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THE AGRICULTURAL RESEARCH
RESOURCE ASSESSMENT
PILOT REPORT FOR
BOTSWANA, MALAWI AND SWAZILAND
November 1983



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PILOT REPORT FOR

BOTSWANA, MALAWI AND SWAZILAND

Submitted to: Dr. K. Oland
Chairman
Agricultural Research Consultative
Technical Committee (ARCTC)
of Southern African Development
Coordination Conference (SADCC)

Submitted by: William H. Johnson
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November 4, 1983

BACKGROUND AND ACKNOWLEDGMENTS

This Agricultural Research Resource Assessment (ARRA) Pilot Study was performed during the period from May to November, 1983.

The study was approved by the Agricultural Research Consultative Technical Committee (ARCTC) of the Southern Africa Development Coordination Conference (SADCC) in May, 1983 at their meeting in Harare, Zimbabwe, where a Cooperation for Development in Africa (CDA) Reconnaissance Report was presented.

A subcommittee of the ARCTC and CDA was formed and was subsequently requested to initiate plans for the pilot ARRA. This committee consisted of SADCC representatives: Dr. K. Oland, Director of Research, Botswana; Dr. D.N.B. Manda, Director of Research, Malawi; and Dr. R. Pereira, Director of the National Institute for Agricultural Research, Mozambique. Dr. V. Johnson (AID Contractor) and Dr. O. Kelley, (AID/Devres Contractor) represented the CDA Agricultural Research ad hoc Committee. Dr. J. Artis of the Midwest University Consortium for International Activities (MUCIA) attended as a technical expert.

The subcommittee met again in Gaborone, Botswana in June, 1983 and reviewed a draft format for data collection. They also agreed on a schedule for the pilot studies in Botswana, Malawi and Swaziland, and on the selection of country study coordinators.

The field work was initiated in July, 1983 with the following officers responsible:

<u>Country</u>	<u>Country Coordinator</u>
Botswana	Howard Sigwele (Planning and Statistics Dept, MOA, Botswana)
Malawi	Dr. Ephrem Whingwiri (Officer in Charge, Agronomy Institute, MOA, Zimbabwe)
Swaziland	Dr. John Menz, Consultant (Former Director of Research and Planning, MOA, Swaziland)

A mid-term review was held in August, 1983 in Gaborone, Botswana. The field wrap-up of the study was held with the ARCTC sub-committee in Gaborone in September, 1983.

During the data collection process, and as the final report has been prepared, material from outside sources has been used. This report attributes the sources of such data. Material has been secured from IBRD and FAO reports, from USAID country documents, from country development plans, and from interviews with government officials and informed and experienced observers. Background information was also provided from a search of the Michigan State University's Africa Studies Library.

Special thanks are due Dr. K. Oland, Chairman of the ARCTC of SADCC. In addition to coordinating SADCC's support of this pilot ARRA, he has contributed a valuable analysis of each country's programmes, which is included as Annex 5. I am grateful, also, for the assistance provided in producing this report by many Devres staff members.

On behalf of the personnel involved in this study and the staff of Devres, Inc., I wish to express my sincere appreciation to the Honorable Ministers of Agriculture and their staffs in Botswana, Malawi, and Swaziland for their excellent cooperation and support as this assessment was performed. Their assistance was essential and was provided in a fully cooperative manner. Thanks also are due to the CDA donor communities in the countries referenced for their cooperation and assistance.

Many individuals contributed to the development of this effort by graciously providing their time and recounting their experience for those who carried out the field work in support of this report. To all of them, I express a special thank you for helping the SAAR project attain its important objectives.

While many persons made important contributions to this report, any shortcomings or impreciseness noted by readers are the responsibility of the the SAAR Project Director and the professional staff of Devres.

William H. Johnson
Senior Associate
SAAR Project Director

LIST OF ACRONYMS AND ABBREVIATIONS

AADC	Arable Agricultural Development Committee
ADB or AfDB	African Development Bank
ADD	Agricultural Development Division (Malawi)
ADMARC	Agricultural Development and Marketing Corporation
ALDEP	Arable Lands Development Programme
APRU	Animal Production Research Unit
ARCTC	Agricultural Research Consultative Technical Committee
ARD	Agricultural Research Division
ARPC	Agricultural Research Priorities Committee
ARRA	Agricultural Research Resource Assessment
ASF	African Swine Fever (Project)
ATIP	Agriculture Technology and Improvement Project
BAC	Botswana Agricultural College
BAMB	Botswana Agricultural Marketing Board
BMC	Botswana Meat Commission
CCA	Common Customs Area
CCU	Central Cooperative Union (of Swaziland)
CDA	Cooperation for Development in Africa
CDC	Commonwealth Development Corporation
CIAT	International Centre for Tropical Agriculture
CIDA	Canadian International Development Agency
CIMMYT	International Centre of Corn and Wheat Improvement
CODEC	Cooperative Development Centre
CRSP	Collaborative Research Support Programme
CSRP and/or CSRPEP	Cropping Systems Research and Extension Training Project (USAID Project)
CTC - CSC	Cold Storage Company <i>Consultative Technical Committee</i>
DAC	Development Assistance Committee
DAD	Department of Agricultural Development
DAFS	Department of Agricultural Field Services
DAH	Department of Animal Health
DANIDA	Danish International Development Agency
DAR	Department of Agricultural Research
DES	Division of Extension Services
DLFRS	Dryland Farming Research Scheme
DVS	Department of Veterinary Services (Malawi)
ECF	East Coast Fever (Project)

LIST OF ACRONYMS AND ABBREVIATIONS (cont.)

EDB	Ethylene dibromide
EDF	European Development Fund
EEC	European Economic Community
EFSAIP	Evaluation of Farming Systems and Agricultural Implements Project
EPA	Extension Planning Area
FAO	Food and Agriculture Organization of the United Nations
FAP	Financial Assistance Policy
FSRP	Farming Systems Research Programme
GDP	Gross Domestic Product
GNP	Gross National Product
GOB	Government of Botswana
GOM	Government of Malawi
GOS	Government of Swaziland
GRAMIL	Grain and Milling Company
IBRD	International Bank for Reconstruction and Development (The World Bank)
ICIPE	International Centre for Insect Physiology and Ecology
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IDRC	International Development Research Council (Canadian)
IDS	International Development Service (U.K.)
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Centre for Africa
ILO	International Labour Organization
ILRAD	International Laboratory for Research on Animal Disease
INTSOY	International Soybean (Program) (U. of Illinois)
IRRI	International Rice Research Institute
ISTA	International Seed Testing Association
ITF	Individual Tenure Farms
MAMC	Mananga Agricultural Management Centre
MOA	Ministry of Agriculture
MOE	Ministry of Education
NDB	National Development Bank
NDP	National Development Plan
NORAD	Norwegian Organisation for Research and Agricultural Development

LIST OF ACRONYMS AND ABBREVIATIONS (cont.)

NARC	National Agricultural Research Centre
NRC	National Research Council (Swaziland)
NRC	Natural Resources College (Malawi)
NRDP	National Rural Development Programme
NRS	National Research Station
NUFFIC	Netherlands Free University
ODA	Overseas Development Agency
PCM	Protein calorie malnutrition
PO	Professional Officer
PQLI	Physical Quality of Life Index
RDA	Rural Development Area
RDAP	Rural Development Area Programme
RDP	Rural Development Project
RDRP	Rural Development Research Project
RFTC	Rural Farmer Training Centre
RSA	Republic of South Africa
SADCC	Southern Africa Development Consultative Conference
SARDC	Swedish Agency for Research in Developing Countries
SASA	South Africa Sugar Association
SASIAA	South Africa Sugar Industry Agronomists Association
SCB	Swaziland Cotton Board
SCOT	Swaziland College of Technology
SDSB	Swaziland Development and Savings Bank
SIDA	Swedish International Development Agency
SIS	Swaziland Irrigation Scheme
SMC	Swaziland Milling Company
SNL	Swazi Nation Land
SSA	Swaziland Sugar Association
SSCAA	Swaziland Sugar Cane Agronomists Association
SUCOMA	Sugar Corporation of Malawi
TA	Technical Assistant
TGLP	Tribal Grazing Lands Policy
TO	Technical Officer
TPI	Tropical Products Institute (U.K.)
TRA	Tobacco Research Authority

Coordination

LIST OF ACRONYMS AND ABBREVIATIONS (cont.)

TRF	Tea Research Foundation
UBLS	University of Botswana, Lesotho and Swaziland
UK	United Kingdom
UNDP	United Nations Development Programme
UOS	University of Swaziland
UPC	Usutu Pulp Company
US	United States
USAID	United States Agency for International Development
WFP	World Food Programme

CURRENCY EQUIVALENTS

Botswana

Currency Unit	=	pula (P)
US\$1	=	P\$1.23
P1	=	US\$0.81
P1	=	100 thebe

Malawi

Currency Unit	=	kwacha (K)
US\$1	=	K 1.14
K1	=	US\$0.87
K1	=	100 tambala

Swaziland

Currency Unit	=	emalengeni (plural lilangeni) (L)
US\$1	=	L 1.08
L1	=	US\$0.93
L1	=	100 cents

WEIGHTS AND MEASURES

ha	=	hectare
km	=	kilometre
mm	=	millimetre
MT	=	metric tonne

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I. EXECUTIVE SUMMARY

A. The Purpose of the Agricultural Research Resource Assessment (ARRA)

Consultative

1. Background

This ARRA has been performed as a pilot study by three of the Southern African Development Coordination Conference (SADCC) member nations, with the cooperation and support of the Agricultural Research Coordination Technical Committee of SADCC and Devres, Inc., a private contractor employed by the United States Agency for International Development (USAID). Devres represented the informal association of donor countries known as Cooperation for Development in Africa (CDA). CDA has accorded a high priority to the need to develop strengthened agricultural research capability by Sub-Saharan African countries. Members of CDA are: Belgium, Canada, the Federal Republic of Germany, France, Italy, the United Kingdom, and the United States of America.

CDA members noted that the African nations had established Africa-wide and regional institutions, and that the heads of African states and governments had given unanimous support to the Organization of African Unity (OAU) Lagos Plan of Action which emphasizes the development of a strong capability to increase agricultural productivity. The donors have, therefore, urged African regional agencies such as SADCC to develop country-specific, consolidated and regionally-sensitive analyses of long-term needs and opportunities for donor consideration for the support of agricultural research.

good

National policy goals enunciated by each of the three pilot countries stress food security, employment generation and improvement in per capita incomes. Each has targeted the agricultural sector as one of the key areas that must contribute substantially to achieving these national goals. SADCC has embraced these objectives as regional goals and has assigned leadership responsibility to various member states to carry out regional studies and to develop plans to achieve individual goals. Botswana is responsible for agricultural research.

The rapidly expanding demand for food, not only from a growing total population, but also from the special impact on aggregate food demand from urbanization and increasing per capita incomes, requires an ever more rapid increase in the growth rate of agricultural productivity and in total agricultural output as well. The four (4) to six (6) percent annual growth required in agricultural output necessitates an intensity of effort including higher rates of investment in the agricultural sector well beyond that now being made. Thus, the task imposed on the agricultural sector in Botswana, Malawi and Swaziland by the rapidly expanding demand for agricultural output is a very formidable one. Historically, such a high rate of increase in agricultural

productivity has seldom been achieved on a wide scale over an extended period of time.

2. Suggested Guidelines

The CDA donors, in a series of meetings of their ad hoc committee on agricultural research, and with the participation of representatives of the Scientific and Technical Research Committee (STRC) of the OAU, developed a set of broad guidelines and recommendations for consideration by the various African institutions and individual countries relating to agricultural research¹. These are summarized as follows:

- o Agricultural research should be beneficial to small farmers and livestock holders, who are the primary food producers in most African countries.
- o Research concerns should be confined to Sub-Saharan Africa and tailored to ecological/geographical zones, i.e., the Sahel, Sudan, Coastal Central West Africa, East Africa, Zaire Basin, and Southern Africa. While these are referred to as ecological/geographical zones, they in fact represent a myriad of climatic and soil conditions or sub-zones. In Southern Africa, the nine SADCC countries constitute such a zone.
- o Research should be designed first to strengthen national agricultural research systems and capabilities, while recognizing that more progress may be made at less cost by focusing on agricultural research problems that spread across national boundaries to several countries in an ecological/geographical zone.
- o Regional research programmes should form a network of agricultural scientists representing each country of a zone, in order to spread agricultural technology quickly and ensure expeditious exchange of information. The network should meet periodically to exchange information.
- o Research should be tested on farmers' fields or by livestock producers before being released.
- o Research linkages with extension and training should be strengthened.
- o Research should be conceived of and supported as long-term in nature, on the order of 20-25 years for crops and livestock.

1

William H. Johnson, Southern Africa Reconnaissance Report.
(Washington: Devres, Inc., May, 1983).

B. The ARRA Guidelines

A general plan of action was developed by members of the SADCC Agricultural Research Coordinating Technical Committee (ARCTC) and representatives of CDA for preparing ARRAs as a pilot study for three (3) of the nine (9) SADCC countries. The following general guidelines evolved as a consensus:

- o As a matter of policy in preparing the study, maximum use should be made of indigenous personnel. *malawi*
- o Reviews of research and its needs and opportunities should be related to training and extension institutions and to constraints affecting production.
- o As a significant portion of the ARRA, a research data base and a system for maintaining and using research data should be initiated.
- o The ARRAs should urgently seek ways research can assist in solving the serious problems imposed by drought and the dry cycle-wet cycle on resource utilization in the SADCC countries.
- o The ARRAs should be an initial step in a process that, over time, could be localized and that will increasingly produce better, more comprehensive data and analysis. The ARRA itself should be used as a means to train and develop staff skills in research analysis.

C. Country Summaries

The three countries included in the pilot study (Botswana, Malawi and Swaziland) present a range of experience, capacity, and degree of sophistication in their agricultural research and supporting institutions. As a result, the ARRAs vary significantly from one to another. Following are brief summaries of their suggestions and recommendations.

1. Botswana

a. Technical skills - institutional development

- o Develop a comprehensive 10-year research-extension-training plan.
- o Carry out an in-depth review of the programme of the University of Botswana Agricultural College to develop undergraduate training in some disciplines and to examine the potential for networking arrangements with other SADCC agricultural colleges.

Research orientation and direction

- o Create an integrated semi-arid research capability for both crops and livestock that includes concern for the long-term sustainability of natural resources.
- o Strengthen research-extension linkages and build a social science capability into existing research-extension systems.

2. Malawi

a. Technical skills - institutional development

- o Expand the University of Malawi's Bunda Agricultural College (BAC) to advanced degree level in selected disciplines and develop networking relationships with other SADCC institutions.

b. Research orientation and direction

- o Ensure that adequate information on the agricultural resource base and existing technical skills is available, so that funding and support for agricultural research programmes are directly tied to national priorities.
- o Give priority to research on mixed farming, national food and agricultural policy, and plant and animal diseases and insect control.

3. Swaziland

a. Technical skills - institutional development

- o Expand links between agricultural research and the University of Swaziland, and utilize the University as part of a SADCC agricultural research, extension and training network.

b. Research orientation and direction

- o Carry out a comprehensive natural resource inventory that considers the sustainability of rangeland, as well as social factors affecting natural resource utilization.
- o Conduct research to alleviate the major constraints affecting agricultural production imposed by the natural resource characteristics of Swaziland.

- o Add a livestock component to the USAID-sponsored Cropping Systems Research and Extension Project (CRSP).
- o Carry out research on pre- and post-harvest losses as a means of addressing food security.

D. Preliminary Considerations for SADCC Regional Programmes

1. Background

The three (3) ARRAs for Botswana, Malawi, and Swaziland do not provide specific suggestions regarding additional regional programmes. They do, however, provide information and suggest directions and potential areas for consideration.

Several characteristics of agricultural research should be considered in the process of identifying region-wide activities:

- o Agricultural research is costly, but there is ample evidence that it has a strong potential for high payoffs.
- o Agricultural research is a heavy consumer of both management skills and high quality, sharply-honed technical skills.
- o Since agricultural research follows nature's cycles, funding and human resources must be available on such a schedule and not on arbitrary bureaucratic schedules.

2. Programmes for consideration

a. Present SADCC requests

Several common themes thread through the pilot ARRA reports. In addition, SADCC has already identified four (4) areas as priorities, for which it has secured or requested support. This study concludes, as did the earlier CDA-SADCC Reconnaissance Report¹, that these proposals are directed toward high priority needs in specific countries and in a regional context. They are, as reported earlier:

- o Improved Water Management Systems for Agriculture in Southern Africa

In all countries visited the problems of insufficient and poor distribution of rainfall, in the entire country or in parts of the country, are

First
cut at
Zonal
Program

¹
Johnson, Southern African Reconnaissance Report,
(May, 1983).

outlined

of major importance. It appears possible to develop a strong and important regional programme with most of the countries participating. This research has high priority, and a plan should be developed for such activity.

o Sorghum and Millet Programme

All countries, with the exception of Swaziland, have considerable acreage in one or both of these crops. Therefore, this subject is of major importance. Some countries now have research activities on one or both of the crops. It appears possible to develop a regional activity or improved coordination and support to SADCC country research programmes for these crops. A plan should be developed to implement this proposal.

but accomplish

o Groundnut Programme

Malawi, Zambia and Zimbabwe are the most important groundnut producing countries in the region. Also, all other countries grow groundnuts with the exception of Lesotho. Some countries visited questioned why this was not a grain legume programme including cowpeas, pigeon peas, and possibly beans. Consideration should be given to expanding this proposed programme to include such crops.

o A Research Coordination Cell

There was universal recognition of the need for a SADCC institutional component or unit to coordinate regional programmes and projects. A CDA donor has been approached for assistance for a feasibility study in support of this proposal and funding is available.

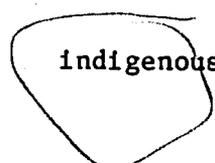
already done

b. Other programmes

This pilot study proposes five programme areas for regional consideration, some of which overlap with the proposals referenced above. The first two areas include recommendations relating to general support for research. The last three are priority areas for research programme development. All of these recommendations need to be further verified as the ARRAs are carried out in other countries in the SADCC community.

(1) Training for research workers and research support

In all countries, there is a paramount need for skilled indigenous scientists, administrators and technical staff to carry



out agricultural research. The STRC of OAU has already noted this need at meetings of the ad hoc committee for agricultural research of the CDA, and has requested CDA member nations to collaborate on developing plans to increase the number of staff available in these categories. The SADCC nations themselves have substantial training capability. If this capability is supported, strengthened and networked, they can meet a substantial portion of their need for effective agricultural scientists, administrative staff and technicians.

Recommendation: SADCC should develop a proposal for networking existing training institutions. This proposal should indicate, on a regional basis, the ways in which specific departments or faculties of agriculture and other training schools in the several countries can be strengthened. Such a proposal should include a plan to ensure that the technical disciplines needed are available in the short-to intermediate-term. In the long-term, SADCC-wide graduate training capability will be needed in the region.

(2) Economic/social agricultural research

The pilot ARRA country reports all illustrate that research programmes are being focused on the problems of the smallholder. In two of the countries, specific research programmes related to farming systems analysis and research-extension linkages are in place. The reports also emphasize the need for relating agricultural research, national policy and infrastructure requirements to regional, national, and local development plans. They also note that relatively few agricultural personnel have formal training in agricultural economics or other social sciences, even at the senior staff level, and that almost no staff at the Diploma level in research or extension have social science training or skills.

Recommendation: SADCC should develop a proposal to train additional agricultural economists and rural social scientists for work in agricultural research and related areas. In conjunction with the proposal, a region-wide analysis should be undertaken with two objectives: 1) increasing the number of social scientists in the agricultural research and agricultural extension programmes, and 2) ensuring that member countries continue to develop the capability to relate social implications of programmes to research designs aimed at improving smallholders' productivity.

The following three (3) research suggestions should be further prepared by SADCC through a process in which all SADCC members participate in developing proposals and implementing them as region-wide programmes.

(3) Research on productivity in semi-arid Southern Africa (400-600mm annual rainfall)

A wide range of technical disciplines and related investigations are needed in this area. The principal types of research that would be carried out are noted in the three ARRAs included in this report.

(4) Research on mixed farming

The country reports tend to separate crop and livestock interests and research. This is in part due to tradition and in part related to the institutional structures that developed before Independence. There is a strong and growing interest in the potential of increasing smallholder productivity through crop-livestock mixed enterprise systems.

(5) Research on agricultural pests and diseases

Food security is strongly affected by agricultural pests and diseases. Technical skills in entomology and plant pathology are in short supply; this subject is a SADCC region-wide concern.

A suggested process for establishing SADCC specific proposals in areas (3), (4) and (5) above follows:

- o Scientists involved from SADCC member countries in relevant discipline areas should be provided with resources and made responsible for meeting together and developing draft proposals.
- o Collaboration with CDA donors and between SADCC member countries should follow to develop and fund specific project concepts.
- o Following these steps, SADCC member nations should develop management methodologies for allocating responsibilities and resources to national programmes in such a way that well-integrated regional research activities will result.

*Focus on this
Then SADCC*

effective

Emphasis of recommendations on new activities, on training, not on integration, e.g. on ext, & sum, Res.

recurrent costs?

*Justification + proliferation
The amount for SADCC would be small
CDA would be willing to contribute
well planned long-term
Some normal procedures
be done first*

II. BOTSWANA COUNTRY REPORT

A. Summary and Assessment of Research

1. Strengths of the Botswana Research Programme

The goals and objectives of the National Development Plan have resulted in an increasing focus on the needs of the traditional farmer and have encouraged an applied and adaptive research approach. It appears also that the Government of Botswana (GOB) has been quite well able to integrate the substantial donor assistance in support of this applied orientation.

Impressive also is the accumulation of a considerable body of knowledge relating to arable crops and to livestock production under the rather difficult ecological setting of the country. Much of this information can now be readily applied by the commercial farming sector. Adapting many of these research findings for use by the traditional farming sector has not yet been accomplished but has now become high priority.

Since much of the research in Botswana is undertaken in the 400 to 600 mm annual rainfall zone, a unique, highly useful, and substantial data base is being built up which can prove a useful resource to other African countries with similar climatic and soil conditions. In most instances only minimal additional research would be needed for adaptation to specific micro-climatic situations.

The livestock research programme has emphasized cattle breeding and range management. The overall crop research programme overall includes crop variety screening for major food crops, limited studies on diseases and pests and limited fertilizer and plant nutrition studies. Together these have provided a data base which can undergird future studies.

An innovative study in design and evaluation of animal-powered equipment for use in semi-arid regions has resulted in several unique approaches for animal power application.

Water use studies, i.e. plant/soil/water relationships, have high priority but are as yet only minimally developed, primarily because a local talent base is not available.

2. Opportunities to strengthen agricultural research

a. Technical capacity

- o About one-half of the degree-holding staff are expatriates. The research programmes would benefit from increasing the proportion of qualified local staff so that increased staff commitment, improved research programme and project continuity can be achieved. While limited opportunities for training of

Focus
plus
then
SACCAD

both senior and junior staff are available, the programmes need to be expanded despite the resulting temporary reduction of locals in residence.

- o The recently strengthened Botswana Agricultural College (BAC) should become an integral part of plans to strengthen national agricultural personnel capabilities. Expansion of its capability for degree-level training should emphasize supporting the needs of the Department of Agricultural Field Services (DAFS) in a limited number of subject matter areas. The DAFS has a need to build a subject matter specialist corps, posted initially at headquarters but later also at regional centers.
- o Planning and implementation schedules for training needs at post-graduate levels for research staff should be undertaken to ensure that gaps in the disciplinary profile are filled. There appears to be a deficiency of agricultural economists, farm management specialists, agricultural engineers, plant pathologists, and specialists in soil and water conservation.

b. The ability to meet development needs and priorities

- o The current programme effort is generally consistent with the National Development Plan. A greatly enhanced capability to accelerate the development of technology packages, adaptable and suitable for the traditional sector, is now needed.
- o Hastening or shortening the time frame for accomplishments requires a cadre of well-trained professionals, organized institutionally on these objectives. A good beginning has been made and a data base is being developed. Harnessing the current base and extending its scope and coverage is highly dependent on the level of the training of the professional cadre, and on the effectiveness of the institutional framework in which they produce and deliver appropriate technologies.

3. Food security and agricultural research

Meeting national food security objectives in Botswana has special significance for research and associated services as it will require that the capability of the traditional sector for increased food output be improved dramatically. Of the 84,560 farms reported in 1981 Agricultural Statistics, only 360 were classified as commercial farms. The output of the traditional sector represented 99 percent of the cattle, 93 percent of sorghum, 76 percent of the maize and virtually all of the millet, beans and pulses production of the nation. Almost all of the rural population live and work in this sector.

Not correct

Despite low annual offtake from the national cattle herd, the traditional sector, by its predominance in the total cattle sector, contributes greatly to the GNP through the export of beef. On the other hand, crop production from this sector is almost totally consumed within the sector, yielding little marketable surplus for urban consumption or for export. Average yields of food crops in this sector are among the lowest in Africa. If, for example, average yields of sorghum by farmers in the traditional sector were increased to 450 kg per hectare, which appears achievable, national output of this crop would be increased by 25,000 metric tons.

This emphasis on the traditional sector also supports the possibility of generating increasing per capita incomes in this sector to reduce dependence on employment in South African mines, opportunities for which have declined in recent years. Reduction in the rate of rural to urban migration would likewise reduce pressure on available food supplies, housing and other services in the urban centres. Prospects for the traditional sector producing a sizeable marketable surplus for urban consumption are highly dependent on the ability of the research institution to fashion adaptable technologies, not only in production, but also in storage, marketing and related problem areas.

4. Recommendations

a. Background

The research challenge of devising effective, low-cost, simple and easy-to-deliver technical packages within the contexts of the Botswana resource base, the infrastructure support constraints, and the socio-economic characteristics of the small-scale producer, is most formidable. Rapidly growing internal demands for food add to the complexity of this task. Resources, and skilled personnel in particular, for immediate and rapid increases in the capability of the research and extension institutions are not available.

However, a substantial investment already has been made in Botswana. The recent shifts in emphasis, especially in research and in research-extension linkages, are believed to be targeted to meet these challenges, and are in line with national food security

objectives and with national development policy. Recommendations which follow must recognize the current capability of the human and institutional resources expected to be available and the necessity for a speedy response.

b. Technical skills

Long-term programmes to accelerate advanced training of staff are needed. A comprehensive, ten-year technical training plan is recommended, to be developed jointly by the Departments of Agricultural Research (DAR) and Agricultural Field Services (DAFS), which will link research and extension needs. This plan should link the building of a faculty of agriculture at BAC to the training schedules and relate this to other SADCC nations' resources. Staffing needs over the range of disciplines, as well as training of existing staff, should not be considered in isolation, but rather in an integrated and collaborative mode. Staffing needs five and ten years hence, for disciplines or specialties not now available on either DAR or DAFS rosters, should be anticipated as programmes shift to build capability in areas not now developed. A plan showing training schedules, numbers and disciplines needed would provide strong motivation for staff.

Several types of short-term training experiences can be provided to hasten the strengthening of current staff competencies:

- o Participation in region-wide, problem-focused workshops and seminars;
- o Participation in specially designed subject matter or research methodology short courses in the region; and
- o Participation and collaboration with other scientists from countries on significant research problems.

c. Institutional resources capabilities

Continued improvement of formal linkages among local research institutions and research institutions in other countries and with international centres is recommended. Critically important is the possibility of more strongly linking DAR and DAFS to reduce time between the generation of technical packages and adoption. Obviously, such technical packages, in most instances, also require infrastructure support from the private and public sectors. Linkages and close collaboration with these entities are required to facilitate adoption.

d. Research orientation and direction

Formulation and direction of research programmes can best be done by professionals in leadership roles in-country. The suggestions below are broadly framed and are based on preliminary observations.

- o An assessment of the parameters of the natural resources base in the country, which specifies the feasible limits of arable crop and cattle production at sustainable levels, would greatly assist future research project designs and would be a valuable aid to decision-makers as they evaluate alternative development objectives, costs and feasibilities.
- o Since most of Botswana's physical resources for agricultural production are in a semi-arid ecological environment, the research programme is recommended to organize even more strongly its resources, and to develop its staffing patterns to match the needs of this natural resource base. Close integration between semi-arid food crop, range grass and livestock production research under one institutional management with a semi-arid lands emphasis would be a potentially useful focus and would provide a home for mixed-farming research and studies. This activity should also establish strong ties with international semi-arid research centers.
- o The farming systems approach now in place is recommended to be used to build even stronger links between research and extension. There is a need for social scientists in research and extension and in the field, as well as at headquarters, to participate in research planning and evaluation of these activities in their efforts to work more effectively with smallholders.

B. The Setting

1. The nation

a. Physical characteristics

A landlocked country, Botswana is bounded by the Republic of South Africa on the south and east, by Zambia and Zimbabwe on the north and east, and by Namibia on the west. With an area of 582,000 square kilometres, Botswana is about the size of Kenya or France. It is generally flat country with a mean altitude of 1,000 metres (3,300 feet).

Botswana's climate is semi-arid, with cold, dry winters and generally wet summers. However, both country-wide and local dry spells often occur even during the rainy season (November to March). Summer temperatures average 23oC to 28oC; winter temperatures average between 15oC and 20oC, but fall dramatically at night. No part of the country is entirely free of the risk of frost, although in the northwest these are few and mild. Extreme and rapid changes of temperature occur as a result of low rainfall and sandy soil.

Average annual rainfall ranges from less than 250 mm in the southeast to more than 650 mm in the northeast. (See Figure 1.) Generally, low and erratic rainfall are serious constraints to agricultural development. Seasonal variations range from as high as 80 percent in the southeast (hence low rainfall reliability) to less than 25 percent in the northeast.

Only about five percent of Botswana's land is estimated to be suitable for arable farming. Most of Botswana's arable soils are sandy and deficient in phosphorus. The better arable soils are located principally in the east hence the concentration of people in this part of the country. Except for isolated areas in the Chobe, Okavango Delta, around Serowe and in the south and eastern parts of the country where relatively clay-rich soils can be found, between sixty and seventy percent of the country is covered by Kalahari sands.

Poor rainfall and generally low-phosphorus soils produce grasses of low-nutritive value and low-carrying capacity. The high sand content of Botswana soils is partly responsible for the high evapotranspiration which in turn adversely affects effective rainfall for crops.

b. The people

According to the 1981 Census, Botswana had a population of about 940,000. An additional 42,000 were estimated to be living abroad, mainly as workers in South Africa. The high annual population growth rate of 4.6 percent over the past decade could be due to net inward migration and/or to an under-estimation during the 1971 Census. Forty-seven percent of the population is under 15 years of age.

Botswana's population density of 1.6 persons per square kilometre is among the lowest in the world. The majority of the people, however, live in the eastern part of the country. The major urban centres--Gaborone (the capital), Francistown, Lobatse, Selibe-Pikwe, Orapa and Palapye--are also located in the east. The percentage of the population living in urban areas increased from 8 percent in 1971 to 17 percent in 1981, doubling in the past decade. The urban population has grown at an average annual rate of about 11 percent, while the average annual population growth rate in rural areas is about 4 percent.

Internal migration from traditional settlements, such as cattle-posts and villages, to urban areas in Botswana has accelerated since Independence. This migration is due in part to the lack of employment opportunities and social services in the rural areas. Poor return from highly risky agriculture has also contributed to this movement.

The per capita GNP was estimated at US\$902 in 1983, higher than most of Botswana's developing neighbors. The Physical Quality of Life Index (PQLI) was 44, on a par with neighboring countries, but less than half that of most higher-income countries.

These and other data relating to socio-economic conditions in Botswana are summarized in Table 1.

c. The economy

(1) The Gross Domestic Product

The Gross Domestic Product (GDP) of Botswana in 1980/81 was about P800 million (US \$780 million). Twenty-six percent of the GDP came from mining, especially of diamonds and copper-nickel. From 1973/74 to 1980/81 the agricultural sector's contribution to the GDP declined from 34 percent to 12 percent, while the mining sector increased from 9 percent to 26 percent. This represents a significant change in the structure of the economy, as illustrated in Figure 2, which shows GDP by source. According to the Government of Botswana Central Statistics Office, the real average annual growth rate of the GDP during this seven-year period has been 10 percent. It was projected in the latest National Development Plan that the GDP will have increased in real terms by an average of 10.1 percent per year between 1979/80 and 1984/85.

(2) Foreign trade

Botswana's export trade is dominated by diamonds (60.8 percent) and copper-nickel (20.7 percent). From 1978 to 1980, minerals' share of exports doubled from 41 percent to about 82 percent, and agriculture's contribution decreased by almost 50 percent, from 14.7 percent to 8.0 percent. Hoof-and-mouth disease has adversely affected Botswana's beef exports.

Botswana's main imports in 1980 were food, beverages, and tobacco (16 percent); fuel (13 percent); machinery, equipment, and vehicles (27.2 percent); and metal and metal products (11 percent). Most of Botswana's import trade is with the Common Customs Area (South Africa, Lesotho, and Swaziland), while its export market is largely in Europe, followed by North and South America.

Table 1: Social and Economic Indicators of Development,
Botswana

Indicator	Average Annual Growth Rate(%)	Comment
Total Population ¹	3.1 - 4.6	Annual growth rate for this 10-year period is ostensibly 4.6 per cent. It is generally believed ¹ that the 1971 census underestimated the population and a rate slightly less than 4.0 is more likely.
1981 census	940,000	
1971 census	585,000	
Percent of Total Population Living in Rural Areas ¹	4	In comparison, the urban population growth rate is approximately 11 percent per annum.
1981 census	83%	
1971 census	92%	
Percent of Labour Force ² Involved in Agriculture ²		The actual number of persons involved in agriculture has increased by about 20 percent over the decade, whereas the overall population has increased between 35 and 45 percent.
1981 (IBRD)	79%	
1971 (IBRD)	83%	
Percent of Population Under 15 Years of Age ¹		
1981 census	47%	
1971 census	45%	
Percent of GDP Attributable to Agriculture ¹		The importance of agriculture has been greatly diminished in <u>relative</u> terms due to the growth of mining since 1969. There has also been, however, a negative growth rate in <u>real</u> terms of 4.5 percent per year.
1980-1981	12%	
1973-1974	34%	
Per Capita GDP ¹	7.9	This average annual growth rate is calculated for the years between 1960 and 1980. ²
1983 (estimated US\$)	\$902	
Physical Quality of Life Index (PQLI) ⁴	44	This figure is on par with most neighboring countries, but about one-half that of most high-income countries. (The PQLI for the U.K. is 95 and for the U.S. 96.)

Table 1: Social and Economic Indicators of Development, Botswana (continued)

Indicator	Average Annual Growth Rate(%)	Comment
Literacy ⁴		Literacy rate is measured among adults 15 years and older.
1983 (estimate)	33%	
1972	20%	
Life Expectancy at Birth ²		
1981	57 yrs.	
Volume of Agricultural Production, 1969-71 to 1977-79 ⁵		
Food	1.1	
Non-Food	2.0	
Total Agricultural Production Per Capita, 1969-71 to 1977-79 ⁵		On a per capita basis, agricultural production has decreased over the years 1969-1979. The decrease is most marked in food production.
Food	-1.1	
Non-Food	-0.2	
Food Self-Sufficiency Ratios ⁶		
1964-66 average	25	
1978-80 average	37	

¹ Statistics Office, Government of Botswana, Country Profile (1982).

² IBRD, World Development Report 1983.

³ FAO, Statistical Yearbook 1983.

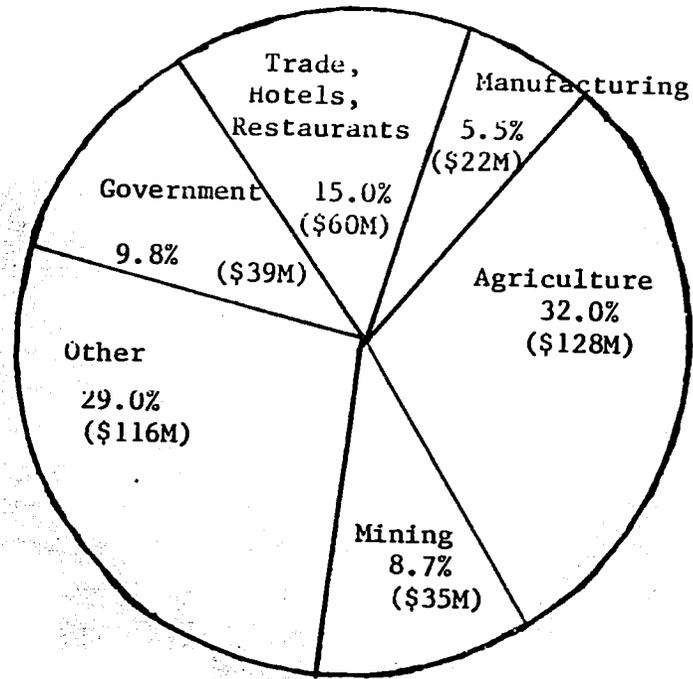
⁴ Overseas Development Council, U.S. Foreign Policy and the Third World--Agenda 1983.

⁵ IBRD, Sub-Saharan Agriculture--Synthesis and Trade Prospects, World Bank Working Paper Number 608 (1983).

⁶

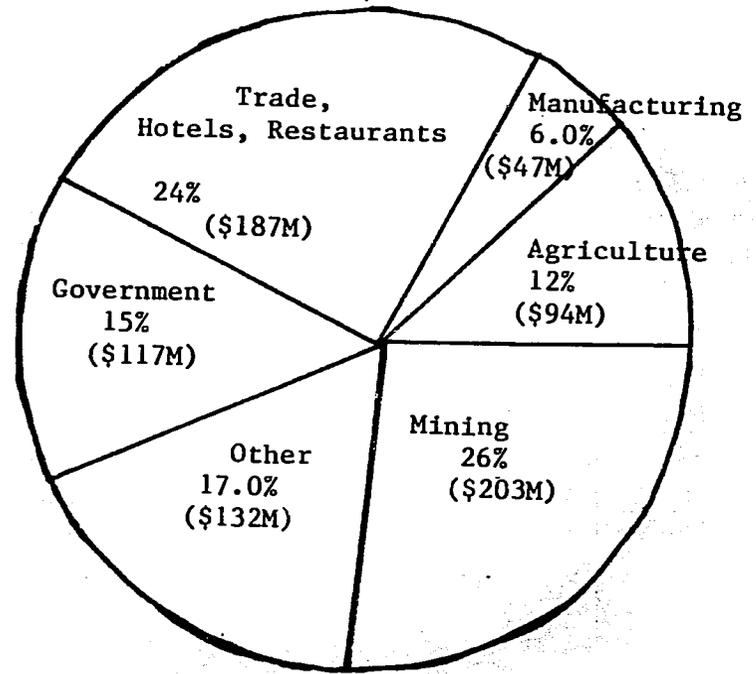
$$\text{Ratio} = \frac{\text{Production of cereals}}{\text{Production} + \text{imports} - \text{exports of cereals}} \times 100$$

Formula and statistics from Sub-Saharan Agriculture--Synthesis and Trade Prospects.



1973-74

Total (1981 Dollars) \$400 Million¹



1980-81

\$780 Million

Real Annual Average Growth Rate of GDP between 1973/1974 and 1980/1981 was 10% according to the GOB Central Statistics Office Report (1982). The large increase in the mineral production is the main reason for this high growth rate.

Figure 2: GDP by Source, Botswana

¹ This figure has been derived from the 1980/81 \$780 million figure and the known rate of 10%.

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(3) Employment

Those employed in the formal sector (wage-earners) have shared disproportionately in Botswana's rapid economic growth. Wage-earners constitute about 17 percent of the total labour force and about 10 percent of the population. The labour force is estimated to be growing at an annual rate of 3 percent. Those employed in the food sector received approximately 37 percent of the GDP in 1979/80; the rural population, about 80 percent of the total, received only 12 percent of the GDP. The principal beneficiaries of Botswana's economic growth have been civil servants and those employed in the private sector.

The public sector was the largest employer, providing 28 percent of wage-based jobs. The government's share of formal sector jobs was followed by construction (16 percent), wholesale/retail trade and hotels (12.5 percent), and mining and quarrying (8.6 percent). The share held by agriculture (freehold and commercial) was very insignificant (5.2 percent).

d. Agriculture

The traditional sector in Botswana comprises 99.6 percent of all farming households who cultivate 96 percent of all land planted to the major food crops (sorghum, maize, millet, and beans/pulses). Traditional farmers account for 85 percent of food grains produced and slightly over half (53 percent) of the major cash crops (groundnuts and sunflowers). Traditional farm households own 84 percent of cattle and 96.4 percent of smallstock in Botswana. Commercial farmers account for the rest of agricultural production, including a monopoly in vegetable and citrus production.

Agricultural loans are made chiefly in the livestock sector. Farmer investment in crop production inputs is low. Fertilizer use, for example averages only two kilogrammes per hectare. Over one-third of Botswana's farm households are headed by women, who have the least access to the basic resource of draftpower, equipment, land and cattle.

2. The development policy

a. Botswana National Development Plan

The four major objectives of the fifth National Development Plan (1979-1985) are rapid economic growth, social justice (which implies an adequate income for all), economic independence and sustained development. Overall, the plan emphasizes employment creation and rural development. Among the strategies to encourage production in rural areas are providing producers with access to markets through membership in the EEC and the Southern African Customs Union are more directly, providing farmers with guaranteed market outlets through the Botswana Meat Commission and Agricultural Marketing Board. Key

elements of the Rural Development Strategy are the Tribal Grazing Land Policy and the Arable Lands Development Programme, which aim to increase productivity of the traditional farmers.

The four aims of agricultural policy are: to help those involved in agriculture to enjoy adequate and secure livelihoods, to help create more such livelihoods to meet demands of a growing labor force, to raise national income by increasing the value of agricultural production and to maintain agricultural land for future generations. While at times there may be difficult choices between "small farmer" strategies that aim at employment (the first two aims) and "large farmer" strategies that aim at production or profitability (the latter two aims); the most difficult choice is between small farmers and non-farmers who lack productive assets, a substantial part of the rural population, especially the female-headed households.

While there will be shift in emphasis from livestock to arable farming lands because the opportunity for employment creation is greater in the latter and because of the need to reduce the nation's dependency on food imports, slightly more governmental resources allocated to agriculture will be dedicated to livestock than to farming because the former constitutes 80 percent of agriculture's contribution to the GDP. In the livestock sector, however, land use and herd management in the communal areas will be given priority.

b. Donor participation

The Government of Botswana sees that donor assistance is in accord with its national development spending priorities. In 1981-1982 most donor assistance focused on education and agriculture. Major bilateral donors, and total funds disbursed from 1977-1981, include: Sweden (US\$72.8 million), the United Kingdom (US\$72.5 million), Germany (US\$65.3 million), the United States (US\$46 million) and Norway (US\$44.9 million). Bilateral aid in 1981 totaled US\$79.4 million¹. Most assistance from international agencies has consisted of loans from the World Bank, the African Development Bank, and the EEC. The largest multi-lateral source of grants was the United Nations (UN), with US\$2.3 million through the UN Development Programme (UNDP) in 1981-1982 and US\$10 million through other UN agencies. Bilateral aid totaling US\$93 million in 1979 was 79 percent of total official development assistance received by Botswana. It was also 16 percent of the GNP and 52.6 percent of gross domestic investment in that year².

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¹
Congressional Presentation Fiscal Year 1984, Annex I: Africa, p. 399.

²
The World Bank, Accelerated Development in Sub-Saharan Africa: An Agenda for Action, 1981, pp. 164-5.

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Agricultural research programmes in Botswana have been supported by Development Assistance Committee (DAC) donors as follows: the U.K. supported the Evaluation of Farming Systems and Agricultural Implements and Dryland Farming Scheme (semi-arid agriculture); Sweden, farming systems in the Okavango Delta; the U.S. Agricultural Technology and Improvement and Cowpea Research. All of these bilateral aid programs aim at strengthening arable production. The Food and Agriculture Organization of the UN (FAO) supports the Malpo Project which deals with flood plain agriculture in the Okavango Delta and, with the UNDP, supports the Range Management Programme.

3. Agricultural research

a. Background

(1) Before Independence

Prior to Independence in 1966, agricultural research in Botswana was largely limited to application-oriented livestock testing, the evaluation and development of management systems for livestock and the adaptation of livestock to the environment. Funding for research was provided almost exclusively through grants from the United Kingdom (U.K.).

The major investments in this development-oriented research were directed to specific cattle production problems such as disease control, other animal health problems and adaptability breeding and testing programmes.

(2) After Independence

Livestock and veterinary research continues to be a strong component of the agricultural research activities, but over the period since the mid-1960s, the Government of Botswana and its donors increasingly have directed research attention and resources to agronomic problems and to the relationships between the physical, economic and social environments in which rural producers must work.

b. Current research focus

Within the Department of Agricultural Research (DAR) the several projects of the agronomy unit and the farming systems research project are closely linked and together provide a national arable production programme.

The Animal Production and Range Programme was established in 1970; it includes a range of research activities, including breeding, nutrition, husbandry and range management.

Botswana's agricultural research has continued to be supported by donors. It has not been possible, with the time and resources available and with the sources reviewed to date, to develop a quantitative, time-phased review of all donor support

of research since Independence. To illustrate the difficulty in restructuring this pattern, it has been noted that, historically, the major supplier of operational support, in terms of both technical skills and operational costs, is believed to be the U.K. But its support has not always been clearly coded as to the specific agricultural research or research-related use.

Other donor support, including that from European nations from and the U.S., can, in most cases, be linked to specific research programmes. Similarly, recent U.K. support is more clearly project or activity specific than categorizable as general budget support.

Section 2b of this report relates donor-supported activities to the overall research programme. On the basis of this review, and being mindful of the imprecision of the data, there is strong evidence that both the GOB and its development donors increasingly have been pairing their concerns in the following broad areas:

- o improved resource utilization, especially the range land and livestock-related aspects such as range management, animal nutrition and disease control, and water management;
- o a rapidly expanding interest in research on food crop production, with emphasis on sorghum, millet and maize, under semi-arid conditions;
- o a strong thrust to strengthen the design of technical/ physical research activities, to include analysis and feedback from the interrelated social/cultural problems of subsistence-oriented, small-scale producers;
- o a continued trend to support somewhat more global approaches to research, by means of allied and linked investments in information systems development, management training, and support for production services, such as marketing, inputs, credit, and for other rural institutions;
- o a growing recognition by both the GOB and donors of the need to provide substantially accelerated and expanded training resources, for the development of high-level technical skills, local training capability and institutions. Donors have not limited their interests either to low-level technical training or to university-level training.

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c. Other considerations affecting research priorities

There are other factors affecting research priorities which are considered by the GOB.

(1) Research needs based on natural resource priorities

Botswana's ecology may be viewed as consisting of three zones, each of which has several subsets. For the purpose of this analysis, the zones will be delineated as shown in Figure 3: (1) the Okavango Delta in the north; (2) the semi-arid area (in the eastern area of the country); and (3) the Kalahari desert (in the central area and southwest, much of which is not arable or useful for grazing).

The agricultural research operations and physical plant, both for agronomic and livestock/veterinary research, are largely related to the semi-arid areas of the country and to a rainfall zone of from 400 to 600mm per year.

The North and North Central Zones, while having more abundant, though seasonal, moisture, are troubled by trypanosomiasis and are natural habitats for tsetse-resistant wildlife. Little agricultural research is currently relevant to these areas.

The Kalahari desert includes pockets of productive range land and, in some areas, large-scale cattle or sheep operations, which can utilize the results of livestock research even if such research is not specifically designed for this unique area.

(2) The relationship of research to the type and size of farms or herds

The historical patterns of research have resulted in findings more useful to the larger producer. While the research results may not be scale sensitive, the need for more sophisticated management, and, in some cases, the need for capital investments such as pumps or farm machinery, tend to make the use of research results unrealistic for small holders with limited access to resources, either land or captial.

(3) Summary of the six present research priorities

The above review of research priorities illustrates the fact that agricultural research now is directed toward solving the problems of smallholders and working with the relevant extension-information systems. In particular, the farming systems approach, though presently limited to arable agriculture, highlights this interest in solving the on-the-ground physical, economic and social problems with which smallholders must deal.

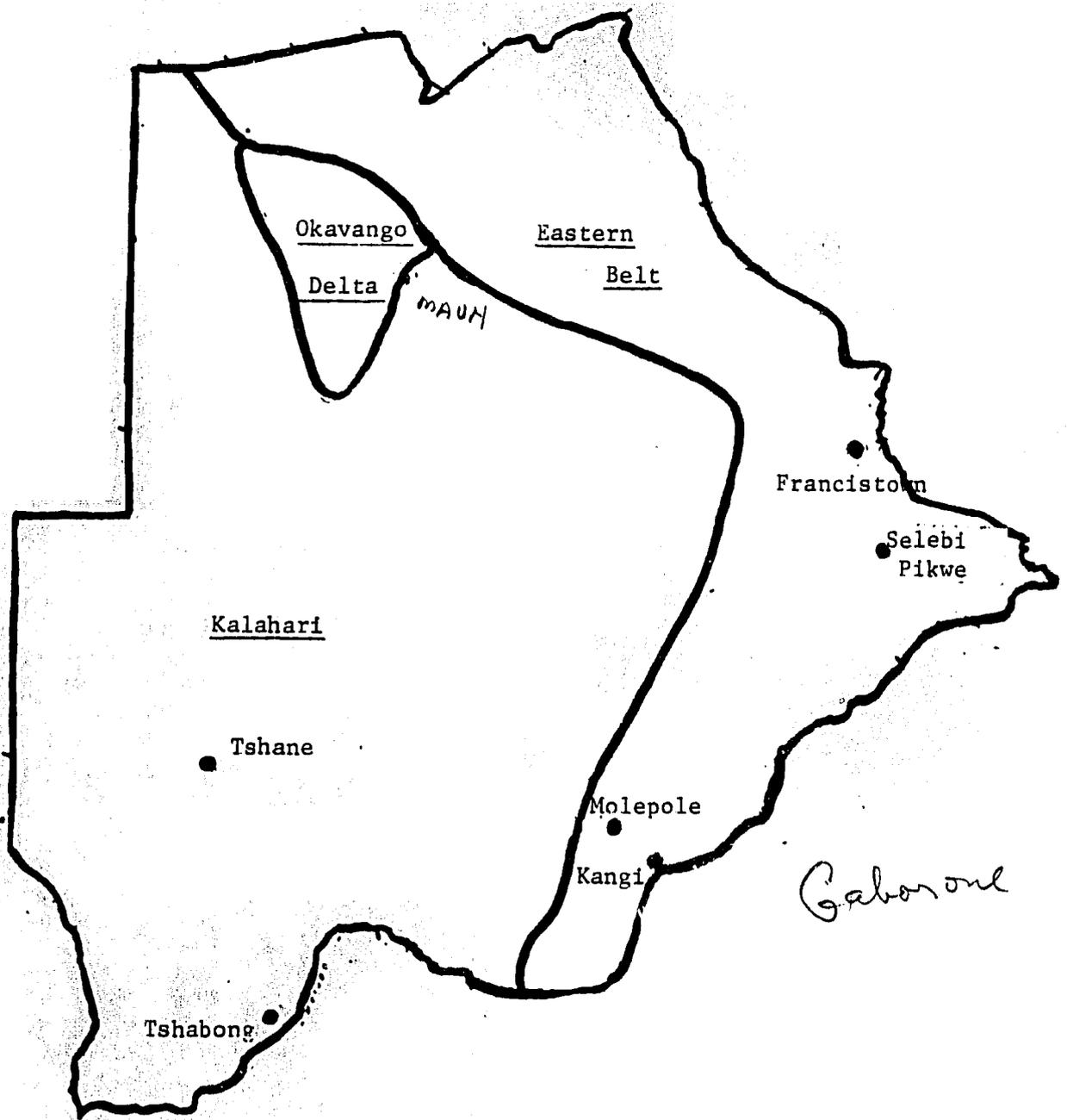


Figure 3: Ecological Zones in Botswana

4. Production potential and constraints

a. The potential for increased productivity

Table 2 below compares average yields of the principal cereal crops and indicators of livestock production between the traditional and commercial sectors. This data makes it clear that the commercial sector's yields are two to three times the level of the traditional sector, and that commercial yields are one-half or less the levels of the research stations. While the data indicates a substantial opportunity to increase productivity by applying current crop research information, there is little potential to do so across the entire country. The research data results, in many cases, reflect the use of inputs affecting fertility, plant diseases, pest control and the timeliness of operations. Furthermore, in most cases the data is from locations on some of the country's better soils and micro-climatic zones. However, the many small-scale producers who have need of productivity improvements have limited land resources or finances for inputs to utilize the new production systems. They also may not have access to the other resources, such as personnel, management experience or mechanical power, which are essential in the more sophisticated processes.

b. Constraints to agricultural production

(1) Constraints as viewed by the GOB
Research, Extension and Training Staff

In Annexes 1 and 4, references are made to interviews with staff of the GOB institutions involved in agricultural research and in directly supporting institutions. Table 3 summarizes the views of these staff. Quite predictably, qualifications of staff, lack of trained staff, budget shortfalls and delays in securing funds were noted by those interviewed as being serious constraints. Many respondents linked this to a need for better trained and supported workers and to a related need for improvements in support services such as transport. Highlighted in these views are the following:

- o Extension inputs to the design and direction of research activities were, in general, not requested.
- o Research workers were not receiving feedback from field staff regarding farmers' problems and related recommendations. A Ministry-wide formal system, although in place, was not yet working effectively in all cases.
- o The use of extension staff in tasks as sales and delivery personnel for input supplies was reported to dilute their effectiveness. This was reported from both the livestock services and from field extension services.

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Table 2 : Indicators of Agricultural Productivity in Botswana

A. Crops

	Yields (kg/ha)		
	Average, Tradition- al Sector, 1981	Average, Commercial Sector, 1981	Optimum, Research Station 1979
<u>Food Crops</u>			
Sorghum	224	450	2,544
Maize	306	893	2,728
Millet	144	600	n.a.
Beans/pulses	176	700	1,303
<u>Cash Crops</u>			
Sunflower	385	508	1,000
Groundnuts	416 ¹	416 ¹	1,119

B. Cattle

<u>Indicators</u>	Levels (percent)		
	<u>Tradition- al Sector, 1978-80</u>	<u>Commercial Sector, 1978-80</u>	<u>Research</u>
Offtake	8	16	20 ²
Mortality	11	4	10
Calving Rate	58	62	78

¹ Figures appear questionable; may be in error.

² Research offtake should be interpreted cautiously: it includes young bullocks between 1 year and 1½ years which must be sold to the Government Bull Subsidy Scheme each year. The approximate offtake after adjusting for the bull subsidy scheme would be about 18 percent.

Sources: Central Statistics Office, Ministry of Finance and Development Planning, Country Profile, Botswana, October, 1982.

Agricultural Statistics Surveys, 1978, 1979, and 1980.

Division of Arable Research, Department of Agricultural Research, Annual Report, 1979/80.

Ten years of Animal Production and Range Research in Botswana, 1980.

Table 3 : Perceptions of Seriousness of Institutional Constraints
by Botswana Research, Training and Extension Staff

	<u>Research</u>		<u>Training</u>		<u>Extension</u>		<u>Summary</u>	
	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>
Recurrent Budget	14	2.0	13	2.2	24	2.3	51	2.2
Foreign Exchange	13	1.2	--	--	--	--	13	1.2
Senior Staff Qualifications	13	2.7	13	1.9	25	2.7	51	2.5
Junior Staff Qualifications	14	2.1	13	2.5	25	2.4	52	2.5
Service/Maintenance	15	2.4	--	--	--	--	15	2.4
Consistency of Support	15	1.5	--	--	--	--	15	1.5
Laboratory Facilities	15	1.7	13	1.6	--	--	28	1.6
Office Facilities	15	1.7	--	--	--	--	15	1.7
Equipment	15	2.0	13	1.6	--	--	28	1.8
Transport	8	2.6	13	2.2	25	3.0	46	2.7
Telecommunication	4	3.0	--	--	23	2.8	27	2.8
Agency Linkages	13	3.0	11	2.8	20	2.8	44	2.9
Teaching Materials	--	--	13	2.4	--	--	13	2.4
Video/Films	--	--	13	2.2	--	--	13	2.2
Bulletins	--	--	13	1.8	--	--	13	1.8
Access to Research	--	--	--	--	25	1.9	25	1.9
Farmer Attitudes	--	--	--	--	25	1.6	25	1.6
Lack of Timeliness	--	--	--	--	24	2.8	24	2.8
Lack of Research Input	--	--	--	--	25	2.7	25	2.7
Policy Problems	--	--	--	--	24	2.3	24	2.3
Service Conditions	--	--	--	2.8	25	2.9	25	2.9

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

- o The respondents, by implication if not by specific comment, expressed a need for more integrated senior staff management and coordination, to better assure that Ministry policies be translated by the various departments in a more consistent pattern and to avoid duplication of scarce technical resources.
- o The most serious constraints as noted by all groups in a previous listing were as follows:
 - the need of strengthened agency/institutional linkages at all levels (within the country, with other SADCC countries and internationally);
 - lack of, or the need for improvement of, consistently available transport, both for personnel and for supplies;
 - improvements in staff qualifications, the need to localize staff, and the need for authorized senior staff positions to be filled.

what about service conditions

In the case of a suggested constraint relating to conditions of service, the extension and training staff were strongly concerned while research workers did not volunteer any specific concerns. Extension and research staff felt that communication was a very serious issue.

Annex 4 includes tables showing responses as coded by the type of position held by the respondents.

(2) Physical and environmental constraints

Botswana has a fragile ecology. It is not blessed with either uniform and adequate rainfall or ideal soils to provide a physical base for intensive high-output agriculture. With this physical resource base, it remains essential that science and research focus on maximizing the use of natural resources in a fully sustainable fashion over time. The GOB research programmes seem to be sensitive to this issue.

What is less clear, to date, is a ^{research focus} research focus on mixed farming practices, crops and livestock in these fragile ecologies. Research to develop indexes or measures of potential productivity for the major soil and micro-climate zones of Botswana, and to relate this to economic and social development costs, has not been structured. Consideration of the physical constraints on production potential -- the climate, the rainfall (both its amount and its erratic distribution) and the soil resources seems to be critical for the Botswana research programme as decisions on research resource allocations are made.

(3) Technical human resources and institutions

(a) General

Section 4.b(1) outlined the concerns felt by the GOB staff regarding constraints resulting from the lack of qualified and experienced staff.

Although there has been an increase in educational opportunities in Botswana since Independence, secondary schools in Botswana are able to absorb approximately 30 percent of Standard 7 into Form I. A very small number of Botswana reach institutions of higher learning.

The inability of Botswana to provide more opportunities for higher education also frustrates its efforts to localize posts. For instance, in 1980 21 and 19 percent of the posts in the central government and education (teachers), respectively, were held by expatriates. The dependence on expatriate staff and untrained teachers in the educational sector, in particular, has been very serious. In 1981 about 43 percent of the 921 secondary school teachers were expatriate, and 34 percent of the 5,974 primary school teachers were untrained. This dependence on expatriate staff, especially in mathematics and science, may cause serious problems, especially for technical institutions such as research and extension, including lack of continuity and the inability of the country to design educational curricula appropriate for its development efforts. Even if the goals of the present National Development Plan for mathematics and science teachers are met, Botswana will still meet less than 30 percent of its requirements in these areas.

Table 4 illustrates the staffing of the levels of professional, junior, and support staff in the GOB Agricultural Research, Training and Extension institutions.

The Department of Agricultural Research is heavily dependent on expatriates. At present the Director of the Department and the heads of the divisions and projects are expatriates. However, the estate management unit, the administrative support staff and the laboratory are supervised by Botswana citizens. The Department has increased its research personnel considerably over the last few years and now consists of 52 scientists. The disciplines of Agricultural Engineering and Veterinary Science are understaffed. Twenty-one of 25 positions at the Master's (M.Sc.) and Doctor of Philosophy (Ph.D.) levels and three of 13 positions at the Bachelor's level are expatriates. Overall, expatriates occupy nearly one-half of the total authorized posts. One-half of the Agronomy and Economics/Social Science posts are held by expatriates. With five vacancies and nine staff on training, only 38 remain to keep programmes operational.

