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AGRICULTURAL RESEARCH RESOURCE ASSESSMENT  
IN THE SADCC COUNTRIES

VOLUME I

REGIONAL ANALYSIS AND STRATEGY

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PREFACE

AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

IN THE SADCC COUNTRIES

This document has been prepared by DEVRES, Inc. in cooperation with the Consultative Technical Committee for Agricultural Research (CTCAR) of the Southern African Development Coordination Conference (SADCC) in accordance with the terms of a contract with US Agency for International Development.

The Regional Analysis and Strategy has been prepared by DEVRES based on a careful analysis of the national reports from eight SADCC countries.<sup>1</sup>

The national agricultural research resource assessments which provide the necessary background information for this document were conducted by national agricultural research scientists from SADCC countries under the guidance of DEVRES in consultation with the CTCAR. Financial support was provided by the US Agency for International Development (under Contract No. AFR-0435-C-00-2084-00 and Project No. 698-0435 entitled Strengthening African Agricultural Research) on behalf of the member countries of the Cooperation for Development in Africa (CDA).

Discussions concerning this regional report, and regional programmes which would help strengthen national research, extension and training programmes were held with the country report authors, responsible officials in the ministries of agriculture, rural development and plan, as well as specialists from international organisations, bilateral donors, and universities. On two occasions, drafts of this final report were examined by SADCC's Consultative Technical Committee for Agricultural Research (CTCAR). Suggestions by its members were incorporated into the report.

It has been agreed that the Strategy and suggested programmes will serve as a useful framework for consideration by CTCAR and its executive arm, the Southern African Centre for Cooperation in Agricultural Research (SACCAR). Study of the report and the suggested programmes over the coming months by CTCAR members and SACCAR will allow for specific decisions to be made as to the programme priorities, selection and timing of individual activities.

It is within this context that the CTCAR unanimously approved this Regional Analysis and Strategy at its 11th meeting in Gaborone, Botswana on April 18, 1985.

The results of the assessment are contained in the following reports:

Volume I - Regional Analysis, Strategy, Programmes and Summaries of Country Reports

Volume II - Country Reports:<sup>2</sup>

Botswana  
Lesotho  
Malawi  
Mozambique<sup>3</sup>  
Swaziland  
Tanzania<sup>3</sup>  
Zambia  
Zimbabwe

These reports are available in English and in microfiche or printed form at a cost determined by document size at the address below. The Regional Analysis and Strategy and the Mozambique country report are also available in Portuguese in the same forms.

US Agency for International Development  
Document and Information Handling Facility  
7222 47th Street  
Suite 100  
Chevy Chase, MD 20815  
Telephone: 301/951-7191 ext. 26

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<sup>1</sup>SADCC member countries are Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe. Angola, however, did not participate in this study.

<sup>2</sup>Each country is printed separately.

<sup>3</sup>Italy provided technical advisors for the preparation of the Tanzania country report and France provided an advisor to help in the preparation of the Mozambique country report.

DEVRES also expresses its gratitude to the governments of the SADC countries, for their encouragement and assistance in this endeavour. We also thank the staff of AID/Washington and USAID field missions, especially the Agricultural Development Officers, for their interest and assistance throughout the many stages of the ARRA.

Many support staff, both in the African capitals and in Washington, D.C., spent many long hours arranging travel and interviews, assembling data, and typing reports. DEVRES thanks each one for their important contribution.

Special tribute also is given to the DEVRES permanent staff, all of whom worked intensively and for many hours with great diligence, skill and good humor to prepare, edit, assemble and reproduce this report.

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## LIST OF ACRONYMS AND ABBREVIATIONS

### Southern African and International

ADB	African Development Bank
AID	United States Agency for International Development
ARRA	Agricultural Research Resource Assessment
BSc	Bachelor of Science
BVS	Bachelor of Veterinary Science
CDA	Cooperation for Development in Africa
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Centre for Tropical Research
CIDA	Canadian International Development Agency
CIMMYT	International Centre for Maize and Wheat Improvement
CIP	International Potato Centre
CIRDAFRICA	Centre on Integrated Rural Development for Africa
CRSP	Collaborative Research Support Program
CTC	Consultative Technical Committee
CTCAR	Consultative Technical Committee for Agricultural Research (SADCC)
DANIDA	Danish International Development Agency
DBMIS	Data Base Management Information System
EEC	European Economic Community
FAAT	Arab Technical Assistance Fund
FAO	Food and Agriculture Organization of the United Nations
FINNIDA	Finnish International Development Agency
FRG	Federal Republic of Germany
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GLIP	Grain Legume Improvement Project
GNP	Gross National Product
GTZ	Agency for Technical Cooperation (Germany)
GVS	German Voluntary Service
IAEA	International Atomic Energy Agency
IARC	International Agricultural Research Centre
IBRD	International Bank for Reconstruction and Development
ICARDA	International Centre for Agricultural Research in Dry Areas
ICIPE	International Centre for Insect Physiology and Ecology
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Council (Canadian

IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Centre for Africa
ILRAD	International Laboratory for Research on Animal Diseases
INSAH	Institut du Sahel
INTSORMIL	Sorghum/Millet International Research Project
INTSOY	International Soybean Programme
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
M'A	Ministry of Agriculture
MSc	Master of Science
MUCIA	Midwest Universities Consuortium for International Activities
MULPOC	Multi-National Programming and Operational Centre for Eastern and Southern African States
NORAD	Norwegian Agency for International Development
OAU/SRTC	Organisation of African Unity/Science and Technology Research Committee
ODA	Overseas Development Administration (United Kingdom)
PhD	Doctor of Philosophy
RSA	Republic of South Africa
SACCAR	Southern African Centre for Cooperation in Agricultural Research
SADCC	Southern African Development Coordination Conference
SAREC	Swedish Agency for Research Cooperation with Developing Countries
SIDA	Swedish International Development Agency
TDRI	Tropical Development Research Instirtute (United Kingdom)
UK	United Kingdom
UNDP	United Nations Development Programme
US	United States
USAID	United States Agency for International Development

## COUNTRY ACRONYMS AND ABBREVIATIONS

### Botswana

ALDEP	Arable Land Development Programme
APRU	Animal Production Research Unit
BAC	Botswana Agricultural College
DAFS	Department of Agricultural Field Services
DAH	Department of Animal Health
DAR	Department of Agricultural Research
GOB	Government of Botswana

### Lesotho

EA	Extension Agents
FSRP	Farming Systems Research Project
GOL	Government of Lesotho
LAC	Lesotho Agricultural College
LADB	Lesotho Agricultural Development Bank
NUL	National University of Lesotho
RD	Research Division (Lesotho Agricultural Research Division)
SMS	Subject Matter Specialist

### Malawi

ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
DAO	Department of Agriculture
DAR	Department of Agricultural Research
DVS	Department of Veterinary Services
EPA	Extension Planning Area
GOM	Government of Malawi
RDP	Rural Development Project
TA	Technical Assistant
TRF	Tea Research Foundation

### Mozambique

CDR	Centros de Desenvolvimento Rural (Rural Development Centres)
CEF	Centro de Experimentacao Florestal (Center for Forestry Experimentation)
CODECO	Centros de Desenvolvimento Cooperativo (Cooperative Development Centres)
INIA	Instituto Nacional de Investigacao Agronomica (National Institute of Agronomic Research)
INIV	Instituto Nacional de Investigacao Veterinaria (National Institute of Veterinary Research)
IREMA	Instituto de Reproducao e Melhoramento Animal (Institute of Animal Breeding and Reproduction)
NINRP	National Inventory of Natural Resources Programme
SEA	Secretaria de Estado do Algodao (Secretariat of State for Cotton)
SEC	Secretaria de Estado do Caju (Secretariat of State for Cashew)

### Swaziland

ARD	Agricultural Research Division
CSRP	Cropping Systems Research and Extension Training Project
DES	Division of Extension Services
GOS	Government of Swaziland
ITF	Individual Tenure Farms
MOAC	Ministry of Agriculture and Cooperatives
RDA	Rural Development Area
RDAP	Rural Development Area Programme
SCB	Swaziland Cotton Board
SDSB	Swaziland Development and Savings Bank
SNL	Swazi National Land
UOS	University of Swaziland

### Tanzania

DAR	Directorate of Agricultural Research
DEF	Directorate of Extension for Fisheries
DETS	Directorate of Extension and Technical Services
LITI	Livestock Training Institute
MATI	Ministry of Agriculture Training Institute



MLNRT Ministry of Land, Natural Resources and Tourism  
MOALD Ministry of Agriculture and Livestock Development  
TAFIRI Tanzania Fisheries Research Institute  
TAFORI Tanzania Forestry Research Institute  
TALIRO Tanzania Livestock Research Organization

TARO Tanzania Agricultural Research Organization  
TPRI Tanzania Pesticides Research Institute  
UAC Uyolet Agriculture Centre  
VFS Village Forestry Services

Zambia

CVRI Central Veterinary Research Institute  
DOA Department of Agriculture  
GRZ Government of the Republic of Zambia  
MAWD Ministry of Agriculture and Water Development  
NCSR National Council for Scientific Research  
RDSB Rural Development Studies Bureau

Zimbabwe

Agritex Agricultural Technical and Extension Services  
BAE Branch of Agricultural Education  
DR&SS Department of Research and Specialist Services  
TRB Tobacco Research Board

CURRENCY EQUIVALENTS  
(December 31, 1983)

Botswana

Currency unit	=	Pula (P)
US\$ 1.00	=	P 1.156
1 P	=	US\$ .865
1 P	=	100 thebe

Lesotho

Currency unit	=	Maloti (M)
US\$ 1.00	=	M 1.35
1 M	=	US\$ .74
1 M	=	100 oicente

Malawi

Currency unit	=	Malawi Kwacha (MK)
US\$ 1.00	=	MK 1.30
1 MK	=	US\$ .769
1 MK	=	100 tambala

Mozambique

Currency unit	=	Metical (M)
US\$ 1.00	=	M 41
1 M	=	US\$ .024
1 M	=	100 centimos

Swaziland

Currency unit	=	Lilangeni (L); plural, Emalangeni (E)
US\$ 1.00	=	E 1.22
1 L	=	US\$ .822
1 L	=	50 two cents

Tanzania

Currency unit	=	Tanzania shilling (T.sh.)
US\$ 1.00	=	T.sh. 12.5
1 T.sh.	=	US\$ .08
1 T.sh.	=	100 cents

Zambia

Currency unit	=	Kwacha (K)
US\$ 1.00	=	K 1.37
1 K	=	US\$ .73
1 K	=	100 ngwee

Zimbabwe

Currency unit	=	Zimbabwe dollar (Z\$)
US\$ 1.00	=	Z\$ 1.058
1 Z\$	=	US\$ .945
1 Z\$	=	100 cents

WEIGHTS AND MEASURES

1 hectare (ha)	=	10,000 m <sup>2</sup>
	=	2.471 acres
100 hectares (ha)	=	1 km <sup>2</sup>
1 acre	=	0.405 ha
1 kilogram (kg)	=	2.204 pounds
1 metric ton (MT)	=	1,000 kg
		2,204 pounds
1 kilometer (km)	=	0.621 miles
1 square kilometer (km <sup>2</sup> )	=	100 ha
1 mile	=	1.609 km
1 liter	=	1.066 quarts
1 quart	=	0.9464 liters

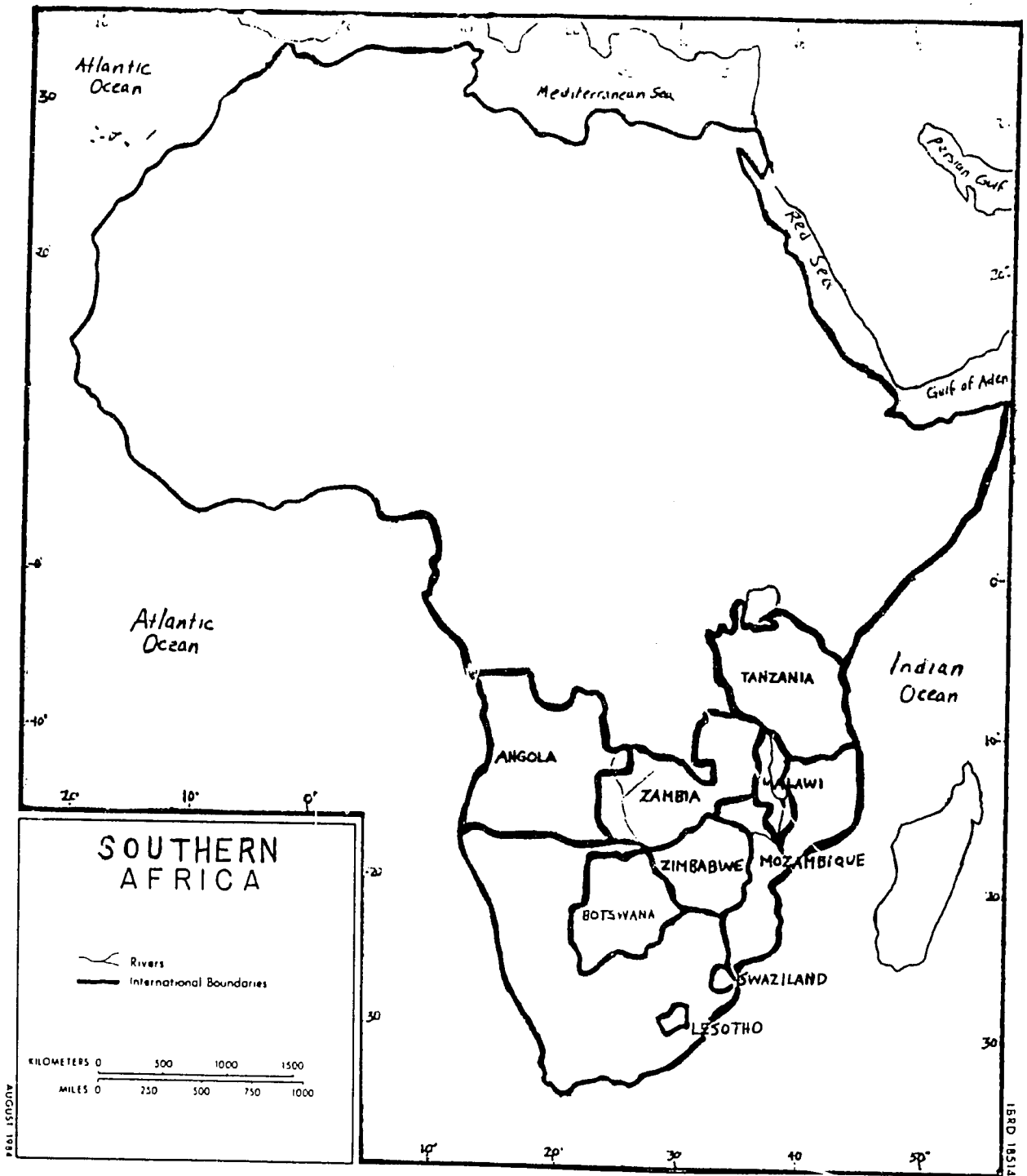
## ABOUT THIS ASSESSMENT

### A. Background

The purpose of this Agricultural Research Resource Assessment (ARRA) was to develop country-specific and regional analyses of existing agricultural research, extension and training resources and to analyse the medium- to long-term needs and opportunities in agricultural research that will lead to increased agricultural productivity. The ARRA was carried out by DEVRES, Inc., a US private consulting firm with headquarters in Washington, DC, together with senior agricultural research personnel from the SADCC countries. It was conducted from July 1983 through August 1984 in the following countries of the Southern African Development Coordination Conference (SADCC): Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe. (See Figure 1.) The ARRA was initiated as a result of discussions between representatives of the SADCC Consultative Technical Committee for Agricultural Research (CTCAR) and the Cooperation for Development in Africa (CDA). The CDA is an informal association of donors including Belgium, Canada, France, Italy, West Germany, the United Kingdom and the United States.

The inventory and assessment were carried out within the framework of the high priority accorded by the CDA to developing and strengthening agricultural research capability in Africa. The United States, assisted by other CDA donors, was assigned the specific responsibility for coordinating the development of CDA-supported agricultural research programmes in the Southern Africa and Sahelian regions. The ARRA inventory reports were financed by the United States Agency for International Development (AID) for CDA, and were carried out with the full collaboration and support of SADCC through the CTCAR. DEVRES, Inc. was engaged by AID to implement the ARRA, together with personnel from the SADCC countries, and to prepare a SADCC regional report. Two other CDA donor countries, Italy and France, also provided technical experts and other assistance for some of the SADCC countries' reports.

The CDA members recognize that the African nations have established Africa-wide and regional institutions such as SADCC, and that the heads of African states have given unanimous support to the Organisation of African Unity's Lagos Plan of Action which emphasises the development of a strong capability to increase agricultural productivity. The donors have, therefore, joined with the African countries and their regional organisations, SADCC in Southern Africa and Institut du Sahel (INSAH) in the Sahel, to carry out analyses of existing resources for each country and for the region, and to develop a 20-year strategy to strengthen existing national and regional activities.



SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Figure 1: Map of the SADCC Countries

Source: The World Bank, Toward Sustained Development in Sub-Saharan Africa (Washington, D.C.: The World Bank, 1984.)

The World Bank, in its 1983 report entitled Sub-Saharan Africa: Progress Report on Development Prospects and Programs, reiterated its emphasis on the high priority which governments and donors should give to agricultural research. More specifically the report noted:

Even within the present state of technical knowledge, improved incentives and marketing arrangements would permit very large increases in agricultural output. However, for the longer term, increased output will depend on the development of effective technical packages, pest and disease control and developments in animal husbandry. . . . In a situation of budgetary stringency and of immediate crisis, expenditure on research having a possible but uncertain payoff, ten years or more in the future is frequently seen as dispensable. This danger is increased when research programs are manifestly weak and unfocused. It is, therefore, essential that these programs be formulated and implemented in ways which will enable them to contribute more effectively to the process of development. . . .<sup>1</sup>

A.W. Clausen, in the Foreword to the World Bank's August 1984 report entitled Toward Sustained Development in Sub-Saharan Africa-- A Joint Program of Action, after commenting that sub-Saharan Africa today faces acute economic difficulties and the long-term outlook appears bleak, goes on to say that this need not be the case:

With sufficient will and determination the nations of Sub-Saharan Africa and the international community can act to set the base for a new era: a time of development progress when the quality of life of tens of millions of Africans can be significantly improved.

... This Action Program [contained in the Bank's report] leaves no doubt that much of the efforts to secure improvements will have to be shouldered by the peoples of sub-Saharan Africa, with the governments of these nations having to make difficult, yet vitally necessary policy changes.

But progress will be achieved only if the international community provides strong and consistent support to the reform efforts of the sub-Saharan nations. There needs to be better coordination among the international institutions involved in Africa's development and by the aid agencies of the donor nations. There needs to be increased international support for sub-Saharan development by the provision of both expertise and concessional funds.<sup>2</sup>

The analysis, strategy and programmes which are contained in the ARRA regional and national reports call for a significant cooperative effort on the part of the Sahelian countries, bilateral donors, the sub-regional, regional and international organisations. The recommended research priorities and programmes within them are set in a 20-year time frame. This long-term time perspective has permitted

the flexibility to make recommendations which are carefully adapted to the needs of agricultural research and which are based on the assumption of a long-term commitment by all participating organisations to the important activities that should be undertaken.

## B. Procedure

This study was carried out with the full participation of African professional agricultural researchers and agriculturalists. It was agreed that such participation was of central importance for all phases of the activity--the design of the questionnaires, the data collection process, the analysis, the assessments of research programmes and direction, the actual preparation of the country reports, and the development and review of a regional agricultural research strategy. DEVRES provided a group of technical experts who had wide African and other international experience to assist the country researchers, to contribute to the analysis of the country reports, and to prepare the SADCC regional report. France and Italy also provided technical experts to assist country researchers in Mozambique and Tanzania, respectively.

The ARRA was initiated with a pilot study performed collaboratively with the SADCC member states of Botswana, Malawi and Swaziland. Following review of this pilot report by both SADCC and CDA members, the ARRA was expanded to include additional SADCC countries: Lesotho, Mozambique, Tanzania, Zambia and Zimbabwe. At the time these countries were added, the pilot country reports were updated and this regional analysis was prepared.

Senior researchers from the SADCC countries were designated as Country Coordinators. Each Coordinator provided overall direction and support for the ARRA in her/his country. In turn, each Coordinator nominated researchers to be in charge of completing the questionnaires and preparing the national reports for their respective countries. The Country Researchers also used other experienced researchers for short periods to help complete questionnaires on specific subjects. The scope of the questionnaires included not only the research institutions, but also training institutions and extension institutions which provide links between research professionals and the farmers who are the intended beneficiaries of research results.

The expanded ARRA was prepared from July to September 1984 by the Country Researchers assisted by researchers from France and Italy in cooperation with the DEVRES staff. A regional report, including summaries of the national reports, has been prepared by DEVRES in consultation with the CTCAR members and the Country Researchers. The regional report is based on a regionally-oriented analysis of programmes and national reports, on the answers to the questionnaires, on contacts with international research organisations and national and international donors, and on other available information. Conceptually, the analysis is set up to move from regional analysis and identification of major regional constraints (Chapter I): to an

exposition of the strategy developed to reduce or eliminate those constraints (Chapter II): to the presentation of the recommended programmes and activities to put the proposed strategy into action (Chapter III).

During the course of the ARRA, DEVRES provided assistance in the development of a computerized data bank to process ARRA data and to assist the SADCC countries in meeting their future needs for research inventories. This is an important first step in creating a data bank which, when combined with other available information, can provide a foundation of practical, useful data that can be continuously updated. The data bank can be a valuable tool for use by those designing programmes and projects in agricultural research.

In preparing recommendations for programmes and projects, the Country Coordinators, Country Researchers and DEVRES staff have taken into account research work already proposed or underway. New ideas are also included in each country report and in this regional report as well. One of the principal objectives of the analysis has been to build on existing national research, analyses, conclusions and recommendations in a manner that would strengthen these research activities. The focus has been on strengthening agricultural research systems. A concerted effort was made to place recommendations in a wider context, involving not only the research institutions, but also the training of researchers, the use of research results by the farmers, and the linkages with other SADCC member institutions or other international research institutions.

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<sup>1</sup>The World Bank, Sub-Saharan Africa: Progress Report on Development Prospects and Programmes (Washington, DC: The World Bank, 1983), pp. 30-31.

<sup>2</sup>The World Bank, Toward Sustained Development in Sub-Saharan Africa--A Joint Program of Action (Washington, DC: The World Bank, 1984), p. v.





## EXECUTIVE SUMMARY

### A. Purpose and Procedure

#### 1. Purpose

The purpose of the Agricultural Research Resource Assessment (ARRA) carried out in eight of the Southern African Development Coordination Conference (SADCC) countries (Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe) was to conduct both a country-specific analysis and a regional analysis of existing agricultural research, extension and training resources and the medium- to long-term needs and opportunities in the area of agricultural productivity. This project was carried out within the framework of the high priority accorded by the member countries of SADCC, and the CDA (Cooperation for Development in Africa)<sup>1</sup> to developing and strengthening agricultural research capability in the region.

#### 2. Procedure

The assessment and the preparation of this regional strategy were carried out by DEVRES, a US-based private consulting firm located in Washington, DC, assisted by a subcontractor, the Midwest Universities Consortium for International Activities (MUCIA), and in collaboration with the Consultative Technical Committee for Agricultural Research (CTCAR) of SADCC. The project was financed by the US Agency for International Development (AID), acting on behalf of all the CDA donors, for the purpose of strengthening agricultural research in the Southern African region.<sup>2</sup>

The assessment of agricultural research resources in the Southern African countries involved about 30 African agricultural researchers from eight of the nine SADCC member countries<sup>3</sup>, numerous specialists on specific aspects of the study, CTCAR of SADCC, and DEVRES' staff of experienced agricultural researchers and development specialists. The inventory used in the assessment was based on a detailed questionnaire developed by DEVRES and MUCIA in consultation with agricultural researchers in the SADCC countries. It covered research, extension and training activities, and human, financial and physical resources of these institutions.

DEVRES' field staff worked with African National Coordinators and Country Researchers appointed by their governments to conduct the inventory and prepare the national reports based on the results of the questionnaire. Data collection and the writing of the pilot country reports for Botswana, Malawi, and Swaziland were begun in July 1983 and completed in November 1983.

Based on an evaluation of the pilot reports by the CTCAR members and others, the questionnaires were revised and administered in the eight participating SADCC countries in July 1984. Country reports, based on the collection and analysis of this data as well as on the pilot reports, were drafted in Africa in July and August. Each report consists of chapters on: background information about the country; the agricultural research, training and extension institutions; constraints to increased agricultural productivity by smallholders; constraints confronting the agricultural research, training and extension institutions; and recommendations for dealing with these constraints. These country reports are summarized in Chapter IV of this regional report.

The information collected in the questionnaire was used in the regional analysis and will be turned over to the Southern African Centre for Cooperation in Agricultural Research (SACCAR) in the form of a comprehensive computerized data bank. SACCAR was recently established as a secretariat for the CTCAR, with the purpose of facilitating cooperation in agricultural research within the region. It is based in Botswana and accountable to the CTCAR for carrying out agreed-upon activities. One of its tasks is to maintain and update this ARRA inventory of national and regional research activities and resources.

The regional analysis and research strategy were developed by the DEVRES staff in consultation with the National Coordinators and African researchers in light of the national reports and other data available. From September to November 1984 the DEVRES staff designed the proposed programmes and activities to carry out the strategy elements. Particular attention was given to seeking ways to strengthen existing national and regional research activities. In December 1984, the draft country and regional reports were reviewed by the CTCAR, and several other panels convened by AID, and suggestions were incorporated in this version of the report.

## B. Conclusions

### 1. Food deficits in the Southern African countries are increasing.

Food production in the SADCC countries is failing to keep pace with population growth. Traditional agricultural production systems which constitute the livelihood of most of the people of these countries grew out of generations of adaptation to local agro-physical and ecological conditions. Since 1950, efforts to respond to increasing food demand have resulted in increases in acreage and production in the smallholding subsistence-oriented sectors. However, in the face of rapidly expanding population, these traditional systems are no longer capable of meeting national and regional food requirements or of generating the income growth and employment opportunities required for the region's development.

For example, over the last ten years total cereal production declined six percent, while population for the same period increased 35 percent.<sup>4</sup> Population in the SADCC countries (68 million in the region in 1984) will almost double by the year 2000, while urban population will likely triple during the same period.

Cereal imports for the SADCC countries over the same period increased from 375,000 MT in 1966, to about 600,000 MT a decade ago, to about 1,871,000 MT annually over the last four years. In 1984 imports are expected to exceed 2,400,000 MT. At this rate of growth, the region's annual import requirements for cereals is expected to exceed seven million MT per year by the end of the century. On a per capita basis imports have increased three-fold since 1974, and were 36 kg in 1984. It should be noted that food consumption data for the region indicate that past and present levels of food consumption are not satisfactory, since overall caloric intake (as one measure) averages at least 10 percent below the minimum figure, often used for international comparisons, of 2,400 calories per day. An average shortfall of 10 percent is significant because it indicates that the poorer segments of the population will be experiencing much greater deficiencies.

While not part of the team's mandate, it is clear from the above analysis that the rate of population growth in the SADCC countries has put severe pressures on food production, and has resulted in production requirements which the member countries have not been able to cope with. As stated in a recent World Bank report on economic development in Africa, "Improved policies and economic and social management will succeed only if, in addition to attending to short-term crises, countries are able to ease the longer term constraints on development. The growth of population is the single greatest long-term threat to Africa's economic development."<sup>5</sup>

Based on a straight line projection of the cereal production required to keep up with projected population growth for the years 1985-1995 (and to provide an annual per capita output of 150 kg), it is estimated that over this ten-year period, cereal production would need to increase by 82 percent, or roughly 6.1 percent per year on a straight line basis. This increase is required to make up for the production deficit accrued by 1985 and to keep up with the projected increase in population.<sup>6</sup> More complex models can be used to indicate the magnitude of the food problem, and suggest a measure of what needs to be accomplished to catch up. However, the final result is not likely to change substantially.

Achieving or even approaching the target growth rate of 6.1 percent per year when the average rate of growth of cereal production between 1968-1982 was 1.3 percent per year will demand a quantum leap, which can only be met by more effective agricultural research, new technology, and improved farming systems with the results tailored for and adopted by the smallholders. Even this effort will not be

completely successful unless it is combined with adequate infrastructure and appropriate government policies.

2. Agricultural productivity is seriously constrained.

There are a number of serious constraints to increasing agricultural productivity in the SADCC countries which affect the production of food crops, export crops, and livestock. Some are direct constraints--those physical and biological factors which constrain production and productivity directly, such as: irregular and inadequate rainfall, lack of adequate labour, and lack of suitable varieties and/or species adapted to the local environment. Others are indirect constraints--those which impede the development and application of solutions to the direct constraints, such as: pricing policies which are disincentives to increased production; rural tradition-related problems such as raising animals for non-food purposes; institutional weaknesses related to agricultural research, extension and training institutions and policies; focus of research methodology and research on commercial rather than smallholder agricultural problems; inadequate research information, especially on mixed farming; lack of trained and experienced national professionals; and inadequate capacity for training in appropriate disciplines at the graduate level.

These constraints, more fully described in Chapter I, are complex and interrelated, involving political, technical, physical, social and economic factors. They must be reduced or eliminated in order to increase agricultural productivity and move toward a situation of increasing food security. To reduce these constraints, it is vital to strengthen both national and regional research capacity to: (a) plan and establish research priorities; (b) finance and carry out effective agricultural research programs; and (c) successfully disseminate to farmers the results of this work.

3. Agricultural research can help if it is reoriented to meet smallholder problems.

Reorienting current research, extension and training is not exclusively a problem of money, equipment and human resources. Much more could be done with existing facilities and capabilities if they focussed on the problems of and solutions for the smallholder. While research has been largely directed to food crops, the research methodology and procedures are still concentrated on the types of problems more apt to be of concern to the large land owner, rather than smallholders. Until very recently little attention has been given to related problems, such as the smallholders' need for credit to finance inputs, special marketing needs of small farmers, ways to reduce the risks faced by smallholders when using new varieties, and systems research related to needs of smallholders. Therefore, extension workers have lacked technologies useful for smallholders. In many cases, training is carried out with inappropriately focussed

texts, and by teachers who are not properly prepared to handle the new focus on smallholders.

Solutions to the constraints require a systems approach, involving not only agricultural research, but also extension and training staff in the various stages of programme development.

For any national or regional programme to increase agricultural productivity in the SADCC countries, it will need to concentrate on the full range of needs--social, technical and economic--of the smallholders and emerging farmers. Practical, effective ways of meeting these smallholder requirements, be they for crop or animal production, are essential if food production in the SADCC countries is to be increased.

Smallholders generally are at the subsistence level, and do not produce a marketable surplus. Emerging farmers usually are smallholders who produce a modest surplus and are just beginning to use non-traditional techniques in their farming. Size of farms vary from two to eight hectares depending upon the kind of crops and/or livestock raised.

A few statistics will illustrate the importance of the smallholder sector, of which the emerging farmer is a small but vital element. Forty-one million persons or 71 percent of the population in the SADCC region are engaged in agriculture. In Botswana, Lesotho, Malawi, Swaziland and Tanzania over 80 percent of the population is directly dependent on agriculture. In all countries smallholders predominate in the production of the traditional crops; for example, 85 percent of maize in Tanzania, 93 percent of sorghum in Botswana, and 81 percent of all agricultural output in Malawi is produced by smallholders. In livestock production, the smallholder sector is also by far the predominant one.

The potential exists for smallholders to increase yields and total output of food crops and animal production. Knowledgeable persons asked to rate the severity of constraints to increased agricultural production gave those constraints involving economic, traditional and institutional factors the highest ratings. In addition, most respondents indicated that yield increases in the range of twice to three times current yields were possible if these constraints could be eliminated or substantially reduced.

Technical solutions to on-farm problems and systems approaches are essential ingredients for improving the output of the farm unit. However, none of these activities or programmes will be successful if they do not take into account local practices, traditions, and indigenous systems which have evolved over the years to allow the subsistence smallholder to survive in her/his environment. The regional collaborative research programmes, which are listed at the end of this

summary, have been designed separately but together form an integrated strategy to meet these needs in the most practical and effective way possible.

Concentrating help on the emerging farmer as a sub-group within the smallholder segment is of particular interest since resources available to SADCC countries to assist smallholders are limited. Not all farmeres are equally: skilled in working their farm, industrious, capable of using new techniques, reliable, credit-worthy, or able to take the risks of using new inputs, varieties and methods. Therefore, one might well consider concentrating some of the scarce resources on the emerging farmer, who is looking for ways to progress and is receptive to change. The emerging farmers can lead the way and help other smallholders with fewer resources and less initiative who are not in a position to take any risks, by demonstrating the use and value of the new packages or systems. Generally, for the reasons stated above, the programmes which are listed later in this summary focusing on smallholder needs will be of special benefit to the emerging farmers.

4. African-managed research, extension, and training activities are needed.

The strategy proposed in this report is structured so that it will develop over the medium- to long-term a strengthened African capability and a clear African mandate to plan and carry out agricultural research programmes in cooperation with the appropriate elements of the national extension and training institutions. In this way over the next 20 years, programmes will become African-driven rather than donor-driven.

An in-depth understanding of the interrelationships of social, technical and economic factors, and putting to work the combined national services of research, extension and training, will require professionally qualified people from the region who understand traditional as well as commercial viewpoints. It is for this reason that creating an independent capability in the SADCC region--both to plan and execute agricultural research and extension programmes, and to upgrade the existing training institutions to provide the manpower needed for this process--is a condition sine qua non for success in achieving the objective of a significant per capita increase in production over the next 20 years.

5. A regional approach is needed.

A regional approach to agricultural research, extension, and training is needed in SADCC countries to: (a) avoid duplication among members participating in a given programme; (b) realize a synergistic effect in research productivity through the exchange of information among researchers and by providing opportunities for researchers, extension and training people to work together at conferences, workshops, and technical meetings; (c) undertake research on

socioeconomic elements affecting agricultural production which might be potentially difficult to study in depth at a country level; (d) make possible the development of high priority collaborative agricultural research projects in food crop production, economic analysis, farm power, small ruminants, land and water management, and horticulture.

Such regional collaborative research programmes can be of significant help to smaller countries, since they can provide resources for these countries which may not be able to afford a comprehensive research establishment, and by so doing allow them to concentrate on adaptive research according to their country-specific needs.

While regional activities are attractive in concept, they have been very difficult to execute for various reasons, usually not technical. They must be developed by the countries themselves and not imposed from the outside. They should take into account the individual member country interests, and must assure that all countries receive a fair share of the benefits in a timely fashion.

6. Donor and country commitments to finance recurrent costs are needed.

There is a great need in the SADCC countries for a consistent and long-term commitment, both by donors and by national governments, to financial stability and the timely availability of funds for their agricultural development efforts. As part of the programme/project design process for successful regional projects, financing for the full life of the project is a high priority requirement, along with identification of the source of financing and amount due from each source. Even with the priority accorded agricultural research by the SADCC countries, the economic situation in which they find themselves makes it doubtful that many SADCC country governments will be able to cover fully the recurrent costs of expanded regional and national research, extension, or training projects. While they will be able to contribute personnel and facilities, it is doubtful that they can provide sufficient operating budget funds. Therefore, it is clear that donor countries will be called upon to finance significant recurrent costs over the short to medium term.

It is equally necessary for the recipient countries to work out with donors time-phased plans for increased country contributions to recurrent costs as the research, extension, or training projects are implemented and become productive. While the time frame may be somewhat longer for this in the agricultural research area than for agricultural production projects, good management suggests that a realistic plan for the full assumption of the recurrent costs (albeit on a phased basis) should be established by the recipient governments at the outset.



In sum, the success of the national and regional programmes and projects will depend, to a great extent upon donor/country agreement on resources becoming available in local and foreign currency and on a timely, scheduled basis to ensure adequate life-of-project financing for both start-up and recurrent costs.

C. Recommendation: Establish a Regional Agricultural Research Strategy for the SADCC Countries

The principal objective of the 20-year strategy for agricultural research is to achieve a significant increase in per capita agricultural output, thus increasing the well-being of the citizens of the region and enhancing national food security in the SADCC countries.

Another objective is to develop an independent SADCC national and regional capability vested with the design, implementation and evaluation of its own collaborative agricultural research, extension and training programmes. This will result in the needed increases in agricultural productivity being brought about by African controlled and managed institutions. The hallmark of this strategy should be its ability to effectively meet the challenge of increasing smallholder productivity.

Conceptually, the strategy was developed by identifying major national and regional constraints and determining the best and most readily achievable means for eliminating or reducing them. The elements of the strategy were then linked to programmes and activities that would translate them into action, thereby achieving the objective of increased agricultural productivity. The analysis upon which this strategy is based is sensitive to the technical and physical aspects of agricultural productivity, and also to issues relating to the socioeconomic environment of smallholders and rural traditions. Further, the analysis is based on the belief that the purpose of the regional programme is to strengthen the national programmes, with the regional programme in a strong supporting role.

The strategy, more fully described in Chapter II, has two primary themes. Substantively, the theme is to increase smallholder productivity. Procedurally, the theme is to begin a deliberate effort to prepare African institutions to take complete charge of their research, extension and training activities.

On the substantive side, the strategy must be hard-hitting and focussed enough to ensure increases in agricultural productivity, especially among smallholders and emerging farmers. On the procedural side, it must be flexible enough to enable national institutions themselves to develop and manage effective means for attaining these increase in productivity.

The strategy is based on a 20-year time span, and while much can happen in this long time period, the strategy reflects the art of the possible. Thus, the elements of the strategy are consonant with the present and projected institutional and human resource base available, and with the high priority already accorded agricultural research, extension, and training by both the SADCC and CDA countries.

The task is difficult and stakes are high. However, if the potential for increased food production in rural areas is realized, it will contribute to:

- o Welfare of the rural population including increased income;
- o Marketable surpluses of food, which can then be made available to the urban population, and of export crops;
- o Increased per capita GNP;
- o Increased foreign exchange earnings and savings;
- o Lessened imported food requirements, and
- o Increased employment in the rural areas.

Within this context it is important to understand that among the SADCC countries there is wide variation in the potential for food production. Botswana, Lesotho and Swaziland, for example, will have difficulty in achieving the food self-sufficiency because of the biological limitations, including the amounts of arable land and the unreliability of rainfall. Other SADCC countries, however, have the natural resource base to make food self-sufficiency possible. It is more realistic, therefore, for some SADCC countries to seek food self-sufficiency while others seek economic self-sufficiency.

The overall strategy to accomplish the objective set out above is composed of four strategy elements which follow:

1. **Strategy Element No. 1: Strengthen national and regional capacity to develop and transfer the technology needed to assist smallholders.**

Increasing smallholder productivity is the key to increasing per capita food output in the SADCC countries. Smallholders have been particularly vulnerable to a wide range of constraints since the colonial period, when the best land for cropping and grazing was allocated to the European owners of large commercial farms. The infrastructure and transportation network that was developed primarily served the needs of the large farmer. Likewise, credit facilities, extension services and new technology were designed primarily to meet the needs of large farm enterprises.

In the past, research has emphasised export or other cash crops. Even now, research on food crops such as maize, sorghum, millet or wheat, tends to assume use of the methodologies more sensitive to the traditional needs of commercial farmers. Much of the useful research already done must now be adapted to the needs of the smallholder.

For the smallholder, inappropriate technical packages, lack of adequate labour, and insufficient animal power at planting, weeding and harvest time continue to be major constraints to increased production, together with traditions of land tenure and farm size. Losses from pests, weeds and diseases are also problems. Identifying cost-effective and culturally sensitive ways to alleviate these problems is essential if smallholders are to become more commercially oriented, and to provide the additional food production needed.

Several basic climatic/ecological factors also impact upon the potential for increased productivity. The low moisture environment and frequent drought have caused inadequate forage for livestock. This situation, aggravated by rural traditions which assume that livestock are valuable status symbols and not to be used for commercial purposes, has led to overgrazed fields and ranges, higher-priced beef on the market, and little animal protein in people's diets.

Food crop varieties well adapted to the local environments are not generally available. Where these improved varieties are present, the technological packages available are not always adapted to and suitable for the smallholders' physical, economic or traditional environment.

There are not enough trained and experienced nationals in professional positions, nor are enough local people trained in several of the specialised disciplines required for agricultural research, extension and training institutions. As a result, expatriates will be needed to fill many positions for some years to come. However, there is an urgent need to provide means for training African professionals to fill these gaps.

Conferences, workshops, technical meetings, research grant programmes, technical information, and a data base are tools in the process of developing the programmes listed below to resolve the above-mentioned constraints. This process is integral to obtaining the appropriate technologies suitable for the smallholder. It is essentially a collaborative process, involving setting up a mechanism for communication among the agricultural researchers in their respective fields, as well as communication with extension and training. Outside technical assistance and publications should also be made available so that viable programmes can be designed, taking into account social, economic and technical factors; and, perhaps most important, programmes should be put together in a way that is suitable for and attractive to smallholders.

Strategy Element No. 1 is closely related to Strategy Element No.3, use of a systems approach to agricultural research and extension. While having the appropriate technical solution is a precondition to providing small and emerging farmers with viable technical packages, it is not the final solution in and of itself. Disseminating the technological advance to the farmer in a fashion which is useable, making corrections when it is not, and determining what modifications are necessary to make it fit into the total farm unit or system, are also indispensable requirements. A systems approach, such as that described in Strategy Element No. 3 involving agricultural research and extension, provides this dimension--i.e., of assuring the practical use of the new innovation or technological advance.

The following programmes and activities taken together comprise the programmes and activities proposed to implement Strategy Element No. 1:

- o Development of policy guidelines and a management system for collaborative activities;
- o Conduct of conferences, workshops and technical meetings;
- o Implementation of a research grant programme;
- o Development of a food crop production collaborative research programme;
- o Development of a land and water resource management collaborative research programme;
- o Development of a small ruminants, swine and poultry collaborative research programme;
- o Development of a farm power collaborative research programme;
- o Development of a horticulture and specialty crop collaborative research programme;
- o Establishment of a region-wide research data base; and
- o Establishment of regional professional-oriented and extension/layman-oriented publications.

2. **Strategy Element No. 2: Increase national capability within the region to recruit, train and retain professionals required in research, training and extension.**

One of the serious impediments to increasing agricultural productivity lies in the field of manpower development. At the present time, there is a deficiency of trained and experienced national professionals. In some of the SADCC countries over half of the professional positions in agricultural research are now held by expatriates. In the region as a whole, nearly one-third of these positions are held by expatriates. This is not because national governments prefer expatriates, but because they lack qualified national personnel.

In extension, the percentage of expatriate professionals is much smaller than in research (16 percent compared to 31 percent). However, the percentage of national professionals in extension work with graduate degrees is significantly less than the percent of those in research with graduate degrees in all SADCC countries.

Training institutions present a similar picture regarding the use of expatriates: 31 percent of the professional positions are currently held by expatriates. A look at student/professor ratios in some of the baccalaureate and technical schools indicates some capacity which could be utilised to increase the number of qualified Africans needed in the research and extension services.

Short course training could be used to upgrade rapidly the needed special skills of existing staff. There are other areas of need where persons with training in specialised disciplines, such as social sciences, sub-disciplines in the biological and physical sciences and information management, are in short supply. Absence of these skills is hampering effective programme implementation.

One of the problems which inhibits rapid elimination of constraints is the lack of secondary school leavers qualified to enter baccalaureate programmes in mathematics and the sciences. In the mid- to long-term, the best way to meet this need is through a special pre-baccalaureate programme to increase the number of students qualified for entry into BSc level training. Further, there is a lack of capability to provide graduate training in several critically needed disciplines within the SADCC region.

There is also a need for multidisciplinary training to assure that those working in farming systems research and extension, in both agronomic and livestock disciplines, are provided with some skills in the social sciences to make their contributions more effective.

Textbooks for certificates and diploma schools are often inappropriate for the students, and in some cases were written with a temperate zone orientation. Training is also needed to equip science

and technical information writers with the skills to translate technical information into articles and publications suitable for use both by research professionals and by extension staff and laypersons.

In the longer term, intra-regional programmes should result in providing the SADCC countries with adequate manpower development and training capability so that they can meet their own manpower needs from regional resources, except for an occasional specialised skill which might require training out of the region.

