fuel and building materials, and to provide trees for water and soil conservation. It is suggested that this highly specialized research remain where it is. It combines closely and well with operations in the Woodlot Project. Research results should be filed on a timely basis with the Director of the RD.

3. The TTDRDP

The research component of the TTDRDP should be incorporated as soon as possible into the RD. The component should then constitute a substation, with as large an area of land being involved as is mutually agreed upon. One of the research officers should be designated as superintendent. Locally, the research staff would report to him and he would have charge of all logistical operations at that location. In addition, the technical officers would have responsibility to the appropriate Section head at the Main Station, and be recognized as bona fide members of that Section.

4. The Planning Division

The PD would continue to have the responsibility for assembling and reporting crops and livestock data for the Kingdom of Lesotho. However, this type of activity does not in itself constitute research. In addition, the PD will conduct marketing studies for planning and recommending policy.

To what extent and how agricultural marketing research should be divided between the RD and the PD is a moot question, largely because much of the marketing is not farm research. The contractor suggests that this matter be given considerable further study before a final decision is made on assignment of responsibilities.

5. BASP

- a. "Testing" the recommended package of inputs in crop production. The type of farm trials/demonstrations that are being carried out by BASP on maize and sorghum, wherein a combination of recommended inputs, is being "tested" under farm conditions, is useful. Normally, in most countries, this function is carried out by Extension and/or Research. In Lesotho, there should be an early conference (pending establishment of LARC) of representatives of BASP, RD including FSRP, CD, and Extension to determine: (1) number, kind, and

location of trials to be conducted; (2) how best to amalgamate the research efforts now being put forth by the various MOA Units; (3) the responsibility of each Unit in the unified program; and (4) how the research results will be analyzed and brought together into one joint report.

6. BASP and The Bureau of Statistics

Farm surveys or farm management studies are now being conducted by RD (FSRP), BASP, and the Bureau of Statistics. In view of the dearth of farm management data in Lesotho, the combined efforts of the three Units probably do not constitute a total of too much emphasis on this field of research. However, the three Units should carefully and thoroughly coordinate their efforts to maximize research findings so that all of the data can be combined into joint reports and publications. From a longer point of view, leadership in this research field should be assumed by the RD, in fact, RD might ultimately carry the entire research load. However, the final disposition of assigning farm management research should be made by LARC.

7. THE LAC

LAC staff should be utilized to do research as rapidly as staff capability and time are available. The geographical side-by-side location of LAC and RD is most fortunate. It would be very convenient for persons to hold joint appointments in the two Divisions. Various percentages of time of each individual involved could be allocated to each of the two agencies, as would seem indicated. This means, too, that officers in the RD could also be assigned some teaching duties. An additional mechanism that could be utilized would be for the Director of the RD to make research grants to LAC faculty for specific research projects. Another fortunate circumstance is that the GOL has ordered that the LAC become a Faculty of the NUL by 1983. A concomitant development should be

upgrading of IAC staff qualifications. Thus the staff should be increasingly capable and desirous of doing research.

Johnson (6, p.70) in a symposium address in the RSA stated recently, "...the separation of the Department of Agriculture from the Agricultural Faculties of the Universities (in the Republic) several years ago was a major mistake! ...the separation is wasteful of personnel as well as facilities".

VII. STRUCTURE OF THE RD

A. Organizational Charts

Previous plans for the structure and make-up of the Research Division are shown in Figure 1. This plan represents good, sound thinking with respect to the nature of the organization needed as well as appropriate restraint in holding the size down to what is reasonable in view of Lesotho's resources.

The Contractor is proposing some modifications as shown in Figure 2, and as discussed in greater detail in the discussion which follows.

It is recognized that there is a "critical mass" needed to make an agricultural research organization viable.

Without most of the officers proposed the organization simply could not function effectively. For example, research on maize, to be fully effective, requires the services of the ATSS, an agronomist, the 3 officers in Plant Protection, the soil management officer, a soil testing laboratory, probably the herbarium (weed control), and all of the FMS and AES officers.

The point of the above is that if Lesotho is going to have an agricultural research program the "critical mass" must consist of a minimum of approximately 28 technical officers and the administrative staff listed in Figure 2. More staff will need to be added as time goes along.

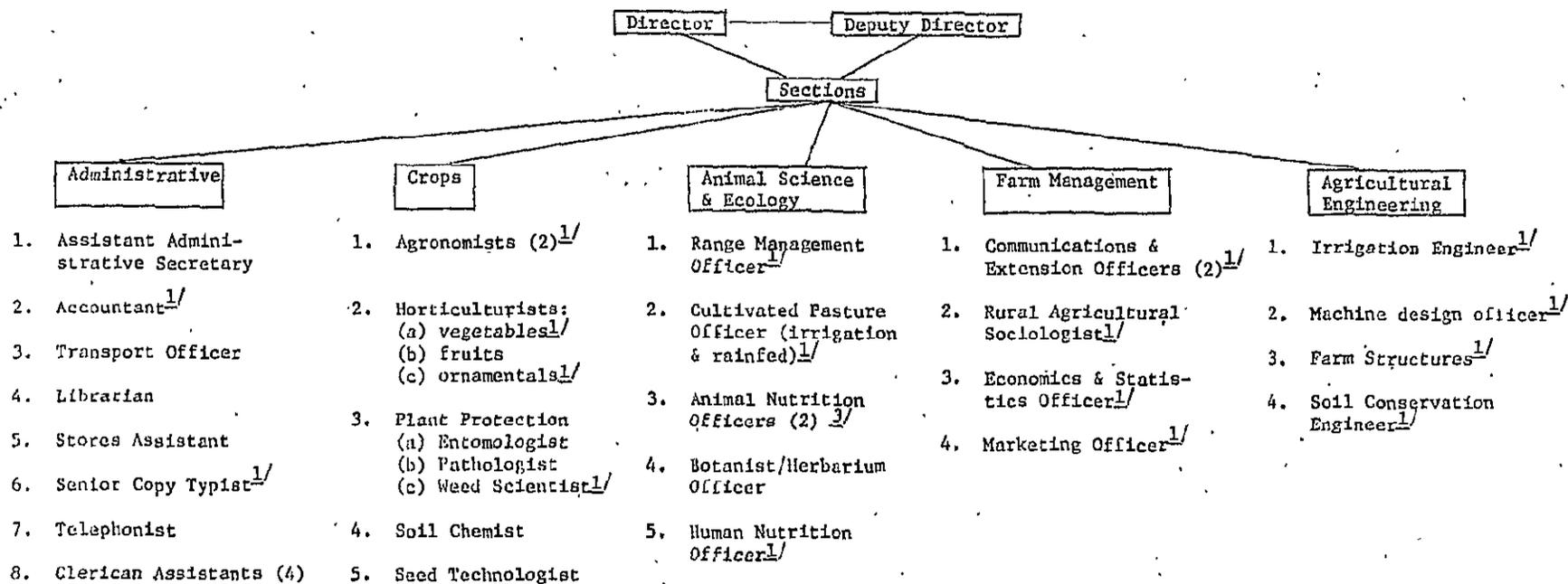
The Contractor is proposing the addition of a 6th Section to be known as the Auxiliary Technical Services Section. There would also be some shifts of proposed officer positions from some Sections to others, some positions would be retitled, a few would be added, and two would be eliminated.

B. Explanation of Changes Shown in Figure 2

1. Auxiliary Technical Services Section

The Contractor feels that the research capability and productivity can be materially strengthened by the addition of a 6th Section, i.e. the ATSS.