Table 4 : Human Resources in Agricultural Research, Extension, and Training in Botswana

<u>Department Institutions</u>	<u>Professional Staff</u>				<u>Technical Support Staff¹</u>	<u>Professionals in Training</u>	<u>Vacant Posts</u>
	<u>Nationals</u>	<u>Expatriates</u>	<u>Total</u>	<u>Percentage Expatriates</u>			
Department of Agricultural Research	14	24	38	63	105	9	5
Botswana Agricultural College	16	9	25	36	14	5	n.a.
Department of Animal Health	3	22	25	88	355	11	40
Department of Agricultural Field Service	<u>47</u>	<u>13</u>	<u>60</u>	<u>22</u>	<u>313</u>	<u>19</u>	<u>51</u>
<u>Total</u>	80	68	148	46	787	44	96

¹ Includes teaching assistants, technical assistants, and extension agents, but not general administrative support staff.

Localization of the staff in the department has been difficult because of the scarcity of students in Botswana with the necessary prerequisite of a science base at the senior secondary level. The lack of localization disrupts the continuity in the professional base supporting all programs, as expatriate staff typically have short tenure within the projects, often less than two or three years. Rotation of this staff can be disruptive to project foci and to the achievement of project objectives.

Although nine of the department's staff currently are receiving training, the impact on "localization" in the near future is minimal because of long training periods required. Five of the nine staff studying for degrees are studying Agronomy and crop-related subjects.

The DAR plans to add about 79 additional staff persons over the next five years. These will be trained in various agricultural disciplines and at varying academic levels. Because in-country training facilities for degree and professional specialities are not available, the staff to be trained will be scheduled for training outside of Botswana. None of these is presently scheduled for training elsewhere in Africa. This highlights the need to develop African centres to train personnel in the needed agricultural specialties, with a specific orientation to the development of technology appropriate for African farmers.

There is no provision to train Botswana as veterinarians. It is presumed that the Department of Animal Health (DAH), itself presently understaffed, will require special attention. The DAR plans to train almost four times as many senior agriculture and crop scientists as livestock specialists (20 M.A./Ph.D agronomists/ crop specialists to 5 M.A./Ph.D. livestock scientists).

(b) Agricultural training

The BAC is headed by a principal (a local graduate) who is directly responsible to the Permanent Secretary (PS) of the MOA.

The Course Directors for the Animal Health and Community Development programmes are expatriates. However, a Botswana recently has been appointed to take over as Director of the Community Development programme. The administrative staff are all nationals, as are the Vice Principal and the Course Directors of the Agriculture programme.

Expatriates constitute nearly one-half of BAC's senior teaching staff. Three of the eight expatriates are in Animal Health, one of the most seriously personnel-constrained departments in the entire Ministry. The lack of availability of trained staff in Animal Health (Veterinary Science) has been noted by the Government as a serious problem. The number of

those prepared for work in the Ministry has been disappointingly low (see also the following section on Extension). For example, while there are six members of the college who are presently receiving degree level training, none of these are pursuing a career in veterinary medicine.

According to the BAC Five-Year Training Plan, about 50 additional staff will be required as follows:

a good analysis;

- o Twelve staff members need to be trained at the M.S. or Ph.D. level in the developed countries (eight men and four women).
- o At the B.S. level, sixteen staff members need to be trained at the Diploma level (eight men and two women in Botswana), one man and three women elsewhere in Africa, and one man and a woman in the developed nations.

During this period, six staff members presently in training will have completed their studies.

(c) Agricultural extension

In the Department of Agricultural Field Services (DAFS), only about four percent of the total staff are expatriates. Most of these serve at the Headquarters. The majority of the department's staff are located at field posts and are required to have Certificate or Diploma level training. Most have been trained within the country. Of the 424 established positions, 12 percent currently are vacant. Ninety percent of these vacancies are at the village level which is especially critical for effective farmer-extension relationships. In addition, 102 officers are presently on leave receiving training at the Certificate level; upon their return, they will fill some of the vacancies. The ratio of women to men currently working in the Department, as well as of those on leave receiving training, seems extremely low. There are few women extension officers in the DAFS and, indeed, in the whole Ministry.

In the next five years, the DAFS plans to increase its professional/technical staff by 384 people. At the Diploma level, at least twelve of the additional staff are to be trained elsewhere in Africa. The lack of training facilities in Botswana for specialist degree level personnel requires that these be trained in the developed countries. A long-term goal of the Ministry is to have professionals in extension trained either in-country or within the SADCC region.

good analysis.

The Extension staff disciplines generally reflect the concentration of personnel by major programme areas. However, programmes requiring Agricultural Engineers and Range Ecologists currently are understaffed. Livestock and food crop production programmes are the major foci of the Department; the latter has a disproportionately smaller number of officers, and neither is

represented by specialist staff at the district levels. The Regional staff in these areas/disciplines are scheduled to visit the district and village extension areas regularly. Both the district and village extension areas are serviced by generalist agricultural extension officers who divide their time and expertise between livestock and food crop production. With a diverse farming community, it is very doubtful that these extension officers, constrained by transportation and communication problems, are effective.

Horticulture is a minor programme area for the Department, with officers based at the national and regional levels. The limited production potential suggests that it is wise, at least in the short run, to continue posting only at these levels.

The Department of Agricultural Research supports extension by providing farmers with diagnostic services in Entomology and Pathology. Since these services are now provided from Gaborone, and are not always responsive in the essential time frame, it seems desirable that these services be decentralized through the DAFS.

The DAFS currently does not have economists or social scientists. When these expertises are needed, the Department requests assistance from the Division of Planning and Statistics which has several economists and rural sociologists. This does not appear to be a satisfactory procedure.

The DAFS has a relatively large number of officers in Information and Broadcasting, all based at the national-level Headquarters. None of these have yet been stationed at the regional or district level. Such staff, if assigned to these areas, could provide a continuous flow of locally relevant, up-to-date information to farmers and others to encourage programme participation.

Agricultural Management or Group Development Officers are generalists who encourage farmers to form groups or associations for needs such as fencing, spraying and borehole syndicates. They work in collaboration with the general agricultural extension officers. They are trained to provide broad agricultural development and management information, and are not specialized in any particular field of agriculture. They are based at both the district and village levels.

A number of district general extension staff also serve in the rural training centres, which provide short-term training to farmers at five rural Farmer Training Centres.

(d) The Department of Animal Health (DAH)

The Department of Animal Health has 25 veterinarians for the entire country, 88 percent (22) of whom are expatriates. The department needs trained nationals, especially to assure the continuity of programmes. Few qual-

ified candidates have been available for DAH positions. There are currently 159 Batswana receiving training for the Department, but of these, only eleven (ten men, one woman) are studying for degrees in veterinary medicine. The remaining 148 consist of 29 men and three women studying at the Diploma level in Animal Health, and 111 men and five women studying at the Certificate level.

During the next five years, the DAH plans to prepare 360 additional personnel at various academic levels. Since Botswana does not have facilities to train veterinarians, these personnel will continue to be sent abroad, with many having to study outside of Africa.

(4) Constraints to productivity related to rural infrastructure and agricultural policy

Botswana's agricultural sector has two major marketing institutions serving its needs. This report notes the major, nearly exclusive, role of livestock and livestock products in the generation of foreign exchange from the rural sector. The European Economic Community (EEC) purchases boxed frozen beef and canned corn beef. The Botswana Meat Commission implements a GOB pricing policy for cattle which appears to provide a satisfactory incentive for producers. Allied cooperative marketing schemes seem to be useful in their activities which permit relatively small-scale producers to participate in the livestock industry.

A strong need is reported for expansion of trek routes, allied communications and transport capabilities. Similarly, the need for another (northern-located) abattoir has been expressed. This report does not attempt to quantify or provide economic rationale on these suggestions.

The observations above regarding transport and communication are also relevant to the food sub-sector of the rural sector which is served by the Botswana Marketing Board (BMC). Government policy through the BMC with regard to food grain

1

The following discussions of constraints related to rural infrastructure, services and agricultural policy, and of social/cultural constraints, should not be viewed as based on extensive surveys or scientific analysis. They are consolidated summaries of the comments and opinions of many informed Botswana citizens contacted during the study, tempered with informal reviews of reports and other written information by the Michigan State Library Staff and with extensive on-the-ground experience of the study's field staff and senior personnel.

prices is based on the equivalent local currency prices of Republic of South Africa (RSA) crops plus the cost of transport. This policy, while realistic, tends to place the large numbers of individual small Batswana producers in direct (unsubsidized) competition with the estate operations of the RSA farmers. These RSA farmers have substantial advantages in transport costs for inputs and also have savings in the purchase of supplies. As a result of their larger-scale operations, they also may have some cost advantages in operations. Several other infrastructural or institutional constraints, which have been noted and discussed, relate to commonly perceived needs (by developed nations' personnel) for credit and input delivery systems, be they publicly managed, cooperative or private. These needs tend to be closely interwoven with social/cultural constraints to increased productivity and will be discussed in that context.

(5) Social/cultural constraints to increased agricultural productivity

There is a need, expressed by many Botswana staff, expatriate workers and observers, for rural institutions to provide local marketing, credit and input delivery services. These, however, are not always seen as necessary by many subsistence-oriented producers who are unfamiliar with the largely Western concepts such as banks, cooperatives and similar institutions. On their small-scale, subsistence-oriented production units, the advantages of increasing production above basic subsistence levels, with the attendant risks, is not seen as reasonable or necessary. National statistics, as reported in Table 2 and Annex 1, illustrate the low levels of unit productivity at present. To expect a leap to commercial yields by large numbers of individually small units, each producing extensively cultivated, relatively low unit value crops, is unrealistic. Coupled with the problems of their small size and their unfamiliarity with service institutions are several other basic and traditional issues affecting utilization of research. These are as follows:

- o Only a relatively few large-scale producers, both livestock and cereal farmers who have freehold title to their holdings, have the capability of securing credit, can purchase on scale and have access to transportation and communication. The vast majority of rural Batswana cannot participate in this Western-oriented production methodology. Little research is aimed precisely at addressing this problem and at initiating the process of change effectively to provide that the advantages of development can be spread to these less well-franchised citizens.

- o Thirty percent of the rural households are headed by women. Women are seen in the rural communities as producers of food. Women, however, have even less access to resources and collateral for investment credit than do men, and therefore are less able to participate in many programmes.

- o Botswana shares a livestock tradition with much of Africa. Botswana small-scale producers are gradually changing from a principal focus on the number of cattle to a more market-oriented view. This movement has been an important contribution to the growth of the livestock sub-sector.

- Too much description
- little assessment

WEAK

- what were Mandi
containing

- what does S+T/ITR stand for
Entry 2

- How re. baseline is
communication +
information?

III. MALAWI

A. Summary and Assessment of Research

1. Strengths of the Malawi research programme

The Malawi agricultural research programme is seen to be one of the strongest and best directed in Southern Africa. The priorities of the research programme and the funding for research activities are internally consistent. A major strength of the Malawi programme has been in the aggressive linking of the researchers and their programmes to international research centres and other institutions of excellence. A further, and most significant strength of the programme, has been the Government of Malawi (GOM) support for training of its professional staff. The strengthening of the University of Malawi's Faculty of Agriculture and their facilities at Bunda College and the strong urging by the GOM to its donors to support this long term effort and provide allied external training is developing internal capability in technical fields and in management which will continue to build local leadership for research and related agricultural development.

Should
state
WR / ICT
effort to
development
10 yr
Res. plan

The National Rural Development Programme (NRDP) of Malawi's Ministry of Agriculture (MOA) is an additional strong resource. The opportunity provided for field staff and research staff interaction in planning and evaluation of research for the purpose of assuring that research is relevant to the problems of small-scale producers is of high potential value.

2. Opportunities to strengthen agricultural research

a. Technical capability

The wide range of agricultural production potentials in Malawi makes it essential to target technical skills and resources on those lands and crops which best serve the national needs. The pressure to disperse resources to meet all perceived needs or priorities must be resisted to assure adequate funding and support for capital and recurrent costs for the most important crops or livestock.

The University of Malawi's Faculty of Agriculture at Bunda College is a national resource of great long term value. Bunda could become a component of a SADCC-wide network of training capability. The plan to develop advanced degree training in one, or more, disciplines should be strongly supported so as to develop M.Sc. level training in the short term and Ph.D. training the long term.

The NRDP could be strengthened technically by upgrading technical skills of its field staff and, in particular, including more technical specialists in appropriate disciplines at district level.

b. Its ability to meet development needs and priorities

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for
The research programmes of the GOM appear to be related to the development needs and priorities of the country. This study concludes that necessary mechanisms and coordination are effective within the GOM administrative systems. This is highlighted by the preliminary findings of the present in-depth review of the structure, content and future course of action for research and extension programmes. The following are identified as priority areas for programme focus:

- Research and extension working toward the goal of sustained productivity in less favorably endowed natural resource areas;
- Research on mixed farming;
- Research on national food and agriculture policy; and
- Research on protection of crops and animals from pests and disease.

These priorities are strongly endorsed by this study.

3. Food security and agricultural research

Malawi is a net exporter of basic food crops, of which the most important is maize. This is true notwithstanding the drought presently affecting large areas of southern and south-eastern Africa. The 1983 maize crop was even higher than the 1982 crop of 1.4 million metric tons. Together with the large maize surplus stock accumulated from the 1982 crop, the 1983 surplus has made it possible for Malawi to export about 100,000 metric tons to neighboring countries which have been seriously affected by the drought.

Arable land is a fixed resource in Malawi and its use for maize production has a trade-off with other crops perhaps of greater economic value.

The goal of Malawi's agricultural policy is to increase production of food crops in order to meet rising domestic demand and continue to export these commodities.

In spite of the current surplus of maize, there is no room for complacency, given the country's population growth rate of nearly 3 percent and the relatively low average maize yield (about 1,200 kg/ha). In 24 years the population will have doubled, and, in the absence of increased production, the country's maize surplus will have disappeared.

Under the circumstances, research leading to increased yields by smallholders assumes an element of urgency if national objectives of self-sufficiency and export are to be met.

4. Recommendations

a. Background

The following recommendations are general and are not project-specific at this time. They can be expected to require additional analysis and prioritization by the GOM and its donors before investments on particular projects can be made. These recommendations endeavor to set a framework within which Malawi can build a strengthened and internally consistent research capability over the long term. They endeavor to link Malawi's internal needs for support to its potential for receiving support from other SADCC countries, African institutions, international research centres and other centres of excellence.

b. Research orientation

The GOM national policy of maintaining agricultural productivity as the driving force of the Malawi economy and the NRDP Goal of retaining self-sufficiency in food production in a strongly agricultural based export economy leads to a GOM strategy of even stronger focus on increasing production by smallholders of both cash crops (including food crops) for export and food crops for national consumption. Those basic parameters will continue to orient agricultural research. Projects and proposals will be measured by the degree to which they meet these standards.

c. Research directions for consideration

Three (3) research programme areas can be considered as meeting the parameters noted above:

- o A comprehensive inventory of arable land related to its production potential for traditional crops. This should include an analysis of the comparative advantage of alternative resource uses related to a wide variety of constraints faced by smallholders.

- o Research on management systems and the economics of alternative systems of mixed farming (crop and livestock or food crops and export crops) by small holders.
- o Research on plant genetics and on cultural practices with the objective of reducing dependence on expensive and imported production inputs, or of providing ample economic evidence of the advantages of these inputs to smallholders.

d. Training recommendations related to research

The Faculty of Agriculture of the University of Malawi and its facilities at Bunda College should continue to be strongly supported.

The continuing need for technical staff, agricultural managers, and implementation staff is a long-term problem. Availability of qualified staff throughout the research-extension system will be a troublesome and persistent issue. Bunda College and the Natural Resource College both will need support and investments in institution building for a substantial period.

Bunda should be considered for upgrading to advanced degree level, perhaps within a specific department. Bunda and the GOM can become an important component of a SADCC wide network of agricultural training institutions.

e. Extension-field services linkages to research

Within the extension service, there will be a continuing need for a well-trained cadre of technical specialists who can relate to and work with researchers. The intention of the NRDP to focus on smallholder needs and opportunities can be better implemented with such skills used in project planning, evaluation, and in support and feedback to research programs.

B. The Setting

1. The nation

a. Physical characteristics

Malawi is a landlocked country with a total area of 118,700 square km. Malawi's portion of Lake Malawi covers 23,900 square kilometers of this total area. Malawi is bordered on the north and northeast by Tanzania; to the east, south and southeast by Mozambique; and to the west by Zambia.

The topography ranges from river valley to isolated peaks. These features and other physical characteristics are also discussed in Section 4.

b. The people

Malawi's population was estimated at 6.4 million in 1982, with an annual growth rate of 3.0 percent and an average population density of 65 persons per square kilometer. The population, however, is unevenly distributed, with approximately 12 percent of the population in the Northern region, about 30 percent in the Central region, and more than half of the entire population in the Southern region. An estimated 10 percent of the population lives in urban areas. As a result of internal migration, the urban population is reported to be increasing at a rate of 7.3 percent per year. *show compared to Kenya*

About 48 percent of the population was under 15 years of age in 1981. Average family size in the rural areas is about five persons. An estimated 25 percent of the population is literate.

The Physical Quality of Life Index (PQLI) is recorded at 31 for Malawi. This is somewhat lower than normal for many African countries (Swaziland, 45) and much lower than most western countries. These and other socio-economic data are summarized in Table 5. *norm on average*

c. The Economy

(1) The Gross Domestic Product

Since Malawi's independence in 1964, the country has made rather impressive progress in its economic development. Considering the lack of natural resources, the difficult environment and neglected infrastructure, progress has been remarkable and due mainly to the Government's strong commitment to development and careful planning. Between 1960 and 1981, GDP grew at an average annual rate of almost 5.7 percent. GDP in 1980 was US\$ 1,420 million, compared to US\$ 170 million in 1960. Per capita GDP in 1980 was US\$200.

1

World Bank, "Staff Appraisal Report", (1983).

2World Bank, "World Bank Development Report", (1983).

Table 5: Social and Economic Indicators of Development,
Malawi

Indicator		Average Annual Growth Rate(%)	Comment
Total Population		3.0	If this rate of growth remains unchanged, Malawi's population will surpass ten million by the year 2000. IBRD projections estimate that the population will approach twelve million by 2000, based on an average annual growth rate of 3.4 percent between 1981 and 2000. ³
1982 ¹	6,400,000		
1975 ²	5,250,000		
Percent of Total Population Living in Rural Areas ¹			Rural growth rate is not currently available. Urban population growth rate is approximately 7.3 percent per annum.
1983	90%		
Percent of Labour Force Involved in Agriculture ²			The actual number of persons involved in agriculture has increased by 22 percent over the decade, whereas the total population has increased by about 30 percent.
1980	84%		
1970	89%		
Percent of Population Under 15 Years of Age ¹			
1981 ¹	48%		
Percent of GDP Attributable to Agriculture ⁴			
1980	43%		
1970	51%		
Per Capita GDP ³		2.7	This average annual growth rate is calculated for the years between 1960 and 1981.
1980 (US\$)	\$200		
Physical Quality of Life Index (PQLI) ⁵	31		This figure is significantly lower than that of neighboring African countries. PQLI is based on an average of life expectancy at age one, infant mortality, and literacy.

Table 5: Social and Economic Indicators of Development, Malawi (continued)

<u>Indicator</u>	<u>Average Annual Growth Rate(%)</u>	<u>Comment</u>
Literacy ³		
1980	25%	Literacy rate is measured among adults 15 years and older.
Life Expectancy at Birth ³		
1981	44 yrs.	
Volume of Agricultural Production, 1969-71 to 1977-79 ⁴		
Food	3.1	
Non-Food	8.6	
Total Agricultural Production Per Capita, 1969-71 to 1977-79 ⁴		On a per capita basis, food production has just kept pace with the population.
Food	0.3	
Non-Food	5.8	
Food Self-Sufficiency Ratios		See footnote 6 for ratio formula
1978-80	97	
1964-66	101	

¹National Statistical Office and Economic Planning Division, Government of Swaziland.

²FAO, Statistical Yearbook 1983.

³IBRD, World Development Report 1983.

⁴IBRD, Sub-Saharan Agriculture--Synthesis and Trade Prospects, World Bank Working Paper Number 608 (1983).

⁵Overseas Development Council, U.S. Foreign Policy and the Third World--Agenda 1983.

⁶

$$\text{Ratio} = \frac{\text{Production of cereals}}{\text{Production} + \text{imports} - \text{exports of cereals}} \times 100$$

Formula and statistics from Sub-Saharan Agriculture--Synthesis and Trade Prospects.

Agriculture provided about 43 percent of the GDP at factor costs in 1980 and four-fifths (87 percent) of this came from the smallholder subsector. Industry accounted for 20 percent of the GDP and manufacturing and wholesale/retail each contributed thirteen percent (see Figure 4).

(2) Foreign trade

The economy of Malawi is heavily dependent on three agricultural commodity exports -- tobacco, sugar and tea. In 1980, agricultural exports accounted for 90 percent of Malawi's merchandise exports. In 1981, tobacco provided the largest share of agricultural exports (48 percent), followed by sugar (26 percent), tea (12 percent), and groundnuts (4 percent). Only about 20 percent of this export production came from the smallholder sector.

Malawi's current account deficit increased from an annual average of nine percent prior to 1978 to 24 percent in 1981. Debt service in 1981 was the equivalent of 30 percent of exports.

(3) Employment

Of the more than 360,000 persons employed in 1981, 180,000 or 50 percent were in Agriculture, Forestry and Fisheries. Eighty-seven percent were males and 13 percent were females. The employment in agriculture, forestry and fisheries to total employment has been relatively constant over the years, attesting to an element of stability in the sector.

d. Agriculture

The agricultural sector in Malawi consists of smallholders and estates. In 1981 the smallholder sub-sector accounted for 81 percent of all agricultural production, meeting the country's demand for food staples (maize, rice, beans, cassava, sweet potatoes, groundnuts, sorghum, and millet), providing about 20 percent of Malawi's agricultural groundnuts, tea, coffee, and beans).

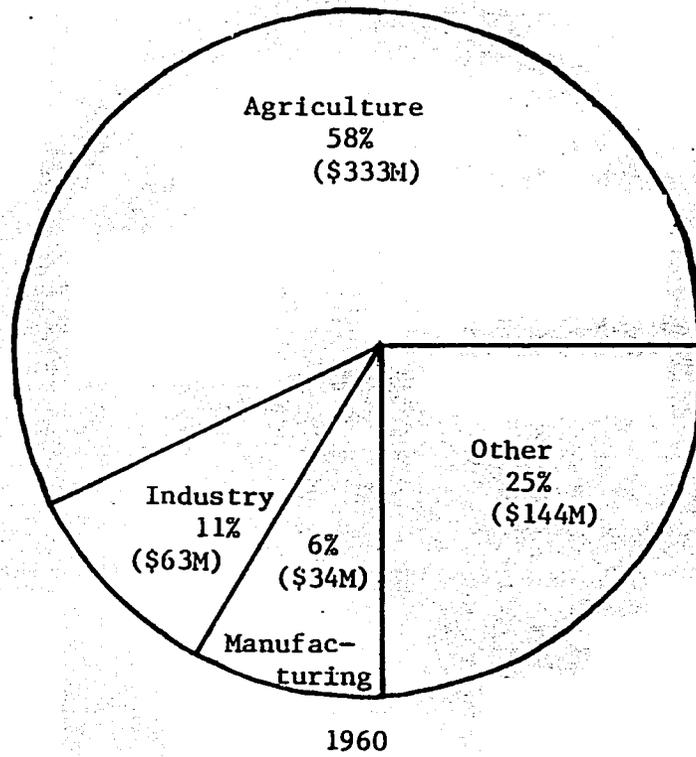
Roughly 70 percent of Malawi's total land area is available to smallholders. Three quarters of this is considered arable, although less than half has been cropped recently. Under Malawi's traditional smallholder tenure system, small farmers are given cultivation, but not ownership, rights by village headmen. Most smallholders produce maize as a staple crop on two-thirds to three-fourths of their cultivated land.

Cattle, goats, sheep and poultry are raised largely by smallholder cultivators. A small commercial sector, which includes small-scale operators, provides nearly all the meat and

1

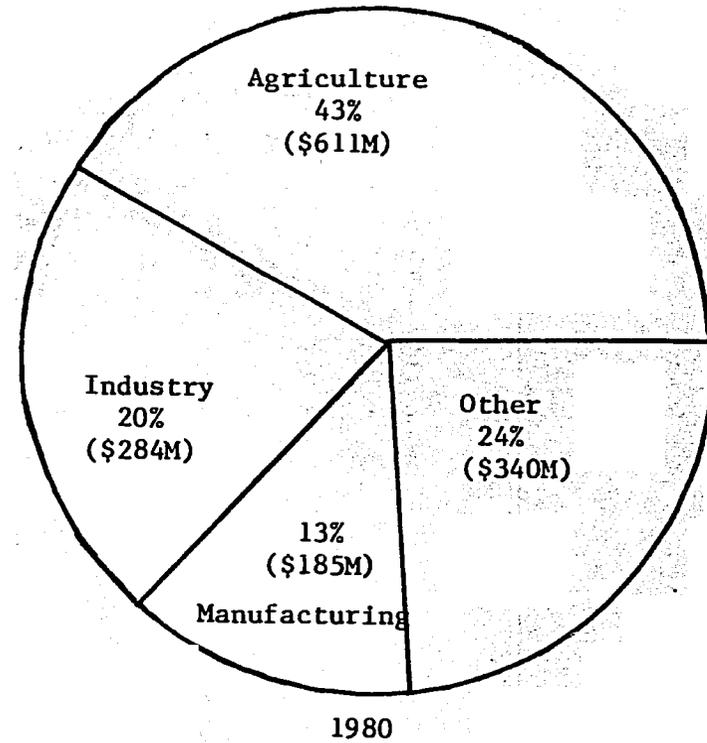
National Statistical Office and Economic Planning Division.

Figure 4: GDP By Source,¹ Malawi



45

TOTAL (1980 US\$) \$574 Million*



(1980 US\$) \$1,420 Million*

* (based on 170 Million U.S. Dollars converted to 1980 Dollars on basis of average annual inflation rate of 2.4% from 1960-70 and 10.3 from 1970-81)¹

¹ World Development Report 1983, IBRD/World Bank, 1983.

eggs purchased in urban areas. The traditional sector provides meat and eggs to the rural population and some urban consumers, and produces feeder steers destined for production of top grade beef. A more detailed account is given in Annex 2.

2. The development policy

a. Malawi's National Development Plan

The overall goals of the National Development Plan for 1981-1985 are to improve productivity and income of the rural population and upgrade the social quality of life of the smallholders.

The government's agriculture objectives are to maintain self-sufficiency in food production, expand export crop production, and improve rural income. Since land for new cultivation is limited, the emphasis is on a sustained increase in productivity. The government has followed a dual agricultural development strategy: one approach for the estate sector and another for the smallholder sector. The GOM supports development of the estate sector without directly subsidizing either inputs or outputs. To achieve a real annual growth rate of 4-8 percent, a target growth rate of 2-9 percent per year was set for the estate sector and 5 percent per year for smallholders.

The primary means to implement the development objectives for the over one million smallholders is the National Rural Development Programme (NRDP), established in 1977 and designed to be carried out over a twenty year period. The NRDP aims to increase the level of smallholder production, with emphasis on the production of cash crops for export and food crops for domestic consumption; to provide the inputs and services needed to increase yields; and to preserve natural resources by encouraging soil conservation, conserving key watershed areas, and developing forestry resources. On the farm level, while more effort than before will be given to livestock, the greatest emphasis will be given to extension services and credit to promote use of new seeds, fertilizers and increased farm power (by financing purchase of oxen and ox-drawn equipment).

1

Information in this section, unless otherwise noted, is from Drs. L.B. Fletcher and J.R. Moore, "CDSS Agricultural Strategy Supplement," (July, 1981).

Another key element in achieving productivity goals is the Agricultural Development and Marketing Corporation (ADMARC), a statutory company which purchases and markets smallholder cash crops and surplus food crops. The prices, set by ADMARC in consultation with the GOM, have "subsidized" food production and "taxed" smallholder production of cash crops, although the new development plan modifies the latter. ADMARC also distributes agricultural inputs (seeds, fertilizers, pesticides) to smallholders, sometimes at subsidized prices.

b. Donor participation

Donor assistance has been concentrated in the areas of education, agriculture, and rural development. Since its establishment in 1977, the National Rural Development Programme has received \$155 million in outside assistance¹. The Government of Malawi has solicited outside support for this integrated approach to assisting the smallholders which has also facilitated collaborative donor assistance.

Major bilateral donors, and total funds disbursed from 1977-1981, include: the U.K. (\$141 million), West Germany (\$121.4 million), Canada (\$94.3 million), Denmark (\$31.9 million), and the U.S. (\$19 million). The bilateral aid total in 1981 was \$92.4 million². Major multilateral donors include the World Bank (IBRD and IFC), the African Development Bank, the EEC and the UN agencies, especially the UNDP.

U.S. Small
donor

4 CDA
donors

Bilateral aid totalling \$139 million in 1979 was 66 percent of total official development assistance received by Malawi. It was also 12 percent of GNP and 39 percent of gross domestic investment in that year³.

The majority of agricultural research conducted by the Ministry of Agriculture is funded nationally; only 20 percent is funded by external sources⁴. The U.S. is providing assistance to the University of Malawi's Bunda College through the University of Florida and to the MOA and Bunda College through the CRSP bean/cowpea programme of Michigan State University. World Bank consultants are participating in the review of the Government's agricultural research and extension programmes. The U.K. has supported agricultural research staff and programmes in crops, soils and livestock, and Canada supports an ICRISAT groundnut research project⁵.

ICRISAT
Canada
↓
Groundnut

¹ U.S. Agency for International Development, Congressional Presentation Fiscal Year 1984, Annex I: Africa, p. 431.

² U.S. Agency for International Development, Congressional Presentation Fiscal Year 1984, Annex I: Africa, p. 431.

³ The World Bank, Accelerated Development in Sub-Saharan Africa: An Agenda for Action (1981), pp. 164-5.

⁴ The International Agricultural Development Service, Cooperation in Agricultural Research, (SADCC), (1983), Annex 3-D, p.2.

⁵ Report of Devres team visit to Malawi, March 11-16, 1983.

3. Agricultural research

a. Background

Agricultural research in Malawi is carried out by the Department of Agricultural Research (DAR) and the Department of Veterinary Services (DVS) of the Ministry of Agriculture (MOA); the Faculty of Agriculture of the University of Malawi (Bunda College of Agriculture); the Tea Research Foundation (TRF); the Tobacco Research Authority (TRA); and the Sugar Company of Malawi (SUCOMA).

Following are brief statements regarding the overall programmes of these institutions.

b. Overall research programme

(1) The Department of Agricultural Research (DAR)

(a) Background

The Department of Agricultural Research's programmes serve the needs of the smallholder farmer in food and cash crops (with the exception of tea, tobacco, and sugar), in horticulture and in farming systems research. The DAR also provides rural services such as foundation seed multiplication and seed certification. The DAR performs related research on land and water use and conservation, on crop fertilization, on plant disease and pest control, and on plant protection. Some of these programmes are strongly commodity-focused, but most work is with crops known to be adapted to particular micro-ecological areas and mixed farming systems. These linkages are enhanced because of the close relationship between agricultural research activities and Malawi's National Rural Development Programme (NRDP).

Administratively, the DAR is organized on the basis of research stations, which in turn have sub-stations. Each of the research stations has its own budget and administration.

(b) Research programmes

The commodities emphasized by the Department of Agricultural Research are maize, cotton, groundnuts, rice, and horticultural crops. Programmes in farm machinery development, crop storage, and livestock also are in place. The programmes being undertaken at the various research stations are listed in Annex 2.

At the national level, livestock and poultry research activities are shared between the Chief Veterinary Officer and the Chief Agricultural Research Officer, with animal disease and management studies the responsibility of the veterinary services

and grass/range work being carried out by the agricultural research staff. Little research has been done to date on poultry, goats (the most numerous livestock species), and sheep.

Although of less priority than livestock and poultry, research is undertaken on sorghum and pearl millet, Phaseolus beans, wheat and triticale, root crops (sweet potatoes, European potatoes), pastures, and on legume microbiology.

(2) The Department of Veterinary Service (DVS)

(a) Background

The Department of Veterinary Services is attached to the Ministry of Agriculture. The Chief Veterinary Officer has overall responsibility for the Department. The Department discharges its responsibilities through three branches: the Central Veterinary Laboratory at Lilongwe, Field Services (extension) in each Agricultural Development District (ADD), and the 17 Livestock Production Centres distributed throughout the country.

(b) Programme areas

The department's livestock development programme is undertaken at three levels of operation: research, extension, and the provision of cross-bred cattle for sale to small farmers. The purpose of the research programme is to increase livestock quality through better disease control, nutrition, and management. To achieve this, the department's research projects are summarized below. The other activities of the department are referenced in following sections.

(i) East Coast Fever (ECF) Project

The East Coast Fever Project was begun in 1980 to develop immune mechanisms against the disease. It is funded for four years for US\$ 314,300. Six researchers (two Ph.D.s and four B.V.M.s), four Technical Officers, and three Technical Assistants are involved.

(ii) African Swine Fever (ASF) Project

The African Swine Fever project was begun in 1980 to study the spread and incidence of swine fever and to develop control measures. It is funded by the Government of Malawi for three years for US\$ 87,750. One Ph.D. is assisted by a Technical Officer and a Technical Assistant.

(iii) Newcastle Disease Vaccine V4 Project

The Newcastle Disease Project was begun in 1981 to develop and evaluate the V4 strain into a vaccine for poultry. It is funded by the Government of Malawi for three years for \$US 887,750. One researcher with a Bachelor's degree

is assisted by a Technical Officer and a Technical Assistant.
(3) Bunda College of Agriculture, University of Malawi

(a) Background

The Bunda College of Agriculture was created in 1965 and is described in detail in Annex 2. It is discussed here because of its activities in agricultural research.

(b) Research programme

There are research programmes in each of the four departments of the College, i.e., Crop Production, Agricultural Engineering, Livestock Production and Rural Development. Bunda College cooperates with the Ministry of Agriculture's Department of Agriculture to ensure that projects undertaken are related to the country's development needs, and to avoid duplication of effort. In some cases Bunda staff are participants or consultants on research projects carried out by government research stations.

There are seven projects in the Crop Production Department, two in the Agricultural Engineering Department, four in the Livestock Production Department and two in the Rural Development Department. These projects and their objectives are summarized in Annex 2.

(4) Tea Research Foundation (TRF)

(a) Background

The TRF of Central Africa performs research for the tea industry in Malawi. The Foundation undertakes research in all aspects of tea production and provides advisory and extension services to tea producers in Malawi, Zimbabwe, and other countries in Southern Africa. The principal objective of its programmes is to maintain and improve the efficiency of the tea industry at both estate and smallholder levels.

Tea research in Malawi is carried out at the Tea Research Foundation at Mulanje (which has two sub-stations: Mimoso and Nsuwadzi) and at Thyolo Tea Research Station.

(b) Research programmes

Research projects are undertaken in the following broad areas:

- o agronomy
- o plant improvement and physiology
- o plant pathology
- o entomology
- o chemistry

- o biochemistry
- o tea biochemistry and technology
- o tea manufacture

As tea is largely an estate crop, the research is directed to estate production. However, the plant improvement and physiology programme includes research specifically designed to serve the needs of the Malawi Small Holder Tea Authority. This research is expected to help small tea farmers become more productive.

(5) Tobacco Research Authority (TRA)

(a) Background

The TRA was created by the Government in 1980 to institute and maintain facilities for tobacco research and to disseminate advice concerning tobacco production and management. It conducts its work at two research stations, Kandiya (Lilongwe), and Mwimba (Kasungu). The TRA General Manager has overall responsibility for its programmes.

(b) Research programmes

The TRA's research programme is primarily concerned with the selection of improved varieties, the improvement of cultural practices, the development of methods of control of insects and other pests and diseases, and the design and improvement of machinery for planting, harvesting, handling, curing, and marketing. The programme is both estate and smallholder oriented. Annex 2 details the TRA's programmes.

(6) The Sugar Corporation of Malawi

(a) Background

The Sugar Corporation of Malawi (SUCOMA) is a subsidiary of Swaziland Milling Company Ltd. and entirely funded by the private sector. Current research is, in the main, limited to importation and testing of cane varieties. A small research unit, started in 1968 at the company estate, investigates problems associated with sugarcane production at the Nchalo Sugar Estate.

(b) Programme areas

The research unit is concerned with variety introduction and testing, disease trials, and, recently, furrow irrigation trials.

(7) Summary of current research focus

As described above, Malawi's agricultural research programmes have both a commodity orientation as well as strong links to micro-climatic zones and mixed farming systems through their close relationship to the NRDP.

Malawi's research programmes are strongly directed toward working on the problems of smallholders. The donors likewise have been increasingly directing resources to food crops such as maize, beans, cassava and millet, and to linkages with research and the NRDP. Livestock research is directed to cattle, poultry and pigs. Research support is also directed to smallholder cash crops such as groundnuts.

c. Other considerations affecting research priorities

The Government of Malawi (GOM) has a strong and sustained commitment to agricultural research. As noted earlier, its national plans strongly emphasize, and allocate resources to, maintaining agricultural productivity as the driving force behind Malawi's economy. Its 20-year development programme includes the following goals, each having strong implications for agricultural research priorities:

- (1) Increase the general level of productivity of smallholders, for growing food crops for internal use and cash and food crops for export;
- (2) Make agricultural inputs available and accessible to farmers on a timely basis;
- (3) Conserve natural resources and productivity, and sustain productivity of such resources, especially for soils, and conserve key watersheds;
- (4) Enhance integrated development in key areas; and
- (5) Develop and improve forest resources.

Allied with this long term plan are three other significant actions and programmes which will also contribute to the decisions made by government when resource allocations to agricultural research are being made:

- o The close linkages between research, extension, and input delivery-marketing services by the NRDP is expected to result in research designs and evaluations more closely linked to the smallholders and their perceptions of problems and opportunities.

Would address community info problems?

- World Bank
supported*
- o An in-depth review of the structure, content and future course of the GOM research and extension programs is now in the final stages of completion and acceptance by the GOM. The preliminary drafts of this plan suggest the following priority research areas for the next 10-20 years.
 - Sustained production in less favorable natural resource areas;
 - Mixed Farming (Crop-livestock enterprise combinations);
 - National Food and Agricultural Policy;
 - Protection of crops and animals from pre- and post-harvest losses.
 - o Malawi's agricultural research system has developed outstanding linkages with international research institutions. Bilateral relationships with external research centres and organisations are summarized in Table 6.

4. Production potential and constraints

a. Potential for increased agricultural productivity

Table 7 compares present productivity levels of smallholders, estate farms and research stations. Productivity levels of both food crops and export (or cash) crops by smallholders are included in this table.

Data in the table generally indicate higher levels of productivity on research station fields than on those of the estate-holders, with yields of the smallholders lower than either research or estate yields. The data appear to indicate a substantial opportunity to increase productivity by applying current crop research information. However, there is little potential to do so across the entire country because the research results are derived from the application of intensive management and the precise application of high levels of fertilizer, pesticides, water, and other inputs unavailable to resource-poor small farmers. Also, in most cases the research plots are located on some of the better soils and in more favorable micro-climatic zones. The many small-scale producers, whose participation is essential for country-wide productivity to rise substantially are not apt have adequate land resources access to resources required to utilize modern production systems.

Table 6 : Linkages of Malawi's Agricultural Research System with International Research Centres

<u>Organisation</u>	<u>Activity</u>
CIMMYT	Provision of wheat and maize germ plasm and information and training from its farming systems research training centres in Kenya and Mexico.
IITA	Contribution of support for cowpeas, cassava nurseries, and maize variety testing; conduct of training (at IITA) in crop agronomy; provision of assistance in the biological control of green spider mite and various mealybug pests.
ICRISAT	Assistance with training in groundnuts, pigeon peas, chickpeas, and sorghum production; provision of information and assistance from an ICRISAT regional sub-station for groundnut research (an activity that SADCC has proposed <u>to CDA</u> to be converted to a regional grain legume project).
ILRAD	Provision of vaccine to combat animal diseases.
CIAT	Contribution to enable inclusion of <u>Phaseolus</u> beans in the grain legume programme.
ILCA	Provision of support for small farm animal power and small farmer dairy research.
IRRI	IRRI staff visits and provision of new rice varieties for testing in Malawi.
USAID/CRSP	Contribution of resources to enable Michigan State University's involvement in the bean and cowpea research project of the Department of Crop Production and Bunda College of Agriculture.
Others	Cooperation with the International Red Locust Organization, International Seed Testing Association (ISTA), and SADCC.

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CDA
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Table 7: Indicators of Agricultural Productivity in Malawi

A. <u>Crops</u>	Yields (kg/ha)		
	<u>Average Range, Traditional Sector</u> ¹	<u>Average Range, Estate Sector</u>	<u>Average Range, Research Station</u> ¹
<u>Food Crops</u>			
Maize	325 - 5,200	4,000 (MFI2) 6,000 (CCA)	3,500 - 9,000
Pulses	160 - 330	--	--
Sorghum	250 - 2,200	--	3,500
Millet	260 - 1,100	--	--
Rice	1,100 - 2,950	--	2,300 - 4,000
<u>Cash Crops</u>			
Groundnuts	260 - 1,200	--	700 - 1,250
Cotton	325 - 1,000	--	2,000
Tobacco	--	1,800 (flue-cured)	2,600 (flue-cured)
Tea	--	2,000 (burley) 2,659	3,000 (burley) 3,000
B. <u>Livestock</u>			
<u>Cattle Indicators</u>			
Offtake	10	10	10
Mortality	12	15 (0-1)	4
Calving Rate	40 - 60	5 (over 1 yr.) 40 - 60	70

wide range

¹The great variability in average yields is due mainly to ecological differences, rather than differences in cultural practices. A more detailed picture of yields on farmers' fields and research stations in different regions is given in Annex 2.

Source: National Sample Survey of Agriculture
 ADD 1982/83 crop estimates
 Sorghum and pearl millet breeding programmes report, 1980/81.
 Groundnut breeding annual report, 1981/82, (released variety)
 The Smallholder Tea Authority Annual Report, 1980/81.
 Tobacco Research Authority.

Table 8: Perceptions of Seriousness of Institutional Constraints
By Malawi Research, Extension and Training Staff

<u>Topic</u>	<u>Research</u>		<u>Training</u>		<u>Extension</u>		<u>Summary</u>	
	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>
Recurrent Budget	12	2.3	5	2.6	5	2.8	22	2.5
Foreign Exchange	12	1.4	--	--	--	--	12	1.4
Senior Staff Qualifications	12	1.9	7	2.0	5	2.2	24	2.0
Junior Staff Qualifications	12	1.6	6	2.7	5	1.8	23	1.9
Service Maintenance	12	1.6	--	--	--	--	12	1.6
Consistency of Support	12	1.2	--	--	--	--	12	1.2
Laboratory Facilities	12	1.8	7	2.1	--	--	12	1.8
Office Facilities	12	1.4	--	--	--	--	12	1.4
Equipment	12	2.2	7	2.1	--	--	19	2.2
Transport	--	--	--	--	--	--	--	--
Teaching Materials	--	--	1	3.0	--	--	1	3.0
Access to Research	--	--	--	--	5	1.4	5	1.4
Farmer Attitudes	--	--	--	--	5	1.4	5	1.4
Lack of Timeliness	--	--	--	--	5	2.4	5	2.4
Lack of Research Input	--	--	--	--	5	2.4	5	2.4
Policy Problems	--	--	--	--	5	1.6	5	1.6

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

b. Constraints affecting agricultural productivity

(1) Constraints as viewed by the GOM research, training, and extension staff

Table 8 contains responses by the staff of Malawi's research, training and extension agencies regarding to a survey constraints affecting these programmes. These responses may be summarized as follows:

o General observations

Research, training, and extension workers suggested that recurrent budget short-falls contributed to their inability to carry out the programmes and schedules as planned. Research and Extension personnel were also strongly affected by transport breakdowns or lack of availability of vehicles and shortages of spare parts.

o Research staff comments

Research staff noted the need for continuity of staff and the need for greater maturity and experience by senior staff, and their importance to guide junior staff. (It was recognized that the relatively rapid expansion in the number of local professionals, most with less than five years experience, is a problem only correctable by time.) The tension between the overriding need to solve current problems in a consistent fashion and the need to train and upgrade staff was also noted.

o Training staff comments (Bunda College)

Staff noted that when training needs and research needs completed for resources, usually research was curtailed. They noted a need for upgrading the qualifications (and quality) of technicians. There was a concern regarding capacity of both laboratories and classrooms, and the view was expressed that the physical capacity of the institutions could constrain the numbers of qualified Form IV students who were interested in a career in agriculture.

where?
Secondary?
College?

o Extension staff concerns

In addition to limitations imposed by recurrent budget and transport, the staff voiced concern that senior technical staff were not as adequately trained as desirable. It was noted that there were few technical specialists in extension and that for the most part, the extension subject

matter specialists did not have technical training in their assignment speciality. Service support, especially financial support services, were cited as needing additional staff and skill.

Timeliness of inputs is considered a serious problem the staff must deal in its efforts to assist farmers. Fertilizer was reported to have been, in most years, inadequate in quantity and delivered late due to transport problems.

Senior officials in the Department reported that, even though they have access to research, most of the research findings contribute little to solving farmers' "on the ground" problems. They suggested that researchers do not have adequate funds for, or the inclination to design, research activities useful to extension workers. Strengthened linkages between research, extension, and the farm community were suggested with the expectation that research developed as a result of such contact could be more problem-oriented. The staff believed that the creation of adaptive research units by the MOA will and is enhancing the relevance of research to small farmer problems. The Extension Department has 698 vacant positions at all levels, more than 25 percent of the total. This was seen as a serious limitation to the effective dissemination of information.

This not brought out in communication

(2) Physical/environmental limitations

Malawi has an extremely diverse natural resource base. It is landlocked and has a total area of 118,700 square kilometres of area. Malawi's portion of Lake Malawi comprises 23,900 square kilometres (20 percent) of this total. Malawi is about 900 kilometres from north to south and less than 200 kilometres from east to west. The country is bordered on the north and northeast by Tanzania; to the east, south and southeast by Mozambique; and to the west by Zambia. Administratively, it is divided into three regions -- northern, central, and southern. Malawi can also be divided into four topographic regions:

- o The Great Rift or Shire Valley, the dominant feature of the country, cutting across the nation from north to south and containing numerous lakes including the Lake Malawi littoral and the Shire River Valley;
- o The Central Region where plateaus rise to an altitude of 800 to 1500 meters and lie beyond the littoral to the west, covering about 75 percent of the total land area;

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How

- o The highland areas of isolated tracts, some rising to an elevation of 27,000 meters. They comprise the Nyika, Vipya and Dowa Highlands, the Dedza-Kirk Mountain range in the north and west, and the Shire Highlands in the west;
- o The isolated peaks of Mulange (3300 meter) and Zomba (2400 meters) in the east make up the fourth geographical region.

Annual rainfall in Malawi varies greatly from year to year. There appears to be a pattern of several years of ample rainfall followed by several years of poor rainfall, but no regular cycle can yet be defined. In the Shire Valley and the Lake Malawi littoral region, annual rainfall varies greatly from year to year. In the highland areas, annual rainfall can be as high as 1,500 mm and is usually distributed throughout the year.

Malawi is fortunate in possessing some of the most fertile soil in South Central Africa. Of particular importance are the soils found in the lake-shore plains and the upper and lower Shire Valley. The plateau regions are also areas of high fertility. However, the mountainous terrain in this region prohibits much of the land from being used for farming.

As this brief review indicates, a wide range of micro-climatic zones in Malawi are being utilized for the production of agricultural commodities. Even those crops requiring specific combinations of water, temperature, and elevation are being produced in many different locations. Thus, although Malawi has a substantial amount of fertile cropland, physical constraints do exist to increased crop productivity such as the wide diversity of soils and the many different micro-ecological areas being farmed. This situation suggests the need for a more accurate inventory of the variegated agricultural resource base and for research efforts to link this knowledge to its potential for productivity increases under varying technologies and management practices.

(3) Technical skills and institutions

(a) Education

Malawi's literacy rate is estimated at about 25 percent. In 1980/81 primary school enrollment was about 810,000 or 58 percent of the children of primary school age. Secondary school enrollment amounted to 18,000 students or 4% of the secondary school age population.

(b) Technical Skills

Table 9 illustrates the technical skills resources now in place and being trained for agricultural research, extension and training.

Table 9: Technical Skills for Agricultural Research Extension and Training in Malawi

<u>Department/Institution</u>	<u>Professional Staff</u>			<u>% Expatriate</u>	<u>Technical Support Staff</u>	<u>Profs. Training</u>	<u>Vacancies</u>
	<u>National</u>	<u>Expatriate</u>	<u>Total</u>				
A. <u>Public Sector</u>							
Department of Agricultural Research (DAR)	76	12	88	14	307	29	n.a
Department of Veterinary Services (DVS)	10	8	18	44	64	7	n.a
Department of Agricultural Development (DAD)	9	7	16 ¹	44	2737 ¹	2	698
Funza College	29	12	41	29	19	15	n.a.
Colby College	<u>5</u>	<u>1</u>	<u>6</u>	<u>17</u>	<u>25</u>	<u>3</u>	<u>n.a.</u> ²
TOTAL, Public Sector	129	40	169	24	3152	56	n.a.
B. <u>Private Sector</u>							
Tea Research Foundation (TRF)	8	7	15	47	90	--	1
Tobacco Research Authority (TRA)	6	2	8	25	17	2	0
Sugar Corporation of Malawi (SUCOMA)	<u>1</u>	<u>1</u>	<u>2</u>	<u>50</u>	<u>3</u>	<u>--</u>	<u>--</u>
TOTAL, Private Sector	15	10	25	40	110	2	1

¹ To compare the DAD (extension) staff more uniformly with the other institutions only the sixteen DAD professional staff who have college degrees have been included as "professionals". The additional 123 persons at the certificate or diploma level who are posted as professional officers (PO's) have been included as part of the technical support staff.

² It is hoped that the new National Resources College at Colby will eventually have 17 additional professional staff members and 28 additional technical support staff.

(4) Rural infrastructure and institutions(a) Transportation

Malawi, as a landlocked country, is vulnerable to external transport difficulties. Imports and exports generally move by train across Mozambique to the port cities of Beira and Nicala. Within Malawi, the railroad runs through the Shire Valley and north to Salima (400 km), then west to the Zambian border (200 km). The northern two-thirds of the country has no rail transport. The southern half of the country is fairly well served by all-weather roads, but the roads in the northern region provide less extensive coverage and are largely gravel. These northern areas are constrained in development due to poor accessibility, especially during the rainy season. The country had 10,772 kilometres of classified roads in 1981. Malawi is also serviced by air (Air Malawi); the central and northern regions of the country receive air transport services for passengers and freight.

(b) Communication

There are two radio broadcasting companies in the country that broadcast in both Chichewa and English. In 1981, Malawi reported 275,000 radio sets and 29,000 telephones, largely in or near the major population areas. There are nine publishers in Malawi, whose publications range from newspapers to religious tracts.

(c) Service oriented institutions:Marketing

The Agricultural Development and Marketing Corporation (ADMARC) is a statutory company established to serve smallholders for both foodcrop and non-foodcrop needs. ADMARC both purchases and sells food crops. It also sells and delivers crop production inputs (seeds, fertilizers, chemicals, and sometimes farm implements). ADMARC operates

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The following discussion concerning rural infrastructure, and policy and social/cultural constraints are not based on scientific surveys or data secured during this study. The comments are qualitative and based on contacts with a wide range of Malawians and expatriates who have had extensive experience in agricultural research and in development, and specific experience increased agricultural productivity, but most are descriptions of the reasonably good infrastructure in place.

a national network of marketing sheds and storage facilities. It invests in agricultural and agro-industrial enterprises and pays or charges prices as agreed upon and authorized by the Price Review Committee of the GOM.

Estate produce is marketed almost entirely through the private sector. The Grain and Milling Company (GRAMIL) is the major maize purchaser, and the Tobacco Auctions at Limbe and Lilongwe serve the tobacco industry. Tea and coffee are exported through international trading companies.

Two separate livestock markets operate. The Cold Storage Company (CSC) buys animals at a fixed price per kilogramme, dependent upon the grade. In addition, several auction markets exist where animals are purchased by CSC by local butchers, farmers and by rural development programmes for stallfeeder use.

Credit

No central agricultural credit institution exists in Malawi. Smallholders have access to seasonal and medium-term agricultural credit through the Ministry of Agriculture's rural development projects (which have their own credit funds and staff), through settlement schemes under the Ministry of Agriculture, or through the Loan Board under the Ministry of Trade and Industry.

Fertilizers and Seed

Fertilizers for the estate sub-sector are imported under monopoly rights granted to private concerns. Other agro-chemicals are provided by commercial firms. The National Seed Company of Malawi stocks and sells a wide range of seed. Most direct sales are to estates, or to ADMARC which then sells to smallholders.

(5) Social/cultural constraints

Roughly 70 percent (6.7 million hectares) of Malawi's total land area of 9.41 million hectares is available to smallholders through the traditional system. Three-quarters of this (5.1 million hectares) is arable, although less than half of this amount has been recently cropped. Under the traditional smallholder tenure system the small farmers live under the control of family heads, village headmen and chiefs. Cultivation rights, rather than ownership, are granted. Matrilocal residence, in which a husband leaves his home to live with his wife who inherits cultivation rights, is common. The reverse is common in the northern region.

In 1981 the smallholder sub-sector accounted for 81 percent of all agricultural production and provided most of Malawi's staples (maize, rice, beans, cassava, sweet potatoes, groundnuts, sorghum, millet, and tobacco).

The remainder of Malawi's arable land (0.5 million hectares) is held, in the main, by large agricultural estates, often owned by expatriates. The estate sub-sector in 1981 accounted for 19 percent of Malawi's agricultural production. The estate sub-sector has functioned as the principal foreign exchange earner, with exports of tobacco, sugar, tea, tung oil, coffee, and macadamia nuts. A small proportion of the livestock is raised by estates, government, or private farms using management practices other than those of the traditional smallholder farms.

Nine language groups are historically associated with modern Malawi. Chichewa and English are the official languages. In 1966, English was understood by less than 20 percent of the population, while Chichewa was spoken by more than 50 percent and understood by about 77 percent.

c. Summary

Malawi's smallholders have been relatively quick to modify their systems of farming and to become involved with technological changes. The GOM has directed its agricultural research to meet the needs of smallholders and, to a small degree, those of estate cash-crop producers.

The present major review of research, training, and extension by the GOM and its donors is very useful in further increasing the focus and efficiency of agricultural research. An important need, still unmet, is to develop a data base and detailed understanding of the micro-ecological zones in the country so as to have confidence that agricultural research directions and outputs are realistic, capable of realization, and sustainable.

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IV. SWAZILAND COUNTRY REPORT

A. Summary and Research Assessment

1. Strengths of the Agricultural Research Division (ARD)

The ARD has some notable strengths, in particular:

- o ARD's three research stations, their farms and offices, laboratories and equipment effectively support research and the day-to-day administrative work necessary to carry it out. The three environments in which they are located are representative of the country's ecological zones-- with the exception of the Highveld.
- o The institutional/research focus of the ARD on cropping systems research linked to the needs of Swazi Nation Lands (SNL) farms is highly appropriate.
- o The ARD's training programme, about to be localized with well-trained scientists, is an important contributor to Swaziland's agricultural research effort.

2. Opportunities to improve agricultural research

a. Its technical capacity

- o ARD's facilities, including offices and laboratories, should be rehabilitated and, in some cases, expanded to increase the ability of the Division to resolve agricultural research issues.
- o The recurrent budget of the ARD must be increased to adequately support existing and potential agricultural research activities.
- o A data base of pertinent facts and research results relating to the cultural/social/economic aspects of farming, rural families and communities should be developed for use in guiding future research efforts.
- o The training needs of junior staff and those senior researchers presently at their posts should be given detailed attention as a means of further upgrading ARD's research capacity.

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- o An inventory of climatic, water, soil and other natural resource characteristics by region of the country is needed to provide researchers and other decision-makers with more scientific information on which to base their work and decisions. This information is especially important for those who establish research priorities and allocate research resources.
- b. Its capacity to meet developmental needs and priorities
- o ARD's continued localization of its staff should help it to understand and meet Swaziland's development needs more fully.
 - o Closer ties (i.e., networking) with other research institutions in the SADDCC countries and elsewhere, including the international and multi-national institutions, would improve ARD's capacity to meet Swaziland's development needs.
 - o Closer working relations with the Luyengo Campus of the University by ARD are desirable. Such a relationship will reduce duplication, sharpen ARD's research focus, and enhance its research capacity.

3. Food security and agricultural research

Food security is of paramount importance in Swaziland, and agricultural research has a critical role in this important area.

The current drought highlights the precarious food security situation in Swaziland. A recent Food and Agriculture Organization of the United Nations (FAO) report on global information relating to foodcrops and shortages¹ stated that, in Swaziland:

The 1983 maize production was reduced by drought to 50 percent of normal. Government has estimated that over 108,000 people (about one-fifth of the total population) require food assistance ... [and that] maize import needs in 1983/84 are estimated at over 100,000 tons, about double the normal level . . .

Even before Independence in 1968, a prime objective in agriculture was self-sufficiency in the production of maize. This objective, if achieved, not only would protect against natural disaster, but also would reduce dependence on the

¹

FAO, Foodcrops and Shortage (Rome: FAO, 1983).

RSA for Swaziland's staple foods. A considerable portion of the resources and energies of the Rural Development Area Programme (RDAP) have been directed to attaining this objective.

Despite the above prime objective, the maize gap (total consumption minus total production) continues to widen. Presently, maize output is stagnating. Reductions in area planted are not sufficiently compensated for by increases in yield to allow per capita intake levels to be maintained without additional imports. According to FAO, several constraints must be overcome before Swaziland can achieve a higher level of self-sufficiency in maize production. These constraints are:

- o the lack of a clearly defined policy regarding food security;
- o the belief that land capability is a constraint; and
- o the Government of Swaziland's (GOS) unwillingness to change the existing land tenure system even when such changes can be shown to contribute to much greater productivity.

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The FAO recommended adopting open-pollinated "synthetics" and "composites" having different lengths of maturity suited to local agro-ecological conditions.

The FAO also stated that the Extension Service is constrained by the lack of information and qualified staff, and that the programme does not provide full geographic coverage. For maize there is "ample scope for improvement in extension."¹

The institutional structure necessary for a food security policy exists, but the regulatory powers of Government need to be strengthened to complete the policy matrix.

GOS strategy to achieve national food security should include:

- o quantification of a food self-sufficiency strategy and the incorporation of this into a National Food and Nutrition Plan; the Plan would provide the means for interrelating production with consumption, distribution and nutrition;
- o adaptation of the traditional land tenure policy to new technology, decision-making systems and management practices;
- o strengthening marketing policy and expanding it to include procurement and regulatory controls;

¹

FAO, Foodcrops and Shortage.

- o adaptation of credit policy to give greater attention to small farmer needs and to ensure that farmers can qualify to receive credit; and
- o establishment of an emergency reserve storage and stock policy as part of a national food policy.

For extension, the system of using general extension workers at the farm level supported by specialized maize officers is appropriate. However, considerable improvement in the information base is essential. The DES also needs to be extended in geographic coverage. Priority should be given to the improvement of cultural practices as this should yield relatively rapid results from known technology. More attention must be given to training local extension staff and to providing extension aids.

With regard to the nature of research, "applied research should have priority over pure research and the programme should be developed based on the application of modern research to meet small farmer needs. Research results after practical field testing should be incorporated into the extension system."¹

4. Recommendations

a. Background

The GOS development policy for smallholders on SNL is to utilize the RDAP. Swaziland agricultural research therefore must be tightly related to this programme, and decisions regarding research directions and alternatives must be made in this context. Research programmes traditionally have not been directed to solving problems related to, or unique to, the enterprise mix between crops and livestock (either cattle or small stock or both) which is common among small-scale producers.