Establishing the short, medium and long term training programs, strengthening the intra-regional capacity to train, and preparing better qualified students to do university level work are vital parts of this agricultural research strategy for the SADCC countries. The communication opportunities offered at conferences, workshops, and technical meetings (i.e., the joint selection process for the short courses in training for staff, the joint preparation of programmes for multidisciplinary training, and joint selection of institutions to expand or utilise existing capacity for graduate level training) will help assure that the results of these activities are responsive to the needs of the region and sensitive to the needs of the smallholder.

The following programmes are designed to meet these manpower development requirements and to focus on methods responsive to smallholder needs:

- o Conduct of conferences, workshops and technical meetings;
- o Provision of short course training for staff;
- o Development of SADCC capacity in graduate-level training;
- o Provision of training in disciplines critical to collaborative research programmes;
- o Provision of science training for students entering baccalaureate training;
- o Development of appropriate texts and reference materials for certificate and diploma training institutions;
- o Provision of multidisciplinary training for staff required for adaptive research; and
- o Provision of advanced training for agricultural technical editors and science writers.

**3. Strategy Element No. 3: Develop and strengthen use of a systems approach to agricultural research, extension and training for programmes that focus on smallholder problems and solutions.**

A major constraint to helping the smallholder become more productive is the lack of knowledge (or concern) on the part of the research, extension and training institutions about rural technology and tradition-related constraints among smallholders. These include traditions related to tenure, security and size of holdings and the way they in turn affect credit availability, herd management systems and cropping patterns.

For example, a smallholder or emerging farmer tends to look at the totality of his operation with its strengths and weaknesses. If a new variety with a higher yield is proposed, he makes his decision to use it or not in terms of the total requirements of the innovation, and the possible risks or returns for his effort. If a variety with potential for higher yield requires extra weeding to be successful, he recognises that extra persons will be needed at a critical time when labour is likely to be in short supply. Therefore, the innovation will probably not be used. If a good variety has excellent yield, no weeding problems, but attracts the weaver birds in the area, the small farmer will not see this variety as much of a net gain to his operation.

As indicated in the discussion of development of appropriate technology, a problem, relevant to support for the smallholder, is that historically government services were organised for the commercial farmer (usually much larger in size); therefore, research and extension services tended to specialise and to separate crops and livestock into different departments. But for the smallholder, it is the total system that must be considered, including traditional practices such as keeping cattle as a sign of wealth and not especially for food needs.

Another constraint to increasing productivity and/or to moving from subsistence to small-scale commercial farming, is that as more and more men leave the rural areas and migrate to the urban areas in search of more remunerative work, women have had to take over the management of farm operations. However, in some of the SADCC countries a major drawback for the women assuming this role is their lack of decision-making authority which is still reserved for the husband even though he is gone. Other problems faced by these women are: the lack of extension services, the inability to gain access to cooperative membership, and the unavailability of credit, etc.

Since smallholders account for 90 percent of the persons engaged in food production in the SADCC countries, it is vital to understand how to work with the smallholder in terms s/he can understand and trust. Adaptability of the national and regional programmes to the

smallholders' economic, traditional and physical (climate, soils, etc.) environment is an essential ingredient of effective agricultural programmes.

This strategy element suggests a systems approach to agricultural research, extension and training. Through the conferences, workshops and technical meetings, specialists in the many disciplines involved in dealing with issues such as the total farm operation, mixed farming, or smallholder operations emerging from subsistence farming into the commercial sector will be able to combine their skills, and work together in a practical way on concrete systems, programmes or activities.

This process of intra-regional consultation at conferences, workshops and technical meetings proposed in the regional programmes, combining indigenous skills and outside assistance as needed, and supported by multidisciplinary training, will lay the groundwork for the introduction of the systems approach into each of the collaborative research programmes listed below. These programmes will help ensure that the collaborative research results are useful to the smallholder.

Strategy Element No. 3 is closely related to Strategy Elements 1 and 2. Strategy Element No. 1 will strengthen the process through which improved technologies are developed and ensure their applicability to the problems and desired solutions of smallholders. By making the systems approach an integral part of the training process for researchers, extensionists and trainers, Strategy Element No. 2 will help guarantee that those prepared to work on agricultural productivity issues in the SADC countries in the future will be more effective in doing so.

The following programmes are proposed to reduce or eliminate the above mentioned constraints:

- o Conduct of conferences, workshops and technical meetings;
- o Provision of short course training for staff;
- o Provision of multidisciplinary training for staff required for adaptive research; and
- o Development of food crops, land and water resource management, small ruminants collaborative research programmes.



**4. Strategy Element No. 4: Upgrade national capacity to conduct agricultural policy research and analysis.**

A major constraint, confirmed in the assessment, is the inappropriate, counterproductive agro-economic policy matrix of some of the SADCC governments which discourage, hinder, or prevent smallholder increases in production. A government's economic policy vis-a-vis the agricultural sector is a vital aspect of increasing per capita agricultural productivity over the short, medium and long term. The success of a well focussed, carefully prioritised national or regional research programme cannot be assured unless national economic and agricultural policies provide adequate incentives for increased production.

This strategy element is designed to provide the information and options needed by government to make sound, timely agricultural policy decisions. For example, if an inappropriate price is set by a government for a food crop (e.g., one that is below the cost of production or imports), it does not matter how attractive and well adapted the agricultural research package is, the farmer will not use it. Other factors such as lack of inputs and agricultural credit, or malfunctioning or non-existent marketing systems, can prevent the successful application of new technologies from bearing productive results and waste research and extension investments. In addition, over the longer term, shortsighted policies on environmental and ecological questions, assignment of a low budget priority to research in relation to other development activities, and permitting uncoordinated research and extension to continue, can prevent an increased contribution by the agricultural sector to national development.

The collaborative process provides for careful consultation, exchange of information, definition of the subject requiring research, and benefit from other SADCC country experiences. Out of this process (i.e., conferences, meetings, technical sessions, etc.) will come a consensus on how better to provide vital economic and related information to policy makers. These steps would lead to a collaborative research programme on agricultural economics and policy analysis, through which issues requiring specific research could be analyzed and resolved. The result would be African managed research closely attuned to the needs of the SADCC countries.

The following programmes are designed to assist in, and make possible, a process of providing SADCC country governments with better information and a basis for decisions which are more apt to result in achieving national agricultural goals.

- o Conduct of conferences, workshops and technical meetings;
- o Provision of short course training for staff; and
- o Development of an economic and agricultural policy collaborative research programme.

#### D. Regional Strategy Implementation

Eighteen regional agricultural research programmes and activities have been proposed to carry out the above described strategy. They are listed below.

- o Programmes 1 to 6 represent the tools or instruments for establishing programmes and deciding priorities. It is recommended that SACCAR, as CTCAR's secretariat, be mainly responsible for implementing programmes 1 to 6, and assisting in the development of the remaining programmes, 7 through 18. The totality should be looked upon as an interrelated series of actions to establish processes for dealing with the economic, social, cultural and environmental factors affecting the smallholder;
  - Development of policy guidelines and a management system for collaborative activities;
  - Conduct of conferences, workshops, and technical meetings;
  - Establishment of regional professional-oriented and extension/layman-oriented publications;
  - Establishment of a region-wide research data base;
  - Provision of short course training for staff;
  - Implementation of a research grant programme;
- o Programmes 7 through 12 develop the essential professional and technical skills needed by the SADCC countries to achieve per capita increases in agricultural productivity during the next 20 years;
  - Provision of multidisciplinary training for staff required for adaptive research;
  - Provision of training in disciplines critical to collaborative research programmes;

- Provision of advanced training for agricultural technical editors and science writers;
- Development of SADCC capacity in graduate-level training;
- Provision of science training for students entering baccalaureate training;
- Development of appropriate texts and reference materials for certificate and diploma training institutions;
- o Programmes 13 and 14 are high priority collaborative research programmes which can move ahead quickly;
  - Development of a food crop production collaborative research programme;
  - Development of an economic and agricultural policy collaborative research programme;
- o Programmes 15 through 18 also represent priority collaborative research programmes;
  - Development of a land and water resource management collaborative research programme;
  - Development of a farm power collaborative research programme;
  - Development of a small ruminants, swine and poultry collaborative research programme; and
  - Development of a horticulture and specialty crop collaborative research programme.

The above programmes and activities create detailed, SADCC-specific processes which, when taken together, will increase agricultural productivity in the member countries. Some of the programmes are umbrella programmes which provide a framework within which more specific projects can fit. These 18 specific programmes and activities are presented as integral parts of a process which combines substantive activities and the development of in-depth African capability to carry them out. These programmes form a framework for a 20-year strategy. The specific programmes suggest a schedule of activities with sufficient precision and substance to show how they would contribute to significant increases in agricultural productivity.

The proposed 18 regional programmes are designed to implement these four strategy elements so as to reduce or eliminate the constraints hindering increased agricultural productivity. The implementation schedule for these 18 programmes (see Table 9 in Chapter III) looks at each of them from a different perspective. It takes into account the fact that one cannot start all 18 projects simultaneously. Regardless of the priority attached to a specific program, certain preliminary steps must take place initially before it can be designed and carried out; therefore, the sequential list of programmes reflects their implementation in a logical time progression. Chapter III of this regional report contains summary descriptions of each program listed, delineating each of the 18 programmes and activities and giving illustrative dates for the design and start-up of each one.

While the CTCAR has already given its general approval to the strategy and programmes contained in the regional report, the CTCAR will continue to refine and adjust priorities as it develops further the proposed programmes, which are set in a 20 year time frame, in consultation with donor countries, the International Agricultural Research Centers (IARCs), and appropriate international aid agencies such as the World Bank, UNDP, African Development Bank, the EEC, etc.

CTCAR will be greatly assisted in moving this regional programme forward by SACCAR which was created in the fall of 1984, and will act as the CTCAR Secretariat. SACCAR is currently receiving financing from Canada, Italy, Sweden and the United States. Its staff will include a Director, a Manpower and Training Officer, an Information/Publications Officer, an Administrative Accounts Officer, and a Liaison Officer for the IARCs.

**It is recommended that CTCAR divide the 20-year time frame into 5-year plan periods to provide for assessment of progress and mid-course corrections. Both national governments and donors will require this kind of assessment to justify investments.**

An indirect measure of the success of this strategy would be the progress toward achieving food security (i.e., the amount of per capita cereal production needed to catch up and keep pace with population growth for the region). Thus, one measure would be to determine how far the region as a whole had progressed toward meeting the goal of an 82 percent increase in cereals production by 1995, or roughly 6.1 percent per year. Of course, other more sophisticated measures of progress could be added any time or during each five year assessment of progress.

<sup>3</sup>Angola, which is a SADCC member, did not participate.

<sup>4</sup>Comparison of three year averages of 1972-1974 and 1982-1984 taken from Table 2-1 in Annex 2.

<sup>5</sup>The World Bank, Toward Sustained Development in Sub-Saharan Africa--A Joint Program of Action (Washington, DC: The World Bank, 1984), p. 26.

<sup>6</sup>Annex 7 describes the data, calculations and methods used. The annual per capita cereal production rate of 150 kg is commonly used by international specialists in situations where the production is derived principally from the traditional sector with a minimal influence from commercial production.

<sup>7</sup>It is planned that at the conferences and technical meetings each collaborative research group will consider its relationship to farming systems and build this aspect into its programme as appropriate.

## I. REGIONAL ANALYSIS

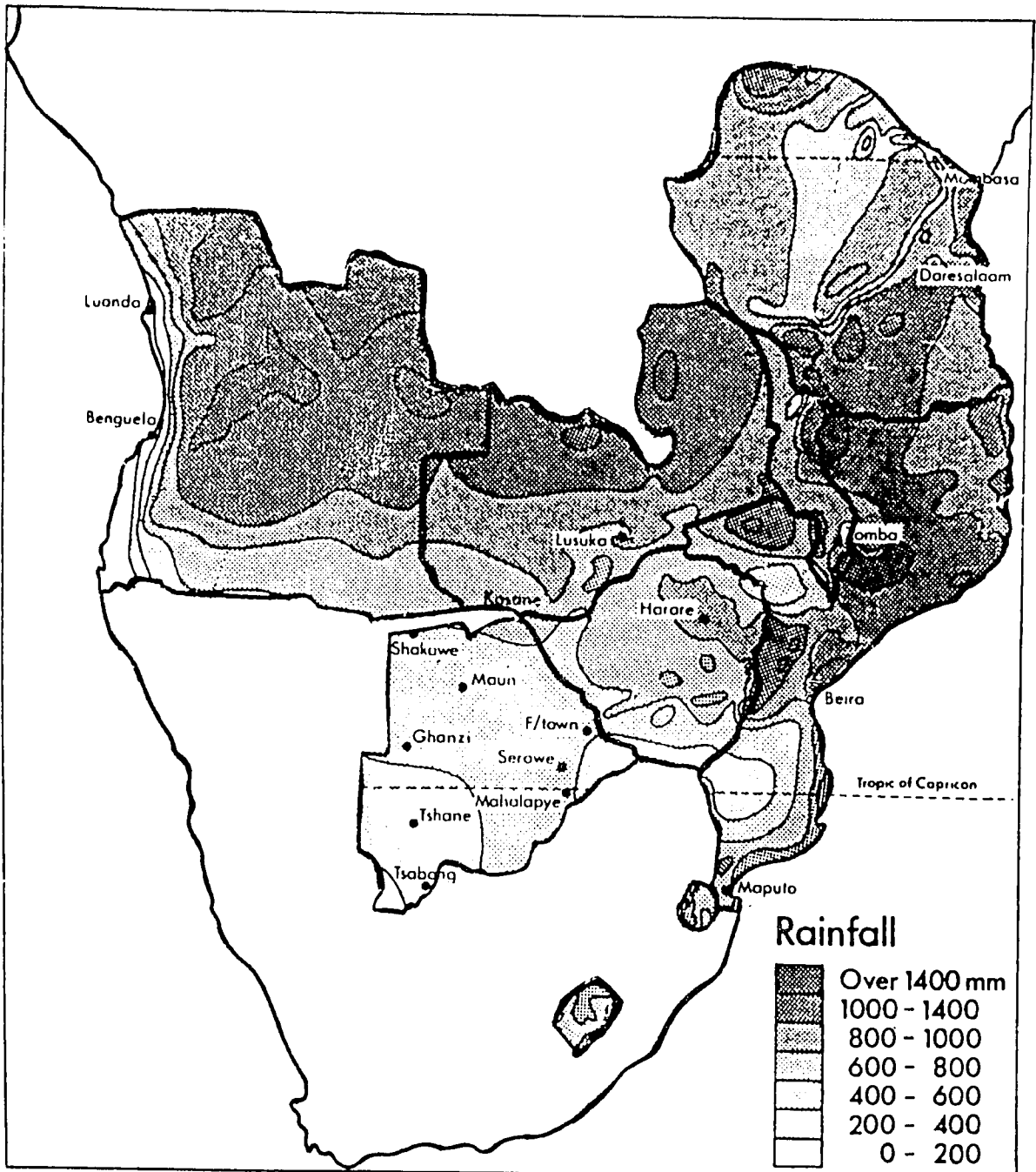
### A. Agricultural Production in Southern Africa and Food Import Requirements

Agricultural production in Southern Africa has experienced recent and consecutive droughts, declining productivity over the past two decades, a disquieting decline in per capita food consumption, reduced income from its export crops, and a continuing disparity in resources accessible to, and productivity and income derived from, the modern commercial and traditional subsistence sectors.

Traditional agricultural production systems which constitute the livelihood of most of the people of the SADCC countries grew out of generations of adaptation to local physical and agro-ecological conditions. Since 1950, efforts to respond to increasing population-led demand have resulted in increases in acreage and total production in the smallholding/subsistence-oriented sectors, but decreases on a per capita basis. Moreover, in the face of rapidly expanding populations, these traditional systems are no longer capable of meeting national and regional food requirements or of generating the income growth and employment opportunities which development in the region requires. The following paragraphs will highlight some of the principal characteristics, concerns and opportunities in the region.

Food production is largely in the hands of the smallholders whose traditional methods of cultivation have not yet been adapted to utilise improved methods of farming and external farm inputs. Most SADCC countries report yields of food crops as unchanged or declining over the past two decades. The FAO has observed that overall food crop yields in the region appear to average 30 percent below levels obtained in Asia and Latin America. The extreme variability of rainfall--both intra-seasonal and inter-seasonal variance--can result in long periods of sub-normal production followed by equally long periods of favourable rains and above-normal production which accentuates variability in yields (See Figure 2.)

It should be recognised that there is a wide variation in the ability among SADCC countries to respond to increasing food demand arising from rapid population growth. Factors which impinge on this ability include: variations in the amount and quality of land per family unit; differing arrangements for access to land; the degree and level of subsistence oriented crop production systems; and the relative importance of traditional cattle production systems. For example, Botswana shows a large hectareage of arable land per family unit, which reflects the use of large areas of the semiarid portions of the country. Likewise, the high number of livestock units per family indicates the extensive use of these essentially dry rangelands, largely through traditional cattle production systems. On the other hand, Swaziland has a relatively high number of livestock units per family which utilise rangelands more intensively, while arable



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Figure 2: Rainfall in the SADCC Countries

cropland per family is near average levels as compared to other SADCC countries. (See Table 1 and Table 2-3 in Annex 2.)

Region-wide, further large expansion in arable land utilised (except perhaps in Zambia and possibly Angola) has severe limitations that would be costly to overcome. Irrigated areas now represent a relatively small part of the arable land and produce primarily high unit-value cash/export crops. While the potential exists for increased irrigation in several countries, this development is constrained by high costs, especially for the large-scale systems. There is also potential for small-scale irrigation.

Thus, in the short term, perhaps within ten years, the best hope for increased output of food lies in introducing yield-increasing technology adapted for smallholder use on existing arable land.

There is no question but that national populations will continue to grow at the rapid pace of about 3 percent per year for the region as a whole. The population of the region is projected to increase from 68 million in 1984 to about 108 million by the year 2000. Thus, the region's population will increase rapidly over the next two decades, an expansion that will complicate the challenge of adjustment and restructuring facing agriculture.

Equally significant, there is also every expectation that urban populations will continue to increase at a growth rate in the neighbourhood of 7 to 8 percent per year. By the end of the century, only 16 years away, urban populations are projected to more than triple in the region. This expansion will greatly increase the demand for food and other farm products. It will require either large increases of imports or a restructuring of domestic production and marketing systems to provide the grains, vegetables, fruits, meats and other products needed. In the same sixteen-year period, rural populations will nearly double. Agricultural production must increase at least in step with this population growth. Otherwise, rural incomes will continue to decline and very serious problems will face the region in the task of providing food for its population.

Commenting on long-term constraints to development, the World Bank in its 1984 report on Toward Sustained Development in Sub-Saharan Africa states:

Improved policies and economic management will succeed only if, in addition to attending to short-term crises, they [the governments] ease the longer-term constraints on development. The growth of population is the single greatest long-term threat to Africa's economic development. Others include the widespread existence of disease; inadequately trained manpower; the slow development of new technologies, especially in agriculture, and



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Table 1: Comparative Selected Characteristics of Agriculture in SADCC Countries

<u>Country</u>	<u>Total Arable Area</u> (000 ha)	<u>Family Units in Agric.</u> (000)	<u>Arable Area Per Family Unit<sup>a</sup></u> (ha)	<u>Total Livestock Units<sup>b</sup></u> (000)	<u>Livestock<sup>a</sup> Units Per Family Unit</u>	<u>Irrigated Areas as Percent of Total Arable Area</u> (Percent)
Angola	2,950	1,238	2.4	3,341	2.7	0.0
Botswana	1,360	118	11.5	2,997	25.4	2.0
Lesotho	292	269	1.1	1,013	3.8	2.0 <sup>c</sup>
Malawi	2,300	1,179	1.9	1,030	.9	2.3
Mozambique	2,850	1,300	2.2	2,046	1.6	1.7
Swaziland	200	83	2.4	839	10.1	2.0 <sup>c</sup>
Tanzania	4,110	3,468	1.2	15,736	4.5	2.0
Zambia	5,100	875	5.8	2,340	2.7	1.6
Zimbabwe	2,465	829	3.0	5,017	6.1	4.0

<sup>a</sup>Calculated from data in source indicated below.

<sup>b</sup>A standardised unit which accounts for differences in forage/feed requirements across species of animals: 1 livestock unit = the requirement for one mature beef animal, whereas one mature sheep would equal .2 livestock unit.

<sup>c</sup>Indicated in source below as estimate.

Source: Training of Manpower for Agricultural and Rural Development in Africa, (Rome: Food and Agriculture Organization, May 1984).

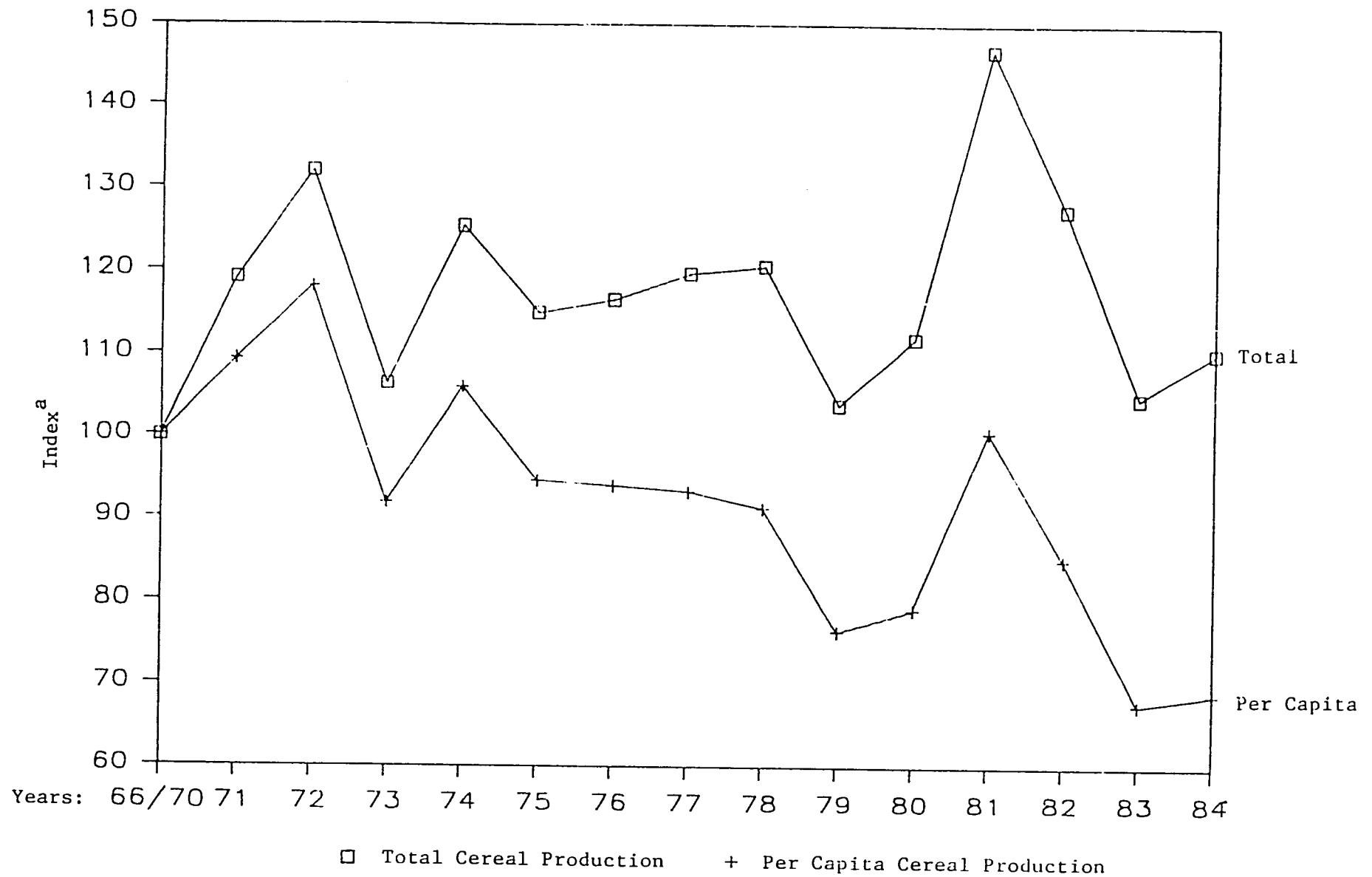
the erosion and deforestation of the land. Many of these basic issues have been neglected or, as in the case of education, programs to address them have often been poorly designed.<sup>1</sup>

On the other hand, if agricultural production and productivity can keep pace with increased population and demand for its products, the farm sector, both traditional and modern, can prosper. In prospering, agriculture would also be providing increased employment opportunities for a growing rural population. A prospering agriculture could spearhead development in most of the region by serving as an expanding market for industrial goods and for financial, marketing and other services of the urban areas as well.

Overall, the region's food balance has deteriorated over the past two decades to the point where food security is a major concern of all the governments. Food production is failing to keep pace with population growth. Over the last ten years cereal production declined 6 percent<sup>2</sup>, while population grew 35 percent. During this ten-year period there has been a decline in total food production as well: total cereal production in the SADCC countries decreased from 7.9 million MT in 1974 to 7.0 million MT in 1984, a decrease of nearly 12 percent. Per capita cereal production decreased from 158 kg to 103 kg, or 35 percent, in the same period. (See Figure 3 and Table 2-1 in Annex 2.) Declines have been much more dramatic in recent years as a result of the worst drought in the century which has reduced both yields and production in most of the countries in four of the past five years.

Food consumption is concentrated in a few staples: cereals--maize, sorghum and millet; root crops--mainly cassava; followed by pulses, groundnuts, and fruits and vegetables. Calories from animal sources are of varying importance among countries, being very important in Botswana and Swaziland but much less important in Malawi and Mozambique. Fish is an important source of protein in Malawi, Tanzania and Zambia.

With population increasing at a more rapid rate than production, the margin of consumption requirements over production has been increasing so that the food balance has become increasingly precarious. The governments of the area, as a result of the growing food gap, have become more dependent on cereal imports to meet domestic consumption needs. Thus, cereal imports have increased from levels of about 375,000 MT per year in 1966 to about 600,000 MT per year a decade ago, to about 1,371,000 MT per year during the past four years. In 1984, regional cereal imports are expected to be about 2,400,000 MT. On a per capita basis, imports have increased from nine kg in 1966 to 12 kg in 1974, to 36 kg in 1984, a 400 percent increase in 18 years. Between 1974 and 1984 the increase was 300 percent. (See Figure 4 and Table 2-2 in Annex 2.)

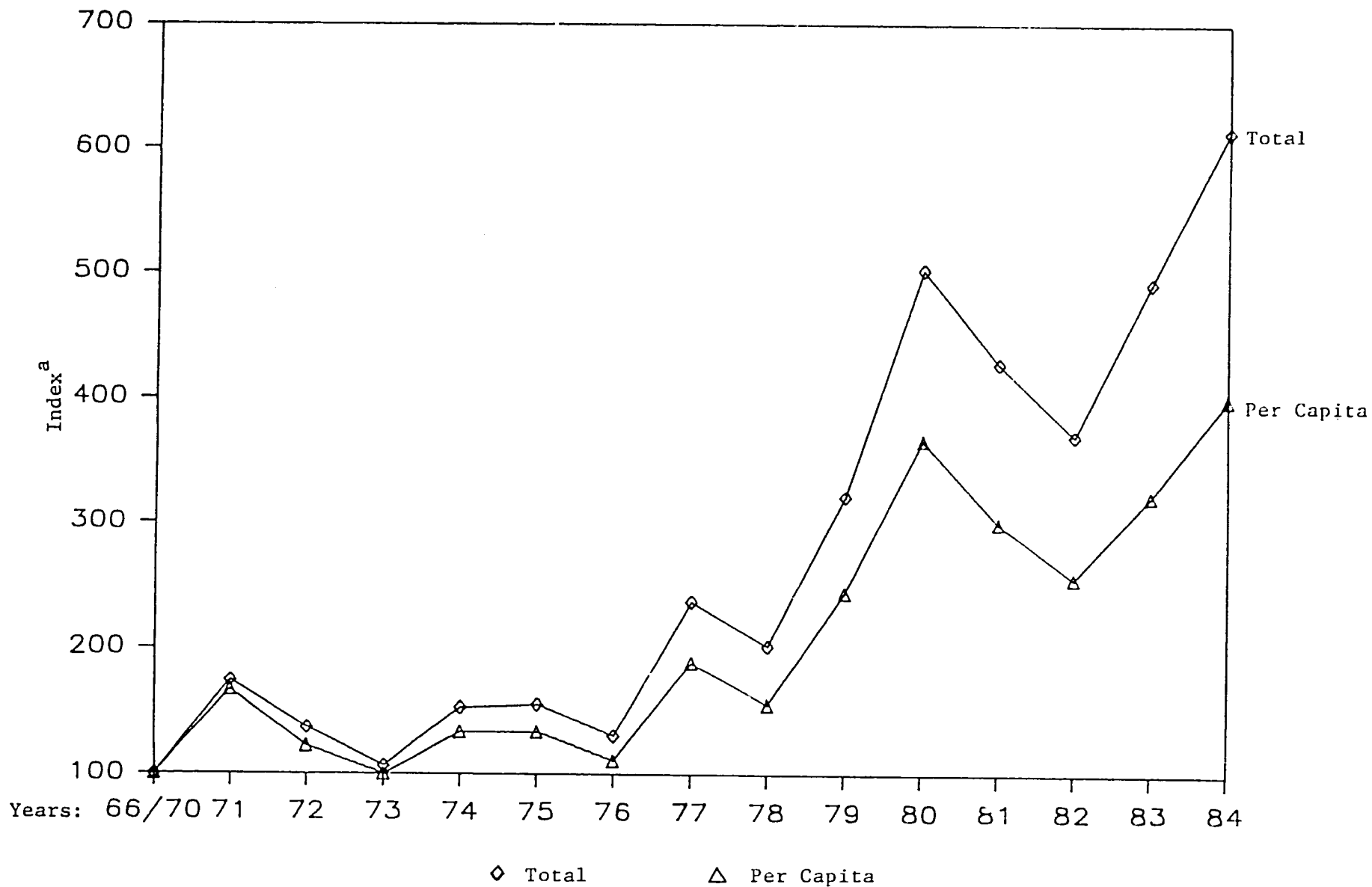


<sup>a</sup> Index base: average production for years 1966-1970 = 100. Figures for 1981 are high due to large maize production increases in Tanzania and Zimbabwe.

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Figure 3: Total and Per Capita Cereal Production in SADCC Countries, 1966-1984.

Source: Table 2-1



<sup>a</sup>Index base: average imports for years 1966-1970 = 100.

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Figure 4: Total and Per Capita Cereal Imports in SADCC Countries, 1966-1984

Source: Table 2-2.

If trends in food production and population growth prevail, as projected by FAO, there will be an enormous increase in the region's dependence on cereal imports to about seven million MT per year by the end of the century. Given the above situation, the low incomes in the region and its limited exports and foreign exchange reserves, the SADCC region is likely to become increasingly reliant on concessional food aid imports. While Malawi and Zimbabwe have been net exporters of food, their own increasing populations will limit their ability to continue as food exporters.

National caloric intake levels of food consumption are below the minimum daily requirement of 2,400 calories generally used by international organisations for many SADCC countries. A national average below the minimum daily requirement for adequate nutrition is significant because it indicates that the poorer segments of the population will be experiencing much greater deficiencies. The changing food preferences of the growing urban population is another factor that will influence future food requirements. The demand for convenience foods and especially for wheat and flour will undoubtedly increase because of the ever more rapidly growing urban sector. Many of these food needs will not be met from within the region, although growing urban demand for such foods may offer opportunities for intra-regional trade to satisfy the demand.

Based on a straight line projection of the cereal production required to keep up with projected population growth for the years 1985-1995 and provide a per capita output of 150 Kg (see Annex 7 for the method of calculation), it is estimated that over this ten year period (1985-1995), the cereal production would need to increase by 82 percent, or roughly 6.1 percent per year on a straight line basis, in order to make up for the production deficit accrued by 1985 and to keep up with the projected increase in population. While this does not take into account livestock production, and many other factors such as variable climate, use of improved farming systems, changing prices of inputs and outputs, development of new technological packages, etc., it is not likely that these factors would alter the fact that formidable effort is required in order to keep up with current population growth rates in the SADCC countries.

The difficult food balance situation highlights the need for governments to place special emphasis on policies and programmes to promote increased food production and food security. In turn, such programmes must be effective in reaching and changing the production patterns and output levels of emerging farmers and other smallholders if domestic food production goals are to be met.

In addition to the above information, Annex 1, Description and Characteristics of the SADCC Region, contains a fuller review of agriculture in the member states including topics such as: physical characteristics, geography, climate and rainfall, population, an economic overview, and agriculture and food production. Also Annex 2, Statistical Data on the SADCC countries, has 23 tables of regional and

SADCC country data on cereal production, food imports, caloric intake, population, socioeconomic indicators, numbers of staff of agricultural research, training and extension institutions, and sources of financing for agricultural research, etc.

## B. Agricultural Research, Extension and Training Institutions

### 1. Historical roots

The research institutions in the SADCC region are an outgrowth of experiment stations established during the colonial period. These were historically focussed on the needs of cash/export crops and large-scale producers which were, at that time, being encouraged by colonial interests. In several countries, Botswana in particular, livestock disease prevention and control received major attention. The experiment stations were directed, and predominantly staffed, by expatriate professionals. During the period of colonial rule, and in early post-colonial times, expatriates continued to provide most of the professional skills, and their research results were often recognised in the relevant professional journals in their home countries. Indeed, much of their work on crops and livestock is recognized as valid today for use by large-scale producers of crops and livestock products.

Until the last decade, the link between research and application was short and direct and was accomplished in the context of the needs of the commercial sector producing non-food crops, mainly for export. The research methodologies and the specific objectives of research tended to be directed at solving problems important to the relatively few large-scale commercially-oriented producers, usually expatriate farm operators and parastatal organisations. The research institutions in SADCC countries have been slow to adapt to making a priority of meeting the research needs of smallholders. Thus, even today, most of their resources are still focussed on issues that are primarily the concern of large-scale commercial agriculture producers.

Single-purpose extension organisations evolved over time which also were closely allied with growers of commercial crops. Some were partially funded and supported by private associations of farmers growing the crop, such as tea-growers, sugar-growers and similar commodity groups. The present public extension services, or agricultural field services, are relatively new in SADCC countries. More broadly based extension efforts for crops and livestock were developed only in the late 1960s and 1970s. The present agricultural training institutions are new also. Except for Zimbabwe, the university systems were established in the late 1960s and 1970s. The technical training schools, some of which were established prior to independence, expanded greatly in number during this period.

The SADCC countries inherited another tradition which remains a strong force today. There is still a lack of communication and relationship between those responsible for research (and extension) on

crops, and those responsible for livestock research and extension. In some countries this division is carried to the extreme of having different ministries responsible for separate research and extension programmes. The division between crops and livestock has made it difficult to establish research programmes to deal with the full range of problems of the smallholder who, in many cases, includes crops and some type of livestock in his/her farming system.

2. Current focus and capacity of research, extension and training institutions

a. The institutional base

Excluding Angola, there are now 30 government research institutions with more than 1,000 professional staff members in the SADCC countries. In addition to these publicly-funded research institutions, there are 18 research agencies in the region which are usually funded from private sources and which, in general, provide research applicable to commercial or export crops, nearly exclusively on the larger farms. (See Table 2.)

The methodologies used and the principal objectives of the individual research projects, in many cases, are addressing problems that are not of the highest priority to the large numbers of smallholders (subsistence farmers) and emerging farmers (small-scale producers beginning to move from subsistence to commercially oriented activities). Individual research projects continue, in varying degrees, to be concerned with solving problems of importance to larger-scale producers. For example, maximising yield may be the principle objective of a crops research project while other concerns, such as resistance to disease or birds, are not considered as part of the research effort even though they are very important to small-scale producers.

Substantial numbers of technical staff now are employed by extension service institutions. (See Table 3.) Certificates in agriculture or animal disease protection are held by 91 percent of this staff. Most are employed as field staff and in systems developed after independence which require them to perform many service functions. Thus, they provide inputs for crop or livestock producers or relay information to rural people on government agricultural policy or goals. More potentially useful tasks such as assisting smallholders with proven and practical innovations or providing assistance during the design and implementation of research efforts on practical agricultural technology are not high-priority activities in many research/extension programmes in the region.

b. Research and extension programmes in place

Tables 2 and 3 and Figures 5 and 6 illustrate the programme foci of research and extension in the SADCC countries at this time. These are reported in terms of the percent of the total

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Table 2: Number of Agricultural Research Institutions, Professional Staff and Programme Focus by Country, 1984

Country	Number of Government Institutions Conducting Research <sup>a</sup>	Number of Private/Parastatal Research Institutions	Number of Professional Staff <sup>b</sup>	Programme Focus: Percent of Total Manpower Assigned to Area <sup>c</sup>				
				Food Crops	Commercial Crops	Livestock	Farming Systems	Other
Botswana	1	-	46	35.0	-	24.0	27.0	14.0
Lesotho	1	-	15	16.7	-	11.1	50.0	22.2
Malawi	3	3	177	13.5	38.0	13.0	7.5	28.0
Mozambique	10	-	79	19.0	29.1	11.4	6.3	34.2
Swaziland	2	4 <sup>d</sup>	24	50.0	12.0	-	23.0	15.0
Tanzania	1	6 <sup>e</sup>	353	32.7	24.0	15.9	3.6	23.8
Zambia	7	-	212	29.0	10.0	26.0	11.0	24.0
Zimbabwe	5	5	222	20.4	33.7	18.7	1.3	25.9
TOTAL	30	18	1,128	27.0	18.4	15.0	16.2	23.4
	==	==	=====	====	====	====	====	====

<sup>a</sup>Figures represent the number of institutions conducting agricultural research described in the country reports. In most cases, one is the agricultural research agency of the Ministry of Agriculture; some are other entities of the Ministry of Agriculture or of other ministries, including universities which conduct agricultural research.

<sup>b</sup>Professional staff total includes both citizens and expatriates with a BSc degree or above. However, administrators are not included in this total, although some of them have degrees.

<sup>c</sup>Programme focus is measured by percent of total professional manpower (FTEs) assigned to programmes or projects in each country. In Botswana, Lesotho and Swaziland, administrators were included in these figures. Totals are average percentages of total manpower assigned to areas for all SADCC countries (excluding Angola).

<sup>d</sup>Staff of these private research institutions are not included in figures for total professional staff or programme focus.

<sup>e</sup>All are parastatals funded by the Government of Tanzania.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.



SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 3: Number of Agricultural Extension Institutions, Professional Staff and Programme Focus by Country, 1984

Country	Number of Government Extension Institutions	Number of Private/Parastatal Extension Institutions	Number of Professional Staff <sup>a</sup>	Programme Focus: Percent of Total Manpower Assigned to Area <sup>b</sup>				
				Food Crops	Commercial Crops	Livestock	Farming Systems	Other
				Botswana	1	-	37	38.0
Lesotho	1	-	49	20.1	-	22.5	-	57.4
Malawi	1	-	124	15.8	22.6	12.0	3.0	46.6
Mozambique	3	-	NA <sup>c</sup>	NA	NA	NA	NA	NA
Swaziland	1	-	29	52.0	-	31.0	-	17.0
Tanzania	3	-	202	71.5	-	-	-	28.5
Zambia	4 <sup>d</sup>	-	107	42.7	-	37.3	-	20.0
Zimbabwe	3 <sup>d</sup>	6 <sup>e</sup>	371	39.2	19.6	15.7	10.0	15.5
TOTAL	17 ==	6 ==	919 ===	39.9 ====	6.0 ====	21.5 ====	2.6 ====	30.0 ====

<sup>a</sup>Estimated professional staff total includes both citizens and expatriates with BSc degrees or above. However, administrators are not included in this total, although some of them have degrees.

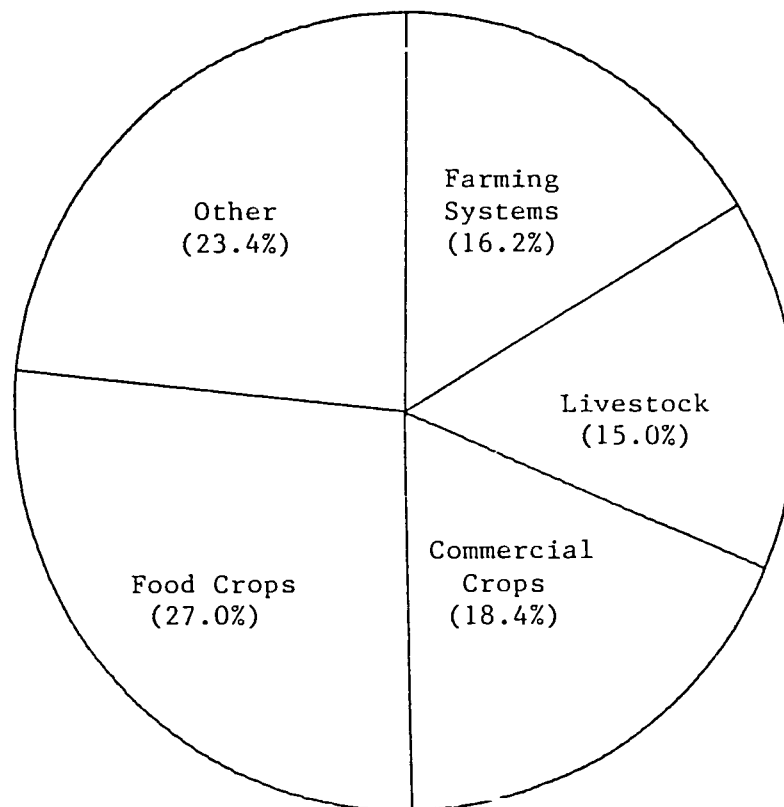
<sup>b</sup>Programme focus is measured by percent of total professional manpower (FTEs) assigned to programmes or projects in each country. Above does not include private extension work in various fields (e.g. Swaziland, sugar cane and citrus; Malawi, tea and coffee; and Malawi, Zambia, Zimbabwe, sugarcane and tobacco). Totals are average percentages of total manpower assigned to areas for all SADCC countries (excluding Angola and Mozambique).

<sup>c</sup>NA = Not Available.

<sup>d</sup>Not all institutions fall under the aegis of the Ministry of Agriculture.

<sup>e</sup>Staff of these institutions are not included in figures for total professional staff or programme focus.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.



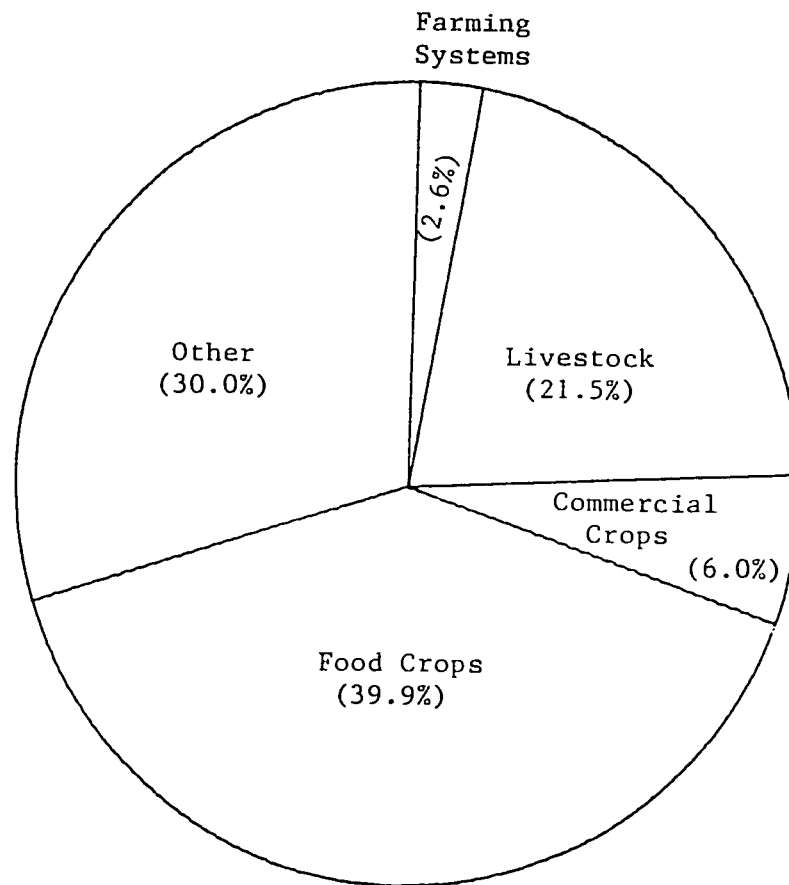
SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Figure 5: Programme Focus<sup>a</sup> of Agricultural Research Institutions

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<sup>a</sup>Programme focus is measured by percent of total professional manpower assigned to each area.