Figure 1. AGRICULTURAL RESEARCH DIVISION STRUCTURE (Present)

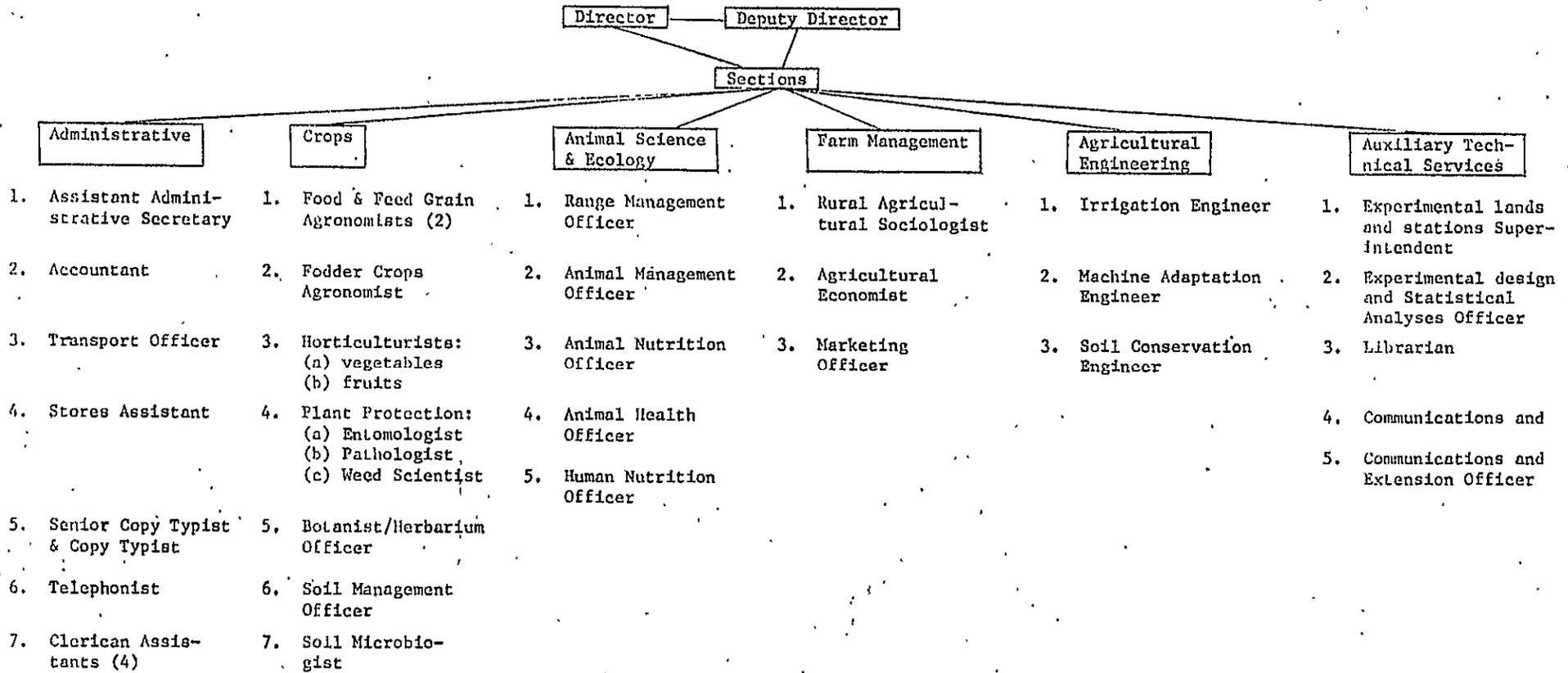


^{1/} One Senior Officer in each Section is Head of the Section.

^{2/} One vacant post

^{3/} Two vacant posts

Figure 2. AGRICULTURAL RESEARCH DIVISION STRUCTURE (Proposed)



The staff in this Section would do relatively little research on their own. Their primary role would be that of assisting the other scientific staff in maximizing the amount of meaningful research done and in making the results of research available in readily usable form to the appropriate audience.

a. Functions of the ATSS Officers

(1) Experimental Lands and Stations Manager

The functions of the ELSM are so important that the Deputy Director might well be assigned this responsibility along with his other duties. This person must have had adequate scientific academic training and background to be able to understand and appreciate the needs of the other scientists and at the same time have sufficient practical know-how to be able to get the farming aspects properly performed. "Good" farming includes a timeliness of operations; servicing and adjustment of equipment; proper seedbed preparation; precision planting; effective tillage operations; proper application of fertilizers and chemicals; and performing other field operations.

To some this may sound simple, but it is not.

"Good" farming and production practices in field plot experimentation are among the most difficult aspects of research to achieve, and failures to get them accomplished constitute one of the most common causes of inferior research results, the world over.

In Lesotho, the condition of most of the field experiments at the substations attest to the need of improving the farming practices. The Main Station is better handled. Still, additional planning and supervision are obviously needed. For example, as of 4th March, there had been no plowing done for fall wheat plots. The inter-cropping test showed need for uniform cropping in the preceding crop

year, as there was extreme variability in productivity of the soil.

The duties of the Manager would include the following:

- (a) With the help of the Soil Conservation Division, obtain detailed soils maps of all experimental lands .
 - (b) Annually assess needs of all Officers conducting field experiments and assign land areas, accordingly
 - (c) Grow crops (uniform cropping) on lands not used for plot work that year in preparation for experimental planting the next year
 - (c) See that land preparation is done properly and on a timely basis where field experiments are to be conducted
 - (e) Conduct any field operations for which regular farm equipment is appropriate from planting through harvest, as needed and as directed by the investigator
 - (f) Keep weeds cut in roadways and alleys, and otherwise see that the station lands are kept in acceptable order
 - (g) Check the substations sufficiently often to make sure that the above operations are also being properly carried out there
- (1) Experimental Design and Statistical Analysis Officer
 Assistance in selecting experimental designs and in getting data analyzed can presently be obtained from the Bureau of Statistics. However, experience dictates that such services can most effectively be provided through an officer who is part of the Agricultural Research "Team", a person who has day-to-day contact with the agricultural researchers, who himself has an agricultural background, and who through frequent visits to experimental field plots has a full understanding and appreciation of the

problems involved. Agricultural scientists generally "feel more comfortable" with and utilize the services involved more freely if the statistician is one of their own group.

Most agricultural researchers need the assistance of a trained statistician to obtain maximum information from and precision in their experiments. He will help them in selecting an experimental design (probably one of the seven that constitute 90% of the designs [9, p.v] used in agricultural research), and otherwise assist in planning the experiments. Having been involved in the planning of the experiments from the start, the statistician will be better able to analyse the data and help in the interpretation of the results obtained.

Smaller, simpler and less costly computers have been becoming increasingly available (for equal degrees of capability) as the years have gone along. Many of the data generated in the proposed research programs can be analyzed with equipment in place in this Section. However, as need be, the statistician would utilize the services of the Bureau of Statistics, including the large computer available. Also, plans for strengthening the Planning Division call for including a position of statistician there. Possibly, the Division will add some hardware, which could also be utilized.

b. Transfers From Other Sections

(1) The library provides technical support and assistance, and will be utilized by all other Sections. Hence it should be in this Section.

(2) Communications and Extension is another unit which will serve all of the subject matter sections and hence belongs in this Section. Important as this service is, the Contractor believes that in view of the very small number of the total staff in the

RD, only one senior officer can be allocated to this Section. Some of the work is of such a nature that junior assistants can be utilized effectively.

- (3) Seed Technologist. The position of seed technologist is eliminated. The reason for this is that responsibilities for seed multiplication and seed testing are presently assigned to the Crops Division. There is no seed certification program in existence, but if it is added, it could logically be combined organizationally with the above first two programs. Whether seed work should be included in the Crops Division or Research Division is open to question. However, in view of the fact that what seed work there is, is presently in the Crops Division, there appears to be no good reason for initiating a second unit in the Research Division.

2. Crops Section

- a. It is suggested that the two agronomists be more specifically identified as food and feed grain agronomists. This is in keeping with the present operation. Between them these two officers would be responsible for agronomic research on maize, sorghums, wheat, beans, peas, soybeans, and any other grain crops that might be investigated.
- b. The fodder crop agronomist replaces the "Cultivated Pasture Officer" listed under the ASES Section in Figure 1. The problems to be worked on are primarily agronomic in nature. It is believed that the research on production of fodder crops will be more important than cultivated pastures, but actually the officer could not work on both. The amount of time and resources he should devote to particular crops and practices will become more apparent as time goes along.

- c. The ornamentals horticulturist position is eliminated. Ornamentals can certainly improve the quality of life and are important. Flowers could become an export crop but the possibility appears to be somewhat remote at the present time. It is quite possible that Extension may want to do some work in this area. If so, they will have to depend on seed companies and research results from neighboring areas for their information. With the limited resources available, higher priorities in agricultural research are suggested for food and feed crops. The amenities can come later.
- d. Botanist/Herbarium Officer. This position has been shifted from ASES to the CS because plants are the heart of the latter Section. The other Officers in the CS will have had more botanical training on the average than those in ASES. Therefore, the curator would relate more closely to them than to most of those in ASES. Also, as CS develops, there will likely be more problems in the CS particularly in plant identification, than in the ASES.
- e. Soil Management Officer. The position of "Soil Chemist" has been changed to "Soil Management Officer". The reason for this is that a more general knowledge of soils is essential in carrying out crop production research than is implied in a soil chemist position. If soil testing is to be administratively under the Research Division (which is where the Contractor would place it rather than in the Conservation Division where it now is), the position of "Soil Chemist" to be in charge of the soil testing laboratory, would be necessary.
- f. Soil Microbiologist. One of the most economical ways of providing nitrogen for crop production is through its fixation by bacteria living symbiotically on roots of legumes.