The following recommendations are not project-specific at this time. They do foresee the potential for Swaziland to share and participate in developing SADCC-wide research and networking capability.

b. Research orientation

As is noted in this study, the Swaziland research programme only recently has received a strong mandate. The GOS

1

FAO, Report of the Food Security Policy Formulation and Project Identification Mission to Swaziland (Rome: FAO, 1981).

policies related to food crops and to food security strongly

suggest the need to relate agricultural research to the production problems of smallholders.

The crop-livestock mix in the smallholder sector indicates the need to relate research to this particular environment. In broad terms, the commercial crop sector does not require publicly-funded research at this time, nor is such contemplated.

c. Research activities recommended

Swaziland has a partial data base of soils maps, land use planning analysis, and climatic and hydrological information. This information should be examined, organized and related to alternative crop or crop-livestock potentials. Other segments of a resource inventory would be very desirable additions:

- o A comprehensive physical inventory, including correlations of climatic, edaphic, and land use data is needed. One use for this would be the preparation of maps of agro-climatic and soil fertility zones for land use planning.
- o A comprehensive analysis of the carrying capacity of the Swaziland rangelands, to determine at what level this resource can be sustained, is of great potential value to policy makers.
- o A research-developed data base linking social and economic information to smallholders' needs and responses is also needed to better design and evaluate research activities.
- o Research studies on land/smallholder relationships, focused on retaining Swaziland's rich traditions and customs while endeavouring to ascertain alternative tenure patterns or incentives, is of potential value for increasing productivity.

As this study was performed, a number of other recommendations were suggested. Some of these are self-evident but nonetheless are listed below, although not in terms of priority.

- o Research should be carried out leading to the development of appropriate technology for small farmers, especially in the area of water harvesting, utilization and conservation. This should include determination of the consumptive use of water for the major crops cultivated in the country.

- o Research on minimal tillage and dry-land farming is strongly relevant and useful to the Swaziland rural situation.
- o A livestock component should be included in the ongoing CRSP to make it even more relevant to the Swazi farmer.
- o On-farm grain storage and processing research focused on the needs and capabilities of the Swazi farmer would aid in reducing high post-harvest losses.

d. Training recommendations

The University of Swaziland's Faculty of Agriculture is located within a few kilometres of the Agricultural Research Station. It is strongly recommended that the Faculty of Agriculture be included in a network of SADCC training institutions and programmes. Swaziland's Mananga Agricultural Management Centre also has the potential for short-term training of managers, with additional strong regional potential.

Swaziland's internal needs for scientists and advanced degree personnel in research seem, to date, to be met by external training. The expected demand for such narrow technical skills does not indicate a need for in-country advanced level training capacity.

B. The Setting

1. The nation

a. Physical characteristics

The Kingdom of Swaziland is the second smallest country in Africa, with a total area of 17,364 square kilometres. It is surrounded largely by the RSA, with a minor portion bordered by the People's Republic of Mozambique.

Despite its small size, Swaziland is a country of considerable natural diversity. It is divided into four major topographic and climatic regions, extending longitudinally from north to south in roughly parallel belts referred to as the Highveld, Middleveld, Lowveld and the Lubombo encampment (see Figure 5 and Table 10). It has a wide range of climatic conditions which may be described as subtropical, with relatively fertile soils and adequate rain. Four main perennial rivers traverse all four topographical regions en route to the Indian Ocean.

Swaziland's soils are complex, with distribution of the major types being closely related to relief and geological

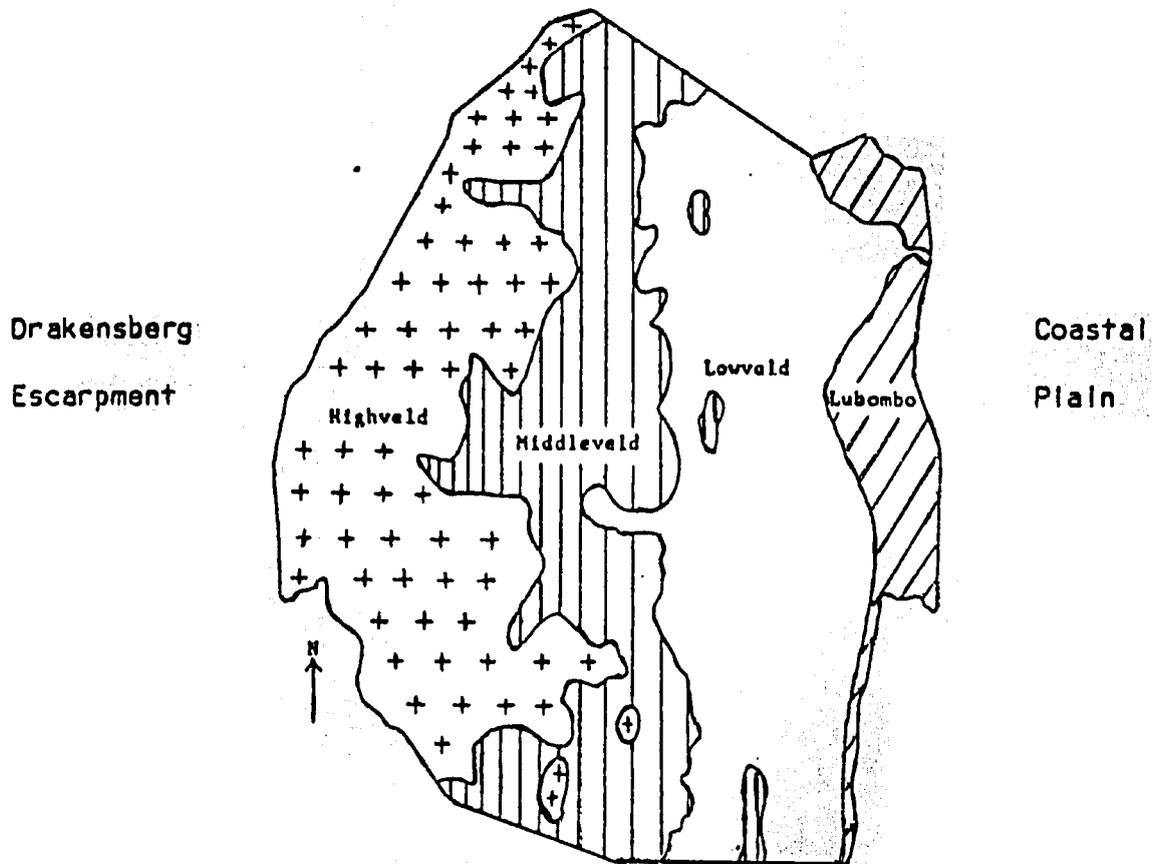


Figure 5: Topographical Regions, Swaziland

Table 10: Ecological Regions and Their Characteristics, Swaziland

<u>Region</u>	<u>Area (sq km)</u>	<u>Average Altitude (m)</u>	<u>Average Rainfall (mm)</u>	<u>Climate and Mean Temperature Ranges (c)</u>	<u>Predominate Vegetation</u>
Highveld	5,029	1,300	1,270	Humid, near-temperate 10.8 - 22.6	Sour grassland with some natural and man-made forests
Middleveld	4,597	700	940	Near-humid, sub-tropical 11.7 - 22.6	Tall grass and mixed bush
Lowveld	6,416	200	660	Semi-arid, hot 15.4 - 29.8	Broad-leaved savanna in west, thorn parkland and scrub in east
Lubombo	1,321	600	784	Near-humid, sub-tropical 13.9 - 24.9	Mixed bush

structure. Most have developed in place from underlying parent rock, thus reflecting the weathering and chemical characteristics of the rock base.

In the Middleveld and the Lubombo, the main soil types are deep, acidic and freely drained red and yellow ferrisolic and ferralitic. Many are underlain by quartz. The natural fertility of these soils is low and there is little or no reserve of weatherable minerals due to leaching. The rooting depth is between 40-70 centimetres, although on more gentle slopes it increases to 100 centimetres or more.

Much of the Lowveld is underlain by shale and sandstone which give rise to heavy-textured clay pan soils. These often are covered with light-textured material. Poor subsoil drainage and high exchangeable sodium restrict the use of these soils for irrigated agriculture. Other areas of the Lowveld are underlain with basalt, which gives rise to an association of red, brown and black clays. Shallow (20-30 centimetres) variants of these clays cover about 45 percent of the Lowveld area. The fertility of these soils is excellent, although they are deficient in phosphorous. Poor drainage is a problem with the black clays, and sodicity and salinity occur in some low-lying soils. However, for rainfed cropping, these soils yield well if rainfall is sufficient.

b. The people

Based upon the 1976 Population Census, Swaziland's total population was estimated to be 605,000 in mid-1983. The vast majority (97.6 percent) of the Swazi people share a common language and tradition, and both English and siSwati are official languages. Roughly half (52 percent) of the population is below 15 years of age. According to the GOS, Swaziland's population is growing at a rate of 3.4 percent per annum. If the growth rate remains unchanged, Swaziland's population will nearly double by the year 2000.

Most of the population live in rural areas where subsistence farming is prevalent. In 1982 the urban population was estimated at 106,000, or 18 percent of the total. The two largest urban centres (Manzini and Mbabane) are growing at an estimated annual rate of 10 percent, largely due to internal rural to urban migration that has been in process since shortly after Independence in 1968. Basic social and economic indicators for Swaziland are given in Table 11.

Table 11: Social and Economic Indicators of Development,
Swaziland

Indicator		Average Annual Growth Rate(%)	Comment
Total Population		2.9	If this rate of growth remains unchanged, Swaziland's population will reach one million by the year 2000.
1983 (estimate)	605,000		
1975 ¹	483,000		
Percent of Total Population Living in Rural Areas			Rural growth rate is not currently available. Urban population growth rate is approximately 10 percent per annum.
1983	82%		
Percent of Labour Force ¹ Involved in Agriculture			The actual number of persons involved in agriculture has increased by 16 percent over the decade, whereas the total population has increased by about 30 percent.
1980	72%		
1970	81%		
Percent of Population Under 15 Years of Age			
1983	52%		
Percent of GDP Attributable to Agriculture ²			
1980	24%		
1970	31%		
Per Capita GDP			
1982 (\$US)	\$618	5.5	The average annual growth rate is calculated for the years between 1960 and 1980. ³
Physical Quality of Life Index (PQLI) ⁴	45		This figure is on par with most neighboring countries, but about one-half that of most high-income countries. (The PQLI for the U.K. is 95 and for the U.S. is 96.)
Literacy ⁴			Literacy rate is measured among adults 15 years and older.
1983 (estimate)	55%		
1972	36%		

USAID
Wants
3.8

Table 11: Social and Economic Indicators of Development,
Swaziland (continued)

Indicator	Average Annual Growth Rate(%)	Comment
Life Expectancy at Birth ³		
1981	54 yrs.	
Volume of Agricultural Production, 1969-71 to 1977-79 ²		
Food	3.7	
Non-Food	14.6	
Total Agricultural Production Per Capita, 1969-71 to 1977-79 ²		
Food	1.2	
Non-Food	12.1	
Food Self-Sufficiency Ratios ⁵		
1964-66 average	86	
1978-80 average	85	

¹ FAO, Statistical Yearbook 1983.

² IBRD, Sub-Saharan Agriculture--Synthesis and Trade Prospects, World Bank Working Paper Number 608 (1983).

³ IBRD, World Development Report 1983.

⁴ Overseas Development Council, U.S. Foreign Policy and the Third World--Agenda 1974 and U.S. Foreign Policy and the Third World--Agenda 1983.

⁵ Ratio = $\frac{\text{Production of cereals.}}{\text{Production + imports - exports of cereals}} \times 100$
Formula and statistics from Sub-Saharan Agriculture--Synthesis and Trade Prospects.

c. The economy

(1) The Gross Domestic Product

Gross Domestic Product (GDP) for 1982 has been estimated at US\$ 374 million -- a per capita GDP of US\$ 618. During the period from 1977 to 1982, the average rate of growth of GDP was five percent (see Table 11).

Agriculture is by far the dominant feature of Swazi life and, with agro-industry, is the largest economic activity. Alone, it generates about one quarter (26 percent) of the country's GDP (see Figure 6). Furthermore, a large part of the manufacturing sector is based on the processing of agricultural products. Thus, agro-industry, including forestry, contributes three quarters (74 percent) of manufacturing value added. In 1980 four establishments (two sugar mills, a pulp mill and a fruit canning factory) accounted for 68 percent of all manufacturing value added. All manufacturing accounts for 25 percent of the GDP, government services follow with 16 percent and distribution, hotels and restaurants contribute 10 percent.

(2) Foreign trade

Agriculture contributes more than 70 percent of the value of all national exports. Due to a limited local market, most of the production from the modern sector is exported. For example, in 1981, sugar alone accounted for 40 percent of the country's foreign exchange earnings. This overwhelming reliance on sugar whose price fluctuates erratically has increased the vulnerability of the economy to external forces. From 1981 to 1983, because of lower sugar prices, the GOS lost the equivalent of US\$1.0 million a day in revenue foregone from lower export levies. While the country is a net exporter of agricultural products (sugar, processed and canned fruits, wood pulp), it is a net importer of food for local consumption, including from 30 to 40 percent of its maize consumption.

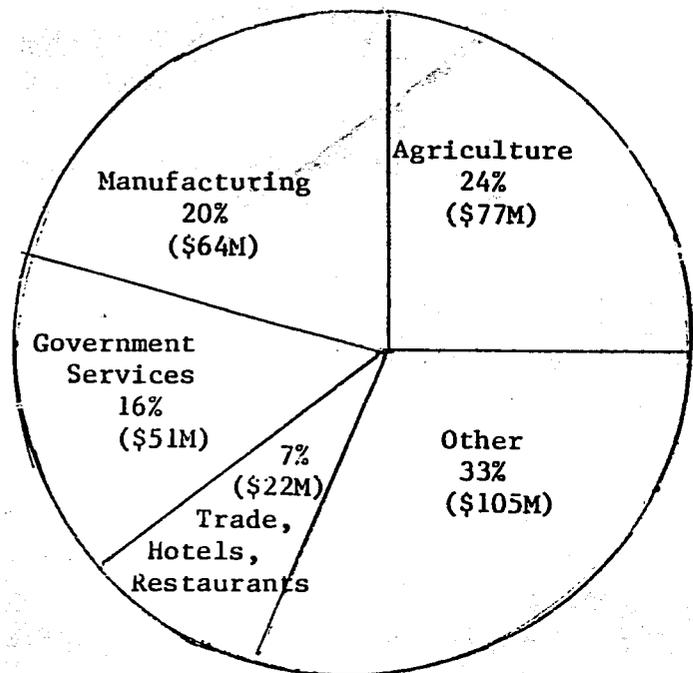
3. Employment

Agriculture employs approximately 75 percent of the total indigenous work force. Agriculture and forestry also provide the largest number of paid jobs--40 percent. Social services employ the next largest number of paid workers (19 percent). Manufacturing provides 12 percent of total wage

1

For additional detail see Annex 3 and The Prime Minister's Office, Economic Review: 1978-1982 (Mbabame: GOS, 1983).

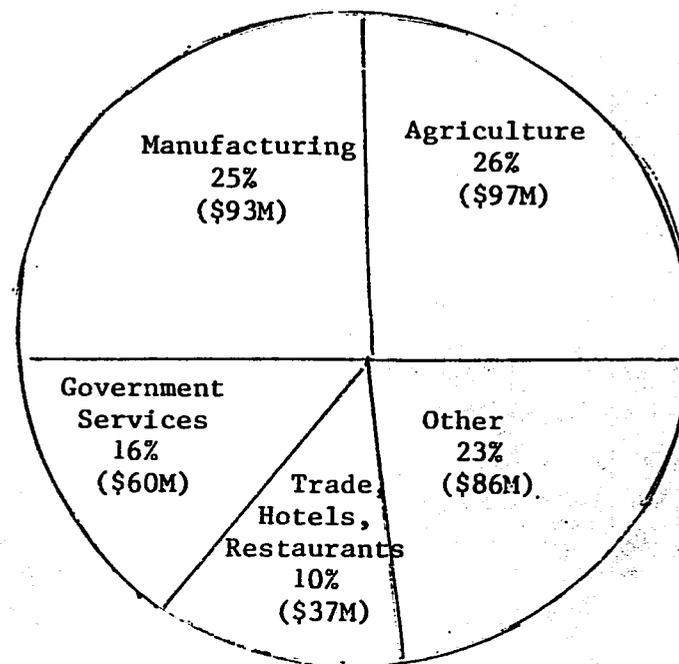
Figure 6 : GDP By Source, Swaziland



1977¹

Total

(1980 U.S. Dollars) \$319 Million



1982²

(1982 Dollars) \$373 Million

¹ Central Statistical Office, Government of Swaziland, Annual Statistical Bulletin (1981).

² Prime Minister's Office, Department of Economic Planning and Statistics, Government of Swaziland, Economic Review: 1978 - 1982 (February, 1983).

employment, construction accounts for nine percent and distribution for eight percent. The private sector provides about 74 percent and the public sector 26 percent of paid employment. Nearly 90 percent of paid employment is in the formal sector while 11 percent is in the informal sector.

Agriculture and forestry account for 69 percent of the employment in the manufacturing sector. The two sugar mills and the pulp and fruit canning factories together provide 45 percent of manufacturing employment.

The average annual growth of formal sector employment was 3.4 percent (resulting in the creation of some 2,400 new jobs each year). However, it is estimated that each year some 7,500 school leavers enter the job market. Thus, the numbers of the unemployed are increasing by five thousand per annum, which is equal to more than five percent of all those employed in 1983. Historically, Swaziland's "excess" labor was able to find gainful employment in the South African mines. However, in the last five years this source of employment has been drastically reduced-- from 21,000 to 11,000.

d. Agriculture

The agricultural sector of Swaziland is sharply dualistic, with a modern capital-intensive subsector, largely owned and managed by foreigners and produced mainly for export, alongside a traditional subsector producing mainly for subsistence. The modern subsector consists of about 790 privately-owned farms and estates on title deed land called Individual Tenure Farms (ITFs), averaging over 800 hectares (roughly 2,000 acres) in size and covering 36 percent of Swaziland's total land area. Much of this title deed land is either undeveloped or occupied by Swazi squatters who use the land with methods similar to those of the traditional farms. The most important crops produced on the ITFs are sugarcane, citrus, pineapples, cotton, maize and rice. These farms also account for more than half of the land area devoted to vegetables.

The traditional subsector coincides largely with the SNL, containing roughly 42,000 traditional homesteads with an average size of two and three-quarters hectares. The great majority (over 80 percent) of SNL, however, is communal grazing land. SNL encompasses approximately 63 percent of the land in Swaziland. The land varies in quality depending on the ecological zone in which it is located.

Ninety percent of the farmers on SNL grow maize. Both ITF and SNL farmers grow cotton. Tobacco and horticultural crops are also grown on SNL.

Livestock, mainly cattle, are owned by both ITF and SNL farmers. Considerable overgrazing results from the large number of cattle held by farmers on SNL. By 1981 there were 655,700 cattle in the country, a figure estimated to exceed the

country's natural carrying capacity by 50 percent. Moreover, the national herd is growing at approximately three percent per annum, although such growth is taking place primarily on SNL, rather than on ITFs.

In 1970 the GOS embarked on a nationwide rural development programme involving SNL which was supported by bilateral funds supplied by the United Kingdom. Presently there are 18 RDAs covering 537,808 hectares, or approximately 49 percent of total SNL (1,092,357 hectares). There are 26,600 homesteads in the RDAs involving 227,000 people, of which 77,000 (34 percent) have their main economic activity away from RDAs. Presently the US\$ 32 million devoted to the RDAs is being supplied by several donors. Loans of US\$ 18.5 million have been supplied by the African Development Bank, the World Bank and the United States; and grants of US\$ 9.3 million have been received from the European Development Fund and the United States. In addition, the GOS has supplied counterpart funds of US\$ 4.2.1 As a result of the RDAP, numerous management and infrastructure improvements have been realized. These include building and improving roads, making agricultural inputs available, fencing grazing areas, improving credit and marketing facilities, intensifying extension activities, improving livestock management and consolidating land holdings. Tractor-hire schemes also have been established. Yields have grown somewhat, as a result of the increased use of fertilizer and hybrid varieties, although the yields of some food crops such as beans and groundnuts appear to have remained relatively stable.

Despite these positive results, however, the RDAP has disappointed its sponsors because it has fallen short of the goals set for it. The output of staple crops, including maize, has risen only slightly on RDAs. The expected increase in the production of cash crops such as cotton and tobacco has not taken place, nor has cattle destocking occurred. In part, these shortfalls may be the result of farmers using modern inputs only to the extent necessary to produce the maize they need for subsistence. Once this limited goal is met, they seek off-farm employment that is more rewarding. Perhaps it is not so much that the RDAP failed, but that unrealistic goals were set for it in the absence of more fundamental structural changes in tenure and tradition. As stated in the aforementioned Economic Review published by the Prime Ministry's Office:

1
Ministry of Agriculture and Cooperation, Rural Development Areas' Programme, Annual Report 1982 (Mbabane: MOAC, 1983).

In the future, with formal sector employment prospects looking increasingly unfavorable in relation to the growth in the labor force, the traditional agricultural sector will have to absorb substantial amounts of additional labor. In order to prevent rural per capita incomes from falling further, structural change in agriculture and rural employment is required if school leavers are to be employed in a remunerative manner. While the RDAP would allow some progress in this direction, a more complete solution to the problem will wait upon more fundamental changes in the structure of traditional agriculture itself.

The net result of Swaziland's efforts to increase agricultural output among traditional farmers has been an annual increase in production over the past several years of only 0.36 percent. During the same period, the commercial farming sector has been increasing its output at an annual rate of over 12 percent. The overall consequence is that food production in Swaziland currently is lagging behind population growth.

2. The development policy

a. Swaziland's National Development Plan

The three overall objectives of the Third National Development Plan (1978/79 - 1982/83) are economic growth, self-reliance, and social justice with stability. To attain the first, the plan set a target to increase agricultural production by 6.5 percent per annum. Achieving this was seen to entail: a higher proportion of cash cropping; the extension of the RDAP to cover 60 percent of traditionally farmed SNL; an improvement in the ratio of extension agents to farmers to 1:300 (1:250 in RDAs); the provision of farm inputs and marketing facilities; conservation; improvement in profitability of livestock farming; an increase in the annual offtake rate of cattle (to 12 percent); and the attainment of self-sufficiency in maize.¹ High growth in the agricultural sector was expected, principally due to the new sugar mill which would increase output more than 50 percent. Strategies to achieve the goal of self-reliance were: to secure more control of productive assets, to strengthen governmental administrative capacity, to develop local sources of goods and services, and to diversify external economic relations. The third goal of social justice would be promoted by spreading economic opportunities and social services more widely and involving rural people more in decision making.

1

The Government of Swaziland, The Third National Development Plan 1978/79 - 1982/83, (Mbabane: GOS, 1984), p. 33-34.

The overall policy in the agriculture sector was "to enhance the quality of rural well-being and to assist Swazi Nation farmers to make the transition from subsistence to commercial and semi-commercial farming,"¹ with the RDAP the primary mechanism. The following were sector objectives: to protect the natural environment; to promote the transfer of agricultural land from foreign to Swazi ownership; to increase crop and livestock production and diversification; to improve extension services; to make farm inputs and services, including credit and marketing, more accessible to farmers and cattle owners; to make basic services; including access roads and potable water, available to RDA households; and to make animal husbandry more profitable.

b. Donor participation

The Department of Economic Planning and Statistics of the GOS coordinates donor assistance to Swaziland. Donor assistance is concentrated in agriculture, industry and education, with most of the activity in agriculture designed to bring small farmers into semi-commercial and commercial production. The most significant activity is the RDAP, which began with U.K. funding and in which USAID, the UK, IBRD and the AfDB are the principal donors. RDAP goals are to increase employment, income and welfare. Also important is the Land Purchase Program, funded by the U.K., which from 1975-1983 has increased the SNL from 45 percent to 63 percent of the total.

Major bilateral donors, and total funds disbursed from 1977-1981, include: the U.K. (\$66 million), Germany (\$31.6 million), the U.S. (\$22 million), Sweden (\$10.6 million), and Canada (\$7.4 million). Total bilateral aid in 1981 was \$25.3 million.² Multi-lateral donors are the World Bank, the African Development Bank, the E.E.C., and the United Nations agencies, especially the UNDP.

Bilateral aid totaling \$49 million in 1979 was 65 percent of total official development assistance received by Swaziland. It was also 15 percent of the GNP and 72 percent of gross domestic investment in that year.³

1

GOS, Third National Development Plan, p. 74.

2

U.S. Agency for International Development, Congressional Presentation Fiscal Year 1984, Annex I: Africa, (Washington: USAID, 1983), p. 441.

3

The World Bank, Accelerated Development in Sub-Saharan Africa: An Agenda for Action, (Washington: World Bank, 1981), pp. 164-5.

Agricultural research programs in Swaziland have been supported by DAC donors as follows: the U.K. helps support the ARD of the MOAC; the U.S. is funding the Cropping Systems Research and Extension Training Program, which aims to increase the economic viability of farming on SNL; Canada has supported research in improving intercropping practices of subsistence farmers conducted by the Faculty of Agriculture of the Luyengo Campus of the University of Swaziland.

3. Agricultural research

a. Background

Agricultural research in Swaziland played a very minor role in agricultural development prior to Independence in 1968. The commercial agricultural subsector had ready access to, and utilized data and results from, other sources of agricultural research. The crop and livestock issues faced by small-scale producers on SNL received almost no research effort.

In 1959 the ARD of the MOAC was created, and in 1962 the National Research Station (NRS) was established at Malkerns. Its initial research was geared more to the needs of the larger ITFs and estates than to those of the smaller farmers living on SNL.

Very little research has been directed to livestock to date. Rather, livestock investment has been in operational programmes such as tick control and dipping, establishing government "fattening ranches" and in protecting Swaziland's borders against hoof and mouth disease.

b. Current programme focus -- commodity groups

Currently, several commercial concerns producing and processing timber, sugarcane, tobacco, citrus and pineapple, support research directed to meeting the needs of their specific crops and companies. These activities are funded by the private sector and, while the results are sometimes available to others, their usefulness is mostly limited to the larger farms and estates which also grow the livestock or crops involved.

Some research has been done on smallholder crops which, until recently, was limited largely to adaptability testing. Swaziland has now introduced the USAID-sponsored CSR which focuses on a broader range of the smallholder's needs. Swaziland also participates in international seed testing programmes, such as INSOY and other varietal evaluations in cooperation with several international agricultural research institutes. Present commodity-oriented research efforts have strong components relating to current or planned cropping combinations for application on SNL.

c. Other considerations affecting research priorities

(1) Research priorities related to financial support

Budgetary support for Swaziland's ARD in recent years has been around US\$600,000 per year, of which the major portion (about US\$500,000) has been in operational or recurrent costs. These funds have been nearly exclusively in support of research on food crops and small-scale farm management, as a result of the recent re-orientation of research policy and priorities brought about by USAID's funding of the CSR. At present, these amounts principally are Swazi counterpart contributions to the CSR supported by USAID.

Meanwhile, estate-oriented research (i.e., pineapple, citrus, sugar cane and forestry) continues to be supported by the respective industries concerned. For example, the annual expenditure for research amounts to US\$50,000 for cotton and to US\$60,000 for forestry. Comparable statistics are not available for pineapple. Research expenditures for the three major sugarcane estates, together with that on the Swaziland Irrigation Scheme (SIS) on which sugarcane and cotton are grown, are estimated to be about US\$ 500,000 annually.

(2) Research priorities related to the assignment of professional manpower

Although at present Swaziland's agricultural research positions mostly are filled, a large percentage of the Swazi staff are undergoing training abroad. When these staff members return, most will be assigned to research activities dealing with food crops and the needs of smallholders on SNL. Table 12 summarizes Swaziland's manpower in research, extension and training. Annex 3 identifies the present training schedules for Swazi research personnel.

(3) Priorities related to donor support

Table 13 shows cumulative donor contributions to agricultural research and related training and extension activities. Recent trends include a reduction in assistance from several traditional sources of support, particularly the IBRD and the U.K., but an increase in support from others including USAID and the EEC.

(4) Other measures of research priorities

An official objective of the GOS is to become self-sufficient in the production of the country's basic foods, primarily maize. As a result, considerable research resources have been directed to these ends by both the ARD and the University of Swaziland (Luyengo Campus).

Table 12 : Human Resources in Agricultural Research, Extension, and Training in Swaziland

<u>Division/Institution</u>	<u>Professional Staff</u>			<u>Percentage Ex-patriates</u>	<u>Technical Support Staff¹</u>	<u>Professionals in Training</u>	<u>Vacant Posts</u>
	<u>Nationals</u>	<u>Ex-patriates</u>	<u>Total</u>				
A. <u>Public Sector/Donor-Funded</u>							
Agricultural Research Division	4	5	9	56	26	n.a.	10
University of Swaziland	8	19	27	70	21	4	10
Mananga Agricultural Management Centre (MAMC)	3	7	10	70	2	---	---
Extension Services Division	33	2	35	6	351 ³	24	---
Total, Public Sector/Donor-Funded	48	33	81	41	398	28	20
B. <u>Private Sector Funded</u>							
Swaziland Fruit Cannery	---	1	1	100	---	---	---
Usutu Pulp Company	---	1	1	100	1	---	---
Simunye Sugar Estate	1	2	3	67	6	---	---
(Two other sugar estates)	(n o t a v a i l a b l e)						
Swaziland Irrigation Scheme	---	3	3	100	4	---	1

¹Includes teaching assistants, technical assistants, and extension agents but not general administrative support staff.

²The MAMC staff includes 85 clerical, maintenance, and other support personnel, but no technical level support staff were identified.

³Includes some persons at diplomate or certificate level who are working in professional positions.

Table 13 : Donor Funding for Agricultural Research, Extension, and Training in Swaziland

<u>Item</u>	<u>Donor</u>	<u>Amount</u> <u>(US \$ millions)</u>
1. <u>Research</u>		
a. <u>Research division</u>		
14 researchers x 14 years @ \$4,000/yr (Salaries topped up)		0.8
Housing		0.1
Offices and laboratories		<u>0.4</u>
Subtotal	U.K.	1.3
USAID Cropping Systems Research and Extension Project ¹	U.S.	9.6
Peace Corps	U.S.	<u>0.1</u>
Subtotal, U.S.		9.7
b. <u>Luyengo campus</u>		
IDRC-Intercropping Projects	Canada	<u>0.2</u>
Total donor funding for government research	CDA donors	11.2
2. <u>Extension</u>		
a. Multilateral Support to 1983		
	IBRI	0.8
	EDF	0.9
	AFDE	<u>1.3</u>
		3.0
b. USAID Cropping Systems Extension and Training Project¹		
	U.S.	<u>3.3</u>
Total donor funding for Extension	U.S. and Multilateral Donors	6.3

¹ Six of the eight-person team are in research and two are in extension.

Table 13: Donor Funding for Agricultural Research, Extension, and Training in Swaziland (continued)

<u>Item</u>	<u>Donor</u>	<u>Amount</u> <u>(US \$ millions)</u>
3. <u>Training</u>		
a. Luyengo (Faculty of Agriculture)		
SIOA Project Personnel		5.6
Associated experts		0.1
Honsiyad offices		<u>0.5</u>
Subtotal	SIDA (Sweden)	6.2
b. Mananga Agricultural Management Training Centre - Recurrent costs (10 yrs. @ \$1 million/yr)		
		10.0
Original capital outlay		<u>1.0</u>
Subtotal	CDC	<u>11.0</u>
Total donor funding for training	Sweden/U.K.	17.2
Overall Total for research, extension, and training		34.2

Sources: Ministry of Finance, Budget estimates for selected years.

Ministry of Agriculture and Cooperatives, Rural Development Areas' Programmes Annual Report, 1982, Mbabane, 1983.

Devres estimates.

Another measure of research priorities is that of "problem areas" as defined by farmers, researchers or others. One such problem area is the increasing stress that the land resource base of Swaziland appears to be under as the population of cattle and small stock increase. Much of the agricultural land of Swaziland is mountainous or hilly, especially on SNL where most of the rural population live. When overstocked, this land area cannot maintain its range productivity. This is even more true with regard to cultivated cropland on this same terrain. Development of a strong data base and preparation of a detailed analysis of it would help ensure that land utilization decisions were made with the benefit of a factual and technically responsible analysis. The MOAC already has operational capability in land use planning and land development, but it has undertaken no research in the broad area of resource management.

4. Production potential and constraints

a. Potential for increased productivity

Table 14 gives current levels of production for selected food and cash crops and calving rates on SNL, together with those documented on ITFs and/or estates and research farms.

The estates are believed to be producing crops at levels very close to the optimum. Their in-house research and testing is linked to similar work being done by both private and public research agencies outside Swaziland. Centralized management also makes it probable that cultural practices, such as time of cultivation, planting rates, and the selection of varieties, levels and timing of use of fertilizers, irrigation and similar activities, follow optimum schedules.

b. Constraints to agricultural production

(1) As viewed by the GOS research, training and extension staffs

Annex 3 describes and analyses the results of interviews with personnel of the ARD, Division of Extension Services (DES) and the Faculty of Agriculture of the University of Swaziland in more detail. Table 15 and Annex 4 summarize the findings of these interviews. Several serious constraints were cited by all three units -- Research, Extension, and Training -- as follows:

- o An inadequate recurrent budget was prominently cited as a serious constraint. This, as well as the responses to other topics, indicates a shortage of financial resources available to the GOS to fund efforts to increase agricultural productivity.

Table 14: Indicators of Agricultural Productivity in Swaziland

A. <u>Crops</u>	<u>Yields (MT/ha)</u>		
	<u>Average Swazi Nation Land, 1980/1981</u>	<u>Average Individual Tenure Farms¹</u>	<u>Potential</u>
<u>Food Crops</u>			
Maize	1.7	--	4 - 6 ²
Jugo beans	0.9	--	1.3 ³
Sorghum	0.7	--	3.5 ²
Beans	0.5	--	n.a.
Sweet Potatoes	1.9	--	n.a.
<u>Cash Crops</u>			
Cotton	1.1	--	n.a.
Groundnuts	0.4	--	2.5 - 4 ²
Tobacco	0.2	--	0.8 ²
B. <u>Cattle</u>	<u>Traditional Sector</u>	<u>Modern Sector</u>	
Offtake	9	13	
Mortality	8	n.a.	
Calving Rate	30	50	

¹The food and cash crops grown on Swazi Nation Land are not generally grown on Individual Tenure Farms. Interviews with several freehold farmers who grow food grains for their workers, however, indicate yields approaching those in the "potential" ranges.

²University of Swaziland at Luyengo, Research Advisory Bulletin, No. 1, 1978.

³Mr. Frank Buckham, Chief Research Officer, personal interview, September, 1983.

Source: Central Statistical Office, Government of Swaziland, Annual Statistical Bulletin (1981).

Table 15: Perceptions of Seriousness of Institutional Constraints
By Swaziland Research, Extension and Training Staff

<u>Topic</u>	<u>Research</u>		<u>Training</u>		<u>Extension</u>		<u>Summary</u>	
	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>	<u>No.</u>	<u>Response</u>
Recurrent Budget	14	2.6	28	2.2	15	2.9	57	2.5
Foreign Exchange	12	1.7	--	--	--	--	12	1.7
Senior Staff Qualifications	12	2.4	28	2.3	16	2.4	56	2.4
Junior Staff Qualifications	14	2.6	28	2.0	15	2.3	57	2.2
Service/Maintenance	13	2.4	26	2.5	--	--	39	2.5
Consistency of Support	12	2.4	--	--	--	--	12	2.4
Laboratory Facilities	14	2.4	27	2.1	--	--	41	2.2
Office Facilities	12	2.1	--	--	--	--	12	2.1
Equipment	13	2.6	27	2.4	--	--	40	2.5
Transport	6	3.0	1	3.0	15	2.5	22	2.7
Telecommunications	--	--	--	--	14	1.8	14	1.8
Teaching Material	--	--	8	2.8	--	--	8	2.8
Video/Films	--	--	3	3.0	--	--	3	3.0
Access to Research	--	--	--	--	16	2.2	16	2.2
Farmer Attitudes	--	--	--	--	15	2.2	15	2.2
Lack of Timeliness	--	--	--	--	16	2.3	16	2.3
Lack of Research Input	--	--	--	--	15	2.3	15	2.3
Policy Problems	--	--	--	--	15	2.5	15	2.3
Service Conditions	--	--	3	2.0	--	--	3	2.0

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

- o Staff qualifications, both senior and junior, were cited as serious constraints. This implies the need for further training. In the case of research, however, all but three senior personnel already are undergoing training.
- o Worn out, antiquated and non-existent equipment was an important constraint to the personnel in all three units.

From Table 15 it also can be seen that:

- o DES personnel emphasized the lack of teaching aids, with specific reference to audio and visual aids, as a serious constraint.
- o DES staff also felt strongly that they had inadequate linkages with ARD. (This, unfortunately, has been the case. However, the USAID Cropping Systems Research and Extension Training Project is a new programme designed to bring the two services closer together. Two of its personnel are posted in the DES and the remaining six in the ARD.)
- o ARD personnel felt strongly that laboratory facilities were inadequate and dilapidated, and needed renovation. New laboratories also are needed.

(2) Physical/environmental constraints

With reasonably good soils, relatively adequate rainfall (although on the light side), and an extended dry season, Swaziland has a modestly good environment for agriculture. Water resources for irrigation, largely limited at present to high consumption levels on estates, are marginally adequate, although subject to potential interdiction by both the Republic of South Africa and Mozambique. However, there is scant knowledge in the country relating to its present and future water needs; this poses a definite constraint. Another major physical constraint to expanded productivity appears to be topography. Much of the SNL is on slopes which, by internationally accepted standards, are considered too steep for crop production. In addition, livestock grazing and stocking decisions have been made based more on tradition and custom than on research findings and recommendations. While such judgements may be valid, the lack of necessary knowledge for proper soil and water management over much of the country poses a clear danger and constraint to long-run sustained production, rural employment and welfare. A comprehensive physical inventory, including rainfall and other climatic data, topographic and vegetative cover, surface geology and soils and land use by soil type, is needed. One use of this data should be used in the preparation of maps of agro-climatic zones containing soil fertility indications and land use information. Research investigations aimed at reassuring both maximum productivity of the resources and sustained yields of

both crops and livestock should build upon the results of this assessment.

While the distribution of rainfall ranked as an important constraint to increased production by a considerable proportion of those interviewed, this subject has not been researched in Swaziland. The development of small-scale water collection, utilization and conservation deserves to be researched. Likewise, research is needed to determine the consumptive use of water by the major crops being cultivated. Such research is essential for the country to be able to prepare its long-overdue national water resources plan.

Like other countries in the SADCC region, Swaziland suffers from high pre- and post-harvest losses. The cost in real terms of such losses, especially in the case of maize, amounts to as much as 20 percent of the crop. If saved, these losses in earlier years would have closed the production gap. Thus, there is a pressing need for on-farm grain storage and processing research geared to the needs and capabilities of the Swazi farmer.

Livestock, mainly cattle, is the common thread running through Swazi society, and is the prime cause of much of the on-going degradation of the country's soil and water resources. However, the USAID-sponsored CSRSP does not include a livestock component, perhaps because of the failure of previous attempts to solve the problems caused by livestock. While it is difficult to change cultural practices which are so interwoven with local tradition and custom, such difficulties should not preclude the inclusion of significant livestock research efforts as part of an overall agricultural research programme.

(3) The capacity of supporting institutions, their management and linkages

The agricultural extension programmes of Swaziland are closely linked to the RDAP, as it is in these areas that between 80 and 90 percent of all expenditures for extension services are spent.

In the past there have not been close linkages between the ARD and the DES. However, more recently MOAC policy directives have been promulgated that emphasize closer working relationships between these Divisions. As a result, the ARD and DES are working together more closely and the DES is also becoming the "feedback" mechanism so vitally needed by the ARD. Further assistance in this re-orientation also is resulting from the activities of the CSRSP, which has its personnel posted both in the ARD and DES.

The other public entity which has close, albeit weak, linkages with the ARD is the Faculty of Agriculture at the Luyengo Campus of the University (one time the ARD of the MOAC was part of the University). Unfortunately, however, while the University does give a BS degree in General Agriculture, it

does not have the facilities or personnel to train students in the physical sciences required in research laboratories and programmes. Thus, students who wish to work in agricultural research must seek further training outside the country.

(4) Infrastructure serving agriculture

Adequate credit and marketing services are extremely important in the agricultural development process. In Swaziland, these services are inadequate--especially as they affect farmers and farming on SNL.

While short-term credit is available, it can only be obtained by mortgaging cattle (from US\$80 to US\$100 per animal, depending on its condition). If the farmer does not own cattle, or if they already have been mortgaged, his only recourse is to have a friend or relative lend their cattle as security. Yet in spite of the importance of cattle to the overall culture of the country, only a small number (28,000) of those living on SNL own cattle--thus the amount of short-term credit that can be granted under existing conditions is limited. Most SNL farmers cannot obtain long-term credit either. Those who farm SNL, including those in RDAs, do not have title to the land for mortgage purposes, which means that little long-term credit is available to them. As a result, very few SNL farmers are able, or willing, to lime their soils, provide drainage, plant fruit trees or carry out any other activities of a long-term nature. The RDAP recognizes these as constraints and has sought to solve some of them by: providing lime at subsidized prices which the farmers could afford; by providing fencing; by making tractor-hire pools available at subsidized costs; by providing other such services. In addition, the Land Development Unit and Land Use Planning Sections of MOAC provide irrigation and land treatment measures, including terracing, drainage, road building and other long-term capital improvements to the RDAs.

With the exception of those crops which have institutionalized marketing structures (e.g., sugarcane, forest products, pineapple, citrus, tobacco and cotton), Swazi agriculture is faced with a serious constraint in the form of marketing facilities that are poorly organized and deficient. This is especially true in the case of maize (inadequate pickup, grading, storage, etc.) and horticulture (transportation, grading, packaging and farmers' market facilities).

Both the Central Cooperative Union of Swaziland (CCU) and the RDAP have provided some marketing services, but their efforts have not met the need fully. Under the RDAP, for example, investment in facilities such as marketing depots and farmer's sheds have been made. However, the absence of a crop marketing or procurement system to utilize these facilities to service small farmers means that their access to market outlets for any crop surplus is still restricted.

There is a pending IFAD project to finance a US\$6 million Marketing Board which, if approved and accepted by the GOS, would contribute considerably to alleviating the country's marketing problems. In addition, Government has recently installed silos for grain storage which have been justified on the basis of food security. However, the extent to which they will become functional is unclear at this time.

(5) Policy constraints

Policy constraints to Swazi agricultural development are varied. However, they can be "lumped" into two broad categories--those having to do with the GOS's contradicting goals of 1) self-sufficiency in maize production and 2) low food prices for the urban population. The policy supporting the latter goal includes the relatively free importation of maize at RSA prices plus transport. Large RSA farmers take advantage of economies of scale and receive direct and indirect subsidies from their government, thus producing maize at low costs. This enables low maize prices in RSA, which constitute an integral element of that country's policy of keeping wages down so as to subsidize its industry. Swaziland thus is able to import South African maize at mill prices plus transport. The result is that small unsubsidized Swazi farmers using traditional cultural practices are at a distinct disadvantage in seeking to produce maize at relatively high costs which must be sold in a market with ready access to cheap supplies from the RSA. Given the prices gazetted annually for maize by the GOS, Swazi farmers, especially those on SNL, cannot produce and market the crop at a profit. Further, under existing conditions, the returns to labor from maize production do not match those from urban-based activities or working in South Africa mines.

(6) Social/cultural constraints

Social and cultural constraints to increased agricultural output are important in Swaziland. One such constraint is the relatively uncontrolled cattle grazing on SNL, which is slowly but surely destroying the country's land base. A prominent slogan of the GOS printed on all official stationery reads "The Soil is our most important resource--help conserve it!" However, until Swaziland comes to grips with this problem, little can be done to stop the persistent degradation of this asset. The late King Sobuza stated: "We must keep those elements of Swazi tradition and custom that are useful and meaningful and eschew those that are not." He also spoke of Western values in this same manner, i.e., accepting those that would enrich Swazi society and spurning those that would not.

Another constraint of importance (and to some of those interviewed, the most important) is the relationship of the price of maize and the area farmed by an individual. The production of maize is not profitable in comparison with other alternatives -- whether real or imagined. To raise prices offered for maize, however, would cause considerable disruption in the market and could result in hardships for the population as a whole.

Merely enlarging the area to be farmed by one farmer is but one alternative among many. However, other models exist which could be investigated. For example, cooperative or kibbutz-type farms offer some potential. Other models might be structured that would pose no threat to the basic fabric of Swazi custom and tradition. The GOS should encourage the ARD and the Economic Analysis and Planning Section, both in the Department of Research and Planning of the MOAC, to research the various alternatives and produce a set of recommendations and options for consideration by the proper authorities.

c. Summary analysis of production potential and constraints

Much room remains for the enhancement of yields on SNL. However, it is not practical to attempt to increase yield levels of smallholders to those on experimental farms or on the better private farms without radically changing the state-of-the-art of the former. This area of research needs to be more effective to enable smallholders to realize some of the potential evident in Table 14. Furthermore, because a set of encumbering customs and traditions hinder the nation's farmers from accepting and implementing appropriate technical and management systems (the product of agricultural/social research), changes in the state-of-the-art for smallholders must be accompanied by new criteria to govern economic, technical and social decisions. This area needs to receive more attention than is accorded it at present. In addition to these factors, natural resource characteristics such as topography, soil type, rainfall levels, etc. pose important constraints to agricultural production in Swaziland. However, little is being done in agricultural research to alleviate these natural resource constraints with the possible exception of research related to dry-land tillage, agronomy and soil fertility. More research needs to be carried out in this important area. For example, as pointed out above, research related to soil and water consumption (excluding pasture carrying capacity for livestock and sustained crop yields) should be undertaken. To do this, however, would require a significant alteration in the structure of the ARD on an expansion of the Division.

The possibilities for notable increases in yields being realized are not optimum now for another reason. Specific problems faced by the research, extension and training institutions that serve small farmers hinder agencies, effectiveness in removing constraints in the three broad areas outlined above. These problems have already been mentioned, but they

include: an inadequate recurrent budget; poorly qualified staff; inadequate facilities, institutional support service and infrastructure; and insufficient data concerning the country's natural endowment. To enable the entire farming community to realize its full potential, these problems must be dealt with definitively and as quickly as possible.

ANNEX 1

Botswana

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ANNEX I

Botswana

A. General Background

1. The land

A landlocked country, Botswana is bounded by the Republic of South Africa on the south and east, by Zambia and Zimbabwe on the north and east, and by Namibia on the west. With an area of 582,000 square kilometres, Botswana is about the size of Kenya or France. It is a generally flat country with a mean altitude of 1,000 metres (3,300 feet).

The climate of Botswana is subtropical with an average annual rainfall of about 475 mm, ranging from less than 250 mm in the far southeast to more than 650 mm in the northeast. Rainfall is quite erratic and temperatures vary greatly from area to area. Temperatures may reach 38°C in the summer, but they seldom fall below 5°C in winter. There are, however, wide diurnal changes. Night frosts do occur, especially in the southern part of the country.

Surface water is very scarce throughout the country, except in the Okavango Delta in the northwest. As a result the groundwater system plays a very important role in the livelihood of Botswana.

While the Okavango Delta has aquatic plants, vegetation in other parts of the country is sparse due to dry spells and periodic severe droughts. Because of its higher rainfall, the Chobe District in the northeast supports a belt of indigenous forest and dense bush. Limited commercial hardwood exploitation is possible in this area. The rest of the country is characterized by scrub and tree savannah. The Kalahari Desert in the south supports only small-shrub savannah.

2. The people

At the time of the 1981 Census, Botswana had a population of about 940,000. An additional 42,000 were estimated to be living abroad, mainly as workers in South Africa. The high annual population growth rate of 4.6 percent over the past decade could be due to net inward migration and/or to underestimation of the population in the 1971 Census. Botswana's population density of 1.6 persons per square kilometre is among the lowest in the world. The majority of the people, however, live in the eastern part of the country. Most (83 percent) live in rural areas (see Figure 1-1) The major urban centres--Gaborone (the capital), Francistown, Lobatse, Selibe-Pikwe, Orapa and Palapye--are also located in the east. The percentage of the population living in urban areas increased from eight percent in 1971 to 17 percent in 1981, doubling in the past decade. The urban population has

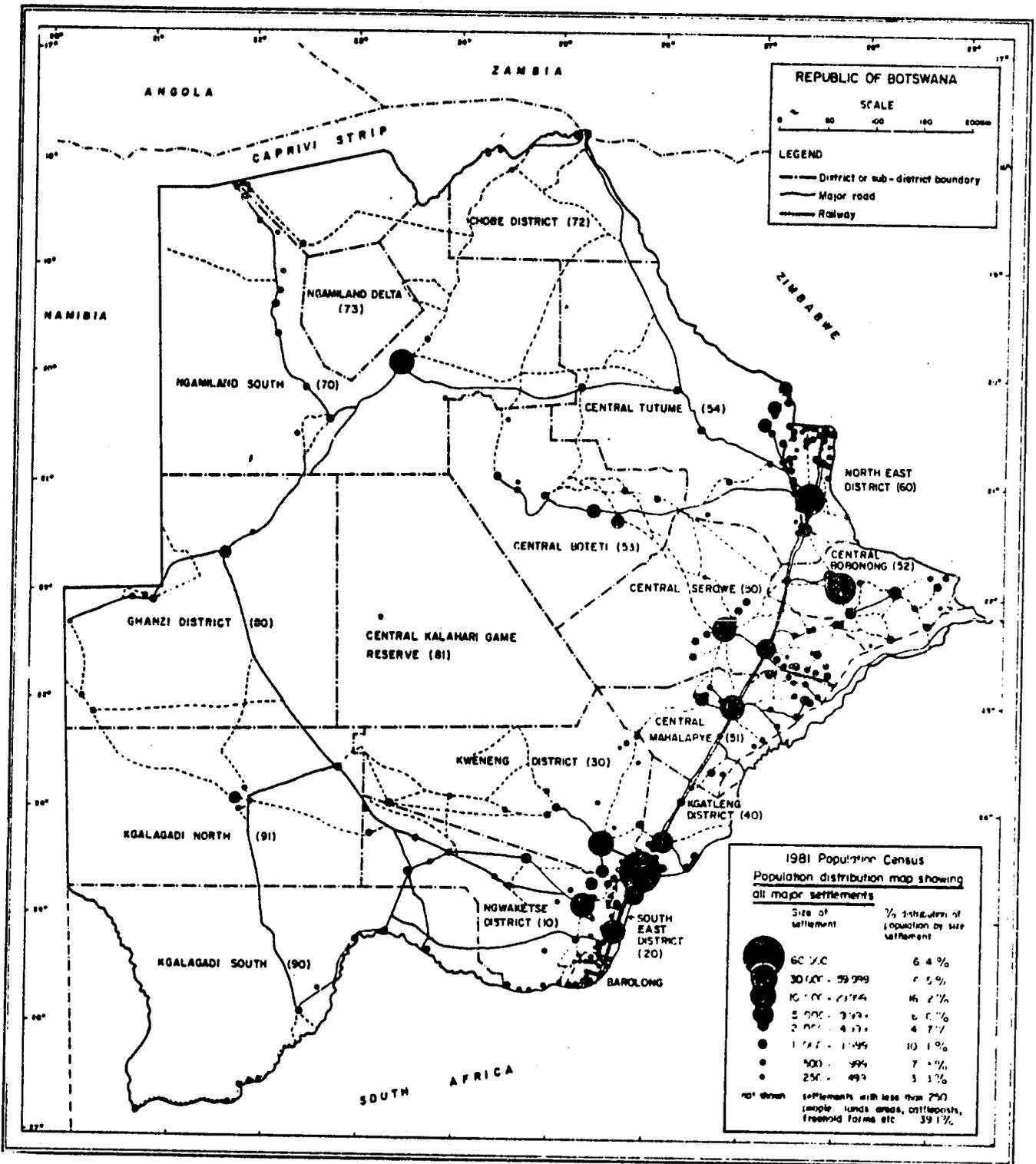


Figure 1-1: Population Distribution (1981 Census), Botswana

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grown at an average annual rate of about 11 percent, while the rural population growth rate is about four percent.

About 50 percent of the population is under 15 years of age and 54 percent of the population is female. In 1971, eight percent of Batswana resided outside the country, primarily in South Africa, and 80 percent of these were men; in 1981 only four percent of Batswana resided outside the country. In both 1971 and 1981 two percent of Botswana's population were foreign.

The per capita GNP was estimated at US\$ 902 in 1983, a figure higher than that of most of Botswana's developing neighbours. The Physical Quality of Life Index (PQLI) was 44, on a par with neighbouring countries, but less than half that of most higher-income countries.

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Internal migration from traditional settlements, such as cattle-posts and villages, to urban areas in Botswana has accelerated since Independence. This migration is due in part to the lack of employment opportunities and social services in the rural areas. Poor return from highly risky agriculture has also contributed to this movement.

A large number of Batswana emigrate to South Africa to work in the mines or in the towns. The majority are males from 15 to 34 years old. About half are illiterate. The number of Batswana migrants working in South African mines has decreased significantly (from over 40,000 in 1976 to under 18,000 in 1981), due to South Africa's policy of giving first priority to Africans within South Africa.

3. The economy

a. The Gross Domestic Product

The Gross Domestic Product (GDP) of Botswana in 1980/81 was about US\$ 780 million (P800 million). Twenty-six percent of the GDP came from mining, especially of diamonds and copper-nickel. Agriculture contributed only 12 percent to the GDP. This represents a significant change in the structure of the economy. From 1973/74 to 1980/81 the agricultural sector's contribution to the GDP declined from 34 percent to 12 percent, while the mining sector's increased from 9 percent to 26 percent. Agriculture is an important contributor to the manufacturing sector, which is dominated by the Botswana Meat Commission. The manufacturing sector's share of the GDP remained about the same (increasing from 5.5 percent to 6.0 percent) during this seven-year period. The trade, hotels and restaurants sector's contribution to the GDP rose from 15 percent to about 24 percent. The Government's contribution to GDP during this period increased from 9.8 percent to 14 percent. The real average annual growth rate of the GDP during this period was 10 percent. It was projected in the latest National Development Plan that the GDP will have increased in real terms by an average of 10.1 percent per year between 1979/80 and 1984/85.

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b. Foreign trade

Botswana's export trade is dominated by diamonds (60.8 percent) and copper-nickel (20.7 percent). From 1978 to 1980 the share of exports contributed by minerals doubled from 41 percent to about 82 percent; agriculture's contribution decreased by almost 50 percent, from 14.7 percent to 8.0 percent, particularly because foot and mouth disease adversely affected Botswana's beef exports.

Botswana's main imports in 1980 were food, beverages and tobacco (16 percent); fuel (13 percent); machinery, equipment and vehicles (27.2 percent); and metal and metal products (11 percent). The proportions of these items in relation to the country's total imports did not change significantly from 1978 to 1980.

Most of Botswana's import trade is with the Common Customs Area (South Africa, Lesotho and Swaziland), while its export market is largely in Europe, followed by North and South America. Botswana's trade with African nations other than members of Common Customs Area is very insignificant. However, with the formation of the Southern African Development Coordinating Conference (SADCC), it could be expected that trade with Africa may grow. Among SADCC's long-term aims are: reducing dependency on South Africa, increasing interstate economic and technical cooperation, and improving the use of scarce human and physical resources to the benefit of all while acknowledging the comparative advantage of each member state.

c. Employment

Most of the people of Botswana, in both the urban and rural areas, are either unemployed or under-employed. That the number of Botswana migrants employed in South Africa has diminished by over half since 1976 adds to the existing problems, especially in urban areas. Those who have been dependent on the remittances received from their family members working in South Africa are also adversely affected.

The labour force in Botswana is estimated to be growing at an annual rate of three percent. Wage-earners, those employed in the formal sector, constitute about 17 percent of the total labour force and about 10 percent of the population. They received approximately 37 percent of the GDP in 1979/80; on the other hand, the rural population (about 80 percent of the total) received only 12 percent of the GDP. The principal beneficiaries of Botswana's economic growth have been civil servants and those employed in the private sector. The public sector was the largest employer, providing 28 percent of the jobs in the formal sector. The government's share of formal sector jobs was followed by construction (16 percent), wholesale/retail trade and hotels (12.5 percent), and mining and quarrying (8.6 percent). The role of agriculture (freehold and commercial) has been insignificant (5.2 percent) in this sector. The mean monthly

earnings of those employed in the formal sector differ significantly between citizens and non-citizens and between sectors. For instance, while the average monthly earning of citizens employed in agriculture was US\$38 in 1980, that of non-citizens in this sector was US\$442; in electricity and water the earnings were US\$185 and US\$1,559 for citizens and non-citizens respectively. The monthly earnings in government positions were also significantly different for citizens and non-citizens.

Employment in agriculture involves many Batswana, but most people in this sector are under-employed even though they may work in a combination of agriculture and off-farm activities. Cattle, for example, provide no employment for 30 percent of farm families (84,200 households) because they do not own any cattle. Furthermore, 45 percent of the national herd of about 3 million cattle are owned by less than ten percent of the farming households. The most disadvantaged with respect to unemployment in agriculture are women, the elderly and children. Consequently, most of these engage in a combination of risky agriculture and off-farm activities, such as beer-brewing, clothing and basketry. As a result of these and other disparities, farm income contributed only 13 percent of the total income of the poorest households, while contributing 65 percent of the income of the richest households. Off-farm activities contributed 44 percent to the income of the poorest households and less than 20 percent to the income of the richest ones (see Figure 1-2).

4. Basic infrastructure

a. Transportation

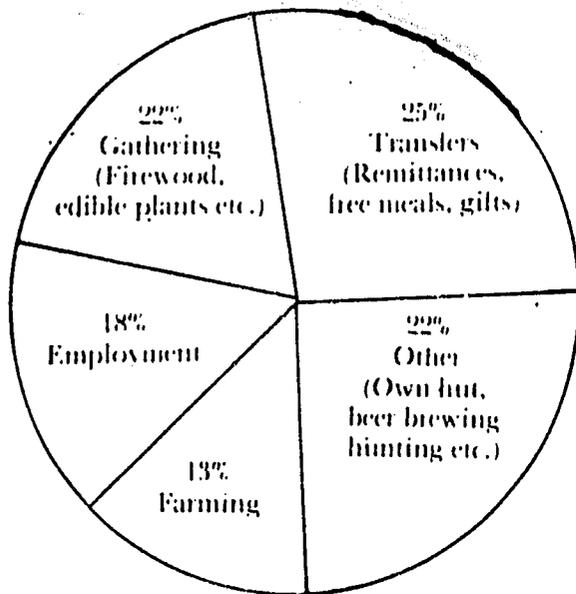
In 1980/81 Botswana had a road network of 8,015 kilometres, of which 15 percent were bitumen, 21 percent gravel and 64 percent earth. Much of the road network in sparsely settled areas in the western portion of the country is not highly developed nor is it of a standard to accommodate trucks for the transport of goods and cattle. Government-financed cattle trek routes have been established to assist in moving cattle to markets.

There are ten local airports. A new international airport is under construction at Gaborone.

The National Railways of Zimbabwe presently owns and manages 714 kilometres of railway line along the eastern edge of Botswana. This contributes to the transportation of people, goods and mail among major urban and mining centres. It is planned for Botswana to take over the railway line by 1986;

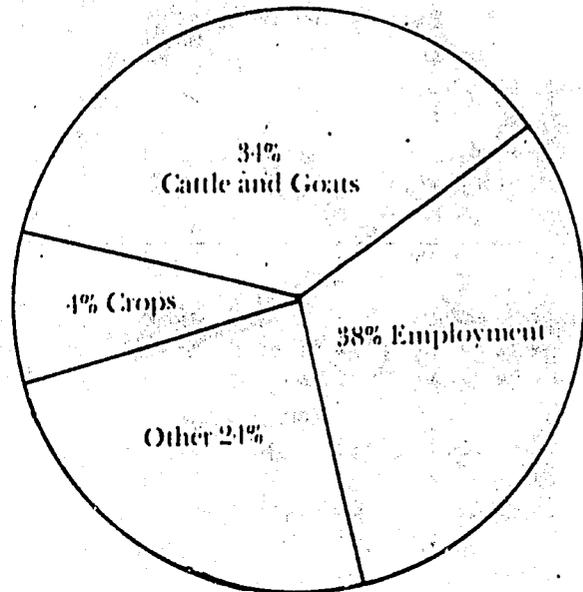
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Based on 1983 official exchange rate of about 1.23 Pula per U.S. dollar.