Source: Table 2.



SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Figure 6: Programme Focus<sup>a</sup> of Agricultural Extension Institutions, 1984.

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<sup>a</sup>Programme focus is measured by percent of total professional manpower assigned to each area.

Source: Table 3.

full-time equivalent (FTE) professional effort spent in several programme categories. A comparison of the region-wide research and extension efforts according to programme area is as follows: efforts related to the production of food crops (research 27 percent, extension 40 percent); livestock production (research 15 percent, extension 22 percent); commercial crops (research 18 percent, extension 6 percent); farming systems (research 16 percent, extension 3 percent); and other areas (research 23 percent, extension 30 percent).

With the exception of Lesotho and Malawi, more than 19 percent of the available professional skills in each country was devoted to research programmes in food crop production. However, Swaziland devoted more than 50 percent of its research effort to this programme area. Region-wide, about 27 percent of the research professional staff effort was devoted to work with food crops.

Region-wide, about 40 percent of extension professional manpower was engaged in food crop extension. Swaziland and Tanzania both reported that above 50 percent of the staff effort was allocated to food crops extension.

The most noticeable difference between countries is in the professional effort devoted to farming systems research and in the striking difference between time spent on farming systems by research workers as compared to extension staff. Lesotho, Botswana and Swaziland each reported substantial efforts by their research institutions in this work. Zambia also has a modest programme. The remaining countries reported little or very modest effort. There are some problems of definition with this classification and some of the current work in both research and extension might be considered by some observers to meet farming systems criteria. In this report, activities are included in this category only when specifically identified as a "farming systems" project by those reporting the country data.

The data shows that while agricultural research programmes remain strongly focussed on solving the physical/biological constraints to increased production of crops and livestock, there is a trend in the current strategy of some of the countries (not implemented or broadly supported by all the research professionals) to emphasise the introduction of farming systems approaches in smallholder-oriented agricultural research and extension programmes.

The other major areas of programme focus in research and extension were in reasonable balance between countries and in the region. For instance, livestock programmes region-wide were allocated 15 percent of research effort and about 22 percent of extension effort (due in part to the many extension activities in disease and parasite control).

Research on commercial crops remains a strong programme element representing nearly 20 percent of the regional effort. The extension efforts are less with only 6 percent of the staff effort involved. Malawi, Mozambique, Tanzania and Zimbabwe reported the largest effort in research on commercial crops, and Malawi and Zimbabwe in extension on these crops.

On balance, the SADCC countries have made a significant effort to focus research and extension on food crop programmes. There is also a growing movement toward farming systems research but, to date, extension has little involvement in farming systems approaches.

The present capacity of the SADCC countries to train technical and professional agriculturalists includes 15 institutions providing certificate-level training (usually one year of semi-technical training) in crops, livestock, forestry, fisheries or other related agricultural technologies. There are 12 schools which offer a diploma, usually two or three years of technical training. Five universities offer BSc degrees, two of which now have MSc and PhD level training capability. (See Table 4.)

c. Professional and technical personnel

(1) Total manpower

Table 5 shows that the total professional and technical staff reported in the SADCC countries for their agricultural research, training and extension programmes was 20,454. Of this total 15,374 were in extension, 3,804 in research and 1,276 in training. Professional and administrative personnel represented 21 percent of the total. Of the total of 16,201 technical staff (diploma and certificate level), 87 percent were employed in extension institutions. Of the total staff available, 730 were expatriates while 826 were reported to be in training. Of those in training 60 percent were professional and administrative level staff.

As noted above, the certificate and diploma graduates tend to be employed largely in the extension services of the governments with fewer employed as technical assistants in the research or training systems.

(2) Nationals and expatriates

In SADCC countries, expatriates account for more than 25 percent of the professional staff in research, extension and training. (See Table 5.) Fifty-three percent of these are in research positions with 26 percent in training and 22 percent in extension.

In the extension institutions less than 10 percent of the nationals have academic qualifications at the BSc level while nearly all (about 95 percent) of the expatriates have BSc or above qualifications.

SADOC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 4: Agricultural Training Institutions: Staff, Programmes and Enrollment by Country, 1984

Country	Institutions	Number of Teaching Staff <sup>a</sup>	Types of Programmes			Enrollment <sup>b</sup>		
			Certificate	Diploma	Degree	Certificate	Diploma	Degree
<u>Botswana</u>	Botswana Agricultural College	47	Animal Health Agriculture	Animal Health Agriculture	-	57 <sup>c</sup> 47	19 <sup>d</sup> 20 <sup>d</sup>	-
		—						
		<u>47</u>				<u>104</u>	<u>39</u>	<u>-</u>
Subtotal, Botswana								
<u>Lesotho</u>	Lesotho Agricultural College (Maseru and Leribe campuses)	25	Agriculture Rural Domestic Economy Mechanization Forestry	Agriculture	-	60 <sup>c</sup> 35 <sup>c</sup> 22 <sup>c</sup> 18 <sup>c</sup>	34 <sup>c</sup>	
		—						
		<u>25</u>				<u>135</u>	<u>34</u>	<u>—</u>
Subtotal, Lesotho								
<u>Malawi</u>	Bunda College of Agriculture	89	Agriculture	Agriculture	Agriculture (BSc)	162	91	30
		41	Natural Resources College	Veterinary Science		62		
		—						
Subtotal, Malawi								
		<u>130</u>				<u>224</u>	<u>91</u>	<u>30</u>
<u>Mozambique</u>	NA <sup>e</sup>	NA				NA	NA	NA
<u>Swaziland</u>	University of Swaziland, Faculty of Agriculture	42	Agriculture	Agriculture Agr. Education Home Economics	Agriculture (BSc)	40	39 16 35	11
		—						
		<u>42</u>				<u>40</u>	<u>90</u>	<u>11</u>
Subtotal, Swaziland								

SADOC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 4: Agricultural Training Institutions: Staff, Programmes and Enrollment by Country, 1984 (cont.)

Country	Institutions	Number of Teaching Staff <sup>a</sup>	Types of Programmes			Enrollment <sup>b</sup>		
			Certificate	Diploma	Degree	Certificate	Diploma	Degree
<u>Tanzania</u>	Directorate of Training, MDA	389	Agriculture Livestock	Agriculture Livestock		310 205	393 229	
	Directorate of Training, Fisheries	42	Fisheries Boat Building Marine Mechanics Nautical Science Fish Processing	Fisheries Boat Building Marine Mechanics Nautical Science Fish Processing		34 [4] <sup>f</sup> [6] <sup>f</sup> [6] <sup>f</sup> [6] <sup>f</sup>	25 4 4 4 4	
	Directorate of Training, Forestry	33	Forestry	Forestry		97	35	
	Sokoine Agricultural University	137			Agriculture (BSc, MSc, PhD) Forestry (BSc, MSc, PhD) Veterinary Medicine (BSc, MSc, PhD)			172 (BSc) 71 (BSc) 67 (BSc) 80 (MSc, PhD) <sup>g</sup>
	Subtotal, Tanzania	<u>601</u>				<u>646</u>	<u>698</u>	<u>390</u>
<u>Zambia</u>	University of Zambia, School of Agricultural Science	30			Agriculture (BSc) Ag. Economics (BSc)			60
	Natural Resources Development College	29		Agric. develop- ment fields (7 total)		160		
	Zambia College of Agriculture - at Monze	6	Agriculture			140		
	- at Mpika	8	Agriculture			80		
	Zambia Institute of Animal Health	4	Animal Health			100		
	Zambia Forest College	6	Forestry	Forestry		25	25	
	Popota Tobacco Centre	4	Tobacco protection			30		
Subtotal, Zambia	<u>87</u>				<u>375</u>	<u>185</u>	<u>60</u>	

## SADOC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 4: Agricultural Training Institutions: Staff, Programmes and Enrollment by Country, 1984 (cont.)

Country	Institutions	Number of Teaching Staff <sup>a</sup>	Types of Programmes			Enrollment <sup>b</sup>		
			Certificate	Diploma	Degree	Certificate	Diploma	Degree
Zimbabwe	University of Zimbabwe	26			Agriculture (BSc)			166 <sup>c</sup>
	- Faculty of Agriculture				Ag. Research (MSc)			20 <sup>c</sup>
					Food Science (MSc)			10 <sup>c</sup>
	- Faculty of Veterinary Science	18			Agriculture (PhD)			18 <sup>c</sup>
					Veterinary Science (BSc)			18
	Ministry of Agriculture							
	- Branch of Agricultural Education (2 Colleges)	29		Agriculture			80	
	- Branch of Agricultural Education (4 Institutions)	52	Agriculture			610		
	Veterinary Training Institute	4	Animal Health			24		
	Tobacco Training Institute	11		Tobacco Culture				32
Natural Resources Centre	4		Wildlife and Protected Area Management				33	
Cotton Training Centre	7	Cotton Prod.			671			
Subtotal, Zimbabwe		153			1,305	145	232	
TOTAL		1,085			2,829	1,282	723	

<sup>a</sup>Professional teaching staff includes administrators and teaching professional with BSc degrees or diplomas, with the exception of Zambia, which includes only those with BScs.

<sup>b</sup>Figures are for 1982 enrollment, except where noted otherwise.

<sup>c</sup>1984 enrollment.

<sup>d</sup>1983 enrollment.

<sup>e</sup>NA = Not Available.

<sup>f</sup>These figures are projected yearly averages and are not included in total, since programmes began July 1984.

<sup>g</sup>Includes MSc and PhD enrollment for 1982, undifferentiated between fields of study.

Source: Data collected from the DEVRES/SADOC Agricultural Research Resource Assessment, 1984.



SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 5: Total Agricultural Research, Training and Extension Staff for the SADCC Countries, 1984

<u>Institutions</u>	<u>Nationals in Posts</u>	<u>Expatriates</u>	<u>Total Number of Staff</u>	<u>Positions Vacant</u>	<u>Staff in Training</u>
<u>Research</u>					
Administrative	1,043	17	1,060	123	13
Professional <sup>a</sup>	777	355	1,132	142	172
Technical <sup>h</sup>	<u>1,596</u>	<u>16</u>	<u>1,612</u>	<u>154</u>	<u>97</u>
Subtotal, Research Staff	<u>3,416</u>	<u>388</u>	<u>3,804</u>	<u>419</u>	<u>282</u>
<u>Training<sup>c</sup></u>					
Administrative	169	3	172	23	3
Professional <sup>a</sup>	385	173	558	197	114
Technical <sup>d</sup>	<u>538</u>	<u>8</u>	<u>546</u>	<u>56</u>	<u>71</u>
Subtotal, Training Staff	<u>1,092</u>	<u>184</u>	<u>1,276</u>	<u>276</u>	<u>188</u>
<u>Extension<sup>c</sup></u>					
Administrative	409	3	412	37	6
Professional <sup>a</sup>	773	146	919	187	89
Technical <sup>e</sup>	<u>14,034</u>	<u>9</u>	<u>14,043</u>	<u>1,185</u>	<u>261</u>
Subtotal, Extension Staff	<u>15,216</u>	<u>158</u>	<u>15,374</u>	<u>1,409</u>	<u>356</u>
TOTAL	19,724 *****	730 *****	20,454 *****	2,104 *****	826 *****

<sup>a</sup>Professional = ESc or above.

<sup>h</sup>Technical = diploma only, except for Lesotho, Mozambique, Zimbabwe where technical = diploma and certificate.

<sup>c</sup>Does not include data for Mozambique.

<sup>d</sup>Technical = diploma, except for Lesotho, Tanzania, Zimbabwe where technical = diploma and certificate.

<sup>e</sup>Technical = diploma and certificate.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

The data indicate that SADCC countries need to continue to staff technical disciplines with expatriates at this time. It has been difficult (in many of the countries) to find qualified nationals with professional training to fill posts.

(3) The mix of professional disciplines

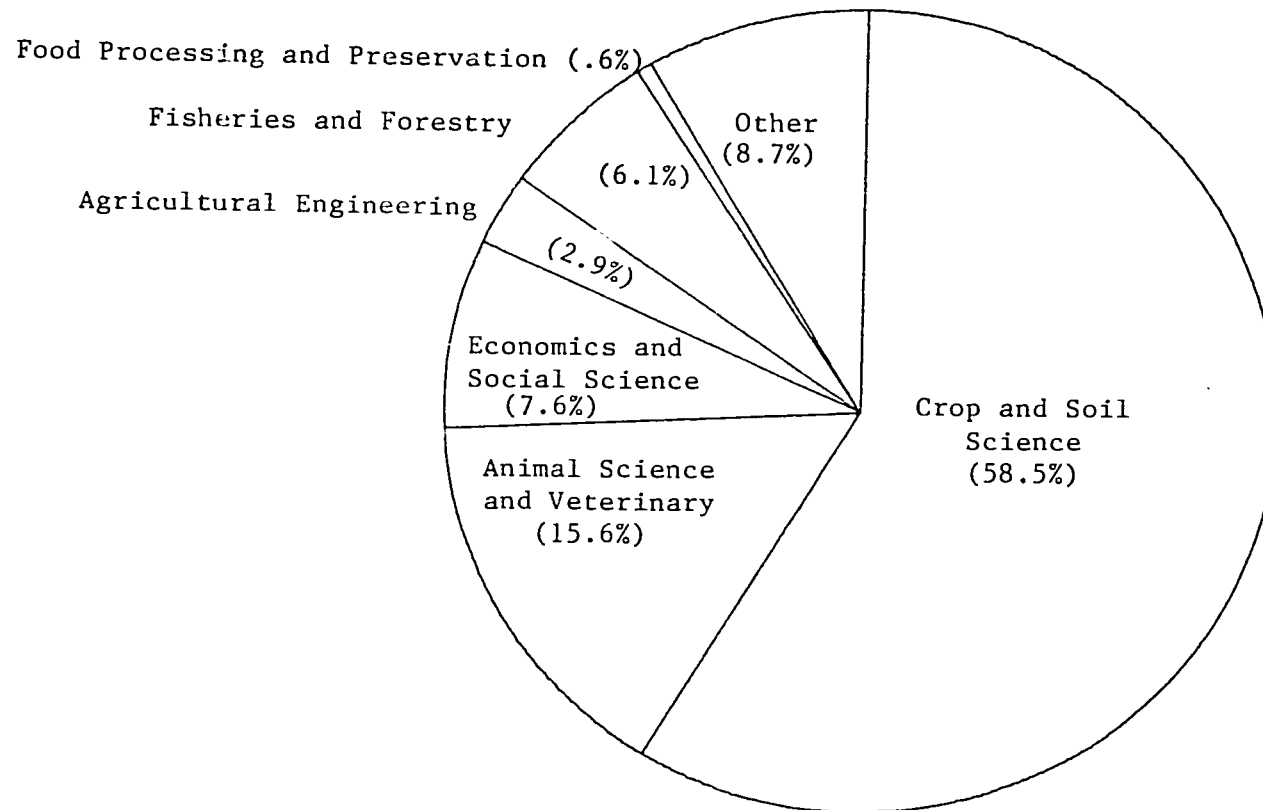
Over 90 percent of all national professionals in agricultural research institutions have studied in disciplines related to plant science, soil science, animal science, veterinary science, forestry and fisheries, engineering and other similar areas. Relatively few professionals in these institutions are in disciplines relating to systems analysis or social science such as agricultural economics or rural sociology. (See Figure 8 and Annex Table 2-12.)

(4) Training for professional staff

In SADCC countries, 375 professionals are now in training. Of this number, 46 percent are from research institutions, 30 percent from training and 24 percent from extension institutions. Nearly all of these are being trained in institutions outside of Africa, mostly in the UK or US. This large number of students is being trained abroad because of the limited capability of SADCC country universities to provide graduate-level training. These universities also lack programmes in some of the disciplines desired at the BSc or graduate levels.

Fields of study of those currently in training compared to those of the staff currently in posts reflect some change in the emphasis in training. (See Figures 7 and 8.) There is a decline in the percentage in training in the crop and soil sciences but a large increase in the animal and veterinary science fields. There is also a decline in percent of those training in agricultural economics, social sciences and agricultural engineering, the disciplines necessary to mount specific high-priority research programmes which have a greater focus on smallholder needs.

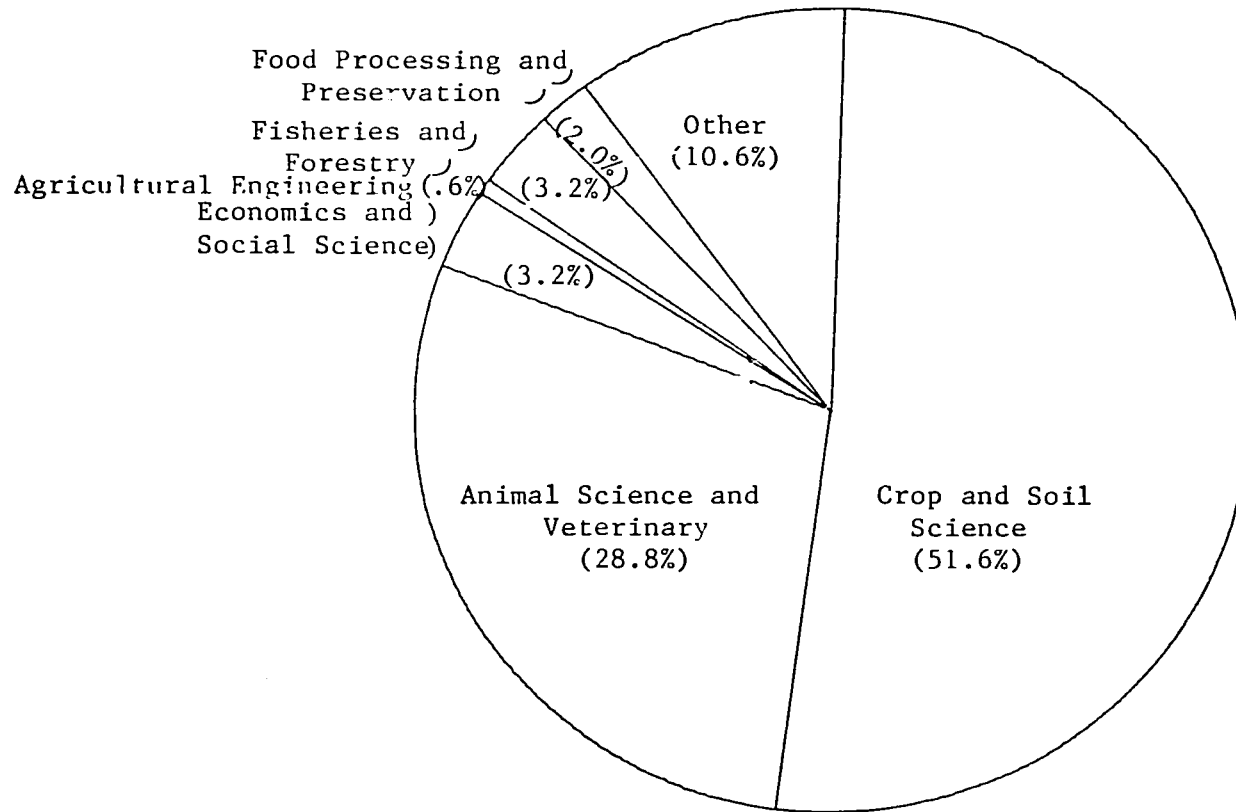
Very few secondary school students in several of the SADCC countries have adequate credentials, especially in the areas of science, to enable them to be accepted into either national (or other SADCC country universities) or in universities abroad. This problem is caused by the fact that there are few secondary institutions in some of the countries with adequate facilities and qualified staff to provide the mathematics, science and biology courses which are essential to securing entry to technical studies at the university level. Some universities in SADCC countries reportedly have had to lower entry standards to alleviate this difficulty. This constraint will continue to affect the ability of the countries to train sufficient high-caliber professionals in Africa or abroad.



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Figure 7: National Professional Staff Currently Posted in Agricultural Research Institutions, by Field of Study, 1984

Source: Table 2-12.



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Figure 8: National Professional Staff of Agricultural Research Institutions Currently in Training, by Field of Study, 1984

Source: Table 2-13

(5) Staff morale and conditions of service

Concerns of professional and technical staff were reported as part of the ARRA. (See Table 6.) Admittedly, these remarks are from biased observers, but the comments were so uniform and widespread that they are worth noting. The staff did not have confidence in the personnel evaluation systems in use. Thus, they did not believe they would receive either financial rewards or promotions based on superior performance. They also expressed their view that the opportunities for advancement and higher salaries were significantly greater in ministries other than agriculture or in firms outside the public sector. They were of the opinion that there should be an allowance or other incentive provided for staff serving in remote posts or where there were other hardships and that greater opportunities for training should be available.

d. Financial support for agricultural institutions

Financial support of the SADCC countries research programmes is summarised in Figure 9.3. The figure shows that there are major differences between SADCC countries in national levels of support for agricultural research and in the percentage of total research budgets supplied by donor funds. Several of the SADCC countries secure a very high percent of their funds for agricultural research from donors (e.g., 82 percent in Lesotho). However, other countries in the region that have lower percentages of donor funding actually receive a larger amount of resources from donors. For instance, Mozambique, Zambia and Zimbabwe each have more than US\$ 8 million in donor funds during the current fiscal year compared to Lesotho which has less than US\$ 2 million during the same period.

Examination of the donor support for research also gives some indication of the donor community's priorities toward agricultural research in the region. It appears, for example, that there is a trend toward funding more integrated or systems-oriented programmes. Strong donor support has arisen for farming systems research and similar projects which use implementation techniques that link research activity to farms and to smallholders themselves.

Donor support for regional projects remains oriented toward traditional programmes such as solving the physical constraints affecting crop production. Present donor commitments and SADCC expectations of funding support for the four regional projects already requested (in food crops, pulses, land and water development and support for a regional research support centre) are examples of the types of activities receiving donor funding at this time.

The ARRA country reports identify donors who are currently active in support of agricultural research. These include:

- o The Food and Agriculture Organisation (FAO) and the United Nations Development Programme (UNDP) of the United Nations;

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Table 6: Staff Assessment of Research, Training, and Extension Institutions in Four Countries<sup>a</sup>

Problems/Criteria	Degree of Seriousness <sup>b</sup>				Number of Respondents		
	Research	Training	Extension	Average	Research	Training	Extension
<b>Budget:</b>							
Consistency of support	3.9	3.8	4.4	4.0	86	59	74
Level of funding	4.4	4.0	4.5	4.3	86	60	75
Release of funds	3.8	3.5	4.1	3.8	86	59	73
<b>Foreign Exchange Difficulties:</b>							
For purchase of parts	4.0	3.8	3.8	3.9	85	56	73
For purchase of equipment	4.3	4.1	4.2	4.2	86	57	73
For purchase of books/journals	3.5	3.7	3.3	3.5	86	57	73
For purchase of special supplies	4.1	3.4	3.5	3.7	85	55	73
<b>Senior Staff:</b>							
Lack of training opportunities	3.3	3.9	3.8	3.7	86	59	76
Lack of interest in further training	1.7	2.0	2.3	2.0	86	59	76
Lack of experience/background	3.2	3.1	3.4	3.2	86	59	74
Lack of motivation	3.0	3.4	3.3	3.2	85	58	75
Lack of leadership	3.0	2.8	3.1	3.0	86	59	76
<b>Junior Staff:</b>							
Lack of training opportunities	3.6	3.9	4.1	3.9	86	62	76
Lack of interest in further training	1.8	2.1	2.5	2.1	86	59	76
Lack of experience	3.1	3.0	3.2	3.1	87	60	76
Lack of motivation	3.0	3.6	3.5	3.4	87	60	76
<b>Support Staff:</b>							
Lack of training opportunities	3.6	3.4	3.8	3.6	87	59	75
Lack of interest in further training	2.1	2.7	2.3	2.4	87	58	74
Lack of experience	3.0	3.1	3.2	3.1	86	59	72
Lack of motivation	3.0	3.3	3.1	3.1	85	58	75
<b>Conference/Meeting Rooms:</b>							
Number of conference rooms	2.5	-	2.8	2.7	85	57	75
Capacity of conference rooms	2.5	-	2.7	2.6	85	56	75
Adequacy of conference rooms	2.8	-	2.8	2.8	85	57	74
<b>Classrooms:</b>							
Number of classrooms	-	2.7	NA <sup>c</sup>	2.7	-	58	NA
Capacity of classrooms	-	2.5	NA	2.5	-	57	NA
Adequacy of classrooms	-	2.5	NA	2.5	-	57	NA
<b>Laboratories:</b>							
Number of laboratories	2.9	3.3	NA	3.1	58	42	NA
Capacity of laboratories	3.1	3.1	NA	3.1	59	43	NA
Adequacy of laboratories	3.2	3.1	NA	3.2	59	42	NA

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 6: Staff Assessment of Research, Training, and Extension Institutions in Four Countries<sup>a</sup> (cont.)

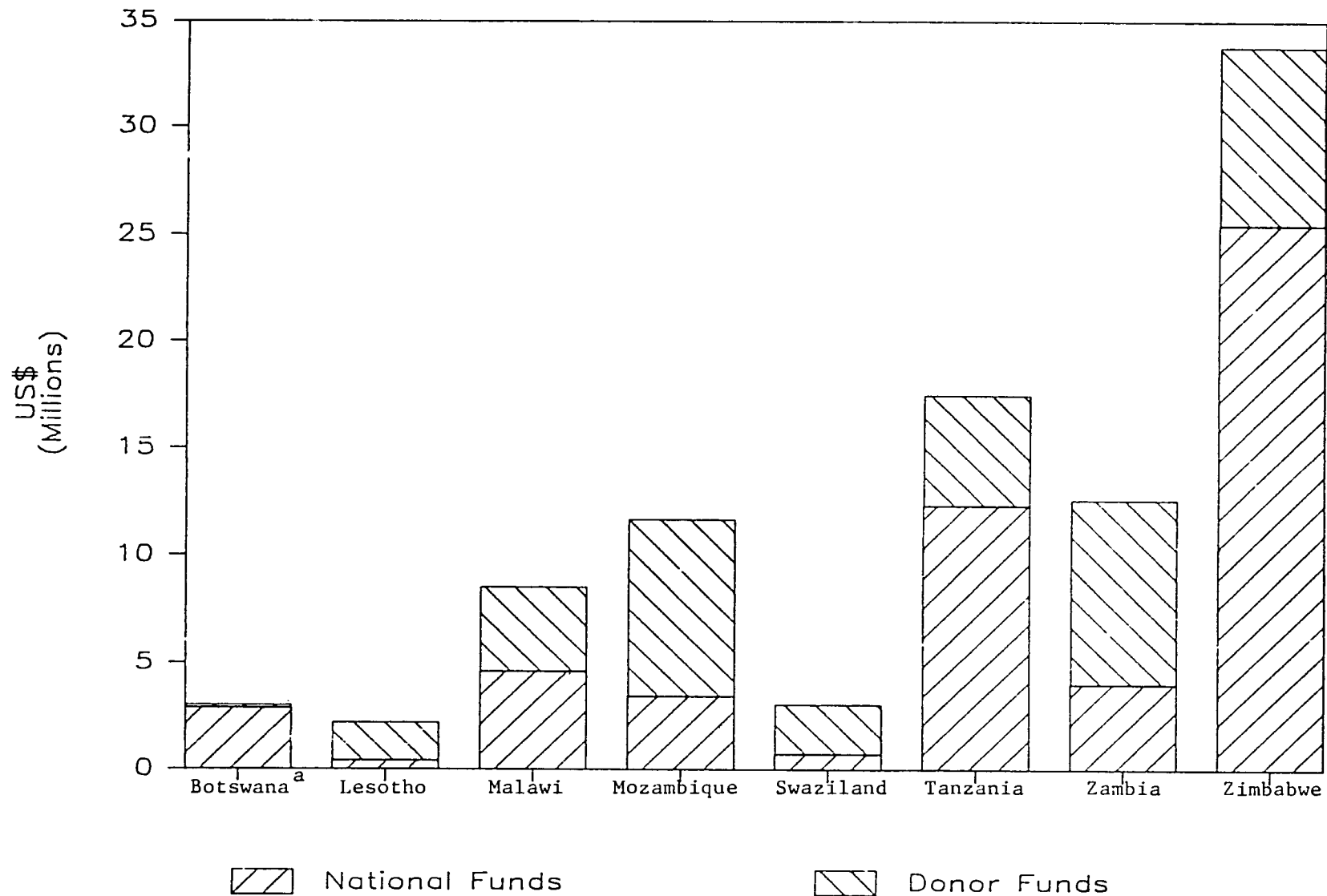
Problems/Criteria	Degree of Seriousness <sup>b</sup>				Number of Respondents		
	Research	Training	Extension	Average	Research	Training	Extension
<b>Offices:</b>							
Number	3.1	3.6	3.4	3.4	85	60	80
Capacity	2.6	3.3	3.1	3.0	87	57	79
Adequacy	2.6	3.0	3.1	2.9	87	57	79
<b>Equipment:</b>							
Insufficient number/obsolescence	4.1	4.1	4.1	4.1	86	56	78
Lack of repair/maintenance	4.3	4.6	4.2	4.4	87	56	79
Funds for essential equipment	4.4	4.8	4.4	4.5	87	60	77
<b>Transportation:</b>							
Budget for operations	3.9	4.1	4.2	4.1	84	56	76
Availability/Access	3.5	4.2	4.4	4.0	86	60	76
Adequacy of allocation	NA	3.9	3.5	3.7	NA	57	75
Maintenance/Care	3.7	3.9	3.7	3.8	85	54	76
Number of vehicles/bicycles	3.9	4.5	4.4	4.3	86	56	78
<b>Staff Housing:</b>							
Number of houses	4.1	4.1	4.6	4.3	83	59	77
Adequacy of staff housing	3.3	3.5	4.3	3.7	82	58	78
<b>Salary Scales/Levels:</b>							
Not sufficient to hold staff	4.3	4.6	4.2	4.4	88	60	78
No differentiation for remote posts	-	-	3.5	3.5	-	-	78
Competition from government sector	3.0	3.0	3.9	3.3	87	60	77
Competition from private sector	4.2	4.3	3.4	4.0	86	59	78
<b>Promotion System:</b>							
Promotion schedule	4.1	4.5	4.2	4.3	85	59	77
Rewards for superior service	4.1	4.2	4.5	4.3	86	59	79
Without higher training certificate	NA	NA	3.5	3.5	-	-	79
Staff evaluation procedure	3.8	4.0	4.1	4.0	84	60	80
<b>Tenure System:</b>							
Tenure security rules	2.4	2.4	3.5	2.8	84	59	78
Tenure for superior young staff	2.4	2.9	2.8	2.7	82	57	78
<b>Other Benefits:</b>							
Leaves of absence schedule	2.0	2.0	2.7	2.2	84	60	76
Health benefits	3.2	3.3	2.4	3.0	81	60	77
Retirement benefits	3.4	3.5	3.6	3.5	83	59	79

<sup>a</sup>Countries included are Lesotho, Tanzania, Zambia and Zimbabwe.

<sup>b</sup>Weighted average of respondent rankings: 1 = Not serious, 5 = Very serious.

<sup>c</sup>NA = Not Available, Not Applicable, or No Answer.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.



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Figure 9: Amount of National and Donor Funding of Agricultural Research, 1983-1984

<sup>a</sup>Current figure for Botswana is not typical because several projects have been recently completed and proposed projects have not yet been funded.

Source: Table 2-19.



- o The World Bank or International Bank for Reconstruction and Development (IBRD), and organisations associated with the Consultative Group for International Agricultural Research, including the International Institute of Tropical Agriculture (IITA), the International Rice Research Institute (IRRI), the International Livestock Centre for Africa (ILCA), the International Food Policy Research Institute (IFPRI), the International Service for National Agriculture Research (ISNAR), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Centre for Maize and Wheat Improvement (CIMMYT), the International Potato Centre (CIP), the International Centre for Tropical Agriculture (CIAT), the International Laboratory for Research on Animal Diseases (ILRAD), the International Centre for Research in Dry Areas (ICARDA), the International Sorghum and Millet Project (INTSORMIL), and the International Cowpea Project, and the International Board for Plant Genetic Resources (IBPGR);
- o The International Development Research Centre (IDRC);
- o The Canadian International Development Agency (CIDA);
- o The Overseas Development Administration (ODA) of the United Kingdom;
- o The United States Agency for International Development (USAID);
- o The Tropical Development Research Institute (TDRI);
- o The Technical Cooperation for Development (GTZ) of the Federal Republic of Germany;
- o The International Atomic Energy Agency (IAEA);
- o The International Soybean Program (INTSOY);
- o The Asian Vegetable Development and Research Centre (AVDRC);
- o The International Centre for Insect Physiology and Ecology (ICIPE);
- o The Centre on Integrated Rural Development for Africa (CIRDAFRICA);
- o The Swedish Agency for Research Cooperation with Developing Countries (SAREC);
- o The Swedish International Development Authority (SIDA);
- o The Danish International Development Agency (DANIDA);

- o The Arab-Technical Assistance Fund (FAAT);
- o The Yugoslavia Maize Institute;
- o The Scandinavian Aid Programme;
- o The German Democratic Republic; and
- o Other donors providing support in agricultural research, including Argentina, Australia, Belgium, the Democratic Republic of Korea, Finland, France, Italy, Japan, the Netherlands, Norway, and the Union of Soviet Socialist Republic.

A listing of donors and a description of some of their activities is described in Annex 3. The individual country ARRA reports, in some cases, provide additional detailed information regarding the individual donor contributions to the country programmes.

e. In-country, intra-SADCC country, and international linkages

(1) Internal linkages between institutions at national level

The research, extension and training staffs and their administrative units in SADCC countries are not sharing their skills and experience in planning and implementing their programmes for increasing agricultural production. Links between crops and livestock professionals and technical staff are, in most countries, virtually nonexistent. These poor linkages must be improved dramatically if efforts to help improve smallholders' welfare are to succeed. Linkages between the Ministry of Agriculture's activities in research and extension in crops and livestock and the training schools or national universities also are very weak.<sup>4</sup> This lack of linkage and resulting difficulty of communications is further complicated in SADCC countries because the universities are administered by Ministries of Education while the research and extension services are under the Ministries of Agriculture and/or Livestock.

One result of the weak or nonexistent linkages between research and extension and training programmes is the underutilisation of existing professional skills. Another is the continuation of research and extension programmes which are less effective than desired and have less impact on smallholders' welfare and productivity than expected.

The reasons why such linkages are not in place and are so difficult to establish are summarised briefly below:

- o There is a strong differentiation and effective separation between crop and animal programmes and institutions. These institutions and their senior staff are not prone to collaborate with one another and in some cases operate duplicative or competitive programmes;
- o There are substantially fewer professionals in extension than in research. As a result, extension staff alleges that the researchers do not accept them as equals, particularly with respect to designing and planning for research;
- o The extension staff are often used as message-carriers or deliverers of supplies. They are not perceived as having the requisite skill and judgment to play a useful role in policy and programme formulation; and
- o Lack of involvement of skilled extension specialists and social scientists in the design and implementation of smallholder research problems tends to result in research designs less sensitive to the opinions, needs and constraints of smallholders than would be desirable.

These conditions nearly preclude the opportunity for linkages to evolve on a professional or collegial basis. Thus, poor linkages between research, extension and training will continue until: the staff of the extension service are upgraded; the extension service is a full participant in the planning and design of programmes (including the training of staff for such tasks); and there is a greater recognition of the valuable insights field-oriented professionals can provide to programme focus.

## (2) Intra-regional linkages

The establishment of the CTCAR by SADCC has brought about a degree of contact and understanding between SADCC country research directors and their assistants which is useful to the region. It also has helped generate broad agreement between the SADCC countries on research priorities and programmes. Unfortunately, to date this process has not yet included the senior-level project staff to any major degree; nor has it included regular participation by training professionals or senior extension staff from the several countries.

The development of regional approaches in research projects for multi-donor support is subscribed to by national governments as SADCC strategy, as evidenced by the creation of the CTCAR and the requests by SADCC for donor support for several regional projects. Most of the SADCC countries also are participants in regional efforts to control pests, such as the red locust, and in regional associations in areas such as land and water development. By these actions and others, the SADCC countries have proven their willingness to work with one

another. They have also demonstrated their continued interest in and ability to collaborate in research investigations.

### (3) Linkages with international agencies

SADCC countries, both individually and regionally, have established working relationships with international agricultural research centres (IARCs) and universities outside the SADCC region. However, the national extension services, and, to a lesser degree, the research institutions, are not yet able to utilise and adapt the information from the international centres to the problems of their agriculture and their farmers. The relationships established have, in most cases, been via short-term professional consultations, field tests of varieties of various crops, and regular correspondence and communications. A recent innovation, the USAID-funded Collaborative Research Support Program (CRSP), is now active in several countries and with several commodities or groups of commodities such as sorghum/millet and beans/cowpeas. This arrangement provides close contacts with several US university research programmes and also provides funds for national scientists' travel to conferences or other important activities.

#### f. Establishment of the Southern African Centre for Cooperation in Agricultural Research (SACCAR)

The recent creation of the Southern African Centre for Cooperation in Agricultural Research (SACCAR) establishes an institution which serves as a focal point for cooperation in the region and coordination of activities in agricultural research. This initiative by SADCC is a positive step toward further regional cooperation and coordination. As a secretariat for the CTCAR, SACCAR will be able to play a major role in facilitating intra-regional and intra-institutional involvement in establishing better linkages. Further, it will be able to relate to the IARCs and donors in order to utilise more effectively their contributions to SADCC countries.

### C. Constraints to Agricultural Productivity in SADCC Countries

Constraints limiting crop and livestock productivity in SADCC countries are numerous and varied and interrelated to each other in a complex pattern that includes physical and biological factors, economic policies and factors, institutional and traditional factors. The first category of physical and biological factors represents the direct constraints while the remaining three categories are classified herein as indirect constraints to increased agricultural productivity. (See Table 7.)

The primary difficulty in increasing regional agricultural productivity is that the agricultural research, extension and training institutions are not geared towards solving the priority issues that concern smallholders who constitute the vast majority of farmers.

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Table 7: Major Constraints to Increased Agricultural Productivity and Strategy Elements to Eliminate These Constraints

MAJOR CONSTRAINTS	STRATEGY ELEMENTS <sup>a</sup>			
	<i>Develop and transfer technology to assist small holders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<u>Direct constraints--physical and biological</u>				
1. Climatic and ecological limitations--irregular and inadequate rainfall; degraded soils. 2. Losses due to pests, weeds and diseases, and post-harvest losses. 3. Lack of crop varieties and livestock species adapted to the local environment(s). 4. Seasonal shortage of human labour and farm power. 5. Insufficient forage, water or access to water for livestock. 6. Inadequate disease and parasite control for large and small ruminants. 7. Lack of technological packages adapted to and suitable for smallholder farming systems, practices, socioeconomic and environmental conditions.	X	X	X	X
	X	X	X	X

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Table 7: Major Constraints to Increased Agricultural Productivity and Strategy Elements to Eliminate These Constraints (cont.)

<u>MAJOR CONSTRAINTS</u>	<u>STRATEGY ELEMENTS<sup>a</sup></u>			
	<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<u>Indirect constraints</u>				
<u>Economic constraints</u>				
8. Inappropriate pricing policies, inadequate marketing infrastructure for inputs and outputs and lack of credit availability for smallholders.				X
<u>Constraints related to rural traditions</u>				
9. Lack of knowledge on part of research, extension and training personnel about smallholder farming systems, practices and traditions (land and livestock holding patterns and low farmer status).	X		X	
<u>Constraints related to the role of women</u>				
10. Lack of delegation of authority to women farm managers by absentee husbands; lack of access of women to government support services, extension, credit inputs, etc.	X	X		

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Table 7: Major Constraints to Increased Agricultural Productivity and Strategy Elements to Eliminate These Constraints (cont.)

MAJOR CONSTRAINTS	STRATEGY ELEMENTS <sup>a</sup>			
	Develop and transfer technology to assist smallholders	Train professionals in research, extension and training	Use a systems approach in agricultural research, extension and training	Conduct research on agricultural policy
<u>Indirect constraints (cont.)</u>				
<u>Constraints related to agricultural research, extension and training institutions and policies</u>				
11. Lack of trained and experienced nationals in professional positions in agricultural research, extension and training programmes.		X		
12. Inadequate number of national professionals trained in needed disciplines such as social sciences, selected biological and physical sciences, and information management.		X	X	
13. Inappropriate mix of needed disciplinary skills among existing agricultural researchers, extension workers and trainers.		X		
14. Inadequate capacity for training in appropriate disciplines at all levels (especially the graduate level) for agricultural research, extension and training personnel.		X		
15. Inappropriate and poorly focused training materials and textbooks.		X		

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 7: Major Constraints to Increased Agricultural Productivity and Strategy Elements to Eliminate These Constraints (cont.)

MAJOR CONSTRAINTS	STRATEGY ELEMENTS <sup>a</sup>			
	<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<b>Indirect constraints (cont.)</b>				
16. Insufficient understanding and capability to design and implement multidisciplinary research extension and training efforts.		X	X	
17. Lack of collaboration between research, extension and training personnel and between them and smallholders.	X		X	
18. Inadequate ability to effectively manage agricultural research, extension and training programmes and institutions, and establish research priorities.		X		
19. Inappropriate orientation of agricultural research (particularly of food crops) toward large-scale commercial agricultural needs, rather than smallholders'.	X			
20. Insufficient research on smallholder mixed crop and livestock farming problems and solutions.	X		X	



SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 7: Major Constraints to Increased Agricultural Productivity and Strategy Elements to Eliminate These Constraints (cont.)

MAJOR CONSTRAINTS	STRATEGY ELEMENTS <sup>a</sup>			
	<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<u>Indirect constraints (cont.)</u>				
21. Lack of training focus on the problems confronting smallholders and solutions for them.		X	X	
22. Inadequate technologies to sustain appropriate private sector activities in support of smallholders.	X			
23. Inadequate national and agricultural institutional budget and staffing policies.				X

<sup>a</sup>Strategy elements are described in Chapter II, Regional Agricultural Research Strategy.

Only recently have the governments started to shift the focus of their agricultural institutions to meet smallholders' needs.

1. Direct constraints--physical and biological

a. Climatic and ecological limitations

Most of the SADCC countries are in a relatively harsh agro-ecological zone where rainfall is low and erratic and much of the soil is of relatively low fertility and already degraded. Although lack of rainfall is not a serious problem in all countries, and in others there are some micro-climatic zones where moisture is not a severely limiting factor, most of the region is affected by shortages and poor distribution of rainfall. A substantial amount of the arable land of the region is in a rainfall belt of under 600 mm which limits both crop and livestock production. In some countries, erratic rainfall, or rainfall that comes too late in the planting and/or growing season, is a greater constraint than total amount of rainfall. Research for varieties that mature in short time periods is critically important for increasing productivity in these areas.

Erosion is a related problem, and is more serious in steeply sloped areas subject to seasonally heavy rainfall and/or overgrazing. In addition, large areas are covered by soils of low fertility and/or low moisture retaining capacity, e.g., the Kalahari sands.

Given the moisture constraints, the potential for substantially increasing crop production is limited unless the area under irrigation is expanded. However, the potential for expanding irrigation coverage is currently limited by the fact that basic information regarding soils and water is sketchy in most countries. A careful analysis of available hydrological data would be necessary before any major irrigation scheme could be designed. Even a movement into small-scale irrigation would need additional study prior to project design.

The land and water resource management regional activity proposed by SADCC has the potential to provide some useful insights and to develop technologies that include an irrigation component. These could be combined with the results of related land management, range management and soils management studies to alleviate constraints due to the lack of moisture. This programme is and should be a high-priority one, especially when directed toward finding solutions to problems directly related to smallholder productivity.

Both cattle and small ruminant holdings are important in smallholder mixed crop and livestock production systems. However, the variable and erratic patterns of rainfall in most cattle-producing areas of the SADCC region limit forage and fodder availability from rangelands. This has a direct impact upon animal nutrition and health and thus on available farm power. Combined with other factors, such as communal patterns of land ownership, it also gives rise to the additional problem of overgrazing which in turn contributes to soil

food supply systems could help alleviate this constraint; this will require better collaboration among crop and livestock research and extension professionals.

The problems of erosion, desertification, and deforestation are further exacerbated by the rapidly dwindling firewood supply. The increased population using firewood for fuel brings with it the attendant destruction of forest and brush land. In addition, the size of the national herds, contributed to by low offtake rates resulting from traditional values with regard to cattle as symbols of wealth and status, often exceeds the carrying capacity of the land. The increased use of boreholes which provide water to herds of cattle in semiarid areas have also contributed to the destruction of forest and brush land.