The following amounts of nitrogen fixation were reported over a 10-year experiment (1, p.436):

<u>Crop</u>	<u>Pounds of N fixed per acre, annually</u>
Alfalfa	251
Soybeans	105
Field beans	58
Field peas	48

Nitrogen fixation through the symbiotic action between action between the host plants and the bacterium, *Rhizobium* sp., needs to be researched under Lesotho conditions. Soybeans and cowpeas growing at a number of the substations this year, the seed of which was not inoculated, showed no nodulation. Michael McMahon and David Beckman at Thaba Tseka reported a paucity of nodulation on alfalfa roots, even following careful inoculation of the seed. McMahon is applying nitrogen to his alfalfa fields. A soybean variety test at the Research Station, for which the seed was inoculated, showed moderate nodulation.

The phenomenon of symbiotic fixation of nitrogen by *Rhizobium* sp., is complex. For example, there is no cross inoculation among the four different species, respectively, which occur on the above four legume crops listed above. Furthermore, a culture that is highly effective in one part of the world may be relatively ineffective somewhere else. Serious problems are often encountered in attempts to inoculate seed. However, once the particular *Rhizobium* species becomes established in the soil, it normally survives over long periods of time and further inoculation is unnecessary.

The above illustrates the complexity of the problem, along with the possible economic returns from establishing a wide-scale nodulation of legumes in Lesotho; hence the need for research in this field.

3. Animal Science and Ecology Section

- a. Cultivated pasture officer. Modify title and shift to CS (see Section B,b above).
- b. Shift one of the two proposed animal nutrition officers to "Animal Management". This shift broadens the field of animal research. This animal management officer could even get into some aspects of farm structures, rather than one person devoting full time to this area, as proposed in Figure 1.
- c. Animal Health Officer. This position has been added. Livestock health is so important that devoting one full time position to this area seems justified. There is so much that could be done that this officer could not possibly cover very much of the field. He, in cooperation with the Livestock Division, would have to "pick and choose" very carefully the problems on which he would do his research.

4. Farm Management Section

- a. The two positions of "Communications and Extension Officers" have been reduced to one, and shifted to the ATSS (see discussion under that section).
- b. The position of "Economics and Statistics Officer" has been retitled "Agricultural Economics Officer". The word "statistics" has been removed from the title because: (1) it is now used in the Section title of the ATSS, and (2) it may give the wrong implication here. The gathering of crops, livestock and other agricultural statistics belongs more properly in other Units of the GOL.

5. Agricultural Engineering Section

The position of "Farm Structures" has been eliminated. Farm structures are of course of paramount importance, but it should be possible for Extension to draw on other sources for the essential information required. Research in this area can be postponed until some later date.

VIII. STRENGTHENING AND MAXIMIZING THE EFFECTIVENESS OF THE RESEARCH DIVISION

A. General

As pointed out elsewhere in this Report, the RD is presently weak. It must be strengthened as rapidly as possible.

It will take perhaps 10 to 20 years to bring the RD to full strength. This involves a carefully developed program of training Nationals abroad. More immediately, the RD should utilize ex-patriots; develop facilities (lands, laboratories, and equipment); and increase operational funds. By so doing much progress can be made in 5 years. Sufficient data can be generated within that time to start successfully meshing research findings with educational and developmental programs.

One possibility for making sufficient funds available for research is to pool the efforts and expenditures presently being made by various donors in the field of agriculture. To a lesser or greater degree, most of the agricultural programs being supported are handicapped by a lack of adequate research information. Attempts to correct the weakness are being met in some cases by (1) incorporating a research segment in the programs--oftentimes consisting of short-term investigations with results being too superficial and often coming too late to be of maximum value; or (2) making assumptions in place of research information. It is suggested that the GOL and the donors jointly assess the research needs and use a portion of the donor funds to develop and support a solid agricultural research program, including training of Basotho, which in the years ahead will likely do more good than using the same amount of funds for immediate educational and developmental programs.

To be truly effective, RD officers will need to do research at both the stations and on farms. An example of a research program with crops is as follows:

1. At adequately developed experiment stations conduct the more complex experiments. Crop variety selection there might be with 50 or more entries for a single crop at the Main Station, and with 20 or 25 of the best entries being

The recruitment of the expatriates should then proceed accordingly. The term of office is important. Two years is normally too short a time for the expatriate to make a maximum contribution. Although rigid contracts can probably not be made for long terms, every attempt should be made at time of recruitment to encourage plans for tenures of four years. The privilege of termination for cause by either party at any time must always of course, be available.

Even the expatriate route does not offer an easy solution. In the first place, there is a world shortage of qualified people in some disciplinary areas. Secondly, there exists only a fairly small percentage of experienced agricultural researchers in the U.S., for example, who are in position and wish to live and work abroad. And of those willing to do so, are included some who would not necessarily have the best track record in research, and also those who might not fit into an environment of working and living abroad.

It is recognized that there is a limit to the number of expatriates that can be brought into the RD. Accordingly the following list of priorities is proposed, with Phase 1 appointments being filled as rapidly as possible and Phase 2 somewhat later:

Phase 1.

- 1) Advisor to the Director
- 2) Experimental Lands and Stations Manager
- 3) Range Management Specialist*
- 4) Animal Management Specialist*
- 5) Two (2) Food and Feed Grain Agronomists*
- 6) Fodder Crop Agronomist
- 7) Entomologist
- 8) Machine Adaptation Engineer*
- 9) Agricultural Economist-Farm Management*
- 10) Communications and Extension Officer

*To be provided through the FSRP (only one Agronomist). There are additional needs in the FSRP which are not included in this list.

tested at a substation.

2. On farms with the entries consisting of those crop varieties showing greatest promise in tests at the Stations. These on the farm experiments should be limited to not over 10 or 12 treatments, such as 2 varieties X 2 fertilizer applications X 3 spacings. The tests would be replicated and otherwise comply with appropriate experimental designs.

B. Staff

The Director of the RD classifies as Senior Research Officers those staff members who have at least a Bachelor's degree. The RD organizational structure (Figure 1) calls for 26 Senior Officers. There are presently 7 Nationals who so qualify. And even among the 7 there is in some cases a matter of being rather "new" on the job and lack of adequate experience to be able to conduct independent research. It is generally agreed that there exists a critical shortage of qualified staff that overrides all other shortcomings of agricultural research in Lesotho.

What is the solution? Every attempt is being made to send as many people, with good potential, abroad as possible, to earn academic degrees. However, at best, it will be years before the RD can fill all of the Senior Officer positions with qualified Nationals. Meanwhile, it would appear that the only way to make reasonably rapid progress in building the organization and getting almost-desperately needed research information, is to utilize expatriates. It is difficult for expatriates to be very effective without National counterparts. In areas where there is a critical shortage of Basotho, consideration might be given to "borrowing" Nationals from other Divisions to work with the expatriates until the Basotho who will fill the positions permanently return from their training programs abroad. As Nationals develop the necessary depth of experience to be able to proceed "on their own" the expatriates' appointments would be terminated.

The situation for each position should be studied with respect to how long and in what capacity an expatriate will be needed.

Phase 2.

- 1) Experimental Design/Statistical Analysis Officer
- 2) Animal Health Specialist
- 3) Soil Management Specialist
- 4) Soil Microbiologist
- 5) Marketing Specialist
- 6) Irrigation Engineer
- 7) Soil Conservationist

C. Lands for Experimental Purposes1. The Research Center

There are approximately 20 ha in the experimental fields at the Research Center in Masern with the area along the Caledon River being irrigable, and the remainder upland area being rainfed. There is a tight clay layer at a depth of 18 inches on the upland.

2. The RD Substations

A total of 18 RD Experimental Substations have been identified. Thirteen are listed in Table 1. The other five, on which no research is presently underway, are as follows:

Masianokeng
 'Mantsebo
 Matelile
 Lekubane
 Oxbow

The first three listed above were used for seed multiplication in 1981.

The Lekubane Station is comprised of about 1500 acres, according to Tiedeman. Most of the crops substations are 3.3 ha or less in size.

D. Operations of Experimental Lands

The lands for experimental purposes are very poorly supervised and handled at present. That is why it is suggested that a qualified person at a high level in the RD be given the responsibility to carry out the task of management. The researchers should not have to spend valuable research time in getting the necessary "farming" done. They should be able to merely request needed lands, (well in advance of course) be allocated same with proper cropping history and in a

suitable condition of preparation for experimental plantings; be able to call on the ELSM for such farming operations as cultivating, pesticide applications, land weeding, irrigating, and harvesting. For the time being, at least, the land area at the Research Center is adequate in extent. Better management, good farming, and planning ahead constitute the major needs. The appointment of a qualified Experimental Lands and Stations Manager would go a long way in solving the present problems as outlined above.