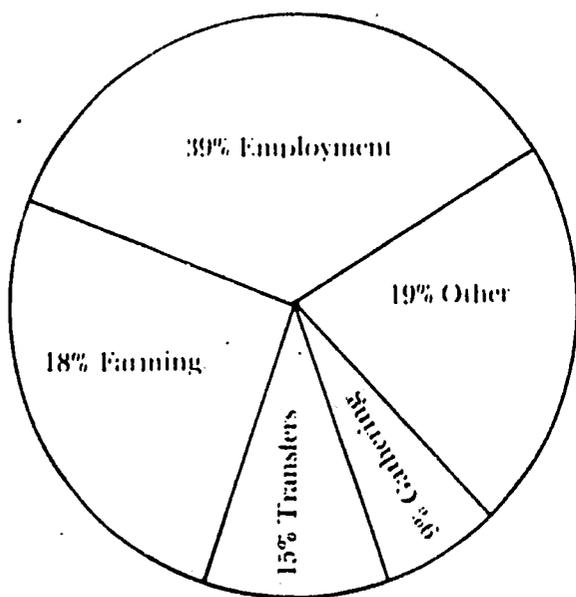
Poorest Households (lowest 10%)
Average income: P160 p.a.
(70% in kind)

(a)



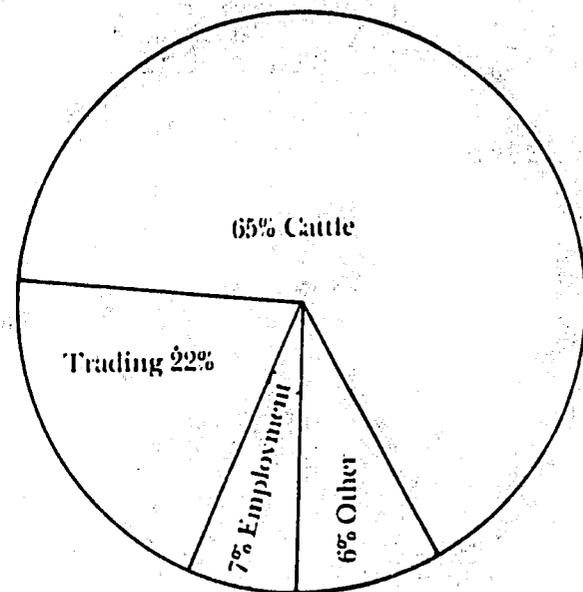
Upper Middle Income Households
(60-95 percentile)
Average income: P1 670 (40% in kind)

(c)



Lower Middle Income Households
(15-50 percentile)
Average income: P130 (50% in kind)

(b)



The Richest Households (99.0-99.9)
Average Income: P9 140 p.a. (30% in kind)

(d)

Source: Rural Income Distribution Survey.

Figure 1-2: Income (By Source) for Rural Households

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twelve locomotives have already been purchased and training of technical staff has been intensified.

b. Communications

In March 1982, there were 7,775 telephone subscribers in the country. About 70 percent of the lines are located in the urban areas. Communications in remote rural areas is a very serious problem. Most people in rural areas must travel long distances to meet their immediate needs, making face-to-face communication difficult as well. Botswana has six radio stations, five of which are AM and one FM. Its two TV stations depend heavily on South Africa for programming. There is an INTELSAT satellite ground station. Over one hundred firms have telex addresses.

c. Education

Although there has been an increase in educational opportunities to Botswana since Independence, secondary schools in Botswana still are able to absorb only about 30 percent of Standard 7 graduates into Form I. A very small number of Botswana reach institutions of higher learning.

The inability of Botswana to provide more opportunities for higher education also frustrates its efforts to localize posts. For instance, in 1980 21 and 19 percent of the posts in the central government and the Ministry of Education, respectively, were held by expatriates. The dependence on expatriate staff and untrained teachers in the educational sector, in particular, has been very serious. In 1981 about 43 percent of the 921 secondary school teachers were expatriate, and 34 percent of the 5,974 primary school teachers were untrained. This dependency on expatriate staff, especially in mathematics and science, may cause serious problems, including lack of continuity and the inability of the country to design educational curricula appropriate for its development efforts. Even if the goals of the present National Development Plan for mathematics and science teachers are met, Botswana will still meet less than 30 percent of its requirements in these areas. The university prepares very few teachers in mathematics and the sciences. As in other developing countries, the education profession must compete for science candidates with other professions, for example, engineering, medicine and agriculture.

d. Health and nutrition

It is estimated that over 90 percent of the population now have access to health care. This achievement is principally due to the many mobile clinics which operate throughout the country. At the end of 1980 there were 14 hospitals, seven health centres, 103 clinics (32 with maternity wards), 215 health posts, and 341 mobile clinics in operation. About 121 members of the medical and dental professions, 1071 nursing personnel and

476 family welfare educators helped to provide health services to the public.

During the years since 1971, the government significantly increased expenditures in health, leading to improved child care and increased outpatient and related services.

The Nutritional Surveillance System, which monitors monthly the conditions of children up to 4 years old, reports that over a quarter of Botswana children attending about 380 clinics in the country in a given month are nutritionally at risk. A high level of physical underdevelopment, exacerbated by protein calorie malnutrition (PCM), is also reported. Malnutrition among children is both seasonal and area-based. Serious malnutrition among children reaches its peak in November and December when food supplies are lowest and falls in June and July during crop harvests. In drought years, however, the problem of malnutrition may be very critical if immediate outside food assistance is not readily available. The vulnerability of children to certain diseases is largely associated with their nutritional levels.

B. The Agricultural Sector

1. Ecology

Botswana's climate is semi-arid, with cold, dry winters and generally wet summers. However, both country-wide and local dry spells often occur, even during the rainy season (November to March). Summer temperatures average 23°C to 28°C; winter temperatures average between 15°C and 20°C, falling dramatically at night. No part of the country is entirely free of the risk of frost, although in the northwest frosts are few and mild. Further, extreme and rapid changes of temperature that occur in part as a result of low rainfall and sandy soil adversely affect planting and germination. Crops such as millet and some varieties of sorghum and maize are best able to withstand high temperatures, if moisture stress is not too severe.

Average annual rainfall ranges from less than 250 mm in the southeast to more than 650 mm in the northeast (see Figure 1-3). Generally, the low and erratic rainfall is a serious constraint to agricultural development. Seasonal variations range from as high as 80 percent in the southeast to less than 25 percent in the northeast. In addition, rainfall distribution varies greatly both between and within areas and seasons. The climate in the east tends to be more favourable for agriculture; it is this to which the higher concentration of people in this part of the country may be attributed.

2. Soils

Only about five percent of Botswana's land is estimated to be suitable for farming. Most of Botswana's arable soils are sandy and deficient in phosphorus. Drainage is not a problem, due to the high sand content of most soils. The most arable

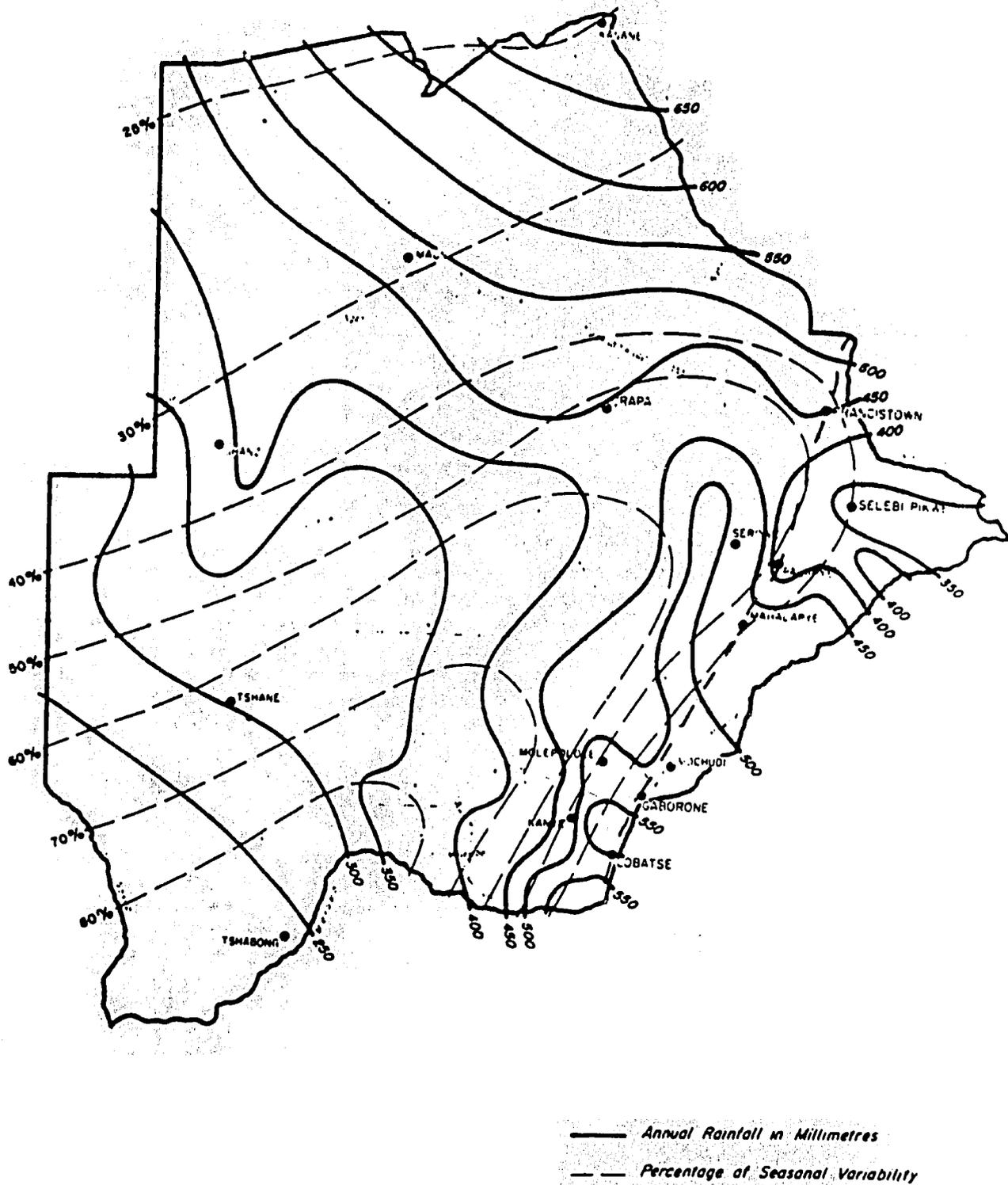


Figure 1-3: Rainfall in Botswana

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soils are located principally in the eastern part of the country. Except for isolated areas in the Chobe, Okavango Delta, around Serowe and in the south and eastern parts of the country where relatively clay-rich soils can be found, between sixty and seventy percent of the country is covered by Kalahari sands.

Poor rainfall and generally low-phosphorus soils produce grasses of low nutritive value and low carrying capacity. The high sand content of Botswana soils is partly responsible for the high evapotranspiration, which in turn adversely affects effective rainfall for crops. Excess acidity or alkalinity is another limiting factor. Kalahari sands usually tend towards acidity, except in the Okavango Delta area.

Organic matter is minimal in Botswana's soils and could improve soil structure, including the ability to retain moisture. Organic matter levels are almost always low except for short periods after harvest or following the application of kraal manure.

3. Land use

In the course of the zoning exercise of the Tribal Grazing Land Policy (TGLP), about 12 percent of Botswana's surface area has been zoned as commercial, 30 percent designated communal, and the eventual use of 25 percent is still undecided (see Table 1-1). The remaining 33 percent is made up of forests (one percent), game resources and wildlife management (27 percent), and existing freehold and leasehold farms (five percent), which fall outside the scope of the TGLP land-zoning exercise.

Lands designated as communal and freehold are both being used for crop and livestock production. Land that has been designated commercial, however, is limited to cattle ranching. It can be developed for commercial cattle ranching by an individual or group by signing a 100-year renewable lease. All prospective cattle ranchers signing leases are expected to follow modern management techniques in order to make their ranches commercially viable units. Freehold farmers are also expected to use modern techniques. Rights of usufruct are granted to each member of district communities for the land zoned as commercial in that district.

The greater proportion of commercial, communal, yet unzoned, and free or leasehold land is presently used by livestock, although some of these areas are not fully exploited by livestock due to inadequate water supplies. It is hoped that land that is not yet zoned can be used for commercial ranching when the need arises.

Table 1-1: Land Zoning and Use in Botswana

<u>Land Use Category</u>	<u>Area ('000 square km.)</u>	<u>Percentage of Total</u>
Zoned Commercial	67.8	11.6
Zoned Communal	172.7	29.6
Not Yet Zoned	148.5	25.5
Free - or Leasehold Farms	27.6	4.7
National Parks and Reserves	103.5	17.7
Wildlife Management Areas	<u>63.0</u>	<u>10.8</u>
Total ¹	583.1	100.0

¹Total differs slightly from Botswana's total area due to the disparate sources of land use data. Percentages have been rounded.

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4. Comparative yields in the agricultural sector

a. Crops

There are three basic production systems in Botswana: communal or traditional, commercial/freehold, and government.¹ In 1980, farmers in the traditional sector (those that produce crops principally for home consumption) accounted for 85 percent of food grain production, while the commercial farms contributed only 15 percent (see Table 1-2). The traditional sector accounted for 96 percent of all land planted in the major food crops (sorghum, maize, millet and beans/pulses). Production of the major cash crops (groundnuts and sunflowers) was about equal in the traditional and the commercial sectors (53 percent versus 47 percent, respectively). The traditional sector, however, accounted for 63 percent of the area planted in these crops. Commercial farmers enjoy a monopoly in the production of vegetables and citrus fruits.

In order to give some indication of the gaps and the potentials of the applications of improved technology in the setting of Botswana, yields of the commercial and traditional sectors were compared. It should be recognized that a full-scale, in-depth analysis was not attempted. A comprehensive study of the gaps between present yields and potential yields on farmers' fields would likely produce greater precision and validity. No attempt was made to conduct a comparative economic analysis of the systems that produced different yields. It should be understood also that only rough yield estimates were obtained. It was impossible to obtain yield estimates of certain crops from data available from various departments within government. Data reported on yields from research stations are shown only to provide some indications of what might be technically feasible.

When yields of the commercial and traditional systems were compared, it was found that yields in the commercial sector were higher than in the traditional sector by a factor of two or more to one in all the crops. Table 1-3 shows the yields of both food and non-food cash crops by production system. While the sorghum yield in the traditional sector is half that of the commercial sector, maize yield from the traditional sector was only one-fifth (1/5) that of the commercial sector. As would be expected, yields obtained from the Government's Research Station experimental plots and fields were considerably higher than those of the traditional sector and the commercial sector.

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Commercial production here includes both farmers in the communal areas who farm commercially and those with freehold farms. The "government" system refers to improved management practiced on research farms, which does not contribute directly to Botswana's agricultural production.

Table 1-2 : Attributes of the Traditional and Commercial Farm Sectors

	<u>Farms</u>		<u>Cattle</u>		<u>Smallstock</u>		<u>Food Crop¹ Production</u>		<u>Cash Crop² Production</u>	
	<u>(number)</u>	<u>(percent)</u>	<u>(thousand head)</u>	<u>(percent)</u>	<u>(thousand head)</u>	<u>(percent)</u>	<u>(metric tons)</u>	<u>(percent)</u>	<u>(metric tons)</u>	<u>(percent)</u>
Traditional Sector	80,000	99.6	2,455	84.3	758	96.4	38,105	85.1	903	32.2
Commercial Sector	360	0.4	456	15.7	28	3.6	6,695	14.9	1,897	67.8
TOTAL	80,360	100.0	2,911	100.0	786	100.0	44,800	100.0	2,800	100.0

1 includes sorghum, maize, millet and beans/pulses.

2 includes groundnuts and sunflowers only. Commercial farmers enjoy a virtual monopoly in the production of other cash crops such as cotton, citrus, etc.

Source: Agricultural Statistics Survey, 1980

Add

Table 1-3: Area Planted, Production, and Yields for Principal Crops in Botswana

	Area, 1981 (¹ 000 ha)		Production, 1980 (¹ 000 MT)		Production, 1981 (¹ 000 MT)		Average Yields, (kg/ha)				Optimum Research Yield, 1979
	Tradition- al Sector	Commercial Sector	Tradition- al Sector	Commercial Sector	Tradition- al Sector	Commercial Sector	Tradition- al Sector, 1980	Commercial Sector, 1980	Tradition- al Sector, 1981	Commercial Sector, 1981	
Sorghum	118.4	4.0	27.2	1.9	26.5	1.8	215	460	224	450	2,544
Maize	53.7	5.6	6.9	4.7	16.4	5.0	167	907	306	893	2,728
Millet	12.6	0.1	2.3	-	1.8	0.06	n.a.	n.a.	144	600	n.a.
Beans/ pulses	14.5	0.2	1.8	0.05	2.6	0.1	144	250	176	700	1,303
Subtotal, ¹ Food Crops	199.2	9.9	38.1	6.7	47.3	7.0	-	-	-	-	-
Sunflower	1.0	1.9	0.2	1.2	0.4 ²	0.4 ²	151	367	385	508	1,000
Groundnuts	1.7	2.6	0.7	0.7	0.7 ²	0.7 ²	116	515	416 ²	416 ²	1,119
Subtotal, ¹ Cash Crops	2.7	4.5	0.9	1.9	1.1	1.1	-	-	-	-	-
Total ¹	201.9	14.4	39.0	8.6	48.3	8.1					

¹ Inconsistencies due to rounding.

² Figures appear questionable; may be in error.

Sources: Central Statistics Office, Ministry of Finance and Development Planning, Country Profile, Botswana, October, 1982.
Agricultural Statistics Survey, 1980.

Division of Arable Research, Department of Agricultural Research, Annual Report, 1979/80.

Although these results are a reflection of performance of each production system, they do not necessarily mean that each sector is more efficient than the other. For instance, it would be inaccurate to suggest that the commercial sector is more economically efficient in grain production than the traditional sector. Unless the physical, technical, social, and economic circumstances of each system are analyzed and understood, conclusions on economically feasible yields would be unwarranted. There are few instances in Botswana where experiment station research results have been evaluated on farmer fields to determine their appropriateness and cost-effectiveness. Almost all the commercial farmers and the Government Research Stations use modern inputs, such as fertilizer and hybrid seeds, and other modern methods of farming. Their resource-base is very different from that of the majority of small farmers. The small scale farmers in the traditional sector rarely use fertilizer or hybrid seeds. They resist using hybrid seeds, partly because of palatability. Many farmers still prefer the long-maturing local varieties. However, the Arable Land Development Programme (ALDEP) is designed to improve the resource base of the majority of small farmers, hopefully enabling them to adopt modern agricultural practices. For instance, ALDEP will subsidize small farmers to purchase draftpower, farm implements, and fencing material, improving their basic resources. In addition, grain pricing policies are being designed to encourage more production. The indicative comparative average yields of Table 1-3 suggest that, even in the difficult ecological situation in Botswana, the technical limits of production for either the traditional or the commercial sector probably are much higher than that currently attained. Achieving higher yields in either sector will depend on the availability of improved technical packages that recognize fully the economic and other constraints facing each sector. However, if it were possible to double the sorghum yield in the traditional sector from 225 to 450 kg/ha, it would contribute greatly to the food security of the rural population. Since a majority of the total production is in this sector, even this moderate increase would obviously contribute greatly to national food security goals.

b. Livestock

Communal, commercial and government systems are also practiced in raising livestock. In 1980, traditional farm households accounted for 99.6 percent of all farming households in Botswana and also owned 84 percent and 96.4 percent of cattle and smallstock, respectively. The commercial sector, with less than one percent of the farming community, owned 16 percent and 3.6 percent of cattle and smallstock, respectively (see Table 1-2).

The differences between these production systems were not as great in livestock production as in crop production (see Table 1-4). In general, commercial farmers and the government research stations use better husbandry methods than traditional farmers. They take frequent disease and parasite control measures; use better grazing systems, especially rotation; provide feed

Table 1-4: Livestock Production Indicators for Botswana

	<u>Population</u> (<u>'000 head</u>)	<u>Offtake</u> (<u>percent</u>)	<u>Mortality</u> (<u>percent</u>)	<u>Calving Rate</u> (<u>percent</u>)
<u>Cattle</u>				
National Traditional Sector	3,000	8	11	58
Commercial Sector	-	16	4	62
Research	-	20 ¹	10	78
<u>Goats</u>	700	n.a.	n.a.	-
<u>Sheep</u>	200	n.a.	n.a.	-

¹ Research offtake should be interpreted cautiously: it includes young bullocks between 1 year and 1½ years which must be sold to the Government Bull Subsidy Scheme each year. The approximate offtake after adjusting for the bull subsidy scheme would be about 18 percent.

Sources: Agricultural Statistics Surveys, 1978, 1979, and 1980.

Ten years of Animal Production and Range Research in Botswana, 1980.

F.A.O. Statistics for 1982.

supplements and a regular water supply; and maintain a better bull/cow ratio. Some of these methods are not practiced by small farmers due to their circumstances. For example, disease control is difficult in the unfenced areas of communal land.

5. Wildlife and forestry

Although forestry is unlikely ever to contribute significantly to the economy (only one percent of Botswana is forested), the plant and animal genetic resources of the Kalahari Desert could prove immensely valuable in the long-term development of Botswana's agricultural productivity.

6. Inputs and services

a. Marketing

(1) Livestock

While a few small-scale livestock producers sell some of their livestock to local traders and butcheries, the Botswana Meat Commission (BMC)¹ is responsible for almost all marketing of livestock in the country. The BMC also is responsible for exporting beef, Botswana's major agricultural export item, to the European Common Market (EEC) and other countries. Cattle are trekked, trucked or railed to Lobatse for slaughter. While there is a new abattoir in the Northwest (Maun) which also slaughters cattle, its beef is not destined for the EEC. Smallstock marketing to BMC is very insignificant.

(2) Crops

While small-scale farmers sell food crops among themselves, the Botswana Agricultural Marketing Board (BAMB)¹ is responsible for marketing both food and non-food crops in Botswana. The BAMB markets through country-wide agencies and branches in the country. Its pricing policy takes into account the transportation costs of each area/zone. Those areas nearer the railway line receive lower prices than remote areas, in order to encourage production in the latter. For cereals, the Board pays producers the cost it would take to import the commodity into the country. For oil seeds, producers are paid the export price, less transport and handling costs.

Among farmers, bartering is sometimes practiced. For instance, four 70 kg bags of sorghum can be exchanged for a cow.

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The Botswana Meat Commission and the Botswana Agricultural Marketing Board are both government owned.

b. Credit and fertilizer

Credit is available to farmers through the National Development Bank. Most loans, however, are in the livestock sector. Ranchers can use their cattle as collateral, and greater potential for cash returns exists through the well-developed export marketing system for beef.

For related reasons, farmer investment in fertilizer is very low. Farmers in Botswana use an average of only two kilograms of fertilizer per hectare.

c. Labour

Labour is a major constraint to agricultural productivity. The lack of available labour during critical periods, e.g. for ploughing, planting, weeding and bird-scaring, is perceived by farmers as partly responsible for poor agricultural production. Yet, due in part to long periods of slack labour demand, there has been considerable migration from the rural districts to urban centres. Most of the people who migrate are able-bodied males between the ages of 15 and 34, who could best contribute their productive labour to agriculture.

A majority (70.9 percent) of farmholders, however, use draft animals for cultivation and an additional 16.4 percent use tractors. Even so, 95.4 percent rely on broadcasting for planting their crops.¹

7. Role of women in agriculture

The 1981 Agricultural Survey found that there were 31,400 female farmholders in Botswana, accounting for about 38 percent of all farmholders. Women constituted about one-third of the total farming households in each of the six regions, except in Francistown where they accounted for 50 percent of the total. Women also provide the bulk of labour for weeding. Yet women have the least access to the basic resources of draftpower, equipment, land and cattle. Between 30 and 57 percent of female-headed households have no cattle, while only 19 percent of the male-headed households have none.²

1

Central Statistics Office, Ministry of Finance and Development Planning, Country Profile: Botswana, October, 1982.

2

Central Statistics Office, Country Profile: Botswana.

C. Agricultural Research

1. Introduction

The Ministry of Agriculture (MOA) was organized in 1935 following the earlier establishment of two autonomous departments, namely the Departments of Agriculture and of Veterinary Services. The MOA has since undergone several changes in organization. At present, the principal divisions are the Department of Agricultural Research (DAR), the Department of Agricultural Field Services (DAFS) and the Department of Animal Health (DAH). It should be noted that each of the three divisions also has assigned to it service and other functions. For example, the DAR, in addition to research, has responsibility for seed multiplication and other service functions. The DAFS, whose primary role is extension, also has responsibility for services and for handling certain input distribution tasks, especially at the field level. Likewise, the DAH, whose chief responsibility is the national animal health programme, also provides local livestock advisory (extension) services.

2. The Department of Agricultural Research

a. Background

The DAR of the MOA is responsible for the development of technology designed to overcome the constraints faced by the farm population in increasing the production of food, leading to enhanced national levels of living. In the context of the severe ecological and resource constraints of the agricultural sector in Botswana, this task is among the most challenging in the government. Nonetheless, it is recognized that agricultural research, appropriately focused on the needs of traditional farmers, constitutes the most feasible, high pay-off approach that the government can exploit to increase production and income and to improve the level of living in agriculture.

The DAR headquarters, principal facilities and laboratories are presently located at Sebele, about 10 km north of Gaborone. Three substations, at Mahalapye (Central District), Goodhope (Southern District) and Maun (Northwest District), provide limited facilities for extending research activities to other ecological zones. In addition, a network of 17 beef cattle ranches located in the principal cattle-producing areas provide research facilities for animal and range management research. The major programme areas are organized under two divisions, namely the Animal Production and Range Research and the Arable Research divisions. The Estate Management, Administrative and Laboratory Services Units serve the entire department in supporting roles (See Figure 1-4).

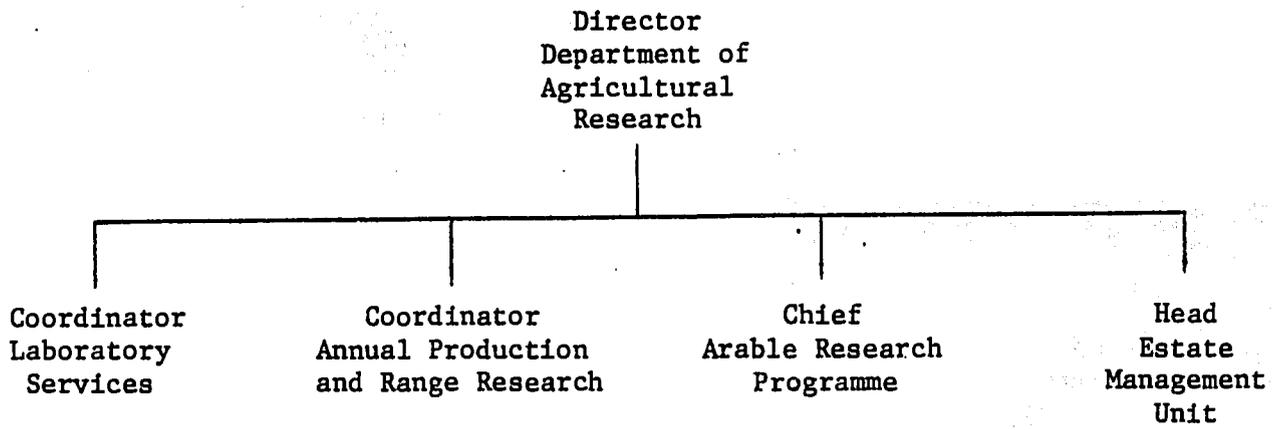


Figure 1- 4: Organisational Chart for the Department of Agricultural Research in Botswana

b. Programmes

(1) Overview

Livestock and, more recently, food crop research have been the DAR's principal emphases since Independence. The current major programme areas of the DAR include foodcrops/agronomy (sorghum, maize, millet and beans/pulses), livestock (both beef and dairy cattle, and small stock except poultry), and farming systems research. A significant service programme area is the seed multiplication activity. Minor research program areas include limited work on horticulture, cash crops and marketing of vegetables (see Table 1-5).

The agronomy/food crops program, with an emphasis on sorghum, maize, millet and beans/pulses, and farming systems projects, together with certified seeds from the seed multiplication unit, aim to provide the farming community with information about innovations and improved seeds to attain a more staple food supply. All of the projects of the agronomy unit and the farming systems research projects are closely related and together constitute a national arable production programme. Twenty researchers and forty technicians are engaged in the national agronomy and farming system programme (See summary of each agronomy/farming system project below).

The Animal Production and Range Research programme was formally organized in 1970, although there had been earlier efforts by the Botswana MOA to improve the production of livestock, especially cattle, through better use of range resources. This programme seeks to investigate the technical and socio-economic parameters related to improved livestock husbandry and sustained production from natural rangeland. The programme has twelve researchers and sixty technicians. A considerable number of the technical staff are based on the livestock ranches of the DAR.

It should be noted that research in this division, over a ten year period, in cattle breeding, nutrition, husbandry and range management, has produced a body of knowledge generated within the context of the conditions in Botswana. To assist in the adoption of these findings a publication, entitled "Beef Cattle Production and Range Management," has been published. Recommendations, based almost entirely on in-country research are for the first time available for extension workers, teachers and commercial farmers. This division has also cooperated with the DAFS staff short courses and farmer training courses. Formal training of local staff has been encouraged.

Table 1-5: Current Research Programmes of the Department of Agricultural Research

	Date		Donor	Life of Project Funding US \$('000)	Focus
	Project Start	Project Finish			
<u>Arable Production Programme:</u>					
Evaluation of Farming Systems and Agricultural Implements	1976	1984	U.K.	800	Farm equipment/cultivation practices
Ngamiland Agricultural Development	1979	1985	Sweden	1,000	Farming systems in Okavango Delta, including appropriate technology for socio-economic conditions of small farmers
Agricultural Technology and Improvement	1981	1989	GOB U.S.	2,250 6,750	Farming systems in eastern Botswana; small farmers
Cowpea Research	1981	1985	U.S.	800	Cowpea production
Dryland Farming Scheme	1970	1984	U.K.	560	Semi-arid agriculture; physical/ecological factors
Malapo Project	1973	1983	FAO	1,200	Floodplain agriculture in Okavango Delta, small farmers
<u>Animal Production and Range Research Programme:</u>					
Range Management	1975	1984	FAO/UNDP	1,100	Semi-arid rangeland, including ecology/management
Communal Lands Grazing Assessment	1982	1983	International Livestock Center (ILCA) GOB	32 128	Grazing resource assessment

¹ Not included in this chart are additional costs for services such as topping up some of expatriates, allowances, and costs allied with services from Central motor pools, etc. Also, other development-orientated programmes and activities are closely linked to research although their funding may be shown in GOB reports and budgets in operational areas. The extensive operations of the MOA and the Botswana Meat Commission (BMC) in livestock and veterinary areas is an example of activities where the data collection and analysis components are strongly research oriented.

(2) Agronomy and farming systems projects

(a) Evaluation of Farming Systems and Agricultural Implements Project (EFSaip)

EFSaip started in 1976 and is scheduled to phase out in 1984 when the remaining local counterparts will be incorporated into the national agricultural agronomy program. About US \$800,000 has been allocated to this project by the British government. The major objectives are: (1) to develop alternative machines and cultivation practices compatible with standard inter-row planting under a monocropping system, as recommended by the DAFS, and (2) to test such implements and practices under actual farmers' conditions. It is expected that the project will encourage the adoption of agricultural implements and thereby help increase food production.

(b) Ngamiland Agricultural Development Project

The Ngamiland Agricultural Development Project, started in 1979, is scheduled to phase out in 1985. It is based in the northwest part of the country, along the Okavango Delta. About US\$1 million has been committed to this project by the Swedish Agency for Research in Developing Countries (SARDC). Its major aim is to develop and promote agricultural technologies for farmers which are appropriate to their socio-economic situation, with top priority given to small farmers. It is expected that the project will help to improve farmer output and income.

(c) Agriculture Technology and Improvement Project (ATIP)

The ATIP, which began in 1981, is one of the newest farming systems projects of the Department and is scheduled to end in 1989. The project will concentrate its efforts in the eastern part of the country, in the Mahalapye, Shoshong and Francistown - Tutume areas. Its major objective is to improve the capacity of the MOA's research and extension programmes to jointly develop and effectively extend suitable technical packages to the needs of small farmers. The project's US\$9 million budget is financed by the GOB and the U.S. Agency for International Development (USAID) for 25 and 75 percent of its budget, respectively.

(d) Cowpea Research Project

Like ATIP, the Cowpea Research Project is one of the newest projects in the Department. About US\$803,000 has been budgeted for it by USAID. The project is planned to phase out by 1985. The major objectives of this project are (1) to identify and develop solutions to cowpea production constraints and (2) to test cowpea varieties that could be suitable for Botswana.

(e) Dryland Farming Research Scheme (DLFRS)

The Dryland Farming Research Scheme (DLFRS) project started in 1970 and is scheduled to end in 1984. About US \$560,000 has been budgeted for the last phase of this project by the British Government. Its major objective is to improve dryland crop production in Botswana through population studies and a better understanding of the soil, crop physiology and water conservation. It is hoped that the project will significantly improve knowledge about raising crops under semi-arid conditions.

(f) FAO/Molapo

The FAO/Molapo project began in 1973 and is scheduled for completion by the end of 1983. About US\$1.2 million has been committed to this project by FAO. Its major objective is to improve the agricultural production of small farmers of the Okavango Delta's Molapo/Floodplain through better water conservation and tillage practices. It is expected that the project will contribute significantly to increased production of staple food for farmers in this area.

(g) Summary

The studies undertaken under these projects, with substantial outside donor support, have now produced a considerable base of data and knowledge concerning arable cropping under conditions of the "drier end" of the semi-arid range. Soil and climate limitations are severe and reinforce each other. Studies of tillage, plant populations, varieties, soil moisture utilization and other factors have begun to define the "limits" of the possible of arable agriculture in several regions in Botswana. These data now provide a significant beginning base for further refinement in technically suitable packages especially in the 400mm to 600 mm rainfall regions. This rainfall zone represents 65 percent of the area of Botswana.

(3) Animal production and range research projects

(a) Range Management Project

The Range Management Project started in 1975 and is scheduled to end in 1984. About US\$1.1 million has been budgeted for it by the Food and Agriculture Organisation of the United Nations and the United Nations Development Programme (FAO/UNDP). The major aims of the project are: (1) to increase sustained livestock production on the semi-arid rangeland of Botswana, and (2) to evaluate local grass species, and the effects of bush control and alternative grazing systems on stocking rate. It is expected that the project will help to improve the sustainable livestock carrying capacity of the rangelands of Botswana.

(b) Joint ILCA/APRU Project

The ILCA/APRU Project is a joint project between the International Livestock Center for Africa (ILCA) and the Ministry of Agriculture's Animal Production Research Unit (APRU). It is a one year project that is scheduled to terminate by the end of 1983. About US \$160,000 has been allocated to the project by the ILCA and GOB, who provided respectively 20 percent and 80 percent of the project's funds, respectively. Its main objective is to assess grazing resources in the communal areas which will lead to better utilization of local grazing resources.

c. Human resources

The Department of Agricultural Research is heavily dependent on expatriates. At present, the Director of the Department and the heads of the divisions and projects are expatriates. However, the Estate Management unit, the administrative supportive staff, and the laboratory are supervised by Botswana citizens. The DAR has increased its research personnel considerably over the last few years and now consists of 52 scientists (see Table 1-6). The disciplines of agricultural engineering and veterinary science are significantly understaffed. Twenty-one of 25 positions at the Master's and Doctor of Philosophy (Ph.D.) levels and three of 13 positions at the Bachelor's level are expatriates. Overall, expatriates occupy nearly one-half of the total authorized posts. One-half of the agronomy and economics/social science posts are held by expatriates. With five vacancies and nine staff away on training, only 38 remain to keep programme operational.

Localization would assist in building a continuity of the professional base supporting all programmes. Expatriate staff typically have short tenure within the projects, often less than two or three years. Rotation of this staff can be disruptive to the project focus and to the achievement of objectives. Localization of the DAR staff has been particularly difficult because of the widespread scarcity of students in Botswana who have studied science at the senior secondary level, a necessary prerequisite for training in professional agricultural research fields.

Although nine DAR staff are currently receiving training, the immediate impact on "localization" is likely to be minimal because of the long training periods required. Five of the nine staff studying for degrees are studying agronomy and crop-related subjects. Over time this will lessen the DAR's dependency on expatriates in this area and presumably will improve the continuity of research. The areas of agricultural engineering, veterinary science and economics/social science especially need to be strengthened. Botswana citizens need to be trained to fill these positions as rapidly as is possible. Having staff in various disciplines will not only help to cross-fertilize the ideas of research scientists, but also increase the ability of the DAR to develop appropriate technology which takes into

Table 1-6: Department of Agricultural Research
Professional¹ Staff, by Discipline: Botswana

<u>Discipline</u>	<u>Bachelors</u>	<u>Masters/Ph.D.</u>	<u>In Training</u>	<u>Vacant Positions</u>	<u>Total Authori Posts</u>
Agronomy/Crop Science	4	15 (14) ²	4 Adv. Deg. ³ 1 B.Sc.	4	28
Agricultural Engineering	1	--	1 B.Sc.	--	2
Animal Husbandry/Livestock	4(1)	3 (1)	1 Adv. Deg.	1	9
Veterinary Medicine	--	1 (1)	--	--	1
Agricultural Economics	--	6 (5)	1 Adv. Deg. 1 B.Sc.	--	8
Range Science	<u>4(2)</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>4</u>
TOTAL	13(3)	25(21)	6 Adv. Deg. 3 B.Sc.	5	52

¹ Other staff include 105 technicians and 200 other support staff, all nationals of Botswana.

² Numbers in parentheses refer to expatriate staff.

³ Adv. Deg. (advanced degree) refers to persons in training for masters or Ph.D. degree.

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account the diversity and interactions of the unique environment farmers face in Botswana.

Over the next five years the DAR plans to add about 79 additional staff persons trained in the various disciplines at needed academic levels. Because of the lack of in-country training facilities for degree and professional specialities, almost 90 percent of the staff to be trained is scheduled for training in the developed countries. None of the 79 additional staff presently scheduled for training will be sent elsewhere in Africa. For SADCC in particular, this fact highlights the need to develop regional centres to train personnel in the needed agricultural specialities, with a special orientation to develop technology appropriate for the majority of African farmers.

There is no provision to train local persons as veterinarians in the DAR. It is presumed that the Department of Animal Health, itself presently understaffed, will require special attention. It is interesting to note that the DAR plans to train almost four times as many senior agriculture crop scientists as livestock specialists (20 M.Sc./Ph.D agronomists/crop specialists compared to 5 M.Sc./Ph.D. livestock scientists). However, the current dependence on expatriate personnel is significantly higher in agronomy than in livestock production. The inclusion of economists/social scientists in the projected personnel plan of DAR deserves praise, since all too often the socio-economic aspects of technology development for small farmers have been overlooked by technical scientists.

d. Budget and expenditures

For the past 3 years, the GOB on the average has spent about US\$2.10 million for the DAR operating budget. The GOB is the source of all the operating budget funds. However, the DAR's operating budget does not include vehicles and machinery, which are budgeted for separately by the Ministry of Works and Communications. Of the total \$0.43 million available to the DAR for capital investment, the GOB, CDA donors and other donors contributed 19 percent, 55.4 percent and 25.6 percent respectively.

e. Main assets

(1) Buildings

Several new buildings have just been completed for the DAR. The Department now has seven laboratories whose total floor space is approximately 500 square metres. All are in good to excellent condition, with the exception of the crop physiology laboratory which needs some improvement. These laboratories are used for soil and plant analysis, entomology, plant pathology, seed technology, rumen concentrate analysis and crop physiology investigations. In addition, the DAR has three greenhouses in good condition whose total floor space is about 580 square metres. There are five offices used for

administration; while the one at headquarters is in good condition, the four countryside offices are in poor condition. There are also three workshops (for maintenance, farm implements storage and implements fabrication) and a seed processing plant. The workshops are in only fair condition while the seed processing plant is in good condition. There is also a clinic, a consumer co-operative shop and a primary school.

(2) Equipment

Besides laboratories, green houses, offices and workshops, the DAR has a substantial complement of equipment, including 24 trucks, 30 four-wheel drive vehicles, 17 tractors and associated tools. Laboratory and field equipment include a plot planter and thresher, forage digester and dryer, ultra-centrifuge and germination cabinet. Its analytical capability is supported by a Hewlett-Packard (HP-86) and Apple II micro-computers.

(3) Library

The DAR has approximately 1,000 books and acquires about 100 new books and 120 periodicals/scientific journals each year. The Department has access to agricultural information from several international organizations including: ILCA, International Institute of Tropical Agriculture (ITTA), International Maize and Wheat Improvement Centre (CIMMYT), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), USAID, International Development Service (IDS-UK) and FAO/UNDP. Besides access to these centres, the Department also benefits from the inter-library loan system from countries such as the U.S., Zimbabwe, South Africa and the United Kingdom. Over the last five years the DAR has produced five and eleven reports covering livestock and arable farming respectively.

(4) Land

The Animal Production Division of the DAR has 15 government ranches, two District Council ranches and two grazing cells. These ranches are located in Botswana's eight ecological zones and three vegetative zones (the hardveld, sand veld and mopane veld).

Of the total 40,400 hectares of pasture land, 400 hectares are used for raising beef and small stock for the Botswana Agricultural College; 95 percent of the remaining 40,000 hectares are used for the maintenance of the beef herd and 5 percent for experimentation by the programme of the Animal Production Division. The DAR livestock programmes concentrate on beef, dairy and dual purpose cattle, sheep, and goats.

The Division of Crop Production carries out field experiments at Sebele (the Headquarters) and/or the sub-stations (at Maun, Mahalapye and Goodhope).

Approximately 200 hectares of cultivated land are used for dryland crop production (sorghum, maize, millet, groundnuts, and sunflower). Twenty-five percent of this is for experimentation, 25 percent is for seed multiplication, 25 percent lies fallow, and the remainder is used for other purposes. Seven hectares of the DAR's arable land are under experimental irrigation for horticulture and germ plasm screening. The livestock division uses 10 percent and 90 percent, respectively, of the remaining 50 hectares for experimentation and field scale cultivation.

f. Linkages and services¹

A majority of the fifteen DAR staff interviewed expressed deep concern over the weak relationships and lack of communication between the DAR and other MOA departments. For instance, they questioned the usefulness of documents reporting on research results which are often too technical for junior extension staff to interpret and integrate for use in recommendations to farmers. An interpretive capability is urgently needed within the DAFS to integrate research findings into extension programme components to be carried out in farm demonstrations and included in educational materials.

In addition, many indicated that research programmes are often planned without input from other MOA agencies, especially from the DAFS, regarding the potential applicability of the results to farmers. For instance, the DAR emphasizes monocropping and row planting, and thus develops technology largely based on these techniques. Ninety percent of Botswana's farming population, however, still practices broadcasting. Likewise the DAR has been developing beef production techniques quite well adapted for commercial ranching conditions, while an overwhelming majority of livestock owners still practice cattlepost/communal livestock production. The staff felt that, despite the presence of Research and Extension coordinators in the MOA, they did not provide adequate help with inter-departmental liaison to develop technology targeted for use by small farmers.

g. Staff's assessment of problems¹

(1) Overview

It was generally accepted that the DAR has contributed much information for the development of agriculture in Botswana. However, as in most research institutions, the tendency has been to be preoccupied with technical results (such as yield, plant population, and growth rate) with little attention paid to the resource endowment factor of the highly heterogeneous farming community. The DAR, like most of its counterparts in the developing world,

¹ Sections f and g were largely based on interviews with 15 members of the staff.

has usually been organized on single crop or single discipline lines, although the subsistence farmer, who is the client for much of this research, does not often practice extensive monoculture, but usually manages a complex system of inter-cropping. As a result of these circumstances, many research projects only a limited relationship to small farmer needs. . . [In addition, there has been a] general lack of national research policies that specify priorities so that these can be used to effectively determine the most appropriate allocation of available resources.¹

One research scientist in Botswana remarked during this assignment "there has been little professional agricultural research planning".²

The DAR--and especially its Division of Animal Production, which strongly influenced the GOB to establish the Tribal Grazing Lands Policy (TGLP)--has produced technically persuasive improvements in such areas as calving percentage, growth rates, calf mortality and liveweight gain. The techniques underlying these changes are most appropriate for use by large commercial farmers.

Furthermore, through its animal breeding programs, the DAR has provided the farming public with relatively encouraging results. For instance, the use of Brahman, Tuli and Simmental cattle breeds has been generally accepted in Botswana; improvement of the local breed, Segaolane, has also impressed some farmers in Botswana. A number of staff remarked that designing research programmes with a focus on the needs of the small farmer who has severe resource constraints is now urgently needed. Further, the DAR's change of research focus from predominantly livestock research to arable agriculture and more recently horticulture and farming systems programmes is a positive change that should contribute measurably to the country's development.

The DAR's staff expressed concern over some issues they felt adversely affected the Department's ability to achieve its goals. The serious problems were the weak linkages with other MOA agencies and the need for an improved focus on smaller farmers' needs. A significant number indicated that lack of adequate

1

Daniels, Douglas and Barry Nestel (editors), Resource Allocation to Agricultural Research (Proceedings of a Workshop held in Singapore 8-10 June, 1981), International Development Research Centre, Canada, 1981, p. 9.

2

Anonymous, personal interview, September, 1983.

telecommunications, shortages of both junior and senior staff, technical staff, and support (service) staff, and poor conditions of service are also problems. These problems, however, are common to almost all MOA Departments.

The following sections discuss and summarize the comments made by DAR staff on specific issues that adversely affect the institution's ability to achieve its objectives.

(2) Operating budget

Of the 15 DAR officers interviewed, only five considered the operating budget to be a serious problem. Those who expressed concern over the budget or lack of operating funds felt that they were unable to acquire necessary equipment and facilities for their projects. In addition, some felt that the process for the allocation of budgetary resources between and within programmes and projects needed to be improved. The tardy release of financial resources was also considered a constraint because officers felt they could not carry out timely field observations or obtain needed casual labour.

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(3) Shortage of senior technical officers

Like most Departments of the MOA, the DAR suffers an acute shortage of local qualified senior officers. The heavy dependence on expatriate personnel was seen by some of the research staff as creating a serious problem of continuity and consistency in research focus. In turn, this adversely affected the ability of the DAR to develop appropriate small farmer technology. Some staff felt that some of the foreign-funded projects had done very little to identify and train local counterparts.

(4) Shortage of junior technical staff

Seven out of the fifteen DAR staff interviewed considered the shortage of junior qualified staff to be a serious constraint. The Department has 105 technicians, most of whom tend to lack both technical and practical skills. In particular, the DAR lacks mid-level technical staff. Even if there were a larger pool of locally trained junior officers, the sharp competition for them already from other departments would make it difficult for the DAR to meet its annual hiring requirements. Consequently, the DAR research programmes are adversely affected by the shortage of qualified technical staff.

(5) Facilities

In general, the Department's staff felt the present facilities were adequate and in relatively good condition, except for some concern regarding the shortage and obsolescence of some research equipment. However, the maintenance of facilities and especially equipment was considered

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poor, largely because there were few in the DAR qualified to service them.

(6) Transport

Six of the department's fifteen staff interviewed considered lack of good transportation a serious problem. Although a shortage of vehicles was indicated they felt this was further aggravated by poor maintenance and management of the vehicle pool.

(7) Telecommunications

One of the most serious problems, not only for the MOA but for the whole Government, is lack of telecommunication, especially when research stations and test sites located in the rural and remote areas need to be contacted. This affects in a very real way the costs of conducting research and the timeliness of operations.

(8) Coordination

Some staff within the DAR expressed concern about the degree of coordination and communication between the many predominantly foreign-financed projects. Recently, however, a sense of teamwork has developed following the establishment of a farming systems approach. It is hoped that coordination and communication between the various DAR programmes and projects will be given top priority in the Department's efforts to more effectively develop appropriate technologies for small farmers. Failure to do so could adversely affect the country's ability to achieve food self-sufficiency. Finally, feedback and communication between the research staff and farmers was reported to be disappointingly weak. Several of those interviewed indicated they would place their highest priority on efforts to improve effective communication with, and feedback from, farmers. Otherwise the expected multiplier effects of the various on-going projects and programmes for the farmers would be significantly reduced.

(9) Conditions of service

Thirteen of the fifteen staff expressed concern over the poor conditions of service that prevail in the DAR. In particular, housing was considered to be very inadequate; it was noted that certain officers were compelled to share housing with others against their will. Promotion prospects, especially for the junior research staff, seemed bleak and could affect their morale and, presumably, their productivity. Some of the officers felt that promotion prospects in other Ministries appeared to be better than in the MOA.

D. Agricultural Training

1. Introduction

Achieving higher levels of agricultural productivity requires people trained in a range of specialties for work at all levels within the agricultural sector. This need was recognized prior to Independence, in the early 1960s, by the establishment of the Agricultural Training Center at Mahalapye and the Veterinary Training School at Ramatlabama, each offering training to the certificate level. Additional opportunities for training at the certificate, diploma and degree levels became available with the establishment of the University of Botswana, Lesotho, and Swaziland (UBLS) in 1964. In 1975, Lesotho withdrew to establish its own institution. Botswana withdrew in 1982 to establish the University of Botswana. At present the University of Botswana does not offer degree level training in the agricultural sciences.

After independence in 1967, the Botswana Agricultural College (BAC) was established at Sabele (near Gaborone and adjacent to the main research center) with the transfer of the Agricultural Certificate course from Mahalapye. In 1970, the college established an Animal Health Certificate programme by transfer of the programme from Ramatlabama. A certificate level program in Community Development was initiated at the College in 1972.

A special training course is offered at the Ranch Management Centre at Ramatlabama for potential managers of the Tribal Grazing Lands Program (TGLP) ranches. The TGLP provides managers to individuals and groups who qualify, assisting them in establishing commercial-type ventures aimed at reducing overgrazing of communal lands through better grazing systems and optimal allocation of water resources.

2. Botswana Agricultural College

a. Background and curricula

The Botswana Agricultural College (BAC) is the principal training institution providing certificate level programs in three areas: agriculture, animal health, and community development. Graduates of these programs provide the manpower for the Ministry of Agriculture and for the Ministry of Local Government and Lands primarily at the field level. BAC programs consist of approximately 50 percent practical work and 50 percent classroom instruction. Until 1981 the College offered only certificate (two-year) courses in agriculture, animal health, and community development. The latter course provides Assistant Community Development Officers for the Ministry of Local Government and Lands. With the expansion of facilities and staffing in 1981, the College was able to introduce two-year

Diploma courses in agriculture and animal health and production with an initial enrollment of about 20 students in each course. The College also has doubled enrollment in the Agriculture and Animal Health Certificate programmes to about 60 students each.

The entry qualifications for the Certificate Course require applicants to have a Junior Certificate (three years of secondary school education), a General Certificate for Education or a Third Class Cambridge School Certificate, i.e., five years of secondary education. To qualify for a Diploma programme, candidates should have a Certificate in agriculture or animal health, with a minimum of two years of field experience or a high passing mark in the Cambridge School Certificate.

Students wishing to be accepted as degree program candidates at the University of Swaziland or at universities in other countries must have achieved distinction in obtaining their Diploma and have either field experience or a Second Class or above Cambridge School Certificate, with credit in Mathematics and English.

The expenses of all Botswana students are met by the Government of Botswana (GOB). In return, Diploma graduates are expected to work for the GOB for a minimum of two years and to remit 10 percent of their salaries to the Government. Certificate graduates are expected to work for the government for a minimum of three years.

b. Human resources

(1) Staff

The BAC is headed by a Principal (a local graduate), who is responsible directly to the Permanent Secretary of the MOA. The Principal is assisted by a Vice Principal, by the Course Directors of the Agriculture, Animal Health and Community Development programmes and by the administrative staff (see Figure 1-5).

The Course Directors for the Animal Health and Community Development programmes are expatriates. However, a Botswana has been appointed recently to take over as Director of the Community Development programme. The administrative staff are all local persons as are the Vice Principal and the Course Director of the Agriculture programme.

While the College hopes to fill positions with local persons, expatriates still constitute nearly one-half of BAC's senior teaching staff (see Table 1-7). Three of eight expatriates are in animal health, which is one of the departments most seriously constrained by lack of qualified personnel in the Ministry of Agriculture. Lack of trained staff in animal health (veterinary science) has been perceived repeatedly by the GOB (including officers interviewed in this study) as a serious problem. The number of those prepared for work in this field for the Ministry

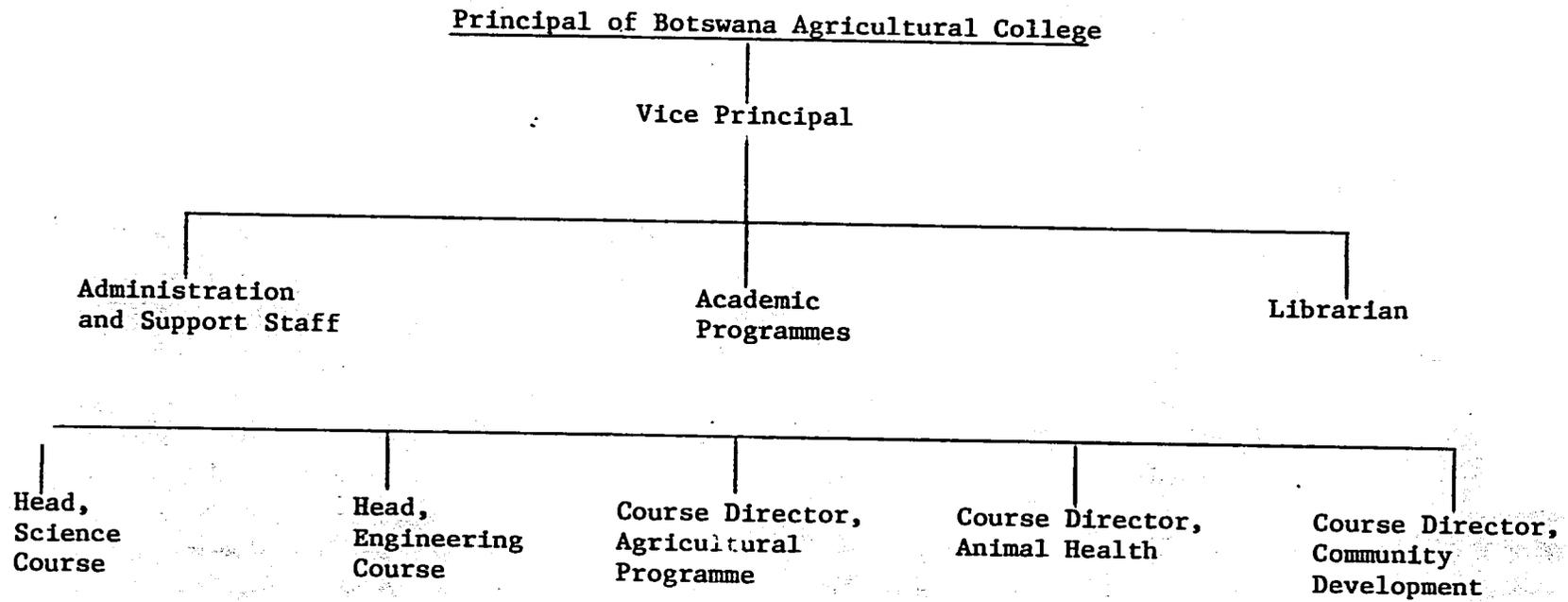


Figure 1-5: Organisation Chart, Botswana Agricultural College (BAC)

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Table 1-7: Human Resources for Agricultural Training:
Botswana Agricultural College (BAC)

Function	Qualifications of Staff						Total	In Training
	Certificate	Diploma	Bachelor's	Master's	D.V.M.	Ph.D.		
Teaching	-	-	11	10 (5) ²	(3)	-	24 (8)	1 M.Sc., 4 B.Sc.
Teaching Assistant	5	9	-	-	-	-	14	1 Dipl.
Administration ¹	-	-	-	-	-	(1)	(1)	-
TOTAL	5	9	11	10 (5)	(3)	(1)	39 (9)	1 M.Sc., 4 B.Sc. 1 Dipl.

¹ One national on the teaching staff also devotes part of his efforts to administration.

² Numbers in parentheses indicate those of total who are expatriates.

has been disappointingly low. For example, although six staff members of the college are presently receiving degree level training, none of them is pursuing a career in veterinary medicine.

According to the BAC Five Year Training Plan, about 50 additional staff shall be required as follows:

- o Twelve staff members need to be trained at the M.Sc. or Ph.D. level in the developed countries (eight men and four women)
- o Sixteen staff members need to be trained at the B.Sc. level in Botswana; (three men and one woman elsewhere in Africa and two men and two women in the developed countries)
- o Sixteen staff members need to be trained at the diploma level (eight men and two women in Botswana); one man and three women elsewhere in Africa and one man and one woman in the developed nations)

During this period, the six staff members presently being trained should have completed their studies.

(2) Student body

At present 98 percent of the student body are from the traditional sector in rural areas. The other two percent of the student body come from the commercial sector in the rural areas. No students of urban origin attend BAC at present and this situation is expected to continue for some time.

c. Budget and expenditures

During the last three years, the BAC has spent an average of US\$0.72 million per year in recurrent expenditures, all of which was provided by the GOB. Of the US\$2.04 million per year allocated for the College's capital expenditure, 26 percent, 54 percent and about 20 percent came from the GOB, CDA donors, and other donors (especially Norway and the Netherlands), respectively. CDA donors contributed over 50 percent of the capital required by the College's capital investment program.

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More detailed information is provided in the next section of this report on extension.

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d. Assets

(1) Buildings

Substantial additions in classrooms, administrative and staff offices have been completed recently. The classrooms are in good condition, with 1019 square metres of total floor space. In addition, there are 530 square metres of floor space dedicated to teaching laboratories. The College also owns workshops (mainly used for demonstrations) whose total floor space is about 383 square metres. The Library has 403 square metres of space and the Lecture Theatre (mainly used for films and seminars by both the College and the MOA's various departments) whose total floor space is about 100 square metres. All of these facilities are in good condition.

Major pieces of equipment (valued at US\$ 5,000 or more) include the incinerator, the photocopier and several vehicles.

The BAC has available to it several buses, trucks, tractors, shop equipment and farm equipment for use in demonstrations and for the practical portions of the curriculum.

(2) Library and acquisitions

The library has 9,400 books available for student and faculty use and acquires 1,000 more each year. In addition, the College receives twenty periodicals and scientific journals. There are also subject matter slides used in teaching, closed-circuit television, and overhead projectors.

(3) Land

The College has 30 hectares that are used for student "practicals" and for demonstration plots. An additional 20 hectares are used for student livestock projects. These facilities are shared by both the College and the DAR of the MOA.

e. Linkages and services

Formal linkages between the BAC and the DAR have been described by some officers as very "disappointing" and "very unsatisfactory and weak." The College, however, does have a generally good working relationship with the DAFS of the MOA. During the school term, students conduct "practicals" and attend demonstrations in the surrounding villages, working closely with local extension staff. When the students are on their field exercises during the holidays, they are assigned to local extension officers in order to familiarize them with local conditions. In this way they develop practical insight into extension work and experience. While the College does not offer any short courses, it serves as a meeting place for conferences, seminars, and workshops undertaken by various departments both in the MOA and in other Ministries.

f. Opportunities for graduates

The College awards Diplomas and Certificates in Agriculture and Animal Health. Over the past three years, the average number of Diploma recipients has been 36 and the average number of Certificate recipients has been 120. Almost all of these graduates are employed by the Ministry of Agriculture. It is planned that the College will soon become part of the University of Botswana, and thereby be able to provide degree level training under the Faculty of Agriculture. At the moment, degree students are trained either at the University of Swaziland or abroad, especially in the United States.

g. Staff's assessment of problems

(1) Introduction

Although the College has been successful in establishing an effective training program and also has been very helpful to farmers around the College, most of the 13 staff members interviewed felt that a number of important constraints limit the institution's ability to achieve fully its purpose and potential contribution.