While this set of constraints may appear longer-term in nature, starting now to find solutions is no less pressing. If these problems are not resolved, lack of protection and restoration of the ecosystem may turn out to be the ultimate constraint to increasing agricultural productivity in the region over the next 20 years.

b. Losses due to pests, weeds and diseases and post-harvest losses

In SADCC countries, as is true in most of Africa, there are several pests or diseases which have for many years restricted access to good land for both crop and livestock production. These pests have been studied for many years. However, to date, there has been little success in developing practical and affordable solutions.

The most problematic pests, weeds and diseases are:

- o Tsetse fly--Infestations of tsetse fly constrain the use of some of the better rangelands in many of the SADCC countries. Two-thirds of the land in Botswana, Tanzania and Mozambique is infested with tsetse;
- o Striga (Witch weed)--This parasite is found in most of the SADCC countries where maize, sorghum and millet are grown.

While perhaps not as serious a problem in SADCC countries as it is in West Africa, the weed affects the traditional food crops of the poorest of the rural populations and, when coupled with low rainfall and frequent drought, is a serious problem;

- o Onchocerciasis (river blindness)--This disease affects only a small part of the SADCC region, particularly Angola;

- o Quela Quela (weaver birds)--In SADCC countries, as in most of Africa, losses due to birds is a continuing problem. Aside from small boys throwing rocks at them, no economically feasible method of control has been identified; and
- o Other animal diseases--Additional diseases which limit animal production are East Coast Fever (ECF), foot and mouth disease, brucellosis, rabies, african swine fever, new castle, tick and tick born diseases.

Several agencies and institutions are conducting research on methods to control losses, including post-harvest losses, from these pests, weeds and diseases but no solutions appear imminent.

Losses due to pests have a serious impact on agricultural productivity, particularly of smallholders. The thrust of current research programmes emphasising reliance on chemical control of pests is unsuitable for relieving the effects of this constraint on smallholders who cannot afford the required investments in chemicals and application equipment. Since they are mostly subsistence farmers, they do not generate surpluses with which to purchase such inputs even though the initial investment and use might result in surplus production.

c. Lack of adapted crop varieties and livestock species

The lack of crop varieties adapted to the particular agro-climatic conditions of the production regions, especially the drought-prone areas, is a limiting factor. At present, most of the research programmes and field adaptability testing is performed without reference to smallholder systems of farming. It takes little account of the constraints under which smallholders operate with respect to use of land holdings, labour availability and limited access to technology. The research may produce well-adapted varieties to the physical environment but the required management practices are not always well-designed and inputs are not often affordable by smallholders. While the problem may be a physical/biological one, the solution requires focussing upon conditions of smallholder cultivation and not exclusively on crop and species development.

An additional constraint is that there is little information or applied testing of crop varieties and management practices related to the production of fruits and vegetables. These enterprises offer excellent opportunities for some smallholders with access to markets, water and farm labour, but lack of available information limits expansion of this activity. Increased fruit and vegetable production could provide a means for generating additional incomes for smallholders.

Traditional breeds of livestock are considered a constraint to increased livestock production in most SADCC countries except Botswana, which has a relatively well-developed livestock industry. A relevant

If, for example, the purpose of livestock ownership is not for commercial sale, the traditional breeds, which are well-adapted to existing on sparse food supplies and in occasional drought, are suitable for holding as stores of wealth and status. If the purpose of ownership is principally to provide beef commercially to consumers, traditional breeds are not appropriate because their quality does not meet the requirements of the marketplace. Research can improve traditional breeds to better meet consumer requirements. However, until traditions regarding the purpose of livestock ownership change, additional research to improve cattle breeds would not have a large impact on smallholder welfare.

d. Seasonal shortage of human labour and farm power

A recurring constraint to increased productivity is the lack of labour and/or animal power and suitable mechanical devices to meet seasonal labour requirements at planting, weeding and harvest times. These improved devices include plows, tillage tools, planters/drills, harvesters and improved wagons for transport suitable for animal power. The specific concerns identified in each country differ and include: a universal limitation on the area cultivated to the amount of hand labour available by the family for seed bed preparation; in Lesotho, male migration from the rural areas causes shortages of labour, and women and children become solely responsible for farm tasks; and in Malawi, concurrent demands for labour arise in food and cash crops, resulting in one or the other being slighted. Finally, in most countries, despite the well-understood relationship between crop yields and adequate weed control, labour is often not available for weeding at the appropriate time.

Animal power, especially cattle, is not yet widely used by smallholders, for many reasons. Cattle are not often healthy enough for the main tillage due to malnourishment. This occurs because tillage takes place right after the dry, cool season when forage is limited. On the other hand, rural traditions that encourage large livestock holdings also increase the likelihood that cattle could be used to provide animal power. This is an area that could benefit from increased interdisciplinary research efforts.

2. Indirect constraints

a. Economic constraints

The primary economic constraints that hamper increased productivity of smallholder producers are low prices and counter-productive or conflicting pricing policies, lack of marketing infrastructure and insufficient credit or access thereto. In addition, international terms of trade have not been favorable to the SADCC countries in recent years. Low prices and softening demand for many primary products produced in the region have had a negative impact on the member countries' ability to finance development programs.

Some SADCC countries are faced with a particularly serious problem in that there is easy access to food imports from nearby countries which have large-scale, well-structured, and in some cases, subsidized crop production systems in place. The exporting country's advantages in having better marketing facilities and lower prices often result in shipping agricultural commodities to the receiving country at CIF border prices below the costs of production in the importing country. Under such conditions, even if the government has a policy to encourage increased smallholder production, it is difficult to implement because the appropriate price incentives do not exist to engender positive producer response. In some cases, the result may even be a decline in production levels. This has happened, for example, in Lesotho.

Difficulties exist both in marketing output and in the timely delivery of inputs to producers. Marketing costs are high because transport is difficult. The lack of storage and processing facilities increases costs due to greater output losses. In most countries of the region these constraints have a greater impact on smallholders who tend to be located in remote areas.

Smallholders are also disproportionately affected by the lack of credit availability. Few financial institutions exist that are willing to lend to smallholders; this constitutes a constraint on their ability to adopt new technological packages which often require investments in inputs. One of the major difficulties faced by smallholders in securing loans is their inability to furnish collateral because in most places they do not traditionally own their land.

Female-headed rural households are at a particular disadvantage because they have even less access to collateral, which can include cattle.

b. Constraints related to rural traditions

(1) Land holding patterns

Land tenure arrangements prevailing in the countries of the SADCC region are an important constraint to increased smallholder productivity in crops and livestock. Traditionally, every male in the society has the right to use a plot or several plots for crop cultivation and to have access to communal grazing lands for his livestock. This tradition frequently results in fragmented holdings of uneconomic size, unsuitable for improved crop production. The tenure arrangement is too insecure to justify making improvements, or the size of the holdings may be too small to provide economic returns or may require far more labour than is available to produce marketable surpluses of the relatively low-value food crops that are grown by smallholders. The result is smallholder inability to meet the challenges of the expanding demand for food. This land tenure problem is an urgent one. However, to date very little analysis of

alternative policies has been carried out nor has research of the issue been included in the governments' long-term plans and forecasts.

Constraints to crop producers also exist in some SADCC countries where cattle have free access to all land. This makes it difficult for farmers to engage in systems of production that depend on green manure crops or on the salvage of crops' residues for use in feeding stock. Likewise, farmers are reluctant to improve the long-term productive capability of their land because the benefit is distributed communally. Finally, the high stocking level leads to overgrazing which degrades to soil and causes further injury to the fragile agro-ecology of the region.

### (2) Livestock holding patterns

In many countries cattle are not generally held for commercial purposes by smallholders but as a stock of wealth and for status. Hence, value is placed on the number of cattle held and this results in overstocking and overgrazing. Existing management practices such as not providing cattle with food supplements and medication are constraints to production but they are not likely to be resolved effectively until traditions with respect to cattle holding change. In addition, traditional land tenure patterns of communal grazing lands are a disincentive to good herd management practices, including health practices, by individual families. Meanwhile, the tradition is a constraint to generating increased incomes. Finally, the tradition of using young boys for cattle herding limits the boys' educational opportunities. This can become a long-term constraint for it reduces their ability to accept technological change by making it more difficult for them to understand and use technological innovations.

### (3) Low farmer status

The tradition of assigning a low status to farming is a constraint to the entry of technically trained young men and women into the agricultural sector. It has been found, for example, that virtually none of those who received certificate or diploma-level agricultural training are engaged in agriculture. There is a lack of enthusiasm for agriculture as a worthy occupation and only those who have no other options are apt to remain.

#### c. Constraints related to the role of women

Traditionally, in many of the SADCC countries women are responsible for food crop production and men for the livestock and cash crop production. Because of these strict divisions of labour, food crop production is negatively impacted when women are unable, because of other responsibilities, to provide adequate labour at the appropriate time for weeding. Even if they are already overworked in performing the many household tasks they are also responsible for, the men will not assist them. An additional problem is that men have the

sole responsibility for decision-making on crops to plant, time of planting, and proper cultivation practices. Women have difficulty accessing government support services, extension, credit, inputs, etc. This becomes a serious constraint in countries where the men migrate to urban areas or outside the country but still retain decision-making rights in absentia. The resulting delays in weeding and harvesting are often critical in adversely affecting crop yields.

d. Constraints related to agricultural research, extension and training institutions and policies

The constraints listed in this section have already been discussed in an earlier section of this chapter. Hence, they are only mentioned briefly here.

(1) Lack of trained and experienced national professionals

Expatriates account for more than 25 percent of the professional agricultural institutional staff, most of them in research. One difficulty of relying on expatriate staff is the lack of continuity in programmes. Another is that expatriate staff tend to focus on commercial agricultural activities instead of on needs of emerging farmers and smallholders. Although 75 percent of the professional staff regionally are nationals, they lack higher training and experience. They represent an inappropriate mix of disciplines and there is an insufficient number in specific disciplines that are urgently needed. The number of trained professionals is limited in disciplines such as social sciences and information management. Furthermore, there is insufficient understanding and capability to design and implement interdisciplinary research and extension efforts.

(2) Inadequate capacity and orientation of training

Within the region the overall capacity for graduate training is limited; especially serious is the lack of graduate training opportunity for several disciplines critically needed to fully staff the research programmes in the region. Although there are emerging strengths in several countries, up to now mechanisms for sharing capacity within the region have not developed.

At the baccalaureate level as well, there are wide variations in capacity among SADCC countries to produce sufficient training for developmental needs. The possibility of sharing capacity between countries has not been exploited to the extent it might be. There is also a need for a curriculum which will permit sub-specialisation in several baccalaureate programmes (i.e., majors in farm management, agricultural marketing, agricultural credit) to provide skills for building the infrastructure components required for the smallholder sector. In several countries the science background of entry level students was deemed deficient.



While diplomate and certificate-level training capacity is generally adequate in terms of numbers required, its focus on development is hindered by the use of textbooks which lack sufficient relevant content appropriate to SADCC country conditions. In some instances, curricular revisions may be needed as well.

(3) Lack of institutional collaboration and linkage with smallholders

The isolation of research and extension institutions from each other and the separation of crop and livestock institutions and their respective research and extension services has resulted in unsuitable policies, research that does not account for the actual situation of smallholders, and extension efforts that disseminate technology that does not work. This pervasive lack of adequate linkages, then, constitutes a constraint to achieving greater agricultural productivity among smallholders.

(4) Institutional focus upon the commercial rather than the smallholder sector

Despite government policies in most of the SADCC countries to develop smallholder agriculture, much of the agricultural institutional capabilities until recently have been focussed upon production in the commercial farming sector. Since independence, most countries rapidly expanded the extension staff for the purpose of serving the smallholder. However, insufficient attention was given to building linkages with the research staff to build the appropriate focus over time. It has been a slow and difficult process to shift institutional resources into helping the smallholder sector. Specifically, research and extension information related to smallholder mixed farming systems is inadequate. This affects the development of appropriately adapted technological packages that would facilitate technology transfer to smallholders.

(5) Inadequate national and agricultural institutional budget and staffing policies

Deficiencies in the level and timing of funding is a constraint that affects all aspects of institutional work, as do staffing policies. The effect of low and uncertain budget allocations results in discontinuities in research programmes and the inability to carry them out effectively. It also results in low salaries, lack of adequate equipment, insufficient building and equipment maintenance and lack of adequate transport which particularly affects extension work.

The terms and conditions of service of the staff at the institutions represent a further constraint. Problems include lack of an appropriate salary structure and system of promotions to provide incentives. Civil service policies are sometimes insensitive to the problems of posting in remote areas, and lack of staff housing is also cause for dissatisfaction.

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<sup>1</sup>The World Bank, Toward Sustained Development in Sub-Saharan Africa-A Joint Program of Action (Washington, DC: The World Bank, 1984) p. 26.

<sup>2</sup>Comparison of three-year averages of 1972-1974 and 1982-1984 of cereal production data in Table 2-1 in Annex 2.

<sup>3</sup>An unusual characteristic of the data should be noted. In Botswana the reporting year (their current budget year) coincided with the end of the major donor-funded projects and new projects under consideration were not yet on-stream. As a result, the comparisons of national budget funding and donor funding may be understated, and the data may not reflect Botswana's ongoing support level or the correct relationship between national support and donor support. This factor also affects these same relationships for the SADCC-wide figures.

<sup>4</sup>In one of the SADCC countries, two extension or field services operate parallel programmes but are unable to provide inputs for one another to the same farmers. In another country, a university is assisted by a donor in an agricultural project in which the support is given to a faculty member of the institution who has no contact with the national agricultural research station or even with his own University's Faculty of Agriculture.

## II. REGIONAL AGRICULTURAL RESEARCH STRATEGY

### A. Objective

The principal objective of the 20-year strategy for agricultural research is to achieve a significant increase in per capita agricultural output, thus increasing the well-being of the citizens of the region and promoting national food security in the SADCC countries. Another important objective of the proposed strategy is to ensure that in the long-term, the means for attaining this per capita increase in agricultural production are developed, adapted and implemented by African institutions.

Both objectives are consistent with the proposals of the Lagos Plan of Action of the Organization of African Unity (OAU) and with the views of the CDA members, the UN and the World Bank. The SADCC member countries and CDA donors have agreed that an essential element in achieving these objectives is strengthening agricultural research capability in the region. Thus, means must be found to increase agricultural productivity to more than offset the region's rapid population growth while also sustaining its fragile natural resource base. Moreover, these means must be rooted in African institutions and implemented by SADCC at national and/or regional levels if food security goals are to be reached and sustained in the long term.

### B. Proposed Strategy Supports National Development Goals

Virtually each country in the region has enunciated development goals which stress food security, employment generation, and improved per capita income. Since the largest segment of the population in each of the SADCC countries is engaged in agriculture, the enhancement of food security and increased rural incomes requires substantial increases in agricultural productivity by this group. Forty-one million persons, or 71 percent of the population in the SADCC region, are engaged in agriculture. In Botswana, Lesotho, Malawi, Swaziland and Tanzania, over 80 percent of the population is directly dependent upon agriculture, reflecting the great importance of agriculture to the people of the SADCC countries. (See Annex Table 2-6.)

Characteristics of agricultural production vary by country depending on the climate, natural resource endowment, and historical and cultural factors relating to land tenure and use and agricultural production systems. In all countries, smallholders predominate in the production of the traditional food crops. For example, 85 percent of the maize in Tanzania, 93 percent of sorghum in Botswana, and 81 percent of all agricultural outputs in Malawi are produced by this segment of the population. Commercial production of several food crops, as well as the traditional cash crops, is relatively more important in the more diversified economies of Zambia and Zimbabwe. On the other hand, the smallholders produce a significant percent of cash crops for export in several countries, especially Malawi and

Tanzania. In livestock production, the smallholder sector is also by far the predominant sector.

Except for a relatively small number of private and public estates, virtually all of agriculture is in the hands of smallholders in Lesotho, Malawi and Tanzania. The number of large commercial estates is small in the three countries, while traditional family units in agriculture are reported to number 269,000 in Lesotho, 1.2 million in Malawi and 3.5 million in Tanzania.<sup>1</sup> Botswana and Swaziland report 360 and 790 commercial farms, and 80,000 and 42,000 traditional farms, respectively. The number of farms reported by Zambia is 607,000. Of these only 730 are classified as large-scale commercial farms and 21,000 as medium-scale commercial farms. There are some 463,000 traditional farms and 122,400 small-scale commercial farms (1-10 ha). These small-scale commercial farms can properly be called the emerging farm sector. Zimbabwe, even more than Zambia, has highly organised commercial agricultural production and marketing systems. However, the traditional sector, where less development has taken place, is comprised of more than 820,000 families, and contributes only 15 percent of the cash agricultural economy.

Throughout the region, crop and livestock yields of the smallholders are well below those obtained by the commercial sector. Consequently, the per capita income of smallholders is among the lowest in each country. Their contribution to the marketable surplus of food grain in most countries is relatively minor thus increasing the dependence of urban populations on external sources of food supply.

The relative importance of the constraints to smallholders' achieving higher yields of selected food crops and livestock was obtained from knowledgeable persons in each country. (See Annex Tables 2-20 to 2-24.) Respondents rated the constraints according to importance in achieving higher yields and productivity and gave those constraints associated with economic, traditional and institutional factors the highest ratings. In addition, most respondents indicated that yield increases in the range of twice to three times current yield were possible in the smallholder sector.

By attributing great importance to the economic, traditional and institutional constraints, the respondents showed their awareness of the preeminent role of these factors in overcoming barriers to increased agricultural productivity. Therefore, the strengthening of the institutional capability to discover new insights on dealing with these constraints, to develop and adapt technology appropriate for use by the smallholders, and to communicate it to them is of highest national priority.

Since most food production in each of the SADCC countries is by smallholders, a small increase in productivity of this sector by the use of yield-increasing technology and more effective farming systems would result in a substantial increase in total national agricultural production.

In summary, when the potential for increased food production in rural areas is realised, it will contribute greatly to:

- o The welfare of the rural population;
- o Marketable surpluses of food crops, which can then be available for the urban population at lower prices, and of export crops;
- o Increased per capita GNP;
- o Increased foreign exchange earnings and savings;
- o Lessened imported food requirements; and
- o Increased employment in rural areas.

Implementing the strategy recommended in this report, which enhances capacity of national institutions to deal with constraints facing smallholders in food production, is essential if the SADCC countries are to achieve national development goals, especially with respect to their food security objectives.

In this context, it is important to understand that among the SADCC countries there is wide variation in the potential for food production. Botswana, Lesotho and Swaziland, for example, will have difficulty in achieving food self-sufficiency because of the biological limitations of their available arable land and the unreliability of their rainfall. Other SADCC countries, however, have the natural resource base to make self-sufficiency possible. It is more realistic, therefore, for some SADCC countries to seek food self-sufficiency while others might best seek economic self-sufficiency.

#### C. Strategy to Increase Agricultural Productivity in Southern Africa

The regional agricultural research strategy presented here is designed to increase agricultural productivity and to ensure that such increases, in the long term, are brought about by African-controlled and managed institutions. Implementing this 20-year strategy will greatly strengthen the national and regional capacities of African institutions to carry out effective research, extension and training. This institutional enhancement will enable local and regional institutions to develop and manage the means for attaining the productivity increases needed during the next 20 years.

The strategy included here is based on the detailed analysis of direct and indirect constraints to increased agricultural productivity presented in Chapter I. The strategy was developed conceptually by identifying major regional constraints and determining the best means--strategy elements--for reducing or eliminating them. The strategy elements were then linked to programmes and activities which would translate them into action and thereby achieve the objective of increased agricultural productivity. The resulting strategy and its accompanying programmes, thus, are constraint driven--that is, they are designed to achieve the objective of increased per capita agricultural output by reducing or eliminating the principal constraints hindering attainment of that goal in the SADCC countries and region.

The analysis upon which this strategy is based is sensitive not only to the technical and physical aspects of agricultural productivity issues, but to the socioeconomic and cultural aspects as well. These physical, technical and cultural elements are interrelated at each point of decision that affects agricultural productivity--on the farm, in the processing plant, and at the point of purchase by the consumer. The strategy developed herein is designed to deal with each of these elements and their interrelatedness by expanding the capability of the SADCC countries and region, over a 20-year period, to develop and manage economically viable and yield-increasing technologies that also are appropriate in terms of the cultural and physical attributes of each country and the region.<sup>2</sup>

To achieve this regionally-specific result, the strategy contains both a substantive and a process focus. On the substantive side, the strategy must be effective in increasing agricultural productivity. On the process side, it must be flexible enough to enable African controlled institutions to develop and manage the means for attaining these productivity increases.

To achieve the critically needed increases in agricultural productivity, the strategy calls for redirecting the methodologies and focus of agricultural research, extension and training from commercial agricultural activities to the needs of emerging farmers and other smallholders. The strategy also establishes ways to couple effective research on key issues with the ability to disseminate results to smallholders. With this approach, more agricultural research, extension and training resources can be concentrated on the problems and solutions of this critical group of agricultural producers.

While definitions of smallholders differ for the purposes of this analysis, a smallholder is a farmer who is still using traditional methods, whose production is close to the subsistence level, and who by and large has no marketable surplus. However, among the smallholders, there are usually some who are beginning to use modern methods of production and to produce a marketable surplus. While average farm sizes will vary depending on location,

quality of land, rainfall, crops grown, and livestock raised, these are farms with no more than five to ten ha of land and which often average much less.

Concentrating some portion of available resources on the better farmers within the smallholder segment is of particular interest since resources available to SADCC countries to assist smallholders are limited. Not all farmers are equally: skilled in working their farm, industrious, capable of using new techniques, reliable, credit-worthy, or able to take the risks of using new varieties, inputs and methods. Therefore, one might well consider utilizing some of the scarce resources on those smallholders who are looking for ways to progress and are receptive to change. These smallholders can lead the way and help other smallholders with fewer resources and less initiative, who are not in a position to take any risks, by demonstrating the use and value of the new packages, or systems. By and large, good smallholder farmers are known to the Extension Services in the SADCC countries, and can readily be identified as candidates for priority assistance.

Generally, for the reasons stated above, the programmes proposed in Chapter III focussing on smallholder needs will especially benefit the emerging farmers.

To enhance the capability of African institutions--both national and regional--the strategy's focus is threefold: to create greater individual researcher, extensionist and trainer capacity; to develop institutional capacity; and to develop an adaptive and collaborative approach to research, extension and training. This method addresses the substantive objective above by ensuring that the means of achieving productivity increases fully account for the cultural and socioeconomic setting(s) and agro-ecological conditions of the SADCC nations and region, especially of its emerging farmers and smallholders. It will also strengthen national and regional institutions, engaging them in collaborative research, extension and training activities to sustain progress in meeting the SADCC region food needs.

The strategy takes account of the time necessary to achieve the results needed and expected. The importance of taking a long-term view in addressing problems and fashioning solutions undergirds the strategy and many of the programmes and activities proposed to implement it. However, shorter term and more immediate opportunities consistent with the long-term plan are identified and made part of the overall strategy as well.

The strategy elements reflect the art of the possible. They also take account of the present and projected institutional and human resource bases available, and recognize the SADCC countries' substantial national commitments to provide technical and financial resources to existing programmes and projects and to ones which have already been requested by SADCC agencies.

The overall strategy to accomplish the stated objectives set out above is composed of four strategy elements. (See Figure 10.) These elements, which are presented in detail later in this chapter, are to:

- o Strengthen national and regional capacity to develop and transfer the technology needed to assist smallholders;
- o Increase national capability within the region to recruit, train and retain professionals required in research, extension and training;
- o Develop and strengthen the use of a systems approach to agricultural research, extension and training programmes that focus on smallholder problems and solutions; and
- o Upgrade national capacity to conduct agricultural policy research and analysis directed toward increasing the contribution of agriculture to national development.

The implementation of this strategy will be greatly assisted by the newly created Southern African Centre for Cooperation in Agricultural Research (SACCAR) established by SADCC. This service institution will provide support and information services to the CTCAR of the SADCC countries as the strategy elements are developed, refined and implemented. (See Annex 6 for more information on SACCAR.)

**D. Strategy to Increase Smallholder Agricultural Production in the SADCC Countries**

Table 8 presents the four strategy elements mentioned above, and Table 7 in Chapter I lists the major constraints and relates them to specific strategy elements. The programmes proposed to carry out the strategies detailed below are prioritised by time, and developmental sequence, in the short- and long-term in Chapter III where they are also more fully described.

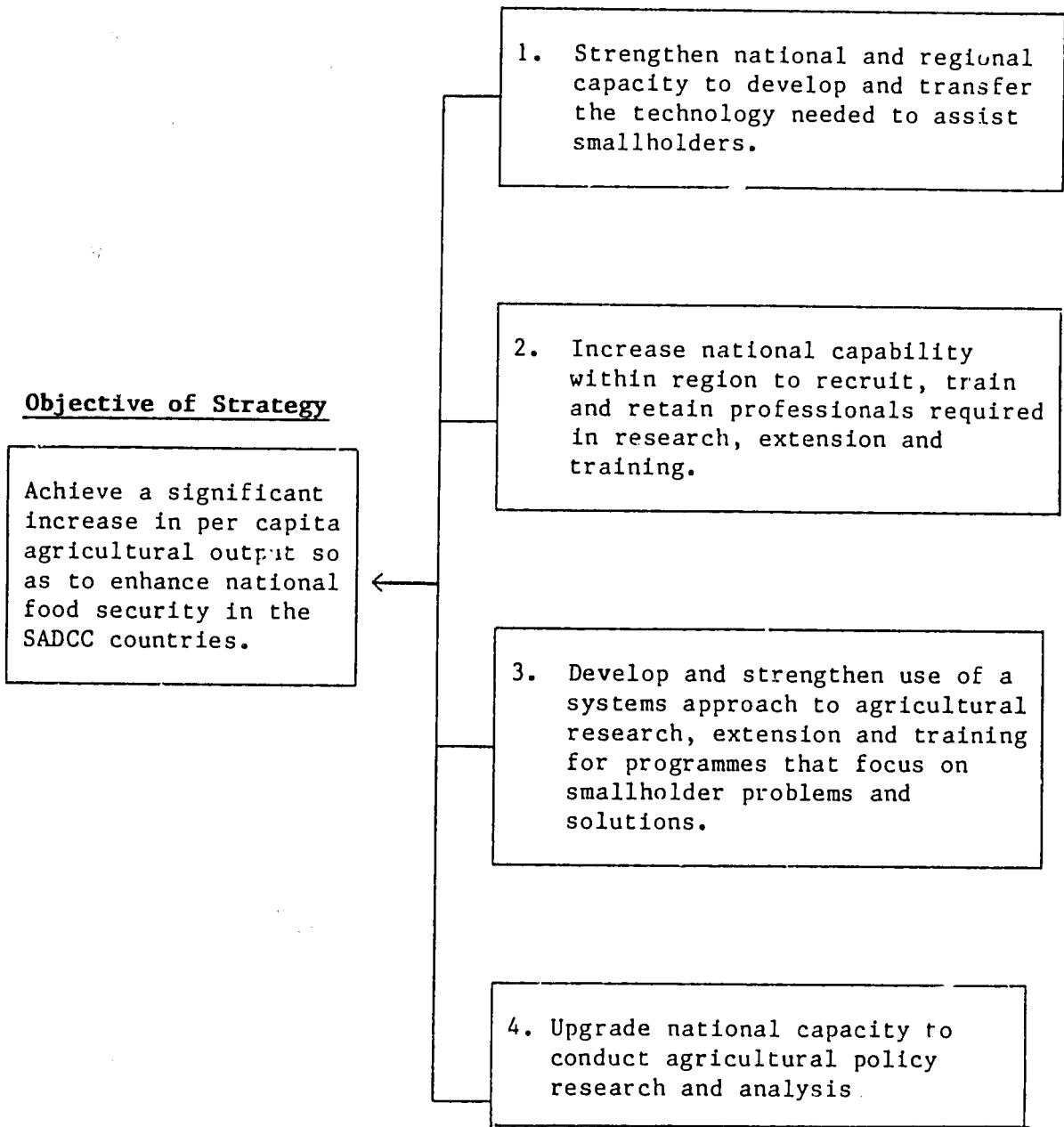
**1. Strategy Element No. 1: Strengthen national and regional capacity to develop and transfer the technology needed to assist smallholders.**

This strategy element is designed to address many of the key constraints hindering the development, adaptation and use of technology to increase the productivity of emerging farmers and smallholders in Southern Africa. The principal constraints addressed by this strategy element are:

- o Climatic and ecological limitations--irregular and inadequate rainfall and degraded soils;
- o Seasonal shortage of human labour and/or farm power;



Strategy Elements



SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Figure 10: Regional Agricultural Research Strategy for the SADCC Countries

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 8: Major Elements of Strategy to Increase Agricultural Productivity and Proposed Programmes to Carry Out the Strategy

PRIORITY	PROGRAMME <sup>a</sup>	STRATEGY ELEMENTS			
		<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<u>First Group</u>					
Activities for immediate consideration	1. Development of policy guidelines and a management system for collaborative activities	X			
	2. Conduct of conferences, workshops and technical meetings	X	X	X	X
	3. Establishment of regional professional-oriented and extension/layman-oriented publications	X			
	4. Establishment of a region-wide research data base	X			
	5. Provision of short course training for staff		X	X	X

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 8: Major Elements of Strategy to Increase Agricultural Productivity and Proposed Programmes to Carry Out the Strategy (cont.)

18	PRIORITY	PROGRAMME <sup>a</sup>	STRATEGY ELEMENTS			
			<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
	<u>First Group</u> (cont.)					
		6. Implementation of a research grant programme	X			
	<u>Second Group</u>					
	Activities for design or re-design and funding	7. Provision of multidisciplinary training for staff required for adaptive research		X	X	
		8. Provision of training in disciplines critical to collaborative research programmes		X		
		9. Provision of training for agricultural technical editors and science writers		X		

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 8: Major Elements of Strategy to Increase Agricultural Productivity and Proposed Programmes to Carry Out the Strategy (cont.)

PRIORITY	PROGRAMME <sup>a</sup>	STRATEGY ELEMENTS			
		<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<u>Second Group</u> (cont.)					
10.	Development of SADCC capacity in graduate level training		X		
11.	Provision of science training for students entering baccalaureate training		X		
12.	Development of appropriate texts and reference materials for certificate and diploma training institutions		X		
13.	Development of a food crop production collaborative research programme	X		X	
14.	Development of an economic and agricultural policy collaborative research programme				X

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 8: Major Elements of Strategy to Increase Agricultural Productivity and Proposed Programmes to Carry Out the Strategy (cont.)

PRIORITY	PROGRAMME <sup>a</sup>	STRATEGY ELEMENTS			
		<i>Develop and transfer technology to assist smallholders</i>	<i>Train professionals in research, extension and training</i>	<i>Use a systems approach in agricultural research, extension and training</i>	<i>Conduct research on agricultural policy</i>
<u>Third Group</u>					
Activities to be undertaken when skills and funds are available	15. Development of a land and water resource management collaborative research programme	X		X	
	16. Development of a farm power collaborative research programme	X		X	
	17. Development of a small ruminants, swine and poultry collaborative research programme	X		X	
	18. Development of a horticulture and specialty crop collaborative research programme	X		X	

<sup>a</sup>Programmes are discussed in Chapter III, Regional Programmes and Activities for SADCC Countries (1985 - 2005).

- o Lack of collaboration between research, extension and training personnel and between them and smallholders;
- o Lack of crop varieties/livestock species adapted to the local environment(s);
- o Lack of technological packages adapted to and suitable for smallholder farming systems, practices and environmental conditions;
- o Lack of knowledge on part of research, extension and training personnel about smallholder farming systems, practices and traditions (land and livestock holding patterns, the role of women and low farmer status);
- o Insufficient research on smallholder mixed crop and livestock farming problems and solutions;
- o Inappropriate orientation of agricultural research (particularly for food crops) toward large-scale commercial agricultural needs, rather than smallholders';
- o Inadequate technologies to sustain appropriate private sector activities in support of smallholders;
- o Losses due to pests, weeds and diseases, and post-harvest losses;
- o Insufficient forage, water or access to water for livestock; and
- o Inadequate disease and parasite control for large and small ruminants.

By reducing, eliminating or adapting to these constraints, SADCC countries will be in a much better position to meet their critical food needs. Thus, the development of a new seed variety that is appropriate in terms of farmers' total resource and value systems may increase productivity substantially. Likewise, artful packaging and dissemination of management and technical practices chosen in light of the traditions and experiences of smallholders may result in their adoption and in greater yields per unit of input.

The technologies needed are special. They must provide smallholders and emerging farmers with feasible alternatives that take into account the limited extent of their soil, water, labour and other resources and their control over these resources. Put another way, the technologies developed for transfer to smallholders must, when applied, increase per capita agricultural output in the agro-climatic, economic, and social environment in which decisions are made at the farm level.

The technologies required by smallholders and emerging farmers, as noted in the introduction to this strategy, are best developed, adapted and disseminated by African institutions. This will require the strengthening of institutions and the training of many more individuals. It also will require regional collaboration among existing African institutions and individuals. This collaborative approach will vest the prioritisation of research efforts to develop new technology in SADCC regional and national institutions and representatives. It also will ensure that the technologies promulgated are sensitive to the agro-ecological and traditional settings in which they will be applied.

Strategy Element No. 1 is closely related to Strategy Element No. 3, use of a systems approach to agricultural research and extension. While having the appropriate technical solution is a condition sine qua non for providing small and emerging farmers with viable technical packages, it is not the final solution in and of itself. Disseminating the technological advance to the farmer in a fashion which is useable, making corrections when it is not, and determining what modifications are necessary to make it fit into the total farm unit or system, are also indispensable requirements. A systems approach, such as that described in Strategy Element No. 3 and involving agricultural research and extension, provides this dimension--i.e., of assuring the practical use of the new innovation or technological advance.

Specific programmes to implement this strategy element are listed below:

- o Development of policy guidelines and a management system for collaborative activities--to assist CTCAR in its role as the regional coordinator for agricultural research and in its related extension and training activities;
- o Conduct of conferences, workshops and technical meetings--to increase information exchange, reduce duplication, establish consensus on research priorities and focus, and eliminate intellectual isolation of researchers;
- o Implementation of a research grant programme--to provide resources for professionals otherwise unable to become involved in problem-solving (especially those in training institutions), and to direct resources to high priority areas not supported by institutional programmes by providing funding on an individual basis;
- o Development of a food crop production collaborative research programme--to support national research programmes and to ensure that adequate research resources at the regional level are brought to bear on each of the key aspects of food crop production for the major crops;

- o Development of a land and water resource management collaborative research programme--to include studies of soil and water resources, range and forage production, ecological problems and other topics;
  - o Development of a farm power collaborative research programme--to address the labour shortage at seeding, weeding and harvest times, a critical problem in all SADCC countries;
  - o Development of a small ruminants, swine and poultry collaborative research programme--to realize the productive potential of small ruminants and poultry. Many issues associated with small ruminants are unresearched; addressing these issues could result in production increases. Moreover, small ruminant management is less constrained by the intractable problem of traditional practices than is large ruminant management;
  - o Development of a horticulture and specialty crop collaborative research programme--to offer special opportunities for increasing family food supply and for incomes of farmers near markets. It also would assist women who in many areas are principally responsible for growing these crops on the smaller farms. Appropriate technological packages suitable for smallholders need to be developed;
  - o Establishment of a region-wide research data base--to provide a higher level of information to those working on technical solutions at national and regional levels, and to provide a means for them to find out about research going on in other SADCC countries. It would also provide information for the appropriate researchers, trainers, and extension supervisors; and
  - o Establishment of regional professional-oriented and extension/layman-oriented publications--to achieve a better means of communication for professionals and lay persons.
2. **Strategy Element No. 2: Increase national capability within the region to recruit, train and retain required professionals in research, extension and training.**

Strategy Element No. 2 addresses not only the objective of increased per capita food output, but also the objective of initiating African-driven research, extension and training as well.

To achieve these objectives, multiple constraints inhibiting increases in per capita food output and deterring the creation of an in-depth African capability to plan, develop, adapt and utilise



research, extension and training must be alleviated. Increasing per capita agricultural output in the long run will require trained research, extension and training personnel able to develop and adapt appropriate new technologies for smallholders and to skillfully convince them to use them. It also will require strengthening national and regional manpower over time, especially with respect to specific disciplines needed in the SADCC region. Without this strengthened local human resource and institutional capability, significant increases in per capita food output in the SADCC region during the next 20 years are unlikely to be realised.

At present, expatriates fill many of the key professional and supervisory staff positions in research, training and extension institutions in SADCC countries. In certain disciplines, only a limited number of country nationals are trained. Nationals with graduate degrees are also in short supply relative to the need. Thus, research now tends to be expatriate- or donor-driven rather than being designed and managed by Africans. Strategy Element No. 2 is specifically designed to solve this problem.

The major constraints this strategy element addresses are:

- o Lack of training focus on the problems confronting smallholders and solutions for them;
- o Lack of trained and experienced nationals in professional positions in agricultural research, extension and training programmes;
- o Inappropriate mix of needed disciplinary skills among existing agricultural researchers, extension workers and trainers;
- o Inadequate capacity for training in appropriate disciplines at all levels for agricultural research, extension and training personnel;
- o Inadequate number of national professionals trained in needed disciplines such as social sciences, selected biological and physical sciences, and information management;
- o Insufficient understanding and capability to design and implement multidisciplinary research and extension efforts;
- o Inadequate ability to manage effectively agricultural research, extension and training programmes and institutions, and establish research priorities; and
- o Inappropriate and poorly focussed training materials and textbooks.

As noted in the earlier analysis of constraints (Chapter I), the above constraints are indirect with respect to increased agricultural productivity and total output levels. However, they must be reduced or eliminated if greater agricultural production is to be realised in the SADCC countries. Moreover, by reducing these constraints, the goal of increasing the capacity of African institutions to formulate and manage successful research, extension and training efforts also will be addressed. As this process unfolds, all the key decisions about research priorities and research, extension and training programmes will be made by trained local professionals working in stronger, indigenous institutions. The regional and collaborative nature of this process will help utilise scarce research resources efficiently and maximise the substantive results obtained from their use. The programmes proposed below to carry out this strategy element will develop the mix of professional skills and institutional strengths needed to reduce the constraints identified above and increase the productivity of smallholders and others in the agricultural sector.

- o Conduct of conferences, workshops and technical meetings--to strengthen existing training institutions, and prepare the way for medium- to long-term programmes (for example, increased graduate-level training in specific disciplines, specialised training programmes, and curriculum revision);
- o Provision of short course training for staff--to upgrade and inform BSc staff on such topics as farming systems research, adaptive research, and smallholder focus. Training courses designed to meet specific management needs at various levels will be an important part of this programme;
- o Development of SADCC capacity in graduate-level training--to meet the regional requirements in selected fields for MSc to doctoral degree-level personnel for research, extension, and training. This will utilise and strengthen existing educational institutions within the SADCC region which have unused capacity;
- o Provision of training in disciplines critical to collaborative research programmes--to fill the gaps in selected disciplines such as agricultural engineering, horticulture, and economics;
- o Provision of science training for students entering baccalaureate training--to enhance entry qualifications, through a university science preparatory course in math, physics, biology and chemistry, for professional agricultural curricula. This will help eliminate the shortage of properly qualified university candidates, and will utilise unused capacity in some of the SADCC area universities;

- o Development of appropriate texts and reference materials for certificate and diploma training institutions--to increase the relevancy of reference materials for smallholders, including refresher courses for teaching staff;
  - o Provision of multidisciplinary training for staff required for adaptive research--to upgrade their skills in adaptive research and to orient their work toward the needs of the smallholders; and
  - o Provision of advanced training for agricultural technical editors and science writers--to prepare materials for professionals, and extension workers and smallholders. There is an acute shortage of nationals trained in this area.
3. **Strategy Element No. 3: Develop and strengthen use of a systems approach to agricultural research, extension and training for programmes that focus on smallholder problems and solutions.**

This strategy element is designed to address the direct and indirect constraints that keep the productive activities of emerging farmers and smallholders from being treated as a system, thus limiting productivity increases by them and reducing the effectiveness of current research, extension and training efforts. The strategy element focusses attention on the on-farm situation of emerging farmers and smallholders where a wide range of conditions, resources and activities influence production decisions. To increase the productivity and total output of smallholders, all of these factors and their interrelations must be understood so that research can be designed to account for their influence as a system and so that research results are applicable in the context of the system. This helps ensure that research conducted on behalf of smallholders is efficient and that new practices based on the research will be effective in the context in which they will be used.

To achieve productivity increases by smallholders requires not only appropriately designed research efforts, but also effective extension/dissemination efforts as well. Both of these efforts are dependent upon the adequate training of research and extension staff. Thus, staff must be given training and experience in effective uses of the systems approach to the problems and solutions of emerging farmers and smallholders. This training of and learning by research, extension and training staff, together with the institutional development necessary to support it, is an important part of the process that will be begun by implementing this strategy element.

Strategy Element No. 3 is closely related to Strategy Elements 1 and 2. Strategy Element No. 1 will strengthen the process through

which improved technologies are developed and ensure their applicability to the problems and desired solutions of smallholders. By making the systems approach an integral part of the training process for researchers, extensionists and trainers, Strategy Element No. 2 will help guarantee that those prepared to work on agricultural productivity issues in the SADCC countries in the future will be more effective in doing so.

The particular constraints that will be reduced by the implementation of this strategy element are:

- o Insufficient research on smallholder mixed crop and livestock farming problems and solutions;
- o Lack of knowledge on part of research, extension and training personnel about smallholder farming systems, practices and traditions;
- o Insufficient understanding and capability to design and implement multidisciplinary research, extension and training programmes;
- o Inadequate number of national professionals trained in needed disciplines such as social sciences, selected biological and physical sciences and information management;
- o Lack of training focus on the problems confronting smallholders and solutions for them; and
- o Lack of collaboration between research, extension and training personnel and between them and smallholders.

The following programmes are proposed to implement this strategy element:

- o Conduct of conferences, workshops and technical meetings --to exchange information and to encourage cooperation among researchers, trainers and extension workers;
- o Provision of short course training for staff--to upgrade and inform BSc staff on such topics as farming systems research, adaptive research, and smallholder focus. Selected management training short courses will meet specific needs for management skills at various levels and types of institutions;
- o Provision of multidisciplinary training for staff required for adaptive research--to upgrade their skills in adaptive and systems-oriented research and orient their work more toward the needs of the smallholders; and

- o Development of food crop, land and water resource management and small ruminants collaborative research programmes--to consider their relationship to farming systems research and add a systems element where appropriate.

4. **Strategy Element No. 4: Upgrade national capacity to conduct agricultural policy research and analysis.**

This strategy element is designed to enable SADCC countries to develop and put into place an incentive system consonant with and supportive of their efforts to increase agricultural output in the smallholder and commercial subsectors. Too often, even the best technological breakthroughs for emerging farmers are offset by higher level policies that negate the benefits of the new technology. To optimise the efficacy and productivity of the new technologies, trained staff, strengthened institutions and a systems approach, these outputs of an effective research strategy must be applied within a policy environment that is at least conducive to significant increases in agricultural productivity. Thus, this strategy element focusses on establishing a strong incentive system to encourage emerging farmers, other smallholders and commercial agricultural producers to increase their productivity and output levels.

To improve the incentive system in SADCC countries for smallholders and others, government officials must have reliable information about the consequences of alternative policy decisions. They must also learn how to utilise policy itself as a powerful stimulus to increased production. Improved policy research capability also is needed in the SADCC countries to avoid contradictory policies. The proposed collaborative research process will enable countries to share information on those incentive systems which seem to be most conducive to achieving their agricultural output and development goals. The SADCC regional forum will initiate a process of policy research, discussion and consideration that will highlight policy's central role in achieving the objectives of this 20-year agricultural research strategy.

The principal constraints that will be reduced by the implementation of this strategy element are:

- o Inappropriate pricing policies, inadequate marketing infrastructure and lack of credit availability for smallholders;
- o Inadequate national and agricultural institutional budget and staffing policies; and
- o Climatic and ecological limitations--inadequate government measures to reduce the impact of these limitations.

The following programmes are proposed to strengthen the capacity of national governments to carry out useful research and analysis on agricultural policy:

- o Conduct of conferences, workshops and technical meetings  
--to enable countries already working in this field to share with those countries just beginning to undertake policy-related research;
- o Provision of short course training for staff--to enable them to analyse and recommend government agricultural policies; and
- o Development of an economic and agricultural policy collaborative research programme--to analyse existing government policies, policy options and their consequences and to develop and provide other relevant policy-related information to policy makers.

Chapter III, which follows, contains summary descriptions of the specific programmes and activities mentioned in this chapter, sets out criteria for their selection, and ranks them in order of logical time progression for action by donors and the SADCC countries.