The crops substations are for the most part too small to be suitable for experimental purposes. There should be enough land so that an area to be used for experimental purposes one year would have been uniformly cropped the previous year. There should be sufficient land area to take care of all the experimental needs. The exact size of the area needed can be determined only by making plans ahead for the field experimental work to be done at that location.

Substations are manned only with caretakers who have limited capabilities. There are no buildings, except for caretakers' houses and there is no equipment.

The RD should discontinue work at most of the substations until arrangements can be worked out to make them acceptable places to do research. Substations should then be activated to the extent and at the rate that funds, personnel, and suitable land in adequate amounts become available. There is not presently a sufficient information base to determine how many substations are really needed. Possibly six would be a good target number for the foreseeable future.

In planning further, attention should be given to locating substations as near District Headquarters as suitable land can be obtained.

An acceptable crops substation involves a resident supervisor who understands good farming and appreciates the needs of the researcher; necessary labor and guards for security; a building for an office and to store small equipment, hand tools and supplies; and necessary farming equipment. A visit to the

Lekubane Station showed remnants of plot work, and some enclosures (presently being partially grazed). Mr. R. V. Ramakhula, now in residence at Washington State University, formerly conducted research at this Station. Basically it represents a good range area. It would appear that abandoning the Lekubane Station, when there is a highly qualified range expert (Dr. James Tiedeman) available, is a waste of valuable resources. It is especially unfortunate in view of the fact that range research is perforce largely of a long term nature. Continuity should therefore be one of the first considerations in planning work in this area. Whatever research had been started at the Lekubane Station has apparently been terminated, while new range research is being started elsewhere.

Roche (13) stated that seedlings dating from the 1970's at the Oxbow Station are examples of what should not be done. They were made on peat soils which are not high priority areas.

E. Buildings and Improvements.

The RD officers and supporting personnel are located in good quarters at the Research Center. The recent addition of a building with support from USAID, as a part of the FSRP, constitutes a very fine addition to space needed for offices and laboratories.

There is adequate space for the library, for the present laboratories (except that Engibous [3] states that more space should be allotted to the Soils Testing Laboratory), and for the conference room. The facilities are modern, fully acceptable by any standards, and under good custodial care.

There is a field crops laboratory building at the Research Center, consisting of two fairly large work rooms. These have cement floors, on which threshing is done and where seed is put up. Off of one of the work areas are three rooms, each about 12 by 36 feet in size. One of each of these is used for (1) seed storage, (2) as a tool room, and (3) fertilizer storage. There is only one electric outlet in the entire building, which is entirely inadequate. Otherwise, the space is fairly satisfactory for present usage.

Outside of residences for the caretakers, there are no buildings on the Substations. Each substation should have a building which would include an office, an area to process experimental crops materials, a place to put up and store seed, rooms to store chemicals and fertilizers, a space to service farm equipment, a room to store tools and small experimental field equipment, and a toilet. Suitable housing should also be provided for the Superintendent.

Each Substation should be secured with appropriate fencing. This will need to be woven wire in order to keep out sheep.

F. Equipment

Numerous Senior Officer positions are vacant. It would not be wise to purchase equipment for the programs involved until the posts are filled--so that the investigator can help choose his equipment. Where the posts are filled the chief need expressed was for more transport. There is need at the Center for field equipment, especially for specialized equipment adapted to plot work.

The Soil Laboratory presents a special case. It is virtually non-functional. Its role is soil testing. Yet Engibous (3) states "...no sample has been processed in over 10 months". Engibous did not explain why soil tests are not being made but he did suggest the following to get the laboratory operational (short term needs): (1) Obtaining the services of an expatriate to assist in (a) selecting the necessary items of equipment, and (b) developing with a Mosotho counterpart, management of the laboratory, and appropriate laboratory procedures and interpretations; (2) Adding space for sample preparation and storage; and (3) Purchasing \$12,000 to \$15,000 worth of laboratory equipment (a prioritized list of items was provided).

Mr. N. T. Peshoane indicated to the Contractor that he would like to run correlation studies of soil test results with field tests, and he would also like to be able to test for micro-nutrients (when the necessary equipment is forthcoming).

There is no equipment at the Substations. Each Substation should be provided with farm equipment, including power, necessary to carry out ordinary farming operations. Small equipment used in performing experimental operations can best be brought in by the researcher when he carries out his various field operations. However, there should be hand tools such as hoes available at all of the Substations.

G. Procurement of Equipment and Supplies

There was a wide divergence of opinion expressed by the technical Officers on whether or not procurement constitutes a major problem. There was sufficient criticism expressed to lead to the conclusion that the process should be carefully checked and improved if possible. There may be problems which are beyond the control of the RD or even the MOA.

H. Budgeting

There was criticism among some of the Officers to the effect that no allocation of funds is made below the Division level. Where qualified Section heads are present, it would appear that budget allocations could be made to them at the beginning of each fiscal year. And in turn where qualified sub-section Officers are available, allocations could in turn be made to them by the Section heads.

From a crops experimental standpoint it is perhaps unfortunate that the fiscal year starts in April, the fall of the year. It would be much better for the officers involved to get their budget allocations in the spring of the year, so that they could determine the size of their programs, accordingly. But this is one of those unfortunate circumstances about which nothing can be done.

The Contractor was told appropriations or allocations of funds are made to the Division three or four times a year, and sometimes are late in coming. Apparently, expenditures cannot be made until such time as the allocations are "solid". Delays in obtaining funds can be serious from the standpoint of carrying out experimental programs because timeliness of operations is often very important. A means of correcting the situation should be sought.

I. Salaries

Fortunately, the salary level does not appear to constitute a major problem. There is underway a major effort to upgrade the level of training in the RD. It is hoped that in setting salaries, adequate recognition will be made of the level of academic training attained.

J. Housing

Suitable housing could well be provided for all Senior Officers at the Research Center. Some of them may not have personal automobiles. They need to have ready access to their experiments, as research underway may require their attention at almost any time. A good researcher is not a "clock watcher" and often times wants to put in extra time if it can be conveniently done.

There is also a morale implication involved. Researchers and their families will be more desirous of staying in the RD if they are provided with pleasant working conditions. This might help in solving the heavy turn-over problems. Appropriate housing should also be provided for the Superintendents of the Substations.

IX. LESOTHO AGRICULTURAL RESEARCH COUNCIL (LARC)

It is proposed that there be established within the MOA a Lesotho Agricultural Research Council. The purpose of the Council would be: (1) to identify the most pressing problems and research needs of the Lesotho farmers; (2) to suggest personnel, approaches and support for activating appropriate research projects; (3) to obtain periodic reports from the researchers and making on-the-spot inspections for the purpose of monitoring progress; (4) to receive reports of research findings and recommendations as the investigations are far enough along to justify same; and (5) finally to make certain that the information and materials (like seed of new varieties) are getting into the hands of the Delivery System and/or the farmers directly.

LARC would be governed by an Executive Board which could be made up of the following members^{1/}:

Permanent Secretary, Honorary Chairman
 Deputy Permanent Secretary, Technical
 Director of the CD
 Director of the LD
 Director of the RD
 Director of the SWCD
 Director of Extension
 Director of the PD
 Principal of the LAC
 Manager, ATSS, RD
 Head of the CS, RD
 Head of the ASES, RD
 Head of the FMS, RD
 Head of the AES, RD

LARC would not be an administrative body per se, it would not involve additional technical staff and it would not carry out functions already assigned to the various units of the MOA. It is certainly not intended to add another layer of bureaucracy, but rather to utilize in a more formal manner personnel already available. Rather it would concern itself primarily with identifying

^{1/} Admittedly, the suggested membership of the Governing Board is fairly large. Its functions might be expedited through designating an Executive Committee, and/or one or more Subcommittees.

problems, suggesting research projects to answer pressing problems, monitoring research, coordination, avoidance of duplication, seeing that research findings and materials are made available to the subject matter specialists in the MOA who are involved in educational and/or development work, along with farmers themselves. LARC would need office and filing space, office equipment, an administrative office, clerical help and some operational funds.

All new project program proposals having agricultural research components or even implications would be submitted to LARC in advance, for appraisal and suggestions with respect to: (1) likely value, (2) possible duplication, (3) need, and (4) where and with whom the research component should be placed. Special attention would be given to proposals involving donors. Such information would be of paramount importance to the decision makers, by helping in the future to avoid some of the confusion, duplication, lack of critically needed research, and lack of coordination which now exist.

Much of the work of LARC would be carried out by Coordinating Commodity/Discipline Committees (CCDC) established by LARC. As the title indicates, these Committees would be organized around Commodity/Discipline areas. The membership could be drawn from LARC, others in the MOA, and also from outside of the MOA.