(2) Relations within the Ministry of Agriculture

The College's staff, in particular, felt that there was a very weak linkage between the DAR of the MOA and the College. Although occasionally some Research Officers teach at the College, this is done on an ad hoc basis; consequently both the academic staff and the students are not adequately exposed to the research programmes. There was a feeling among BAC staff that joint research and teaching appointments should be promoted and institutionalized in order to reduce the knowledge gap that besets the two institutions. For instance, the DAR is involved in the fabrication of animal-drawn implements, but neither the staff nor students in the Agricultural Engineering section of the College participate in the program.

The linkages between the BAC and the DAFS were generally considered adequate.

There was little feedback between the former students of the college presently employed in the field and the college itself regarding the strengths and weaknesses of the knowledge and skills acquired by the students during their training. Such feedback would enable the BAC to identify its strengths and weaknesses and improve the curriculum in order to make the training program more relevant to the country's needs. For instance, inter-cropping and mixed-cropping have received very little attention at the college; yet the majority of crop farmers in Botswana still mix their crops.

The BAC staff recommended that the linkages, communication, feedback and working relationships between the college, other

appropriate departments in the MOA and other Ministries be strengthened and eventually institutionalized, in order to enhance the development of appropriate technology for farmers.

(3) Operating budget

The staff felt that the shortage of operating funds has adversely affected the ability of the institution to provide faculty and students with vital information and experiences based on actual field circumstances. For example, the staff also expressed concern over the lack of financial resources to purchase books and demonstration materials for students. This constraint has forced teachers to prepare notes for students as substitutes for textbooks. Meager travel funds have forced the College to eliminate its vital extension programme, designed to give the students practical experience based on case studies gathered from surrounding villages.

(4) Shortage of trained and qualified senior teaching staff

One-half of BAC's senior teaching staff are expatriates, and 40 percent of these expatriate personnel teach in the Animal Health Department. When the teaching staff is classified according to academic level, the problem of localization becomes more serious. Currently, BAC does not have a local staff person with a Ph.D. degree. At the M.Sc. level, it is 50 percent dependent upon expatriates. All three veterinarians are expatriates. As was pointed out earlier, the need for increased localization for this institution is especially acute both in animal health and in agronomy. While some of the staff presently on leave receiving training are pursuing professional careers in agronomy, no national on the BAC staff is receiving training in veterinary science.

One of the major concerns raised by the College staff during the interviews was the failure of the Ministry to fully develop a national long-range plan for training of degree level personnel, especially in areas of critical need. At present, the allocations of highly trained local persons is achieved by competition among various departments in the Ministry, the BAC and other agencies. Thus, given the severe national shortage of trained Batswana at the various degree levels, the College is now forced to compete for such scarce personnel especially with other Departments of the MOA, and this situation is unlikely to change soon.

At present the College has a relatively heavy concentration of animal scientists. This can be understood because the country's agriculture historically has been and continues to be livestock-based. However, the equity emphasis expressed in the National Plan would require, in the long run, that the country diversify its agricultural/rural economy. This, in turn, would change the mix of the professional disciplines required in the MOA, BAC and other agencies. Consideration of the mix of

disciplines required to support the shift in the Ministry's programme emphasis is needed and could be part of a national long-range plan for increasing the number of local personnel with advanced degrees. (The establishment of the Arable Lands Development Programme (ALDEP) and the recent Financial Assistance Policy (FAP) were partly due to a realization of the need to diversify substantive agricultural development activities.)

(5) Conditions of service

Among the major problems over which the College staff expressed concern were the conditions of their service. The staff felt that better housing should be given top priority to improve morale. Serious concern was expressed over promotion and salary policies as well. A majority felt that upward mobility was hampered by the lack of available posts. The staff felt there was a need to increase the number of senior posts so as to motivate some members to be more productive. In addition, staff requested that short in-service training programs be provided. Given the dynamic nature of agriculture, the need to keep abreast of new technological changes in a training institution is very critical. Finally, the staff recommended that a comprehensive plan to improve the conditions of service be developed in order to improve productivity of the College staff.

E. Agricultural Extension

1. Introduction

Extension activity and the institutions performing it are widely considered to be essential to agricultural development. The most widely agreed upon function of extension is that of diffusing information developed through research to farmers, which also helps insure the relevance of research to farmers' problems. However, many agricultural extension programmes fail to keep this function as their central purpose. In many instances, national extension services are predominately engaged in delivery of inputs and other services with few or no ties to research and training.

Typically, extension staff have little time or capacity to interact with research and training staff to insure the relevance of their information. Building an institution to perform this function is difficult; it requires broad understanding of this need and a staff capable of a high degree of interaction with researchers, teachers, and farmers. It is understandable that Botswana, a young country occupied with many concerns, has yet to fully develop this institutional capability.

The Department of Agricultural Field Services is the country's primary extension institution and has considerable responsibility for delivery of agricultural inputs and services. However, the Department of Animal Health, primarily a field service organization, also provides information on animal health

at the field level. Both departments, then, perform functions of information delivery but neither has the full capacity to ensure relevance of information in the context outlined above.

2. Department of Agricultural Field Services (DAFS)

a. Background

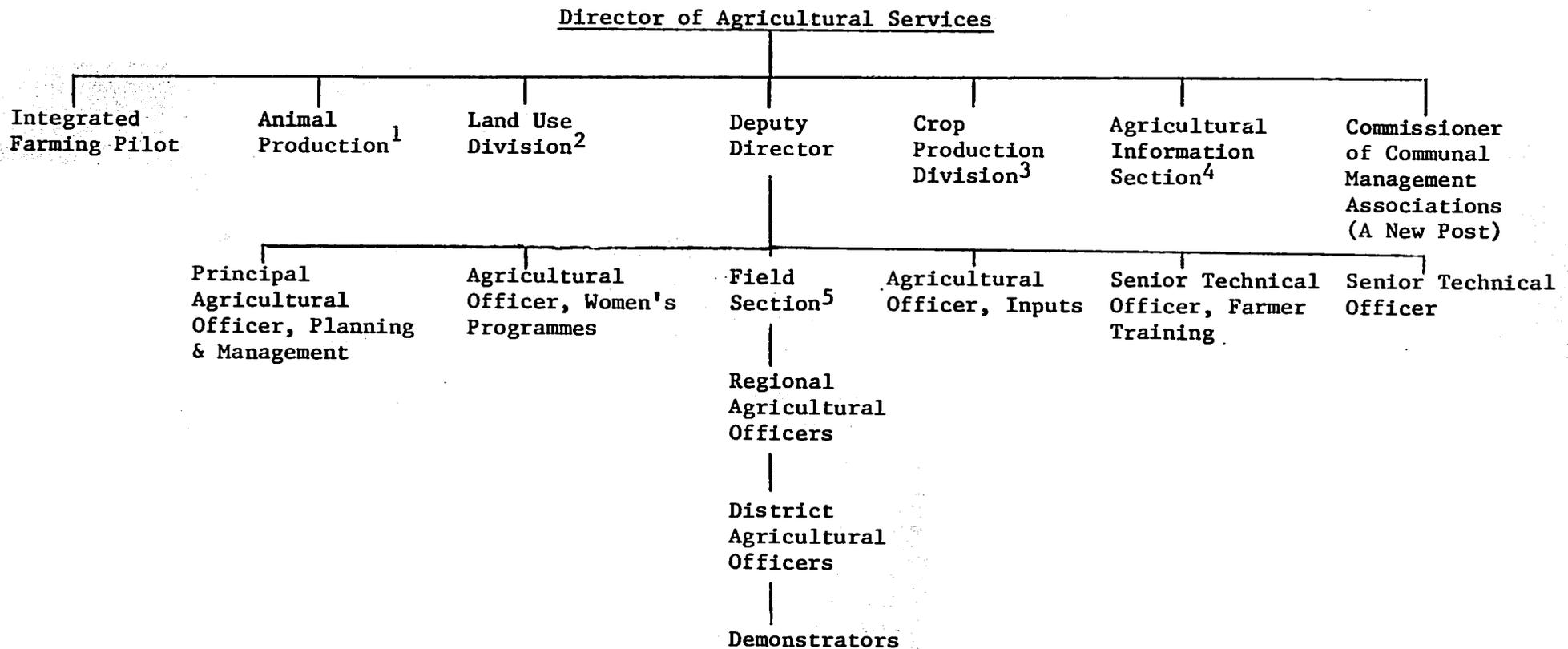
The DAFS is the largest department in the MOA. Like others in the Ministry of Agriculture, this department has experienced changes in organization and in the scope of services it provides, especially since Independence. While the DAFS is mainly responsible for communicating innovations in agriculture from research, it is substantially involved in delivery of other services as well (Figure 1-6).

The DAFS is organized geographically into six regions, which in turn are subdivided into districts and extension areas. The regional and district offices are usually headed by graduate level and Diploma level staff respectively. Each extension area is manned by a Certificate level graduate who is responsible for 250-300 farming families. Some extension areas are very large and thinly populated. As a result, farming households are widely scattered, making farmer contact difficult and also limiting the extension staff's understanding of farmers' circumstances and diagnosis of their problems. The village-based extension worker has to travel by bicycle, motorbike (if available), or even by foot. This shortage of suitable transportation and telecommunication facilities is a serious constraint to agricultural extension.

b. Nature of activities

The major extension programme effort of the DAFS involves two broad areas: 1) increasing production of food crops (sorghum, maize, beans/pulses and millet), and 2) increasing production of livestock (cattle, goats, sheep, poultry and pigs). Fortunately for extension, much of the research information for both food crops and livestock production now has been based on local conditions. During the last decade especially, this base of knowledge has been expanding. Much of this information can be and is being applied by the better endowed farmers in the relatively small commercial sector. However, a considerable effort will be required to utilize this growing data base in developing technologies for use by the vastly larger number of farmers in the traditional farming sector. Special efforts have been undertaken only recently to address the needs of these traditional farmers.

A significant effort designed to increase production of food crops in the traditional sector is the recently established Arable Lands Development Programme (ALDEP). In addition to providing recommendations on crop practices, the programme provides credit to farmers in communal areas for the purchase of draft power, implements, fencing materials, water catchment



1 The animal production unit includes beef and dairy husbandry, goats and sheep, marketing, poultry, pig husbandry, and fisheries.

2 The land use division includes dam building, range ecology, soil survey, soil conservation, cartography, land use planning, and forestry.

3 The crop production division includes horticulture, seeds supply, marketing, and post-harvest.

4 The agricultural information section includes publications, radio, graphics, campaigns, action research, and demonstrators' handbooks.

5 The field section includes the Rural Training Centres, the Short Course Centres and a variety of agricultural officers and supervisors, including animal production officers, land use officers, and ranch extension officers.

Figure 1-6: Organisation Chart of the Department of Agricultural Field Services, Botswana

equipment, and other purposes. A similar effort to introduce improved management and grazing techniques in communal areas is being attempted under the Tribal Grazing Lands Policy (TGLP). The GOB also procures for small farmers other production inputs, notably improved seeds.

The DAFS, in collaboration with the DAR, has become actively involved in the recently initiated Farming Systems Research Programme. This joint programme is intended to bring specialists in research and extension together in an interactive process for the development and implementation of more effective programmes for the small farmer. If this programme is successful, it will sharpen the focus of both the research and extension programmes, leading to greater effectiveness of both. The DAFS has given cash crops--mainly sunflower, groundnuts, vegetables, and citrus fruits--a low priority.

c. Human resources

Within the DAFS, only about 4 percent of the total staff are expatriates; most of these serve at the Headquarters (see Table 1-8). The majority of the DAFS staff located at field posts are required to have only Certificate or Diploma level training and most have been trained within the country. Of the 424 established positions, 12 percent are currently vacant. Ninety percent of these vacancies are at the village level, positions that are especially critical for effective farmer-extension relationships. In addition, 102 officers are presently on leave to receive training at the Certificate level; upon their return, they should help fill some of the vacancies. The ratio of women to men currently working in the DAFS or slated to receive training seems extremely low. There are few women extension officers in the Department and, indeed, in the whole Ministry (see Table 1-9).

In the next five years, the DAFS plans to increase its professional/technical staff by 384 people. There is clearly a very strong commitment to in-country training for junior staff, especially at the Certificate level. At Diploma level it is interesting to note that at least twelve of the additional staff will be trained elsewhere in Africa. This could improve regional technical cooperation, especially if these people are trained within the SADCC region. Owing to lack of training facilities in Botswana, especially for specialist degree level personnel, most will be trained in the developed countries. A long-term goal, however, is that professionals in extension be trained either in-country or within the SADCC region. Botswana is about to establish its Faculty of Agriculture, following the recent establishment of independent universities in both Botswana and Swaziland. However, the 139 personnel currently on leave receiving training will meet, in part, the manpower requirements of the DAFS.

Table 1-8 : Department of Agricultural Field Services
Personnel by Specialty and Location

<u>Specialty/ Discipline</u>	<u>Headquarters Staff</u>	<u>Regional Staff</u>	<u>District Staff</u>	<u>Village Staff</u>
Agronomy/ Crop Science	3	11	-	-
Agricultural Engineering	2	-	-	-
Animal/Livestock Husbandry	16	38	-	-
Veterinary Science	-	-	-	-
Horticulture	4	5	-	-
Entomology/ Pathology	-	-	-	-
Economics/ Social Science	-	-	-	-
Range Ecology	4	5	-	-
Information/ Broadcasting	27	-	-	-
Agricultural Mgt./ Group Development	3	5	-	-
General Extension	18	20	85	178
Total	77	84	85	178
Vacancies	(5)			(46)

Table 1-9: Department of Agricultural Field Service,
Professional Staff by Academic Level and Sex

<u>Academic Level</u>	<u>Authorized Posts</u>			<u>In-Training</u>		
	<u>Men</u>	<u>Women</u>	<u>Total</u>	<u>Men</u>	<u>Women</u>	<u>Total</u>
Master/Ph.D.	8	1	9	3	1	4
Bachelor	48	4	52	12	3	15
Diploma	134	8	142	14	4	18
Certificate	200	21	221	81	21	102
Totals	390	34	424	110	29	139

Finally, the Department's staff, by discipline, generally reflects the concentration of personnel by major programme areas (see Table 1-8). However, the programmes utilizing agricultural engineers and range ecologists seem highly understaffed. While livestock and food crop production programmes are the major foci of the DAFS, the latter has a disproportionately smaller number of officers, and neither is represented by specialist staff at the district levels. The regional staff in these discipline areas regularly visit the district and village extension areas. Both the district and village extension officers must share their time and expertise between livestock and food crop production. With such a diverse farming community, it is very doubtful that extension officers of such calibre, who are constrained by transportation and communication problems, can be very effective. Horticulture is a minor programme area for the DAFS with officers based at national and regional levels. Given the scarcity of water resources, which limits potential production areas, it may be wise in the short run to continue posting only at these levels.

The DAR offers farmers diagnostic services in Entomology and Pathology. However, since these services are provided from Gaborone, in the long run decentralization of these services through the DAFS should be encouraged. Failure to do so could deny farmers this vitally needed information and expert advice.

The DAFS does not have any economists or social scientists. If their expertise is required, the DAFS requests assistance from the Division of Planning and Statistics, which has several economists and rural sociologists.

The DAFS has a relatively large number of officers in information and broadcasting, all based at the national level headquarters. None has been stationed at the regional or district levels. The traditional practice of staff periodically visiting outlying areas from headquarters is neither satisfactory nor efficient. Staff should be assigned to these areas as soon as possible to provide a continuous flow of up-to-date information to farmers and to encourage programme participation.

Agricultural Management or Group Development Officers are generalists who encourage farmers to form groups and/or associations for such purposes as fencing, spraying, and borehole syndication. They are based at both the district and village level and work in collaboration with the general agricultural extension officers. They are trained to provide broad agricultural development and management information and are not specialized in any particular field of agriculture.

A number of general extension staff at the district level also serve in the Rural Farmer Training Centres (RFTC). These centres provide short-term training to farmers at five locations, covering most of the regions of the DAFS.

d. Main assets

The DAFS has a rather extensive complement of outlying offices, including five Regional Offices, five Rural Farmer Training Centres, ten Demonstration Ranches, and 17 District Offices. All are in generally good condition. Besides offices and training and demonstration centres, the department has a large fleet of 106 large trucks, 97 four-wheel drive vehicles, and heavy earth-moving equipment.

e. Linkages and services

(1) With and for farmers

The Information Services Unit produces leaflets on various subjects such as livestock diseases, row planting, and seed treatment, and general fact sheets on livestock and crop topics. It also produces a monthly publication in newspaper format, Agrinews, which is distributed throughout the country.

The Agricultural Information Unit produces seven radio programmes each week which are broadcast over Radio Botswana. The Department of Non-Formal Education produces one radio programme a week directed to farmers, while the Cooperative Development Unit produces one weekly radio program dealing with cooperative issues.

Each year, in-service training courses are conducted for extension staff to consider new projects or programmes to be introduced. Refresher courses are also held.

(2) With research institutions

In addition to the Research and Extension Liaison Officers -- one for the livestock sector and one for arable agriculture -- mentioned earlier, two committees have been established to foster improved internal linkages.

The Arable Agriculture Development Committee (AADC) is composed of researchers, extension workers and farmer representatives. Its purpose is to suggest broad policy guidelines for the development of extension programmes in arable agriculture. A second committee, the Arable Research Priorities Committee (ARPC) also includes researchers, farmer representatives and extension agents. Its purpose is to ensure that researchers are aware of farmers' problems and to suggest priority areas for research.

The Farming Systems Research Programme (FSRP) is designed, in part, to encourage improved linkages between research and extension. It is hoped that intimate understanding of the interaction of endogenous and exogenous factors that influence farmers' behaviour will lead to improved research and extension planning, and ultimately set the pattern of formal and informal relationships between research and extension staff.

f. Staff's assessment of problems

(1) Overview

The DAFS has tried to increase its contact with farmers through various means at its disposal. In particular, it believes that its work has greatly accelerated the adoption of improved cattle management techniques. On the other hand, many feel that the DAFS had little impact in increasing the adoption rate of crop husbandry innovations. While farmers are becoming aware of disease control, dehorning, and other production management practices in livestock production, a very insignificant number of farmers follow DAFS crop husbandry recommendations. For example, of the estimated 90,000 farming households in Botswana, less than 10 percent plant their seeds in rows; the majority still broadcast seeds. While large farmers plough under crop residues immediately after harvest, a recommended soil moisture conservation practice, far less than 10 percent of the total farming households follow this recommendation.

Most of the staff interviewed pointed out that highly variable rainfall patterns are partly responsible for the poor adoption of recommended arable practices and for the resulting low food grain production of the major food crops. It is difficult to persuade farmers to adopt new crop production practices under such a high-risk situation. Others pointed out that disparity between the larger resource base of livestock growers and the smaller resource base of many arable farmers may explain, in part, the differences in the rates at which improved practices are adopted in each sector. Several felt that greater effort must be devoted to tailoring practices more precisely to fit the needs of farmers, especially those in the traditional sector.

The DAFS staff expressed concern over other problems that affect DAFS' ability to achieve its goals. A summary of their comments on these other problem areas is set out below.

(2) Operating budget

Some of the staff interviewed considered insufficient operating funds to be a factor contributing to poor extension service. For instance, it was pointed out that there was a shortage of equipment and facilities for use in soil conservation, small stock, information and youth programmes. The inadequacy of such resources led to poor farmer-extension contact.

(3) Shortage of senior technical staff

Shortage of senior technical staff is a serious problem for all MOA departments. Few students qualify to study science at the University of Botswana. On the average, about 60 enter for degrees leading to science-related careers each year; yet, less than 10 percent of these choose agriculture as their

career. The author surveyed 51 university students currently enrolled in the Faculty of Science and asked them to list their career preference. Forty percent preferred engineering and 30 percent preferred medicine. Among the major reasons for choosing engineering and medical careers over agriculture were better salaries, prestige, and the influence of family and friends.

In addition to the low enrollment of science students at the University, the traditional tendency of the MOA to spread out, and thus delay, the further training of serving officers also partly contributes to the shortage of more highly qualified personnel. The most affected sections of the DAFS were those of Horticulture, Range Ecology/Management, Information and Broadcasting, Small Stock, Land Use, and Agronomy. Some officers raised concern over the serious misallocation of the already scarce human resources in the DAFS. Others felt that some of the senior staff lacked the practical experience required to be effective. A few officers pointed out that there was a tendency for the Division of Planning Statistics to receive a disproportionately large number of highly trained personnel.

(4) Shortage of junior technical staff

The shortage of qualified junior staff is primarily related to the lack of availability of adequate local facilities for additional students. Although the BAC has recently doubled its enrollment of students, at the projected level of expansion of the Ministry's programmes the supply of trained individuals will continue to fall short of meeting demand. Further, there is sharp competition for their services within the MOA. Some officers expressed concern over the limited technical competence and practical experience of many junior officers and the lack of effective supervision of these officers by their immediate seniors.

(5) Support staff

The support staff lack specialized training in their present jobs. This was a concern expressed most seriously by Information/Broadcasting, Small Stock, and Land Use staff. The support staff also generally lack practical experience.

(6) Access to research

Access to the DAR staff was generally considered by the DAFS staff to be a minor problem. However, it does appear that some extension officers do not seem to be aware of the availability of research services and facilities supporting their extension services, e.g. soil testing, entomology, and plant pathology diagnostic services. It appears that better communication between MOA agencies, stressing mutual assistance, should be given more emphasis.

(7) Lack of inputs or timelines

The shortage of farm inputs and their untimely delivery to farmers have been cited by DAFS staff as very serious problems. Sufficient supplies of seeds and other farm inputs either have not been delivered or were delivered too late to farmers.

This view was confirmed by farmers who had organized a one-day seminar, attended by the author, "aimed at finding ways of helping crop farmers overcome their problems." Toward the end of the seminar, the 50 farmers attending unanimously agreed that timely delivery of an adequate supply of farm inputs (especially seed and fertilizer) needed urgent attention by the MOA. The Department's staff felt strongly that this problem complicated their extension work significantly. To aggravate matters, seeds are initially processed and packaged at one centre (Gaborone) from which they are later distributed to various parts of the country. This service needs to be decentralized as much as possible to facilitate timely delivery of farm inputs. The staff also expressed concern about the inability of transport facilities to convey these inputs to farmers in remote areas on a timely basis.

(8) Lack of useful research information

The amount of useful research information has been considered by the Department's staff to be seriously inadequate. For instance, the staff expressed concern about the lack of reliable technological recommendations about crop production suitable for small-scale farmers. Two studies on the traditional arable sector in Botswana have recently been completed. Both examine the impact of different arable production practices on harvesting rates and average food crop production levels in the traditional sector.¹ The agricultural extension staff has been recommending some of these practises to farmers. However, the recommendations are based largely on technical co-efficients such as yield and planting populations, and do not sufficiently take the resource base of farmers into account. Thus, almost all of the practices recommended by conventional research to date have required more inputs per unit area than are available to most small farmers. Labour has been considered by most studies, and by the department's staff, to be one of the major limiting factors in agriculture.

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Litschauer, John and Kelly William F., Traditional Arable Production Practices in Botswana. Division of Planning and Statistics, Ministry of Agriculture, 1981; Sigwele, Howard K. An Analysis of Research and Extension Strategies to Improve Cropping Systems for Small Farms in Botswana. (Research Paper for M.S. in Agricultural Economics), Michigan State University, East Lansing, Michigan, USA 1982.

The 1980 Agricultural Survey and the 1981 ALDEP Pilot Project concluded that although row-planting maize may result in yields significantly higher than broadcast planting, row planting without the use of other complementary inputs and management practices (such as timely planting, weeding, and use of improved seeds) will not guarantee higher average production levels, especially among small farmers. This suggests the importance of adopting a broad farming systems perspective in research efforts which will account for understanding the interaction of more of the important factors in production. It appears that the MOA, through a joint inter-departmental technology development programme, can improve its ability to provide farmers with adaptable and reliable agricultural production information. The recently established FSRP should provide a useful framework for diagnosing and understanding the circumstances of small farmers.

(9) Policy problems

Although the MOA has been trying hard to provide assistance to farmers as fairly as it can, the DAFS staff expressed concern over the relatively low subsidies available for crops as compared to those available for livestock. Assuming that crop production is more risky than livestock production in Botswana, the staff felt that crop farmers who attended the seminar previously mentioned confirmed that their livestock counterparts received more material assistance from the GOB than did they. In addition, much of the credit available from the National Development Bank is designed to support livestock production. Several staff members felt a need for a study of the costs and benefits of subsidizing farmers in Botswana, with a view to developing a comprehensive programme to ameliorate small farmers' problems.

(10) Transport

Although they recognized that there is a general shortage of transportation facilities (especially vehicles), the Department staff felt that this problem was exacerbated by poor allocation of vehicles between and within Departments. For instance, the districts tended to get fewer vehicles than headquarters. The DAFS staff expressed concern over the lack of accountability by some officers when using these vehicles. Some officers felt that poor maintenance and delay of vehicles during servicing also complicated the transport service.

(11) Communications

The lack of reliable telecommunication service, especially with the remote rural areas, has been a serious and recurring problem throughout the country. There is very little the DAFS or even the MOA can do, since the service falls outside of their responsibility. Hopefully, telecommunications will improve in the near future.

(12) Conditions of service

The Department's staff expressed deep concern over the poor conditions of service in their present job situation. There is a serious shortage of housing for field staff, especially for the junior village level extension staff. Several officers considered the present housing of the junior staff in the field rather unsatisfactory and too hot to live in. Those who worked in urban areas also experienced the same housing difficulty. While this problem in general is common to all officers of the GOB in rural areas and towns, the junior MOA field staff when comparing themselves to fellow field staff working for other Ministries, found that their accommodations were disproportionately inferior.

The Department's staff felt their promotion prospects looked very bleak, especially in view of escalating costs of living. For instance, it is not uncommon for junior officers to spend more than 10 years at the same level of remuneration. They felt such a condition adversely affected their morale and productivity.

(13) Linkage with other MOA agencies

The DAFS staff felt that the relationships and communication between various MOA departments, especially between the Research, Training and Planning departments, appeared weak and needed much improvement to facilitate a more effective extension service to farmers. Although there have been research-extension coordinators within the DAFS, the staff felt that this was not adequate to meet the problems of the small farmer. For instance, there has been very little useful animal production technology developed for small farmers, especially regarding grazing and management systems.

However, it is hoped that the multi-pronged approach of the newly established FSRP will bridge the gap between and within the various MOA agencies. In addition, there are joint committees on which most of the MOA agencies are represented, such as the ARPC and the Animal Production Technical Committee. However, the effectiveness of these committees needs to be monitored to determine their impact on the overall development of technology appropriate for the majority of the small farmers.

3. Department of Animal Health (DAH)

a. Background

The Department of Animal Health (DAH), established nearly 40 years ago, is responsible for the diagnosis, control, and prevention of livestock diseases. It also provides livestock production information to farmers via its Livestock Advisory

Centres, which are located in nearly every part of the country. Recently, foot and mouth disease and the control of tsetse flies in the northwest have been major concerns.

The DAH is also responsible for the national abattoir (See Figure 1-7). The abattoir, headquartered at Labatse, now has another branch at Maun in the northwest. The DAH, together with its two abattoirs, plays a vital role in the meat industry, which accounts for a major share of Botswana's agricultural exports.

b. Nature of activities

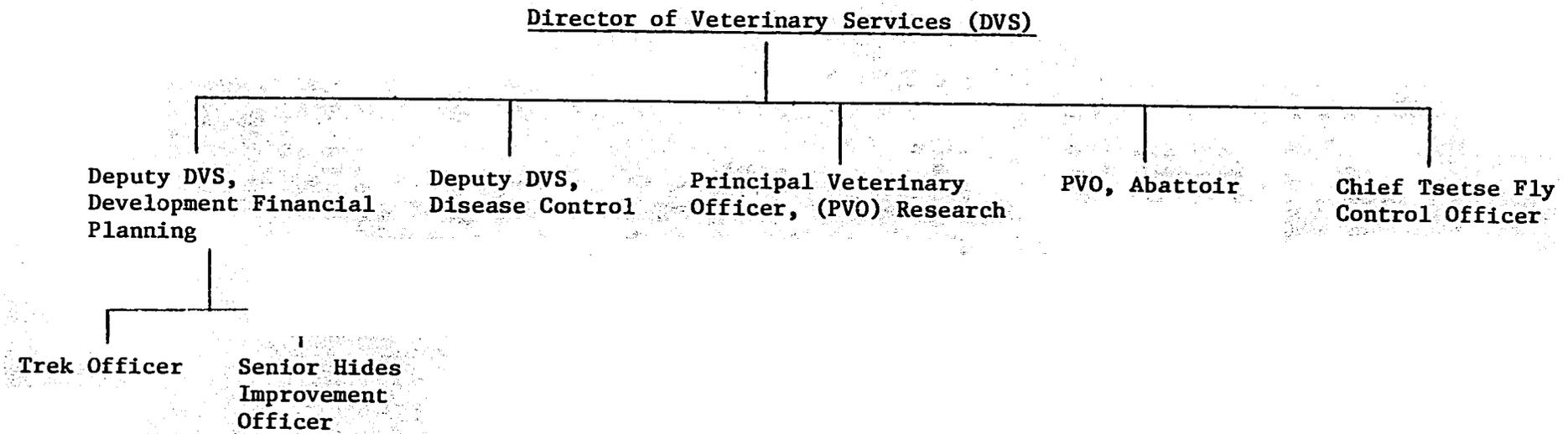
The major programme area for the Department is livestock production through the prevention and control of diseases. This is achieved largely through vaccination and other health programmes and by the use of cordon fences to separate livestock (especially cattle) from wildlife.

Unlike the Department of Agricultural Field Services, which has village-level staff, the DAH field staff are located only at the district level. The district staff, however, visit the farming community during the vaccination campaigns scheduled according to a livestock disease-control calendar. At other times, the farmer with a livestock problem must contact the veterinary staff at the nearest district or regional office. This appears to be an inadequate means of delivery of services to farmers. The laboratory diagnostic services are concentrated in Gaborone and Lobatse. These services should be decentralized, subject to the availability of staff and other resources, so that farmers in the remote areas will not continue to be disadvantaged.

c. Human resources

The DAH has 25 veterinarians for the entire country, 22 of whom are expatriates. The DAH urgently needs trained locals, especially to assure continuity of programmes. Few qualified candidates have been available for DAH positions. There are currently 159 locals receiving training for the DAH, but only 11 are studying for degrees in veterinary medicine. One is a woman with a junior degree in Veterinary Medicine pursuing a senior degree. The remaining 148 consist of 29 men and 3 women studying for Diplomas in Animal Health and 111 men and 5 women studying at the Certificate level. The Department of Animal Health, like the Department of Agricultural Field Services, has a disproportionately small number of women extension officers.

During the next five years, the DAH plans to prepare 360 additional personnel at various academic levels. Since Botswana does not have facilities to train veterinarians, a majority of those in higher level training will continue to be sent abroad, with some studying in other places in Africa. The establishment



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Figure 1-7 : Organisation Chart for the Department of Animal Health (Veterinary Services) in Botswana

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of veterinary training facilities in an African university, presumably within the SADCC area, could further support needed regional technical cooperation. This would contribute to efficient utilization of present and planned national and regional resource centres. As with the DAFS, practically all the junior staff will be trained in country.

d. Budget and expenditures

The DAH's average recurrent budget of US\$9.8 million is financed almost entirely by the GOB. The capital budget of US\$5.8 million is shared: 56.3 percent, 10.1 percent and 33.6 percent of the capital expenditure are provided for by the GOB, CDA, and other donors, respectively. Both the recurrent and capital budgets' figures reflect the average for the past three years.

e. Main assets

The DAH facilities--laboratories, abattoir plants, and livestock advisory centres are generally in good condition. Its extensive facilities include the central Veterinary Diagnostics Laboratory, Botswana Vaccine Institute, Tsetsefly Laboratory, 27 livestock advisory centres and 16 district and regional offices. It also has two abattoir plants, the large capacity plant at Labotse and the recently completed smaller plant at Maun. Its large complement of vehicles and equipment--obviously some of it highly specialized--is indicated as being in good condition.

f. Linkages and services

The Department issues a variety of circulars about effective control and prevention of livestock diseases, including parasites. Additional circulars are issued about vaccination of dogs and other pets. The Agricultural Information Section of the Department of Agricultural Field Services (Extension), through its three-day-per-week Radio Programmes, covers a variety of topics related to livestock production, disease and parasite control.

The department does not conduct any farmer meetings by subject area or by geographic zone.

Through its contribution to the monthly publication of Agrinews, the Department of Animal Health does provide farmers with information on better livestock disease prevention, parasite control, type of drugs and feeds recommended for good livestock management.

The Department does not have any veterinary research facilities. The field staff submits problems and specimens received from farmers to headquarters and the diagnostic laboratory for resolution and analysis. After diagnosis, the laboratory staff reports back to the field staff. If the problem

requires a policy decision, the field staff is informed when such a decision is reached. There is very little direct communication between laboratory staff and farmers.

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g. Staff's assessment of problems

(1) Disease control

The DAH has been able to substantially improve livestock disease control and management in Botswana. This has helped to provide the country with reasonable levels of meat exports, although outbreaks of disease have resulted in some periodic problems. In 1977, there was an outbreak of foot and mouth disease which led to the ban of beef exports to the EEC from northern Botswana. This was a serious problem and prevented farmers in the northwest from selling to the abattoir for almost six years. The DAH has played a positive role in the arrest and control of this disease so that the export ban could be removed.

Other problems and constraints the DAH faces are similar to those faced by the DAFS. A brief summary of the major problems facing the Department follows.

(2) Operating budget

Lack of operating funds to procure equipment for the DAH has been a serious problem and has adversely affected the ability of the Department to effectively carry out its programmes, particularly at the local level.

(3) Preparation of senior technical staff

Because of the acute shortage of qualified and trained locals, almost 90 percent of the senior posts in the DAH are held by expatriates. Continuity of veterinary service, important to effective extension and animal health service in the long run, could be seriously affected by this heavy dependency on expatriate staff. This is also true for laboratory and diagnostic services and abattoir veterinary support staff. It appears that a comprehensive plan should be developed to increase the number of local veterinarians. In addition, those responsible for career guidance in schools should publicize the programme and employment prospects in this Department.

(4) Access to research

The DAH does not have a veterinary research institute other than the Diagnostic Laboratory. The Department needs its own research facilities for it to carry out its

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Section g is based on interviews with senior departmental staff.

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extension and service functions more effectively. This is especially important since Botswana has been given a livestock portfolio responsibility by SADCC.

(5) Farmers' attitudes, timeliness of inputs, and availability of research information

Like their counterparts in DAFS, the DAH's staff perceive that the problems seem to lie primarily with extension and local agents' approaches. They believe that farmers' attitudes are generally compatible with change, as long as the risks involved are relatively minimal. Comments by DAH staff on problems related to timeliness of inputs and availability of adaptable research information were similar to those of the DAFS.

(6) Lack of village-based extension workers

The DAH, unlike the DAFS, does not have village-based extension workers. Its field staff are based at the regional district level, which is rather unsatisfactory and results in inefficient extension of services. There is a need for DAH to station its junior field staff alongside the DAFS staff at the village level. This would mean duplication of the local level. There is therefore a need for restructuring the entire extension service so that unnecessary duplication of efforts and underutilization of field services is avoided. Failure to do so could lead to inefficient allocation and utilization of very scarce human resources. This may require restructuring the extension service by providing expert staff support in needed subjects in several disciplines at the district and local levels.

(7) Lack of farmer meetings

Since the DAH does not hold any farmers' meetings to learn of their problems, it is very important to promote direct contact of its staff with farmers. This is necessary to develop effective feedback on the impact of its livestock disease and parasitic control measures, etc. Failure to do this could deny the DAH information from farmers vital for its development programmes. It is believed this need for contact could be accomplished in part by restructuring the entire extension service.

ANNEX 2

Malawi

Annex 2

MALAWI

A. Country Background

1. The land

Malawi is a landlocked country with a total area of 118,700 square kilometres. Malawi's portion of Lake Malawi covers 23,900 square kilometres of this total area. Malawi is about 900 kilometres from north to south and less than 200 kilometres from east to west. The country is bordered on the north and northeast by Tanzania; to the east, south and southeast by Mozambique; and to the west by Zambia. Administratively, the country is divided into three regions-- the northern, central and southern regions. Malawi can also be divided into four topographic regions:

- o The Great Rift or Shire Valley, which is the dominant feature of the country, cutting across the country from north to south and containing numerous lakes including the Lake Malawi littoral and the Shire River Valley.
- o The Central Region Plateaus rise to an altitude of 2,500 to 4,500 feet and lie beyond the littoral to the west, covering about 75 percent of the total land area.
- o The highland areas are mainly isolated tracts, some rising to an elevation of 8,000 feet. They comprise the Nyika, Vipya and Dowa Highlands, the Dedza-Kirk Mountain range in the north and west and the Shire Highlands in the west.
- o The isolated mountains and plateaus of Mulanje (10,000 feet) and Zomba (7,000 feet) in the east make up the fourth geographical region.

2. Population

Malawi's population was estimated to be 6.4 million in 1982. The annual growth rate of the population is 3.0 percent and the average population density is 65 persons per square kilometre, (170 inhabitants per square kilometre of arable land). Only 10 percent of the population lives in urban areas. However, as a result of internal migration, the urban population is increasing at a rate of 7.3 percent per year. Malawi's population is unevenly distributed, with approximately 12 percent of the population in the Northern region, 30 percent in the Central region and more than half of the entire population in the Southern region. New investment (particularly in agriculture and

transport) in the Northern and Central Regions, the movement of the capital in the early 1970s from Zomba in the South to Lilongwe in the Central region, and the construction of a new international airport at Lilongwe are helping to redress the imbalance in Malawi's population distribution.

About 48 percent of the population was under 15 years of age in 1981. Average family size in the rural areas is about five persons. An estimated 25 percent of the population is literate. The Physical Quality of Life Index (PQLI) -- which is based on an average of life expectancy at age one, infant mortality and literacy -- is recorded at 31 for Malawi. This is lower than many African countries (e.g., Swaziland at 45) and much lower than most western countries (United Kingdom 95, United States 96).

Nine main groups historically are associated with what is now Malawi. Each has its own language and customs although many aspects of traditional ways of life are common to all. Although Chichewa and English are the official languages, in 1966 English was understood by less than 20 percent of the population, while Chichewa was spoken by more than 50 percent and understood by about 77 percent.

3. The economy

a. The Gross Domestic Product (GDP)

Since Malawi's independence in 1964, the country has made impressive economic development progress mainly due to the Government's strong commitment to development and to careful planning. Between 1960 and 1981, GDP grew at an average annual rate of almost 5.7 percent. GDP in current dollars in 1980 was US\$1,420 million, compared to US\$170 million in 1960. Per capita GDP in 1980 dollars was US\$2001.

Agriculture provided about 43 percent of the GDP at factor cost in 1980, of which four-fifths (87 percent) came from the smallholder subsector. Also important were the manufacturing and wholesale/retail sectors, both representing 13 percent.

b. Foreign trade

The economy of Malawi is heavily dependent on three agricultural commodity exports-- tobacco, sugar and tea. Ninety percent of all merchandise exports are agriculture. In 1981, tobacco provided the largest share of agricultural exports (48 percent), followed by sugar (26 percent), tea 12 percent), and groundnuts (4 percent). Only about 20 percent of export production came from the smallholder sector.

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World Bank, World Development Report, (World Bank: Washington, 1983).

Malawi's current account deficit increased from an annual average of nine percent prior to 1978 to 24 percent in 1981. Debt service in 1981 was the equivalent of 30 percent of exports.

c. Employment

Of the more than 360,000 persons employed in Malawi in 1981, 180,000 or 50 percent were in Agriculture, Forestry and Fisheries. Eighty-seven percent were males and 13 percent were females¹. The ratio of employment in agriculture, forestry and fisheries to total employment has been relatively constant for an extended period of time.

4. Basic infrastructure

a. Transportation

Because it is a landlocked country, Malawi is vulnerable to external transport difficulties. Imports and exports generally move by train across Mozambique to the port cities of Beira and Nacala. Within Malawi, the railroad runs through the Shire Valley and north to Salima (400km), then west to the Zambian border (200km). The northern two-thirds of the country is without rail service. The southern half of the country is fairly well served with paved roads but there are fewer roads in the northern region, and they are largely gravel. Altogether, the country had 10,772 kilometres of classified roads in 1981.

Air Malawi services the Southern, Central and Northern regions of the country, carrying both passengers and freight.

b. Communications

Two radio stations broadcast in both Chichewa and English in Malawi. By 1981, there were 275,000 radio sets in the country and 29,000 telephones. Nine publishers exist, printing items ranging from newspapers to religious tracts.

c. Education

Malawi's literacy rate is estimated to be about 25 percent. The primary school pupil/teacher ratio was 64:1 in 1980-81. Primary school enrollment was about 810,000 or 58 percent of children of primary school age. Secondary school enrollment amounted to 18,000 or about 4 percent of the secondary age group. The GOM is seeking to make secondary schools more relevant to Malawi's needs. For example, it is equipping up to one half of them with technical programmes to provide students with pre-vocational training.

¹

National Statistical Office, Monthly Statistical Bulletin, June 1981 (NSO: Zomba, 1982).

A variety of vocational schools are available for students who go beyond the secondary level.

d. Health and nutrition

The life expectancy at birth in Malawi is only 46 years and infant mortality is high at 45 per 1,000 live births. The number of people per physician in 1977 was 40,192.

B. The Agricultural Sector

1. Ecology

Malawi may be divided into four basic topographic regions. The Great Rift Valley, which includes the Lake Malawi lakeshore and the Shire River valley; the plateaus of the Central Region, which cover about three-fourths of Malawi's total land area; the highland areas, mainly independent highlands rising as high as 8,000 feet; and isolated mountains and associated highlands rising as high as 10,000 feet (Mt. Mulanje).

Annual rainfall in Malawi varies greatly from year to year. There is a tendency for a number of wet years to be followed by a number of years with poor rainfall, but there is no regular cycle. In the Shire Valley and Lake Malawi littoral region, annual rainfall is often less than 750mm, with most falling between November and March. In the highland areas, annual rainfall can be as high as 1,600 mm and may fall throughout the year.

2. Soils

Malawi is fortunate in possessing some of the most fertile soils in South Central Africa. The soils found in the lake-shore plains and the upper and lower Shire Valley are especially supportive of agricultural production. The plateau regions are also areas of high soil fertility. Mountainous terrain in some areas, however, prohibits land from being used for farming.

3. Land tenure

Most of Malawi's arable land is under traditional smallholder tenure systems. The small farmers live under the control of family heads, village headmen and chiefs. Cultivation rights rather than ownership are granted by village headmen. Matrilineal residence, where a husband leaves his home to live with his wife who inherits cultivation rights, is common. However, patrilocality is common in the Northern region.

The remainder of Malawi's arable land is held by large agricultural estates, owned by both the public and private sectors.

4. Land Use

a. Agriculture

(1) Smallholders

Roughly 70 percent (6.7 million hectares) of Malawi's total land area of 9.41 million hectares is available to smallholders. Three-quarters of this is considered to be arable, although less than half has been cropped recently (see Table 2-1). The average farm size for smallholders is 1.7 hectares. Most smallholders produce maize for their staple food on two-thirds to three-fourths of their cultivated land. Most grow flint maize for food and save some for seed. However, Malawi's maize research until recently has concentrated on dent maize although flint maize stores better than hybrids. Other significant crops grown by the smallholder are beans, groundnuts, cotton, sorghum, millet, and tobacco (see Table 2-2). Thus smallholders account for 1.0 million hectares in maize, 400,000 hectares in groundnuts, 35,000 hectares in sorghum and millet, 9,000 hectares in rice, 4,000 hectares in sweet potatoes, 850,000 hectares in beans (pulses), 3,000 hectares in tobacco, 37,000 hectares in seed cotton, and 2,000 hectares in tea. Pulses (cowpeas, beans and pigeon peas) are generally intercropped by smallholders. Yields are low.

Tobacco is grown by about 10 percent of the smallholders. The production of fire-cured, air-cured, sun-cured and oriental tobacco by smallholders is controlled to assure product quality and market stability. Flue-cured tobacco is usually restricted to estates, though some smallholders in Kasungu District are licensed to grow it on lease-hold land, on the condition that they sell their tobacco through the Kasungu Flue-cured Tobacco Authority.

Some 4,000 smallholders grow about 2,000 hectares of tea under the auspices of the Smallholder Tea Authority.

Cotton is grown by about 60,000 smallholders. Although the average national yield for cotton is 500 kilogrammes per hectare, higher yields are realizable if available technology, which includes timely planting and pest control, is used.

Groundnuts are produced entirely by smallholders. Yields are in the range of 400-500 kilogrammes per hectare (shelled). The low yields are attributed to disease, unfilled pods, and inadequate prices. The crop is labour-intensive and vulnerable to fungal and viral diseases, and prices have not been sufficiently high to make pest control profitable.

Cattle are mostly raised by smallholders, although the estate subsector has a large number of dairy cattle. Their

Table 2-1: Land Use in Malawi

<u>Land Use Category</u>	<u>('000 hectares)</u>	<u>(percent of total)</u>
Land available to smallholder:		
Cropland:	<u>2,860</u>	<u>30.4</u>
cropped	1,660	17.6
fallow ¹	1,200	12.8
Arable but unused	2,250	23.9
Non-arable grazing and unused	<u>1,550</u>	<u>16.5</u>
Subtotal, smallholder land	6,660	70.8
Agricultural estates	490	5.2
Forestry and forest reserves	870	9.2
Game parks	1,040	11.1
Infrastructure and urban	<u>350</u>	<u>3.7</u>
TOTAL ²	<u>9,410</u>	<u>100.0</u>

¹ Cropped within past five years.

² The total refers to the total area of Malawi less that portion which falls in Lake Malawi.

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Table 2-2: Indicators of Agricultural Productivity in Malawi

A. <u>Crops</u>	Yields (kg/ha)		
	<u>Average Range, Traditional Sector</u> ¹	<u>Average Range, Estate Sector</u>	<u>Average Range, Research Station</u> ¹
<u>Food Crops</u>			
Maize	325 - 5,200	4,000 (Mh12) 6,000 (CCA)	3,500 - 9,000
Pulses	160 - 330	--	--
Sorghum	250 - 2,200	--	3,500
Millet	260 - 1,100	--	--
Rice	1,100 - 2,950	--	2,300 - 4,000
<u>Cash Crops</u>			
Groundnuts	260 - 1,200	--	700 - 1,250
Cotton	325 - 1,000	--	2,000
Tobacco	--	1,800 (flue-cured) 2,000 (burley)	2,600 (flue-cured) 3,000 (burley)
Tea	--	2,659	3,000
B. <u>Livestock</u>			
<u>Cattle Indicators</u>			
Offtake	10	10	10
Mortality	12	15 (0-1) 5 (over 1 yr.)	4
Calving Rate	40 - 60	40 - 60	70

¹The great variability in average yields is due mainly to ecological differences, rather than differences in cultural practices. A more detailed picture of yields on farmers' fields and research stations in different regions is given in Annex 2.

Source: National Sample Survey of Agriculture
 ADD 1982/83 crop estimates
 Sorghum and pearl millet breeding programmes report, 1980/81.
 Groundnut breeding annual report, 1981/82, (released variety)
 The Smallholder Tea Authority Annual Report, 1980/81.
 Tobacco Research Authority.

population is greatest in the Central and Northern Regions, although some also are raised in the Shire Valley. About 1.5 million hectares of Malawi's land area is non-arable grazing or unused land and some cropped and fallowed land also is used to graze cattle and other livestock.

(2) Estates

Estates control 470,000 hectares, of which 28,000 hectares are in tobacco, 16,000 in tea, and 15,000 in sugarcane. In terms of members, there were over 1,100 estates registered with the GOM in 1979, of which 98 percent produced tobacco. Twenty six others grew tea and two others raised sugarcane. Combined estate production has increased over four-fold since 1968 and some of this increase has been the result of expansion of the area under cultivation.

b. Forestry

Forests and reserves occupy about 870,000 hectares (9 percent of Malawi's land area). About 6,000 hectares of new forest area is planted each year. There is little natural forest lumber suitable for general carpentry. Softwood plantations begun in the 1950's are now producing lumber for poles and crates. Fuelwood is an important source of energy for smallholders and for tobacco curing.

5. Input and services

a. Marketing

The Agricultural Development and Marketing Corporation (ADMARC) is a statutory company established to purchase smallholder crops (foodcrops and non-food crops), to sell food crops, and to sell and deliver crop production inputs (seeds, fertilizers, chemicals and sometimes farm implements). ADMARC operates a national network of marketing sheds and storage facilities for these purposes. It invests in agricultural and agro-industrial enterprises and pays/charges prices as agreed upon and authorized by the Price Review Committee of the Malawian Government.

Estate produce is marketed almost entirely through the private sector. The Grain and Milling Company (GRAMIL) is the major maize purchaser and the Tobacco Auctions at Limbe and Lilongwe provide the vehicles for tobacco sales. Tea and coffee are exported through international trading companies.

Two separate livestock markets operate. The Cold storage Company (CSC) buys animals at a fixed price per kilogramme, depending upon the grade. In addition, several auction markets exist where animals are purchased by CSC, local butchers, other farmers and rural development programmes for stallfeeders.

b. Credit

No central agricultural credit institution exists in Malawi. Smallholders have access to seasonal and medium term agricultural credit through the Ministry of Agriculture's rural development projects (which have their own credit funds and staff), through settlement schemes under the Ministry of Agriculture; through extension agents as part of a community credit group; or through the Loan Board under the Ministry of Trade and Industry.

c. Fertilizers and seed

Fertilizers for the estate subsector are imported under monopoly rights granted to Optichem; other agro-chemicals are provided by commercial firms. The National Seed Company of Malawi produces, processes and stocks a wide range of seed for sale. Most direct sales are to estates and ADMARC. Smallholders normally purchase their seed requirements through ADMARC.

6. Production and performance of the agriculture sector

In 1981 the smallholder subsector accounted for 81 percent of all agricultural production, meeting the country's demand for food staples (maize, rice, beans, cassava, sweet potatoes, groundnuts, sorghum and millet), providing some export surplus (tobacco, groundnuts, tea, coffee, and guar beans) and certain raw materials for domestic industry (cotton and fire-cured tobacco). However, the export surplus from the subsector comprises only about 20 percent of all agricultural exports.

Most livestock in Malawi are raised by smallholder cultivators who are also livestock owners (see Table 2-3). A commercial livestock sector, including many smallholders, provides virtually all the meat and eggs demanded by the urban consumers. Smallholders in the subsistence sector provide meat and eggs to the rural population and produce feeder cattle to be used by commercial livestock producers.

The cattle population in Malawi has been increasing over the past 30 years and now has a national growth rate of 4.87 percent. The off-take has averaged 9-10 percent per annum. The calving percentage is currently reported to be 55-60 percent for both estate and traditional herds. However, calving rates of 80-90 percent have been achieved by some estates principally due to adequate nutrition. Growth rates and final slaughter weight are significantly better on estates than among traditional herds, with slaughter weights of 230-240 kilogrammes reached at three years.

Nearly all the goat population in Malawi is owned by smallholder farmers. Goat meat is preferred to sheep. They are generally not milked. The national herd is growing at an annual rate of 1.52 percent; the kidding rate is 120 percent. The off-

Table 2-3: Livestock Production Indicators for Malawi

	<u>Total Population ('000 head)</u>	<u>Smallholder Population (percent of total pop'n)</u>	<u>Offtake (percent)</u>	<u>Mortality (percent)</u>	<u>Growth Rate</u>	<u>Reproduction rate (percent)</u>
<u>Cattle</u>						
Dairy	200	60	-	-	4.87	-
Beef	700	95	-	-	-	-
Traditional Sector		-	< 10	12	-	40 - 60
Estate Sector		-	10	15 (0-1 yr.) 5 (over 1 yr.)	-	40 - 60
Research Station		-	10	4	-	70
<u>Goats</u>	718	79	40	30 (0-1 yr.) 5 (over 1 yr.)	1.52	120
<u>Sheep</u>	85	88	50	15 (0-1 yr.) 5 (over 1 yr.)	n.a.	80 - 120
<u>Pigs</u>	206	98	n.a.	n.a.	1.75	n.a.
<u>Poultry</u>	8,468	94	10	n.a.	1.96	n.a.

Sources: Report of the Livestock Task Force, 1983.

Department of Livestock Production, Bunda College.

Department of Veterinary Services, Livestock and Meat Study, 1982.

take rate runs about 40 percent and the average slaughter weight is 11 kilogrammes.

Most sheep also are owned by traditional farmers, although several estates run small flocks. The off-take rate is estimated to be 50 percent and the reproduction rate ranges from 80 to 120 percent.

Two types of pigs are kept by farmers: the traditional village pigs which scavenge around homesteads, and exotic breed pigs which are raised commercially. Pigs tend to provide farmers with low margins over feed costs and there are periodic outbreaks of African Swine Fever (ASF) which have reduced the pig population. The Department of Veterinary Services has a research project aimed at controlling ASF.

Under average management, producers raise 16 piglets per sow per year. No adequate record on feed conversions was available due to poor records. However, Milolongwe production records indicated conversions of 3.5 pounds of feed per pound of gain for porkers and 3.7 to 1 for baconers, given proper feed formulations.

Traditional village poultry production is based on small scale flocks scavenging on insects, seeds and household waste. Most poultry is reared by smallholders, but some commercial production occurs on estates. Banks and others have been actively seeking to enhance the productivity of the smallholder sector for several years. However, to date no consistent or major yield improvements have resulted from such efforts.

The estate subsector functions as the principal earner of foreign exchange, with exports of tobacco, sugar, tea, tung oil, coffee and macadamia nuts. The major estate crops are tea, flue-cured and burley tobacco, and sugar. Estates contribute 15 percent of total agricultural production, while producing about 80 percent of agricultural exports. A certain proportion of the livestock population is raised by government and private estates under better management practices than those of the traditional smallholder farms.

Estate output has increased substantially since 1968, growing on an annual basis at a rate of about 17 percent. Between 1970 and 1977, for example, production of burley and flue-cured tobacco increased by about 80 percent and 400 percent, respectively. During the same period, tea production increased by about 70 percent. In general, estate production increases are attributed to expansion of area under cultivation, better management of some of the estates, and greater use of inputs.

The rate of growth in real output by the smallholder subsector is not known with certainty, but has been about three percent per year in recent years. This is a slow increase given the importance of the subsector to Malawi's overall economy and Malawi's population growth rate of three percent. As a result, the GOM, the World and USAID and others have concentrated their

attention on ways to improve the productivity of Malawi's smallholders. Table 2-2 provides yield data of the major food and cash crops for smallholders, estates and research stations. As might be expected, research and estate yields are generally higher than those achieved by smallholder farmers. This suggests that there is potential for increases in productivity by smallholders, even if their yields cannot reasonably be expected to be as high as those in the estate subsector.

7. Food security

Malawi is unique in comparison with most other SADD countries because it is self sufficient in basic food crops. In fact, except for major crop shortfall occasions and lack of a food reserve to meet such situations, Malawi is a net exporter of maize and other staple foods. Moreover, Malawi has continued to produce and export excellent maize crops despite the drought presently affecting large portions of Southern Africa. For example, the 1983 maize crop was even higher than the 1982 crop of 1.4 million metric tons. Together with the large maize surplus stock accumulated from the 1982 crop, the 1983 surplus made it possible to export about 100,000 metric tons to neighboring countries which were affected by the drought. In addition, Malawi donated foodstuffs to Mozambique.

In spite of this current surplus of maize, there is no room for complacency given the country's population growth rate of 3.0 percent and the relatively low maize yield of 1,200 kg/ha. In a short 25 years, the population will have doubled, and in the absence of increased yields, the country's maize surplus will have disappeared.

Under the circumstances, appropriate research leading to increased yields by smallholders assumes an element of urgency if Malawi is to continue to feed itself and have a surplus for export.

C. Agricultural Research

1. Introduction

Agricultural research is carried out by the Departments of Agricultural Research (DAR) and Veterinary Services (DVS) of the Ministry of Agriculture (MOA), the Bunda College of Agriculture of the University of Malawi, the Tea Research Foundation, the Tobacco Research Authority, and the Sugar Company of Malawi (SUCOMA).

2. The Department of Agricultural Research (DAR)

a. Background

The Department of Agricultural Research is headed by the Chief Agricultural Research Officer. As indicated on the accompanying organisation chart (Figure 2-1) research programmes emphasize the needs of the smallholder farmer in food and cash crops (with the exception of tea, tobacco, and sugar), horticulture and farming systems. The DAR also provides services such as seed multiplication and certification; information about soil and water conservation, disease and pest control; and diagnostic services. Administratively, the DAR is organized on the basis of research stations, which in turn have sub-stations and district sites. Each of the research stations has its own budget and is controlled by an officer in charge.

b. Research programmes

The emphasis in the Department of Agricultural Research is on maize, cotton, groundnuts, rice, and horticultural crops improvement. Programmes also exist in farm machinery development, crop storage, and livestock improvement. Although of lesser priority, significant research has been undertaken on sorghum and pearl millet, Phaseolus beans, wheat and triticale, root crops (sweet potatoes, European potatoes), pastures, and legume microbiology. Programmes being undertaken at the various research stations are listed in Table 2-4.

Responsibility at the national level for livestock research is divided between the Chief Veterinary Officer and the Chief Agricultural Research Officer. The emphasis has been on cattle; very little research has been done on poultry, goats (the most numerous livestock), and sheep.

c. Human resources

There are a total of 436 research staff, ranging from the level of Technical Assistant to Senior Administrative staff. There are three levels of staff qualification: the Professional Officers (PO) who hold at least a bachelor's degree; Technical Officers (TO) who have diplomas in Agriculture; and Technical Assistants (TA) who hold certificates in Agriculture. Various grades exist within each level of qualification. Nine professional officers' posts are vacant at present. See chart of number of staff at each level of qualification at headquarters and at the research stations (Table 2-5).

DAR professional researchers (POs) have been classified according to discipline in Table 2-6.

The DAR offers the opportunity for further training of promising staff. Under a USAID/University of Florida project, 13 men are training abroad at the Ph. D. level, eight men and four women at the Master's level, and two men at the Bachelor level.