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<sup>1</sup>Information in this paragraph is from Food and Agriculture Organization, Training of Manpower for Agricultural and Rural Development in Africa, ARC-84-3 (Rome: FAO, May 1984) and ARRA country reports.

<sup>2</sup>Dr. Vernon Ruttan, Agricultural Research Policy (St. Paul: University of Minnesota Press, 1982) p. 17.

### III. REGIONAL PROGRAMMES AND ACTIVITIES FOR SADCC COUNTRIES (1985-2005)

#### A. Overview

There is an overwhelming need for SADCC countries to build effective agricultural research systems in the next two decades. The effectiveness of these systems, however, will not be measured solely on their development of technology. Rather, the meaningful criteria will be the extent to which the technology is adopted by those for whom innovations are intended. It therefore is critical that extension institutions' capabilities and their collaboration with research are also strengthened, to ensure both the applicability of research efforts to the needs of the rural population and the dissemination of technical solutions to farmers, especially those emerging as surplus-producing farmers.

The measure of effectiveness to be used in assessing training institutions also is important. The ability of training institutions to understand and teach high technology suitable for large-scale and commercial farming is not a satisfactory measure of their success in serving the current needs of agricultural development in SADCC countries. A more useful measure of training effectiveness is the success of graduates in understanding the constraints restricting the agricultural productivity of emerging farmers and smallholders, and their ability to plan, design and implement practical programmes that reduce those constraints.

Overall, the investments in agricultural research and related activities in the region have not yet yielded the desired result, as is shown by the trend of declining aggregate and per capita food output. Therefore, the need at this time is to undertake those institutional and system-building activities which are likely to lead progressively to increases in total and per capita agricultural production.

Ultimately, an improved total institutional system will make possible measurable increases in national food output. The building of this capacity must proceed as quickly as is feasible so that the expected increases in food supplies become evident early on in this effort.

Establishing activities which strengthen the human resource base and programme foci will produce the preconditions necessary for increased investment in agricultural research to obtain better returns. To identify and implement these activities means that certain issues must be resolved, including, but not limited to, the following: Are activities to be undertaken solely on a national basis or for the region as a whole? To what degree, and for what length of time, is dependence on external assistance acceptable? What is the potential for adapting or adopting activities and methods used

elsewhere? Which regional approaches will be most effective in strengthening national programmes?

B. Characteristics of SADC Countries Relevant to Proposals for Regional Activities

1. National linkages between research, extension and training

Relatively few national institutions of research, extension and training in SADC countries are intimately linked; nor, where programmes are underway, have they been jointly developed, designed and implemented by research, extension and training institutions. The achievement of increased agricultural production, a professed objective of all the countries, will require the building of national systems encompassing these three functional institutions. These systems must lead to effective relationships between the "developer" of useful technology, the "deliverer" of this technology and the "consumer", the emerging farmer/smallholder. At present, however, there are still some historical, organisational and structural impediments which, together with the traditional orientation of most of the research and extension entities, make these close linkages very difficult to establish. Even if serious attempts are made to establish such linkages, these same impediments will, no doubt, make it difficult for them to be fully effective in the short term. Regional programme proposals must be designed so as to help solve these problems.

2. Smallholder focus

All of the SADC countries have established national policies focussing their rural programmes on the smallholder component of their agriculture. Despite these policies, however, there is still less agricultural research, extension and training focussed on the actual situation of this important category of agricultural producers than is desirable. Thus, regional programmes should explicitly support these national policies by emphasising the development of practical solutions for the emerging farmer and smallholders. While increases in the number of staff in both research and extension may be warranted in some countries, deficiencies in focus result primarily from organizational and programmatic orientation, heavy involvement of staff in ancillary activities and deficiencies in appropriate training and experience of existing staff to deal with smallholder problems.

3. Differences in available resources

There is a wide range among the SADC countries in amount of funds budgeted for research, training and extension programmes. This reflects, to a degree, differences in the national resource base of each nation. Smaller countries with a limited resource base have greater difficulty in supporting the national research capability required for the full range of crop and livestock problems in their country. A significant part of the research needs of these countries



can be accommodated through collaboration with other countries within the proposed regional framework.

A number of measures or ratios have been developed to indicate the ideal size of the research activity using the following variables: number of professionals or expenditures per 100,000 hectares of a crop in question, or per family unit, per number of farmers, or per total value of the crop or livestock output. Likewise, ratios have been developed for the ideal size of national extension programmes: the number of extension workers or expenditures per numbers of farms, family units or total numbers engaged in agriculture. While helpful, these standards have to be applied with care.

In addition, the capacity of higher educational institutions in some countries may exceed the long-term need for professional manpower. Therefore, recurrent costs in excess of need becomes an unnecessary budgetary burden.

The attractiveness of regional approaches, therefore, becomes very apparent where there are large differences in the resource base among countries or where important food crops in a country are small in terms of hectareage and too small to justify a full scale research effort. In these cases it would be far more cost-effective if the needed research information could be obtained through collaborative efforts with another country whose hectareage justifies a larger research programme. Possibly only adaptive and varietal trials for crops may be sufficient for research needs of these limited-area, yet important food crops.

These differences in ability to support initial and recurrent costs among countries must be kept fully in mind by the CTCAR and donors in the design and funding of activities. Further, it would be timely for the CTCAR itself to determine ideal or model ratios for research institutions in SADCC countries.

Within the above context, the critical problem posed by the inability of SADCC countries to meet the recurrent cost requirements of any new level of effort must be considered at the outset. While every Southern African country taking part in a regional project should be prepared to contribute something in cash and/or in kind (buildings, equipment, personnel, etc.) for each regional programme or activity, this contribution often will not cover all of the local currency costs. It is clear then, that although agricultural research is a high priority for SADCC governments, donors will still need to finance a significant part of the recurrent costs over the full life of the project. This is especially important in the planning of medium- to long-term programmes for which continuity from year to year is crucial. If such programmes are not sustained or fully implemented because governments cannot meet their recurrent cost requirements, the programmes will not succeed and the long-term strategy will ultimately fail as well.

On the other hand, it is not realistic or feasible to expect the donor countries to finance recurrent costs indefinitely. SADCC countries should work out mutually acceptable plans by which they progressively assume more and more responsibility for recurrent costs of individual research, extension of training activities--for example, as the programmes become operational or productive. While CTCAR and SACCAR can help by developing criteria and norms to assist member countries in their dialogue with donors, a flexible approach to alleviating the recurrent cost problem is essential given the variety and long-term nature of many of the programmes.

Thus, if a 20-year strategy is to be successful in substantially increasing total and per capita food output in the SADCC region, long-term financial arrangements will need to be developed at the design stage that enable all SADCC members to participate in research programmes essential to increasing their agricultural productivity.

#### 4. Need for agreements

Agreements and ground rules for collaborative programmes between and among SADCC countries in research, extension and training are necessary and their development will be time-consuming and challenging. Such agreements need to be worked out by SADCC members and the CTCAR and not imposed by the donors. To avoid duplication and ensure complementarity, these agreements should apply to all regional activities. This will reduce the likelihood that donors will proceed independently to set up regional projects administered and funded under different sets of rules and perhaps by different entities as well.

#### C. SADCC Regional Programme Focus

The proposed SADCC regional strategy and programmes contain two main elements. One is composed of substantive activities to achieve agricultural productivity increases, especially among emerging farmers and smallholders. The other is the process by which the substantive accomplishments are to be realised.

The two most important substantive areas for regional activity to focus upon are: 1) the need to concentrate more research, extension and training resources upon problems and solutions relevant to emerging farmers in the smallholder category in their economic and social environment; and 2) the need to shape a training and re-training programme that will produce technical and professional staff with abilities and a mix of skills better suited to finding solutions to emerging farmer/smallholder problems.

Both directions are necessary. In the SADCC countries, research has been traditionally oriented toward the needs of larger-scale commercial agriculture rather than on smaller emerging farmers and subsistence producers. Also, the current group of research, extension and training professionals does not have the range of skills to satisfactorily meet the needs of smallholders or the agricultural development requirements of the SADCC countries and region. For example, there are few professional staff members with specialised training to deal with crop losses and storage, food processing, and marketing. In several countries where forestry and/or fisheries are important, professionals trained in disciplines related to these areas are also in short supply. These gaps in professional and technical skills must be filled if research capability and focus is to become more effectively oriented to smallholder needs. Unless the present mix of disciplines in the countries' research units is adjusted, it is not likely that the focus of collaborative research proposals, whether now underway or proposed herein, will be of much value in increasing smallholder productivity. The proposed training and retraining programmes are intended to change the mix as well as increase the number of trained professionals to strengthen national and regional programmes of research, extension and training targeted to increase productivity of the smallholder sector.

To facilitate the achievement of the agricultural productivity increases needed in the region, SADCC and the donors should develop a process to share information about national programmes and to provide additional resources to permit them to collaborate regionally on current or new research efforts and related extension and training needs and activities. The professionals of the research, extension and training institutions should become the initiators and drivers of these collaborative efforts.

The benefits and cost-effectiveness of such regional collaboration is dependent upon reinforcing national research, extension and training capabilities and upon establishing a well-understood process for coordination and cooperation. Building better regional and national capacity to perform research on the problems of improving smallholder productivity does not require at this time a substantial increase in numbers of staff. Nor is there a need for immediate major investments in structures or research facilities. Rather, what is needed is the internal use of a wide range of activities and efforts to strengthen staff capabilities through seminars, short courses, publications, networking, developing new linkages between individuals and institutions, and through collaborative participation in programmes.

Institutionalisation of these activities, including the building of SADCC-wide collaboration in agricultural research, training and extension, is a complex process and of necessity will take place over time. The elapsed time needed would be determined in part by the time required to achieve mutual understandings and agreements between the SADCC countries and their donors. To develop these institutional

capabilities in the short-term would require that national professionals and policy-makers become fully, and promptly, involved in the design, implementation, monitoring and evaluation facets.

D. Considerations for Policies and Management of CTCAR-Developed Programmes

1. Background

Policies and management guidelines are urgently needed to ensure the effectiveness of the activities proposed to strengthen national institutions and national and regional research systems. To hasten the process for building institutional capacities, external procedures and experiences should be drawn upon or used whenever they are appropriate in the SADCC context.

Central to the success of this approach, is the simple point that each country can and must receive positive benefits, easily recognised by researchers and policy-makers that are reflected in more rapid attainment of national goals of increased agricultural productivity.

SADCC has already begun to develop a process for collaborative research, extension and training and for strengthening national capabilities. It has established working consultative technical committees to achieve regional cooperation in several broad areas, one being the CTCAR which has responsibility for agricultural research. CTCAR has developed regional research programmes and has a new secretariat, SACCAR.

Likewise, seven donor countries have established Cooperation for Development in Africa (CDA) and have expressed a desire to coordinate their efforts to provide support for agricultural research to achieve more effective utilisation of SADCC country skills and resources and their own investments. These initiatives now provide the foundation for the regional strategy and programmes proposed.

The CTCAR has requested and received considerable technical support from several International Agricultural Research Centers (IARCs), which contributed significantly to the development of several regional research and training activities now underway in the SADCC region. It is anticipated that this support will continue to be available to the CTCAR as it launches future regional programmes. SACCAR, on behalf of the CTCAR, will be able effectively engage these technical resources for use in the region. The IARCs have recently established a liaison officer post on the SACCAR staff to assist in building such linkages.

## 2. Role of the Southern African Centre for Cooperation in Agricultural Research (SACCAR)

As the secretariat of the CTCAR, SACCAR has a key role in initiating and implementing not only the regional programmes proposed in this report but also others which are within the general guidelines of the CTCAR. Because it is an established office, it will be able to provide the continuity of support required in successful collaborative activities among SADCC members. Senior staff of SACCAR are expected to be involved in all phases of regional programme and project development. In addition, SACCAR would be expected to actively manage and support a number of region-wide services such as: inventory of research capacity; other needed data bases; short courses, conferences and workshops; documentation and publications; research grant programmes, and other services determined by the CTCAR. (See Annex 6 for further information about SACCAR.)

## 3. Policy and management structure for recommended programmes

The CTCAR of SADCC has already established a mode of operation with respect to its executive and policy responsibilities. With the establishment of SACCAR, it now has a secretariat in operation. The CTCAR's experiences over the past several years and its already-developed understanding have demonstrated its capability to cooperate in a region-wide context. This demonstrated capability indicates that CTCAR will be successful in engaging the talent of training and extension professionals in special roles as it initiates programmes requiring integrated and collaborative approaches.

It is recognised that SADCC has established three advisory committees under the SADCC Food Security Programme. These are the Consultative Technical Committees for Extension and Training, for Agricultural Economics and Marketing and for Agricultural Research (CTCAR).

From the CTC titles one might surmise that the role proposed for the CTCAR would overlap the areas of concern of the other CTCs. However, the fact that all three CTCs already exist under SADCC is fortuitous. As pointed out previously in this assessment and confirmed by world-wide experience, closer linkages and collaboration between the developers of viable technology and the deliverers of such technology are greatly needed. Further, the producers of the talent required by both research and extension must also be concerned and involved to insure that the mix of disciplines and level of training is consonant with national needs.

The membership of the CTCAR is composed of the Directors of Agricultural Research in the Ministries of Agriculture of the SADCC member countries. They are already fully engaged research administrators. Their formidable responsibility is to achieve higher levels of institutional research capacity at the national level. To be fully successful, it requires that linkages must be made with

counterparts in training and extension, leading to strengthened manpower resources, improved programme focus, and effective delivery systems.

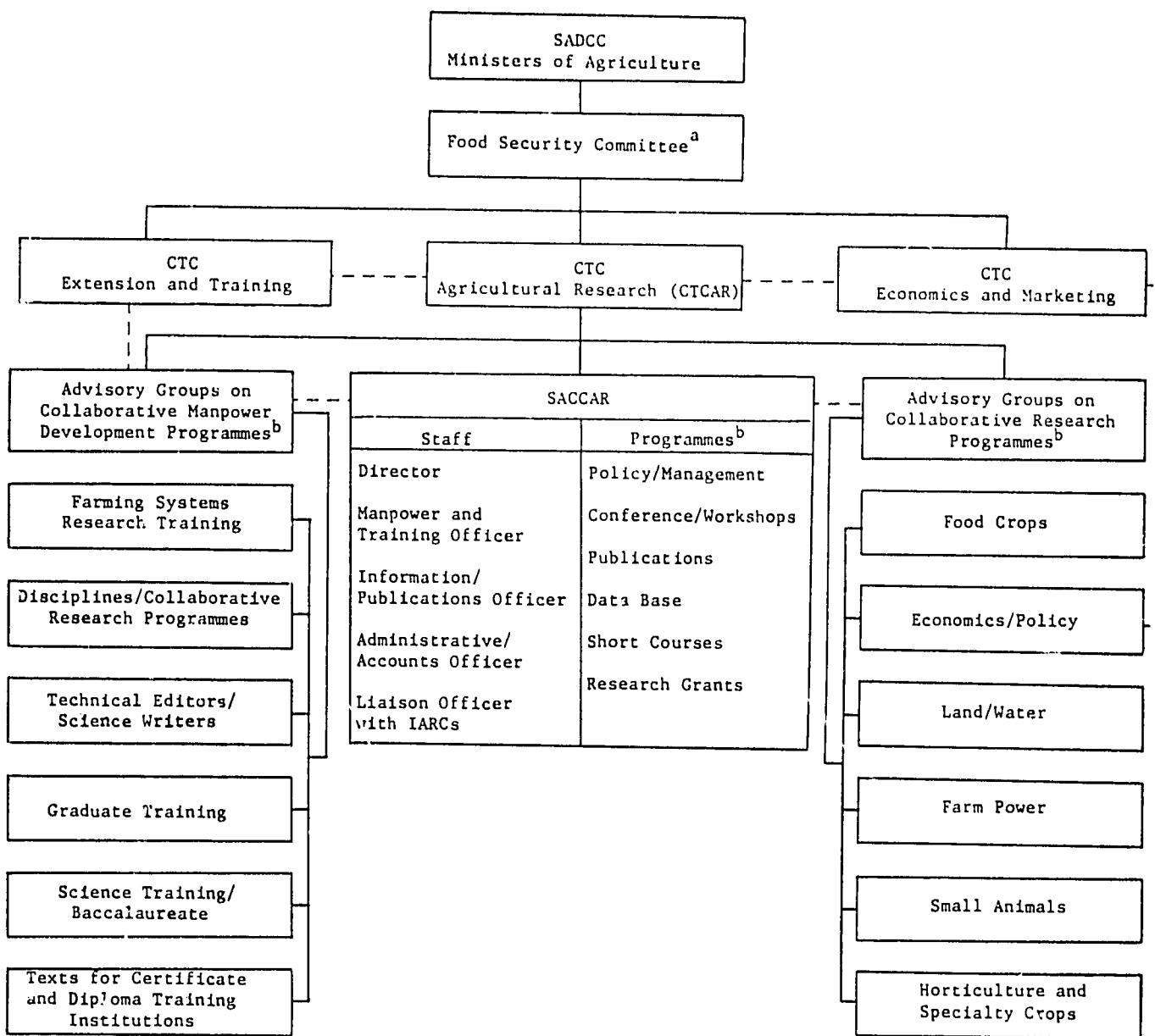
It is critically important that CTCAR have access to advice and help of professional talent from many sources throughout the SADCC region. For example, some of the disciplines required for the various programme areas may not be available in any of the research institutions. It is strongly suggested that the talent, wherever it may be located, be made available. For example, a university professor may have special training and experience which would be useful in initiating the Land and Water Resource Management Programme; a professor in another university may have special capability related to policy research.

Similarly, as manpower training programmes are planned and implemented, professionals representing sister institutions (i.e. those from research and extension) should be involved to ensure that the array and level of disciplines, as well as the orientation of the training, is consonant with their needs.

The establishment of close relationships and the effective utilisation of professional talent from sister institutions as suggested is feasible within the SADCC structure. The structure and relationships between the CTC's, SACCAR, and other advisory groups as of December 1984 that would include representatives of extension and training institutions is shown in Figure 11. (Note: Since the writing of this report SACCAR and its relationship within the SADCC have been evolving. Those desiring the current operational procedures should contact SACCAR directly.)

CTCAR and SACCAR will play the major role in refining the proposed regional programmes and bring them into operation over the coming years. The linkages with extension and training are essential, especially in relation to its manpower development programmes. It will be important for CTCAR to keep members of the CTC for Extension and Training regularly informed and to invite appropriate members to take part in the multidisciplinary ad hoc groups which will be set up to advise CTCAR and help refine and to put into action the specific regional programmes in manpower development and training needed for effective agricultural research. Likewise, CTCAR should also keep the CTC for Economics and Marketing informed and ask them to be a resource in the development of an economic and agricultural policy collaborative research programme.

To mobilise this assistance it is expected that the CTCAR would establish advisory groups as needed for each manpower programme area and research programme area. They would be expected to be temporary and short-term. However, the CTCAR may find through experience that one or more may be given a long-term role; for instance, one advisory group might be called upon to advise on priorities to activate programmes and/or projects within programmes. In any event, it would



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Figure 11: Structure and Relationships of Recommended Programmes with the CTCs and SACCAR, December 1984

<sup>a</sup>The other SADCC Committees are listed in Annex 1, page 3.

<sup>b</sup>Full titles of programme areas appear in Table 9.

be essential that terms of reference and guidelines be established in each case to insure effective performance of these advisory groups on behalf of the CTCAR.

#### E. Criteria for Programme Selection

Eighteen programmes designed to implement the strategy set out in Chapter II are discussed in detail in the following sections. These include: collaborative research proposals; activities for building institutional and professional capability; and proposals for additional and strengthened roles for SACCAR. They have been selected from a large number of possible options which were noted as the ARRA was being implemented. Those selected were seen as possible actions that the SADCC countries could jointly support in furthering their national goals of increased agricultural productivity. They are all sensitive to the constraints noted in this report and are an integral part of the overall regional strategy which has been proposed.

For completeness in presentation, the support and management activities (Programme Nos. 2 through 6) are presented even though they have been included in the SACCAR mandate. Descriptions of these are presented for the use of the CTCAR and SACCAR as they begin to refine the development of these activities. Programme No. 1, dealing with guidelines on policy and management, likewise was included for completeness of the overall integrated strategy to ensure that attention is paid to this very important need.

Collaborative activities included in Programme Nos. 7 through 12 deal with manpower and institutional development critical to building effective institutional research capacity. They will require the counsel and involvement of sister institutions of training and extension to obtain an overall and integrated programme. In addition to the CTC on Extension and Training, representatives of universities, other training institutions, and extension services will be called upon for advice as appropriate.

The Collaborative Research Programmes (Nos. 13 through 18) represent umbrella programme areas and a number of individual projects could be developed under each one. This list of collaborative research programmes should not be considered exhaustive and could be extended to include others. For example, a programme on large ruminants—dairy cattle—could also have been included.

In selecting the 18 programmes, three conditions essential to achieving SADCC's goals of increased agricultural productivity were identified. Each of many potential programmes was weighed against the following criteria:

- o Would the programme complement and strengthen national programmes?



- o Would the programme be part of an internally consistent and complementary set of programmes?
- o Would the programme strengthen the focus on smallholder issues and the needed training and/or extension support required to resolve them?

Programmes that met the above criteria were then further analysed in the light of:

- o The present and projected requirements for trained technical and professional skills and local financial support;
- o The capability of research, extension or training institutions to effectively support programmes in the other areas; and
- o The likelihood that other essential services and infrastructure would be in place.

This analysis led to the selection of the 18 programmes emphasized in the strategy which were likely to be the strongest in helping to increase total and per capita food output in the region.

A further analysis of the constraints, strategy and programmes resulted in a recommended sequence for the implementation of these programmes.

#### F. Recommended Programmes and Time Frame

Table 9 outlines priority programmes and time frames for implementing them, taking into account the several regional programmes and projects already initiated or requested by SADCC. These SADCC projects include the following: Southern African Centre for Cooperation in Agricultural Research (SACCAR); Multi-National Programming and Operational Centre for Eastern and Southern African States (MULPOC) with emphasis on maize improvement in the SADCC region; Grain Legume Improvement Project (GLIP); and the Land and Water Resources Project. The latter two are in feasibility and/or design process. Others are in beginning stages of implementation.

The selection of the programmes proposed is based, in part, on an analysis of the current and potential professional manpower, institutional capabilities and financial resources required to support the programmes.

While CTCAR has endorsed the programmes, priorities and timings recommended in this regional document, it has reserved for itself the right to make the final decisions on the specific priorities to be assigned individual projects and activities as they develop. Some of the specific timing and readiness for immediate implementation can only be determined as the specific parameters and details of the

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Table 9: Implementation Schedule for CTCAR Regional Programmes

<u>Activity</u>	<u>Programme Design (year)</u>	<u>Programme Start-up (year)</u>	<u>Term (years)</u>
<u>Six (6) activities for immediate consideration to support programmes and assist CTCAR to establish policy and management methods</u>			
1. Development of policy guidelines and a management system for collaborative activities	1985	1985	1-2
Establishment of SACCAR	1983	1984	
2. Conduct of conferences, workshops and technical meetings (SACCAR-managed activity)	1985	1985	Indefinite
3. Establishment of regional professional-oriented and extension/layman-oriented publications (SACCAR-managed activity)	1985	1985	Indefinite
4. Establishment of a region-wide research data base (SACCAR-managed activity)	1985	1985	2-3
5. Provision of short course training for staff (SACCAR-managed activity)	1985	1985	5
6. Implementation of a research grant programme (SACCAR-managed activity)	1985	1985	5

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Table 9: Implementation Schedule for CTCAR Regional Programmes (cont.)

<u>Activity</u>	<u>Programme Design</u> (year)	<u>Programme Start-up</u> (year)	<u>Term</u> (years)
<u>Six (6) programmes to develop professional technical skills and two (2) high priority Collaborative Research Programmes</u>			
<u>Training Programmes<sup>a</sup></u>			
7. Provision of multidisciplinary training for staff required for adaptive research	1986	1987	5-10
8. Provision of training in disciplines critical to collaborative research programmes	1986	1987	5-10
9. Provision of training for agricultural technical editors and science writers	1986	1987	3-6
10. Development of SADCC capacity in graduate-level training	1986	1988	10-20
11. Provision of science training for students entering baccalaureate training	1986	1987	5-10
12. Development of appropriate texts and reference materials for certificate and diploma training institutions	1985	1986	2-5

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Table 9: Implementation Schedule for CTCAR Regional Programmes (cont.)

<u>Activity</u>	<u>Programme Design</u> (year)	<u>Programme Start-up</u> (year)	<u>Term</u> (years)
<u>Collaborative Research Programmes<sup>a</sup></u>			
13. Development of a food crop production collaborative research programme			5-10
a. Maize Research Project	in design phase		
b. Sorghum/Millet Project	underway since 1984		20-25
c. Grain Legume Improvement Project	in design phase		5-10
14. Development of an economic and agricultural policy collaborative research programme	1986	1988	
<u>Four (4) Collaborative Research Programmes for consideration, preliminary design and for implementation as technical and professional skills become available in member countries<sup>a</sup></u>			
15. Development of a land and water resource management collaborative research programme	1984	1987	10-20
Land and Water Resources Project	In design phase		
16. Development of a farm power collaborative research programme	1988	1990	5-10
17. Development of a small ruminants, swine and poultry collaborative research programme	1988	1990	5-10
18. Development of a horticulture and specialty crop collaborative research programme	1988	1990	5-10

<sup>a</sup>SACCAR, as CTCAR Secretariat, is to provide leadership in convening organizational meetings, design effort, obtaining CTCAR and SADCC approvals and carrying out necessary assessments and evaluations.

programmes recommended in the regional document are developed and defined. SACCAR, in its role as the CTCAR secretariat, will play an important role in helping define the priorities and plan timing of implementation of activities.

This position seems sensible given the changing situations which develop around such questions as: the availability of funding (timing, program inputs, and amount and timing of funding available from donors); priority decisions of member governments over the next several years on their national agricultural research programmes; SADCC and country funding, opportunities and limitations, etc.

The manpower development and institution-building orientation of these activities necessarily require a long-term and consistent effort and so a 20-year time frame was adopted in this analysis. However, it would be highly desirable that the CTCAR divide this 20 year time frame into five-year plan periods to provide for assessment of progress and mid-course corrections. Both national governments and donors will require this kind of assessment to justify investments.

An indirect measure of the success of this strategy would be the progress toward achieving food security (i.e., the amount of per capita cereal production needed to catch up and keep pace with population growth for the region). Thus, one measure would be to determine how far the region as a whole had progressed toward meeting the goal of an 82 percent increase in cereals production by 1995, or roughly 6.1 percent per year. Of course, other more sophisticated measures of progress could be added any time or during each five-year assessment of progress.

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<sup>1</sup>The scope of the activities envisioned for SACCAR is described in Annex 6.

1. Development of policy guidelines and a management system for collaborative activities

a. Description

This programme would address the need for policy guidelines and a management system to guide the development of regional collaborative activities in agricultural research, extension and training. The policy guidelines and management system would be used by CTCAR and SACCAR in support of its activities and in specifying the roles of the proposed advisory groups and technical leaders of the various programme areas.

b. Background

The principal constraint addressed by this programme is the lack of collaboration between research, extension and training staff and between these groups and smallholders. Other constraints that will be reduced by this programme include, but are not limited to: insufficient research on smallholder mixed crop and livestock farming problems and solutions; lack of technological packages suitable for smallholder farming systems, practices and environmental conditions; lack of knowledge on the part of research, extension and training personnel about smallholder farming systems, practices and traditions (land and livestock holding patterns, the role of women, and low farmer status); inadequate ability to manage effectively agricultural research, extension and training programmes and institutions; and inadequate inability to establish regional research priorities.

Although CTCAR has an impressive record of accomplishment since it was organised in April 1982, there is still a lack of sufficient collaboration between agricultural researchers, extensionists and trainers in the SADCC countries. This lack of joint regional effort leads to duplicative national research programmes, to low levels of resources devoted to specific regional research needs (because national finances, human skills and capital goods are spread thinly among too many national research programmes), to a more piecemeal approach establishing national and regional research priorities, and an over-emphasis on donor agencies' role in determining these priorities.

Insufficient collaboration reduces the potential for achieving substantive agricultural research, extension and training results. The lack of sufficient research on smallholder mixed crop and livestock farming, for example, stems from national research programmes being inappropriately oriented toward larger-scale commercial agricultural needs. It also results from lack of collaboration of research by entities dedicated exclusively to crops or livestock research. Insufficient understanding and capability to design and

implement interdisciplinary extension programmes is partly the result of lack of training and experience in such activities. A collaborative regional research programme is likely to be cost-effective at the national and regional levels, both in setting research priorities and in developing appropriate technological packages for crops and livestock.

Programme No. 1 is intended to encourage the full involvement of African administrators and professional staff. Policy and management should be dealt with as soon as feasible so that the expected benefits from each programme element can be achieved.

c. Objective

The objective of this activity is to develop general policy and management guidelines for the use of the CTCAR in its relationships with national programmes, SACCAR, donors, the IARCs, other international agencies or institutions and with standing committees it may establish and utilise.

d. Suggested approach

Under the leadership of the CTCAR and SACCAR, a study group should be organised to develop policy guidelines and management systems needed to initiate and sustain collaborative activities. These guidelines should be as simple as possible and should lend themselves to simple modifications as experience is gained. Service to national programmes and national needs in research and related extension and training must be a central focus of the policy and operational guidelines, if these regional institutions are to become useful to the SADCC community.

The study group should be chaired by a CTCAR member and be provided assistance from sources with experience in similar types of institutions. The Consultative Group for International Agricultural Research (CGIAR), with their extensive experience in issues such as core funding and resource allocation, should be requested for assistance. Other groups including IBRD, development banks, CDA and other donors may have suggestions on regional approaches and institutions.

It is recommended that advisory groups be established by the CTCAR and that their specific roles, composition (to include extension and training participation as needed), responsibilities and procedures be also established by the study group referenced above.

e. Expected results

The expected results of this activity are to provide guidelines and a management system for the efficient and effective implementation of the regional programmes. It will build the relationships among administrators and professionals in agricultural research extension and training institutions within countries and between member countries that are essential to undergird the process of strengthening national institutional capacity. It will provide a framework for relationships between national institutions and the regional structure, and will provide an opportunity for better donor coordination in support of nationally and regionally determined high-priority research needs. It is also expected that more effective coordination with the International Agricultural Research Centres, and with other international agencies, will result in substantial benefits derived from more effective programming. Ultimately the effective system resulting from this activity will result in improving smallholder productivity and welfare.



## 2. Conduct of conferences, workshops and technical meetings

### a. Description

This programme would plan for and carry out a long-term series of regional workshops, seminars and technical meetings to facilitate information flows between research, extension and training personnel about critical issues affecting smallholder productivity.

### b. Background

The inability of professional agricultural researchers, extension workers and educators to easily communicate with one another is a constraint to more effective and efficient national agriculture programmes. Too often research or extension workers in SADCC countries are independently attempting to resolve the same problems or are having the same difficulties with their programmes. Likewise, solutions discovered by one tend not to be passed along to others. This separation makes agricultural research, extension and training much less effective, both in cost and end result.

Other constraints include, but are not limited to, the following: inadequate agricultural research information base; lack of adapted technological packages; insufficient research on smallholder problems and solutions; especially mixed crop and livestock farming; and insufficient understanding and capacity to conduct social science and interdisciplinary research.

One method to update professionals on problems, issues and methodology is through carefully structured workshops and seminars. There is little opportunity at present among professionals in the SADCC region to participate in these kinds of activities, and communication between them is almost non-existent. For example, changes in curriculum, innovations in research methodology or in extension programming are underway in several SADCC countries, but such developments frequently are unknown elsewhere in the region.

Deterrents include lack of funds and support for travel, and the lack of a regional structure to initiate, evaluate and respond to requests for conducting meetings on high-priority topics of concern to professionals.

### c. Objective

The objectives of this activity are to provide a systematic process by which conferences, workshops and technical meetings can be prioritised according to members' suggestions, and to strengthen linkages between researchers, extensionists and trainers at all levels, and professionals from IARCs, other international agencies and donors.

d. Suggested approach

It is suggested that the CTCAR appoint an ad hoc work group to develop guidelines for use in the planning for and organisation of the various workshops and seminars. This group must work closely with SACCAR which is the management unit for such conferences. This ad hoc work group should also recommend to the CTCAR specific high-priority subjects for consideration which could benefit from region-wide participation in this seminar. Examples of such areas might be: research methods for dealing with mixed farming systems; improving linkages between research, extension and training for smallholders; and determining reasons why technological packages are not used by smallholders.

Subject matter priorities for researchers should include current high-priority problems, or relate directly to topics in support of one or more of the regional collaborative research programmes. In fact, a seminar or workshop may be an initial awareness step prior to activation of the planning process for a regional collaborative research programme. Limits on numbers and frequency of these types of activities should no doubt be specified prior to activation of this project.

It will be important to assure that extension and training specialists, in addition to agricultural researchers, are included in the workshops, seminars and conferences on all appropriate occasions so that the planning and design work of the proposed programmes have a realistic, balanced approach to help assure that the results are relevant to the needs of the farmer.

e. Expected results

This activity is expected to result in many-faceted benefits including: accelerated exchange of information; enhanced professional capabilities; a process developed to shorten the time required to respond to needs for regional and national resources to use on problems and requests important to the region; and a positive impact on developing and utilising professional capabilities. In particular, and as is consistent with SADCC members national policies, it is expected that the capabilities of staff to deal with smallholder problems will be improved.

3. Establishment of regional professional-oriented and extension/layman-oriented publications

a. Description

This programme would establish region-wide professional journals as well as a lay journal for extension personnel, bankers, agro-industry personnel and others. SACCAR would be responsible for the coordination and publication of these journals.

b. Background

A serious constraint to more effective national programmes is the limited availability of technically and developmentally oriented information for researchers, extension staff trainers and agricultural lay persons. Related constraints are: the lack of an adequate agricultural research information base; lack of knowledge on the part of research, extension and training personnel about smallholder attitudes, values and beliefs; and insufficient understanding and capability to design and implement interdisciplinary research and extension efforts.

Regularly available publications relevant to the region and to the concerns of professional staffs are fundamental to the strengthening of communications among professionals at all levels. Publications to fill these needs in the SADCC region should have a developmental orientation and a bias toward smallholder food production.

Professional journals are needed at the regional level. They should share information about research, extension and training results and describe innovations in approaches and methodology. This can contribute substantially to strengthening the interest and motivation of the national professional agricultural cadre. These journals will also provide publishing outlets for useful information that now languishes in the files of research staff.

A popular or extension journal also is needed in the region. It would be targeted to a broader audience, one which has the potential of realising greater agricultural productivity. This journal should be written in a format and at a technical level that would make it useful to the entire extension staff, including the local extension officer. It should also be made available to the growing lay sector--bankers, agribusiness firms, officials in parastatals, cooperatives, national development banks and others--with strong concerns in agricultural development. The purpose of this journal will be to share ideas, approaches and new developments targeted to increasing smallholder food production.

Research, training and extension professionals must recognise that they have public mandates to produce and deliver adaptable technology to rural producers. The publications discussed will build public and professional reinforcement of these professionals in their roles and bring greater public appreciation for their responsibilities and the services they provide. Since they are the producers of the material for publication, an internally-generated peer relationship and individual concern for quality will be established, thus helping to build a cooperative spirit, a willingness to be challenged by problems, and a positive attitude among professionals and lay leadership involved in the process.

c. Objective

The purpose of this activity is to support the overall objective of increasing agricultural productivity and output by building regional linkages with national communications channels and among professionals of SADCC countries. The programme will have as one of its goals to facilitate communication among professionals, and permit them to become more knowledgeable about the latest developments in their field, thus shortening the time needed to put new technology and systems into operation. In addition, those publications written for the non-agricultural professional will help develop the support of governments and the public for these programs by focussing more attention on ways accelerated agricultural development, fueled by effective agricultural research and extension, can benefit smallholders and the national economy.

d. Suggested approach

It is proposed that the CTCAR and SACCAR commission a study, using agricultural and editorial professionals, to specify the content, format, editorial orientation, frequency of publication and relationships with national correspondents and contributors to the publications/journals. The news and information releases from the IARCs and from other international organisations could be a regular feature of such publications. Detailed aspects of the journals editorial policies also should be addressed. The content of both the professional and the extension journals should be multidisciplinary in subject matter and oriented towards agricultural development in the broadest sense. They should not be used solely as outlets for research results.

Since the research orientation of the SADCC countries is applied rather than basic, the publications should provide an outlet for applied agricultural research in a context of serving the full range of research activities. Basic researchers will continue to have outlets in other existing international journals.

To ensure that these publications are acceptable and are useful, the authors must receive credit and, to the degree possible in the countries' systems, professional rewards should be given to encourage research and extension staff to contribute to the journals.

The CTCAR must give careful ongoing analysis of the issues as these publications are developed. SACCAR will be responsible for the coordination and production of these publications.

e. Expected results

The success of this activity is dependent on the quality of the publications and the skills and orientation of the editor and writer. The organisational and editorial relationship of the SACCAR office to the national systems is obviously important. The results sought, while not easily measurable in a quantitative sense, will be improved communications among the research, extension and training professionals in the region. These publications will also build a clientele among those concerned with agricultural development and enhance the know-how and effectiveness of the professional community. Those publications directed toward the educated non-agricultural professional in government and the private sector will increase understanding of and support for national and regional research programmes designed to increase agricultural productivity and output. This in turn should help assure a broader base of public support, more adequate and sustained funding and administrative support.

A long-term output is to instill a developmental orientation among agricultural lay leaders and the larger national audience. The size of the smallholder farmer audience for these publications will grow slowly. However, a beginning must be made to develop this information and the means for disseminating it to smallholders and emerging farmers.

4. Establishment of a region-wide research data base

a. Description

This programme would create an information system aligned with the present SADCC agricultural research data base that would provide member country staff with a current record of research, extension and training efforts underway. The data would be more detailed than that prepared for the SADCC data base as part of the ARRA activity. It would be primarily for use by technical officers in SADCC countries as they plan, review and develop projects.

b. Background

This programme would eliminate the a constraint to more effective national research programmes among the countries due to the inability of scientists to conveniently and economically ascertain information about past, current or planned research, extension and training projects. Other constraints addressed by this programme include: lack of collaboration between research, extension and training personnel; an inadequate agricultural research information base; inadequate ability to manage agricultural research, extension and training programmes; and to establish research priorities.

The CTCAR, soon after it was established, recognised that a data base accessible to the administrators and professionals of member countries was a high priority need. In the course of the ARRA study, a substantial data base has been developed and utilised in the preparation of this regional report and the ARRA country reports. This data base can become the foundation for extending and accommodating the evolving needs of member countries and the CTCAR. It now includes information in the following areas:

- o Personnel--Data includes numbers of staff in all three types of institutions, and in each country, in categories including their professional or technical disciplines, whether they are nationals or expatriates, the institutions they are assigned to and the numbers in place, in training or on leave as well as plans for training of staff;
- o Research and extension programmes--Numbers and types of research activities underway in all of the various public or private research institutions and an analysis of the professional manpower applied to each programme area. Where it is possible, similar information on extension programmes is also provided;

- o Budget data--Budget information, including donor funding in support of research programmes, is provided. This information is not, in all cases, in a common reporting system due to differences in national budget systems or unavailability of information;
- o Constraints to increased production--Information is available from interviews with informed national staff, senior officials and development specialists on physical, biological, economic/policy, and rural tradition-related constraints to increased smallholder production and is identified and quantified. Constraints to institutional capability as seen by staff members is also quantified; and
- o Other information--Information is also provided about production of crops and livestock, population trends, and other economic indicators.

The data noted above has been processed through a commercial programme, DBaseII, on an Apple IIe computer enhanced with two 10-megabyte Corvus hard disk drives. This equipment is in place in Botswana and is expected to be used by the recently established SACCAR headquarters office. SACCAR intends to continue to utilise this data resource and to update the information as needed.

c. Objective

The objective of this programme is to provide a complete and comprehensive data base and reporting system for agricultural research, extension and training programmes and projects for the use of the SADCC countries' research, extension and training staff.

d. Suggested approach

This activity, allied with the more general data base already located at SACCAR headquarters, will likely require assistance from an advisory group to determine the user needs and to establish the guidelines for the data base itself. The initial concept, to be developed by means of a professional analysis, will be to design a common format for project activity reporting which can be used by all countries. Included in such a standard report form would be information as to the type or class of activity, the professional and technical staff assigned, the research or implementation methodology, the present status of the activity, the funding levels and life of the activity, results to date or results of evaluations, specific lessons learned, donor or other outside collaboration, and other factors.

This report form would need to be acceptable to all the countries. National ministries would be provided with equipment and training for staff so that they will be able to perform their own updates by accessing the SADCC-wide data base.

e. Expected results

As a result of this activity, staff in any one country will have easy and rapid access to up-to-date and specific information about past and present programmes or projects elsewhere that are related to any current, past or proposed activity. The comprehensive data base would also be able to access the considerable amount of research information already compiled in SADCC countries. Further, it would be able to collect and provide access to research information on SADCC country problems or relevant problems from the IARCs, other international organisations, and other sources. In addition, national professional staffs will be knowledgeable of research in place and results from investigations which have an important relationship to their own. The ability of this proposed system to rapidly access this information will make the data even more timely and relevant. Donors with long experience in SADCC countries will be encouraged to make available the research information in their files for inclusion in the regional data base.



## 5. Provision of short course training for staff

### a. Description

This programme would provide in-service training via short courses for research, extension and training staff at the technical and professional levels. The courses would focus on specific technical, methodological and management problem areas identified by national country staff.

### b. Background

At present, there is a lack of communication and joint training efforts between research, extension and training and, in many cases, between livestock and crops staff or between land development and land utilisation professionals and technical staff. This constraint inhibits the development of effective programmes and projects at the national level which are directed to the specific target of smallholders and emerging farmers.

Other constraints identified in the SADCC countries that are addressed by this programme are: lack of knowledge on the part of research, extension and training staff about smallholder attitudes, values and beliefs and the resulting lack of inclusion of these factors in the design and implementation of research, extension and training activities; lack of focus of training on smallholder problems and solutions; lack of trained and experienced personnel in professional positions in agricultural research, extension and training programmes; insufficient understanding and capability to design and implement interdisciplinary research and extension efforts; inadequate ability to manage agricultural research, extension and training programmes and institutions and to establish research priorities; inappropriate and poorly focussed training in textbook design; and inappropriate budget and planning priorities within agricultural research, extension and training, especially with respect to their focus on smallholder problems, issues and solutions.

The increased interest in systems research and in establishing multidisciplinary team approaches to research provides an important opportunity for in-service training, especially for technical staff but also for professional-level staff. This training, involving participants from several SADCC countries and from several types of institutions with similar problems, could help increase the efficiency and productivity of ongoing activities.

The country reports and the researchers who were responsible for them indicate that many of the research and extension staff, especially the junior staff, feel that they need additional skills. The potential for relatively economical short course training, which can be tailored to current problems and designed to meet the level of understanding of the trainees, offers an attractive opportunity for a regional activity.

c. Objective

The objective of this programme is to provide in-service training in the SADCC countries that directly supports specific programmes of research and extension affecting smallholder agriculture.

d. Suggested approach

This programme could benefit from study by advisory groups addressing the concerns regarding manpower skills and training. This proposed programme, managed by SACCAR, is to be directed principally to the needs of the technical staffs of the several countries and several types of institutions. However, professional staff also would be involved. There are several international training institutions and training centres within the SADCC countries that have experience in such programmes, and they should be involved in the development of material and in the management and presentation of short courses.

This programme can also offer a means for SADCC research and extension administrators, at various levels, to obtain management training tailored to their needs. In most countries, for example, evaluation systems and promotion policies are either not managed effectively or are not developed. Thus, personnel administrators are likely candidates for training to help build staff confidence in personnel policies in institutions of research, training and extension in the several countries.

e. Expected results

This programme would build manpower capability in-country and within the region. It also would reach the junior staff and the technical staff of the institutions who might otherwise not have an opportunity to participate in training to improve their skills, stature and salary levels. The short course training programmes also have great flexibility: they can be rapidly developed to address issues which become problems. Thus, they can make a strong contribution to improving the effectiveness of field research and extension efforts.

## 6. Implementation of a research grant programme

### a. Description

This programme would provide research grants to university and extension professionals to engage them in collaborative and supporting research focussed on and designed to help solve specific technical, policy, methodological and managerial issues related to agricultural productivity.