Standing Committees would be established by LARC to meet ongoing or continuing needs. For example, a CCDC would be set up for maize/sorghum, because there will be a continuing need for research and education on the production of these crops. Membership could consist of an agronomist, entomologist, plant pathologist, weed specialist, soil management specialist, farm management specialist, marketing specialist, agricultural sociologist, machine adaptation officer, soil and water conservationist, farmers and perhaps others.

Ad hoc Committees would be established to analyze and make recommendations on special problems. For example, suppose a proposal is made to utilize donor funds to initiate a development program in a certain geographical area. An ad hoc Committee would be set up to

assess the research information available, its adequacy, need for additional research, and where and by whom would the research be conducted.

The delivery system for the technical information involved would also be considered by the ad hoc CCDC's.

LARC would formalize cooperation, coordination, selection of research projects, approval or rejection of newly proposed projects, appropriate conduct of research, reporting of research, and functioning of the delivery system. But even more important is voluntary and informal cooperation which should be enhanced thereby. Independent of LARC, all of the personnel involved in doing research, in identifying needs for research, and in the delivery system should make every effort to discuss their mutual problems, keep each other informed, and seek helpful suggestions from each other.

In presenting the concept of LARC at a number of conferences, considerable discussion ensued among the Basotho on how much authority should be vested in LARC. Some thought that it should have a good deal of power in directing agricultural research. The Contractor believes that final judgements of this type can best be worked out by the proper Basotho authorities, but he leans in the direction of giving LARC as much authority as possible.

The establishment of LARC should not preclude or even interfere with the calling of informal meetings of others for research considerations. For example, the Division Directors might wish to meet to consider mutual problems involving research. They should feel entirely free to do so. However, it would be helpful for LARC to keep informed on proceedings at such conferences and hence might well be invited to be represented.

It should be noted that LARC is not responsible for the final step of the delivery system. That is responsibility of Extension and other Divisions. But it is LARC's responsibility to see that research information is provided in usable form to the subject matter specialists in the MOA, to Extension, and in some cases directly to farmers.

X. QUALITY AND CONTINUITY OF RESEARCH

Research of poor quality, for whatever reason, scarcely justifies the name. A compilation of data can be valuable or it can be worthless, depending on how well the experiment has been planned and conducted. Analyses of data cannot detect all cases of poor experimentation.

Officers should conduct experiments only as they have the necessary time, facilities and opportunity for adequate supervision to make sure that the experiments are properly conducted. For example, planting time is a good time to drop an experiment if the seedbed has not been properly prepared. If the researcher learns from one year's experience that the help available at a substation is ineffective, he had best do no more work there until the situation is corrected.

The philosophy of "testing for testing's sake" or "going through the motions" of running experiments with little regard to either the quality of research or the need and use to be made of the results, is all too common. Limited resources can thus be wasted, albeit the researcher has data to use as a screen in case an evaluation is made of his programs.

The strengthening of the research structure in Lesotho, outlined elsewhere in this Report, should do a great deal to minimize the above possible weakness in the future.

The second point that needs to be emphasized is continuity. Each year of research should be built on information generated in previous years. There is, for example, no need to keep testing materials that have already been found to be inferior. Yet records of previous experimentation in Lesotho are in many cases incomplete, making such appraisals impossible.

Experiments requiring a number of years for meaningful results should not be started unless there is reasonable assurance that they can be carried to completion. An example of research requiring several, or even many years time, is that having to do with range management. Tiedeman (20, p.5) points out, that Schome in 1973 outlined range research to be carried out at the Lekubane Station, including grazing rotations and water runoff. But the only data Tiedeman can find from

these experiments are few in number, on livestock gains. Research at the Station appears to have been abandoned. Instead of being abandoned, the research should have been continued and likely would now be yielding many useful data.

Lesotho can ill afford to start experiments which cannot be carried to completion. Good planning, with adequate emphasis on the future, can go a long way to carrying experiments to completion, regardless of the number of years required.

45

XI. THE ROLE OF THE FSRP AND RELATED MATTERS

There is discussion in the various FSRP reports about the possibility of setting up a FSR Section in the Research Division. It is assumed that the establishment of such a Section would replace the Farm Management Section, now shown in the organization chart (Figures 1 and 2). The Contractor defers a decision on this to those in the MOA primarily concerned with the FSRP, with counsel from the WSU Team and USAID, as to whether or not this should be done.

In this connection, the following points are noted: Gilbert, Norman and Winch (4) suggest that FSR can either be incorporated into existing research programs as a "philosophy" or established as separate administrative unit.

Farming System Research means somewhat different things to different people, as shown in an analysis of Farming Systems Research Programs at 5 different IARC's, 1 regional institution, and 3 national institutions (4).

In the Lesotho Third Five-Year Plan, it is stated, "The purpose of the project (FSR) is to develop more productive mixes for agricultural enterprises..." (15). The Project Paper (12) states "...the project has set as its purpose and primary focus the creation of farming systems as 'rural enterprise mixes' that will significantly improve the farmers' productivity".

With respect to the FSRP underway in Lesotho, Engibous (3) states, "Not everyone, including the team members, has a clear definition of the term..."

The Contractor has been impressed of the similarity of farming systems research with farm management research of earlier times. It is interesting to note that Gilbert, Norman and Winch (4) also draw an analogy between farm management research of earlier times and present farming systems research, their concluding statement on the subject being "Thus, in a sense the wheel has come a full circle."

The Ministry of Agriculture has committed itself to conducting the program of the FSR. Much good can accrue therefrom. There need to be close linkages among all officers of the RD, including the

expatriates in the FSRP, to maximize the potential accomplishments of the program.

The three major components of the Farm Management Section can identify problems; needs; social, institutional, and economic constraints to agricultural development; ascertain the present "status of the art" in farm production practices; characterize the infrastructure; and hopefully arrive in a relatively short time at recommendations for improvements. Through close working-relationships and frequent discussions, the production researchers need to participate directly in these survey-type socioeconomic studies. However, taking into account these findings of the Farm Management Section, their own observations and some discussions with farmers and MOA officers, guidance from the IARC; past research findings in Lesotho and elsewhere; counseling with other members of the appropriate CCAC, and finally utilizing their own training and experience in their respective disciplines, the production scientists should be in excellent position to select the most important problems on which to conduct meaningful research.

The Contractor favors incorporating both the "upstream" and "downstream" approaches in the FSRP (see Reference 4 for further elaboration of these terms). The socioeconomic officers would follow largely the latter approach, and the production officers largely the former. The "downstream" types of FSR are site specific programs that identify and test possible innovations which can be easily integrated into current farming systems. They of necessity depend heavily upon basic research information already available (unfortunately there appear to be only limited data from past research in Lesotho). Major breakthroughs would not be expected from "downstream" FSR, but significant progress is foreseeable.

"Upstream" FSR involves research on and off the Stations, and normally represents data produced over several years time. Since there is only a limited amount of traditional research information available in Lesotho, it would appear that the production research officers should follow the "upstream" approach. For production research officers to immediately follow the "downstream" approach would be to leave a void in research knowledge and materials which might never be filled.

The Contractor sees another serious drawback in doing all or most biophysical research on farms. In this approach the Stations are by-passed and as a result will likely remain largely undeveloped. This would constitute a weak link in institution building.

The present FSRP in Lesotho involves prototypes which will have housing, a store, and some lands for research. These establishments could conceivably be designated as substations, providing they meet the test of representing major ecological areas and other criteria used in locating substations.

XII. GETTING RESEARCH INFORMATION TO FARMERS

A. The Technical Divisions

Lesotho is fortunate in having the Technical Divisions in the MOA. The officers in these Divisions constitute the "Extension subject matter" specialists (in addition to carrying out their operational programs). They are the first line in the delivery system.

These subject-matter specialists will conduct testing/demonstrations on farms, which may be of two types as follows:

1. On farm experiments.
2. Final verification of recommended practices and materials through demonstrations. For crops, these could consist of 2 or 3 plots (one being the farmer's traditional system), and fairly large in size (2 or 3 M square). Even with these, a simple statistical analysis could be made by considering each farm a replication (randomization must be taken into account).

B. General Extension.

All field experiments, on Stations and off, should be utilized by General Extension staff for demonstrations and farmer-field meetings. The General Extension staff would serve as "arrangers" --the subject matter specialists and in some cases the researchers as the technical leaders at demonstration meetings.

C. Putting it altogether.

All research findings will be submitted annually and promptly to the RD.

The RD will be responsible for analyzing all research data, amalgamating them into appropriate summaries and publishing the results along with interpretations, in annual reports, with the subject matter specialists as the primary receiving audience.