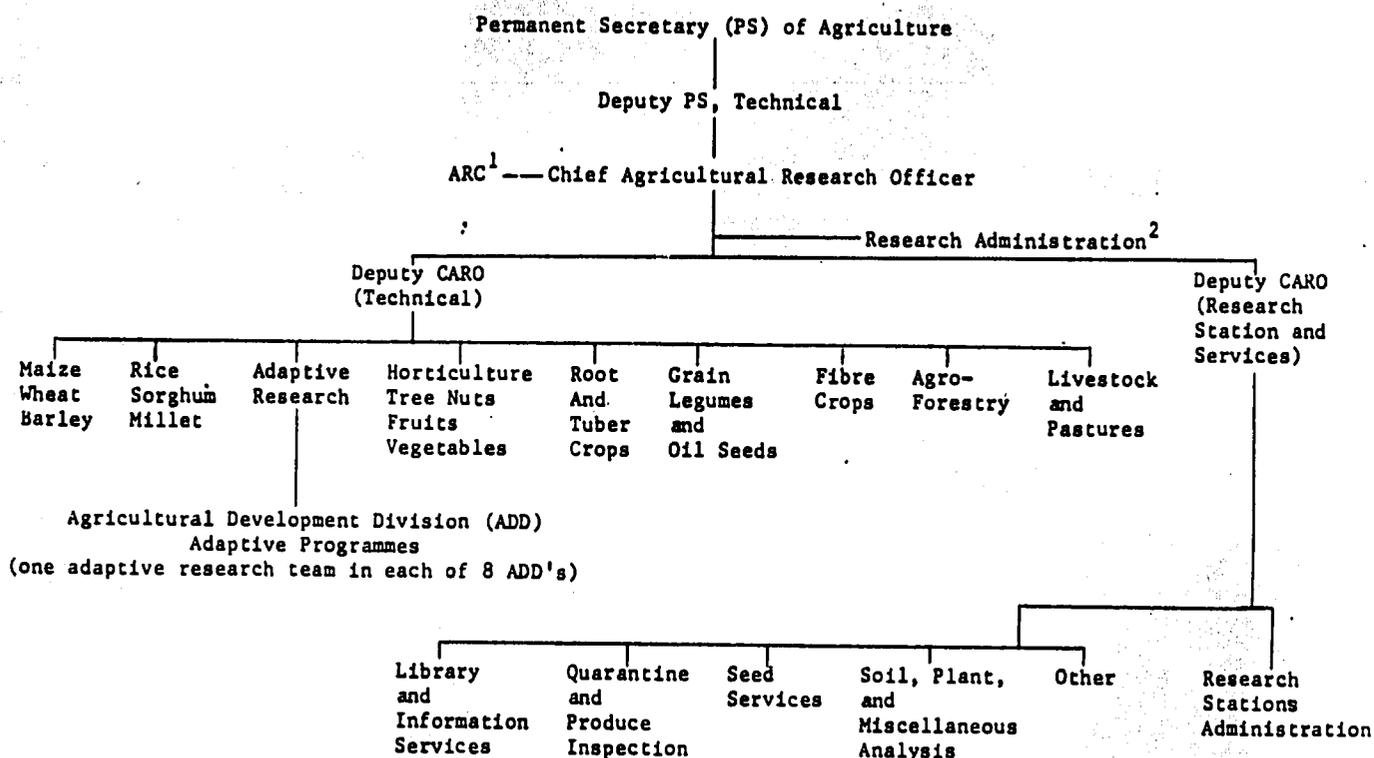


Figure 2-1 : Organisation Chart for the Department of Agricultural Research, Ministry of Agriculture, Malawi

¹ The Agricultural Research Council (ARC) is comprised of the following:

- Principal Secretary, Ministry of Agriculture (MOA)
- National Research Council
- Economic Planning Division
- Chief Agricultural Officer, MOA
- Chief Agricultural Research Officer (CARO)
- Deputy CAROs
- Chief Projects Officer
- Chief Veterinary Officer
- Bunda College
- Chancellor College
- Estates Advisory Board
- Others as required

² The Research Administration is comprised of the following:

- Administrative Officer
- Financial Controller
- Research Economist
- Secretaries and support staff

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Table 2-4 : Research Programmes of Department of Agricultural Research Stations in Malawi

Research Station	Location	Research Programmes
Chitedze	Lilongwe	Soil fertility and plant nutrition; farm machinery development; maize breeding and agronomy; groundnut breeding and management; wheat seed technology service; crop storage; pasture improvement; livestock production; farming systems and agricultural economics research.
Bvumbwe	Blantyre	Soil fertility, soil moisture and physical properties; variety and management trials on vegetables, fruit, tree nuts, maize, wheat, potatoes, and cassava; plant protection with plant quarantine facilities; crop storage; production and distribution to farmers of macademia and tung planting material.
Makoka	Liwonde	Cotton research, biometrics unit of DAR, and the army worm forecasting service.
Kasinthula	Ngabu	Research on irrigated crops - water consumption/use studies on maize, wheat, beans, and cotton; testing station for national maize and cotton research; tests on vegetables and bananas, including variety, fertility, and moisture requirements.
Lifuwa	Salima	Irrigated and rain-fed rice research including agronomy, breeding, rice seed production; evaluation of mangoes and cashews.
Ngabu	Ngabu	Agronomy and variety trials of rain-fed sorghum, millet, guar, maize, groundnuts, cowpeas, and cotton breeding; on-farm verification trials programmes.
Mbawa	Mzuzu	Mixed cropping; adaptation trials on maize, wheat, groundnuts, beans, sunflowers, upland rice, and some tobacco; agro-forestry; pasture improvement; livestock research.

Table 2-4: Research Programmes of Department of Agriculture
Research Stations in Malawi (cont.)

Research Station	Location	Research Programmes
Baka	Karonga	Maize varieties, spacing and fertility; beans; groundnuts; burley tobacco; coffee; forage grass; cassava; cotton; rice.
Makhanga	Ngabu	Studies of rain-fed and irrigated crops -- tree crops, maize, rice, groundnuts, cotton, and cocoa.
Chitala	Salima	Variety evaluation; agronomy and crop protection trials of maize, groundnuts, cowpeas, sunflowers, pigeon peas, cassava, beans, sorghum, cotton, tree fruit and nut crops; fruit tree nursery; livestock.
Linyangwa	Mzuzu	Root crops research -- cassava and sweet potatoes; trials on coffee; agronomy evaluation work on legumes, cotton, pastures, livestock, and macadamia.

Table 2-5: Department of Agriculture Research Staff Professional Officers by Station and by Level of Qualificaton

<u>Station</u>	<u>Professional Officers (POs)</u>			<u>Technical Officers (TOs)</u>	<u>Technical Assistants (TAs)</u>
	<u>Administration</u>	<u>Administration and Research¹</u>	<u>Research</u>		
Chitedze/ headquarters	3(3)	12	25(5) ³	28	58
Bvumbwe		10	9(2)	26	48
Makoka		3	9	8	33
Kasinthula		1	4(2)	3	10
Lifuwu		1	1	3	6
Ngabu		2	2	2	13
Mbawa		1 ²		3	10
Baka		1		3	12
Makhanga		1 ²			9
Chitala		1 ²		1	12
Lunyangwa		1	1	6	8
Soil Survey Unit		1	2	1	4
TOTAL	3(3)	35	53(9)	84	223

¹ Officers in charge of stations' and section heads who share their time between administration and field research commitments.

² Station head at Chief Technical Officer (CTO) level, without degrees.

³ Numbers in parentheses refer to expatriates.

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Table 2-6: Department of Agriculture Research Staff by Discipline
and by Level of Qualification

<u>Discipline</u>	<u>Bachelor's</u>	<u>Master's</u>	<u>Doctorate</u>	<u>Total</u>	<u>In Training</u>
Agronomy	10	6	1	17	1 Ph.D., 4 M.Sc.
Plant Breeding	3	3	4	10	3 Ph.D., 2 M.Sc.
Plant Pathology	3	2	1	6	1 Ph.D., 1 M.Sc.
Plant Physiology	--	--	--	--	1 Ph.D.
Entomology	4	2	2	8	2 Ph.D.
Animal Nutrition/ Breeding	--	--	1	1	1 Ph.D.
Livestock Production	2	2	--	4	--
Pasture Agronomy	--	1	1	2	1 Ph.D.
Agricultural Engineering	2	3	--	5	1 B.Sc.
Soil Sciences	4	3	4	11	2 Ph.D.
Agricultural Economics	6	4	--	10	2 M.Sc.
Biometry	2	1	--	3	1 M.Sc.
Seed Technology	--	2	--	2	1 M.Sc.
Horticulture	3	2	--	5	--
Nematology	1	--	1	2	--
Microbiology	1	--	1	2	1 B.Sc.
General Agriculture	--	--	--	--	2 B.Sc.
TOTAL	41	31	16	88(12)¹	13 Ph.D., 11 M.Sc. 4 B.Sc.

¹Numbers in parentheses refer to expatriates

In addition, several are being trained at local institutions: two men at the Bachelor level and three men at the diploma level.

A planned reorganization of the Department will provide staff for additional programmes, especially the farming systems programme. For the period 1984-89, an additional nine research staff, including a librarian, must be trained to meet the needs of these programmes. An administrative officer and controller will be recruited locally.

d. Budgets and expenditures

Table 2-7 shows expenditures under capital and recurrent accounts for the past six years and identifies the portion of the recurrent budget disbursed for payment of personnel.

Operating budgets of DAR Stations are shown in Table 2-8. Although the three larger stations account for about 80 percent of DAR's professional staff, they receive less than half of the operating budget. The Department is currently evaluating its allocation of research funds.

e. Assets

(1) Land

Descriptive data on the land and its use at each of the eleven research stations is given in Table 2-9. A comparison of Tables 2-5 and 2-9 reveals little correlation between amount of land and number of staff.

(2) Buildings

See Table 2-10 which describes assets of government research centers in Malawi. All of the research stations have at least some office space, with the most at Chitedze, followed by Bvumbwe and Makoka. The first two of these have five DAR laboratories each for studies in the basic discipline areas of soil and chemistry, pathology, entomology, crop storage, and seed technology (Chitedze) or nematology (Bvumbwe). See Table 2-11 for research focus at the various research stations. The DVS has laboratories at three other locations. There are 15 greenhouses at Chitedze and two at Makoka with a total space of 375 square metres. All research stations have workshops for the maintenance of vehicles and machinery.

(3) Equipment

No field or laboratory equipment with a replacement value of US\$5000 was identified other than vehicles and tractors (see Table 2-10).

Table 2-7: Expenditures for Agricultural Research in Malawi, 1976 to 1981
(US\$ 000)

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u> ¹	<u>1980</u> ¹	<u>1981</u> ¹
Capital	493	476	983	468	1985 ^{1 2}	965
Recurrent	892	949	1185	1454	1645	1808
Salaries & Wages						
Established Posts	(313)	(356)	(577)	(588)	(650)	(727)
Non-established Posts	(91)	(154)	(201)	(226)	(260)	(266)

¹ Estimates

² Includes about US\$ 1.5 million for USAID project

Table 2-8: Operational Budgets and Staff of Department of Agricultural Research stations in Malawi, 1982 to 1983

Research Station	Operational Budget (excluding salaries) ¹ (000's US\$)	Professional Officers	Technical Officers	Technical Assistants
Chitedze	164.7	37	28	58
Bvumbwe	17.0	19	26	48
Makoka	100.8	12	8	33
Kasinthula	89.2	5	3	10
Lifuwu	116.1	2	3	6
Ngabu	66.7	4	2	13
Mbawa	62.7	1	3	10
Baka	86.8	1	2	12
Makhanga	68.4	1	--	9
Chitala	30.6	1	1	12
Lunyangwa	106.3	2	6	8
Soil Survey	5.9	3	1	4
TOTALS	915.2	88	84	223

¹ Includes labourers' wages, transport and travel, building maintenance, and miscellaneous expenses.

Table 2-9: Ecological Description and Land Use of Research Stations in Malawi

<u>Station</u>	<u>Altitude</u>	<u>Major Soil Type</u>	<u>Annual Rainfall (mm)</u>	<u>Total area (ha)</u>	<u>% Cultivated</u>	<u>Comments</u>
Chitedze	1150 m	sandy clay loam	750-875	560	48	20 percent of plots used for experiments 20 percent of land under pasture
Bvumbwe	1145 m	sandy clay loam	1207	260	-	
Makoka		sandy loam to sandy clay loam	1014	100	-	
Kasinthula	100 m	-	800	300	83	66 percent of plots irrigated
Lifuwu	500 m	clay	1130	202	45	41 percent of plots used for seed multiplier 4 percent of plots used for experiments 20 percent of plots irrigated
Ngabu	100 m	-	-	30	99	
Mbawa	1245 m	sandy clay loam	855	300	33	
Baka	457 m	sandy clay loam	1200	240	6	

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Table 2-9: Ecological Description and Land Use of Research Stations in Malawi (cont.)

<u>Station</u>	<u>Altitude</u>	<u>Major Soil Type</u>	<u>Annual Rainfall (mm)</u>	<u>Total Area (ha)</u>	<u>% Cultivated</u>	<u>Comments</u>
Makhanga	-	-	-	83	50	58 percent of plots used for experiments 41 percent of plots used for seed multiplication 75 percent of plots irrigated
Chitala	600 m	sandy clay loam	895	495	-	
Lunyangwa	1342 m	deep dark-red clays	1270	800	13	

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Table 2-10: Assets at Government Research Centres in Malawi

Research Centre	Laboratories	Greenhouses	Offices	Vehicles	Motorcycles	Tractors
<u>Department of Agricultural Research (DAR)</u>						
Chitedze	5	15	67	13	6	4
Bvumbwe	5	-	46	6	2	1
Makóka	2	2	20	5	2	2
Kasinthula	-	-	6	4	2	3
Lifuwu	-	-	5	2	-	3
Ngabu	-	-	6	1	2	-
Mbawa	-	-	4	2	2	2
Baka	-	-	4	-	3	1
Makhanga	-	-	2	1	1	-
Chitala	-	-	2	1	1	3
Lunyangwa	-	-	7	3	2	2
Soil Survey	n.a.	-	3	1	-	-
Headquarters	-	-	-	1	-	-
Subtotal, DAR	12	17	172	40	23	21
<u>Department of Veterinary Services (DVS)</u>						
Lilongwe	3		5			
Blantyre	1		3			
Mzuzu	1		1			
Subtotal, DVS	5		9			

Table 2-11: Focus of Major Use by Type of Structure and Condition of Government Buildings for Agricultural Research

<u>Focus of Major Use</u>	<u>Type of Structure</u> ¹	<u>Location</u>	<u>Condition</u> ²
<u>Department of Agricultural Research</u>			
Soil and Chemistry	(L)	Chitedze	P
	(L)	Bvumbwe	G
Entomology	(L)	Chitedze	G
	(L)	Bvumbwe	F
	(L)	Makoka	G, a/c
	(L)	Makoka (insectary)	G
	(G)	Makoka	G, c/c
Pathology	(G)	Makoka	G, c/c
	(L)	Chitedze	F
	(L)	Bvumbwe (nematology)	F
	(L)	Bvumbwe	F
Crop Storage	(L)	Chitedze	G
	(L)	Bvumbwe	G
	(L)	Lunyangwa	G
Seed Technology	(L)	Chitedze	G
	(L)	Lifuwu	G
Groundnut Research	(G)	Chitedze (15 greenhouses)	G
Rice Breeding	(L)	Lifuwu	G

¹ L = Laboratory, G = Greenhouse.

² P = Poor, F = Fair, G = Good, E = Excellent, a/c and c/c indicate structures with air conditioning or climate control, respectively.

Table 2-11- Focus of Major Use by Type of Structure and Condition of Government Buildings for Agricultural Research (cont.)

<u>Focus of Major Use</u>	<u>Type of Structure</u> ¹	<u>Location</u>	<u>Condition</u> ²
<u>Department of Veterinary Services</u>			
African Swine Fever	(L)	Lilongwe	E, c/c
Newcastle Disease	(L)	Lilongwe	E, c/c
East Coast Fever	(L)	Lilongwe	E, c/c
	Large-animal compound	Lilongwe	n.a.
	Large-animal barn complex	Lilongwe	n.a.
Disease Diagnosis	(L)	Mzuzu	G
	Small-animal compound	Lilongwe	n.a.
TBT and Rabies	(L)	Blantyre	P

¹ L = Laboratory, G = Greenhouse.

² P = Poor, F = Fair, G = Good, E = Excellent, a/c and c/c indicate structures with air conditioning or climate control, respectively.

The biometrics unit of the Department of Agricultural Research is located at the Makoka Research Station and has a Hewlett-Packard HP85 micro-computer.

(4) Library and publications

The main library for all stations is located at the Chitedze research station. This library has approximately 3,000 books and acquires 30-50 books per annum. It receives approximately 250 periodicals/scientific journals and it has access to library resources of the University of Florida and Tropical Products Institute (TPI) in the U.K.

While Malawi does not have a national agricultural research journal, agriculture-related articles are published in the Malawi Journal of Science, an organ of the Association for the Advancement of Science in Malawi. Scientists can report on their work in the Research Bulletin, Research Circulars, the Guide to Agricultural Production in Malawi, and Research Highlights. The first two are published monthly in Malawi, and the second two yearly. Scientists are also free to publish their results in international research journals.

f. Linkages and services

(1) Within country

(a) Linkages with extension

Researchers and extension officers participate together on a number of committees. The Research Liaison Committee, established before the Agricultural Development Divisions (ADD) structure was implemented, is still operating, mainly in the northern and southern regions. The Committee now includes the ADD leadership as well as the researchers in the region. Research and extension headquarters staff may also be invited.

The Livestock Production Committees operate at regional and national levels. DAR and DVS staff and ADD staff attend these committee meetings.

Research personnel are currently attached to some of the ADDs (e.g., at Ngabu and Liwonde). With the introduction of Adaptive Research Units attached to each ADD, greater ties between the ADDs and research can be expected.

Technical information in extension circulars and handbooks is reviewed by DAR staff before publication. Informal linkages affecting research programme content also include on-farm trials.

(b) Linkages with other institutions

Since the Department of Agricultural Research has the primary responsibility for research in Malawi, linkages have been established between it and the Bunda College of Agriculture, the Tobacco Research Authority, the Sugar Corporation of Malawi (SUCOMA), the Tea Research Foundation, and the Smallholder Coffee Authority. However, these links do not appear to be well developed.

The Crop Variety Research Committee is based at the DAR Headquarters. The Committee is made up of the Chief Agricultural Research Officer, the Chief Agricultural Extension Officer, ADMARC, other private agricultural groups, the National Seed Company, and other seed technologists. The Marketing Inputs and Crops Officer may also be invited by the Chief Agricultural Officer.

(2) External linkages

The DAR has bilateral relationships with many international research centres and organisations. See Table 2-12.

g. Staff's assessment of problems

In the opinion of some DAR senior staff interviewed, a limited recurrent budget places a serious constraint on research activities.

The rapid expansion of DAR's professional staff, and the fact that 60 percent of them have served less than five years, results in a shortage of experienced researchers to guide the newer personnel. The older researchers tend to be drawn into administration.

The senior staff also indicated that laboratories and equipment were inadequate and the quality of work by service and maintenance staff is sometimes hampered by a shortage of spare parts.

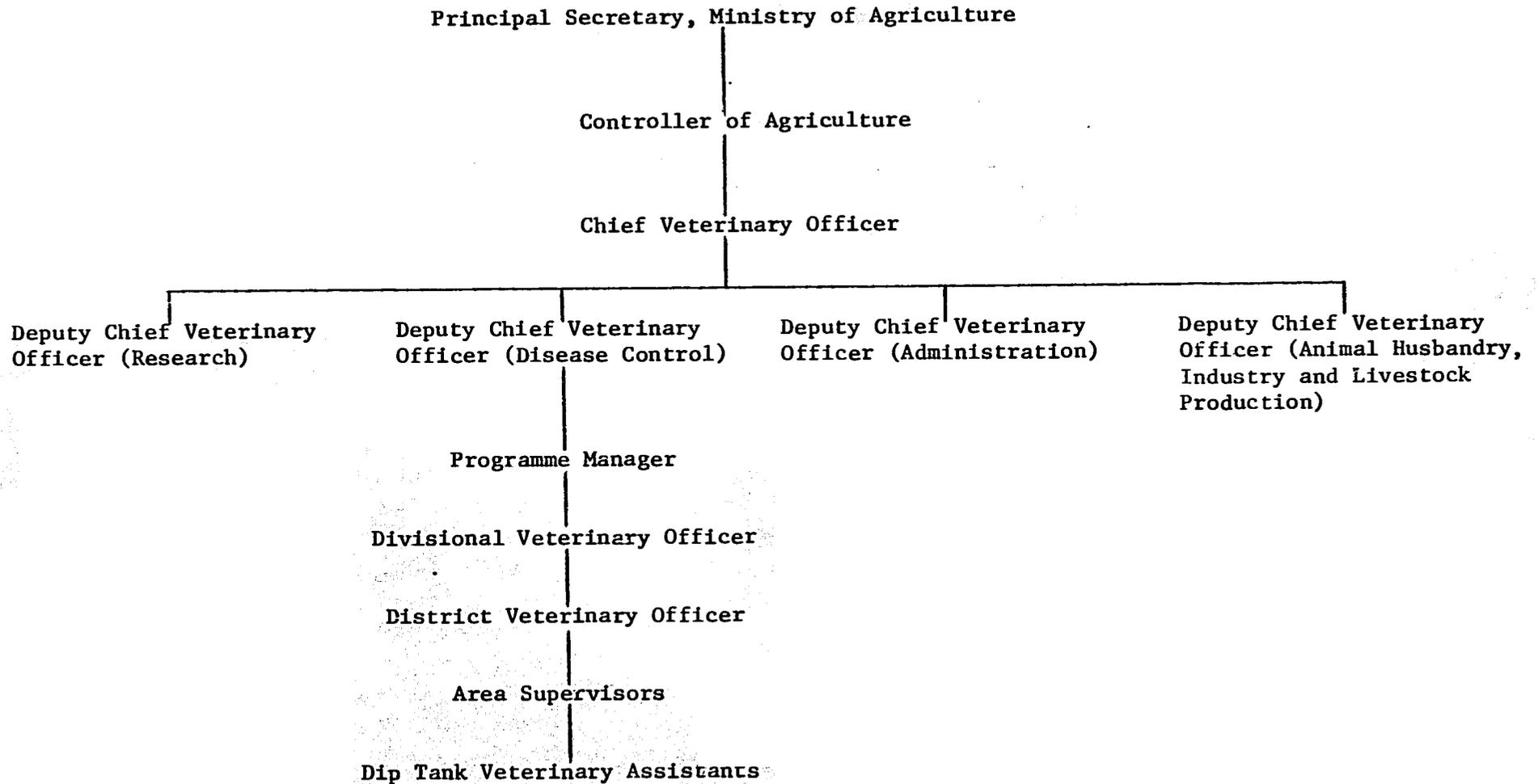
3. The Department of Veterinary Services

a. Background

The Department of Veterinary Services (DVS) is attached to the Ministry of Agriculture. The Chief Veterinary Officer has overall responsibility for the Department as shown on the organisation chart (Figure 2-2). The Department has three major functions: research, extension and provision of services. DVS research is principally conducted at the central veterinary laboratory at Lilongwe, and field services (extension) in each ADD. The DVS provides services to small farmers principally through its 17 livestock production centres distributed throughout the country.

Table 2-12: Linkages of Malawi's Agricultural Research System with International Research Centres

<u>Organisation</u>	<u>Activity</u>
CIMMYT	Provision of wheat and maize germ plasm and information and training from its farming systems research training centres in Kenya and Mexico.
IITA	Contribution of support for cowpeas, cassava nurseries, and maize variety testing; conduct of training (at IITA) in crop agronomy; provision of assistance in the biological control of green spider mite and various mealybug pests.
ICRISAT	Assistance with training in groundnuts, pigeon peas, chickpeas, and sorghum production; provision of information and assistance from an ICRISAT regional sub-station for groundnut research (an activity that SADCC has proposed to CDA to be converted to a regional grain legume project).
ILRAD	Provision of vaccine to combat animal diseases.
CIAT	Contribution to enable inclusion of <u>Phaseolus</u> beans in the grain legume programme.
ILCA	Provision of support for small farm animal power and small farmer dairy research.
IRRI	IRRI staff visits and provision of new rice varieties for testing in Malawi.
USAID/CRSP	Contribution of resources to enable Michigan State University's involvement in the bean and cowpea research project of the Department of Crop Production and Bunda College of Agriculture.
Others	Cooperation with the International Red Locust Organization, International Seed Testing Association (ISTA), and SADCC.



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Figure 2-2: Organisation Chart for the Department of Veterinary Services,
Ministry of Agriculture, Malawi

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b. Research programmes

(1) General programme

The Department has a Livestock Development Programme which it undertakes at three levels of operation: research, extension, and the provision of cross-bred cattle for sale to small farmers. The purpose of the programme is to improve the quality of livestock through better disease control, nutrition, and management. To achieve this, the Department currently has three research projects which are summarized in the following section.

(2) Specific projects

(a) East Coast Fever Project

The East Coast Fever (ECF) Project was begun in 1980 to develop immune mechanisms against the disease. It is funded for four years for US\$314,300. Six researchers (two Ph.D.s and four B.V.M.s), four technical officers, and three assistants are involved.

(b) African Swine Fever Project

The African Swine Fever project (ASF) was begun in 1980 to study the spread of swine fever and to develop control measures. It is funded by the Government of Malawi for three years for US\$87,750. One Ph.D. is assisted by a Technical Officer and a Technical Assistant.

(c) Newcastle Disease Vaccine V4 Project

The Newcastle Disease Project was begun in 1981 to develop the V4 strain into a vaccine for poultry. It is funded by the Government of Malawi for three years for US\$87,750. One researcher with a Bachelor's degree is assisted by a Technical Officer and a Technical Assistant.

c. Human resources

The DVS staff of 82 consists of five administrators, 13 Professional Officers, 24 Technical Officers and 40 Technical Assistants. The five full-time administrators (the Chief Veterinary Officer, his deputies and the Division Veterinary Officers) and all the Technical Assistants are Malawian nationals. The eight Professional Officers and two of the Technical Officers are expatriates. Department Professional Officers are shown by discipline and levels of training in Table 2-13.

d. Budgets and expenditures

The DVS budget for the past two years is in Table 2-14. While the recurrent budget is totally financed by the Government of Malawi, the capital budget is largely funded by

Table 2-13: Department of Veterinary Services Professional Officers by Discipline and by Level of Qualification: Malawi¹

Discipline	Qualifications of Staff				In Training
	Bachelor's	Masters	Doctorate	Total ³	
<u>Research</u>					
Veterinary Medicine	8 (n.a.) ²	1(n.a.)	2(2)	11(7)	4 B.V.M.
Biochemistry	-	-	1	1	-
Virology	-	-	1(1)	1(1)	-
Parasitology	-	-	-	-	1 Ph.D.
Animal Nutrition	-	-	-	-	1 M.Sc.
Animal Breeding	-	-	-	-	1 M.Sc.
Dairy Technology	-	-	-	-	2 Dipl.
Subtotal	8	1	4(3)	13(8)	9

¹ Other DVF Staff include: 5 Administrators, 24 Technical Officers (of whom 2 are expatriates) and 40 Technical Assistants.

² Numbers in parentheses refer to number of those who are expatriate.

³ Total refers to number of POs in post.

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Table 2-14: Average Annual Budget and Expenditures
of the Department of Veterinary Services,
Malawi: 1981 to 1983

	<u>Budgeted Amount</u> (US\$ millions)	<u>Expended Amount</u>
Capital	1.51	1.18
Recurrent	2.46	2.69

CIDA, DANIDA, ODA, FAO, and the European Development Fund. The Government of Malawi contributes about 10-15 percent of the capital budget.

e. Assets

(1) Land and buildings

The department has five laboratories: three at Lilongwe and one each at Blantyre and Mzuzu. There are five offices in excellent condition at the central veterinary laboratory in Lilongwe, three offices in poor condition at Blantyre, and one in good condition at Mzuzu. At Lilongwe there are three livestock compounds:

- o a small animal compound for poultry, pigs, rabbits, and guinea pigs, approximately 200m² in area.
- o a large-animal compound with a protected environment used for East Coast Fever immunization. Approximately 150m² in area.
- o a large-animal complex of 1.2 ha with sheds, used for the East Coast Fever project.

(2) Equipment

The following items were reported to have replacement values above US\$5,000:

- o stereoscope microscope
- o gas chromatograph
- o autoclave (semi-room)
- o centrifuge
- o liquid nitrogen apparatus
- o 60 vehicles (est.)
- o 15 tractors
- o 100 motorcycles (est.)

(3) Library

The library at Chitedze Research Station has 5,000 books and 20 scientific journals. The department has not issued any publications during the last five years.

f. Linkages and services

The research programme has links locally with Bunda College of Agriculture and externally with a number of countries

and organisations, including:

- o Zambia: FAO's East Coast Fever Project
- o Zimbabwe: Department of Veterinary Services
- o Kenya: ILRAD, ICIPE in Muguga, and the Government Veterinary Laboratory in Nairobi

Research facilities are used for in-service courses for technical officers.

g. Staff's assessment of problems

The recurrent budget was reported by both respondents in the Department of Veterinary Services as a serious constraint on the Department's ability to accomplish its objectives. They especially noted constraints on travel. The service and maintenance staff were reported as unsatisfactory and lacking experience.

4. Bunda College of Agriculture, University of Malawi

a. Background

The Bunda College of Agriculture was created in 1965 and is described in detail in section D, Agricultural Training.

b. Research programmes

There are research programmes in each of the four departments of the college: Crop Production, Agricultural Engineering, Livestock Production, and Rural Development. Bunda College cooperates with the Ministry of Agriculture to ensure that projects undertaken are related to the country's development needs and to avoid duplication of efforts. In some cases Bunda staff are participants or consultants on research projects carried out at government research stations.

There are seven research projects in the Crop Production Department, two in the Agricultural Engineering Department, four in the Livestock Production Department and two in the Rural Development Department. The projects and their objectives are summarized in Table 2-15.

5. Tea Research Foundation

a. Background

The Tea Research Foundation (TRF) of Central Africa undertakes research in all aspects of tea production and provides advisory and extension services to tea producers in Malawi, Zimbabwe, and private companies in South Africa. The Foundation has a director to oversee its administrative and research responsibilities.

Table 2-15: Research Projects at Bunda College of Agriculture, Malawi, by Department

<u>Department</u>	<u>Objective</u>	<u>Research Projects</u>
Crop Production	To improve crop production at small-holder and estate	<ul style="list-style-type: none"> o Studies on maize/legume rotations o Selection studies with UCA maize o Pasture and fodder production and utilization o Insect pest and entomophagous arthropod population status in a mixed cropping system o Evaluation of beans, cowpeas, groundnuts, and pigeon pea cultivars for resistance to root-knot nematode o Selection for yield in pigeon pea cultivars o Bean improvement project
Engineering	To diminish post harvest losses in storage by small farmers	<ul style="list-style-type: none"> o Grain drying and storage
	To obtain soil-erodability factor for some soils in the Bunda area	<ul style="list-style-type: none"> o The determination of the USLE (Universal Soil Loss Equation) erodability factors for soils around Bunda College
Livestock	To improve disease control, proper housing and feeding using locally available materials	<ul style="list-style-type: none"> o Studies on the effect of bitter cassava on growth and reproduction of pigs o Evaluation of crop residues-- maize stover, groundnut and bean hulls -- as feed for goats
	To assess reproductive performance of cattle, pigs, goats and poultry, mainly for the small-holder sector	<ul style="list-style-type: none"> o Evaluation of various types of rabbit housing which could be used by smallholder farmers o Evaluation of the effects of drying and temperature on protein quality in terms of available lysine
Rural Development	n.d.	<ul style="list-style-type: none"> o Studies of agricultural change and rural development in the Lilongwe Rural Development Project o Analysis of the application of appropriate technology to farm systems in Malawi

Tea research is carried out at the Tea Research Foundation at Mulanje, which has two sub-stations (Mimosa and Nsuwadzi), and at Thyolo Tea Research Station.

b. Research programmes

As of October 1982, research projects have been undertaken in the following areas: agronomy, plant improvement and physiology, plant pathology, entomology, tea biochemistry and technology, and tea manufacture.

Since tea is largely an estate crop, and since much of the research program is industry-financed, most of the research is aimed at estate production. However, the plant improvement and physiology programme is conducting a project for the Smallholder Tea Authority.

c. Human resources

The resident research staff is comprised of a full-time Director, 15 Professional Officers, 50 Technical Officers, and 40 Technical Assistants. A breakdown of research staff into research discipline and qualification is provided in Table 2-16.

d. Budgets and expenditures

There are three main sources of funding for the Tea Research Foundation: the tea industry, revenue from the Foundation's experimental tea crop and planting material, and the United Nations Development Programme.

The TRF budgets and expends an annual average of US\$43,900 on capital development and US\$438,900 on recurrent costs.

e. Assets

(1) Land

The main research station is in a high rainfall forest zone with 1100-1650 mm of rainfall and sandy clay loams. It has 175 hectares of cultivated land, of which 70 percent is used for experiments, 28 percent for crop production and two percent for seed/plant material multiplication. Twenty hectares of the cultivated land are irrigated. About 30 hectares of the cultivated land are in pasture for a dairy herd which is kept mainly to provide the staff with milk products.

(2) Other assets

The Tea Research Foundation has three laboratories, a greenhouse, and a maintenance workshop. The location, approximate size, function, and condition are summarized in Table 2-17. No conference facility is available.

Table 2-16: Tea Research Foundation Professional Staff by Discipline and by Qualification

Professional Post	Qualifications of Staff				Vacant	Total Filled Posts
	Diploma	Bachelors	Masters	Doctorate		
Director & Ass't/Advisor	-	2	2(2) ¹	1(1)		5(3)
Agronomist	-	2	-	-		2
Plant Breeder	-	1(1)	1	-		2(1)
Plant Pathologist/ Entomologist	-	-	-	1(1)		1(1)
Process Engineer	-	-	1(1)	-		1(1)
Chemist	1	-	-	-		1
Biochemist	-	-	-	-	1	-
Tea Seed Oil Researcher	-	1	-	-		1
Productivity Officer	-	1(1)	-	-		1(1)
Horticulturist	<u>1</u>	<u>-</u>	<u>-</u>	<u>-</u>		<u>1</u>
TOTAL	2	7(2)	4(3)	2(2)	1	15(7)

¹ Numbers in parentheses indicate those of total who are expatriates.

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Table 2-17: Buildings of the Tea Research Foundation

<u>Type of Building</u>	<u>Location</u>	<u>Approximate Area (m²)</u>	<u>Major Use</u>	<u>Condition</u>
Laboratory	Nsuwadzi	250	Biochemistry, plant improvement	F
	Mimosa	100	Horticulture	F
	Nsuwadzi	500	Tea Factory	G
Greenhouse	Nsuwadzi	25	General use	P
Maintenance	Mimosa	100	Vehicle Maintenance	F

¹ G = Good, F = Fair, P = Poor. All buildings lack climate control.

A cold room and high pressure liquid chromatograph are the only equipment belonging to the Foundation which have a replacement value above US\$5,000.

The library has about 3,000 books with an annual acquisition rate of approximately 20 books. It also receives about 500 periodicals, and scientific journals.

f. Linkages and services

(1) Within country

Two professional officers, the Assistant Director and the Advisory Services Officer, are specialists in tea cultivation and provide extension advice to growers. The station holds annual field days and ad hoc training courses for research personnel and farmers.

(2) External

The Tea Research Foundation maintains close contact with the following organizations, each of which contributes to its operation:

- o Tea Association of Central Africa
- o Zimbabwe Tea Growers Association
- o SAPEKO (private companies in South Africa)
- o Transkei Tea Development Cooperative

g. Staff's assessment of problems

A senior official of the Tea Research Foundation indicated that continuity in research was seriously hampered by the loss of qualified staff who obtain more attractive posts in urban areas. The need for continuity also conflicts with the need for younger staff to continue their off-site training.

6. Tobacco Research Authority

a. Background

The Tobacco Research Authority (TRA) was created by the Government in 1980 to undertake research and dissemination. It conducts its work at two research stations, Kandiya (Lilongwe) and Mwimba (Kasungu). The General Manager has overall responsibility and in turn delegates administrative duties to officers-in-charge and senior officers.

b. Research programmes

The TRA's research programme is primarily concerned with developing improved: plant varieties; methods of control of diseases, insects and other pests; and machinery for planting, reaping, curing, and marketing. The programme is estate and

smallholder-oriented. The research work includes studying the effects of tobacco rotation with other food crops and Katambora grass.

TRF's research activities are in nine areas. These areas, with the specific projects, are as follows:

- o Flue-cured agronomy -- fertilizer and herbicide trials.
- o Flue-cured physiology -- curing experiments for efficient use of wood fuel; minimum tillage using draft animals; inter-planting tobacco and eucalyptus.
- o Flue-cured breeding -- variety trials; nitrogen responses; trials to test resistance of varieties to Fusarium.
- o Engineering -- comparison of performances of rectangular vs. conventional flues; testing effects of forced draft to the furnace under varying circumstances.
- o Fire-cured Breeding -- testing of new fire-cured breeding lines; varietal responses to fertilizers; assessment under smallholder conditions of selection of crosses; selection of foundation seed stock.
- o Burley Breeding -- evaluation of the breeding carrying the Aurea Colour gene; making crosses and single plant selections; breeding high yield Burley varieties with resistance to Fusarium wilt and nematodes.
- o Burley Agronomy -- effects of topping height, spacing within the row, and levels of nitrogen upon yields, and quality and proportion of red leaf on variety Banket A1; effects of nematicides in various combinations with and without ethylene dibromide (EDB); comparison of the effects of different sources of nitrogen and determine rates of nitrogen necessary to produce Burley tobacco on soils traditionally used in Flue-cured tobacco.
- o Pathology -- determine if topping methods have any effect on the incidence of hollow stalk.
- o Oriental tobacco -- comparison of four varieties of different nitrogen levels and ridge spacing; comparison of manure and chemical fertilizer on five oriental varieties.

c. Human resources

The Tobacco Research Authority employs nine Professional Research Officers (four of these assist as part-time research administrators), five Technical Officers, and 12 Technical Assistants. The research discipline and qualification of the professional research staff is shown in Table 2-18.

Table 2-18: Tobacco Research Authority Professional Research Staff
by Discipline and by Qualification

<u>Discipline</u>	<u>Staff Qualifications</u>		<u>Total</u>
	<u>Bachelor's</u>	<u>Master's</u>	
Plant Breeding	1	2	3 (1) ¹
Plant Pathology	1	-	1
Crop Physiology	-	1	1
Engineering	-	1	1 (1)
Agronomy	<u>1</u>	<u>-</u>	<u>1</u>
TOTAL ²	3	4	7 (2)

¹ Numbers in parentheses indicate how many of the total are expatriates.

² The total excludes the General Manager, who has overall responsibility, and a graduate accountant. TRA staff also includes five technical officers and 12 technical assistants.

While there are no vacant positions, a Malawi national is being recruited as an understudy to the engineer, who is an expatriate. One agronomist and a breeder are presently studying for an M.Sc. degree in the United States, and the pathologist is on a study tour. There is a plan to expand staff to twelve Professional Officers consisting of four agronomists, one physiologist, one soil chemist, two breeders, one entomologist, one nematologist and two liaison officers.

d. Budgets and expenditures

TRA is a commodity-financed institution relying totally on a growers' levy and programme income. However, the FAO has assisted with the provision of the General Manager and scholarships to the value of US\$150,000. On the average, TRA annually budgets and expends US\$175,000 on capital development and US\$351,000 on recurrent costs.

e. Assets

(1) Building

Assets at the two stations are provided in Table 2-19. Unlike the situation at Kandiya, there is no laboratory nor electricity at Mwimba Research Station. The Authority has a conference room with a capacity of 30. While there are no greenhouses now, three are being constructed in 1983 and an additional ten are projected.

(2) Equipment

The following field and laboratory equipment has replacement value above \$US5,000.

- o 4 motor vehicles
- o 5 tractors
- o computer (TRS-80)
- o Spectro-photometer and a cold room

(3) Library

TRF has a small library of ten books, with approximately two book acquisitions per year, and six scientific journals. The research staff has access to Chitedze Research Station and Bunda College Libraries, as well as the British Council Library.

f. Linkages and services

(1) Within country

The Chitedze and Bvumbwe Research Stations of the GOM provide TRA with soil analysis and phytosanitary services. Estate representatives attend meetings of the TRA

Table 2-19: Assets of the Tobacco Research Authority

<u>Asset/Location</u>	<u>Number or Size</u>	<u>Major Use</u>	<u>Condition</u> ¹
<u>Laboratories</u>			
Kandiya	40 sq.m.	Chemistry	G
	40 sq.m.	Pathology	G
	40 sq.m.	Breeding	G
	40 sq.m.	General Purpose	G
	4	Growth Rooms for Breeding	G, c/c
	1	Computer Room	G
<u>Offices</u>			
Kandiya	23	Office	G
Mwimba	4	Office	G
<u>Maintenance Shops</u>			
Kandiya	40 sq.m.	Motor Vehicle Maintenance	G
	40 sq.m.	Carpentry	G
	40 sq.m.	Plumbing	G
	40 sq.m.	Tractor Shed	G
Mwimba	40 sq.m.	Motor Vehicle Maintenance	G
<u>Barns</u>			
Kandiya	200 sq.m.	Fire Cured Barns	G
	300 sq.m.	Burley Barn	G
	300 sq.m.	Flue Cured Barns	G

¹ P = Poor, F = Fair, G = Good, E = Excellent; a/c and c/c indicate structures with air conditioning or climate control, respectively.

Board when it is planning research. Each station has a liaison officer who organizes courses for MOA extension field staff. During 1982, extension staff courses were held at Namiasi and Tuchilla Training Centres.

A pamphlet on tobacco diseases was recently rewritten and updated. Eleven issues of the newsletter were produced in conjunction with the National Bank of Malawi and sent to all registered growers.

(2) External

Linkages exist between TRA and Tutsaga Tobacco Research Station in Zimbabwe, North Carolina State University, and the Tobacco Research Institute at Rustenburg in South Africa.

g. Staff's assessment of problems

According to staff members, the Tobacco Research Authority has had to restrict its research programmes as result of budget limitations.

7. The Sugar Corporation of Malawi

a. Background

The Sugar Corporation of Malawi (SUCOMA) is a subsidiary of Swaziland Milling Co. Ltd. and entirely funded by Lonrho Ltd. There is currently very little research beyond the importation and testing of varieties. The small research unit which started in 1968 at the Nchalo Sugar Estate mainly aims at investigating problems associated with sugarcane production at that estate. All funds for research are provided by the estate and the estate manager has overall responsibility for research activities.

b. Research programmes

The research unit is mainly concerned with variety introduction and testing, disease trials, and furrow irrigation trials.

c. Human resources

Five people are involved in research on the estate: an Agronomist and an expatriate Pathologist (with B.Sc. degrees), and three Technical Officers.

d. Assets

(1) Land

The experimental block is mainly on sandy clay loam and sandy loam soil and receives about 700 mm of rainfall. The estate has 9,223 hectares under cultivation, most

of which is used for commercial sugarcane production. All the cultivated land is irrigated by overhead sprinklers.

(2) Equipment

The unit has six books and 20 scientific journals. However, it has access to Mount Edgecombe Sugarcane Research Station Library in Natal, South Africa, and the GOM Ministry of Agriculture Research Headquarters. An annual report is the only publication.

e. Linkages

The Sugar Corporation maintains links with MAO's Bvumbwe Research Station for plant quarantine procedures and the Mount Edgecombe Sugar Research Station in Natal, South Africa.

D. Agricultural Training

1. Introduction

Agricultural training begins at the primary school level (standard 6), continues through form four, and is offered at the certificate level at Colby College of Agriculture (now of the Natural Resources College) and at the diploma and degree levels at Bunda College of Agriculture. Students who enroll in these colleges come from secondary schools. During 1978 to 1981, 2.9 percent of all form two graduates entered Colby College of Agriculture and 10 percent of form four graduates enrolled at Bunda College.

2. Bunda College of Agriculture, University of Malawi

a. Background and curricula

The Bunda College of Agriculture of the University of Malawi was established in 1966. Ninety percent of its students come from rural areas. It has four departments: Agricultural Engineering, Crop Production, Livestock Production, and Rural Development. While the College is under the Ministry of Education, it also has strong links with the Ministry of Agriculture. It trains students for diplomas (3 years) and general B.S. degrees in Agriculture (an additional 2 years), with no optional specializations. The entry level requirements for the diploma program include a full certificate at the "O" level with credits in English, mathematics, biology or general science, and agriculture. One-fourth to one-third of those who complete the diploma level are selected to continue for the B.S. degree course. Diploma graduates who go into the field may return to complete the additional two years of training required to obtain the B.S. degree.

The college offers no postgraduate courses; however, the curriculum is currently being revised to introduce some specialization. The teaching staff in each department undertakes research projects in addition to their classes. These research projects have been summarized in Table 2-15.

b. Human resources

Of the administrative staff, eight are full-time administrators (including the principal of the college), and one is a part-time administrator and researcher. The full-time teaching/research staff are listed by duty, by discipline and by qualification in Table 2-20. There are two expatriate plant breeders working on the Bean Research Project from Michigan State University (one has a Ph.D. and the other has a M.S. and is studying for a Ph.D). This table also lists those who are on leave receiving training abroad.

Teaching/research staff members are assisted by ten technical officers and nine technical assistants.

c. Budgets and expenditures

The recurrent budget of Bunda College is US\$936,200. The capital development budget is sought from donor agencies when needed. The Government of Malawi pays all student fees and allowances.

d. Assets

(1) Buildings

The college has 42 offices, two lecture halls and four classrooms. The two lecture halls are used for conferences and have capacities of 200 and 120 persons respectively. The classrooms are considered too small. The college also has six laboratories and two greenhouses which are used for both teaching and research. Buildings at Bunda College are described in Table 2-21.

(2) Equipment

The following items are identified as having replacement values of US\$5,000 or more.

- o 9 vehicles
- o 1 photocopying machine
- o 1 set of welding equipment
- o 1 maize sheller

Table 2-20:

Human Resources for Agricultural Training in Malawi:
Bunda College Departments by Discipline and by Qualifications

Department	Qualifications of Teaching Staff ¹				
	Doctorate	Masters	Bachelor's	Other	On Leave ²
<u>Crop Production</u>			-	-	
Seed Physiology	1	-	-	-	
Plant Breeding	2(2) ³	-	-	-	
Plant Pathology	-	1	-	-	
Horticulture	1(1)	-	-	-	
Crop Physiology	-	1	-	-	
Soil Science	-	1(1)	1	-	
Environmental Biology	-	(1)	-	-	
Entomology	1(1)	-	-	-	B.Sc.
Biometry	-	-	-	-	M.Sc.
Pasture Agronomy	-	-	-	-	Diploma
Agriculture	-	-	-	-	Diploma
Subtotal, 1981	5(4)	4(2)	1	0	4
Subtotal, 1983 ⁴	7(5)	4(1)	0	n.a.	3 M.Sc., 2 Ph.D. ⁵
<u>Livestock Production</u>					
Livestock Production	1(1)	1	-	-	
Animal Health	1	-	-	-	B.V.M.
Animal Breeding	1	-	-	-	
Ag. Chemistry	1	1(1)	-	1	
Poultry Management	-	1(1)	-	1	
Animal Nutrition	1	-	-	-	M.Sc.
Animal Physiology	-	-	-	-	B.Sc., Ph.D.
Subtotal, 1981	5(1)	3(2)	0	2	4
Subtotal, 1983 ⁴	6	(1)	0	n.a.	3 M.Sc., 2 Ph.D. ⁵

¹ Teaching and research staff are assisted by ten technical officers and nine technical assistants.

² On leave comprises those receiving training and those on sabbatical.

³ Numbers in parentheses indicate how many in each category are expatriate staff.

⁴ The breakdown of disciplines within each department available only for 1981, not 1983.

⁵ Numbers in diploma - level training not available for 1983.

Table 2-20: Human Resources for Agricultural Training in Malawi:
Bunda College Departments by Discipline and by Qualifications

(Cont.)

Department	Qualifications of Teaching Staff ¹				On Leave ²
	Doctorate	Master's	Bachelors	Other	
<u>Agricultural Engineering</u>					
Farm Power & Mach.	(1) ³	2(1)	-	-	Diploma
Soil & Water Eng.	-	1	-	-	M.Sc.
Mathematics	1	-	-	-	
Environmental Eng.	-	-	-	-	Diploma
Farm Structures	-	-	-	-	B.Sc.
Subtotal, 1981	2(1)	3(1)	0	0	4
Subtotal, 1983 ⁴	3(2)	4(2)	3	n.a.	1 M.Sc., 1 Ph.D. ⁵
<u>Rural Development</u>					
Ag. Economics	(1)	(1)	-	-	
Communications	-	(1)	-	(1)	2 B.A., 1 M.Sc.
Human Nutrition	(1)	-	-	-	B.Sc.
Home Economics	(1)	(1)	-	-	Diploma
Farm Management	-	1	-	-	
Extension & Rural Soc.	-	(1)	-	-	Diploma, M.Sc.
Subtotal, 1981	(3)	5(4)	0	(1)	7
Subtotal, 1983 ⁴	3(2)	8(1)	2	n.a.	1 M.Sc., 2 Ph.D. ⁵
<u>Administration</u>					
Senior Administration	2	-	-	-	
Librarian	-	1	-	1	
Support	1	2	2	3(1)	
Subtotal, 1981 ⁶	3	3	2	4(1)	0
TOTAL STAFF, 1981	18(9)	18(9)	3	7(2)	19
TOTAL STAFF, 1983	19(8)	17(4)	5	n.a.	15

¹ Teaching and research staff are assisted by ten technical officers and nine technical assistants.

² On leave comprises those receiving training and those on sabbatical.

³ Numbers in parentheses indicate how many in each category are expatriate staff.

⁴ The breakdown of disciplines within each department available only for 1981, not 1983.

⁵ Numbers in diploma - level training not available for 1983.

⁶ Administration figures not available for 1983.

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Table 2-21: Buildings at Bunda College

	<u>No.</u>	<u>Approximate Area (m²)</u>	<u>Condition</u>
<u>Classrooms</u>			
Lecture halls	2	168 and 132	Good
Classrooms	4	80 (2) and 63 (2)	Good, but small
<u>Laboratories</u>			
Chemistry	1	162	Good
Biology	1	108	Good
Plant Science	1	108	Good
Soils	1	135	Good
Livestock	1	135	Good
Home Economics	1	90	Good

(3) Library and publications

The library has a total of 25,000 books, an annual acquisition rate of approximately 600 books, and 350 scientific journals and periodicals. The learning resources section, which is separate from the University Library, has film and overhead projectors, photocopiers, microfilm and microfiche readers. The library is open for 68 hours a week during the school term but only 42 hours during vacation.

The college has its own publication, Research Bulletin of Bunda College of Agriculture, compiled by the research committee and distributed by the library to approximately 300 institutions on an exchange basis.

(4) Land

Bunda College has a multi-purpose farm with approximately 1800 hectares that is used for teaching and research as well as for commercial production.

The farm has 523 hectares of arable land (see Table 2-22) which are primarily used for growing maize, tobacco, beans and horticultural crops. Sixty-three hectares consist of grass and legume pastures; another 109 hectares are in dambo (Vlei) pastures, a natural grassland. Approximately 70 hectares are set aside for research and teaching purposes. There are 475 hectares of forest.

The college farm is used for practical instruction in both crop and livestock husbandry. Crops grown by students include maize, beans, cotton groundnuts and tobacco. Livestock enterprises include beef and dairy cattle, sheep, pigs and layer and broiler chickens. Fish are produced in a 12.5 hectare pond and eight other fresh water ponds. Livestock research units include rabbits, goats, beef stall feeding, a farrowing house for pig research and a small animal unit.

e. Linkages and services

As mentioned earlier, Bunda College cooperates with the Ministry of Agriculture to ensure that projects undertaken are related to the development needs of Malawi, and to avoid duplication of effort. In some cases, members of Bunda's staff act as consultants to research projects carried out at government research stations. The college has conducted short courses for both extension and research personnel of the Ministry.

f. Employment opportunities for graduates

All students who obtain B.S. degrees are offered employment by the Ministry of Agriculture. Of those receiving diplomas, however, employment opportunities are evenly divided between the private sector and the Ministry of Agriculture. Male

Table 2-22: Land Use at Bunda College

<u>Land Use</u>	<u>Area (ha)</u>
Arable	523
Dambo (vlei) pastures (natural grassland)	109
Improved pastures	63
Research and teaching	70
Dam and fish ponds	15
Forest	475
Woodland, roads, verges and farm headquarters	<u>545</u>
TOTAL	1,800

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and female students who graduate at the degree or diploma level are equally qualified to accept these government positions, since their training has been the same (with the sole exception that women take a home economics course rather than agricultural engineering).

g. Staff's assessment of problems

The three staff members interviewed were of the opinion that while the recurrent budgets for both teaching and research at Bunda College were inadequate, the research budget was more inadequate than the teaching budget. Both further training of those currently employed and additional staff are solely needed. Staff estimated that four additional classrooms are needed. Since laboratories are small, faculty must provide several sessions of a given class. While there may be a large number of form four students interested in undertaking studies in Agriculture, the capacity of the college will limit enrollment.

3. Natural Resources College (NRC)

a. Background and curricula

The Ministry of Agriculture is responsible for the training of Field Assistants at the Colby College of Agriculture and the Thuchilla Farm Institute for Farm Home Assistants. Colby College's training programme is for two years while Thuchilla course is a one-year programme specially designed for rural women. The new Natural Resources College, which opened in October 1983, brings together on one campus natural resources personnel at the Technical Assistant level (Agriculture and Home Economics, Veterinary Fisheries, Wild Life and Game). The college will also offer a diploma in Soil Survey. The new institution hopes to offer in-service training courses for teaching staff and TAs who were trained years ago. Colby College has been offering courses to TAs in dairy related subjects, army worm control, land and water conservation and use and technical teaching methods.

b. Human resources

At present, Colby College has 5 Professional Officers, 14 Technical Officers (at various grades), 9 Technical Assistants and 2 Demonstrators. One expatriate (a Peace Corps Volunteer) is teaching at Colby. The Natural Resources College has a teaching staff of approximately 40, plus the Principal and his Deputy. Three people are receiving further training in the U.K.: one man and one woman at the B.S. level, and one woman at the certificate level. It is hoped that in the future the new college will build its staff to 22 POs, 13 CTOs, 13 STOs, 6 TOs, 16 STAs, and 5 TAs.

About 95 percent of NRC students come from rural areas and 5 percent from urban areas. The entry level requirement is the Junior Certificate with passes in Mathematics, two science

subjects and English. The government pays all student fees including allowances, and each student receives a travel warrant for the journey from home to school and back.

c. Budget and expenditure

When the decision to build the Natural Resources College was made five years ago, capital investment at the other colleges was halted in order to concentrate all available capital development into the NRC. The other colleges received only recurrent budgets. In the case of Colby College US\$266,000 was budgeted in 1981/82, of which US\$250,000 (97 percent) was expended. US\$376,000 was budgeted in 1982/83 (an increase of 41 percent) and US\$293,000 (78 percent) expended.

d. Assets

(1) Buildings

The Natural Resources College has two conference rooms, each with a capacity of 30 seats, and 14 classrooms, each 68m² with a capacity for 32 students.

(2) Equipment

No pieces of equipment were valued above US\$5,000.

(3) Library

Colby College has 4,000 books and acquires approximately 500 books per year. The library, which is open seven days a week, receives seven journals. The Natural Resources College is planning to acquire 10,000 books for its library.

(4) Land

The Natural Resources College has a total land area of 292 hectares, of which 100 hectares are arable. 68 hectares are reserved pastures and demonstration plots; 19 hectares are improved pastures.

e. Employment opportunities for graduates

All graduates are employed by Government since each is bonded for 2 years.

E. Agricultural Extension

1. Introduction

Agricultural extension services in Malawi are the responsibility of the Ministry of Agriculture through the Department of Agricultural Development (DAD). Extension services are integrated into the National Rural Development Programme (NRDP), and organized by Extension Planning Areas (EPAs) and Agricultural Development Divisions (ADDs). The chief Agricultural Officer has overall responsibility for the Department, and is supported by a Deputy and subject matter specialists.

2. The Department of Agricultural Development

a. General background

The country is divided into eight Agricultural Development Divisions (ADD). Each area will include some 25-30 thousand families (i.e., 125,000 - 150,000 people). Each Division is administered by a Programme Manager who is aided by two assistants and subject matter specialists.

Forty Rural Development Projects (RDPs) are planned for phased implementation during a 15-20 year period, and 17 are already in operation. Each RDP is headed by a Project Officer who is supported by a number of subject matter specialists. A Senior Field Officer assists the Project Officer with the supervision of all field services, particularly agricultural extension. Project Officers are responsible for a number of Extension Planning Areas (EPAs) which geographically are relatively uniform. Each EPA has a headquarters with an office for the Field Supervisor (Development Officer) and day training facilities for both farmers and field staff. A female extension worker or farm house assistant, generally holding a certificate in agriculture with some further training in the specific field, is based at the centre.

Each EPA is further sub-divided into sections containing from 500 to 700 families depending on such factors as the terrain, population density, and ease of communication. Each section is headed by a Field Assistant who holds a certificate in Agriculture.

b. Emphasis of activities

Extension services are directed principally toward smallholder farmers. Priority is given to food crops such as maize, beans, cassava and millet, although attention is also given to smallholder cash crops such as groundnuts, cotton and rice. In the livestock category, cattle is the highest extension priority, followed by poultry and pigs. No extension services are provided for goats.

Very few extension services are provided to the estate sector. Recently there have been requests for extension services for tobacco, despite the fact that the Tobacco Research Authority trains Field Assistants in tobacco production.

The emphasis of the extension effort is on improving productivity per unit area of land. Every extension worker is required to encourage his farmers to form or join Farmer's Clubs. Dairy farmers, for example, organize themselves into associations that sell milk, buy cross-bred heifers with calf on credit, and manage communal stall-feeders.

c. Human resources

There are 3,451 posts in the eight Agricultural Development Divisions of which 2,753 are filled (see Table 2-23). In each job category (Project Officer, Technical Officer and Technical Assistant), women account for less than 5 percent of the total. While there are no Ph.D.'s, at headquarters three men hold M.Sc.'s (two in Extension and the other in Land Husbandry) and three men hold B.Sc.'s plus diplomas in Extension. The Department has one graduate Horticulturist and a graduate Social Economist at Headquarters. The ADDs have eight Economists with degrees. One man is training at the M.Sc. level in Land Survey and one woman at the B.Sc. level in Home Economics.

The majority of the field staff are either diploma or Certificate holders who receive annual in-service training to acquaint them with new practices. Apart from local in-service training, each year a number of staff are sent outside the country for post-graduate or specialized short courses.

d. Budget and expenditure

A summary of the budgeted and expended funds for the Department is provided in Table 2-24.

e. Main assets

The Department maintains 147 day training centres, 121 residential training centres, and three farm institutes for training purposes. A day training centre and a demonstration facility are located at each EPA Centre.

Day training centres have a capacity for 20-30 participants; residential training centres for 30-100. Teaching facilities at the residential centres are more elaborate and include demonstration gardens for field and horticultural crops, and areas for livestock and poultry. Agricultural courses last one week, home economics courses last for two. While training is conducted year round at the day training centres, residential training centres operate from the end of the growing season to the beginning of the next crop season.

Table 2-23: Department of Agricultural Development Staff
by District and by Position, Malawi, 1983

Agricultural Development Division Region	Professional Officers		Technical Officers		Technical Assistants	
	Filled Posts	Vacant Posts	Filled Posts	Vacant Posts	Filled Posts	Vacant Posts
National Headquarters	14	n.a.	2	n.a.	5	n.a.
Karonga	25	7	46	13	205	98
Lilongwe	16(1)	7	80	21	408	198
Blantyre	18(1)	2	30	17	262	29
Liwonde	17(5)	4	21	6	258	58
Salima	12	1	28(1)	0	228	22
Ngabu	13	6	28(2)	11	424	33
Kasungu	19	2	40(2)	23	282	92
Mzuzu	16	9	39	16	236	23
TOTALS	139(7)	38	311(5)	107	2303	553

Table 2-24: Budget and Expenditures for the Department of Agricultural Development, Malawi: 1980/81 to 1982/83

Amount each year (US\$ millions)

	<u>1980/81</u>		<u>1981/82</u>		<u>1982/83</u>	<u>Average</u>	
	<u>Budgeted</u>	<u>Expended</u>	<u>Budgeted</u>	<u>Expended</u>	<u>Budgeted</u>	<u>Budgeted</u>	<u>Expended</u>
Recurrent account	4.7	4.9	5.5	7.0	10.2	6.8	5.9
Capital account	14.9	15.1	20.3	22.1	18.1	17.7	18.6

Each ADD has its own fleet of vehicles, tractors and motorcycles. There are a total of 401 vehicles, of which 137 are at Lilongwe.

f. Linkages and services

Linkages between the extension and research services have already been discussed in the Agricultural Research section. With regard to livestock, the Department of Veterinary Services carries out animal health programmes in close cooperation with ADD extension staff. Staff members of the Department of Veterinary Services provide training courses in animal health for extension staff.

A system of committees or action groups is designed to disseminate policy and strategy issues to farmers. In each field assistant's section there are Village Planning Committees for the whole section consisting of representatives from Village Planning Committees. The Section Planning Committee nominates representatives to an EPA Planning Committee. Farmers and extension services are also represented on District Development Committees.