### b. Background

This programme would reduce the constraint of lack of collaboration between research, extension and training, as well as the general lack of applied research involvement by training and extension staff. Other constraints also addressed by a research grant programme are: fragile and weak ecological base; lack of adequate labour and labour intensity at specific times of the crop cycle; lack of varieties/species adapted to local environment(s); lack of technological packages adapted to and suitable for the smallholders' economic-traditional environment at the farm level; and insufficient research on smallholder mixed crop and livestock farming.

Historical antecedents were major factors affecting the development of and relationships among the research, training and extension institutions in the SADCC region. Research institutions were focussed on the narrow issues of concern to large-scale, export-oriented agriculture in the pre-independence period. Most training institutions had their origins in the immediate post-independence period to fill urgent needs for technical-level personnel as expatriates left. Extension institutions were late arrivals on the scene, established on the premise that readily-available technological packages could be rapidly extended to greatly increase production.

Each of these institutions developed in an autonomous fashion within their respective ministries with little attention to the need for programme integration or linkages. Several countries recently have taken initial steps to integrate these institutions and for their programmes to provide better technology development and delivery. However, the linkages remained weak and the efforts to improve them have not yet been effective.

Professional agricultural scientists from training and extension institutions, until now an underutilised resource, could contribute to increased agricultural growth in SADCC through participation in this grant programme and in national research programmes.

In this way a stronger relationship between research and training could be forged. This would begin to change the emphasis of university teaching professionals from the theoretical to an applied and hands-on practical approach to problem-solving. These grants would also bring some training professionals into the mainstream of national research concerns.

Similarly, grants for research could also be made to extension professionals who might, with ministry agreement and in collaboration with their associates in research and training, carry out research applicable to smallholders' operational and practical problems. These extension professionals can accurately reflect the view of smallholders, a factor of strong potential value to the development of useful and acceptable technological innovations.

c. Objective

The objective of this activity is to encourage greater utilisation of professional agricultural science resources in-country and, by so doing, to forge stronger linkages between research scientists, trainers and extension staff and to strengthen integrative approaches to solving smallholder agricultural problems.

d. Suggested approach

The CTCAR should organise a work group of relevant professionals to study the scope for this type of programme. Such a study should recommend the format, eligibility qualifications, conditions of service (or agreements between the grantees, their institution and the grantor), types of support to be covered by grants, matching support by host institutions and other matters. The study group should be assisted by professionals who have worked with grant programmes. It is recommended that individual grants be established for a fixed number of years (perhaps two years initially) with the provision that an evaluation be conducted to determine the need for revisions or if the grant should be continued. SACCAR would serve as the management entity for this programme.

e. Expected results

The involvement of professionals from several institutions in research efforts will assist in forging stronger professional and programme linkages between national institutions. This programme will help focus interest of trainees and students both undergraduate and graduate, on national concerns. In some institutions it would serve, in part, to undergird emerging graduate programmes. In the case of extension staff participation, it will more closely tie research and extension efforts to smallholder problems and solutions. This programme will strengthen the professional as a teacher or extension worker. Experience by trainers in dealing with current national problems would heighten the relevancy of the agricultural subject matter taught in the classroom about smallholder farming systems. The teachers, and others who have been critical of research programmes of the government can, by this system, become participants in the process and not mere observers of the programmes and projects.

7. Provision of multidisciplinary training for staff required for adaptive research

a. Description

This programme would provide multidisciplinary training of research, extension and training professionals to better prepare them for dealing with the diversity of farming systems.

b. Background

Several constraints are addressed by this programme. In particular, it addresses the inappropriate mix and insufficient quantity of specific disciplinary skills among existing agricultural researchers, extension workers and trainers, and the inadequate number of persons trained in disciplines such as social science, selected biological and physical sciences and information management. This programme also helps reduce other constraints as follows: lack of knowledge on the part of research, extension and training staff about smallholder attitudes, values and beliefs, and the exclusion of these factors from the design and implementation of research, extension and training; lack of technical packages adapted to and suitable for the smallholder economic-traditional environment at the farm level; insufficient research on smallholder crop and livestock farming; and inappropriate orientation of agricultural research toward larger-scale commercial agricultural needs.

The adaptive research and farming systems research underway in many SADCC countries represents a limited but very appropriate approach to smallholder and emerging farmer needs. However, donor-supported projects in such research do not provide for training of professionals and technical staff in sufficient numbers to develop a cadre of nationals capable of sustaining these efforts when expatriate support is withdrawn.

It is timely and urgent, then, to begin strengthening the sustainability of these efforts. An expanded training effort is urgently needed to build professional skills on a broader basis and, for a number of countries, to provide talent to deal with the diversity of local smallholder farming systems due to different crop mixes, differences in land, water and other resources available and differences in traditional and cultural backgrounds.

In the longer term, systems and adaptive research will have to have deeper commitments from the national research, extension and training institutions to establish a practice of integrating these activities with the ongoing programmes of the institutions. Further, the process of establishing research priorities will be improved as adaptive research yields useful information.

c. Objective

The objective of this activity is to provide sufficient national staff to serve as research counterparts for existing and future farming systems and adaptive research approaches. This larger pool of talent which views the emerging farmers and other smallholders as a prime target for increased food productivity will, over time, shift the focus of research, extension and training institutions from larger-scale commercial agricultural problems and solutions to those of import to smallholders.

d. Suggested approach

Each country's needs for national staff to serve in active and supporting roles in farming systems research and adaptive research projects should be assessed early by the CTCAR, assisted by an advisory group or task force. This assessment should identify the requirements for training for adaptive research and the needs for various skills in closely supporting roles in extension. This analysis should specify the disciplines of the staff to be trained.

It is suggested that experienced BSc graduates in general agriculture be considered as candidates for more specialised MSc training. They should have professional skills in disciplines closely related to the thrust of current effort. Thus, candidates would be those with training in crop production, animal production, agricultural engineering (with interest in energy issues at the smallholder level), and general degree-holders with farm management experience or training. Those selected for training should understand and be committed to the concepts inherent in adaptive and systems research approaches.

Much of the multidisciplinary training in this programme would be outside Africa. It is desirable that thesis research investigations be done in each trainee's home country on problems associated with national adaptive research programmes. Graduates of these programmes should be given strong consideration for additional training at the CIMMYT-University of Zimbabwe training programme on farming systems.

e. Expected results

This training effort will result in a better mix of professional skills to match the needs of the several countries' current and anticipated programmes. It will relieve the current shortage of national staff for farming systems and applied research approaches. It will contribute to the development of staff attitudes and skills which will support a refocussing of national research

efforts towards smallholder issues. This programme also will assist in a more rapid accumulation of a data base and information on the relative effectiveness of various interventions suggested to meet smallholder needs.

8. Provision of training in disciplines critical to collaborative research programmes

a. Description

This programme would establish a long-term expanded effort to train technical and professional personnel to fill the gaps in the disciplines required and to provide the total number of qualified staff needed to carry out effective research, extension and training programmes. The training would be at an advanced level.

b. Background

The main constraints addressed by this programme are: 1) the inappropriate mix and insufficient quantity of specific disciplines among existing agricultural researchers, extension workers and trainers; 2) the inadequate number of persons trained in disciplines such as social science, selected biological and physical sciences and information management; and 3) the lack of trained and experienced nationals in professional positions in agricultural research, extension and training programmes. Other constraints which this programme will help reduce are: lack of focus of training on smallholders' problems, issues, and solutions; inadequate ability to manage agricultural research, extension and training programmes and institutions and to establish research priorities; and inappropriate orientation of agricultural research toward larger-scale, commercial agricultural needs rather than toward smallholders.

The SADCC region has begun to change the direction and focus of programmes to the food crops area, to production orientation and to problems and solutions important to smallholders and emerging farmers. However, without a major training effort by the countries and the donor community, the desired redirection of research, extension and training will be very difficult, since more and more scientists with these disciplines will be needed.

This analysis suggests several areas of research and a re-direction of programme focus which will require, in the next several years, a modified mix of technical disciplines as compared to the present heavy tilt toward crop and animal scientists. One of the constraints to establishing effective regional research collaboration is the number of available national researchers in the disciplines needed for proposed regional research programmes. In addition, each national researcher will need to acquire skills to establish objectives, specify research methodology, and implement proposals as part of his or her contribution to proposed regional research projects.



An examination of several regional projects when they were being established or were in the planning process confirmed that shortages of staff in some disciplines was a serious impediment. Therefore, a training programme, specifically directed to such needed disciplines, has often been incorporated into the project design although at the minimum level needed to support the specific project. This is laudable and is essential to these important projects at this time. However, these activities, once they are operational, will absorb many national resources thereby reducing the capability of the national research systems to carry on their own programmes requiring these skills or to respond to other regional initiatives. As a result, continued dependence on expatriates will be necessary.

A long-term, expanded study is recommended which reviews the total needs of institutions and disciplinary gaps in light of the need for national professionals required, prior to the implementation of other regional collaborative research programmes. This activity should begin soon in order to build the national competence in disciplines so that viable and substantive contributions can be made early in the design and implementation process by nationals. Some of this training, as was the case in the preceding section of these recommendations, can be the training of presently posted BSc nationals in specialisations related to their basic disciplinary background. For example, a staff person trained in general animal science might be considered for advanced MSc work in animal nutrition. Similarly, those with BScs in crop sciences or general agriculture would be good candidates for training in subspecialties such as plant pathology, cropping systems, range management, entomology, processing and other such fields as determined to be needed.

The number of professionals with social science credentials working in agricultural institutions in this region is seriously deficient. Agricultural economists trained in micro and macro analysis are needed for several of the programme areas, as are professionals with skills in agricultural engineering, food processing, crop losses and storage and marketing.

c. Objective

The objective of this training recommendation is to provide national research programmes with adequate numbers of trained professionals. These well-trained professionals will contribute to their national programmes, as these are increasingly directed to solving smallholders' problems, and to regional collaborative research programmes also. Both contributions will be accomplished through an advanced training programme for professionals in disciplines relevant to the expected skills required to successfully execute these programmes.

d. Suggested approach

This activity is a necessary precursor to viable collaborative regional research efforts. Therefore, an analysis of the present relevant national human resource base and the required additional talent needed to activate the proposed regional programmes should be undertaken by the CTCAR and SACCAR. Ideally, the needs should be identified soon so that much of the training can take place prior to activation of a specific collaborative research project. It is not expected that the full and ideal complement of talent will be available prior to project activation. However, anticipating needs and accelerating the training for these needs will allow fuller participation of African nationals in early stages of project development.

Additional regional research projects should only be initiated when the national research institutions' capabilities in needed disciplines now in short supply are available. The alternative of continued reliance on the use of expatriate staff is less desirable. At this time, even with an expanded programme of training, it will take four to six years to build this indigenous capacity for most of the regional projects proposed.

e. Expected results

The result of this activity will be an initial build-up of staff in disciplines required to support effective regional collaborative research projects. In the longer term an anticipated outcome would be a greatly enhanced capability of the national institutions to prioritise, design, and implement research, extension and training projects with minimum dependence on external, donor-provided and donor-oriented technical experts.

9. Provision of degree training for agricultural technical editors and science writers

a. Description

This programme would train staff to be technical agriculture editors and science writers. These staff would assist others in preparing and disseminating scientific information, including research results. They also would be important actors in carrying out the networking essential to achieving effective research, extension and training results.

b. Background

The major constraints addressed by this programme are the inadequate number of persons trained in disciplines such as information management, and the lack of collaboration and communication between individuals as well as the institutions of research, extension and training. Other constraints addressed include the lack of knowledge on the part of all staff about smallholder attitudes, values and beliefs, a lack of the inclusion of these factors in the design and implementation of research, extension and training activities, and an inadequate agricultural research information base to ensure quality and permit transfer of technology to smallholders.

Communication among and between researchers, extension staff, as well as training staff, is not well established in SADCC countries. The shortfall in communications that results is a serious constraint to achieving more effective programmes in each area as well as to agricultural development in general.

Information exchange, both scientific and practical, is an essential component of effective networking of professionals within a country and among countries. If this interaction is to occur, a special, though relatively low-cost, effort must be undertaken within the national research, extension and training institutions to ensure that it does take place. Further, the proposed region-wide activities in the workshops and seminars programme and the programme for professional and lay journals and publications require deliberate professional backstopping by national institutions. Busy professionals often neglect to share information and data with others in the systematic manner necessary to support region-wide journal and information networks.

c. Objective

The priority objective of this activity is to ensure that professionals will be qualified, through appropriate training, to be responsible for the preparation, assembly and distribution of articles and information for publication in region-wide journals and to formally establish, within national research, extension and training institutions, professional capability to promote the dissemination of useful technical information and knowledge related to smallholder agriculture.

d. Suggested approach

The CTCAR and SACCAR should undertake a review and analysis of the current availability of national staff qualified to serve as technical editors, science writers and information networkers. A large staff is not required (no more than two per country), but recognition of the unique qualifications of the agricultural science editors to assist the agricultural professionals to effectively produce journal-quality articles is essential. Well-qualified staff with these skills can be exceptionally useful in the preparation of annual institutional reports and other such publications. Extension editors should have training to provide needed skills so they can recast research programme results in an easily understandable and persuasive manner for use by extension workers and others. National professional skills in this area should be strongly linked with the regional publications programme to prepare professional and lay journals.

Several countries may already have staff who can provide these services. Others may wish to train or retrain staff to accomplish these unique tasks. However, it is essential that specifications for this training be developed by professional technical editors and writers. An important consideration for the success of this programme will be to select, as candidates, professionals with a BSc or MSc in agricultural science or other backgrounds that provide a useful base for the specialised training. This proposal is not designed to provide the more traditional extension-type information specialists; rather, it is designed to provide, through an individually tailored training programme, editorial and interpretive writing skills to professionals who already have agricultural backgrounds.

e. Expected results

This activity is intended to provide specialised professional skills--technical editing, science writing, subject matter networking, and information exchange--at various levels within countries and across countries. This capability can lead to a broader and more comprehensive understanding by national governments, banking,

agribusiness, and agricultural leaders of the role of research, extension and training in the achieving of national development goals. Journals also may interest more educated young people in pursuing a career in agriculture than is now the situation in most countries.

10. Development of SADCC capacity in graduate-level training

a. Description

This programme would establish a sufficient number of full-cost SADCC graduate fellowships for use in specified disciplines in selected SADCC universities. The fellowships would be provided in sufficient numbers to ensure that together with persons being trained outside the SADCC region, there are enough persons available in each discipline to meet future requirements. The fellowships would provide rational and cost-effective graduate training in the chosen disciplines.

b. Background

The principal constraints addressed by this programme are the lack of trained and experienced nationals in professional positions in agricultural research, extension and training programmes as well as an inappropriate mix and insufficient quantity of specific disciplinary skills among existing researchers, extensionists and trainers.

Another major constraint impeding the development of sustainable African institutional capacity in professional agricultural manpower development is the low level of investment in graduate-level education in the agricultural sciences. These are high unit cost programmes principally because of the relatively small numbers enrolled in them. They require a stable resource base to support them over time and a sufficient number of students to ensure that these unit costs do not become too high. Several countries in the SADCC region have the resources to maintain a limited graduate level programme. None, however, can support from its resources the full spectrum of graduate-level training in all the agricultural fields. Several SADCC nations have begun graduate-level training in selected fields.

The high cost of these programmes has resulted in a pattern of specialisation in graduate-level fields by the agricultural universities in North America and in Europe as well. In fact, many departmental graduate-level programmes have been reactivated recently in the US, thereby encouraging further regional collaboration in graduate level programmes.

African leaders at ministerial-level meetings have expressed concern about the high recurrent cost of graduate education to the national budget. The Lagos Plan of Action strongly proposed the establishment of regional institutions to achieve cost-effectiveness. This proposal suggests an alternative to establishing permanent regional institutions which have not had a high level of

success in Africa. It proposes utilising the evolving strengths of the several departments of member countries' present institutions which together can begin to create a regional capability in graduate training.

c. Objective

The objective of this programme is to encourage member countries to develop a regional plan in which the training and institutional resources presently available can be utilised more efficiently and effectively through regional collaborative efforts. The plan should provide the rationale for effective utilisation of present resources as well as an indication of urgent needs in discipline areas presently not available in the region which require special attention for development.

d. Suggested approach

To achieve the objectives noted above will require a comprehensive assessment of the current status of graduate level education in agricultural sciences and the potential for regional collaboration. A high-level advisory group or task force composed of appropriate national educators plus one or more research staff should be empowered to oversee this in-depth analysis. This group would be expected to identify high-priority fields which might be activated and to establish criteria for the establishment of graduate-level education in terms of faculty required, and facility and support requirements for the various priority fields of training. Further, the advisory group would be expected to suggest the fields of training and specific departments at the several universities within the region which may be considered as part of the regional collaborative graduate level training effort. For example, an MSc degree in plant pathology might be undertaken at university A, entomology at university B and agricultural economics at university C.

It is proposed that this programme be a ten-year programme supported by a number of full-cost graduate fellowships in the regionally designated high-priority fields, to be awarded and designated as SADCC Graduate Fellowships to candidates from member countries other than the country providing the graduate-level training. The fellowships would be given to students for study in the selected fields in specific universities. Sufficient numbers would be awarded for each field, thus for each university programme, to attain an acceptable level of unit costs per student trained.

e. Expected results

The result of this programme will be to establish, within the SADCC region, rational and cost-effective graduate-level training in selected agricultural sciences. The programme would encourage regional collaboration in educational efforts. An important

additional result would be the preparation of African scientists in their own environments. This should lead them to be better motivated and attuned to the problems of smallholder agriculture. Another positive benefit from this programme will be, over time, a reduction of dependency on expatriate professionals in the research, training, and extension institutions of the region.



11. Provision of science training for students entering baccalaureate training

a. Description

This programme would develop special training activities at the pre-baccalaureate level to strengthen students' mathematics and science capabilities to the point where they can gain entry into BSc programmes in agricultural sciences. A baccalaureate full-cost scholarship programme would be made available to the students trained in this special programme, and to other qualified students seeking to study agricultural sciences at the BSc level.

b. Background

The principal constraint this program helps to eliminate is the inadequate number of persons trained in selected biological and physical sciences especially at the secondary school level. Over time it also will help reduce other constraints such as the lack of trained and experienced nationals in professional positions in agricultural research, extension and training programmes.

Governments and donors in the SADCC countries have found that they are often unable to use the allocation of funds available to them for university-level technical training because of the shortage of potential trainees with entry-level credentials, even though many students are interested in university training. While this problem does not affect all SADCC countries equally, an activity should be developed to increase science competency so that students from all countries will be able to enter agricultural science training at the university level. At this time, few schools in SADCC countries offer their secondary school students science training except in the major urban areas of the countries. These students, while perhaps academically qualified, may not have much appreciation or understanding of the environments and situations faced by the great majority of their country's agricultural producers.

c. Objective

The objective of this proposed activity is to increase the pool of potential students for baccalaureate training in agricultural and veterinary sciences (and presumably in other fields requiring strong science skills for entry) and to increase the effectiveness of baccalaureate training through a programme of science and mathematics.

d. Suggested approach

An assessment of the extent of this need should be undertaken by the CTCAR by appointment of a qualified advisory group knowledgeable in these matters. If a need is found for such a programme, it should be established in those countries where the

problem is acute and in institutions which can provide teaching talent with skills and experience in such an accelerated learning programme. A class of 30-40 students with a high teacher-student ratio (perhaps 1 to 10) would provide the ideal situation for effective training. A programme of five years' duration would provide a sizeable cadre who could enter professional agricultural and veterinary fields. The assessment process should ascertain institutions in the SADCC region that would accept successful students from these programmes. Students would be expected to enter African institutions unless spaces were not available. Such a programme could, of course, prepare individuals for entry into institutions outside of Africa, especially for undergraduate options not available in African institutions.

This programme should be allied with a SADCC undergraduate fellowship programme. Successful graduates of the science training activity would then have resources available for entry into a SADCC national university. The scholarships could also be made available to other qualified candidates. Fellowships would fully fund the costs of students entering undergraduate training. Such an activity would provide for very useful cross-country experiences for undergraduate students.

e. Expected results

This activity would provide a source of students qualified for entry into baccalaureate programmes in African institutions. Preliminary indications are that several SADCC training institutions have underutilised capacity which might be made available to qualified students from other SADCC countries seeking more science and math skills. This activity would also increase the number of professionals with African baccalaureate training and encourage intra-country cooperation.

12. Development of appropriate texts and reference materials for certificate and diploma training institutions

a. Description

This programme would develop a set of region-wide agricultural texts explicitly relevant to the issues, practices and solutions of smallholders in the SADCC region for use in training students at the certificate and diploma levels in the region.

b. Background

This programme is designed to reduce the constraints of lack of focus on smallholder problems, issues and solutions and lack of technology, including technological packages, adapted to and suitable for the smallholders' economic-traditional environment at the farm level. The programme would also address the insufficient understanding and capability to design and implement interdisciplinary research and extension efforts.

Many textbooks and work manuals used for the training of students at the certificate and diploma level are not suitable or adequate to meet the needs of students. At present, students at these levels are not usually provided textbooks or manuals for individual use. Instead, they generally study from teacher-prepared mimeographed materials and study guides. These materials are often copied from texts used in the very different agricultural environments of Western countries, especially the United Kingdom and United States.

These training texts and references need to be overhauled and made more relevant. In addition, sub-Saharan African societies have indigenous systems of knowledge relating to agriculture which could be usefully incorporated in appropriate textbooks. Textbooks, especially at this level, which use the learners' background and environment--e.g., examples and illustrations from the local experience of the student rather than from temperate zone agriculture--would likely stimulate student interest in applying science and mathematics to agriculture and be more useful to the student. A photo in a text showing a four-wheeled tractor pulling an eight bottom plow provides minimal educational content for students who study soils and tillage problems in the smallholders' environment.

Thanks to the dedication of many teachers, outside materials have in many cases been adapted to local conditions. General textbooks authored within southern Africa are available, for example, but most require revision also. Given these circumstances, it would be more efficient if a locally or regionally authored text series covering all the major subject areas of the certificate and diploma schools were available. It also would be very desirable if these materials were made available to each student for use and reference in the future. Most graduates of this level of training enter the national service in extension and as technical support staff. A personal library would

help them in their contacts with smallholders as they perform the tasks assigned.

c. Objective

The objective of this project is to encourage the development of instructional materials that build on indigenous experiences to strengthen student interests in applying chemistry, mathematics, and other scientific based disciplines to problems of agriculture. The texts and instructional materials, if well prepared, can help instill an attitude among the junior staff whereby they afford workers in agriculture more status and help ensure that national food production goals are achieved.

d. Suggested approach

The CTCAR/SACCAR, with the help of an advisory group of experienced teachers from the certificate and diploma schools, together with curriculum specialists, should request a determination of needs for texts by subject areas, and assess the extent to which aspects of the prior experience of students and the use of appropriate examples can serve as reinforcement in the learning process. Donor assistance and support should be requested either 1) for grants to selected and invited authors for subject matter fields or 2) for support to a team of SADCC professional training staff who would be charged with the task of producing appropriate materials to cover the curriculum in agriculture. A curriculum revision will likely result from a more appropriately oriented set of teaching materials than what is currently available.

e. Expected results

It is expected that the use of revised materials will substantially increase the ability of those receiving the training to contribute to national developmental objectives. It would be expected that curriculum revisions may well result from this effort. More relevant training and text references will increase the field staffs' ability to relate to farmers by being better able to translate and adapt technology prescriptions effectively. In the longer term this programme will improve the capacity of extension to perform its mission as well as provide that those who become employed as technicians can perform more effectively in supporting roles for the research and the teaching institutions and will better understand the relationship between their tasks and smallholder agricultural development.

13. Development of a food crop production collaborative research programme

a. Description

This programme would establish regional collaborative research activities in food crop production focussed on increasing the productivity of emerging farmers and other smallholders.

b. Background

The principal constraints addressed by this programme are the lack of technological packages adapted to and suitable for smallholder farming systems, practices and environmental conditions and the inappropriate orientation of agricultural research toward large-scale farmers. Several other constraints also are affected by this programme: climatic and ecological limitations, seasonal shortage of human labour and farm power; lack of collaboration between research, extension and training personnel and between them and smallholders; lack of varieties/species adapted to and suitable for smallholder farming systems, practices and environmental conditions; insufficient research on smallholder mixed crop and livestock farming problems and solutions; losses due to pests, weeds and diseases; insufficient forage, water or access to water for livestock; and inadequate disease and parasite control for large and small ruminants.

Most of the countries in the region face very serious problems of increasing populations, declining food production and occasional drought. The physical and biological constraints, and those constraints linked to deficiencies in policy and institutions to increase food production, have been documented in this report. Research programmes on food crops are in place in all the countries of the region. What is needed at this time is region-wide focussed collaboration and sharing of research results and technical information. Collaborative research providing incremental support to assist national programmes achieve a better focus on smallholder food production problems is expected to yield large gains in productivity.

Three cereals--maize, sorghum and millet--provide the bulk of the diet of the population in SADCC countries. These also are the main crops produced in the smallholder sectors. Maize and wheat are also produced in several countries of the region on large-scale commercial operations.

The research capacity in cereal crops in the SADCC countries was originally established, in large part, from the early emphasis of agronomic studies on the crops. This research base, though substantial, has not achieved widespread success in increasing yields in the smallholder sector of the countries. While substantial gains in yields have been proven possible on research plots, the adaptability of the recommended technology and the use of these improved practices has been almost exclusively in the commercial

agricultural sector of the countries. Except for millet, there is a substantial base of indigenously developed germplasm now at hand (either developed locally or from international collections) which can provide an opportunity for further adaptation to the harsh and erratic climatic situations common in much of the region. The need at this time is to develop further this core technology for these crops in the context of smallholder systems where drought resistance, seed viability, reduction in length of growing season, bird resistance and harvesting and storability characteristics become important factors. Research in this context cannot become entirely preoccupied with maximising yields at any cost, but rather must take into account the limited resource base of smallholders.

The skills of agronomists, pathologists, soils and tillage scientists, sociologists and economists, all working together, are required if the adaptation process for plants to make them suitable to smallholder systems is to be accomplished successfully. Indeed, a plant characteristic considered important in commercial sector systems may not be important and may even be undesirable in a smallholder system.

The experiences and knowledge from current research and farming systems research projects in most of the SADCC countries will be useful in identifying constraints to modifying plant characteristics to make them more useful in smallholder environments.

All food crops are candidates for consideration under this collaborative programme. Some crops not now grown in SADCC countries may have potential, but the cost in research talent, the time required and the difficulties faced by extension services in introducing them into smallholder systems mitigate against committing substantial resources to the introduction of new crops at this time. For the short term it is more productive and cost-effective to develop well-designed research activities on the crops with which smallholders are familiar and understand.

c. Objectives

The objective of this programme is to establish a unified and smallholder-focussed approach to improving productivity of crops currently important to smallholders. It is important to fully utilise the talent available in the region, supported by specialist skills as needed from appropriate international sources and professional institutions or agencies, all directed to applied research relevant to smallholders' and emerging farmers' production problems and solutions.

d. Suggested approach

This programme area has the potential to include a large number of crops. Three projects that become part of this collaborative programme are already in varying stages of

identification, design and implementation. These are the maize project, sorghum/millet project and the grain/legume project proposal. The exact nature and scope of the research on these crops for which SADCC countries will have to direct resources are under current consideration.

Central to the effectiveness of a collaborative research programme is the need for a systematic process to select researchable sub-projects that have potential for high payoff. A system is urgently needed to assure that projects and subprojects are planned, using internationally acceptable procedures for problem identification, selection research methodologies suited to the focus of the research on the smallholders' and emerging farmers' issues and their resolution.

Important considerations which apply to all collaborative research projects as they are put in place include the following: (1) the need to develop operational systems that place greater responsibility for project operation and evaluation, or re-direction, on the CTCAR/SACCAR; (2) the development of subprojects which build upon and support national research programmes, rather than creating new institutions which place additional demands on the limited technical resources of SADCC countries; and (3) careful consideration of the timeframe required for programme development and the concurrent ability of the national programmes to prepare sufficient numbers of trained professional and technical staff available to undertake new efforts.

The IARCs and other international institutions should be invited to assist in the development of this (and other) collaborative research programmes. Contributions they can make strengthen research programmes oriented to smallholders needs will be especially valuable.

e. Expected results

It is anticipated that smallholders and emerging farmers, through national research and extension services, will obtain measurable productivity increases from well-designed and directed efforts. Research in this collaborative programme will need to have consistent and long-term support by governments and donors to strengthen professional skills and to provide operational resources. This adaptive research approach, with emphasis on production systems and on land/crop management by smallholders, is of central importance in achieving successful results in the SADCC region. There may be a need for shifts in objectives of research in the future to a stronger concern for protective research orientation which may be required to deal with pathogen outbreaks, etc. Throughout the life of this programme, innovative approaches and ways to solve smallholder-specific problems must be encouraged; thus the adaptive research concept needs to be woven into all collaborative research activities.

14. Development of an economic and agricultural policy collaborative research programme

a. Description

This programme would strengthen SADCC and country capabilities to identify, prioritise and carry out policy research related to agriculture policy.

b. Background

The main constraints addressed by this programme are the lack of appropriate pricing policies, inadequate marketing policies and structure, and lack of credit availability for smallholders. Other constraints addressed include inadequate national and agricultural budget and staffing policies and lack of environmental/ecological policies consonant with the climatic and ecological limitations of the region.

National goals relating to expectations of increased production are not always supported by policies related to farm pricing, import levels (and prices), input supplies (and their pricing), market practices and similar issues. Inconsistency in these and other policies is a serious constraint to increased productivity, especially of smallholders and emerging farmers.

Agricultural policy, sensitive to the needs and problems of the large numbers of producers of agricultural commodities, is central to national development. In the SADCC countries, as in most of Africa, the policies of the past which generally were not supportive of smallholder agriculture and the production of food crops tended to be continued in the post-independence period. The widely accepted view that a green revolution or similar technological innovation would cope with the relentless growth in food demand from a rapidly expanding population is not now seen as a viable solution to the African food problem by most professionals. The reality of higher energy costs and the decline in real prices of export commodities (and the resulting balance of payments problems) have begun to be seen as destabilising aspects of the African situation. These conditions are heightening interest in agricultural economics and in policies supporting the urgent need to increase the production of food. They also are resulting in clarifying national objectives in several countries to give high priority to achieving national food self-sufficiency or food self-reliance.

This greater focus on food availability and the economics of food necessitates harnessing millions of smallholders to the task of food production because this is the only realistic approach to increased food output in the short term. The concern that rural dwellers may increasingly become urban unemployed is a further incentive to find means to provide smallholders with incomes and opportunities not now found in African agriculture.



Increasing the output of these many traditional smallholders requires that national research, extension and training institutions focus clearly on their problems and solutions. Equally important is the policy environment in which smallholders must produce. Policies that result in price (or other) production disincentives negate the adoption of technological innovations. Such counterproductive policies also can result in the waste of research resources on technology development which are unrealistic for smallholder use, no matter how effective they might have been in a more appropriate policy environment.

Research in this area is apt to be politically sensitive. Policy research is also difficult and requires professionals of high skill, good analytical ability and intellectual honesty. Analysis of the effects of alternative policy options must be timely and stated in language understandable to policy-makers so as to assist them in making choices. Thus, senior government officials must view policy research outputs as important for use by government and as extremely important in addressing the concern about food availability.

The list of possible topics for research can be long. Topics relating to producer prices, security of tenure, water rights, credit policy, export policy, transportation and storage policies are all reasonable areas for research. But no matter which policy issues may evolve as suitable for a regional research effort, effective national research programmes should address policy issues such as the selection of priorities for funding, study of effects of policy and of the potential to link policy, technology, and institutional efforts to meet the challenge of increasing smallholder food productivity. All require competent, professional analysis to provide insights and an array of alternatives together with an assessment of the cost-effectiveness of each.

c. Objective

The objective of this programme is to strengthen national capacity for food and agricultural policy research through regional collaboration. The regional programme can help strengthen national programmes and also provide useful inputs to the issues of intra-country trade, ways to share and trade resources needed for agricultural production and in similar areas.

d. Suggested approach

The scope and potential for this programme should be studied by the CTCAR/SACCAR in conjunction with qualified agricultural economists and other policy analysis specialists. It should involve the other CTCs as appropriate. The projects to consider for inclusion in this programme area must be applicable to the main concerns of national policy-makers. Design of the activities proposed will require establishing sub-project objectives, specifications and

proposed methodologies to be utilised. This is especially critical in as much as the data base required for policy research will likely be limited in most countries. New information will be of great future value if standard methodologies and reporting formats are used across the region.

The assistance of professionals from the IARCs and from other international agencies should be sought such as the International Food Policy Research Institute (IFPRI) and relevant agencies within the FAO. Their experience will be valuable in the planning stages of this programme.

e. Expected results

Results of work in this programme area will depend greatly on the skills of the researchers, the nature of the topics chosen for research and the relevance, clarity and practicality of the recommendations that are offered. Modest expectations for the short term are in order since, as noted above, even those policy recommendations that appear simple and straight-forward may be politically sensitive and difficult to implement. The timing, political environment and appropriateness of the policy prescriptions are very important and, until this type of research and analysis is proven useful and fully accepted at senior levels of government, it is unrealistic to expect major shifts in agricultural policies.

Nonetheless, policy research, over time, will lead to greater understanding of the need for policy changes which ultimately may have to be undertaken. Wider understanding of this aspect of policy and economic research will in itself be useful. The flow of benefits from changes in policies generally take place over time and often are not measurable quantitatively in the aggregate. Likewise, the distribution of the benefits among sectors of the society is not easily quantifiable.

15. Development of a land and water resource management collaborative research programme

a. Description

This programme would develop the capacity to identify high-priority research topics in the areas of land and water, to prioritise these topics, and to carry out research in a collaborative mode in this important area that will increase productivity, with particular reference to smallholders, at the same time that it sustains the environment.

b. Background

The important constraints to increased productivity addressed by this programme are climatic and ecological limitations--irregular and inadequate rainfall, degraded soils, and insufficient forage, water or access to water for livestock.

Land and water management issues are leading concerns related increasing food output in a harsh ecological environment--the setting for much food production in the region. Traditional African farming systems which evolved over generations were generally in equilibrium with the environment and were able to supply the food needs of the people, albeit at much lower levels of population. These fragile environments are not able to support the recent rapid growth in population. Soil erosion and forest and forage degradation are everywhere evident. Declining relative output and incomes are only partly muted by out-migration and off-farm employment in cities or outside of the country.

Approaches to increased national food output, in this environmental, economic and social setting, depend on the goals of these efforts. One approach is to deal with these constraints to national food output through adapting in production practices that will yield increases in food output to the producers currently on the land.

Another approach would be to determine the potential of large-scale irrigation for increasing national food output by encouraging small-scale intensive agriculture. In the short term, large-scale irrigation should not be perceived as a panacea. The marshalling of large investments, the design and construction of systems and infrastructure require a long time. The benefits that would accrue to the relatively few well-situated smallholders would have to be balanced against the negative impacts of neglect on the millions of others not afforded this opportunity. Nonetheless, possibilities for irrigation to increase agricultural production in the long term should not be overlooked.

The prospects for rapid increases in productivity are less than would be desirable. Given the fact that a large proportion of the agricultural population is engaged in traditional production systems, even small gains in productivity for each smallholder would in the aggregate be important to national food scarcity.

There is reason for some optimism when the results from adaptive or farming systems research programmes in the region are examined. These results to date, although not startling, indicate the possibility, even in harsh settings, that use of a currently available blend of land and water management, water catchments, biological, mechanical and chemical technologies designed for use within the socioeconomic setting of the smallholders and emerging farmers can result in significant increases in food output.

c. Objective

The objective of this programme is to: 1) devise ways to accommodate or adapt more effective production systems to the environmental constraints posed by the arid and semiarid resource base, and other constraints of smallholder crop and livestock producers; and 2) propose modifications which are acceptable to them.

d. Suggested approach

This challenging research proposal will be a difficult task for the CTCAR/SACCAR to conduct. The individual research topics to be considered under this programme could be developed by establishing an advisory group for each project area. Addressing the problem, recommending project objectives and methodology, and helping secure collaborative agreements within the SADCC region for each activity could be included as responsibilities of such an advisory group. IARCs could provide technical insights to the planning and design of specific projects.

A research programme on land and water management in arid and semiarid lands is broad, and potentially useful research projects under it are many. Establishing priorities among them will require making choices. Climate modification and environmental issues, such as protection of rangeland and reduction in the rate of forest degradation, require large research resources and institutional backup not now generally available in the SADCC countries. Studies leading to the development of large-scale irrigation projects in SADCC countries at this time appear to be counter to the orientation and emphasis on increased smallholder production. They would require skills and funds likely not available in the short term. A hydrological data base is not available for careful analysis of options and opportunities for such large-scale projects.

Land and water research on semiarid lands, in the immediate future, should be largely applied and aimed to reduce or modify the

impact of physical constraints on smallholders' productivity. Research topics would also be dictated, in part, by building on the research results done in the past, whether at the national or regional level. Research results from the IARCs and other international research experience related to the smallholders applications and acceptance of research also could be relevant.

It would appear, for example, that tillage methods to conserve water, improve tilth and reduce erosion and studies of small-scale irrigation would be viable research projects in the arid and semiarid environments.

The specificity, scope, orientation, time sequencing and the priorities of alternative research proposals can be resolved within a regional collaborative research system as outlined above. As noted earlier, a regional Land and Water Resources project is in preliminary design phases.

e. Expected results

It is expected that the research completed in this programme would, in the intermediate term, result in productivity increases by smallholders. Additional incremental increases over time would provide a measurable improvement in the welfare of the millions in the SADCC region now producing food in a relatively hostile environment. This programme would be a long-term continuing activity and require such commitments from both the countries and the donors.

16. Development of a farm power collaborative research programme

a. Description

This programme would develop a collaborative research effort to reduce the constraints in adequate seasonal supplies of labour and/or farm power.

b. Background

The major constraint addressed by this programme is the seasonal shortage of human labour and/or farm power. Other constraints impacted upon by this activity include insufficient research on smallholder mixed crop and livestock farming problems and solutions; lack of knowledge on the part of research, extension and training personnel about smallholder farming systems, practices and traditions (land and livestock holding patterns, the role of women, and low farmer status); climatic and ecological limitations--irregular and inadequate rainfall and degraded soils; lack of technological packages adapted to and suitable for smallholder farming systems, practices and environmental conditions; inappropriate orientation of agricultural research toward large-scale commercial agricultural needs rather than smallholders.

Particularly in the case of the smallholder, limited available labour or power for adequate and timely tillage, cultivation and harvesting is a serious constraint to productivity. This constraint impacts directly on the farm family's ability to produce food from its limited holding and precludes it from farming larger holdings.

The utilisation of animal power and the associated adaptation and improvement of farm tools (i.e., plows, cultivators, harvestors, threshers, etc.) for smallholders needs high-priority attention. Although research in this area has produced mixed and often contradictory results, it has been shown in many tests that timely sowing and weeding can often double yields of the important crops. However, most studies have been on experiment station fields and demonstration farms. Basic data are inadequate on yields and the effects of power and tools on the acreage which can be managed by use of animal traction at the smallholder farm level. Further, most research has been done by expatriates and did not have the continuity needed to develop, test and adapt animal power and associated implements over time.

SADCC countries, like much of Africa, have been slow to move from hand labour to utilisation of animal power. Furthermore, governments have paid little attention to the potential for animal power. In some cases, encouragement of animal power is considered inappropriate as this would continue to infer that the country was somehow backward by western standards. Animal power is a significant source of energy worldwide and in some developing countries represents as much as 90

percent of agricultural power. There is need for practical research on adapting animal power for use by African smallholders as well as for studies designed to lead to improvement in yokes, collars, harnesses, implements and vehicles. Several countries in the SADCC region have indicated a renewed interest in the potential of animal traction. Some have current or earlier project results to build upon.

Often single discipline approaches produce only partial and often contradictory answers to such issues. Research that focusses on smallholders' physical and economic environments and that involves researchers from several relevant disciplines is likely to make more progress. Animal production and range scientists should also be involved since the nutritional problems related to the animals themselves in the harsh environments often is a severe constraint.

The experiences of institutions such as the International Livestock Centre for Africa (ILCA) are significant. The recent development of the single-ox plough suitable for the highlands of Ethiopia also is encouraging. Other recent, as well as historical studies, from West Africa would be valuable in helping determine programme design and focus.

c. Objective

The objective of this collaborative research programme is to encourage researchers and policy-makers to undertake and support research which will reduce several important constraints in the use of power for improved timeliness and effectiveness of tillage operations.

d. Suggested approach

This activity could be initiated by the CTCAR/SACCAR by requesting an intensive literature review in order to determine the feasibility and potential directions for a collaborative research programme. ILCA and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), as well as other institutions with experience in use of animal power by smallholders, should be invited to assist in such an analysis and suggest appropriate areas for investigation.

e. Expected results

The research results of this programme are expected to be practical but perhaps not applicable in all resource situations. Results in some instances may indicate that animal traction is not cost-effective in some of the difficult ecological environments where smallholders have severely constrained resource endowments. Yet this in itself would be useful knowledge and has implications for appropriate government policies. In less constrained situations, it is expected that animal traction research can lead to practical use. In fact, such research may encourage the development of a rural industry involved in the production of needed tools and agricultural equipment suitable for utilising animal power.

17. Development of a small ruminants, swine and poultry collaborative research programme

a. Description

This programme would establish a collaborative research activity to increase the productivity of small ruminants, swine and poultry with particular reference to animals held by smallholders. It would help improve nutrition and increase incomes of smallholders.

b. Background

The main constraint addressed by this programme is insufficient research on smallholder mixed crop and livestock farming problems and solutions. Other constraints reduced in part by this programme are lack of varieties/species adapted to the local environment(s); lack of technological packages adapted to and suitable for smallholder farming systems, practices and environmental conditions; inadequate disease and parasite control for large and small ruminants.

Not all smallholders or emerging farmers have cattle as part of their farm enterprise mix. But many have goats or sheep and/or chickens. These animals represent both valuable sources of nutrition for the family and, in many cases, income from their sale in nearby villages or markets. Their full potential for increased productivity has not been determined. This lack of attention, within the various management and systems used, is a constraint to the improved nutrition and increased income of rural people.

Small ruminants, swine and poultry generally have not received research attention in the SADCC countries. Working for improvement in the productivity and output of these animals as a group offers one of the quickest and easiest ways a research programme can attain its objectives of assisting increased food production. This would greatly improve the nutritional status of the rural population. The full exploitation of these categories of animals as food sources probably would have fewer constraining inhibitions than would cattle.

As in the food crops production sector, the research results in the livestock production sector have not led to the anticipated increases in productivity or total output. As in the food crops sector, the main reason centres on research focus. A report of a seminar in Kenya recounted in a recent ILCA newsletter states:

In the last 20 years more than US\$ 650 million has been spent on livestock development projects in tropical Africa. But the results have been disappointing, mainly because the projects were designed and implemented with a poor understanding of the dynamics and objectives of the production systems they were supposed to improve . . .



The finding that traditional Masai producers are already highly efficient when their efficiency is gauged in terms of their own objectives rather than those of planners and developers is an important contribution to such understanding.

Production and disease problems of small ruminants, swine and poultry recently have received attention in several SADCC countries. A sustained research effort is required to determine the major parameters involved to expand output of skins (including wool and mohair), milk and meat from small ruminants which are important to smallholders, especially in the areas of high environmental stress. Competition for rangeland is an important consideration. In the case of swine and poultry, the need for local feed grains and supplementation restricts rapid expansion except in areas where feed and feed by-products are available. A research effort is needed to discover suitable, applicable technologies that can exploit the potential of these animals in the SADCC region.

c. Objective

The objective of this proposal is to identify, develop and implement technologies that will increase productivity and output of small ruminants, swine and poultry and which are capable of use by smallholders.

d. Suggested approach

This programme area requires a sequential process in developing the high-priority, researchable projects which could be undertaken within the limitations of professional manpower and resources. A task force of knowledgeable professionals appointed by the CTCAR/SACCAR could begin a thorough literature search. Literally scores of potential projects are possible. The first task is to select topics that are researchable and have a potential to produce results useful to smallholders. It is probable that ILCA could provide assistance in the identification of high priority topics for research and also assist in project planning and implementation. The USAID-funded Small Ruminant Collaborative Research Support Project (CRSP) also can be expected to have useful information and could be approached for professional assistance and support.

e. Expected results

Research in this area could contribute to increasing the quality and quantity of food supply. It could also contribute to increased rural income derived from small agro-industries and processing of animal products (e.g., cheese-making, mohair weaving, etc.). At the moment this is a relatively neglected area of research and deserves support, especially as manpower resources become available in the SADCC region.