The subject matter specialists will in turn utilize the research reports (some may be used directly) in brochures, slide presentations, news stories, and taped radio programs in forms that can be understood and utilized by Extension generalists and in many cases, by farmers directly.

The Extension generalists will be the final link in getting

information and materials to farmers. In addition to demonstrations made possible primarily by the subject matter specialists, they will utilize traditional Extension methodology in their education programs with farmers.

An essential element of the above is that there be a great deal of meaningful dialogue among the three components, and that where possible there be joint efforts, as for example a researcher and a subject matter specialist jointly conducting a field trail.

XIII. THE PAYOFF

The distressingly low crop yields and poor returns from livestock in Lesotho, are unacceptable, from the standpoint of both national policy and returns to the individual farmers. That the situation must be improved is recognized by the GOL as shown by the statement of the Prime Minister, Dr. Leabua Jonathan, as follows: "...that Lesotho would be self sufficient in food production in five years' time if projected plans materilize". (5).

That much higher yields can be obtained in Lesotho is demonstrated with maize fields under the Food Grain Self-sufficiency Project. In this program, loans and technical assistance are provided by the Republic of China and the RSA to the cooperating Lesotho farmers. The fields in the program which were examined in late February were in excellent condition. The fields involving Chinese cooperation have heavier stands and higher rates of fertilizer application than those involving the RSA. As a result, under the conditions of 1981, the former will outyield the latter, but both sets of fields will produce good yields. The yield of the "Chinese" fields is estimated at five to seven metric tons per hectare (80 to 112 bu. per acre). This compares with an average yield of maize in Lesotho for the period of 1971-76 of 630 kg per ha (slightly under 10 bushels per acre). As one drives from Maseru across the Caledon River to Bloemfontein, it is obvious that the maize yields are considerably higher in the RSA than in Lesotho. In that part of the RSA, there is also a sizeable hectarage of sunflowers, a crop which might well therefore be further tested in Lesotho.

Through a strong research and education program, it will be possible in time to increase crop yields and livestock returns in Lesotho to the levels of those in the adjoining areas of the RSA. As has been pointed out elsewhere, all available information from the RSA should be obtained and utilized in Lesotho. This can best be accomplished through developing a strong research and educational program in Lesotho so that the staff in the two countries can carry on close cooperation.

With proper planning, strengthening and coordination of research and extension; programs channeling more of the support from donors

into effective research and extension programs; and perhaps some extension of credit and/or subsidization of improved farming practices, it should be possible to double crop yields in Lesotho within a five-year period. Over a longer period of time, yields can be pushed to much higher levels. Substantial gains are also possible in livestock production.

XIV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

1. Lesotho comprises a land area of 30,350 square kilometers. There are only 900,000 acres or approximately 10% of arable land. About 50% of the land is in range, much of which is seriously overgrazed (27). There is a total of 187,000 rural households with more than 90% of the population living in rural areas. Farms average just under 2 ha of arable land. Crop yields are extremely low, and returns from livestock are poor. For example, the weaning rate is only 50% and off-take rates are extremely low. Soil erosion is serious.
2. There is a paucity of solid agricultural research data available in Lesotho. Results of much of the research done in the past are not readily available--either because they are "buried" in old files somewhere in the MOL or because they have been lost. A search should be made to attempt to retrieve as many of these data as possible.
3. Considerable emphasis is placed on agricultural research in the Third Five-Year Plan of the GOL. The Prime Minister, Dr. Leabua Jonathan has stated "...that Lesotho would be self-sufficient in food production in five year's time if projected plans materialize" (5).
4. The role of mission-oriented agricultural research is to develop information and materials (such as improved germ plasm) which when utilized by farmers will increase production, efficiency, net income, and finally the quality of rural living. But this cannot be done through research alone--an effective delivery system (extension education) must be a part of the overall program of attempting to help farmers.
5. Agencies presently doing agricultural research in Lesotho are: The RD (including the FSRP), the DC (including FAO), the SWCD (including the Woodlot Project), the TDRDP, the PD, BASP, and the Bureau of Statistics. Cooperation and coordination among the agencies doing agricultural research are minimal.
6. There were 101 field crop experiments planted in Lesotho in 1981. Very few of the experiments were factorial. There was a heavy

- concentration on variety trials, with a lesser number of experiments having to do with time of planting, intercropping and fertilizers. Still lesser in number were tests of spacing, number of plants per hectare, insects, disease, and forage and fodder crops.
7. Based on a limited number of inspections of field crop experiments, it is obvious that the number which will result in meaningful yield data will be considerably less than the number planted.
 8. The RD is doing research on vegetables, and looking for economic values of indigenous plants.
 9. Primarily through assistance provided through the FSRP, the RD is also doing research in the following areas: livestock production and range management, marketing, farm management and rural sociology.
 10. The SWCD is assembling information on rainfall and runoff in catchments, is doing research on new soils so classified, on forestry (through the Woodlot Project), and is cooperating with the RD (FSRP) in conducting studies on two farms on no-till production of maize.
 11. Generally speaking, the attitude among the MOA officials (in which the Contractor concurs) is that the RD should be greatly strengthened and when the necessary capabilities are established, most of the agricultural research should be conducted by that Division. For various and valid reasons, some research functions should remain with other Divisions.
 12. As staff capabilities are strengthened, the LAC (scheduled to become a Faculty of the NUL) should be utilized to the fullest possible extent in conducting agricultural research. Joint appointments with the RD and fund allocations for specific projects are avenues by which this could be accomplished.
 13. Director Winston Nts'ekhe has developed an organizational chart for the RD. It calls for a Director, Deputy Director and the following Sections: Administrative, Crops, Animal Science and Ecology, Farm Management, and Agricultural Engineering. There would be a total of 26 technical staff members.

The Contractor is suggesting that there be an additional Section, to be titled the Auxiliary Technical Services Section, that there be some changes in the suggested staff positions, and that the total number of technical staff be increased to 28. It is suggested that the proposed staff would constitute the "critical mass" necessary to make the RD viable and effective.

14. The RD is presently very weak, with respect to staff. Not counting the 9 FSRP staff, there are 7 Senior Officers. Some of these have only a bachelor's degree, and also there is a lack of experience among some of them. It is recommended that the present program of sending people with good potential abroad for further academic training be pursued as rapidly and on as large a scale as possible. Meanwhile, utilization of expatriates is the only way that rapid progress can be made in building the RD and in generating much-needed research data. The donors could pool a portion of their resources to fund the necessary number of expatriates for the research positions.
15. Most of the present crops substations are too small and too poorly operated to be of much value in the research program. It is recommended that the substations be limited to the number needed to represent major ecological areas, and that the number be further limited to those of adequate size, which can be properly operated as a part of the research program. Most of the present substations should be dropped. A total of six might be adequate for the future.
16. Office, laboratory and crops processing and storage space are fairly adequate at the Research Center. There are no buildings other than residences at the substations. A building combining the above components should be provided at each substation that is retained or activated. Housing should be provided for all senior officers at the Research Center.
17. The soils laboratory which has tested no soil samples for 10 months can be activated by: (1) adding \$12,000 to \$15,000 worth of laboratory equipment, and (2) bringing in an expatriate to

help determine the equipment needed and assisting in developing a management program.

18. A limited amount of laboratory and field equipment should be added now in the RD. However, purchase of much scientific equipment should be postponed until qualified staff are on deck so that they can help in the selection of same.
19. A review should be made with the objective of strengthening the procedures of procurement, and budgeting and allocation of funds in the RD.
20. It is proposed that there be established within the MOA a Lesotho Agricultural Research Council. It would be governed by an Executive Board, headed by the Permanent Secretary as Honorary Chairman, and composed of the most knowledgeable agricultural leaders of the Kingdom, who either are involved directly in research or who because of their assignments have an important stake in the research programs.
21. The functions of LARC would be to: (1) identify the most pressing problems and needs of Lesotho farmers; (2) pass judgement on all new research proposals with respect to need, possible value, possible duplication, and by whom and in what agency the research should be done; (3) obtain periodic reports from the researchers and make on-the-spot inspections for the purpose of monitoring research underway; (4) receive and evaluate all published reports of agricultural research in Lesotho; and (5) make certain that the research information and materials (like seed of new varieties) are getting into the hands of the delivery system and ultimately to farmers.
22. Much of the work of LARC would be carried out by standing and ad hoc Coordinating Commodity/Discipline Committees (CCDC). The committees composed largely of technicians would be appointed by and report to LARC.
23. Much more attention needs to be given to the quality and continuity of agricultural research in Lesotho. There are too many cases of isolated experiments being conducted on one segment of an overall

problem, with little attention being given to the real needs of the farmers, or else being carried on in isolation, sometimes in a superficial manner. A pooling of research efforts among all of the personnel involved, along with an increased use of factorial experimental designs, could result in much more effective programs even without adding further resources. Long term planning to provide for continuity is also much needed. Creation of LARC together with the CCDC's would help greatly in establishing the needed coordination and strengthening of experiment programs.