The Department of Agricultural Development has an Extension Aids Branch whose purpose is to disseminate useful information to the smallholder sector. The Branch has two mobile film units in each of four ADDs (Ngabu, Karonga, Salima and Lilongwe). It produces an average of seven circulars per year on food crops, tea and tobacco; four circulars per year on livestock; and one on pastures (mainly for estate farmers). In addition to circulars, the Branch publishes bimonthly newsletters and farmers' magazines, and annual extension workers guides.

The Branch also produces the following six radio programmes: Modern Farming, Farm Forum, Farmer's Voice, Family Serial, Cotton Broadcast, and Farmer's Notebook.

g. Staff assessment of problems

According to staff members interviewed, the limited recurrent budget seriously hampers the Department of Agricultural Development's ability to accomplish its objectives. The short-fall of recurrent funds has especially serious implications for projects not included in the budget, which are then expected to run on program income.

Staff considered the most limiting of the budget constraints the lack of sufficient funds to maintain the DAD's fleet of vehicles, motorcycles and tractors in operating condition. When compared to the number of staff (see Table 2-23), the estimated number of available vehicles (401), motorcycles (400) and tractors (34) seems small. Both limitations together impede farm visits by DAD Staff.

It was felt that the senior technical staff are inadequately trained. There are no specialized personnel, with the exception of the land husbandry staff. Even the subject matter specialists have not received specialization in their respective fields of work. The accounting staff in the Department is both understaffed and poorly trained.

Lack of inputs and their untimely delivery is considered another serious problem for the ADD. For example, in most years the supply of fertilizer has been inadequate and delivered late due to transport problems beyond the government's control.

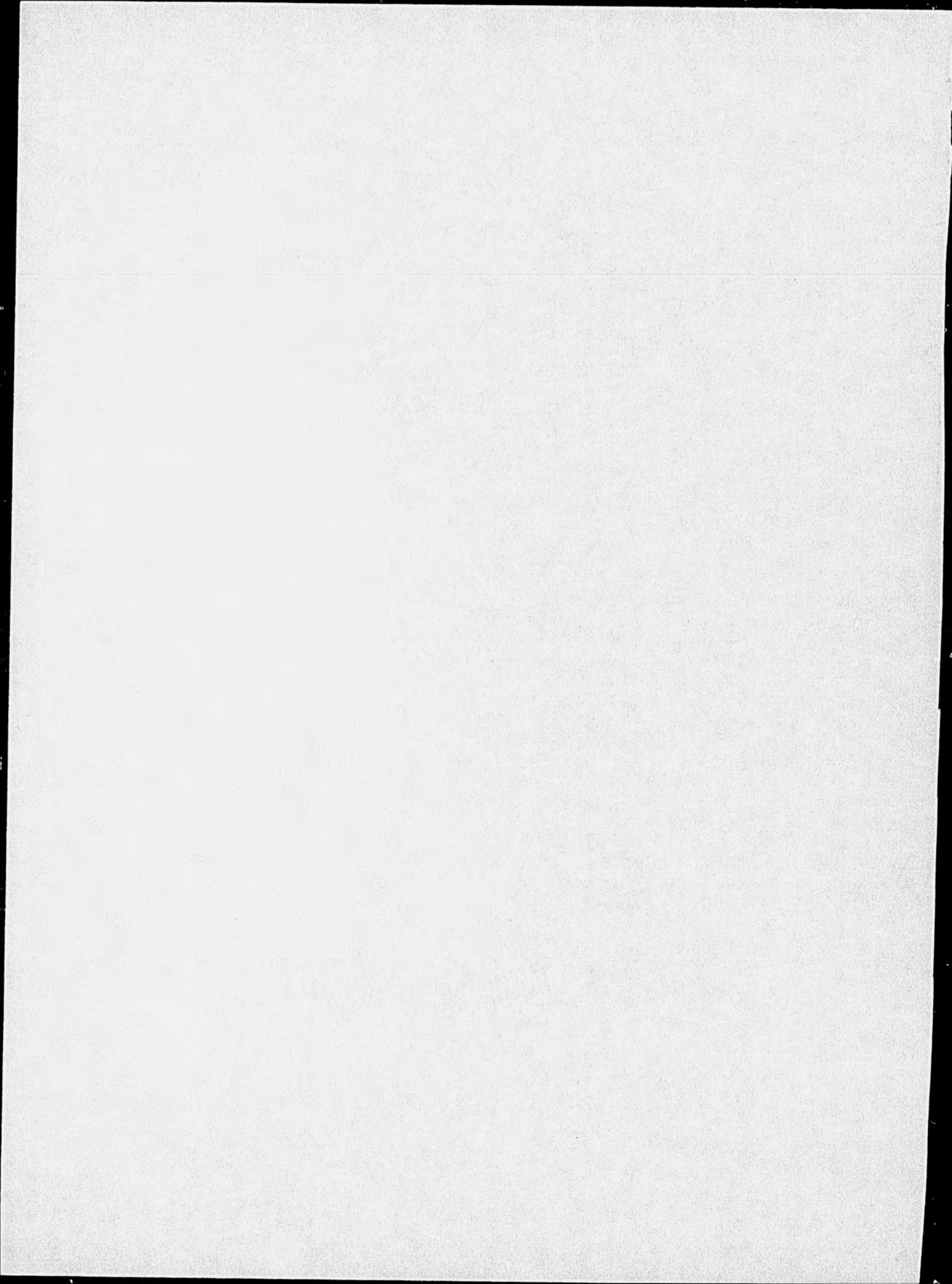
Senior officials in the Department feel that even though they have access to research, much of the research findings have little to offer in solving farmers' problems. It was felt that researchers do not have adequate funds to do the research useful to extensionists; and that since there were very poor linkages between research, extension and smallholders, research generally was not problem-oriented. With the creation of adaptive research units, however, the relevance of research to small farmer problems should improve.

Table 2-23 shows a total vacancy of 698, more than 25 percent of the number of filled posts. This imposes a serious limitation on the dissemination of information.

ANNEX 3

Swaziland

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ANNEX 3

Swaziland

A. General Background

1. The land

Swaziland is one of the smallest countries in Africa, with an area of approximately 17,364 square km. A landlocked nation, it is almost completely surrounded by the Republic of South Africa (RSA), save a 44 kilometre border with Mozambique to the east. The country is divided into four well-defined topographic regions running north to south in roughly parallel belts. It has a wide range of climatic conditions which may be described as subtropical, with fairly fertile soils and adequate rainfall. Swaziland is relatively well watered and has significant potential for irrigation and hydro-electric power production from the four main perennial rivers which traverse all four of the country's topographical regions en route to the Indian Ocean.

2. The people

The size of the population was estimated to be 605,000 in mid-1983. It is growing at an average annual rate of 3.4 percent, and about half of the population is under 15 years of age. If the growth rate remains unchanged, Swaziland's population will reach one million by the year 2000.

Nearly all (97.6 percent) of the Swazi people share a common language and tradition, and both English and siSwati are official languages. The Swazis traditionally are herdsman and farmers and 82 percent of the population still reside in rural areas. The two largest urban centres (Manzini and Mbabane), however, are growing at an estimated annual rate of ten (10) percent, largely due to internal rural-to-urban migration that has been in process since shortly after Independence in 1968. This migration stream may accelerate as a result of the current drought affecting the country and region.

The quality of life for most of the largely rural population in Swaziland is not high nor is it improving very rapidly. The per capita GDP is roughly US\$618, less than one-third that of the neighbouring RSA but about twice that of its neighbour, Mozambique. The Physical Quality of Life Index (PQLI, an index of 1 to 100 based on the average of life expectancy at age one, infant mortality, and literacy) was calculated in 1983 to be 45, on a par with many African countries but well below figures for Europe, North and South America, and much of Asia. (The PQLI for the U.S. is 96; for the U.K., 95.) The birth rate, according to 1982 estimates, is high, at 48 per 1000. Population growth is placing severe strains on limited arable land and social services and is contributing to rising unemployment.

3. The economy

GDP for 1982 has been estimated at US\$374 million, thus amounting to a per capita GDP of US\$618. During the period 1977-1982, the average rate of growth of the GDP, in constant prices, has been estimated at five (5) percent per annum, which by world standards was above average. Agriculture and manufacturing each account for about one-quarter of the GDP. Government services follow with 16 percent and distribution, hotels and restaurants contribute 10 percent.

Agriculture and agro-industry dominate Swazi life and comprise Swaziland's largest economic activity. Agriculture alone generates about one-quarter (26 percent) of the country's GDP, contributes 75 percent of national export earnings, absorbs approximately 75 percent of the total indigenous work force and, together with forestry, accounts for 40 percent of total wage employment. A large part of the manufacturing sector processes agricultural products. Agro-industry, including forestry contribute three-quarters (74 percent) of manufacturing value added and 69 percent of Swaziland's industrial employment. According to the 1980 Industrial Census, six establishments (two sugar mills, two saw mills, a pulp mill and a fruit canning factory) accounted for 68 percent of all manufacturing value added and 45 percent of private sector paid employment. With the addition of a third sugar mill in 1981, the importance of agro-industry in the creation of income and employment has increased further.

Due to the limited local market, most modern agricultural and agro-industrial production in Swaziland is exported. In 1981, sugar alone accounted for 40 percent of the country's foreign exchange earnings. This overwhelming and increasing reliance on sugar whose price fluctuates erratically on the world market has increased the vulnerability of the economy to external forces. For example, although the volume of sugar sold in 1981 increased by nine percent, income from sugar in that year declined by two percent. Indeed, because of the drop in world sugar prices from 1981 to 1983, it has been estimated that the Government of Swaziland (GOS) alone has lost, in terms of revenue foregone from lower export levies, the equivalent of US\$1.0 million a day.

While the country is a net exporter of agricultural products (sugar, processed and canned fruits, wood pulp), it is a net importer of food for local consumption. Approximately eight

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Unless otherwise indicated, the data in this section is taken from Prime Minister's Office, Department of Economic Planning and Statistics, Economic Review: 1978-1982 (Mbabane: GOS, February, 1983).

percent of total imports consist of food products, including about 30 percent of the total maize for human consumption -- the nation's staple food.

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4. Employment

The mid-1983 estimate of paid employment was 94,300, of which 89 percent was in the formal sector and the remaining 11 percent in the informal sector. Agriculture and forestry account for the major share of total employment, which currently amounts to approximately 75 percent of total employment and 40 percent of paid employment. The social services are the next largest provider of wage employment (19 percent), followed by manufacturing (12 percent), construction (nine percent), and distribution (eight percent). The private sector provides about 74 percent and the public sector 26 percent of paid employment. Women hold about 25 percent of the jobs in the formal sector.² During the period 1978-82, the average annual growth of formal sector employment was 3.4 percent, thus amounting to some 2,400 new jobs created each year. However, it is estimated that each year some 7,500 school leavers, educated to at least Standard V, enter the job market. Thus, the number of unemployed is increasing by at least 5,000 per annum. This amounts to slightly more than five percent of all those employed in 1983.

Historically, Swaziland's "excess" labour was able to find gainful employment in the South African mines. However, as that country's own problems of unemployment have increased, opportunities for Swazis to work there are drying up. For example, in 1976 nearly 21,000 Swazis, representing nearly one-quarter of the paid labour force, were employed in the South African mines; five years later (1981), only 11 thousand were so employed. This trend, which is expected to continue, will further aggravate the growing levels of unemployment and underemployment in Swaziland.

Despite the excess of people needing jobs in Swaziland, skilled Swazi technicians and craftsmen are in extremely short supply. Thus, Swaziland is heavily dependent on expatriates for its trained personnel. In 1977, for example, 54 percent of the administrative and managerial positions, 22 percent of professional and technical positions, and 19 percent of all skilled jobs were filled by non-Swazis. In part, Swaziland's shortage of skilled personnel is due to a school system which

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Unless otherwise indicated, the data in this section is taken from Prime Minister's Office, Department of Economic Planning and Statistics, Economic Review: 1978-1982, Swaziland, February 1983.

2

Central Statistical Office, Annual Statistical Bulletin, 1981, Mbabane.

prepares students inadequately in technical, scientific, and practical skills. Institutions such as the Swaziland College of Technology (SCOT) are striving to fill this gap.

5. Basic infrastructure

a. Introduction

Prior to Independence in 1968, Swaziland had a very limited infrastructure, inadequately developed institutions, and weak human resource base due to the extreme neglect of developmental needs by the British until very late in the Colonial period. The principal reason for this neglect was the assumption by the colonial authority until after 1948 that Swaziland would become part of the RSA.

b. Transport and communications

The backbone of the country's internal transport system is its network of roads, which includes 2,800 kilometres of so-called "main" and "district" roads. Only ten percent of the network, including the principal international links, are surfaced. However, more than two-thirds of Swaziland is within eight kilometres of an all-weather road. In addition, the country is well-serviced with air transport, telephone, and cable facilities. Thus, in spite of the disadvantage of being a landlocked country, the transport and communication sector is well-developed and does not appear to present a significant bottleneck to economic development. Swaziland has good transportation and communication links with the RSA, its most important trading partner. RSA traditionally provides it with maize to cover Swaziland's own lack of self-sufficiency.

c. Education

In comparison to other sub-Saharan countries with similar income levels, Swaziland's adult literacy rate of 65 percent and its primary school enrollment ratio of 78 percent are excellent. However, the high school pass rate for compulsory subjects is just under 50 percent and many of the primary and secondary school teachers are unqualified. The Government of Swaziland (GOS) is aiming to provide universal primary education by 1985, eventually extending this to include three years of post-primary training with a strong practical orientation.

The education sub-sector was allocated 16 percent of the central government's capital expenditure budget of slightly more than US\$57 million for 1983-84 partly financed by a World Bank loan. This constituted the largest capital expenditure allocation in the social services sector. As new schools are added to the system, the recurrent costs of the expanding system are being severely felt. Overspending on educational personnel is now a regular occurrence -- during fiscal year 1981-82 this amounted to US\$3.7 million, or 30 percent of the original budgetary provision.

Notwithstanding the emphasis being given to physical plant and personnel, it is doubtful that the country's educational requirements will be met during the years ahead given the rapid growth rate of the population because of the lack of "places" in the education system.¹ Consequently, there is little room for optimism that the existing serious shortage of qualified candidates to matriculate into the agricultural sciences at the college level will be mitigated in the foreseeable future.

d. Health

Life expectancy at birth in Swaziland is only 46 years and infant mortality is high, estimated at 135 per 1,000 live births. The number of people per physician is over 9,100. The Government has emphasized curative, rather than preventative, services. For example, over the five-year period ending in 1983, the proportion of recurrent spending on curative services averaged four times that for preventative services. Diarrheal diseases, respiratory diseases, and tuberculosis are the most prevalent health problems, although schistosomiasis is almost endemic. Malaria is also present.

B. The Agricultural Sector

1. Ecological zones and agricultural production

Swaziland can be divided into four ecological regions, running north to south in roughly parallel belts (see Figure 3-1 and Table 3-1). The Highveld (5,029 square km.) is a mountainous region (average elevation 1,300 metres) in the west with only ten percent of its land having even fair potential for agriculture. Good soils with gentle slope and adequate drainage occupy only three percent of the area. The annual rainfall ranges between 1,000 and 2,300 mm, most of which falls in the summer, between October and March. The soils are highly weathered but suitable for forestry, at least of conifers and eucalyptus trees. Only

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Swaziland simply does not have enough educational "places". For example, in 1976 the ratio of total enrollment to the population in the standard age group for primary education (6-12 years) was 90 percent (indicating that only nine out of ten of the 120,000 youngsters in that age group would have a place). Between one-fifth and one-quarter of those actually enrolled in primary school were overaged. Thus, more than one out of ten aspirants in the standard age group were actually without places. Likewise, again in 1976, the ratio of lower-secondary enrollment to the population in its standard age-group (13-15 years) was 38 percent and the corresponding figure for the upper-secondary bracket was 17 percent -- which meant that 83 percent of those in the latter age bracket were, for whatever reason, unable to attend classes.

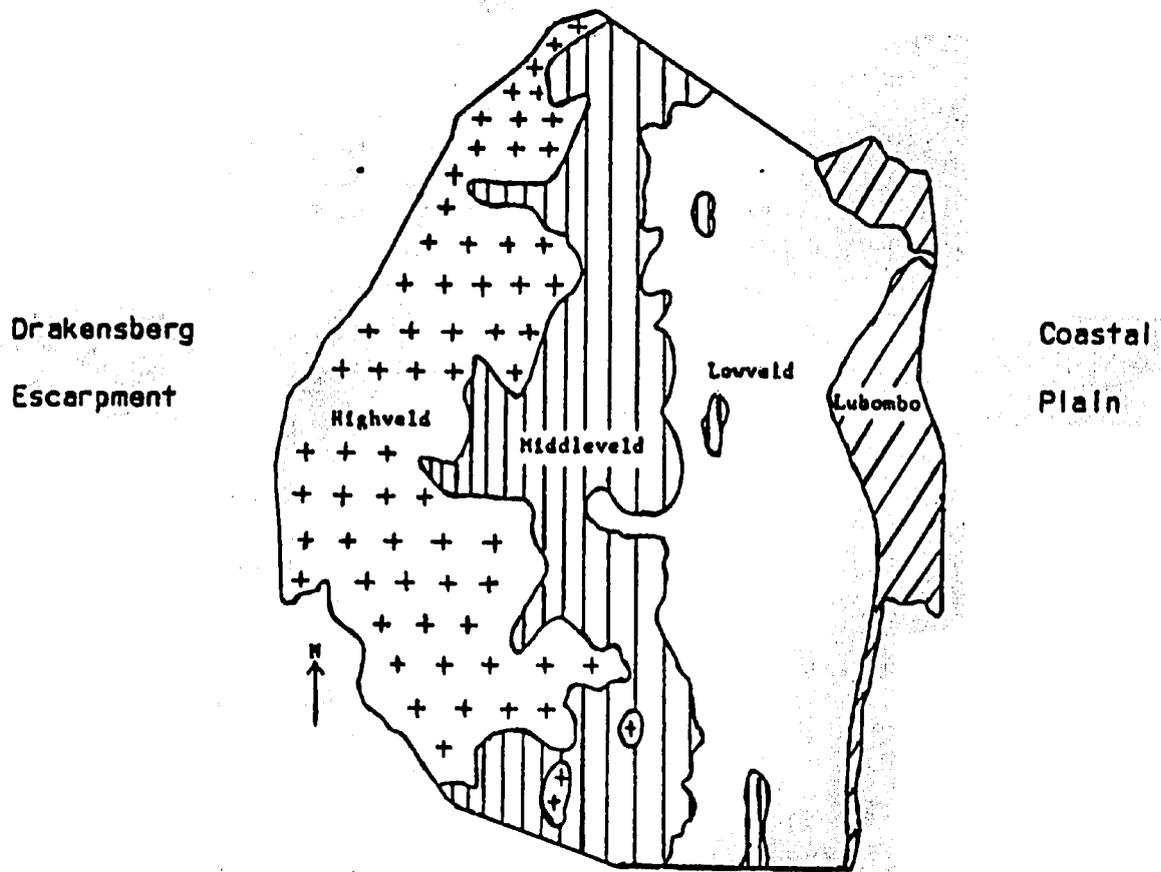


Figure 3-1: Topographical Regions, Swaziland

Table 3-1: Ecological Regions and Their Characteristics, Swaziland

<u>Region</u>	<u>Area (sq km)</u>	<u>Average Altitude (m)</u>	<u>Average Rainfall (mm)</u>	<u>Climate and Mean Temperature Ranges (c)</u>	<u>Predominate Vegetation</u>
Highveld	5,029	1,300	1,270	Humid, near-temperate 10.8 - 22.6	Sour grassland with some natural and man-made forests
Middleveld	4,597	700	940	Near-humid, sub-tropical 11.7 - 22.6	Tall grass and mixed bush
Lowveld	6,416	200	660	Semi-arid, hot 15.4 - 29.8	Broad-leaved savanna in west, thorn parkland and scrub in east
Lubombo	1,321	600	784	Near-humid, sub-tropical 13.9 - 24.9	Mixed bush

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scattered areas of indigenous woodland remain in this area. Soil erosion is a problem, especially on the many overgrazed steeper slopes. Maize is the main crop, although some cotton and tobacco are grown in the south.

The Middleveld (4,597 square km.), which has the highest proportion of Swazi Nation Farms, has a larger proportion (up to 20 percent) of good to fair arable soils. A hilly region with several large valleys, it has an annual rainfall ranging between 750 and 1,150 mm. Maize is the main crop on the SNL of the Middleveld, but peanuts, sorghum, beans, vegetables, cotton and tobacco are also cultivated, the latter two because of their high cash value and ease of marketing. On the private freehold farms (Individual Tenure Farms -- ITF), citrus and pineapple are the most important crops.

The Lowveld (6,416 square km.) is gently rolling country with a highly variable annual rainfall (between 500 and 900 mm). Although in the Eastern Lowveld about 30 percent of the area has good to fair arable soils, the hazard of drought is great. In favorable years, good crops of cotton, sorghum and peanuts are harvested, but most years yield poor harvests and in some years even total crop failures. About 20,000 hectares are under irrigation, mainly for the production of sugar, citrus, rice and cotton. Vegetables are also cultivated. On nonirrigated grazing land, overstocking often leads to bush encroachment and increased soil loss. Privately owned land is most highly concentrated in the Highveld and Lowveld regions.

The Lubombo (1,321 square km.) is a plateau with a climate similar to that of the Middleveld. It contains small areas of deep, cultivable soils, with maize the most important crop on SNL and beans and cattle are grown on the ITFs.

2. Soils

The soils of Swaziland are complex, with the distribution of the major types being closely related to relief and geological structure. Except for areas of alluvial soils, they have developed in place from underlying parent rock, thus reflecting the weathering and chemical characteristics of the rock base.

In the Middleveld, upper Middleveld and the Lubombo, the main soil types are deep, acidic and freely-drained red and yellow ferrisolic and ferralitic. Many are underlain by quartz. The natural fertility of these soils is low and there is little or no reserve of weatherable minerals due to leaching. The rooting depth is between 40-70 centimetres, although on gentle and flatter slopes it increases to 100 centimetres or more.

3. Land tenure

a. Swazi Nation Land (SNL)

The agricultural sector of Swaziland is divided sharply into two parts: a modern, capital-intensive subsector, largely owned and managed by foreigners and producing mainly for export, and a traditional subsector producing mainly for subsistence.

The traditional subsector coincides largely with the Swazi Nation Land (SNL) containing roughly 42,000 traditional homesteads, with an average size of two and three-quarters hectares. The great majority (over 80 percent) of SNL, however, is communal grazing land (see Table 3-2). SNL encompasses roughly 65 percent of the land in Swaziland. The land varies in quality depending on the ecological zone in which it is located.

Swazi Nation Land is owned communally by the Swazi people and is held in trust by the Ngwenyama (the King) for the Swazi Nation. Through local chiefs, holdings are allocated to individual households to be used for farming plots and homesites. Such holdings are relatively secure depending on the "good behavior" of the tenant. Only farming plots and homesites are allocated, all other land being held as communal grazing land. The arable land is open to grazing during the winter months.

b. Individual Tenure Farms

The modern subsector consists of about 790 privately owned farms and estates on Title Deed land called Individual Tenure Farms (ITFs), averaging over 800 hectares in size. Most of the land is owned or managed by expatriates and produces mainly for export. Over 60 percent of the farms are irrigated. Much of the private land is either undeveloped or occupied by Swazi squatters using the land in the same way as traditional farmers. The most important crops produced on the large, privately owned farms are sugar cane, citrus, pineapples, cotton, maize and rice. These farms also account for more than half of the land area devoted to vegetables.

c. The land purchasing programme

Through an aggressive programme of land purchases (mainly consisting of those idle ITFs mentioned above), the GOS has been acquiring land from the private sector to be added to SNL. This programme has been financed primarily with assistance provided by the British Overseas Development Agency (ODA.) The success of the programme can be measured when it is taken into account that between 1975 and 1983, SNL as a portion of total land increased from 45 percent to 65 percent -- by 311,000 hectares.

Table 3-2: Agricultural Land Use and Tenure in Swaziland

Land use category	RDA Lands		Non-RDA Lands		Swazi Nation Lands		Individual Tenure Farms		All of Swaziland	
	'000 hec.	% of total	'000 hec.	% of total	'000 hec.	% of total	'000 hec.	% of total	'000 hec.	% of total
Cropland:										
cropped	56	11	35	7	92	8	38	14	126	9
fallow	8	2	2	<1	10	1	2	<1	12	<1
Subtotal; cropland ¹	65	12	38	7	102	9	40	15	142	10
Grazing land:										
natural veld	(- - - - not available - - - -)				979	90	138	-	1,117	81
improved	(- - - - not available - - - -)				4	<1	20	3	24	2
Subtotal; grazing land ¹	470	87	514	93	984	90	158	60	1,141	82
Other farmland	4	<1	3	<1	6	<1	68	26	74	5
Total ¹	538	.	555		1,092		266 ²		1,359 ²	

¹ Inconsistencies are due to rounding.

² Excludes approximately 265,000 hectares of unused land and 102,000 hectares of commercial forest lands. If included, total land in ITFs would be 633,000 hectares. Adding a further 9,000 hectares approximates Swaziland's total area of 17,364 square kilometres.

³ Disaggregation of land use categories was only possible using less recent data than that used in the text's analysis of land tenure. Since the land use data was collected, total SNL area has increased and ITF area has decreased.

Sources: Land Use Planning Section, Ministry of Agriculture and Cooperatives, 1983.
Ministry of Agriculture and Cooperatives Rural Development Areas' Programme Annual Report, 1982.
Devres calculations.

d. The Rural Development Area Programme (RDAP)

GOS concern about the growing disparity between income and the overall quality of life between SNL and ITF farms dates back to before Independence. In addition, a national goal has been, and continues to be, to achieve self-reliance in basic foods -- especially maize. Consequently, the Government has embarked on a nationwide rural development programme involving SNL.

The present RDAP was initiated in 1970 and at the time was supported by bilateral funds supplied by the United Kingdom's Overseas Development Ministry. By 1974 the RDAs included in the RDAP covered 7 percent of SNL. There are presently 18 RDAs covering more than 537,000 hectares, or approximately 49 percent of total SNL (see Table 3-2). It is estimated that there are approximately 26,600 homesteads in the present RDAs. These comprise 227,000 people of which 77,000 (34 percent) carry on their main economic activities away from the RDAs.

Presently the RDAs are being financed by several donors. Loans of US\$18.5 million have been received from the African Development Bank, the World Bank, and the United States; grants of US\$9.3 million have been obtained from the European Development Fund and the United States; and the GOS has provided counterpart funds of US\$4.2 million for a total of US\$32 million.¹

4. Land use

Land use in Swaziland can be broken down into six categories consisting of cropland, grazing land, "other" farmland, commercial forests, "other" (i.e, unused) lands and urban lands. Excluding commercial forests, urban and unused land areas from the Nation's total leaves approximately 1.36 million hectares of farmland of which 10 percent is cropland, 84 percent is grazing land and 5 percent is "other" farmland (see Table 3-2). The patterns of land use within these categories vary widely according to tenure. Land use efficiency is highest on the ITFs; followed by the RDAs and SNL. For example, a higher ratio of cultivated land to total agricultural land is one indicator of intensity (and hence efficiency) of use. Table 3-2 shows a ratio of 14 percent for ITFs, 11 percent for RDAs, and only 7 percent for non-RDA Swazi Nation Land. Another useful indicator is the ratio of improved to total grazing land which is 13 percent for ITFs, but which is less than 0.5 percent for SNL. Unfortunately, comparable figures for the RDAs are not available; however, it is known that pastures are being improved in accordance with the RDA work plan. That tenure on SNL is usufruct rather than freehold has limited SNL farmers' ability and incentive to obtain long-

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Ministry of Agriculture and Cooperatives, Rural Development Areas' Programme, Annual Report 1982. (Mbabane: GOS, 1983).

term credit for land improvements. Via the RDAP, however, an attempt has been made to compensate for these limitations. One example is the provision of lime, (to counter high soil acidity) at subsidized prices to RDAP beneficiaries. The RDAP budgets also include appropriations for fencing, which would otherwise be an investment requiring long-term credit. The Land Development Unit and the Land Use Planning Section of the Ministry of Agriculture and Cooperatives (MOAC) also provide means for small-scale irrigation development, roads, terracing, and related activities.¹

5. The performance of the agricultural sector

a. Introduction

Agricultural production on SNL, including the RDAs, has not proved to be as successful as was anticipated. Indeed, a primary aim of the RDAP, as expressed in the "Third Five-Year Development Plan, 1978-82," was to narrow the production and income gaps between the commercial and traditional agricultural sectors. However, those gaps have instead widened. While production in the commercial sector was increasing at a rate approximating 12.9 percent per annum during the plan period, production in the traditional sector was increasing by only 0.36 percent per annum.

In 1981, the output of the traditional agricultural sector (SNL) amounted to approximately US\$15 million, or 3.9 percent of GDP at factor prices. ITFs and the forestry plots associated with them produced over US\$85 million of commodities representing 22 percent of GDP.

Crop yield indices for maize, sugar cane, cotton, and oranges over a ten-year period (see Table 3-3) clearly show the widening gap between traditional and commercial sector productivity. Yields for both maize and cotton grown on SNL are down considerably from the 1971-72 base year, although they both have been rising since 1978-79 as a result of improved cultivation practices. Sugar cane and orange growing, on the other hand, are activities in which only ITFs (including estates) engage. Yields of oranges have increased by 37 percent and, although yields of sugar cane remain relatively constant (this sector began with very high technology), overall production of sugar cane increased by 77 percent during this period.

Table 3-4, showing the actual areas planted, production and yield of major crops grown on SNL in comparison with yield potentials, vividly illustrates the existing gap between actual and potential production performance on SNL. Inasmuch as the commercial sector, which is increasing output rapidly, produces mainly for export while the traditional sector, which is showing

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Ministry of Agriculture and Cooperatives, Rural Development Areas' Programme, Annual Report 1982.

Table 3-3: Indices of Selected Crop Yields in Swaziland

Crop	<u>1971/72</u>	<u>1972/73</u>	<u>1973/74</u>	<u>1974/75</u>	<u>1975/76</u>	<u>1976/77</u>	<u>1977/78</u>	<u>1978/79</u>	<u>1979/80</u>	<u>1980/81</u>
Maize	100	65	89	82	83	70	74	42	61	71
Sugar Cane	100	91	82	92	101	98	98	106	99	105
Cotton	100	97	136	165	96	114	104	49	74	80
Oranges	100	94	105	109	123	110	113	113	118	137

Source: Central Statistical Office, Government of Swaziland, Annual Statistical Bulletin (1981).

Table 3-4: Area, Production, and Yields of Major Crops on Swazi Nation Land, 1979/80 and 1980/81

Crop	1979/80			1980/81			Potential Yield (MT/ha)
	Area (ha)	Production (MT)	Average Yield (MT/ha)	Area (ha)	Production (MT)	Average Yield (MT/ha)	
Maize	71,145	96,735	1.3	55,657	93,691	1.7	4 - 6 ¹
Groundnuts	2,740	1,271	0.5	1,494	637	0.4	2.5 - 4 ¹
Cotton	17,709	14,011	0.8	13,035	14,922	1.1	n.a.
Jugo Beans	2,582	1,406	0.5	1,805	1,672	0.9	1.3 ²
Sorghum	2,288	1,582	0.7	1,568	1,147	0.7	3.5 ¹
Beans	1,138	322	0.3	1,768	883	0.5	n.a.
Sweet Potatoes	560	8,400	15.0	1,063	2,039	1.9	n.a.
Tobacco	254	86	0.3	524	83	0.2	0.8 ¹
TOTAL	98,416			76,914			

¹ University of Swaziland at Luyengo, Research Advisory Bulletin, No. 1, 1978.

² Mr. Frank Buckham, Chief Research Officer, personal interview, September, 1983.

Source: Central Statistical Offices, Mbabane

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almost no output increase from year to year, produces food for local consumption, it is readily apparent that food production is lagging increasingly behind the country's population growth of 3.4 percent per year.

b. Food crops

(1) Maize

Maize is the major food crop grown on SNL, in both the RDA and non-RDA areas. Maize is usually intercropped with beans in most areas of Swaziland. In the Highveld and the Middleveld, yields of 1.5-2.0 tonnes per hectare of maize have been recorded. In the Lowveld, about 800 kilograms per hectare have been achieved under dryland farming.¹ However, according to research investigations, maize yields of four to six tons per hectare could be achieved in practically all of the regions under irrigation.² Care must be exercised on determining what the potential output could be on SNL. Although maize yields on some of the better ITF lands have been as high as six to eight tons per hectare, such yields may not be possible on SNL on which the prime variable is fertilizer and very little management is provided.

A study using data from approximately 100 SNL farm units to determine optimum levels of output indicates that, when the additional costs of adding fertilizer are compared with the value of the resulting marginal product, the economic optimum is less than the technically possible yield. In fact, it would approximate the 1.68 tons per hectare realized on SNL for 1980-81.³ Ironically, if the same productivity achieved in 1980-81 had been achieved on the land area planted to maize the year before, Swaziland's maize gap would have been practically closed with a production of 120 thousand metric tons. In actuality, however, maize production has declined. Outputs of maize amounted to 96,700 metric tons and were produced on some 71,000 hectares in 1979-80. One year later, output had fallen by three percent to 93,700 metric tons and was produced on 55,700 hectares, or 22 percent less land (see Table 3-4). What actually appears to be taking place is that farmers are producing just enough to satisfy their own consumption needs. Farmers in the traditional sector (especially those within the RDAs) thus were applying more fertilizer, using higher-yielding hybrid varieties,

¹ Economic Planning and Analysis Section, Ministry of Agriculture and Cooperatives, Crop Profitability Guide Book. (Mbabane: GOS, 1982).

² Research Division, Ministry of Agriculture and Cooperatives, "Research Advisory Bulletin No. 1977," GOS, 1978.

³ A. Low, "The Economics of Fertilizer Use on Swazi Nation Land," mimeographed paper, University of Reading, 1982.

and increasing productivity (from 1.36 to 1.68 tons per acre during the period under observation). As a result, they needed to plant fewer hectares of maize to meet their production targets. That such a "backward bending supply curve" exists is borne out by studies prepared by MOAC and others.¹ In fact, the area of cultivated land in the RDAs has increased from 11 percent to only 13 percent within recent years, while on the less productive parts of the SNL it has fallen by a dramatic 50 percent.²

(2) Sorghum

Sorghum does fairly well in the Lowveld due to its drought-resistant nature. According to research findings, up to 3.5 tons per hectare can be obtained on fertile lands in all of the regions.³ However, the national average is 640 kilogrammes to 1.5 tons per hectare.⁴ No information on sorghum yields in the RDAs was available.

(3) Jugo beans

The SNL area planted to Jugo beans decreased from 2,582 hectares in 1979-80 to 1,805 hectares in 1980-81. Output was 1,406 metric tons in 1979-80 and 1,672 metric tons in 1980-81.⁵ Per hectare yields in 1979-80 and 1980-81 thus were 545 kilogrammes and 926 kilogrammes, respectively. Yields per hectare vary according to regions. Research trials indicate that yields of up to 1.3 tons per

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See the Economic Planning and Analysis Section, Ministry of Agriculture and Cooperatives, "A Study on the Alternatives Available for Estimating Costs of Achieving Maize Self-Sufficiency," 1977, and Prime Minister's Office, Economic Review, 1978-1982, 1982; also, A. Low, "Farm Household Theory and Rural Development in Swaziland," Development Study No. 3, Department of Agricultural Economics and Management, University of Reading, 1982.

2

Although figures are not available for the current year, there is little question but that yields of maize and other crops have fallen dramatically as a result of the drought affecting the area. In fact, Swaziland, like many of its neighbours, is now receiving food aid.

3

Ministry of Agriculture and Cooperatives, Rural Development Areas Programme, Annual Report, 1982.

4

Crop Profitability Guide Book, 1982.

5

Central Statistical Office.

hectare are attainable.¹ Current average yields per hectare for the whole country are about 800 kilogrammes.²

(4) Groundnuts

Production of groundnuts declined over the two-year period from 1979-80 to 1980-81. In 1979-80, 1,740 hectares were cultivated and 1,271 tons were produced, while in the 1980-81 season, 1,494 hectares were under groundnuts and only 637 tons were produced. Yields in 1979-80 and 1980-81 were 464 kilograms and 426 kilograms, respectively. Research findings indicate that yields of 2.5 to 4 tons per hectare of unshelled nuts are normal for recommended varieties.

(5) Vegetables

Vegetable output has improved significantly in Swaziland because vegetable imports from RSA have been banned by the Swazi Ministry of Health to avoid spreading the cholera found in some parts of that country. The RDAs have taken the lead in increasing vegetable production, especially in the 12 irrigation schemes located around the country. As a result, all of the commonly consumed vegetables in Swaziland, i.e., tomatoes, cabbages, onions, potatoes and carrots, now originate within the country. Yields vary according to soil type, availability of water for irrigation, and use of inputs. Vegetable yields per hectare that have been realized both on RDA and non-RDA land are: tomatoes--20 metric tons; cabbages--25 metric tons; onions--20 metric tons; potatoes--25 metric tons; and carrots--19.5 metric tonnes. Research findings reflect yields slightly more than ten percent above the ones indicated.

c. Cash crops

(1) Cotton

Cotton production has increased significantly by area and is a major cash crop on SNL. In 1981 there were approximately 6,000 cotton farmers, including those on Title Deed Land. In the RDAs alone, an area of 7,800 hectares was under cotton in 1982, and 4,695 metric tons were harvested. The average yield was 596 kilograms per hectare. In 1982 farmers did not prepare their fields in time, and credit was unavailable. However, the cotton price in 1981 was disappointing. As a result, the 1982 RDA area under cotton was down by 22.5 percent and output declined by 40.4 percent. In the 1983 season, yields dropped by more than 50 percent because of the drought. However, there is evidence of some improvement in farmer responses to a

¹
Central Statistical Office.

²
Mr. Frank Buckham, Chief Research Officer, personal interview, 1983, and Crop Profitability Guide Book, 1982.

new cotton campaign launched by the Swaziland Cotton Board (SCB) through its cotton registration scheme. Given the absence of drought, the SCB estimates that a further potential land area of 60,000 hectares could be developed for cotton production.

(2) Tobacco

Tobacco has been grown mainly in the Shiselweni District, especially in the Southern RDA. On SNL, however, it has assumed a place of importance in other districts, especially in the Manzini and Hhohho districts. The national average yield was 339 kilograms per hectare in 1979-80. The yields of some farmers went as low as 15 kilograms per hectare in 1980-81, although yields of 400 to 450 kilograms per hectare were recorded by farmers in the RDAs¹ and like yields have been realized in selected farms in the non-RDAs.² Further, it has been demonstrated that under semi-mechanized management in the RDAs, yields of 800 kilograms per hectare can be achieved.

d. Livestock

As noted earlier, the Swazis have a long and important tradition of keeping cattle. In 1981, there were approximately 656,000 cattle in the country, of which 518,000 (79 percent) grazed on SNL land and the remaining 138,000 (21 percent) grazed on ITF land. Between 1966 and 1976 the number of cattle in Swaziland increased by 30 percent. This trend has continued, especially on SNL land where the number of animals has been increasing rapidly due to the low off-take levels in that area. Thus, even though livestock numbers have been diminishing on ITF lands due to a relatively high off-take rate, the overall national herd is growing at a rate approximating three percent per annum.

The potential for economic growth in the livestock sector is good, but traditional uses of cattle to achieve objectives other than production of income make it difficult to fully realize that potential. In addition to being used for the Lobolo (or bride price) cattle bring prestige, are used for ceremonial purposes, till the fields, provide meat, milk and dung for the homestead and are a traditional measure and store of wealth. The high value and priority placed on owning livestock has created special problems. For example, overgrazing has resulted in erosion, deterioration of the natural veld, and a decline in the quality of Swazi livestock. The importance placed on cattle as a means to achieve status, store wealth, etc., means that low calving and off-take rates, poor growth performance, overstocking and similar other factors do not guide farmers' actions with respect to their

¹ Ministry of Agriculture and Cooperatives, Rural Development Areas' Programme, Annual Report, 1982.

² Crop Profitability Guide Book, 1982.

livestock. The number of cattle owned, rather than the current income earned from the herd, becomes the more important management objective.

These values of Swazi farmers with regard to their livestock helps explain why, in spite of a myriad of objectives and programmes designed to upgrade the national cattle herd, the national herd continued to grow until, by 1981, there were approximately 655,700 cattle in the country. The MOAC in 1979 determined the actual carrying capacity of the country. It found that under conditions that would guarantee a sustained yield of forage for livestock, the country could support 440,000 animal units. This means the country is currently nearly 50 percent overstocked. As early as 1947, fully cognizant of the gravity of the problem, His Majesty King Sobuza II issued a decree regarding overstocking that included a provision for compulsory destocking. However, this decree has seldom, if ever, been enforced, despite the facts that 50,000 cattle die on the hoof each year from either poor nutrition or exposure, and that many believe the cattle on SNL are existing on a "Malthusian fringe."

It is primarily on SNL that the growth in livestock numbers is taking place. On ITFs the number of animals is diminishing. However, the net result of these contrasting rates is a livestock population growth rate approaching three percent. Taking into consideration that an animal unit requires approximately an equivalent amount of land for subsistence as does a human, and that Swaziland's population is growing at an annual rate of 3.4 percent, the combination of the nations rapid cattle and population growth rates is alarming.

Presently, the calving rate on SNL averages less than 32 percent, which is low by any standard, whereas on ITFs the corresponding figure is 50 percent and higher.

While the offtake for the country averages around 11 percent, that on SNLs continues at around nine percent. A rate of at least 12 percent would be required to maintain the status quo in terms of numbers of cattle.

6. The Rural Development Areas Programme

The RDAP constitutes the very core of Swaziland's attempt to promote the transition from traditional to commercial agriculture and to enhance the welfare of rural people. However, the RDAP has disappointed its sponsors because it has not achieved the goals set for it.¹

¹ "Prime Minister's Office, Economic Review, 1978-1982, 1982.

As of 31 December 1982, some 55 percent of the funds available to the RDAP had been disbursed.¹ The execution of the project, however, has slipped far behind the original schedule. This is evidenced by the fact that each year only 60 to 80 percent of the capital budget allotments actually have been expended. Nevertheless, considerable physical construction and systems development have been realized. These include building and improving roads, making agricultural inputs available, fencing grazing areas, improving credit and marketing facilities, intensifying extension activities, and improving livestock management and land consolidation. Tractor-hire schemes have also been established.²

In accordance with a recommendation in the Third Five-Year Development Plan, a major objective of the RDAP has been to increase maize production to the level of national self-sufficiency. However, although the uptake of credit, hybrid maize seed and tractor service exceed planned levels, maize yields have continued to fall short of targets. Thus, while maize yields have grown somewhat, the growth has not been adequate to reduce the gap between local consumption and production. In fact, this gap has been growing. In addition, the yields of other food crops such as beans and groundnuts appear to have remained relatively stable. The expected increase in the output of cash crops such as cotton and tobacco also did not take place. Nor has cattle destocking occurred; instead, as noted above, cattle numbers have increased. This disappointing performance, however, must be seen in the perspective of the overall household economy.³ As indicated above, farmers appear to be using modern inputs and the tractor service only to the extent necessary to produce the maize they need for subsistence. Whatever farm labour that was released in the process has been used for employment in off-farm jobs.

It so happened that the 1970s were years when opportunities for off-farm work were plentiful in Swaziland. Roughly one-half

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Mr. Peter Linsey, Financial Controller, RDAP Management Unit, personal interview, 1983.

2

Although the demand for tractor ploughing is high, the scheme is losing money at the rates it charges for its services (which are the same as those of private tractor operators for comparable work.). These losses are due to inadequate maintenance and poor management which have raised operating costs to the point that the RDA tractor-hire service would have to charge at least twice as much as it currently does to break even. There are at present some 300 privately-owned tractors and 34 government-owned ones operating in the RDA.

3

Economic Planning and Analysis Section, "Alternatives Available for Estimating Costs of Achieving Maize Self-Sufficiency," 1977 and A. Low, "Farm Household Theory," 1982.

of SNL households had an adult member working away from the farm; off-farm remittances made up 75 percent of the total income of the households concerned. However, with the drying up of off-farm job opportunities, including the cutback in hiring Swazis in the South African mines, prevailing attitudes could change. Perhaps, as the Prime Minister's office has stated, it is not so much that the RDAP has failed, ". . . but that unrealistic goals were set for it in the absence of more fundamental changes in tenure tradition. . ."¹

The document goes on to say:

In relation to the growth in the labour force, the traditional agricultural sector will have to absorb substantial amounts of additional labour. In order to prevent rural per capita incomes from falling further, structural change in agriculture and rural employment is required if school leavers are to be employed in a remunerative manner. While the RDAP would allow some progress in this direction, a more complete solution to the problem will wait upon more fundamental changes in the structure of traditional agriculture itself.²

7. Forestry

The forestry industry depends predominately on private plantations which are foreign owned, capital intensive, and export oriented. Plantation forest covers approximately 102,000 hectares of freehold land. The two largest plantations, located in the cool humid Highveld, account for 65 percent of man-made forests, mostly pine and eucalyptus (gums). Forest plantations and forestry-based industry contributed about 20 percent of Swaziland's earnings in 1978.

8. Inputs and services

a. Marketing

In general, ITFs producing export-type crops are not faced with serious problems of marketing since most of their crops such as sugar cane, pineapple, citrus and cotton are channelled through well-organized and institutionalized marketing structures. Likewise, timber and wood-pulp enjoy established and effective marketing systems, as does tobacco with its single channel tobacco cooperative. Livestock, mainly cattle, are usually sold at dipping tanks (used for tick control) or directly to a single company (the Swaziland Meat Corporation).

1

Prime Minister's Office, Economic Review, 1978-82, 1982.

2

Prime Minister's Office, Economic Review, 1978-82, 1982.

In contrast, most of the crops currently being produced on SNL are marketed through less sophisticated channels. A high proportion of the locally produced maize is consumed by the producer and his family or traded locally. However, some limited surpluses do reach the larger commercial market; these are often purchased for resale by the Swaziland Milling Company or the Central Cooperative Union of Swaziland (CCU).

The main marketers of vegetables are market women who obtain their stocks directly from producers or from hawkers and wholesalers. Often, they buy bulk packs and repackage into smaller polyethylene bags. Such retailers are numerous in the main markets and are characterized by lack of competition, particularly with regard to price.

b. Fertilizer

Two firms constitute the main suppliers of fertilizer in the country, with each company providing about 50 percent of the N.P.K. requirements. These firms sell fertilizer directly to the ITFs. Sales to SNL farmers are made through the CCU which orders half of its requirements from each company and then sells the fertilizer through one of its District Unions or primary cooperative societies to the small farmer.

c. Agricultural credit

Institutional agricultural credit is well developed in Swaziland, but, again it is geared primarily to the needs of the commercial sector. Credit is available to farmers from three principal sources:

- o The Swaziland Development and Savings Bank (SDSB);
- o Commercial banks; and
- o Processing companies.

In general, SNL farmers have access only to the facilities of the SDSB. Under its Agricultural Advisory Credit Scheme, financed mainly by assistance from USAID, SDSB extends seasonal loans which carry a concessional rate of interest of six percent per annum. Cattle are the primary source of collateral allowable. This implies that small farmers without cattle can only obtain credit if a relative or friend is willing to pledge his cattle to secure the borrower's loan. The use of such loans are restricted to the purchase of agricultural inputs, small farm implements and, in some cases, dairy cows to be bought through the MOAC.

d. Farm labour

There has been considerable controversy about the availability of labour. Indeed the shortage of labour has been cited as a serious constraint. Yet, ITF farmers give the

impression that if a "fair" wage is offered sufficient labour will be forthcoming.¹

Even further, with regard to subsistence farming, a study by the International Labour Organization² indicates that there does not appear to be a shortage of labour and demonstrated that theoretically two males could migrate from the homestead without adversely affecting subsistence production. (However, when considering certain labour-intensive cash crops such as tobacco, a shortage of labour could well be the most important limitation.) Consequently, given the low returns anticipated for their labour used to grow subsistence crops in comparison with the returns they might receive elsewhere, it should not be surprising that many men leave the farm for what they consider more remunerative alternatives. Thus, many traditional farms are operated by women. If all goes well and the men do manage to obtain employment (which could even be on a private farm or estate), they can send remittances to buy seed and other inputs as well as to help provide family sustenance.

Given the infrastructure and inputs made available to the farming community within the RDAs, the GOS hopes that small-scale farming can be made both meaningful and profitable to the extent that it will provide a viable means for earning a livelihood.

9. The role of women in the rural sector

Until the returns to labour from agriculture can make a significant impact, the constant figure on many of the farms on SNL will continue to be the married woman. As well as raising children, she maintains the homestead base, tilling the fields and minding livestock while the husband works elsewhere. She is assisted by the children according to their ages and position in the homestead. However, under present circumstances, she is able to sustain the family from the land only if her husband is able to provide remittances for valuable farming inputs.

10. Food security

The current drought affecting southern and south eastern Africa highlights the precarious food security situation in Swaziland. In a recent report on global information relating

¹ Messrs. Jan Borell and Horace Long, personal interview, 1983.

² B.D. Rosenpuntz and F.A. Prinz, "Migrant Labour and Rural Homestead, an Interpretation of the Sociological Implications of the Migrant Labour Situation in Swaziland." World Employment Programme Working Paper (Geneva: ILO, 1978).

to foodcrops and shortages, the FAO stated that in Swaziland:

...the 1983 maize production was reduced by drought to 50 percent of normal. Government has estimated that over 108,000 people (about one-fifth of the total population) require food assistance until the new harvest in mid-1984. Due to low river levels, water shortages are reported and water rationing is in force in several areas.

Maize import needs in 1983/84 are estimated at over 100,000 tons, about double normal level. Government has requested assistance to cope with food shortages. FAO/WFP emergency food assistance for 90 days for 108,000 people, consisting of 3,888 tons of white maize, 389 tons of pulses and 194 tons of edible oil was approved on 22 June 1983.¹

Even before Independence in 1968, the issue of food security was an important one in Swaziland. In fact, a major objective of the late King Sobuza was for the country to achieve self-sufficiency in the production of its one basic food crop--maize. The objective of maize self-sufficiency was not only repeatedly stressed by His Majesty, but was also prominently included in all three of the country's five-year development plans. A considerable portion of the available resources of the Rural Development Area Programme have also been directed to this end.

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However, in spite of the GOS's objectives, the maize gap continues to widen. Whereas in 1975 about 25,000 metric tons were imported, that figure has now more than doubled. At present, maize output appears to be stagnating, with a reduction in area planted not sufficiently compensated for by an increase in yield. As a result, for per capita intake levels to be maintained, additional imports are necessary.³ Consequently, the importation of maize and other cereals has been increasing steadily. The major source of such imports is RSA. The gravity of this trend can be more readily appreciated when the two factors of population growth and present maize yields are taken into consideration. Swaziland's human population is growing at an annual rate of about three percent, thereby adding over 20,000 persons to the total population each year. Meanwhile, per hectare maize yields on SNL (including RDAs) average 1.0 to 1.2 tons per hectare. Thus, either additional maize land must be added annually, maize yields must be increased substantially each year, or maize imports must continue to rise. Fully cognizant of the seriousness of the problem, GOS requested and

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FAO, Foodcrops and Shortage, 16 September, 1983.

2

Total maize consumption minus total maize production.

3FAO, "Report of the Food Security Policy Formulation and Project Identification Mission to Swaziland." 1981.

received assistance from FAO in the form of a Food Security Assistance Scheme Mission designed to "identify the food security policy and programme needs of the country and to advise on the establishment of security reserves."¹

The Mission recognized, first, that several constraints must be overcome for Swaziland to achieve a higher level of self-sufficiency in maize production, and second, that there were no agronomic limitations to producing enough maize. However, the higher the level of maize output to be achieved, the more complex would become the economic, social and political issues to be resolved.

One constraint is the lack of clearly defined policies for implementing GOS food strategies and follow through with action programmes. Food security decisions and subsequent programme formulation are particularly complex exercises. Several options are open to the GOS, each with different economic and political trade-offs. Selecting an option is necessary because it sets out an identifiable maize production policy and the programmes to achieve it, and enables farmers and others to make decisions in the light of both.

Land is not a constraint to increasing maize production. Sufficient area exists to produce maize to fully satisfy expanding food requirements. The constraints lie rather in access to and use of the land. While the Government is actively pursuing its programmes to modernize agriculture, corresponding attention has not been given to adapting the traditional land tenure system to accommodate modern agriculture. Under present tenure practices, SNL farmers, including those in the RDAs, are limited to small areas. This may be adequate for some. However, the means must be found to give farmers who want to expand access to sufficient cultivated land to encourage them to remain on the land. For maize, returns per unit of land are lower than those provided by some other crops. A farmer thus must grow larger areas to achieve a desired level of income. This land-income relationship for maize will become increasingly important in the future, and care must be taken to reverse the trend (for at least some individuals) of declining size of holdings as rural population increases.

The agricultural research programme in Swaziland has not kept pace with Government strategies and programmes, and it urgently requires improvement and re-orientation to meet present needs. In particular, tested research information must be given to the extension service. Above all, this will require a sharper focus on meeting the needs of the small farmer. Since Swazi farmers have strong social and traditional values, applied research aimed at meeting small farmers' needs must start from a knowledge of what small farmers want and need.

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FAO, "Report of the Food Security Policy Formulation and Project Identification Mission to Swaziland." 1981.

The CDA agricultural research assessment represented by this study and the potential for CDA donors to support needed agricultural research should contribute to meeting the research needs of small farmers. Ensuring the success of these research-related efforts will require a strong commitment on the part of the MOAC in both research and extension.

An important first step to food security would be making more explicit those strategies set forth in the most recent five year development plan (1978-1982), particularly those related to: land use; encouragement of the small subsistence farmers to enter commercial agriculture; improved marketing; and self-reliance in food production. Once policies are agreed upon in both the traditional administration system and the civil service system, programmes can be strengthened. This will require additional commitments by Government. Initially, consideration should be given to:

- o Quantification of a food self-sufficiency strategy and incorporation of this into a National Food and Nutrition Plan; the Plan would provide the means for interrelating production with consumption, distribution and nutrition;
- o Adaptation of the traditional land tenure policy to a modern agriculture development policy, for example: by allowing access to larger areas for individual small farmers; by committing some areas of SNL to extensive maize production; and by adapting grazing practices to desired cultivation practices;
- o Strengthening of marketing policy and expanding the policy to include procurement and regulatory controls;
- o Adaptation on credit policy to give greater attention to small farmer needs and to ensure that farmers can qualify to receive credit; and
- o Establishment of an Emergency Reserve storage and stock policy as part of a national food policy.

With regard to the nature of agricultural research, the Mission concluded that "applied research should have priority over pure research and the programme should be developed based on application of modern research to meet small farmer needs. Research results after practical field testing should be incorporated into the extension system."¹

1

FAO, Report of the Food Security Policy Formulation and Project Identification Mission to Swaziland," 1981.

C. Agricultural Research

1. Introduction

The National Research Council (NRC) is responsible for suggesting research priorities in all areas, including that of agriculture, which is dealt with by its Sub-Committee for Agriculture. However, neither the Council nor its Sub-Committee has a permanent secretariat and, in accordance with the Council's enabling charter, their roles are only advisory. Few NRC meetings are held and most are poorly attended; often those attending are not in a position to orient or re-direct research priorities.

The direction and focus of most agricultural research in Swaziland have historically fallen under the aegis of what is now the ARD of the MOAC. In addition, agriculture-related research is being carried out on the two campuses of the University of Swaziland as well as by five private and/or parastatal companies. The latter generally carry out research directly related to the specific plantation crops grown and processed by them.

2. Historical background

Agricultural research began in Swaziland in 1959 with the establishment of the Agricultural Research Division of the Ministry of Agriculture. The National Agricultural Research Centre (NARC) was established at Malkerns in 1962 and consists of approximately 400 hectares of land, an administration building, various laboratories (for chemical analysis of soils and plants, entomology and plant pathology), greenhouses, and staff housing. Sub-stations were later established at Big Bend in the Lowveld, Nhlanguano and Luve in the Middleveld, and Mangcongco and Hebron in the Highveld. In 1972 responsibility for research was transferred to the University of Botswana, Lesotho and Swaziland, College of Agriculture. It remained there until 1978, when it was transferred back to the MOAC.

At the time of the transfer of research authority back to the Ministry, 14 areas of agricultural research were being pursued, as follow:

- o Crop Agronomy
- o Horticulture
- o Veld and Pasture Management
- o Dryland Crop Production
- o Soil Fertility and Crop Nutrition
- o Soil Chemistry
- o Soil Physics
- o Plant Pathology
- o Entomology
- o Cotton Breeding

- o Cotton Entomology
- o Biometry
- o Forestry
- o Pineapples

The ARD was criticized because the research in these areas was carried out by an all expatriate staff (mostly British whose salaries were supplemented by the British ODA) and was focused on the needs of the estates and larger title deed owners, rather than on those farming small plots on SNL. In addition, the research concentrated on monoculture while the Swazi small farmers practiced polyculture.

For a variety of reasons, transferring the ARD to the MOAC resulted in a serious lapse of research activities. In particular, there was an inordinate delay (almost two years) in the filling of research positions in the civil service system and the corresponding renewal of contracts by the GOS. As a result of this administrative difficulty, all but two of the expatriates on the research staff sought and obtained employment elsewhere. In late 1979, the GOS established and advertised for twelve professional positions, leaving forestry and pineapple research to be taken over by the industries concerned. Unfortunately, during the period that all research posts were filled by expatriates, no suitable candidates were found to serve as counterparts so as eventually to localize the posts.

At present, all but one of the Division's posts are filled by Swazis. The one expatriate still within the ARD is a cotton entomologist whose basic salary is financed by the Swaziland Cotton Board and supplemented by the British ODA. A counterpart now has been found for this post and it will soon be localized, thus ending the expatriate presence and supplementary budget assistance within the ARD.

In its most recent five-year plan (1978-82), the GOS states that it wants to "obtain self-sufficiency in basic staples and raise the level of crop and livestock production and consumption of rural families; and (thus) reverse the stream of rural migration into the urban areas ... which have been growing at an annual rate of approximately 10% whereas the rural areas are being depopulated."¹ Within this context, the GOS is giving appropriate research in agriculture and other disciplines related to rural well-being an enhanced priority.

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Prime Minister's Office, Third Five-Year Development Plan, 1978-1982 (Mbabane: GOS, 1983).

To counter the previous focus of agricultural research on the large farmer and on monoculture, and to add resources to the ARD which was practically moribund at the time (1978), assistance was sought and obtained by the GOS from the Food and Agricultural Organization of the United Nations (FAO). The FAO provided two social scientists to the ARD. They were to develop socio-economic information relevant to determining the nature and composition of the research needed to accomplish national goals. In particular, they were to focus their efforts on the GOS's goals aimed at meeting the needs and aspirations of the Swazi family within the RADP. This project was superseded in fiscal year 1982-83 by USAID's larger and more comprehensive Cropping Systems Research and Extension Training Project (CSRP).

3. The Agricultural Research Division (ARD)

a. Background

The ARD at present is an integral unit of the Department of Research and Planning of the MOAC. The Chief Research Officer, who is responsible for the operation of the Division and its personnel, reports to the Director of Research and Planning, who in turn reports to the Permanent Secretary. A clear-cut chain of command thus exists. The DAR is funded almost entirely by the GOS, including personnel salaries and wages and overhead costs. Some of the research costs for specific commodities are funded by the SCB, the Pineapple Association and the sugar and forestry industries. In addition, there are nine posted officers and one non-posted officer undergoing overseas training. Their fellowships are funded by USAID under the provisions of the CSRP.

The administrative officers for the ARD are located at Malkerns. Research is carried out there and at the Lowveld and Nhlanguano Stations. For a variety of reasons, those at Luve, Mangcongco and Hebron have either declined in importance or are no longer within the jurisdiction of the ARD.