18. Development of a horticulture and specialty crop collaborative research programme

a. Description

This programme would develop a collaborative research activity to increase the productivity and output of horticultural crops by smallholders. Specific high-priority projects will be selected for research at the national level with funding support from the regional level.

b. Background

This programme addresses the constraint of insufficient research on smallholder mixed crop and livestock farming problems and solutions. It also helps alleviate the constraints of climatic and ecological limitations; lack of varieties/species adapted to the local environment; lack of technological packages adapted to and suitable for smallholder farming systems, practices and environmental conditions; and lack of knowledge on the part of research, extension and training personnel about smallholder farming systems, practices and traditions.

Perhaps only a small number of rural smallholders near markets or urban centres would be able to produce horticultural products adapted to smallholdings under labour-intensive conditions. However, to the extent this is possible it would increase incomes, improve diets and reduce the rural to urban migration.

A number of fruits, vegetables and nuts are grown in the SADCC region, often as cash crops for export. Citrus, pineapple, and cashew nuts are important income-earners in several countries. However, the region does not have the level of research effort in horticultural crops as compared to francophone West Africa. There are micro-climates in several of the countries that would permit the growing of horticultural specialty crops, possibly on a scale that would permit commercial development. Knowledgeable observers in the region have suggested that the markets afforded by the rapidly growing urban centres in each country have not been fully exploited and that there are opportunities to diversify smallholder agriculture near these centres and to improve diets of the urban population. Many urban centres remain dependent on imported sources, from outside the SADCC community of nations, for certain vegetables and fruits. This programme also will evaluate the possibility of encouraging the production of certain vegetables in the setting of smallholder production systems in order to improve and to diversify their own diets.

c. Objective

The objective of this programme is to increase the output of specialty crops and their incorporation in smallholder

systems so as to supply such crops to growing urban populations as well as to export them.

d. Suggested approach

This programme is not seen as among the highest-priority activities for early consideration. Research staff and economic analysts now in the region, and professionals, as developed through other Collaborative Programmes, may begin to explore the potentials for research in this programme area through workshops and seminars. It is anticipated that information and advice would be sought from the IARCs and other international research organisations, and especially from the private sector.

e. Expected results

A well-planned programme of research has the potential to lead to the development of horticultural and specialty crop enterprises contributing to national food supplies and providing additional sources of income.

## IV. SUMMARIES OF COUNTRY REPORTS

### A. Introduction

An integral part of the ARRA was the preparation of Country Reports based on the collection and analysis of data in each country from June through August 1984. Each report consists of chapters on: background information about the country; the agricultural research, training and extension institutions; constraints to increased agricultural productivity by smallholders; constraints confronting the agricultural research, training and extension institutions; and recommendations for dealing with these constraints. The Country Reports have been summarised in this chapter.

While each of the SADCC countries participating in the assessment used the same questionnaires and report outline, due to differences in sources and recording of data, different base years of available data etc., in some instances the data collected in the eight countries is not directly comparable.

### B. Botswana

#### 1. Background

##### a. Country description and economic overview

Botswana is a landlocked country, with a population of 940,000 people which is growing at the rate of 4.6 percent per annum. The climate is subtropical; annual rainfall ranges from 250 mm in the southeast to 650 mm in the northeast and is quite erratic. Surface water is very scarce, and groundwater sources are, therefore, very important. Botswana is a democracy with a President and a unicameral legislature, the National Assembly. There is also a Special House of Chiefs that advises on legislation affecting tribal matters.

The Gross Domestic Product (GDP) of Botswana in 1980-81 was US\$ 780 million, 26 percent of which came from mining and 12 percent from agriculture. This reflected a change over the seven-year period from 1973-74, when agriculture provided 34 percent of GDP and mining only 9 percent. Real average growth rate in GDP between 1973-74 and 1980-81 was 10 percent per annum. Through processing of beef for export, agriculture is an important contributor to the manufacturing sector.

The majority of Botswana's urban and rural people are either unemployed or underemployed. The problem is compounded by the fact that the number of workers migrating to South Africa has decreased by one-half since 1976. In addition, the labour force is growing at the rate of 3 percent annually. Wage-earners comprised 17 percent of the total labour force and received approximately 37 percent of the GDP in 1979-80; in the same period, the rural population which is primarily engaged in agriculture, and which constituted 80 percent of the

people, received only 12 percent of the GDP. Most people in the agricultural sector are underemployed even though they combine agriculture with off-farm activities. Earnings differ significantly between citizens and non-citizens, being much higher for the latter.

b. Agriculture in Botswana

Botswana's climate is semiarid with cold, dry winters and generally wet summers. Rainfall is low and erratic, and distribution varies greatly between and within areas and seasons. Rapid and extreme temperature changes and the risk of frost also affect agriculture adversely. The climate in the east is more favorable for agriculture, as are the soils and, hence, this is the more heavily populated part of the country.

Only 5 percent of the land is suitable for cultivation; most of the arable soils are sandy and deficient in phosphorus. Between 60 and 70 percent of the country is covered by Kalahari sands which are partially responsible for rapid evapotranspiration that adversely affects agricultural productivity. Organic matter levels in the soils are also low.

Under the Tribal Grazing Land Policy, about 12 percent of Botswana's land is zoned commercial and is used for cattle ranching. Both crop and livestock production occurs on the 30 percent of the land which is designated communal and the 5 percent that is freehold. About 25 percent of the land is still unzoned, with the intention that it can be used for commercial ranching if needed.

There are three basic crop production systems in Botswana: communal or traditional, commercial/freehold and government. In 1980, traditional farmers engaged in subsistence production accounted for 85 percent of food grain output, while commercial farms contributed only 15 percent. Yields of both food and non-food cash crops were higher in the commercial sector by a factor of two or more to one than in the subsistence sector. Yields obtained on government research station experimental plots were higher than those of the traditional and commercial sectors. However, experiment station results have seldom been evaluated on farmers' fields to determine their applicability.

The difference in yields can be explained by small farmers reliance upon traditional practices whereas commercial and experimental production is heavily dependent upon use of modern inputs such as fertiliser and hybrid seeds. The Arable Land Development Programme (ALDEP) is designed to assist small farmers adopt modern practices by offering subsidies to buy draughtpower, farm implements, etc. The technical limits for traditional and commercial farm yields have not yet been achieved, and moderate improvements would contribute greatly to national food production.

The differences in productivity between the commercial, traditional and government livestock production systems are not as great as in crop production. However, commercial farmers and government research stations use better husbandry methods: disease and parasite control measures, better grazing systems, feed supplements and regular water supplies. The traditional sector owned 84 percent of the cattle in Botswana in 1980.

The marketing of all livestock in Botswana is in the hands of the Botswana Meat Commission which also exports beef--a major export earner after diamonds. Food crop marketing is the responsibility of the Botswana Agricultural Marketing Board, which has agencies and branches throughout the country. Credit is available through the National Development Bank, mostly for the livestock sector in which cattle can be used as collateral and there is greater potential for cash returns through exports.

Labour shortages during critical periods due to male migration to urban areas and the Republic of South Africa (RSA) is a serious constraint to agricultural production. Another problem is that, though women head about one-third of all farm households, they have the least access to basic resources such as draughtpower, equipment, land and cattle.

Improving Botswana's food production will require dramatic improvements in the traditional sector which produces 85 percent of food grain, including 93 percent of sorghum, 76 percent of maize and almost all the millet, beans and pulses. Average yields of food crops in this sector are among the lowest in Africa. Prospects for improvement depend on the ability of the research institutions to fashion adaptable production, storage and marketing technologies for the traditional sector.

## 2. Agricultural institutions

### a. Research

The Department of Agricultural Research (DAR), which is a division of the Ministry of Agriculture (MOA), has the task of developing and testing appropriate technology that will enable small farmers to increase food and livestock production. DAR headquarters are at Sebele near Gaborone, with substations at Mahalapye, Goodhope and Maun. There are also 18 beef cattle ranches and two communal grazing areas for research in animal production and range programmes.

The research programmes in breeding and breed evaluation, animal nutrition, range and pasture management, range monitoring and dairy production are conducted by the Animal Production Research Unit (APRU). Range monitoring is a cooperative effort among the Division of Land Utilisation and the Department of Agricultural Field Services, which gather the data, and the APRU of the DAR, which analyse it.

Dairy development is a fairly recent activity, designed to improve smallholder milk production by making available a package of recommended practices.

The Arable Research Programme consists of variety trials on major cereals, conducted at five different ecological and climatic locations, and dryland crop production research. There are also USAID-funded farming systems projects principally in the eastern part of the country, and collaborative research on cowpea, sorghum and millet production. Smaller research projects are on legume-cereal rotations and fertiliser improvement.

The personnel of the DAR include 46 professionals and 15 administrators, of which the Director, the heads of divisions and projects and over one-half of the total professional and administrative staff are expatriates. There are very few nationals in the fields of agricultural engineering and veterinary science. Although it is desirable for reasons of continuity to increase the number of nationals on the staff, this has been difficult because of the scarcity of trained Batswana. Plans to augment the national staff are slow to implement because of the lack of in-country training facilities and the long time it takes to train people abroad.

The DAR's research facilities include seven laboratories, three greenhouses, five administrative offices, three workshops, a seed processing plant, a clinic, a consumer cooperative shop and a primary school. Its equipment holdings include 24 trucks, 30 vehicles, 17 tractors and three micro-computers. The library has 1,000 books, to which it adds 100 new books and 120 journals each year. The DAR also has access to information from several international organisations, as well as inter-library loan arrangements with several countries in and outside Africa.

The Government of Botswana (GOB) provided US\$ 2.58 million for the DAR's operating budget in 1984. Vehicles and machinery are not provided through the operating budget. Donor contributions amounted to US\$ 0.68 million from SIDA, USAID, FAO and the UK.

b. Training

The Botswana Agricultural College (BAC) of the MOA is the main training institution that offers certificate and two-year diploma-level programmes in agriculture and animal health. The programmes' composition is evenly divided between practical work and classroom instruction. Current enrollment in the agriculture diploma course is 20, and enrollment in animal health is 19. The animal health certificate course has 57 students, and the agriculture certificate course has 47 students. The GOB pays all student fees; in return, diploma graduates are expected to work for the government for a minimum of two years and to remit 10 percent of their salaries to it during that period. Certificate graduates are expected to work for the GOB for a minimum of three years.

The BAC is headed by a Principal, who is assisted by a Deputy and by Course Directors. Staff positions include 23 professionals with BSc degrees. Ten of these are held by expatriates (two in non-authorised posts) and 18 by nationals. Altogether, the teaching staff numbers 48. At present one staff member is in training abroad for the MSc degree in range management, and five are in BSc training abroad in various fields.

Building facilities include classrooms, administrative and staff offices, laboratories, workshops, a library and a lecture theatre, all of which are in good condition. Major equipment includes an incinerator, a photocopier and vehicles such as buses, trucks, tractors and shop and farm equipment. The library has 9,400 books and adds 1,000 each year. It also receives 20 periodicals and scientific journals. The College has 30 ha of land which are used as demonstration plots and 20 ha for livestock projects shared with the DAR.

The BAC's linkage with the DAR is generally acknowledged as being weak, but it has a good working relationship with the Department of Agricultural Field Services. During each term, students attend demonstrations in surrounding villages and work closely with local extension staff.

All recurrent costs for the BAC are provided by the GOB. This amounted to US\$ 1.1 million for 1984-85. USAID has contributed 92 percent of the capital budget of about US\$ 225,000.

c. Extension

Extension services and some agricultural inputs are provided through the Department of Agricultural Field Services (DAFS), while the Department of Animal Health (DAH) provides field service in animal health. Both are departments of the MOA. Organisationally, the DAFS is divided into six regions which in turn are subdivided into districts. These are headed by graduate and diploma-level staff. Extension areas which encompass 250-300 farm families are headed by certificate-level personnel.

(1) Department of Agricultural Field Services

Increased food crop and livestock production are the major programmatic emphases of the extension effort. Research data based on local conditions are already available and have been applied in the relatively small commercial sector, but much remains to be done to disseminate the information to the vast majority of small farmers. The following are some of DAFS' ongoing programmes:

- o The Farming Systems Research Project: Its goal is to improve linkages between research and extension. It does this by promoting collaboration between the DAR and the DAFS



to discover means to implement more effective programmes for small farmers;

- o The Arable Lands Development Programme: It is designed to increase production of food crops in the traditional sector by providing recommendations on crop practices, and subsidies and credit to farmers to purchase farm inputs;
- o Under the Tribal Grazing Lands Policy attempts are being made to introduce improved management and grazing techniques in communal areas; and
- o The Information Services Unit produces leaflets on subjects such as livestock diseases and row planting, general fact sheets on livestock and crop topics, and a monthly publication entitled Agrinews. It also produces seven radio programmes per week.

While all of the 41 administrative staff of the DAFS are nationals, 46 percent of the professional staff are expatriates, most of whom serve at headquarters. The major staffing deficiencies are the low ratio of women extension officers and the shortage of agricultural engineers and range ecologists. Staff activities include dissemination of livestock and food crop production information, agricultural management to encourage farmers to form associations for purposes such as fencing and spraying, and short-term training for farmers at the Training Centres. Since the DAFS does not have any economists or social scientists on its staff, it obtains assistance when needed from the Division of Planning and Statistics of the MOA which employs several economists and rural sociologists.

The DAFS facilities include five Regional Offices, five Rural Farmer Training Centres, ten Demonstration Ranches and 17 district Offices. It also has access to 106 large trucks and 97 four-wheel drive vehicles. Over 95 percent of the DAFS recurrent budget of US\$ 8.3 million is from the GOE and over 90 percent of the capital budget of US\$ 1.2 million is from donors.

## (2) Department of Animal Health

The DAH is responsible for the diagnosis, control and prevention of livestock diseases through vaccination and the conduct of other health programmes. Field staff are located only at the district level, from which they conduct vaccination campaigns by visiting farming communities; at other times farmers with animal health problems must contact the veterinary staff themselves, which places those in remote areas at a disadvantage. The DAH provides livestock production information to farmers, via Livestock Advisory Centres located all over the country, and plays a vital role in the meat industry through the operation of two abattoirs at Lobatse and Maun. The DAH issues a number of circulars on the prevention and control of livestock diseases and parasites. It is assisted by the

DAFS Agricultural Information Section's radio programmes. The DAH does not have field research facilities for diagnostic work, which thus must be done through headquarters; there is no direct communication between laboratory staff and farmers.

The DAH personnel include 25 veterinarians, of whom 22 are expatriates. There is an urgent need for trained local staff; currently, 159 nationals are in training, but only 11 are studying for degrees in veterinary medicine. The rest are studying for diplomas or certificates in animal health. Another staffing deficiency is the disproportionately small number of women extension agents. Facilities include the central Veterinary Diagnostics Laboratory, the Botswana Vaccine Institute, the Tsetse Fly Laboratory, 27 livestock advisory centres, two abattoirs, and 16 district and regional offices. The DAH's recurrent budget of US\$ 9.8 million is financed almost entirely by the GOB. The capital budget of US\$ 5.8 million is contributed by the GOB (56 percent), CDA (10 percent), and other donors (34 percent).

### 3. Constraints to agricultural production and production potential

The overriding constraints to crop and livestock production alike are low and erratic rainfall and a fragile ecology.

#### a. Food crops

The major food crops produced in Botswana are sorghum and maize, along with small amounts of millet, beans and pulses. Smallholder sorghum yields of 200-225 kg/ha are somewhat less than half those in the commercial sector, while maize yields (170-300 kg/ha) are about one-third less. Aside from rainfall, the primary biological and physical constraints affecting both smallholder and commercial production are: the lack of high-yielding, adaptable, short-season varieties of sorghum, maize and millet; field losses from bird and insect damage; high soil temperatures which affect germination; low phosphate levels and poor mechanical properties of soils; and weeds, especially striga. Smallholders are further constrained by lack of timely access to animal or mechanical power for seed bed preparation, labour shortages at critical times, and poor access to supplies and technology.

Policy constraints include inadequate input provisions and delivery, the inappropriateness of recommended technical packages for low moisture levels, and the inadequacy of marketing services. Smallholders, in particular, are further affected by livestock damage to crops, by the lack of incentives to improve productivity through adoption of improved technological practices and by rural tradition-related constraints of traditional land tenure and land use patterns.

b. Specialty crops (vegetables and fruits)

Vegetable and fruit production are relatively new to Botswana, and very little is produced for home consumption. The economic constraints include the lack of irrigation and of input supply and product marketing systems. Among the physical constraints are the need for water supply, the lack of reliable temperature data and the lack of research on pests and diseases.

c. Livestock and livestock products

Since livestock accounts for about 80 percent of agricultural sector output, the importance of livestock production in Botswana's economy cannot be overstated. Despite the 1975 Tribal Grazing Land Policy, aimed at changing the traditional communal system to one of leaseholds with some communal grazing lands around villages, most lands remain under traditional tenure. Livestock problems in communal grazing areas are much harder to solve than in the commercial sector, because ranges are of poorer quality and are often overstocked. The tenure system is a disincentive to modern management techniques. Other physical constraints to livestock production are drought and range degradation. Although animal diseases such as tsetse fly and foot and mouth disease are present, they are limited to certain cordoned areas and are not as serious as elsewhere in Africa because of the effective veterinary service. The most difficult problem to resolve in terms of increasing production is the issue of providing equitable access to range and water resources while maintaining the resource base.

4. Staff assessment of institutions

The main constraints cited by the agricultural research staff were the need for more trained nationals in senior staff positions, the lack of access to well-maintained laboratory equipment and transport, and the inadequate linkage with extension and animal health staff and programmes.

The training staff emphasised the importance of establishing agency linkages between the DAR and the DAFS with the BAC. They also cited the need for additional teaching and audio-visual materials, access to reliable transport, and improvements in staff qualifications and training.

The extension service staff's major constraint was the access to and service for transport. They also stressed the need for improved linkages between the DAR and the BAC, and for better worker incentives.

## 5. Conclusions and recommendations

### a. Agricultural institutions

In research, training and extension, an evaluation of current strategies reveals the following:

- o The GOB's emphasis on improved linkage between the research, training and extension agencies of the MOA is becoming operational. To be made even more effective it must be practiced at the administrative, professional and working staff levels:
- o The MOA needs to establish a policy to deal effectively with the maintenance and service of its transport fleet;
- o A strategy is needed to establish better terms and conditions of service for the staff; and
- o There is a need to train, recruit and hire more nationals for professional posts.

In the food crop sector, the farming systems project provides a basis for strengthening linkages at all levels. More emphasis is needed on appropriately-adapted research packages for small farmers. Other production constraints, such as lack of access to farm power, labour shortages, losses from birds and pests, and lack of weed control, have not been adequately addressed as yet.

In the fruit and vegetable specialty crop sector, there is a need to carefully evaluate the potential for smallholder participation before developing a strategy for its further development.

### b. Agricultural productivity

Despite a lengthy record of research and an extensive data base in livestock production in Botswana, insufficient knowledge about rural traditions and access to rangelands and water rights are serious impediments to the formulation of sound policies and strategies. What is needed is a greater focus on the traditional sub-sector, the establishment of a long-term methodology to accurately determine the carrying capacity of the resource base, and continued efforts to implement and adapt the Tribal Grazing Land Policy to smallholder needs.

## C. Lesotho

### 1. Background

#### a. Country description and economic overview

Lesotho is a small, mountainous country entirely surrounded by the Republic of South Africa (RSA) with a semiarid climate. It has a population of about 1.46 million which is growing at the rate of 2.4 percent per annum. Nearly 90 percent of the people live in rural areas; agriculture accounts for 85 percent of resident employment and for 30 percent of the GDP.

Four major economic problems confront Lesotho in 1984: increasing unemployment, rising government debt, lack of investment and a growing balance of payments deficit. Since migrant worker remittances account for a large portion of earnings, the balance of trade is greatly affected by the state of the economy in the RSA. Lesotho's currency unit, the maloti, is tied to the rand, and a good percent of the Government of Lesotho's (GOL) revenues are collected through the South African Customs Union as most imports and exports are through the RSA.

Lesotho's development goal as outlined in the Third Five Year Plan is to reduce external dependence in the economy and encourage local initiatives. The key is to stem declining productivity in the agricultural sector through increased emphasis on all aspects of agricultural research and development of an effective extension service. The GOL has initiated many projects to increase rural incomes, employment and food production. It has also made infrastructural improvements such as roads, airfields and health clinics, and has provided training for rural people. It has attempted to improve marketing through the establishment of the Lesotho Coop and the Livestock Products Marketing Service. The GOL used the Lesotho Agricultural Sector Analysis sponsored by USAID to assist in the definition and recommendation of long-term agricultural policies.

#### b. Agriculture in Lesotho

The cultivable land area of Lesotho is about 450,000 ha which comprises 13 percent of total land area. Lesotho's soils are generally of low fertility. There are four agro-ecological zones. The Lowlands is the main crop-producing area and represents one-fourth of the country. The Foothills zone is most suitable for cattle raising and dairy production; the Mountain zones are used for summer sheep grazing in the upper ranges, and for beef, dairy cattle and mixed farming in the lower ranges. Some parts of the Orange River Valley can be used for production of irrigated crops such as maize, beans and vegetables. Subsistence agriculture is the norm, although surplus production has long been sold.

Traditional land ownership is communal and animals are grazed on communal lands. Although the system guarantees everyone equal rights to the land, the disadvantage is that it discourages investment in land improvement. Another problem is the scattering of small plots which is uneconomical. The peasants farm approximately 1.4 ha each. The objectives of the Land Tenure Act of 1979 were to increase efficiency and facilitate modernisation by improving tenure security and creating a limited market in land use rights that are transferable and heritable.

The major crops are maize, sorghum, wheat and pulses. After a small annual increase in cropped land area during the mid-1960s, the trend was reversed in the 1970s, probably due to increased migrant remittances which substituted for domestic agricultural earnings. Production and consumption data are not very reliable but, in general, average food consumption is adequate. There is, however, a heavy reliance on imported foods. About 30 percent of maize consumption and about 60 percent of wheat demand are met through imports.

The major livestock are sheep, goats, cattle, poultry, horses, donkeys and pigs. Until the mid-1970s, Lesotho was a net exporter of livestock products, but increased migrant worker earnings also impacted negatively on this sector. In fact, by 1975 beef and cattle imports reached a historic high. Despite the large cattle population which has caused a serious overgrazing problem, annual offtake is very low (12 percent) because cattle are used for draughtpower and as assets.

Fishing is done in rivers, lakes and artificial dams. Recently, aquaculture has been given GOL support through the Fisheries Section of the MOA.

Agricultural marketing problems in Lesotho include the small size of the urban population (13 percent) and the proximity to the RSA which produces some of the same products on large-scale commercial operations, thus at lower cost. In the past, grain trading was done through licensed merchants; prices paid to farmers varied widely and suddenly, and were often low. In 1980 the GOL adopted a policy of greater intervention. The Lesotho Coop was established to buy agricultural products from farmers and to sell them inputs through a network of retail outlets. Outputs are bought at fixed prices and marketed through commission-earning agents. The Lesotho Agricultural Development Bank coordinates all agricultural credit programmes. Credit supplied to farmers is in kind; all crop loans are seasonal and payment in full is due at harvest.

## 2. Agricultural institutions

### a. Research

#### (1) Programmes, personnel and facilities

Agricultural research is conducted by the Lesotho Agricultural Research Division (RD) of the Ministry of Agriculture, whose objective is to develop agricultural technology which will result in increased productivity, higher farm incomes and improved quality of life. Traditional agricultural research in Lesotho was based on experiment station results from which blanket recommendations were made. The shortcomings of this approach led to the adoption of the Farming Systems Research Project (FSRP) in 1979 with USAID assistance. The emphasis shifted to on-farm adaptive research employing multidisciplinary techniques. A systems approach is employed to develop combination package recommendations.

The major research programmes undertaken by the RD include:

- o Crops: The emphasis is on varietal testing of wheat, maize, sorghum and pulses. Recent trials have shown red sorghum to be high-yielding, have identified cold-resistant highland varieties of maize and sorghum, and have shown white Haricot beans, speckled Sugar beans and Pinto beans to be the most productive. Variety trials under irrigation have been conducted on cabbage, asparagus and tomatoes;
- o Livestock: The objective has been to develop cost-effective feeding programmes for oxen, using fodder and a protein/mineral supplement during the winter to keep them healthier for the ploughing in early spring. Grazing and stocking rate trials are also underway. Feeding and selection trials to improve the quality of sheep and goats and research on better range management are also being done;
- o Farming Systems Research methods are an integral part of the Division's work. A prototype area has been developed in each of the three productive geographic zones where on-farm trials are conducted;
- o The farm management programme gathers information on farm records, processes and analyses the data, and conducts costs and returns and marketing analyses;
- o The extension effort is geared towards training in extension education to facilitate transfer of research findings to farmers, to design and test methods to establish cooperative production and management and to obtain feedback at the village level; and

- o A rural sociology program conducts surveys and analyses social data to assist in the solution of production and farmer acceptability problems.

The RD is headed by a Director assisted by a Deputy Director and an advisor, who is also the FSRP team leader. Altogether there are 67 employees, including three administrators, 15 professionals of whom nine are expatriates, 28 technicians and 21 support staff. Currently, 12 professionals and two technicians are in training, the former in the US and the latter at the Lesotho Agricultural College (LAC).

Crop research is conducted at seven field stations which are staffed by caretakers and which have no buildings or equipment. Each of the three prototype production areas has a small field station with four buildings. The library, located at the main agricultural research building, is the official MOA library and serves as the repository for all local agricultural publications. It contains 10,000 volumes and up-to-date holdings of some leading journals. The main experimental farm at Maseru has 22 ha of land, of which eight are used for experimental plots, five for seed multiplication, seven for irrigated vegetable research and two for fodder. The total amount spent on research came to US\$ 2.2 million in 1983-84. The RD programme's funding is from the following sources: the MOA (18 percent), USAID (80 percent) and FAO (2 percent).

## (2) Evaluation

In general, the research programme is directed at high-priority problems. On-farm trials with a systems approach are backstopped by well-planned and well-executed research work at Maseru and selected field stations. The RD cooperates with the SADCC countries and with a number of international organisations. More specifically, its strengths are the following:

- o The emphasis on varietal testing in crop production that explicitly considers the practical situation of farmers;
- o Livestock research focussed on applied animal nutrition feasible for average village farmers;
- o Range research addressing high-priority concerns such as optimal stocking rates, range burning, brush control, and short-duration rotation grazing system;
- o Good long- and short-term staff training programmes to increase the number of nationals in professional positions; and
- o The emphasis on information dissemination, leading to the establishment of an Extension Unit with a link to the Extension Service of the MOA.



Some of the weaknesses are the lack of adequate linkages with the LAC, the lack of sufficient focus in activities on the Main Station and the three prototype areas, and the lack of a computerised data base.

b. Training

(1) Programmes, personnel, and facilities

The Lesotho Agricultural College (LAC), based in Maseru, is a division of the MOA and an affiliated College of the National University of Lesotho. There is a branch campus at Leribe that provides training to the certificate level for up to 30 students. The LAC is located close to the RD which is ideal for expanded collaboration. It is linked to the extension programme through the participation of the students in practical training. The LAC offers: two-year certificate programmes in general agriculture, agricultural mechanisation and home economics; a one-year certificate programme in forestry; and a two-year diploma programme in agriculture. The LAC's operating budget, which amounted to US\$ 549,220 in 1983-84, is received from the MOA.

The LAC is headed by a Principal who is assisted by a Director at each of the two campuses. Ten of the 19 professional positions at the LAC are held by nationals, five by expatriates; four positions are vacant. The College has excellent facilities to accommodate 200 residents, classroom capacity for an equal number, and good conference room and office facilities for the administrators. The library has 500 volumes and 20 periodicals; acquisitions average 20 volumes per year. The College farm has 112 ha and includes soils representative of most of the farming areas of Lesotho.

The Thaba Khupa Ecumenical Centre Farm Institute provides practical training in agriculture to enable students to become self-employed commercial farmers but does not offer certificates recognised by the GOL. Part of the admission requirement for each student is the guarantee of a ha of land in his or her home area, the idea being to design a curriculum of study specifically for students' individual needs. The Institute also conducts short courses. The land for the Institute was granted by the Chief of Thaba-Bosiu; financial support is provided by the World Council of Churches and other local and international organisations. The students are also charged a fee which covers approximately one-fourth of the cost of their training.

The National University of Lesotho (NUL) does not currently offer courses in agriculture but plans are underway to create a Faculty of Agriculture which will offer courses to the bachelor's degree level. The NUL's Institute of Extra-Mural Studies is a nonformal educational service whose work in increasing trained manpower will have a positive impact on agricultural development.

## (2) Evaluation

Some weaknesses of the LAC include: the lack of sufficient linkages with extension programmes and with the RD; the lack of an agricultural information centre that can interpret research findings and adapt them to farmers' needs; and the lack of appropriate salaries and training incentives for the staff.

The Thaba Khupa Institute is unique in providing practical training carefully designed for the needs of Lesotho farmers. It is designed to address the two major national problems of unemployment and increased food production. The weaknesses of the Institute are the limited capacity (35 students), insufficient linkages with the RD and the Extension Division, and limited financial resources. A subsidy from the GOL would enable the Institute to keep fees to a level affordable by its students.

### c. Extension

#### (1) Programmes, personnel and facilities

Agricultural extension services are provided entirely by the National Agricultural Extension Service of the MOA. Its four major units are Agricultural Information, Nutrition and Home Economics, Youth, and Farmer Training Centres. The Field Service is organised into ten District Administrative Units which provide village-level services. The Technical Division of the MOA provides Subject Matter Specialists (SMSs) to train Extension Agents (EAs) and backstop their field work. The RD, through the FSRP, collaborates with the extension field staff by providing information obtained through the Extension Research Unit.

Linkage with producers is provided by the EAs residing in villages. The lack of transportation, however, hinders their contact with outlying producers. Extension programmes are based on national development objectives and farmers' needs. The EAs, working as generalists to diffuse agricultural information, hold training sessions and field trials and demonstrations. The extension work is conducted with help from an information unit and six farmer training centres.

The National Extension Service is administered by the Director who is assisted by the Chief Extension Officer and Senior Extension Officer. At the field level, each of the ten districts is headed by a District Agricultural Officer and an officer for extension who supervises the Area Extension Supervisors and the EAs. Of the 972 staff, there are 39 administrators, 49 professionals with BSc degrees (of whom 18 are expatriates), and 884 technical staff with diplomas or certificates.

The national staff is adequately housed in Maseru. Each district has an office building; however, there are no offices at the village level. The extension budget derives from the GOL through the MOA. Over the past three years GOL's economic difficulties have resulted in austerity measures that have translated into vacancies in the Extension division. The total budget from 1984-85 is US\$ 507,392, or 5.9 percent of the MOA budget.

## (2) Evaluation

The Extension Service can become a most effective means for change and increased productivity. However, it lacks adequate financial and human resources. Other weaknesses are the lack of integration of the administrative and technical units under one administrator, insufficient in-service education for the EAs and training for the technical specialists, weak linkages with the Extension Division, the RD and the LAC, and the lack of an appropriate incentive structure to attract and keep personnel. Some programme restructuring also will be required to encourage local participation in decision-making so that villagers feel the institution is responsive to their needs.

### 3. Constraints to agricultural production and production potential

#### a. Food crops

Average crop yields on peasant farms in Lesotho have increased in recent years, but they are still extremely low relative to those obtained by the RD. For example, RD yields of maize and sorghum were often two to three MT/ha, while small farmer yields were 847 kg/ha and 795 kg/ha, respectively. The major physical, biological, economic, traditional and institutional constraints are discussed below.

The physical and biological constraints to increased production include:

- o Poor rainfall distribution accompanied by severe monsoons and hailstorms, frost and drought;
- o Soil degradation which is caused by erosion and overgrazing, lack of organic matter and infertility;
- o Lack of effective weed control;
- o Lack of availability of appropriate hybrid seed varieties;
- o Farm labour shortages arising from the migration of male work force to the Republic of South Africa; and

- o The weakness of the cattle due to inadequate nutrition at the end of the winter when they must be used for ploughing.

The chief economic constraints are the following:

- o Pricing: The uncertainty created by the variation in crop prices from year to year and the fact that prices are in effect largely determined outside Lesotho in the Republic of South Africa;
- o Marketing: Problems stemming from the facts that much of Lesotho's agriculture is in isolated regions, transport costs are high and communication is irregular; and
- o Credit: The limited availability of credit, despite the founding of the Lesotho Agricultural Development Bank in 1980, due to the facts that the only operating facility is in Maseru and there is no institutional channel to distribute funds to rural districts and that subsistence farmers, especially women, often lack collateral.

The traditional land tenure system is a constraint because it results in very small farm size (1.4 ha), which acts as a disincentive for investment in land and for greater intensity of land use. It is also an obstacle to shifting to commercial production and to adoption of modern technology.

The institutional constraints include lack of applied agricultural research and a lack of adequate training facilities and a developed extension service.

#### b. Livestock and livestock products

The main problems with cattle, sheep and goat production in Lesotho are that the land is already overgrazed and soil erosion is severe. Other constraints are the following:

- o Physical and biological: Lack of availability of fodder and water, insect-borne diseases, internal parasites and poor breed quality;
- o Economic: Input and animal prices, lack of slaughter and marketing facilities, lack of credit availability and inadequate subsidy and import policy;
- o Rural traditions: Communal grazing acting as a disincentive to investment in improving rangelands, and cattle grazing being supervised by untrained herdboys who know little about animal nutrition; and

- o Management: Ineffective range management practices and inadequate pasture land as they negatively impact cattle health and nutrition.

#### 4. Staff assessment of institutions

The main problems affecting the performance of the Research Division, the Lesotho Agricultural College and the National Extension Service as identified through staff questionnaires were the following: insufficient financial support, and inconsistencies and delays in funding; a lack of adequate training for national staff at all levels; an inadequate and insufficient number of laboratories and offices; a lack of essential equipment and maintenance; a lack of funds to purchase and maintain vehicles; and unfavorable terms of service and benefits for staff, including lack of staff housing, low salaries, lack of well-defined promotion schedules, and lack of health and retirement benefits.

A particular concern at the Agricultural College was the limited and outdated collection of library materials and the restriction that books could be used only at the library. In addition, work at the National Extension Service was particularly hampered by the lack of sufficient number of operating vehicles. Suggestions for removing the constraints were improved linkages between the institutions and the establishment of a Research Council composed of officers from the major divisions of the MOA to approve all decision-making.

#### 5. Conclusions and recommendations

##### a. Agricultural institutions

##### (1) Research Division

The following actions are recommended for the Research Division:

- o Continuation of its staff development plan of long-term training of nationals and interim employment of expatriates;
- o Establishment of formal linkages between the RD, the Extension Service and the LAC through joint personnel appointments and memoranda of understanding on joint programming and planning; and
- o Increased funding to cover recurrent costs and expand on-farm applied research.

##### (2) Lesotho Agricultural College

Actions recommended to strengthen the Lesotho Agricultural College are the following:

- o Increased employment of qualified nationals with training in agricultural production and the practical aspects of farm management;
- o Curriculum reorganisation to specialise in areas where the LAC has a comparative advantage in the SADCC region, namely, soil and water conservation and range management; and
- o Conduct of in-service education courses for extension workers and development of programmes to complement training at the Farmer Training Centres.

### (3) Extension Service

Strengthening of the Extension Service requires the following actions:

- o In-country, short-term, on-the-job training and long-term, academic training for the EAs and SMSs, and training for administrators, supervisors and specialists in management, programming, supervision and extension methodology;
- o Consolidation of the MOA's Technical Division and the Extension Division;
- o Provision of better transport at the village and district levels so extension workers can increase contacts with farmers; and
- o Provision of teaching aids and other resources to improve field demonstration projects.

#### b. Agricultural productivity

The following actions are recommended to expand agricultural productivity:

- o Adoption by the GOL of appropriate policies and incentives to develop the agro-industrial sector. This would increase the value added of agricultural products, improve farmer prices, and provide jobs;
- o Development of a nationwide education program to explain the value of the 1979 Land Tenure Act;
- o Judicious use of land leases and GOL designation of certain areas for commercial agricultural production;
- o Establishment of a national computerised data base containing description, objectives, procedures, results and recommendations of all agricultural research activities. This would result in a saving of human and financial

resources that could be directed to solving production-related problems;

- o Continuation of present activities in water, soil and range conservation and urging of donor countries to fund long-term projects;
- o Establishment of labour-intensive production of fruits and vegetables in the irrigated Northern Lowlands;
- o Development of appropriate social technologies: to bridge the gap between the nature and extent of women's agricultural responsibilities and the social custom that assigns decision-making to the men; to maximise acceptance of new technologies; and to convince livestock holders to produce commercially;
- o Development of alternate strategies to increase soil fertility by ploughing under stubble, reducing the livestock population and expanding use of pulses in fertility-building crop rotations;
- o Increased road construction and repair;
- o Improvement in the quality of education to better prepare students to pursue higher education in agriculture; and
- o A GOL strategy to seek long-term donor funding and to carefully coordinate and focus activities on the most pressing problems.

#### D. Malawi

##### 1. Background

###### a. Country description and economic overview

Malawi is a landlocked country with four agro-ecological zones: the lower Shire Valley, which is a low-rainfall, semiarid savannah area; the lakeshore and upper Shire Valley, which have both high- and low-rainfall sections; the medium plateau area, which covers three-fourths of the land area and is composed of savannah and woodlands; and the high-rainfall highland areas, consisting of grasslands and evergreen forests. Soils are among the most fertile in south central Africa. Annual rainfall varies greatly, with a number of wet years being followed by a number of drier years. Rainfall distribution also varies from less than 750 mm of rain per year in the Shire valley to 1600 mm annually in the highlands.

Malawi's population was 6.4 million in 1982 and has been growing at the rate of 3 percent annually. Ninety percent of the people live in rural areas and 84 percent of the labour force in 1980 was engaged

in agriculture. The population is unevenly distributed, with only 12 percent of people in the northern region, 30 percent in the central region and over half in the south.

Since Independence in 1964, Malawi has made impressive economic progress, due in large part to sound government policies and good weather. Between 1960 and 1981, GDP grew at an average annual rate of 5.7 percent, with agriculture contributing 43 percent at factor cost. Four-fifths of agricultural production was from the smallholder sector. In 1980, agricultural products accounted for 90 percent of Malawi's exports with tobacco (48 percent), sugar (26 percent) and tea (12 percent) being the leading commodities. In 1981, Malawi's current account deficit was 24 percent and debt service was the equivalent of 30 percent of exports.

b. Agriculture in Malawi

The traditional pattern of land use among smallholders is through the assignment of cultivation rights by village headmen. Despite relatively intensive cultivation in the central and southern regions, annual smallholder cultivation of 1.7 million ha is generally much less than the available arable land. Average smallholder farm size is 1.7 ha.

The primary staple crop is maize which is grown on approximately two-thirds to three-fourths of smallholder land. Other major crops are tobacco, grown by 10 percent of smallholders, tea grown by 4,000 smallholders, cotton by 60,000, and groundnuts. Cattle, too, are raised mostly by smallholders, although some estates have dairy cattle.

Land in Malawi is publicly and privately owned. There are 1,100 large private agricultural estates, controlling 470,000 ha of land. Tobacco is produced on 98 percent of the estates, tea is grown on 2 percent and sugarcane on two estates. Combined estate production has increased four-fold since 1968 at the annual rate of 17 percent. The increase is attributed to expansion of areas under cultivation, better management and greater input use. Estate production of tea, tobacco, sugar, tung oil, coffee and macadamia nuts are the main foreign exchange earners, providing 80 percent of agricultural exports.

Forests occupy about 9 percent of Malawi's land area, and 6,000 ha of new forests are planted every year. The lumber produced is for poles and crates and is not usually suitable for general carpentry. Fuelwood is an important source of energy for smallholders and for tobacco curing.

Crop marketing is done by the Agricultural Development and Marketing Corporation (ADMARC), which purchases and sells smallholder crops and sells and delivers agricultural inputs at prices determined by the Price Review Committee of the Government. Estate produce is



marketed by the private sector, while tobacco is sold at the Limbe and Lilongwe auctions, and tea and coffee are exported through international trading companies. Livestock markets consist of the Cold Storage Company and several auction markets. There is no central agricultural credit institution in Malawi, but smallholders have access to seasonal and medium-term credit through some MOA projects, the extension service and the Ministry of Trade and Industry's Loan Board.

In 1981 smallholders accounted for 81 percent of agricultural production, meeting the country's food needs and producing some exportable surplus (20 percent of all agricultural exports) and certain raw materials. Currently, the commercial livestock sector (which includes smallholders) provides the entire meat and egg demand for urban consumption. The cattle population is growing at the rate of 4.8 percent and annual offtake averages 9-10 percent. Smallholders own goats and chicken for meat, and pigs are raised by both smallholders and commercial farmers.

## 2. Agricultural institutions

### a. Research

Agricultural research in Malawi is performed by both government and private institutions. The government's research work is funded by a mixture of national budget allocations and external donor support. The total spent on agricultural research amounted to US\$ 8.5 million in 1983-84. Prominent among the external donors are USAID, the UK, DANIDA, and UNDP/FAO. Private research is funded by the respective organisations of growers although tea and tobacco have received some technical support from the UNDP/FAO and the UK. The professional staff engaged in research numbered 177 in 1984, of whom 30, or 17 percent, were expatriates.

#### (1) Department of Agricultural Research

The Department of Agricultural Research (DAR) of the Ministry of Agriculture (MOA) is the main research institution. It also provides services such as seed multiplication, information and diagnostic services. The organisational structure consists of research stations, substations and district sites. The research emphasis is on maize, cotton, groundnuts, rice, horticultural crops, farm machinery development, crop storage and livestock improvement.

The staff consists of 520 people including support staff, technical assistants and senior technical and administrative staff. The recurrent operating budget in 1984-85 was US\$ 2.6 million, half of which was spent on wages and salaries and 29 percent on maintenance and operating expenses. Facilities in each of the 11 research stations include office space. In addition, there are five laboratories, 17 greenhouses and maintenance workshops. The main library is at the Chitedze Research Station. It has 3,000 books and

acquires 30-50 books per annum. It receives 250 periodicals and journals and has access to library resources at the University of Florida and the Tropical Development Research Institute in the UK. Except for vehicles and tractors, there is no major equipment. Six micro-computers are available.

Linkages between researchers and extension officers are maintained through joint participation on committees with the Agricultural Development Division (ADD) and the Department of Veterinary Services (DVS). The DAR has relatively weak institutional linkages with the Bunda College of Agriculture (which conducts seven research projects), the Tobacco Research Authority, the Sugar Corporation of Malawi, the Tea Research Foundation and the Smallholder Coffee Authority. It also has bilateral relationships with many international research centres.

### (2) Department of Veterinary Services (DVS)

The DVS which is attached to the MOA has responsibility for research, extension and provision of services under the direction of the Chief Veterinary Officer. Research is done at the central laboratory at Lilongwe and field services are based in each of the eight ADD's and provided through 17 production centres distributed throughout the country.

The DVS' Livestock Development programme is aimed at improving herd quality through better disease control, nutrition and management and through three research projects: the East Coast Fever Project, the African Swine Fever Project and the Newcastle Disease Vaccine V4 Project.

There are 78 staff members including 22 professional staff, three administrative offices, seven technical officers doing research and 46 support staff. The total DVS budget is US\$ 3.08 million. Of this figure, about 15 percent comes from the COM and the rest from international agencies and only \$140,000 is dedicated to research programmes of the DVS.

Facilities include three laboratories at Lilongwe and one each at Blantyre and Mzuzu, five offices in excellent condition at Lilongwe, three offices in poor condition at Blantyre and one in good condition at Mzuzu. There is a library at the Central Veterinary Laboratory which has 5,000 books and 20 scientific journals. There are also three livestock compounds at Lilongwe. Major equipment holdings include a stereoscope microscope, a gas chromatograph, an autoclave, a centrifuge, liquid nitrogen apparatus, 60 vehicles, 15 tractors and 100 motorcycles.

### (3) Tea, tobacco and sugar research

The private Tea Research Foundation (TRF) conducts research on tea production and provides advisory and extension services. Since much of the research is financed by the industry,

it is aimed at estate production, although there is currently a plant improvement project for the Smallholder Tea Authority. The research staff consists of a Director and his Deputy, 21 Professional Officers and five Technical Officers and 28 Assistants for a total of 56 persons. The budget in 1984 is US\$ 577,000, the main sources of funding being the tea industry, revenue from TRF's experimental tea crop and the United Nations Development Programme. The main research station has 175 ha of land, of which 70 percent is used for experiments, 28 percent for crop production and 2 percent for seed/plant material multiplication. There are three laboratories, a greenhouse, a maintenance workshop and a library with 3,000 books and 500 periodicals. Extension services and training courses are provided for local research personnel and farmers. It maintains linkages with other organisations outside the country that contribute to its operation.