24. The MOA has committed itself to conducting the FSRP. Much good can accrue therefrom. The Contractor recommends that as a part of this large program, adequate attention be given to institutional building.
25. The RD, the various Technical Divisions, and Extension must all work closely together in order to reach the one important objective, i.e. get research information and materials in usable forms to farmers.
26. Lesotho needs to take advantage of all research findings from abroad which are applicable or which can be applied with a minimum of adaptive research. Especially valuable sources of such information are from the adjoining areas of the RSA where growing conditions are very similar to those of Lesotho.
27. Through proper planning, organization and support of research, extension, and possibly action and credit programs, crop yields in Lesotho could be doubled within a five-year period. On a longer-term basis the yields could be brought up to the levels of the adjoining areas of the RSA. Substantial increases can also be effected in livestock production.

XV. LITERATURE CITED

1. Brady, Nyle C., The Nature and Property of Soils, 1978. 8th edition. MacMillan Publishing Co., Inc. New York.
2. Cropping Guidelines for Lesotho. February, 1980. M.O.A. Maseru, Lesotho.
3. Engibous, J. C., Consultancy Report, February 16, 1981. Department of Agronomy and Soils, Washington State University. FSRP, RD, M.O.A., Maseru, Lesotho.
4. Gilbert, E. H., D. W. Norman, and F. E. Winch, Farming Systems Research: A Critical Appraisal, 1980. Paper No. 6, MSU Rural Development, Department of Agriculture Economics, Michigan State University, East Lansing.
5. Government Geared to Produce Enough Food in 5 Years, 27 February 1981, Lesotho Weekly. Volume 4, No. 45, Maseru, Lesotho.
6. Johnson, V. A., Symposium Address, 2 October 1980. University of Stellenbosch, Republic of South Africa.
7. LASA Team, Lesotho's Agriculture - A Review of Existing Information. October 1978, LASA Research Report No. 2. M.O.A., GOL and Department of Economics, Colorado State University.
8. Law, Alvin, Agricultural Research Stations, Lesotho, For 1980-81. Mimeographed Report.
9. Little, Thomas M., and F. Jackson Hills, Agricultural Experimentation - Design and Analysis, 1978. John Wiley and Sons, New York.
10. Project Document, Lesotho Woodlot Project: Second Four-Year Period, 1977. Ministry of Agriculture Co-operatives and Marketing. Maseru, Lesotho.
11. Project Evaluation Summary, Farming Systems Research 1980. USAID/Lesotho. Project No. 632-0065.
12. Project Paper, 1978, Lesotho FSR (632-0065), USAID.
13. Roche, Ben, Narrative on Lesotho. December 1980. Consultant Report. FSR/Department of Forestry and Range Management, Washington State University. FSRP, RD, MOA, Maseru, Lesotho.
14. Schemes of Service Programme II, Range Management, Undated. MOA, Lesotho. (Typed copy.)
15. Third Five-Year Plan, Volume II. October 1979. Penultimate Draft. Kingdom of Lesotho.
16. Plath, J. C., and T. Jobo, Farm Management Research For Lesotho - an Annotaed Bibliography. Undated.

17. Law, Alvin G., Review of Agronomic Data Available in Lesotho of Value to the FSRP. Undated.
18. Klosterman, Earle, W., Animal Science and Development in Lesotho. FSRP. Undated.
19. Tiedeman, J. A., Project Outline, Village Group Ranch. Undated.
20. _____. Annotated Bibliography of Range Related Research in Lesotho. January 1981. RD, MOA and FSRP.
21. Wyeth, Peter, FSRP Marketing Section Research Proposal. Undated.
22. Butler, Lorna M.; MOA, FSR Research Proposal. Undated.
23. Sefeane, A. S., Report on a Course on Application and Diffusion of Agricultural Research Results to Community Level. 11 October 1980. RD, MOA. Maseru, Lesotho.
24. Motoring in Lesotho. Compiled, drawn, and published by the Automobile Association of South Africa.
25. Sperling, David W. Personal conference. 20 March 1981. CIMMYT corn breeder, Mexico City.
26. Report on the Fourth Southern African Regional Wheat Evaluation and Improvement Nursery. 1978. Small Grain Center, Bethlehem, South Africa.
27. Geuting, Horst G. K. Report of the FAO country representatives in Lesotho for the calendar year 1979. 15 January 1980. Maseru, Lesotho.

XVI. APPENDICESA. Acronyms and Abbreviations

AES	Agricultural Engineering Section
ASES	Animal Science and Ecology Section
ATSS	Auxiliary Technical Services Section (RD)
ABSP	Basic Agricultural Services Program
CARIS	Center for Agricultural Research Information Service (FAO)
CCDC	Coordinating Commodity Discipline Committee
CD	Crops Division
CGIAR	Consultive Group of International Agricultural Research
CIDA	Canadian International Development Administration
CIMMYT	Centro Internacional De Mejoramiento De Maiz Y Trijo
CRIS	Cooperative Research Information System (U.S.A.)
CS	Crops Section (RD)
ELSM	Experimental Lands and Stations Manager
FAO	Food and Agriculture Organization
FMS	Farm Management Section (RD)
FSRP	Farming Systems Research Project
GOL	Government of Lesotho
HA	Hectare
IARC	International Agricultural Research Center
IBYAN	International Bean Yield and Adaptation Nursery
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
INTSOY	International Soybean Program (University of Illinois)
Kg	Kilogram
KOL	Kingdom of Lesotho
LAC	Lesotho Agricultural College
LARC	Lesotho Agricultural Research Council
LASA	Lesotho Agricultural Sector Analysis
LD	Livestock Division
M	Meter
MOA	Ministry of Agriculture

N	Nitrogen
NUL	National University of Lesotho
O/a	On or about
ODA	Overseas Development Authority (UK)
PCV	Peace Corps Volunteers (USA)
PD	Planning Division
RC	Research Center (RD)
RD	Research Division
RSA	Republic of South Africa
SARWEIN	South African Regional Wheat Evaluation and Improvement Nursery
SWCD	Soil and Water Conservation Division
TTDRDP	Thaba Tseka District Rural Development Project
UNDP	United Nations Development Project
USAID	United States Agency for International Development

B. Procedures and Assistance Provided to the Contractor

The Contractor arrived in Maseru at 12:00 noon on Tuesday, 17 February 1981, having been delayed in departing from his home base, Lincoln, Nebraska, U.S.A., by one day because of mechanical difficulties of the aircraft. He departed Maseru at 12:00 noon on Thursday, 26 March by automobile to catch a flight at Bloemfontein, RSA for Johannesburg and the continuing return trip home.

The principals worked with in Lesotho were:

1. For MOA:
Mr. Winston Nts'ekhe, Director, RD;
2. For USAID:
Dr. Kenneth Sherper, Assistant Director;
Mr. James F. Dunn, Agricultural Officer;
3. For FSRP:
Dr. Robert Butler, Team Leader

Mr. Winston Nts'ekhe carried the chief responsibility for determining the program of activities, and in arranging conferences and field trips. Guide assistants arranged by Mr. Nts'ekhe were most helpful in directing the Contractor to the various offices and conferences. Mr. Nts'ekhe also provided needed documents. He presented in detail his concept of a structure for the RD, areas of research to be emphasized, and relationships with other segments of the MOA and with donors. His help in carrying out the research study was most valuable.

Dr. Kenneth Sherper provided important background information through enlarging upon the "Scope of Work". He participated in a field trip to Thaba-Tseka. Unfortunately, his valuable assistance was lost from 6 March through 20 March during which period he was absent from Lesotho because of serious illness in the family.

Mr. James F. Dunn was the principal contact in USAID. He also provided important background information and cooperated with Mr. Winston Nts'ekhe in facilitating the working arrangements. He participated in some of the field trips. His sound judgement and agricultural background were most helpful.

Mr. James H. Leo handled the legal, business and financial

aspects of the Contract. Although not much of this sort of thing gets into the written report, his contributions, including a very human philosophy were invaluable in carrying out the Contract.

Dr. Robert Butler helped to spell out both the philosophy and the overall operations of the FSRP. He was generous in providing pertinent documents, and in arranging conferences with the other eight FSRP Team members.

The Contractor is also indebted to all of the other persons listed in Appendix XVUC, "Conferences Held". The persons in Lesotho reported orally and through documents on the structure, assignments, and programs of their respective segments of MOA or other organizations.