Research activities are concentrated in the general areas of food crops, including vegetables, and cash crops, mostly for export. Some attention is given to seed production and multiplication. The ARD carries out no research in the areas of animal husbandry or veterinary science, although the Malkerns station does have a small dairy herd and carries out experiments to measure the feeding value of pasture under different conditions. Serious problems of erosion resulting from overstocking and overgrazing are not being addressed by the ARD. The only specific agricultural research program, other than commodity-specific research funded by private or parastatal organizations, is the USAID-sponsored CSRP.

b. The Cropping Systems Research and Extension Training Project (CSRP)

The objectives of the CSRP are clearly in accord with GOS policy in that it seeks to "increase the economic viability of farming on Swazi Nation Land."¹ The research emphases of the CSRP continue to be on food crops, including vegetables and some fruits, and some cash crops. Certain export crops (especially cotton) also receive attention. The hoped-for end result of such research is enhancement of agricultural production and the quality of rural well-being. The methodology followed by the project is basically that developed and employed by CIMMYT. It consists of various cropping combinations and techniques designed to reduce the constraints faced by small farmers on SNL. The experiments are carried out on the land of "volunteer" (or cooperating) farmers. The trials seek to discover the means to overcome obstacles to improved production, in ways that are relevant both to small farm household needs and goals and to their existing natural, human and financial resources bases. Solutions are being sought for example, which do not require long-term capital investment or enabling legislation. The CSRP not only provides demonstrations to both the farming community and extension workers but also serves as a useful source of in-service training for the GOS's research scientists and others.

The limited personnel presently available in the ARD can but maintain a holding-action on their long-term research activities until those in training overseas return to their posts and become involved in the on-going applied research. The first of the newly-trained personnel will be returning later in 1983, the rest over a three-year period. The addition of Swazi socio-economic research capability should provide valuable inputs to the CSRP's work on cooperating farms, especially those on SNL.

The total costs of the five-year CSRP, shared between the GOS, the U.S. Peace Corps and USAID, are US\$4.4 million, US\$55,000 and US\$12.9 million, respectively.

Expatriate personnel assigned to the five-year project consist of seven professionals and a Chief of Party, for a total of 40 person-years. Two of the seven, the information and extension officers, are posted in Mbabane at the Headquarters of the Ministry. The remaining five are on one or more of the research stations involved in cropping systems research. They include an agronomist, a horticulturalist, an agricultural economist, a rural sociologist and an irrigation specialist. The Chief

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Prime Minister's Office, Department of Economic Planning and Statistics Third Five-Year Development Plan,

Research Officer of the ARD is designated as the counterpart of the CSRP Team Leader. The others in the project have counterparts in the ARD, with the exception of the two project officers stationed in Mbabane, whose counterparts are in the DES.

Of the ten nationals to whom the project is providing training, seven are men and three are women. One of the women already has a Master's Degree in Plant Pathology, but is currently working for a Diploma in Laboratory Technology. The other two women are working for Master's Degrees in Biometry and Rural Sociology, respectively. Six men are working for Master's Degrees, each in one of the following areas: Pasture Agronomy, Horticulture Agronomy, Irrigation Agronomy, Soil Fertility Agronomy, Cotton Entomology and Cotton Breeding. The seventh man is working on a Bachelor's Degree in Soil Chemistry.

c. Human resources

The professional research staff presently working in the ARD have been greatly affected by the CSRP. With the departure of ten Swazis for overseas training, only the Chief and three other Research Officers remain. The Chief Research Officer has a Master's Degree in Agronomy; the cotton entomologist (an expatriate) also has a Master's Degree, the two others have Bachelor's Degrees in Agriculture. Finally, there are 26 technicians (nationals), of which ten are to be assigned to the CRSP; the remaining 16 will be assigned to carry out duties related to the on-going work of the stations.

Over the next ten years, plans are to increase the personnel of the ARD by three: one livestock production/animal husbandry researcher and two researchers in economics and/or the social sciences. All will be trained at the Master's level.

d. Budget and expenditures

Over the three-year period from 1980/81 to 1982/83, the ARD's average capital and recurrent budgets (and expenditures) amounted to US\$114,700 and US\$475,000, respectively. The USAID CSRP just became operational during the 1982/83 fiscal year. Its capital budget and expenditures were US\$1,368,000, and its recurrent budget and expenditures amounted to US\$22,500 during the 1982/83 fiscal year. Nearly one quarter of the total GOS recurrent expenditure for the CRSP is received by the Lowveld (Big Bend) Experiment Station; a slightly lesser amount goes to support the Nhlanguano Station.

e. Assets at the main and branch research stations

(1) Malkerns

(a) Land

The experimental/research farm at the Malkerns Research Station consists of about 320 hectares of deep reddish brown soils in an area of the Middleveld where annual rainfall approximates 1,200 mm. Sixty percent of the station's research farm is used for experimental plots, 15 percent for seed multiplication, and 25 percent for farm cropping systems research. Major types of projects include research on horticultural crops, cereals, grain legumes and cultivated pasture. There are 73 hectares of irrigated land at the the Malkerns Station, all used for horticultural experiments.

(b) Buildings

At the Malkerns Station there are three laboratories in fair condition, with a total floor space of about 400 square meters. They are used for general research, including soils study, plant material analysis, and entomological research. The Malkerns station also houses the administrative offices of the ARD. Three office blocks, with a combined floor space of some 800 square meters (including a library with 100 square meters), are in fair condition.

(c) Equipment

The most important equipment at Malkerns consists of two spectrophotometers, one centrifugal pump, nine tractors, one baler, one land-plane, two trucks, two pickups and one fertilizer applicator. The Division also has one hand-held Hewlett-Packard computer and three Apple II computers. All of the stations are well-serviced with all-weather roads and telephone and radio communication.

(d) Library and publications

The main library at Malkerns has approximately 5,000 volumes and acquires about 50 more each year. It receives 11 periodicals and scientific journals on a regular basis. The Division also has linkages with other libraries, such as those on the two campuses of the University of Swaziland and the libraries at the Universities of Botswana, Pretoria, and Melbourne (Australia). During the past five years, due largely to the transfer and start-up difficulties described earlier, the ARD has produced no significant publications.

(2) Lowveld

(a) Land

The experimental farm at the Lowveld Research Station consists of 400 hectares of duplex dark soils, of which seven hectares are irrigated. The station has an average annual rainfall of some 800 mm.

Nearly 70 percent of the farm area, including all of the irrigated land, is in experimental plots. Ten percent is used for seed multiplication and the remaining 20 percent is devoted to farming systems research. For some time the Lowveld Station has emphasized irrigated agronomy, cotton entomology and breeding, pest control, and dry-land farming research.

(b) Buildings and equipment

The Lowveld Station has two laboratories in fair condition, with a combined floor space of 200 square meters. One is used for research in cotton entomology and the other for cotton breeding. There is one block of administrative offices in good condition, one repair workshop (360 square meters) and one storage shed (400 square meters) in good condition. The station also has two pickup trucks and three tractors.

(3) Nhlangano

At the Nhlangano Research Station there is a farm with more than 90 hectares of unirrigated land. Soil and climatic conditions are similar to those at the Malkerns Station. Approximately 80 percent of the farm is used for experimental plots, with seed multiplication accounting for the remaining 20 percent. There is an administrative office in good condition and one storage shed, with a floor space of approximately 200 square meters, in poor condition.

f. Linkages and services

The ARD has had, and continues to enjoy, close working ties with CIMMYT's East African Economics Program and the International Institute of Tropical Agriculture (IITA) in Nigeria. Most of this networking is limited to letters and exchanges of documents. CIMMYT, however, has a resident economist in Swaziland.

Although the research stations do not have affiliated extension personnel, they do carry out active extension-related programs consisting of field days, demonstrations, farmer and extension training courses, and workshops.

g. Staff's assessment of problems

Fourteen professional and technical staff of the ARD were interviewed concerning the problems they felt most seriously affected the Division's work. An inadequate recurrent budget and poor maintenance of facilities were rated as the most serious problems by 79 percent of the professional and 73 percent of the junior technical staff. It was emphasized that not only was the recurrent budget usually too small, but due to delays in its release, work sometimes would actually come to a halt on experiments being implemented. It also was stressed that both offices and laboratories were old and decrepit, making maintenance difficult. Almost two-thirds (64 percent) of those queried felt that the condition of equipment, especially laboratory equipment, presented a grave problem. Serious delays in repair and replacement are common.

Training also was seen as a problem area deserving high priority. Over 70 percent of those interviewed felt that the junior technicians needed further training. Fifty-seven percent stated that senior technicians also lacked training, although it was felt that this need could be met by short-term workshops and courses. Half of those interviewed complained that the service and maintenance staff were either poorly trained or too few in number. Recommendations included in-service training courses and (again) larger recurrent budgets.

It was also noted that the absence of nearly 80 percent of the professional staff members who are training outside the country has placed a very heavy burden on those remaining to keep on-going projects from deteriorating.

4. The Luyengo Campus of the University of Swaziland

Members of the Faculty of Agriculture at the Luyengo Campus are carrying out a five-year research project to improve the productivity of Swaziland's subsistence farmer intercropping patterns. Five researchers, assisted by six technicians, are carrying out the project. All five researchers work only part-time on the project.

The project is jointly financed by the Canadian International Development Research Council (IDRC) and the University. The budgeted and capital expenditures for fiscal years 1979/80 -- 1981/82 averaged US\$20,000 per year. This was provided in equal shares by both the IDRC and the University, although the University's contribution was in kind only. The recurrent budget for the project over the same period averaged US\$26,000 and was provided by the IDRC. In accordance with the project document signed by both sponsors, however, the University was committed to contributing US\$54,000 toward recurrent costs of the project. The short fall caused by the University's lack of a recurrent cost contribution has made implementing the project's work-plan more difficult than anticipated.

The experiments sponsored by the project are carried out on approximately 2.4 hectares of land belonging to small "cooperative" farmers in the area. As both the Luyengo campus and the farms are in the Malkerns valley, climatic conditions and soil types are similar to those at the Malkerns Research Station. The technologies employed are readily available to the small farmer. In order to disseminate the findings, field day demonstrations are held in conjunction with those sponsored by the Malkerns Research Station.

In assessing the problems facing the project, the staff gave highest importance to the need for additional financial support to compensate for the above-noted short fall in recurrent cost contributions by the University. Other problems cited were that the junior technical staff working on the project were in severe need of further training to the Bachelor of Science level and that the service and maintenance staff also needed more training. Lastly, it was emphasized that sufficient equipment was unavailable and maintenance for that which was available was very unsatisfactory.

5. The Kwaluseni Campus of the University of Swaziland

A Rural Development Research Project (RDRP) was created in 1981 as part of the University's Social Science Research Unit. It is jointly sponsored by the University of Swaziland and the Free University (NUFFIC) in Amsterdam, The Netherlands. The project is in two phases, the first ending in 1983 and the second ending in 1985. Two researchers with Master's Degrees are carrying out the project, one of whom is also responsible for administrative duties. A research assistant with a Bachelor's Degree is also assigned to the project.

The objective of the project is to obtain and evaluate information relating to decision-making processes in Swazi rural homesteads, including constraints to the development process and options for reducing them. The findings and conclusions will be used mainly in training the staff and students of the Faculty of Social Sciences. Government agencies, especially the MOAC also will have access to project outputs in formulating their own programs in the rural areas.

Information concerning the University's financial contribution was unavailable, but it was entirely in kind. The project has a pick up truck at its disposal. Researchers also have access to the "documentation room" operated by the Social Science Research Unit. This contains about 2,500 publications and acquires an additional 500 publications annually, not including 15 scientific journals. Within recent years 10 publications have been issued by personnel working on the project. These deal with a great variety of socio-economic aspects of rural life in Swaziland.

6. Libby's (Swaziland Fruit Cannery)

Swaziland Fruit Cannery, a subsidiary of Nestles, adjoins the Malkerns Research Station. Its main concern is the processing and canning of pineapples, although citrus juices and fruit are also canned from time to time. It has a one-person unit carrying out research related to company objectives; i.e., improving yields and lowering unit costs. The research officer has a Master's Degree in Agronomy. He exchanges information with the Pineapple Research Institute in Hawaii, the Pineapple Research Station in East London (South Africa) and the Malkerns Research Station. Statistics relating to production on the company's farms, throughput of the factory, and Libby's budgetary allocations for research are considered classified information and were not made available for this report. The company provides demonstrations and field days for private pineapple growers in the country.

7. Usutu Pulp Company

The Usutu Pulp Company (UPC) is the largest of several timber-growing companies in the country. It has one soil scientist with a Bachelor's Degree carrying out research related to maintaining or improving forest productivity. Facilities at the Malkerns Research Station, including an office, are made available to the forest research officer, with the proviso that all of his findings be made available to the other timber-producing companies in the country. He is assisted by one technician.

The total recurrent budget for this unit, provided by the Usutu Pulp Company, amounts to US\$45,000.

8. The sugar estates

The Simunye Sugar Estate, also referred to as Swaziland's "third sugar mill", produces sugar for export, as do the country's two other sugar growing/refining complexes. The research carried out at all three estates is similar; therefore, the following consideration of Simunye's agricultural research serves here as a prototype for explaining the research carried out by all three sugar operations.

The research program is designed to maximize sugar yields and returns. All aspects of agronomic research related to sugar cane are addressed, including trials on fertilizer rates, pest and disease control, herbicides, ripeners, new varieties and irrigation.

The research unit at Simunye consists of three researchers and six technicians. One of the research officers and all six of the technicians are nationals; the remaining two research officers are expatriates. The two expatriate researchers have Bachelor's Degrees in Agronomy, while the national has a Diploma in Agriculture. The head of the research unit acknowledged that the company wishes to send two nationals overseas to earn

Bachelor's Degrees in Agronomy and to train one for a Diploma and two for Certificates locally or elsewhere in Africa.

The research unit meets regularly with the Swaziland Sugar Association (SSA) Extension Committee and the Swaziland Sugar Cane Agronomists Association (SSCAA), and interacts less frequently with the South Africa Sugar Association (SASA) Experiment Station and the South Africa Sugar Industry Agronomists Association (SASIAA).

The annual recurrent budget expenditures for the Simunye research unit for period 1980/1982 amounted to US\$220,000 and was supplied by the company.

9. The Swaziland Irrigation Scheme (SIS) -- Inyoni Yami

The SIS, funded by the CDC of London, is concerned with three programme areas: Iysis Sugar Estates, Tunzini Citrus Estate and Iysis Livestock. For all three, the major objective is to improve productivity and economic returns.

As in the case of the other estates growing sugar cane, trials associated with sugar cane at SIS include soil salinity, drainage, irrigation, fertilizer, ripeners and cultivation practices. Citrus experimental trials relate to soil types, the effects of irrigation and drainage, and pest and disease control. Livestock trials are being conducted relating to bush encroachment and control.

Personnel of the research unit include three researchers and four technicians. The research officers (all expatriates) have Master's Degrees in Agricultural Agronomy, Soil Agronomy and Entomology, respectively. A national is currently undergoing training for a Bachelor's Degree in Agriculture. The company plans to send three additional nationals to the University for Bachelor's Degrees in Agriculture and another three to a developed country to earn Master's Degrees in Soil Science, Entomology and Agronomy, respectively.

The average capital budget for the period 1980-1982 amounted to US\$5,000 and the recurrent budget for the same period amounted to US\$80,000.

The staff is assessment of "problems impeding the unit's ability to achieve its purposes" emphasized the absence of an adequate program for training nationals for both senior and junior technical posts.

D. Agricultural Training

1. The Luyengo Campus of the University of Swaziland

a. Background

Higher education and training in agriculture is the responsibility of the Faculty of Agriculture of the University of Swaziland at Luyengo.¹ The University was originally established in 1964 as the University of Botswana, Lesotho and Swaziland (UBLS) with headquarters in Lesotho. In 1975 Lesotho withdrew in order to establish its own university. In 1982 Botswana also withdrew, and the institution was renamed the University of Swaziland (UOS). Presently, there are five major fields of specialization offered by the UOS at three levels.

In an attempt to improve the extension officer/farmer ratio in accordance with the targets contained in the Third Five-Year Development Plan, 1978-82, the MOAC re-established the Certificate Training course in General Agriculture in 1977, making it a one-year programme. Dropped by the university in 1972, the certificate programme is now the primary source of new field officers. The Ministry leases facilities from the University and ensures that 40 students are enrolled each year. Financial support is provided by the European Economic Community (EEC).

b. Human resources

The faculty consists of 37 full-time senior teaching staff, of which ten are away on educational leave and 19 are expatriates (see Table 3-5). In addition, there are four teaching assistants and seventeen technicians. Of the ten teaching staff in training (consisting of seven men and three women), two men are working for Doctor's Degrees and two men and three women for Master's Degrees. Three men are also working for Bachelor's Degrees. Over the next ten years an additional four faculty members, at either the Master's or Ph.D. level, are expected to be recruited.

Over 98 percent of student funding comes from GOS loans which must be paid back once the student has finished his courses and begins working. The remaining funds come from grants and family sources.

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In addition to the Luyengo Campus there is also the Kwaluseni Campus, with concentrates in the humanities and social sciences.

Table 3-5: University of Swaziland Staff by Specialty Area, Qualifications, and Position, 1983

Specialty Area	Staff Qualifications (Highest Degree)					Staff Positions				Total Staff
	Doctorate	Master	Bachelor	Diploma	Other	Lecturers Filled	Teaching Ass't Vac.	Technician		
Animal Production & Health	3	2	1	4	1	6	-	1	4	11
Home Economics	-	4	-	2	-	4	(2)	-	2	8
Crop Production	4	2	-	4	1	6	(1)	-	5	12
Ag. Economics/ Extension & Education	1	7	1	1	-	8	-	1	1	10
Land Use & Mechanization										
Agriculture	-	-	2	-	-	-	(1)	2	-	3
Total Staff	9	17	4	16	2	27	(4)	4	17	52 (19)¹
Staff in Training	3	4	3	-	-	-	-	-	-	10

¹ Of the 52 total staff positions, 19 are filled by expatriates and 4 are vacant.

Source: Dean, Faculty of Agriculture, University of Swaziland, Luyengo.

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c. Budget and expenditures

Within the last three years of record (1980/81 - 1982/83) there was no capital budget appropriated to the Luyengo Campus, although the GOS did provide an average recurrent budget of US\$600,000. The Swedish International Development Agency (SIDA) provided an additional US\$700,000 to the FAO-executed Assistance to the Faculty of Agriculture Project which is to be completed in 1983. This assistance consisted of providing nine experts to serve as teaching staff, ten fellowships, and equipment. Also, the EEC provides US\$80,000 each year as support to the Diploma programme.

d. Main assets

The campus has seven classrooms in good to fair condition, with a total floor space of about 435 square metres. In addition, there are five teaching laboratories in excellent to good condition with a total floor space of 583 square meters. Major equipment items include one spectrophotometre, five tractors, and one power tiller. The campus library has 15,000 volumes and an acquisition rate of 300 volumes per year. It also receives annually publications of approximately 150 periodicals, scientific journals, and serials. The library possesses a microfilm reader. Students have free access to the stacks and, through an inter-library loan agreement, to other libraries in Swaziland and the RSA.

The University farm consists of 316 hectares, of which 110 are cultivated and the remaining 206 are in pasture. The farm is used for teaching and demonstration purposes as well as for some experiments in intercropping.

e. Linkages and services

With the exception of ad hoc contacts on a personal basis, there are no formal linkages with the ARD, even though the Malkerns Station is only three kilometres away. The University does extend its services to other segments of the community. These services include a five-month course in animal production offered to the staff of the prison farms, open field days for agricultural extension staff, and one-day in-service training courses for agricultural education teachers. Special courses are offered for approximately 15 "front-line" extension officers and 40 agricultural education teachers each year.

f. Employment opportunities for graduates

The majority of university graduates find employment either in the MOAC or the Ministry of Education (MOE). A few find employment with the Swaziland Development and Savings Bank (which has an agricultural credit section) and the private sector. Of late, however, there is evidence that employment opportunities in government services are becoming relatively

is well equipped and qualified to provide one or more courses specially geared to the needs of people in this vital area.

MAMC was established in 1972 by the CDC, a British statutory corporation. It is located at Mananga near Mhulme in the Lowveld and the heart of the sugar cane producing area. The institution does not grant a degree. It is best seen as a post-graduate center with nearly 50 percent of its students already possessing Bachelor's Degrees and the remainder having received Diplomas.

Titles of courses programmed for 1984 include the following:

- o The Management of Agricultural Research
- o Agricultural Management in Southern Africa (SADCC countries)
- o Planning and Control in Agricultural Management
- o Senior Management in Agricultural Development

The average course attendance ranges from 25-30; facilities exist on campus for student lodging, meals and recreation.

b. Human resources

The MAMC personnel complement consists of 88 nationals. Three are administrators, and the remaining 85 are teaching and support staff. There are seven expatriate personnel who each year provide 5.5 person-years of teaching each year and 1.5 person-years of administration.

Students come to MAMC mainly from the Commonwealth countries. Thus far some 29 countries have been represented. The majority of students are already in senior management positions in their own country, and they come from both the public and private sectors.

c. Budget and expenditures

The CDC provides all of MAMC's capital financing (US\$100,000 per annum) and approximately 40 percent of recurrent costs (totalling US\$900,000). Course fees cover the remaining 60 percent of recurrent costs.

d. Main material assets

The MAMC possesses two Apple II computers and video equipment facilities, including closed-circuit television. The library contains approximately 2,500 volumes. Its annual acquisitions range from 200 to 300 volumes and it subscribes to some 60 periodicals and scientific journals.

E. Extension Services

1. Background

Agricultural extension services in Swaziland are provided mainly by the MOAC. The minor exceptions are a few "in-house" extension agents associated with specific speciality crops typically grown on title deed (often estate) land: timber, sugar cane, citrus and pineapple.

Until recently, the extension services provided by the MOAC were fragmented, with elements of extension dispersed among several units of the Ministry in accordance with the specific services provided. For example, crop extension was dealt with by the DES within the Department of Agriculture, whereas livestock extension was dealt with by the Animal Husbandry Division. In addition, the extension officers dealing with poultry, fisheries, forestry and home economics came from their respective units of the Ministry. Linkages were informal and ad hoc at the working level; they became formal only at the level of the Permanent Secretary.

This system was recently changed. Now a unified and coordinated DES, under the technical supervision of a Senior Agricultural Officer (Extension), exists. This Division is a component of the Department of Agriculture, whose Director reports to the Permanent Secretary. At present there are almost no formal linkages between the DES and either the University or the ARD. However, the ARD and the DES are within the same Ministry (the MOAC) and, in cooperation with the University, the Ministry has established a one-year course for the training of 40 students per year to the Diploma level to serve as Field Officers. With the advent of the USAID-sponsored CSRP however, it can be anticipated that more formal working linkages will be established between the ARD and DES. The project has assigned specialists to both the DES and the ARD. Likewise, the program of work under the USAID project may well help foster closer linkages with the University.

2. Nature of activities

Although the Government is responsible for providing extension services to the entire agricultural community, within recent years all services have been concentrated on those farmers within the RDAs.

Specific extension services are provided relating to the cultural practices of growing fruits, vegetables, maize, legumes, fish, poultry, and livestock, including beef and dairy. Extension services also are made available to those farmers on SNL (including RDAs) growing export crops such as cotton and tobacco. Of late, increased emphasis has been given to cropping systems, undoubtedly due in large part to the presence of the CSRP. Lastly, services relating directly to the management of the rural household are provided by the Home Economics Extension Officers.

3. Human resources

There are 410 posts in the DES, 386 of which are currently filled. Of these, 30 are posted at Headquarters in Mbabane, 85 at the district level (eight were on leave at the time of reporting), and 263 (or 68 percent of the total) at the local level. More than 50 percent of those posted locally are front-line agronomists specializing in crops. Next in importance are livestock specialists with 11 percent of the total and home economists with nine percent, followed by those in forestry, fisheries and horticulture. More than 20 percent of all extension workers are women. For some time there has been a desire to staff the Extension Services with more generalists; presently, however, specialists continue to dominate.

Almost three-quarters (71 percent) of all extension agents are educated at the Certificate level, and 14 percent possess a Diploma. Twenty-eight men and four women have Bachelor's Degrees; two men and one woman have Master's Degrees.

The DES plans to train and employ an additional 210 agents over the next few years to lower the agent/farmer ratio, especially in the RDAs (in accordance with the third five-year plan). All will be trained in-country. Nearly three-quarters of the new agents will be trained to the Certificate level in the cooperative training program at the Luyengo Campus of the University. Slightly less than one-quarter of the 210 agents will be trained to the Bachelor's level, while ten will be trained to the Master's level. It is estimated that approximately 40 percent of these will be women.

Presently, the ratio of extension agents to farmers is one to four hundred (1/400) on SNL and one to two hundred (1/200) in the RDAs. It is the Government's goal to lower this to one to two hundred (1/200) on SNL and one to one hundred (1/100) in the RDAs.

4. Budget and expenditures

Over the three most recent years of record (1979/80-1981/82), the average capital budget allocation for the DES was US\$1.58 million, while expenditures were US\$1.254 million, 79 percent of allocations. Recurrent budget allocations for the same period were US\$1.714 million while expenditures were US\$1.829 million--an over-expenditure of more than six percent.

The National Government contributed 27 percent of the above capital budget and 65 percent of the recurrent budget. CDA donors (mainly the US and UK) contributed 16 percent of capital expenditures and five percent of recurrent expenditures. Other

donors, consisting of the African Development Bank, the World Bank, and the EEC, contributed 57 percent of capital expenditures and 30 percent of recurrent expenditures.

5. Main assets

The extension services are well-housed with modern offices at the MOAC's Headquarters in Mbabane and at the Crop Production Offices in Manzini, which is considered the headquarter's annex. Four district offices (located in the administrative districts of Hhohho, Manzini, Shiselweni and Lubombo and each headed by a Senior Extension Officer), five sub-district offices (Hlute, Hlatikulu, Piggs Peak, Mbabane and Mankayane), and 18 RDA project centres also have adequate offices. In addition, field officers' houses have been constructed in all areas where extension personnel are located.

At the RDAP project centres, there are adequate facilities such as tractor hire pools, farm sheds and offices. These facilities are used to train farmers in new practices, as well as to train extension workers. A Cooperative Development Centre (CODEC) has fine facilities for in-service training with modern training aids.

DES's vehicles include 20 trucks, 80 autos, and about 30 motorcycles. At any one time, about 30 percent of the vehicles are in the Central Transport Administration (CTA) shops for repairs. The majority of the vehicles are in the RDAs. In many of the non-RDA areas, on the other hand, there are numerous extension agents without transportation of any kind. They often must travel on foot or hitch rides with others to visit farmers in their areas. Thus, not only is the agent/farmer ratio nearly 50 percent lower on non-RDA SNL than on RDAs, but the effectiveness of the former is further reduced because of inadequate or non-existent transport.

6. Linkages and services

a. With and to farmers

The DES staff prepares a programme on general farming information directed toward SNL farmers which is broadcast over the local radio station four times a week. The staff also prepares the Rural Area Development News, published quarterly, which consists of approximately 20 pages of farming information and news items. Nothing other than the above is prepared or distributed by the DES.

Training workshops for local extension workers who work with farmers, with the exception of those offered by the Cooperative Training Centre, are sporadic and inconsistent, although an attempt is made to hold monthly sessions. Such meetings consist mainly of lectures, and the effectiveness of these is severely handicapped by the absence of teaching aids and other facilities.

b. With and to research institutions

According to the Senior Agricultural Officer in charge of Extension Services, personnel of the USAID sponsored CSRP, and others, historically there has been very little linkage between the ARD and DES--notwithstanding the fact that for the past five years they have both been in the same Ministry (MOAC). This lack of linkage is the result of several factors. Perhaps the most important is that, since its establishment in 1959, the output of the ARD has been geared more to the needs of the larger and more prosperous privately-owned farms and estates than to those of the smaller SNL farms.

It is the desire of the GOS, however, that these two interdependent agencies work together more closely in serving the needs of the SNL farmers in general and those within the RDAs in particular. Consequently, the ARD now is reorienting its priorities to make it more effective in meeting the needs of smaller farmers. The CSRP Project is of some assistance to the ARD in defining and altering its priorities to favor the traditional farmer. Personnel of the DES are becoming increasingly involved with the activities of the ARD and are beginning to serve as channels for "feed-back", relaying the needs felt by small farmers to those charged with carrying out research.

With assistance from CSRP project personnel who are assigned to both the ARD and DES, it is planned specifically to:

- o Involve research officers in in-service training sessions being planned for extension officers;
- o Conduct area extension workers' field-days at the on-farm (cropping systems) research sites;
- o Conduct combined national extension worker field days at Malkerns Research Station and the Agricultural College at Luyengo;
- o Conduct regional extension worker field days at the other Research Division stations;
- o Continue to involve all local extension workers in on-farm research trials being conducted in their areas; and
- o Involve the officers of the ARD in the teaching of the Certificate course for field officers being given at the Luyengo campus of the University of Swaziland (College of Agriculture).

7. Staff's assessment of problems

Sixteen staff members of the DES were interviewed for their assessment of the major problems affecting the institution's ability to efficiently carry out its responsibilities. Four-fifths (81 percent) of those interviewed stated that the inadequate recurrent budget of the DES presented a major obstacle. Examples of the impact of this problem ranged from the inability to recruit additional staff to shortages of transport and consumables due to insufficient funds.

Three-quarters of those interviewed stated that a shortage of support materials also presented a serious constraint to their effectiveness. The most common complaint was that there were not enough visual aids. The Director of Agriculture expressed this succinctly in his statement that the "lack of visual aids is most frustrating to those who have been trained in their use and know their usefulness."¹

Insufficient transport facilities and supplies were considered a major problem by 62 percent of those queried. A great number of vehicles assigned to the DES were not operational and repairs in Government-operated shops were time consuming. Even if the "down" vehicles were to be repaired in less time, however, there would still be too little transport to allow the extension agents to visit all the farmers in their areas. Within recent years, vehicles have been idled part-way through the fiscal year because the recurrent budget allocation for transport already had been expended, leaving no more money to purchase petrol.

An insufficient number of support staff was also viewed by 62 percent of the DES personnel interviewed as presenting a serious obstacle. The DES staff stressed that other units of the Ministry with responsibilities that complemented those of DES were also victimized by an inadequate recurrent budget and thus were unable to obtain sufficient personnel, equipment and supplies, transport, etc.

One last item stressed by a large number of those interviewed was in the "other" category. The structure of the civil service system and the promotions procedures were strongly criticized by the DES staff. As the Director of Agriculture put it, "promotion prospects as incentives for better performance are very narrow and administration bureaucracy precludes the use of any other form of incentive to promote efficiency."¹

¹

Director Victor Pungwayo, personal interview, 1983.

F. Constraints To Improving Rural Income and Productivity

1. Introduction

Formal questionnaires relating to constraints confronting the agricultural community were responded to by eighteen persons -- knowledgeable officials in the MOAC or others intimately acquainted with the problems of small farmers. Specifically, and by areas of crop interest, this included seven questionnaires regarding constraints to vegetable growing, four for maize, four for cotton, two for tobacco, and one from the private farmer. In addition, discussed matters relating to constraints were discussed with many others, both in and out of government, who deal with the issues involved on a day-to-day basis. Lastly, recourse was made to various governmental and other official as well as non-official documents.

The questionnaires asked specifically for ratings in seven main constraint areas, including rainfall and climate; soil; diseases, pests, and predators; varieties and species; farm power; economic factors; and rural traditions. The constraints were rated on a scale of 1 to 5, with 5 indicating the most serious constraint. In addition, responses were elicited on a variety of related subjects, such as potential for improvement, research needs, the relative importance of a series of given assumptions, and others.

2. Climate and rainfall

Almost everyone had something to say about the weather, especially with regard to the Middle and Lowveld areas. The 17 persons queried gave climate a combined average rating of 4.1. However, the rating was not uniform; those concerned with the Lowveld and Middleveld, which have less and more unevenly distributed rainfall than elsewhere, naturally gave a rating of higher importance to climate, rainfall, and its distribution than did those in the more moist Highveld.

3. Soil

Three questions were asked regarding soil resources; suitability, degradation, and topography. The averages of all responses were 3.1, 2.8, and 2.3 respectively, with only "suitability" considered overall as a somewhat serious matter. Given that Swaziland soils in general are very acidic, requiring heavy applications of lime, and that there has been a long period of degradation due to cultural practices associated with livestock over-grazing and cultural practices (e.g. burning), it is surprising that these issues were not of serious concern. This is true especially in light of the many who regard soil conservation and its reclamation who regard many as a priority item in the country. It is reported that Swaziland is the most densely stocked country in Africa, with an average density of one animal unit per 1.6 hectares in 1977. According to a recent FAO report, 1 grazing density on SNL grazing lands was one animal unit

per 1.37 hectares, whereas it was 4.57 hectares per animal unit on Individual Tenure Farms.

The consequences of overstocking and overgrazing are widespread. Important areas of the country have been eroded to such an extent that their carrying capacity has been reduced to very low levels. In some areas, the better grasses have given way to inferior ones with less nutritive value; in others the cattle have had to be removed altogether. Each year many tons of the country's topsoil are washed away.

To combat this trend and perhaps contribute to its reversal, the Ministry of Agriculture and Cooperatives, with assistance from USAID, has of late strengthened its Land Use Planning Section with the creation of a multi-disciplinary watershed planning team designed to identify and plan water and soil conservation measures -- whether in the form of land treatment or structural works of improvement. Unfortunately, for a variety of reasons, this in-country team has not yet been able to begin to cope with the main challenge that brought it into existence.

Even with the best of plans, however, until the GOS and the people are willing to deal directly with the cattle, grazing, and overstocking question, little can be accomplished. This is difficult, given the extremely important role of cattle in Swazi culture and tradition. Not only are cattle used as the lobola, or bride price, their influence is inescapable at the highest levels of government. When His Majesty, the late King, wished to speak to the National Council, he did so not in the nation's modern parliamentary building but rather in one of his cattle kraals.

4. Plant diseases, insects, pests and predators

Plant diseases, insects, pests, and predators were considered to be moderate constraints, with average ratings of 3.2 and 3.1, respectively. As might be expected, those persons involved in the growing of cotton, vegetables, and tobacco gave these areas higher ratings. There were several suggestions that further research be carried out in these areas. Notwithstanding the presence of a cotton entomologist presently posted at the Lowveld Experiment Station, where entomological research has been going on for the past several years, that crop continues to be plagued by insects and pests. Overall, a main shortcoming of research at present is that only three researchers are at work in the ARD while the remainder are elsewhere undergoing further training.

1

Food and Agricultural Organization of the United Nations, "The Agricultural Economy of Swaziland", Mbabane, 1980.

5. Varieties and species

Only one of those who completed a questionnaire considered varieties and species an important matter worthy of attention. This person was involved in growing vegetables. Other observers, however, have felt that one area where still more research is needed is the area of maize varieties. The use of hybrid maize seed has markedly increased, notably in the subsistence section in recent years. Two cultivars now predominate, the SR52 and NPPxK64r. Other varieties are available in the commercial market, but their characteristics are not widely known nor are they included in the extension programme. More consideration should be given to adopting open-pollinated "synthetics and "composites" having different lengths of maturity suited to local agro-ecological conditions. Introduction of open-pollinated germplasm from international institutes, coupled with trials and selection in different locations, could provide useful material.

6. Farm power

Farm power was broken into three categories: human, animal, and machinery. Matters relating to animal power did not appear to be of great importance (although reference was made to the fact that animal power was not as efficient as machinery). Issues relating to human power (labour) and machinery were considered important, however, with overall averages of 3.7 and 3.4, respectively. Comments concerning labour power ranged from a shortage of workers to excessive wages. However, a farmer who was interviewed stated that he had no difficulty in obtaining all the labour he needed because, as he put it, he was willing to pay the legal minimum wage. Most comments concerning machinery for farm work stated that there were not enough tractors and other machinery to do all that was required and that their services were not often available at the optimum time. However, as pointed out earlier, the RDA Tractor Pool Scheme is operating at a loss, largely due to poor management.

With regard to labour productivity and returns from off-farm employment, this does not have to be major constraint and, to the extent that it is one, it will likely diminish in importance with time. Declining South African employment opportunities, coupled with an expanding labour force in Swaziland, at rates progressively difficult to accommodate in the off-farm sector, will result in an expansion of the farm labor force. Furthermore, the opportunity cost for labour is not equal for all members of the household, and at the level of the household unit, incremental income accruing from surplus crop sales can be an important factor.

7. Economic factors

a. Pricing

Prices offered farmers were considered an important issue, with an overall rating of 4.3. The questionnaires associated with maize and tobacco growing gave averages of 5 and cotton was a close second at 4.3.

Swaziland is in a dilemma with regard to maize growing. On the one hand there is a national goal for the country to become self-sufficient in this, its basic food; on the other it wishes to keep the cost of living relatively low. Meanwhile, Swazi farmers find themselves in competition with those in South Africa producing maize on capital intensive farms that also benefit from a variety of indirect subsidies. The expatriate farmer interviewed who has in the past grown maize commercially, stated categorically that given the present pricing structure in the country, he could not grow the crop at a profit.

The Swazi farmer is price-responsive and, should input/output price relationships become seriously out of line, maize production will be lowered. This relationship is probably as important as relative prices between crops. There is need to adjust farm prices as costs increase, but because of the need to link Swazi maize prices to those in South Africa, there is also a limit to what can be done through the price mechanism. Because of this, the approach to optimizing small farmer income from maize should be more through increased productivity and larger area plantings than through price increases.

A 1977 study pointed out that perhaps the most efficient way to achieve self-sufficiency in maize production (the country was then producing 100,000 tons, or 83 percent of its total consumption of 120 thousand tons) would be through large-scale production on title deed farms.¹ However, this would run directly counter to GOS policy, which is to promote self-sufficiency by transforming subsistence farming into a viable market-oriented agriculture. The study further indicated that to switch from growing a crop such as cotton to growing maize would require either a price increase of approximately 50 percent for maize or else it would have to be grown by a statutory, Government-controlled body. Whatever the alternative, the basic question would be: who should bear the financial burden involved? Should the farmers be subsidized so that maize and maize products would continue to command low prices, or should the markets be subsidized so that the consumer prices for maize and maize products remain low? If subsidies were offered to protect consumer prices, would they also apply to animal feed manufacturers which are important users of maize?

1

Economic Planning and Analysis Section, "A study on the Alternatives Available for and Estimated Costs of Achieving Maize Self-Sufficiency," 1977.

Finally, there are some opportunity costs of maize self-sufficiency: (a) foregone production of crops that would be replaced in the process (estimated at around US\$0.6 million in 1977 prices) and (b) foregone South African Customs Union revenue amounting to approximately 20 percent of the value of maize imports from South Africa (approximately US\$0.5 million). Updated, these costs would total well over US\$1.5 million in 1983. Nevertheless, and in spite of good intentions and exhortations, the proportion of total imports of maize to Swaziland's total consumption is increasing with each passing year.

b. Marketing

Closely related to the above, marketing was another topic that earned a high score on the questionnaires, with an overall rating of 4. It received a 4.1 rating with respect to vegetables and a 5 with regard to maize marketing. As has been pointed out elsewhere, with the exception of certain guaranteed and institutionalized crops (such as cotton and tobacco, both of which received favorable ratings), the marketing system in Swaziland is poorly organized and deficient.

The marketing of maize provides an example. One firm (Swaziland Milling Company) will pick up and market maize in quantities of no less than 30 bags of 70 kilograms each. Few farmers on SNL have net surpluses of that quantity to market and, unless two or more producers are able to pool their "excess," they are in effect deprived of a market outlet. What markets do exist are generally poorly organized and often (due to transport bottlenecks) contribute to gluts and low prices. Because of the uncertainty of Swazi smallholder production, traders have often preferred to secure their supplies from South Africa, where produce of the required quantity and quality have been easily available, while Swazi production remains unsold.

A further characteristic of Swazi small holder vegetable production that has inhibited marketing is that produce is not washed, graded and packed ready for sale. Indeed, traders wanting produce often harvest the produce themselves or with their own labor. In part, this is because Swazi farmers were not certain of when they would make a sale and therefore hesitated to harvest until the itinerant traders would appear.

According to some authorities, the inadequate marketing system in Swaziland has been the single most important obstacle to development among the smaller and less endowed farmer community. Nevertheless, vegetable production within the country has shown significant improvement due to the ban on imports from South Africa. However, it is open to speculation, given the possible removal of the ban on the importation of vegetables, whether or not the situation would revert to the status quo ante. Unfortunately during the ban to date, an efficient and viable marketing infrastructure has not been developed. An inadequate marketing structure is an impediment to achieving increased crop

production on SNL, and it often frustrates extension staff in advising farmers to increase production. Under the RDAP, investment in facilities such as marketing depots and farmer's sheds has been made. The absence, however, of a crop marketing or procurement system to utilize these facilities to service small farmers means that their access to market outlets for any crop surplus is still restricted. There is an IFAD project pending to finance a US\$6 million Marketing Board which, if approved and accepted by the GOS, would contribute considerably to alleviating the country's marketing problems.

c. Credit

The items that came out with the highest scores were short-term and long-term credit, both receiving an over-all rating of 4.6. At present, farmers on SNL can only obtain short-term credit by mortgaging their cattle (from US\$80 to US\$100 per animal, depending on its condition). In the event farmers do not own cattle, or they have already been mortgaged, their only recourse is to have a friend or a relative lend cattle to them as security. Yet, in spite of the importance of cattle to the overall culture of the country, only a small number of those living on SNL own cattle. Thus, the amount of short-term credit that can be granted under existing conditions is limited.

Even those on SNL who are included in the RDAs do not have title to their land for mortgage purposes. Thus, there is no long-term credit available to them. Nor is there any guarantee that they will be allowed to reap the benefits of any long-term investment of labour and money. Consequently, very few SNL farmers are able, or willing, to lime their soils, provide for drainage, plant fruit trees, or carry out any other activities of a long-term nature.

8. Rural traditions

The three components of rural tradition -- tenure, farm labor and education -- were given overall ratings 3.3, 3.4 and 2.3, respectively. Those Swazis who have had little or no exposure to other countries gave land tenure a comparatively low rating while those who had studied or lived abroad gave it a higher rating.

9. Other constraint areas

The system of using general extension workers at the farm level supported by specialized maize officers is appropriate to Swaziland conditions. However, considerable improvement is needed in the information base upon which the extension officer operates. Also, the service must be extended to include geographic coverage, as many farmers have yet to receive any advice.

For maize, in particular, there is ample scope for improvement in extension. For example, with erratic rainfall,

considerable variation in temperature and different cropping patterns, the time of soil preparation and planting, seeding methods, plant population densities, weeding and other practices can be critical to tasselling, disease control, maturity and yields. Improvement in these cultural practices will require not only an expanded research programme, but a more effective extension programme as well. One unpublished survey undertaken in 1979 determined that in the surveyed area, less than five percent of the women farming may have had contact with an extension officer. This is an extreme case but provides one indication of the scope for improvement.

Another constraint to enhancing agricultural production has been the absence of a meaningful dialogue between the staffs of the Research and Extension Services Divisions. Traditionally little or no feedback from the farmer to the ARD was provided by extension agents. Neither did the agents bring, and explain to the farmers, relevant research findings. This was due to several factors, of which two stand-out: (a) much of the research carried out at the time was irrelevant to the needs of the small farmers and (b) the researchers themselves were Europeans whereas the extension agents were Swazis. Unfortunately, these two groups were very different culturally, socially, and economically. However, with external assistance in the form of the CSR, an adequate number of Swazis are undergoing further training. This will localize much of the research staff, while also blending the culture, social values and traditions of Swaziland with those of the countries in which the returning ARD staff have studied.

ANNEX 4

Tabular Presentation of Staff's Perceptions of Constraints

ANNEX 4:

Tabular Presentation of Staff's Perception of Constraints

During the course of the AARA Pilot Study for Botswana, Malawi, and Swaziland, surveys were carried out relating to constraints confronting agricultural producers and to problems facing the agricultural research, training, and extension institutions. In all, 116 staff members at all levels in the three kinds of institutions were asked to rate the seriousness of constraints to the improved performance of their institutions in such areas as qualifications of staff, recurrent budget facilities, agency linkages, and many others as shown in the following tables. Staff members were also asked to rate constraints to improved agricultural productivity in a number of constraint areas, as follow:

- o rainfall and climate
- o soil
- o diseases, pests, and predators
- o farm power
- o economic factors, and
- o rural traditions

The institutional constraints were rated on a scale of one to three and the productivity constraints on a scale of one to five. The results of a preliminary and rather cursory analysis are presented in the following tables. As the AARA process is extended to the complete SADCC community; and as further refinements in the data base are made possible, a more precise analysis will be forthcoming.

Table 4-1: Staff's Assessment of Constraints to Improving Small Farmer Productivity, By Agricultural Product

<u>Constraint Area</u>	<u>Maize</u>	<u>Rice</u>	<u>Sorghum</u>	<u>Pulses</u>	<u>Vegetables</u>	<u>Cassava</u>	<u>Ground-nuts</u>	<u>Cash Crops</u>	<u>Live-stock</u>	<u>All Agric. Products</u>	<u>(N)</u>	<u>Sum of Responses</u>
Climate	2.7	2.7	2.8	2.1	3.0	1.7	1.6	2.5	2.3	2.5	117	288
Annual Rainfall	2.4	1.9	3.5	1.4	3.2	1.6	1.7	2.7	2.4	2.5	113	282
Rainfall Distribution	3.5	2.7	4.6	2.6	3.1	1.9	2.5	3.3	2.8	3.2	115	369
Soil Suitability	2.4	2.3	2.6	1.4	2.1	1.6	1.8	1.8	1.8	2.1	114	235
Soil Degradation	2.8	2.4	3.7	1.4	2.1	2.4	1.9	2.2	1.7	2.3	113	257
Soil Topography	2.2	2.4	1.7	1.4	2.0	2.3	1.6	1.8	1.3	1.8	113	203
Diseases	2.1	2.3	2.2	2.2	3.3	3.1	2.5	2.6	2.4	2.5	117	289
Pests/Insects	2.3	2.7	3.6	2.2	3.0	2.7	2.1	3.2	2.3	2.8	117	322
Predators	2.1	2.3	2.3	1.1	1.9	2.0	1.5	1.6	1.9	1.9	116	220
Human Power	2.9	2.6	3.3	1.6	3.3	1.4	2.0	2.7	1.8	2.5	116	293
Animal Power	2.5	2.1	3.7	1.3	1.7	1.3	2.4	2.4	1.2	2.2	113	249
Mechanical Power	3.5	1.0	2.9	-	2.3	5.0	3.0	3.6	2.0	3.1	35	108
Prices	3.1	3.7	3.2	3.0	3.2	2.8	3.1	3.6	2.4	3.1	108	333
Marketing	2.4	1.7	3.0	1.6	3.6	2.7	1.9	2.2	2.8	2.5	109	276
Short-Term Credit	2.8	2.0	3.6	1.4	4.1	1.7	2.0	3.2	2.3	2.8	104	287
Long-Term Credit	2.5	2.0	3.1	2.1	4.2	1.7	2.5	3.3	2.5	2.8	99	276
Government Subsidy	1.4	1.7	3.6	1.0	4.0	1.5	1.0	2.3	1.7	2.4	72	170
Import Policies	1.6	1.0	2.3	1.0	1.8	1.0	1.4	1.1	1.8	1.6	77	125
Rural Traditions:												
-Land Tenure	2.1	1.2	2.0	1.0	2.0	1.0	1.0	1.9	2.2	1.8	106	190
-Farm Labor	2.3	1.6	3.4	1.5	3.6	1.0	1.8	1.9	2.1	2.4	89	210
-Education	2.2	1.8	3.6	1.2	3.1	1.6	1.8	1.8	2.8	2.5	97	239
All Constraint Areas	2.5	2.0	3.0	1.3	2.9	1.9	2.0	2.5	2.1	2.4	2160	5221
Sum of Answers	806	273	1201	234	482	237	295	873	820	5221		
Number of Responses	326	124	395	139	166	123	150	355	383	2161		

(Code: 1 to 5; 1 = Insignificant; 5 = Very Significant)

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Table 4-2: Staff's Assessment of Constraints to Improving Small Farmer Productivity, By Country

Constraint Area	Country			All Three	Number of Respondents			All Three
	Botswana	Malawi	Swaziland		Botswana	Malawi	Swaziland	
Climate	2.7	2.1	3.8	2.5				
Annual Rainfall	3.7	1.8	3.9	2.5	24	75	17	116
Rainfall Distribution	4.8	2.6	3.8	3.2	24	71	17	112
					24	74	16	114
Soil Suitability	2.7	1.7	2.8	2.1				
Soil Degradation	3.1	1.9	2.6	2.3	23	73	17	113
Soil Topography	1.6	1.8	2.4	1.8	24	71	17	112
					23	72	17	112
Diseases	2.5	2.2	3.4	2.5				
Pests/Insects	3.7	2.5	3.1	2.8	24	75	17	116
Predators	2.2	1.7	2.2	1.9	23	75	17	115
					24	75	16	115
Human Power	3.5	2.0	3.9	2.6				
Animal Power	3.4	1.9	2.6	2.3	22	75	17	114
Mechanical Power	2.9	3.5	3.0	3.1	21	71	17	109
					17	11	9	37
Prices	2.9	2.9	4.3	3.1				
Marketing	3.2	2.0	3.8	2.5	24	66	17	107
Short-Term Credit	3.5	1.9	4.7	2.7	24	68	17	109
					24	64	17	105
Long-Term Credit	3.2	2.1	4.6	2.8				
Government Subsidy	3.2	1.2	3.2	2.4	24	58	17	99
Import Policies	2.4	1.1	2.0	1.6	24	31	17	72
					24	43	10	77
Rural Traditions:								
-Land Tenure	2.6	1.1	3.2	1.8				
-Farm Labor	3.4	1.7	3.3	2.5	24	65	17	106
-Education	3.7	1.9	2.7	2.5	24	42	17	83
					24	56	17	97
All Areas	3.0	2.0	3.5	2.4	512	1380	353	2245
Sum of Answers	1561	2755	1234	5483				
Number of Responses	512	1380	353	2245				

(Code 1 to 5; 1 = Insignificant; 5 = Very Significant)

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Table 4-3: Staff's Assessment of Problems
Related to Research by
Country

<u>Area</u>	<u>Botswana</u>		<u>Malawi</u>		<u>Swaziland</u>		<u>All Three</u>	<u>(N)</u>
Recurrent Budget	(14)	1.9	(12)	2.3	(13)	2.6	2.3	39
Foreign Exchange	(13)	1.0	(12)	1.4	(11)	1.7	1.4	36
Senior Technicians	(13)	2.8	(12)	1.9	(11)	2.4	2.5	36
Junior Technicians	(14)	2.1	(12)	1.6	(14)	2.6	2.1	40
Service Maintenance	(15)	2.3	(12)	1.7	(13)	2.4	2.1	40
Support Consistency	(15)	1.7	(12)	1.2	(12)	2.4	1.8	39
Laboratory Facilities	(15)	1.6	(12)	1.8	(14)	2.4	1.9	41
Office Facilities	(15)	1.6	(12)	1.4	(12)	2.1	1.7	39
Equipment	(15)	2.0	(12)	2.2	(13)	2.6	2.2	40
Maintenance	(13)	2.3	(12)	1.6	(14)	2.4	2.3	39
Transportation	(9)	2.4	--	--	(6)	3.0	2.7	15
Telecommunications	(3)	3.0	--	--	--	--	3.0	3
Service Conditions	(9)	3.0	--	--	--	--	3.0	9
Agency Linkages	(9)	3.0	--	--	--	--	3.0	9
TOTAL	(172)	2.2	(120)	2.9	(133)	2.4	2.1	429

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

Table 4-4: Staff's Assessment of Problems Related to Training According to Country Staff

<u>Problem Area</u>	<u>Botswana</u>	<u>Malawi</u>	<u>Swazilan</u>	<u>Total</u>	<u>(N)</u>
Recurrent Budget	2.2	2.6	2.2	2.2	(46)
Qualifications of Senior Teachers	1.9	2.0	2.3	2.2	(47)
Qualifications of Junior Teachers	2.5	2.7	2.0	2.2	(47)
Qualifications of Staff Support	1.7	1.7	2.5	2.1	(46)
Laboratory Facilities	1.6	2.1	2.1	2.0	(49)
Equipment Facilities	1.6	2.1	2.4	2.2	(47)
Transportation	2.2	-	3.0	2.3	(13)
Teaching Material	2.4	3.0	2.8	2.5	(22)
Video Films	2.2	-	3.0	2.3	(16)
Bulletins	1.8	-	-	1.8	(13)
Service Conditions	2.8	-	2.0	2.7	(15)
Agency Linkages	2.8	-	-	2.8	(11)
All Areas	2.1	2.2	2.3	2.2	
<u>Sum of All Answers</u>	<u>325</u>	<u>88</u>	<u>412</u>	<u>825</u>	
<u>Number of Answers</u>	<u>152</u>	<u>40</u>	<u>180</u>	<u>372</u>	

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

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Table 4-5: Staff's Assessment of Problems Related to Extension Services, By Country

<u>Problem Area</u>	<u>Botswana</u>	<u>Malawi</u>	<u>Swaziland</u>	<u>All Three</u>	<u>(N)</u>
Recurrent Budget	2.3	2.8	2.9	2.5	(44)
Qualifications of Senior Technicians	2.7	2.2	2.4	2.6	(45)
Qualifications of Junior Technicians	2.4	1.8	2.3	2.3	(45)
Qualifications of Support Staff	2.3	2.0	2.7	2.4	(42)
Access to Research	1.9	1.4	2.2	2.0	(45)
Farmers' Attitudes	1.6	1.4	2.2	1.8	(45)
Lack of Timeliness	2.8	2.4	2.3	2.6	(45)
Lack of Research Input	2.7	2.4	2.3	2.5	(45)
Policy Problems	2.3	1.6	2.5	2.3	(44)
Transportation	3.0	-	2.5	2.8	(40)
Telecommunications	2.8	-	1.8	2.4	(37)
Service Conditions	2.9	-	-	2.9	(25)
Agency Linkages	2.8	-	-	2.8	(20)
All Areas	2.5	2.0	2.4	2.4	-
<hr/>					
Sum of Answers	782	90	390	1262	
Number of Answers	314	45	165	524	

(Code: 1 = No Problem, 2 = Minor Problem, 3 = Serious Problem)

Table 4-6: Staff's Assessment of Problems
Related to Research According
to the Level of
Respondents

<u>Area</u>	<u>Director</u>	<u>Senior Technician</u>	<u>Junior Technician</u>	<u>Senior Admin.</u>	<u>All Staff</u>	<u>(N)</u>
Recurrent budget	1.7	1.6	1.5	2.7	1.8	39
Foreign Exchange	1.5	2.8	1.9	1.3	1.5	
Senior Technician	2.0	2.0	1.9	1.7	2.0	
Junior Technician	2.0	1.6	1.6	1.7	1.7	
Service Maintenance	2.0	2.0	1.7	1.3	1.9	
Support Consistency	1.3	1.4	1.5	1.3	1.4	
Laboratory Facilities	1.8	1.7	1.5	1.3	1.7	
Office Facilities	2.0	1.5	1.8	1.3	1.6	
Equipment	2.2	1.8	1.5	2.3	1.8	
Maintenance	1.7	1.8	1.8	1.3	1.7	
Transportation	--	2.5	1.5	--	2.4	
Telecommunications	--	3.0	1.5	--	3.0	
Service Conditions	--	3.0	2.3	--	3.0	
Agency Linkages	--	3.0	3.0	--	3.0	13
TOTAL	1.8	1.8	1.6	1.6	1.8	
Sum of Answers	109	384	168	49	735	
Number of Answers	60	216	104	30	419	

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

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Table 4-7: Staff's Assessment of Problems Related to Training According to the Level of the Respondents

<u>Problem Area</u>	<u>Director</u>	<u>Senior Teachers</u>	<u>Junior Teachers</u>	<u>Senior Administrators</u>	<u>Technicians</u>	<u>All (N)</u>
Recurrent Budget	2.3	2.3	2.1	3.0	1.8	2.2 (46)
Qualifications of Senior Teachers	1.7	2.0	2.3	2.5	2.7	2.2 (47)
Qualifications of Junior Teachers	2.0	2.3	2.0	2.5	2.2	2.2 (47)
Qualifications of Staff Support	1.7	2.2	2.2	2.0	1.9	2.1 (46)
Laboratory Facilities	2.0	2.1	2.1	1.5	1.6	2.0 (49)
Equipment	2.0	2.1	2.2	2.5	2.3	2.2 (47)
Transportation	-	2.2	2.3	3.0	-	2.3 (13)
Teaching Material	-	2.5	2.6	3.0	3.0	2.5 (22)
Video Films	-	2.2	2.3	3.0	-	2.3 (16)
Bulletins	-	1.8	2.5	3.0	-	1.8 (13)
Service Conditions	-	2.6	3.0	3.0	-	2.7 (15)
Agency Linkages	-	2.8	2.0	3.0	-	2.8 (11)
All Areas	1.9	2.2	2.2	2.6	2.1	2.2
Sum of all Answers	35	465	196	46	83	825
Number of Answers	18	208	89	18	40	373

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

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Table 4-8: Staff's Assessment of Problems Related to Extension Services, According to the Level of Respondents

<u>Problem Area</u>	<u>Directors</u>	<u>Senior Technicians</u>	<u>Junior Technicians</u>	<u>Senior Admin.</u>	<u>All Staff</u>	<u>(N)</u>
Recurrent Budget	2.3	1.8	2.3	1.9	2.0	(44)
Qualifications of Senior Technicians	2.3	2.4	2.2	2.0	2.3	(46)
Qualifications of Junior Technicians	1.8	2.2	2.2	2.1	2.1	(41)
Qualifications of Support Staff	2.0	2.0	2.0	1.8	2.0	(42)
Access to Research	1.8	1.7	2.2	1.8	1.8	(46)
Farmers' Attitudes	1.7	1.7	1.2	1.7	1.7	(45)
Lack of Timeliness	2.3	2.4	2.5	2.3	2.4	(45)
Lack of Research Input	1.7	2.5	2.6	2.2	2.3	(45)
Policy Problems	1.3	2.1	1.6	1.9	1.9	(45)
Transportation	1.7	2.6	2.7	2.2	2.4	(40)
Telecommunications	1.7	2.7	2.8	2.0	2.5	(38)
Service Conditions	3.0	3.0	3.0	3.0	3.0	(24)
Agency Linkages	-	2.7	3.0	3.0	2.8	(20)
All Areas	1.9	2.6	2.3	2.0	2.2	-
Sum of Answers	117	637	156	232	1142	
Number of Answers	61	282	68	114	525	

(Code: 1 = No problem; 2 = Minor problem; 3 = Serious problem)

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ANNEX 5

Objectives, Constraints and Staff Compositions of the
Research Programmes of the Pilot Countries

SWAZILAND'S SUGGESTIONS FOR MODIFICATION
OF DRAFT DOCUMENT

NOTE: UNDERLINING MEANS A NEW OR CORRECTED WORD

- p.64 A.1. The first paragraph should be deleted and replaced with: "ARD's three research stations and its experimental farms, its offices, laboratories and equipment effectively support the day-to-day administrative work necessary to carry out research. The environments in which they are located are representative of the country's ecological zones."
- p.69 d. The University of Swaziland's Faculty of Agriculture is located within a few kilometers of the central Agricultural Research Station.
- p. d. Last sentence second paragraph: "...does not indicate an immediate need for..."
- p.69.B.1.a. Middle of 2nd paragraph: "...the Lubombo escarpment..."
- p.73. Top of page. Average annual growth rate is 3.4% caption should read, "if this rate of growth remains unchanged, the population will double in less than 21 years." Incidentally, who changed this in the first place. My figures came from the Prime Minister's Office; the Swaziland Mission even insisted we use 4.2%.
- p.81.b. Second paragraph. After second sentence insert: "Research has continued on crops agronomy which has served as a support service to the country's seed multiplication project."
- p.83, Table 12. Last two columns top line. The 10 under "vacant posts" should be removed and replaced by --, and then under "professionals in training" remove the N.A. and replace with the "10".
- p.3-30.3.a. Second paragraph. Delete second (or last sentence starting in "For a variety of reasons...", replace it with "Experiments are also carried out on sites located at Luve, Mangcongco and Hebron."
- p.3-30. Bottom of page to be inserted immediately before last sentence. "In spite of staffing and other difficulties, the ARD has been able to maintain a consistent and satisfactory level of crops agronomy research, which served mainly as a support service to the country's seed multiplication project

The last sentence should be modified as
"The only other specific..."