Field trips were made to the northern lowlands, to the southern lowlands, to an area near Maseru to inspect no-till tests on farms, and to the mountains (Thaba-Tseka). A general idea of the areas covered can be gained from the following list of stations and other experimental sites visited.

1. Main RD station at Maseru
2. Woodlot Research Project site at main RD station
3. Berea or T.Y. Station
4. Leribe Station
5. Matseing Station
6. Mafeteng Station
7. Tsakholo Farmer Fields Research Station
8. Siloe (FSR Prototype Area)
9. Machache
10. Lekubane Pasture Station
11. No-till plots on the farm of Mr. H. Makhooane, Thaba-Bosiu
12. No-till plots on the farm of Mr. E. T. Lethale, vai Lancers Gap

The Contractor is deeply indebted to the principals and to all of the other persons listed under Appendix XVIC, "Conferences Held" for the splendid assistance provided. Although it is most difficult, if not a bit unfair, to single out individuals for special credit (because others are omitted), the Contractor

was especially appreciative of assistance provided by the following (in addition to that of the principals):

Dr. Alvin Law, Agronomist, FSRP, who spent considerable extra time in providing pertinent background information, and in taking the Contractor on tours of the Main Station and of the farmer-field, no-till plot tests.

Mr. Trower Namane and Mr. Shoepane S. Moima, who helped conduct the major field trips, and who willingly shared their knowledge of and experiences in research in Lesotho.

The secretaries and typists at USAID who provided office assistance throughout the time spent in Lesotho, especially in typing the first, rough copy of the report.

Mrs. Marjorie Scherer who gave up her "long holiday" weekend of 21-23 March in order to type the draft copy of the final report.

Mr. David Frederick and Dr. Kenneth McDermott were most helpful at the Washington, D.C., level both in helping to plan the work in Lesotho, and in completion of the Contract.

Ms. Mary Glantz of Lincoln, Nebraska, who typed the final report.

Nothing was appreciated more, however, than the non-programmed help of Mr. J. M. Nthongoa, President of the Maseru Chamber of Commerce. At dusk one evening he picked up the hitchhiking foreigner on a country highway and gave him a ride to Mafeteng. This saved the latter from spending a cold, rainy night in a transport vehicle, which was hopelessly stuck in deep mud in an isolated farm field. Mr. James Dunn and Mr. Shoepane S. Moima did so spend the night

C. Conferences Held in Lesotho1. Ministry of Agriculture (MOA)

- a. Mr. Obed Selikane
Acting Permanent Secretary
- b. Mr. Peter Devonald, ODA
Acting Deputy Permanent Secretary - Technical
- c. Mrs. E. M. Monnyane
Deputy Permanent Secretary-Administration
- d. Mrs. A. M. Morojele, Chief Planning Officer
Division of Planning

Mrs. Patricia Hinnen, PCV
- e. Mr. Teboho Kitleli
Chief Training Officer
- f. Division of Soil and Water Conservation
 - (1) Regular Staff
 - Mr. Reatile T. Mochebelele
Chief Conservation Officer
 - Mr. Moeketsi J. Masilo
Deputy Chief Conservation Officer
 - Mr. Thomas P. Helseth
Advisor to Chief Conservation Officer, USAID
 - Mr. Makfelsane J. Lepele
Head, Soil Science Section
 - Mr. Leroy F. Scherer
Head, Engineering Section, USAID
 - Mr. Wally Fausch
Conservation Planner, USAID
 - (2) Woodlot Project Staff
 - Dr. D. F. Davidson
General Manager, Anglo-American
 - Mr. Keith Richardson
Forest Research Officer, Anglo-American
 - Mr. Benedict Marole
Forester
- g. Division of Range Management
 - Mr. Bore Motsamai
Acting Chief Range Management Officer
- h. Crops Division
 - Mr. Eric L. Molise
Chief Agricultural Officer
 - Dr. Guy P. Tewarsi
Agronomist, USAID
 - Michel Leyritz
FAO Fertilizer Program

- i. Livestock Division
 - Mr. S. J. Kao
Director of Livestock Division
 - Mr. J. Ntabe
District Livestock Officer, Mafeteng
- j. Extension Division
 - Mr. Sello Khetsi
Chief Extension Officer
 - Miss 'Neheng Jonathan
Chief Nutrition and Home Economics Officer
- k. Food Grain Self-Sufficiency Project
 - Mr. Anthony Maurice Phakoana
Director of Food Grain Self-Sufficiency Project
 - Mr. A. M. Gugushe
Technical Operation Unit
 - Mr. Chung-Ching Su
Chief, Chinese Agricultural Mission to Lesotho,
Republic of China
- l. BASP
 - Mr. M. G. Khadikane
Director
 - Mr. W. V. Rose
Advisor to BASP Director, ODA
 - Dr. Fred Winch
Senior Agricultural Economist
West German Republic
- m. LAC (Lesotho Agricultural College)
 - Vice Principal
Thesele Motsone
 - Professor of Soils, USAID
Dr. Firouz Rooyani
- n. TTRDP (Thaba Tseka Rural Development Project)
 - Dr. August S. Johnson
Director, CIDA
 - Mr. David Beckman
Livestock and Range Management, CIDA
 - Mr. Brian Wilson
Livestock Marketing, CIDA
 - Dr. Mike Pratt
Crops Research, CIDA
 - Mr. Orla Hansen
Rural Technology Unit, Denmark Aid

o. Basotho Pony Project

Mr. Michael Mahon
Assistant Manager, Thaba Tseka, Irish Aid

p. Agricultural Research Division

(1) Director

Mr. Winston Nts'ekhe (Agricultural Economics)

(2) Deputy Director

Mr. S. B. Mkhize (Entomology)

(3) Farming Systems Research Project

Dr. Robert Butler, Team Leader

(4) Administration

Mr. Keith W. Brandon, Administrative Officer

Assistant Administrative Officer

Mr. Mokhole Napo

(5) Animal Science and Ecology

(a) Dr. Earle Klosterman

Animal Management Specialist, FSRP

Dr. Rod Preston

Short-term Consultant, FSRP

(b) Dr. James L. Tiedeman

Range Management and Ecology, FSRP

(c) Herbarium

Mrs. L. Mohapi

Botanist/Taxonomist

Miss K. Nketsi

Technical Assistant

Mrs. Grinne Gilliland

PCV

(6) Crops Section

(a) Agronomy

Mr. Trower Namane, Intercropping

Ms. Elizabeth Mofoka -- Soybeans, Field Beans, Cowpeas

Mr. Shoepane Simon Moima -- Wheat

Dr. Alvin Law, FSRP

(b) Horticulture

Mrs. Makaiolo M. Kotsokoane

(c) Plant Protection

Dr. B. N. Ndimande, Plant Pathologist

Mr. S. B. Mkhize, Entomologist

(d) Soils and Soil Testing

Mr. N. T. Peshoane (SWCD)

(7) Farm Management Section

(a) Agricultural Communication and Extension

Mr. Abraham Sefeane

Mr. Seth Beckerman, FSRP

(b) Rural Agricultural Sociology

Dr. Lorna Butler, FSRP

Mr. M. Tshabalala

(c) Farm Management

Mr. Thali G. Jobo

Dr. Joel C. Plath, FSRP

(d) Marketing

Ms. M. Motsamai

Dr. Peter Wyeth, FSRP

(8) Agricultural Engineering Section

(no staff presently)

(9) Agricultural Research Library

Ms. Francinah Thabisi

Librarian

Mrs. Margaret Norton

Library Consultant, USAID

2. Donors - General

a. USAID/Lesotho

Mr. Frank D. Correl, Director

Dr. Kenneth Sherper, Assistant Director

Mr. James F. Dunn, Agriculture Officer

Mr. Byron Bahl, Program Officer

Mr. Joseph P. Carney, Human Resources Development Officer

Mr. James E. Leo, Management Officer

Mr. Stephen T. Norton, Capital Projects Development Officer

Mr. Charles E. Brooks, Controller

b. AID/Washington, DC

Mr. David Fredrick, Office of Southern Africa Affairs

Dr. Kenneth McDermott, Leader, FSRP Review Team

c. UNDP

Mrs. Eva Buckholz, Program Officer

d. FAO

Dr. Horst B. K. Geuting, FAO Officer

3. Out-of-Country Consultants and Cooperators

a. Washington State Univeristy, Pullman

Dr. Orville Young

Director of Coop. Extension

Member of FSRP Review Team

Dr. Rod Preston
Head, Department of Animal Science
Short-term Consultant on FSRP

- b. Dr. David Sperling
CIMMYT, Mexico City - Maize Breeder
- c. Mr. Tuck Kamine
Frederiksen, Kamine and Associates
Private Consulting Firm
Sacramento, California