The Tobacco Research Authority is a private organisation that does research on improved tobacco varieties, methods of disease and pest control, marketing and machinery for planting, reaping and curing in both estate and smallholder cultivation. It employs four administrators, 11 professional Research Officers, seven Technical Officers and 48 Technical Assistants and support staff, or a total of 70. The 1984 budget of US\$ 506,000 is financed entirely by a growers' levy and programme income. There are two research stations, one without either a laboratory or electricity. Currently, there are no greenhouses though three are being constructed. The library contains only ten books and six scientific journals but the research staff has access to the Bunda College Library. Linkages also exist with the Chitedze and Bvumbwe Research Stations. The Authority conducts courses for the MOA's extension field staff and publishes a newsletter. External linkages exist with similar institutions in Zimbabwe, the Republic of South Africa and with North Carolina State University.

The Sugar Corporation of Malawi conducts research on introduction and testing of new varieties of sugarcane, with a staff of 11 that includes one professional researcher. It is entirely funded by Lonrho Ltd. and has a budget of US\$ 114,000.

Of the 1229 authorised positions in research only 978 are currently occupied, of which 943 are held by nationals and 38 by expatriates. A BSc degree is required for 177 professional positions, a diploma for 120 technical positions and the rest are for certificate-holders and support staff. At present there are ten people in PhD training, 27 in training for the MSc and five studying for the BSc.

#### b. Training

The Malawi public school system includes basic agricultural training in its general curriculum. Students with the appropriate level of work can enter the higher educational

institutions for agriculture, natural resources and veterinary sciences.

The Bunda College of Agriculture trains students for diplomas (three years) and general BSc degrees in agriculture (an additional two years). The College offers no postgraduate courses although the curriculum is being revised to accommodate some specialisation. Of the total staff of 89 people, 28 have PhDs and the college has a policy of providing training opportunities to upgrade the qualifications of the younger staff. The recurrent budget is US\$ 936,200 and capital development funds are sought from donor agencies when needed. The GOM pays student fees and allowances. The College has 42 offices, two lecture halls, four classrooms, six laboratories and two greenhouses. It has a multi-purpose farm of 1800 ha which is used for both teaching and research and for commercial purposes. It has a library with 25,000 books, 350 journals and an acquisition rate of 600 books per year. Audio-visual training equipment is also available. The College cooperates with the MOA to ensure that projects are related to Malawi's development needs. It has also conducted short courses for extension and research personnel of the MOA. All students who obtain bachelor's degrees are offered employment by the MOA and the private sector.

The Natural Resources College of the MOA is a new institution responsible for training Technical Assistance (TA) personnel to the certificate level in agriculture and home economics, veterinary and fisheries, wildlife and game. There are also plans to offer in-service training courses for teaching staff and TAs trained years ago. The College has 40 teaching staff and a Principal and Deputy. Ninety-five percent of the students come from rural areas, their travel and fees paid by the government. The recurrent budget is US\$ 819,000. The capital account of over US\$ 5 million is funded by the Canadian International Development Agency. The College has two conference rooms and 14 classrooms, and a library containing 4,000 books and seven journals. The total land area is 292 ha, of which 68 acres are reserved for pastures and demonstration plots.

Of the 155 authorised positions for agricultural training officers, 112 are filled by Malawians. Seventy-six of them hold at least the BSc degree and the rest have diplomas. There are 18 expatriates representing 19 percent of the total of professional officers. Continued training at the PhD level is being provided for six people in varying fields related to agriculture. Eleven people are in training for the MSc and three for the BSc.

#### c. Extension

Malawi's extension service is conducted through the Department of Agriculture (DOA) of the MOA. The MOA's Chief Agricultural Officer, with the assistance of a Deputy, has overall responsibility for extension. The national headquarters in Lilongwe administers nine technical sections corresponding to various subject

matter specialties. The country is divided into eight Agricultural Development Divisions (ADD), each of which have several specialists depending upon the area's specific needs. The next organisational level is the rural development area, under which are the 180 Extension Planning Areas (EPAs).

There are between 25,000 and 30,000 families in each ADD which is administered by a manager, two assistants and several technical specialists. Forty Rural Development Projects (RDP) are planned for phased implementation over the next 15-20 years. Seventeen of them are already in operation. A Project Officer heads each RDP and is assisted by a Senior Field Officer. They are responsible for a number of EPAs. Each EPA has a headquarters with an office for the Field Supervisor and day training facilities for both farmers and field staff. A woman extension worker with a certificate in agriculture is based at the centre. The EPAs are further divided into sections containing 500 to 700 families and headed by a Field Assistant having a certificate in agriculture.

Extension services are primarily directed towards smallholders and emphasis is given to food crops such as maize, beans, cassava and millet, with some attention to cash crops such as groundnuts, cotton and rice. Among livestock, cattle production is emphasised, followed by poultry and pigs. The objective of the extension effort is to improve productivity per unit area of land.

Of the total number of 4,520 extension workers, there are 124 professionals with at least a BSc, 514 technical officers with a diploma, 2,519 technical assistants with a certificate and 1,337 support staff. Excluding support staff, women comprise only seven percent of the staff. Eleven staff members are in training, including two women. There are no PhDs, but three men at headquarters hold MScs and three have BScs. The ADDs have eight economists with degrees, a man studying for the MSc in land survey and a woman working towards the BSc in home economics. The majority of field staff are either diplomates or certificate-holders who receive annual in-service training to acquaint them with new practices. Some people are sent abroad for post-graduate training or short courses every year.

The DOA has 147 day training centres, 121 residential training centres and three farm institutes. A day training centre and a demonstration facility are located at each EPA centre. Capacity at the day centres is for 20-30 participants and between 30-100 at the residential centres, where teaching facilities include demonstration. Agricultural courses last a week and home economics courses take two weeks. Each ADD has its own fleet of vehicle, tractors and motorcycles.

The extension service is linked with research services and with the Department of Veterinary Services, with which it carries out animal health programmes. In each Field Assistant's section there are Village Planning Committees designed to function as action groups

disseminating information to farmers. The DOA also has an Extension Aids Branch with two mobile film units in each of four ADDs. The Branch produces an average of seven circulars per year, publishes newsletters and farmers' magazines, extension workers' guides and six radio programmes. Current year funding for the DOA is US\$ 43.1 million, of which 42 percent is from government revenues and 58 percent from donor agencies.

### 3. Constraints to agricultural production and production potential

#### a. Food crops

Ninety percent of the maize crop in Malawi is produced by smallholders whose yields are low (1,000 kg/ha) compared with those on research stations. The major constraints to increased productivity are the low rate of adoption of improved varieties, the high cost and untimely availability of inputs for growing hybrid varieties, and the reluctance of farmers to use fertiliser in low moisture areas. Malawi produces upland (Faya) and irrigated (Blue Bonnet) rice, the former for domestic consumption and the latter for export. Average smallholder rice yields are low (1,100 to 2,900 kg/ha) due to diseases, limited availability of different varieties and Blue Bonnet vulnerability to slow growth at low temperatures, which extends the growing period into the unfavourable dry season. Less than 5 percent of Malawi's wheat requirements are produced domestically and smallholder yields are very low (500 to 900 kg/ha) because of the lack of adaptable wet season varieties, and lack of supplemental irrigation to sustain cool season production. Sorghum and millet planting have declined along with their importance as food crops.

#### b. Commercial crops

Groundnut production has declined since the 1960s because of low farmer prices and diseases such as cercospora, leafspot and rosette. Yields are low (260-1,200 kg/ha) due to delayed planting since the main crops such as maize and tobacco have taken precedence. Premium cotton varieties are grown in Malawi but yields are low compared to research station yields (260 to 480 kg/ha) and production has not increased in the past two decades. The government's policy is to standardise production by encouraging growth of one variety at a time with a change every five years. Major constraints are high production costs (especially for insecticides), low farmer prices, lack of capital and unavailability of inputs. Ten percent of the tobacco crop is produced under a quota system designed to ensure product quality and market stability. Yields are fairly static and farmers have not adopted the full package of recommended technology because of uncertainty about potential returns on their investment. Until recently tea, coffee and sugar were produced on large commercial farms. Now the Smallholder Tea Authority and a similar organisation for coffee have been working on developing smallholder coffee and tea production, and smallholder sugar production has been initiated as

well. Comparisons between small and large farm production cannot be made because the data are not yet available.

c. Livestock and animal products

Malawi's cattle herd is growing at the rate of 5 percent per annum while sheep and goat herds have declined. Only 11 percent of rural families own cattle and 9 to 10 percent of offtake is marketed. Of this, only 25 percent pass through formal markets. Overgrazing on communal lands is a serious problem although adequate grazing potential exists to support expanded cattle production into the 1990s. The main constraints to increased cattle production are insufficient availability of quality forage in the dry months and lack of incentives, due to the land tenure system, for adoption of improved pasture and management technology.

Milk production in 1981 declined 26 percent over 1980 mainly because of poor management of herds and forage resources. Currently rural sector meat supplies are provided by goats, pigs, sheep and poultry but insignificant amounts are marketed. Commercial pig and poultry industries exist but productivity is hampered by cost/price conditions and feed quality and availability.

In general, increased smallholder livestock and crop productivity is inhibited because of lack of improved adapted technology and an unfavourable economic environment. Technological solutions are lacking for maize, for draughtpower to ensure early planting and for semi-arid cereal crops. Moreover, farmer technology adoption is restricted by marketing and pricing structures and by high risk. Livestock productivity is constrained by: inadequate funding for veterinary and marketing services; the low throughput (24 percent) capacity of the main commercial wholesaler, the Cold Storage Company; and by the inappropriateness of existing price policies. This is because of divergent price review mechanisms for producers, wholesale and retail prices, and for the lack of a firm database. Poor pricing policies have had the most serious impact on the pig and poultry industries, which are currently near collapse.

4. Staff assessment of institutions

According to the staff of each of the research, training and extension institutions, the limited recurrent costs budget is a severely constraining factor. In addition, Bunda College is hampered by inadequate numbers of trained staff and insufficient classrooms. Extension work is particularly impeded by the shortage of vehicles, and by need for further training of staff.

## 5. Conclusions and recommendations

### a. Agricultural institutions

Current strategies being implemented at research institutions include: the strengthening of links between research programmes, staff and the ADDs; increased involvement with farmers, particularly to test and evaluate technological packages; and improved coordination between research, extension and implementation of programme goals at the local level. Recommendations for the future include provision of adequate and timely recurrent budget support, and increased investment in agricultural research--up to 1 or 2 percent of agricultural GDP--as recommended by international agencies.

The amalgamation of training institutions offering certificate-level training is now complete and should be followed up by upgrading Bunda College's ability to award the MSc degree in such disciplines as crop and animal production.

Current strategic emphasis in extension is to improve linkages with research at the local level and to achieve a more balanced programme between food and commercial crop extension efforts.

### b. Agricultural productivity

The strategies recommended to overcome the constraints to increased food crop production include: a shift in the emphasis in research and extension from commercial crops to food crop production, accomplished by increased investment in technologies adapted to smallholder needs, and the addition of socioeconomic research and analysis to agronomic research to develop policies and programmes that include dimensions such as price, alternate marketing strategies, and smallholder motivation.

Recommendations for overcoming constraints in the commercial crop sector include: increased focus on developing adapted technology for improving smallholder yields; research and analysis on marketing and price policy options and credit availability for smallholders; and improved on-farm demonstrations to induce farmers to adopt recommended packages.

Recommended strategies for improved production in the livestock sector include: improved coordination between the DAR crop research units and the DVS pasture and range research units; and research, analysis and evaluation of the potential impact of alternate marketing and pricing policies on smallholder production of beef and dairy cattle, including the creation of an economic service for this purpose.

More research should be devoted to small stock (goats, sheep, pigs and poultry) including a breeding and selection programme adapted to the smallholders' resource base and management capability, research



in nutrition, and field testing of management practices such as housing and sanitation.

E. Mozambique

1. Background

a. Country description and economic overview

Mozambique, with an area of 789,800 km<sup>2</sup>, consists of a coastal belt comprising 42 percent of the country, a transitional zone of hills ranging between 180 and 540 m, and a plateau region with an average elevation of 1,000 m. The population was 12.6 million people in 1981 and is growing at the rate of 4 percent annually. The climate varies from subtropical to tropical, with two main seasons: a warm, wet season that lasts from November to April, and a cooler, dry season.

Agriculture contributes about 45 percent to the GNP which in 1981 amounted to US\$ 2.71 billion. Per capita income in 1980 was US\$ 220. After a decade of decline, the economy recovered slightly between 1980-1981, although the rate of economic progress has been hampered by foreign exchange shortages, guerilla attacks upon economic targets, and three years of drought that have drastically reduced agricultural production. The economy depends upon foreign trade which is controlled by the government. The country's growing need for imported food and development goods has led to a trade deficit which is only partially offset by foreign aid and earnings from the transport sector. Transport services are the country's largest foreign exchange earner, as Mozambique provides port facilities for its landlocked neighbours.

b. Agriculture in Mozambique

Agricultural development is one of the government's top priorities as it contributes the bulk of GDP and exports. More than 75 percent of the people are engaged in agriculture, most of these in subsistence farming. All land is held by the state, which determines the conditions for its use and exploitation. The people have the right to work the land, and the government has been encouraging farmers to enter communal villages. The main food crops are maize and cassava, but maize production has declined since the 1970s; Mozambique is a net importer of food grains such as wheat and maize. The cash crop sector has been more successful, with both private and state enterprises increasing production. The major export crops are cashews, tea, sugar, sisal and cotton. Other food crops produced are rice, sorghum, millet and maize.

Livestock holdings consist of cattle, sheep and goats. Cattle numbered 114 million head in 1980; however, production is limited over two-thirds of the country because of tsetse fly infestation. Mozambique is developing its fishing industry with the help of foreign aid, and exports shrimp and lobster.

The lack of adequate marketing and transportation systems constitutes a serious constraint to agricultural production. This problem became particularly acute with the departure of Portuguese traders, following Mozambique's Independence in 1975, which led to a serious disruption of the marketing system. The government then created retail stores, which in 1980 were turned over to private sector businessmen, and instituted a food rationing system. Agricultural cooperatives established in the villages are mostly production-oriented and have not yet resolved their organisational and management problems. Their most serious constraints are the lack of trained personnel and an inadequate supply of agricultural inputs.

## 2. Agricultural institutions

### a. Research

The Ministry of Agriculture coordinates agricultural research through eight specialised institutes. Research also is conducted by the Faculty of Agronomy and Silviculture of Eduardo Mondelane University, under the Ministry of Education, and by the National Sugar Institute, under the Ministry of Industry and Energy. Except for the coordination provided by the National Directorate of Agricultural Technology of the Ministry of Agriculture, there is no formal system of linkages among these institutions.

#### (1) Research institutions

##### (a) National Agricultural Research Institute

The National Agricultural Research Institute (INIA) receives 40.2 percent of the total domestic budget allocated for agricultural research in the country, as well as 45 percent of funds for agricultural research derived from external sources. The human resources, both of nationals and of expatriates, dedicated to agricultural research are similarly allocated. The INIA's programmes include identification and production of strains in Rizobium, pasture management, weed control, plant protection and seed quality control of crops such as maize, sorghum, beans, wheat and cassava.

The maize programme consists of introduction and evaluation of new varieties and hybrids, seed production, and evaluation of agronomic practices. It is funded by FAO/UNDP, and the MOA; technical aid is provided by the Yugoslavian Maize Institute. Seven professionals are involved in the programme.

The sorghum programme's structure is similar. Attempts are made to develop varieties that can be adapted to agro-ecological regions considered marginal for maize cultivation; it also does research on cultural practices and crop management. The sorghum programme is funded by the UNDP and the MOA. There is one senior technician employed on the project. Similar kinds of research are done on beans,

soybeans, vegetables, sweet potatoes, wheat, and cassava with cooperative funding from the MOA and external agencies such as the UNDP and foreign governments.

In addition to the INIA's crop-oriented programmes, there is a research programme termed the National Inventory of Natural Resources Programme (NINRP) which is designed to take an inventory of the climate and soil resources, in order to evaluate the productive capacity of different crops. Funding is from the UNDP, Holland and the Federal Republic of Germany.

The INIA has seven research stations. Of these, the Umbeluzi Station has the most complete infrastructure, including 642 ha of land, 500 m<sup>2</sup> of office space for technicians, greenhouses, warehouses, a garage and two tractors. Each of the other stations also has buildings for offices and specialised activities depending upon their research focus, such as facilities for keeping livestock or warehouses. They also have equipment such as tractors, tobacco dryers and dip tanks. The headquarters consists of four buildings, three laboratories, a herbarium, two warehouses, a workshop and 15 vehicles. The headquarters' library contains 9,500 volumes and 15 periodical titles.

The most serious constraints to the INIA's functioning are a shortage of trained national professionals, inadequately trained senior and mid-level professionals, inadequacies of infrastructure and equipment at the research stations, and difficulties in equipment maintenance because of foreign exchange shortages.

(b) The National Institute of Veterinary Research

The National Institute of Veterinary Research (INIV) provides diagnostic services, produces vaccines and conducts veterinary research. Diagnostic services are performed at the Central Laboratory at headquarters in Maputo and in the network of provincial laboratories. Research programmes focus on epidemiological studies of the principal cattle diseases, the objective being to develop effective methods of control. The four major projects are in tsetse fly control, thrush control, the study of tick-transmitted diseases, and the study of diseases affecting cattle reproduction.

The INIV's material resources are concentrated at the headquarters, which has five rooms for the administrative offices, a laboratory, good installations, and equipment for isolating and managing animals and a library with 2,000 volumes. The Institute's major constraints are an insufficient number of senior professionals, inexperienced technicians, inadequate repair and maintenance of buildings and equipment, and a shortage of laboratory space. Additional laboratory space also is needed for disease diagnosis and vaccine production.

(c) The Institute of Animal Breeding and Reproduction

The Institute of Animal Breeding and Reproduction (IREMA) focusses on livestock breeding research and extension, and on the provision of semen and improved mating breeds to the state and private livestock production sectors. Three research programmes are devoted to the improvement of local beef cattle and dairy cattle breeds through cross-breeding with Friesland cattle. The small ruminants programme seeks to prevent diseases and increase the production potential of goats and sheep. Four senior technicians work on each of these programmes.

The Institute's headquarters at Maputo has offices, a meeting room, a laboratory, a cold room, a garage, 15 stables, laboratory equipment and four functioning vehicles. There is also a small library with 20 books. No new books have been acquired recently. Of the IREMA's three animal research stations, the one at Chobela is the best equipped, with rooms for administrative and research staff, a meeting room, a laboratory, stables and 3,600 ha of land. The Institute's chief constraints are insufficient funds for research programmes and for maintenance of buildings and equipment, lack of trained and experienced professionals and technicians, and lack of linkages with international institutions.

(d) The Centre for Forestry Research

The Centre for Forestry Research (CEF) is a department of the MOA that does research in forest management, wood technology and silviculture. Partial funding for the forest management project is provided by the Scandinavian Aid Programme. Most of the research is done at the headquarters at Marracuene and at the Marrupa Research Station, but there are two additional stations. The Marracuene Station has office space, a laboratory and two vehicles; a library also is being established there. The facilities at Marrupa are more limited.

(e) The Secretariat of State for Cotton

The MOA's Secretariat of State for Cotton (SEA) defines and implements government policies for the cotton sector. Only limited resources are applied to research; therefore, a new Cotton Institute is being created for this purpose. Meanwhile, the SEA's Technical Department has a research programme aimed at reducing production costs through pest and weed control, fertiliser application and crop rotation. A second programme is devoted to evaluation of new crop varieties. The Secretariat, having no research stations, uses those of the INIA.

(f) The Secretariat of State for Cashew

The Secretariat of State for Cashew (SEC) determines policy with regard to cashew production; it also conducts research on improved varieties and improved cultivation practices, including studies of planting density and fertiliser use. The Secretariat does not have research stations and uses those of the INIA. However, the creation of a new National Cashew Institute has been recently approved. The Secretariat has a small library with 50 volumes and six periodical titles. Its chief constraint is the inadequacy of resources devoted to cashew research; the planned Institute should help resolve the problem.

(g) Rural Development Centres

The Rural Development Centres (CDR) undertake a variety of activities, including: surveys of peasant production systems and the sociology of peasant communities; research on cultivation practices and improved production methods; and conduct of agricultural extension by training farmers and technical personnel. The objectives of the survey programme are to understand the systems of production, inventory available physical and human resources, and motivate peasants to participate in the CDR's activities. The CDRs also have a farming systems programme. The CDR is an integral part of the newly formed Department of Rural Development and has 14 regional centres. However, research is not carried out at each of these centres. The CDRs are in the process of developing their facilities; some have not yet received all the installations planned for them. However, there are no financial limitations upon completing the plans. In general, each Centre has adequate work space for professionals, meeting rooms and vehicles. Some of the Centres have small libraries. The major constraints relate to the relative newness of the centres, and to the scarcity of middle-level technicians.

(h) The Faculty of Agronomy and Silviculture

The Faculty of Agronomy and Silviculture is a part of the University of Eduardo Mondelane under the Ministry of Education. Although its principal activity is instruction, it is developing research programmes in improved groundnut production, assisted by Canada's IDRC, and on farming systems assisted by the UNDP, and the Union of Dutch Universities. Since the Faculty does not have research fields, it uses those of the INIA. It has a library of 9,200 volumes and receives 20 periodicals. The main constraint is lack of funding; almost all current resources originate from foreign sources.

(i) The National Sugar Institute

The National Sugar Institute, a department of the Ministry of Industry and Energy, is responsible for delineating

sugar policy. It is also in charge of six agro-industrial complexes. The lack of Mozambican senior professionals has caused research activities to be significantly reduced. There is only one programme in operation; its objective is to improve sugarcane productivity through selection of varieties and perfection of cultivation techniques. The Institute's facilities include three offices, a hangar used as a meeting room, a laboratory, a vehicle and a small library.

(j) The Citrus Directorate

The Citrus Directorate of the Ministry of Agriculture has a single programme which focusses on the conservation and improvement of clones of various citrus fruit species and which is funded by FAO/UNDP. Since it has no facilities of its own, the Unit uses one of the INIA's research stations. Its chief problem is the lack of trained Mozambican senior professionals to continue the work once international aid is terminated.

(2) Total human and financial resources available for research

In 1983, there were 965 people employed in research activities, including professionals, administrators and unskilled workers. About 9 percent of the workers are expatriates who hold 82 percent of the senior professional positions. Almost one-half of the human resources in research are concentrated in the INIA. The major focus of the research programme is on commercial crops (29 percent) followed by land and water management (28 percent), food crops (19 percent) and livestock (11.5 percent). The number of senior professionals is inadequate to implement planned research programmes.

The total amount of internal resources devoted to agricultural research in 1983 was US\$ 3.43 million for capital and recurrent expenditures. Donor-funded agricultural research activities have a total commitment of US\$ 27.8 million over the duration of the projects and US\$ 8.2 million per year annualised value. Thus, in 1983, 70 percent of the total of US\$ 11.6 million available to the ten research institutions was provided by donors.

(3) Conclusions and recommendations

(a) Accomplishments

The principal research programmes have been initiated only recently, but the following improved technologies have already been developed:

- o Adaptable varieties of beans, maize, soybeans, rice and wheat;
- o Improved animal breeds;

- o Techniques adapted to the socioeconomic conditions of the peasant sector;
- o The farming systems programme; and
- o The cassava, groundnut and bean programmes, which are at an advanced phase of selecting genetic material adapted to peasants' needs.

(b) Constraints and recommendations

The following are the major constraints limiting the agricultural research programmes:

- o Lack of trained Mozambican personnel;
- o Lack of adequate and well-maintained facilities and equipment;
- o Insufficient funding from domestic and external sources;
- o Lack of emphasis on research devoted to traditional agriculture;
- o Dispersion of resources through ten different institutions. Each project has less than one full-time scientist; economies of scale could be realised by concentrating research efforts;
- o Lack of a central extension unit. This hampers transmittal of technical information from the research institutions to the productive sectors; and
- o Weak linkages between the research institutions.

Among the recommendations for removing these constraints are: long-term training for professionals and mid-level workers; increased funding, especially from external donor agencies; enlargement of libraries and better information organisation; increased resources for research on cassava, sugarcane, cashew, beans, maize, sorghum and rice; intensified efforts in farming systems; soil conservation and management; management of cattle herds and natural pastures; and increased funding and training for agricultural extension activities.

b. Extension

Extension services in Mozambique, provided by agencies of the Ministry of Agriculture, are weak.

(1) The Secretariat of State for Cotton

The Secretariat of State for Cotton (SEA) directs the provincial cotton enterprises by mobilising peasants to plant cotton, disseminating new technical findings, disseminating improved seeds and other inputs, and providing orientation for insecticide application. Extension work is organised by subdividing the cotton-planting regions of each province into "areas of influence" headed by a supervisor and "zones of influence", each of which is headed by a coordinator of a number of extension workers. The workers are generally drawn from the areas in which they work. The budget for 1983 was US\$ 713,617, of which 90 percent was expended for salaries. The only means of transport used are bicycles.

(2) The Secretariat of State for Cashew

The extension activities of this Secretariat are structured like those of the Cotton Secretariat, the objective being to encourage peasants to produce cashews, to improve cultivation practices and to use better-adapted varieties.

(3) The Department of Rural Development

Extension activities of the Department of Rural Development are carried out by the Rural Development Centres (CDRs) and by the Cooperative Development Centres (CODECO). The CDR's extension activities are directed to the cooperative sector, the most important programmes being the promotion of new varieties and improved cultivation practices. Such varieties and practices are communicated through seminars, demonstration plots and meetings with cooperative members. CODECO's extension efforts are concentrated on animal power and on the administration and organisation of cooperatives.

F. Swaziland

1. Background

a. Country description and economic overview

There are four main ecological and production zones in the small, landlocked Kingdom of Swaziland. The Highveld region in the west is mountainous, and only 10 percent of the land is suitable for agriculture. The Middleveld is a hilly region with 20 percent fair to good soils. The Lowveld, the eastern part of the country, has about 30 percent fair to good soils, but there is great danger of drought. The Lubombo plateau contains small areas of deep, cultivable soils.

The population of Swaziland was 605,000 in 1983, and is growing at an annual rate of 3.4 percent. Most of the people (82 percent) live in rural areas where they are subsistence farmers. Agriculture provides employment for about 75 percent of the work force.



Swaziland's GDP was US\$ 374 million in 1982, having grown at the average annual rate of 5 percent between 1977-82. Agriculture accounts for one-fourth of the GDP. Agro-industry contributes three-fourths to value added in the manufacturing sector, which represents one-fourth of GDP. Agricultural products also contribute 70 percent to the value of exports, although Swaziland is simultaneously a net importer of food for local consumption.

b. Agriculture in Swaziland

Swaziland's agricultural sector is divided sharply between a modern, capital-intensive sub-sector largely owned and managed by foreigners who produce mainly for export, and a traditional sector. The modern sub-sector consists of 790 privately-owned farms and estates averaging over 800 ha. These are termed Individual Tenure Farms (ITFs). Sixty percent of these farms are irrigated and the most important crops grown are sugarcane, citrus fruits, pineapples, cotton, maize, rice and vegetables.

The traditional sector coincides with Swazi National Land (SNL) which makes up 65 percent of the total land area. It is owned communally by the people and held in trust for them by the Monarch. Eighty-five percent of this is communal grazing land; the rest contains about 42,000 traditional homesteads with an average size of 2.75 ha. Since food self-reliance has long been an important national goal, the Government of Swaziland (GOS) instituted a Rural Development Area Programme (RDAP). The RDAs now encompass 49 percent of the total SNL. The objectives of the RDAP are to promote the transition from traditional to commercial agriculture and to enhance the welfare of rural people.

More than 85 percent of available farmland is used for grazing; only 10 percent is crop land. Efficiency is highest on the ITFs, followed by the RDAs and the other SNL. Farmers' ability and incentive to obtain long-term credit for land improvements on the SNL is limited by the fact that the land is held in usufruct. Although efforts are being made on the RDAs to compensate for these limitations, productivity on both the SNL and RDAs lags behind that of the commercial sector. In the period between 1978-79 and 1982-83, production in the modern sector grew at 12.9 percent per annum while that of the traditional sector grew at only 0.36 percent. In 1981, total output in the traditional sector amounted to US\$ 15 million or 3.9 percent of GDP; the modern sector produced US\$ 85 million, or 22 percent of GDP. The situation is especially serious because the traditional sector primarily produces food for local consumption and current production is lagging behind population growth.

Maize yields in the traditional sector ranged between 800 kg/ha to 1.5-2.0 T/ha; sorghum yields averaged between 640 kg/ha and 1.5 T/ha. Jugo bean yields were 926 kg/ha, and average groundnut yields were 426 kg/ha. In each crop, yields obtained in research trials have

been much higher. The area planted to maize, jingo beans and groundnuts declined between 1979-81; output of maize and groundnuts also decreased. As the result of a ban on vegetable imports from the Republic of South Africa, output of fruit and vegetables in Swaziland has improved. Yields vary according to soil type, availability of irrigation water and input usage but are generally 10 percent below those obtained by researchers.

Among cash crops, area under cotton production has increased significantly and in 1981 there were 6,000 cotton producers. In recent years, low prices and drought have negatively impacted the area under cultivation, yields and output. Sugar produced on irrigated estates, is the major export, but has also been affected by low world prices. Average yields of tobacco were 339 kg/ha in 1979-80, though yields were higher (400-450 kg/ha) in the RDAs and as low as 15 kg/ha for some farmers.

In 1981, there were 656,000 cattle in Swaziland, about 80 percent of them on SNL land and the rest on ITF land. The income-generating potential of the livestock sector is constrained by the traditional uses of cattle as a store of wealth and for prestige, and for uses such as supplying milk and dung and for tilling the fields. Other problems are overgrazing, erosion and declining livestock quality. It is estimated that the country's carrying capacity that would guarantee a sustained yield of forage is 440,000 cattle, a figure which has already been exceeded. Moreover, the annual offtake is 9 percent on SNLs and 11 percent on other lands, and a rate of 12 percent is required to maintain the status quo.

Marketing for export crops is well-organised, but most crops produced on the SNL are consumed directly with only small quantities being traded commercially. Agricultural credit is available mainly to commercial farmers through the Swaziland Development and Savings Bank (SDSB), commercial banks and processing companies. SNL farmers have access to credit only through the SDSB at a concessional 6 percent interest rate. Given the low returns to labour in subsistence farming, it is not surprising that men migrate to work in cities and the RSA and the farms are managed by women.

Achievement of self-sufficiency in maize production has long been a goal in Swaziland, but output is stagnant and imports are necessary to maintain per capita consumption at current levels. An FAO mission suggested that the main constraints to the achievement of food self-sufficiency were: the lack of clearly-defined policies to implement the government's stated strategies, the traditional land tenure system, and the failure of agricultural research to meet the needs of smallholders and be integrated with extension.

## 2. Agricultural institutions

### a. Research

Agricultural research in Swaziland is conducted by the Agricultural Research Division (ARD) of the Ministry of Agriculture and Cooperatives (MOAC), the University of Swaziland, and five private companies. Research done by the latter is generally related to the particular crops they grow.

#### (1) The Agricultural Research Division

The Agricultural Research Division (ARD) is a unit of the Department of Research and Planning of the MOAC. The Chief Research Officer of the ARD reports to the Director of Research and Planning. Research is done at the Malkerns Research Station and at Lowveld and Nhlanguano.

Research activities are primarily focussed on food crops, including fruits and vegetables, and on some cash crops grown by smallholders. Projects include research on disease-resistant varieties of mung bean seeds; multi-locational maize variety trials; evaluation of soybean cultivation potential in varied ecological zones; evaluation of the potential for introducing wheat; cotton breeding and control of cotton pests; and a Cropping Systems Research Project (CSRP). The CSRP is funded jointly by the GOS, USAID and the US Peace Corps.

The ARD staff consists of an administrator, 14 professionals (2 expatriates), 26 technical staff and six support staff, for a total of 47 persons.

Research facilities include the 400 ha experimental farm at Malkerns, 60 percent of which is used for experimental plots, 15 percent for seed multiplication and 25 percent for farm cropping systems research. The Lowveld Station emphasises irrigated agronomy, cotton entomology and breeding, pest control and dryland farming research. It has 150 ha of land, two laboratories and a block of offices. The Nhlanguano Station in the Middleveld has 90 ha of land and an office. At Malkerns there are three laboratories, the main administrative offices and a library. The library contains about 5,000 volumes and acquires 50 more each year. It also receives 11 periodicals and is linked to libraries at the Universities of Swaziland, Botswana, Pretoria and Melbourne. The ARD's equipment consists of two spectrophotometers, one centrifugal pump, nine tractors, a baler, a land-plane, two trucks, 22 pickups, a fertilizer applicator and three Apple computers. The budget in 1983-84 amounted to US\$ 2.9 million of which US\$ 2.28 million was contributed by the US. Some funding of commodity research is by private associations of growers.

## (2) The University of Swaziland

A five-year research project at the Luyengo campus of the University of Swaziland (UOS) is aimed at improving the productivity of subsistence farmers' intercropping patterns of maize with pumpkin. The experiments are carried out on 2.4 ha of land belonging to small farmers in the area. The project employs technologies that are readily available to the farmers and disseminates the findings at field demonstrations. The project is jointly funded by the Canadian International Development Research Centre and the University; the budget in 1984 was US\$ 83,000. The University's failure to meet its share of recurrent costs has caused difficulties for the project.

The total number of staff employed in government-sponsored research (66 in ARD and UOS) include 24 professionals, 16 of whom are expatriates, and 34 technical personnel. The total amount devoted to this research in 1984 was US\$ 3.06 million.

## (3) Commercially-sponsored research

Research on special commodities is conducted by the following: Swaziland Fruit Cannery, a subsidiary of Nestle's, on pineapples and citrus; the Usuthu Pulp Company on forest products; the Simunye Sugar Estate on agronomic aspects of sugarcane production; and the Swaziland Irrigation Scheme, which is concerned with sugar, citrus and livestock research.

### b. Training

Higher education and training in agriculture are available through the Faculty of Agriculture of the University of Swaziland at Luyengo. Through the University, the MOA offers a one-year certificate programme in general agriculture which is the primary source of new field extension officers. It also offers diplomas in agriculture, agricultural education and home economics and a BSc degree in agriculture. Most university graduates are employed either with the MOAC or the Ministry of Education; a few are employed with the Swaziland Development and Savings Bank.

The faculty consists of 30 full-time senior teaching staff. The 13 expatriates are 54 percent of the professional staff. The plan for the next ten years is to train 21 additional faculty members, ten to the doctoral level, six to the master's level and five to the bachelor's level. Over 98 percent of student funding comes from GOS loans that are payable when the student graduates and becomes employed. The Luyengo campus facilities include seven classrooms, five teaching laboratories and a library with 15,000 books. The University farm which is used for teaching, demonstration and research consists of 316 ha. Land under cultivation amounts to 110 ha and the rest is pasturage. There are no formal linkages with ARD, even though Malkerns Research Station is only 3 km away.

Between 1980-83, the average recurrent budget was US\$ 600,000 annually. There was no capital budget but the Swedish International Development Agency provided an additional US\$ 700,000 to the FAO Faculty of Agriculture Project that provided nine teachers, ten fellowships and some equipment. The EEC also provides US\$ 80,000 every year to support the diploma programme.

c. Extension

Most agricultural extension services are provided by the MOAC. Historically, there was limited linkage between the ARD and the Department of Extension Services (DES) primarily because of the ARD's orientation towards assisting the larger, more commercial farms. Now, through the CSR, formal links exist between the two agencies, and the orientation is shifting towards the SNL farmers. The organisation of the DES has also changed recently, becoming more unified and coordinated under the technical supervision of a Senior Agricultural Officer.

Extension services have generally been focussed upon the farmers within the RDAs providing them with information related to the production of a variety of crops and livestock. Services have also been available to farmers raising cash crops for export on the SNL and increasingly, emphasis has been given to cropping systems. Services related to the management of rural households are provided by the Home Extension Officers. There is also a radio programme for SNL farmers which is broadcast four times a week, and a quarterly publication known as the Rural Area Development News which provides general farming information for SNL farmers.

The DES currently has five administrators, 29 professional staff with BSc degrees, and 325 technical staff with diplomas or certificates. About 50 percent of professional staff time is devoted to food crops, 31 percent to livestock and fisheries, 10 percent to home economics and 7 percent to forestry. Current reorganisation of the DES is intended to have mostly generalists as extension workers. The plan is to train 210 agents over the next few years, three-fourths of them to the certificate level, less than one-fourth to the bachelor's level and ten to the master's level.

Facilities include offices at the MOAC's headquarters in Mbabane and at the Crop Production Offices in Manzini. There are four district offices, each headed by a Senior Extension Officer, five sub-district offices, and 18 RDA project centres. Wherever extension personnel are located there are also houses for field officers. At the RDA project centres, there are adequate facilities such as tractor hire pools, farm sheds and offices. A Cooperative Development Centre has good facilities for in-service training. The Service's vehicles include 20 trucks, 80 autos and 30 motorcycles. At any given time,

about 30 percent of the vehicles cannot be used because they are being repaired. Furthermore, most of the vehicles are in the RDAs, and the agents for other SNL farmers have no transportation.

The average capital budget allocation over the years between 1979-1982 was US\$ 1.58 million. The recurrent budget averaged US\$ 1.71 million; recurrent expenditures exceeded allocation by about 7 percent amounting to US\$ 1.83 million. The GOS contributed 27 percent of the capital budget and 65 percent of the recurrent budget. CDA donors contributed 16 percent of capital expenditures and 5 percent of recurrent expenditures. The rest of capital expenditures (57 percent) and 30 percent of recurrent expenditures were contributed by other donors.

3. Constraints to agricultural production and production potential

a. Food crops

Average maize yields on the SNL is 1.7 MT/ha whereas research yields are between four to six MT/ha. The difference in yields may be accounted for by several factors, including: the fact that much SNL production is on steep slopes or in drought-prone areas; the lack of viable technological packages adapted for smallholder production; lack of improved maize varieties; low maize prices; seasonal shortage of labour; and factors related to land tenure and size of holding. Pricing policies are an important constraint that limit both commercial and subsistence farmer maize production. Government policy is to keep consumer prices low and this conflicts with the goal of achieving food self-sufficiency. Low producer returns discourage farmers from making larger maize plantings which is one way to increase production. Further, the marketing structure is very inadequate in that markets are poorly organised and contribute to gluts and low prices due to transport bottlenecks. Many of these constraints apply to the other major food crops as well.

b. Commercial crops

Yields in the commercial crop sector on estates are believed to be comparable with international production standards but smallholder production of cash crops such as groundnuts, tobacco and cotton are low. While marketing systems were adequate for cotton and tobacco, credit policies and low prices are important constraints for cotton as are plant diseases, pests and insects. The success of estate crop production is due to efficient management and cost sensitivity.

c. Specialty crops

Smallholder production of fruit and vegetable crops has increased substantially, but little data exists on yield potentials. Most of the research has been done by the extension staff except for

some adaptability testing conducted by the Research Service. The main economic constraints to increased specialty crop production are credit and pricing policies. Marketing is also a problem because most smallholders are new to fruit and vegetable production and uncertain about when to harvest. They also lack knowledge of grading and packing procedures and are dependent upon itinerant traders to harvest and sell their produce. While this informal marketing system is adequate for now, as specialty crop production expands, there will be an increased need for investments in storage, transport, marketing and processing.

d. Livestock production

On SNL and ITFs livestock ownership is widespread in Swaziland but few smallholders raise cattle to supplement their earnings. Little is known about livestock production potential, since no livestock research programme currently exists. Swaziland is the most densely stocked country in Africa. This results in overgrazing which has reduced carrying capacity of the land to very low levels. Since livestock are so deeply integrated into the Swazi tradition, changes in management practices will have to be based on research into livestock holdings, animal/land ratios, social traditions and management practices designed to reduce long-term degradation of the resource base.

4. Staff assessment of institutions

The staff of the research and extension institutions generally agree that the inadequacy of the recurrent budget and the timely release of funds are serious constraints to programmes. Most of the staff of the institutions were concerned about the inadequate qualifications of the support staff, the condition and maintenance of laboratory equipment, the lack of adequate transportation and the lack of incentives in the terms of service. The staff of the research institutions were particularly concerned about old offices and laboratories and the shortage of personnel while so many are being trained. At the University there was some concern for the shortage of housing for students, while staff at the extension institutions were particularly concerned about the shortage of transport and lack of visual aids.

5. Conclusions and recommendations

a. Agricultural institutions

Since Swaziland is a small country with limited resources, it should focus its agricultural research and training efforts in the areas in which it has a unique advantage and continue to utilise external contacts with other SADCC countries and international agricultural institutions for most of its applied research needs. Institutionally, the CSRP provides a working model for the closer coordination that is needed between research and

extension programmes. The Faculty of Agriculture of the University of Swaziland should become a more active partner in research and extension systems.

b. Agricultural productivity

The physical constraints to smallholder crop production require a strong adaptability testing programme linked to research and extension. Basic research needs could be met through closer relationships between Swaziland and other SADCC countries and international institutions. Swaziland's own resources could be directed to developing practical, systems-oriented and farmer-tested technical recommendations. A related priority should be the integration of social and economic analysis into the adaptability testing research, and the use of social scientists at the planning and implementation stages of projects.

The required strategy in livestock production is the establishment of a joint research unit with staff from the Livestock Division and the Planning and Research Division of the MOAC. A strategy linking technical and professional skills in both crop and livestock production would be useful and would reflect the importance of livestock to farmers in the smallholder sector. The development of programmes for small stock and poultry research via such a unit is needed to determine the possibility of improving smallholder incomes.

The present strategy of allowing the estate and commercial crop sub-sector to rely upon their own resources for developing research and technology is appropriate, though smallholder needs for cash crop production technology should not be neglected. Research needs in the specialty crops require the addition of a new research unit, which would consolidate the RDAs' testing programmes and improve capabilities in management, irrigation systems, crop production, marketing and storage. The unit could become a component of a SADCC-wide specialty crop network.

G. Tanzania

1. Background

a. Country description and economic overview

Tanzania, with an area of 939,701 km<sup>2</sup>, is situated just south of the equator. Most of the country except for the coastal region lies between the altitudes of 1,000 and 1,500 m. Tanzania is rich in surface waters which are potentially valuable for both agriculture and energy development. Soils vary from the rich, productive volcanic slopes to the good soils of the river valleys to the moderately productive soils that characterise the majority of the land area. Tanzania has a tropical, semiarid climate mitigated by altitude variations which influence rainfall and temperature. In



general, rainfall varies between 250 and 1,500 mm in different parts of the country and is highly erratic in timing and amount.

There are 21 million people in Tanzania, which has a population growth rate of 3.2 percent per year. The population density is highest in the coastal region. About 80 percent of the people live in rural areas and most are employed in agriculture. More than half (52 percent) of Tanzania's GDP derives from agriculture.

Per capita GDP in Tanzania is US\$ 230, reflecting a decline since 1978 as economic conditions have worsened. This is due largely to a sharp decline in the balance of payments, as a result of decreased production of exportable crops such as cotton, sisal, tobacco and cashew nuts because of low prices, and of the lack of foreign exchange to buy basic inputs. Tanzania received US\$ 143.56 million in development assistance in 1981-82, of which 55 percent was in the form of grants. Food aid received in 1983-84 included maize, rice and wheat.

Agriculture is a top priority in Tanzanian development policies, and maximum emphasis is given to development of cooperative and communal lands. The marketing system is government-regulated; there are fixed prices for agricultural output and inputs which are purchased and distributed through parastatal organisations. A parallel market has arisen where prices are often significantly higher than official ones.

#### b. Agriculture in Tanzania

Only 9 percent of the total arable land of 48.7 million ha is currently under cultivation. Traditional agricultural production by individual households based on rotational bush fallow predominates, although some areas are cultivated more intensively. All land is publicly-owned; user rights are assigned on the basis of customary or communal land tenure, leasehold or rights of occupancy.

The major cash crops grown are coffee, cotton, sisal, tobacco, tea, cashew nuts, pyrethrum and cloves. Coffee is the major export. Cotton used to be a major export crop, but now it is in decline as are the other cash crops. Maize is the most important staple food and is produced by more than 50 percent of the smallholders. Other important food crops are sorghum and millet, rice, legumes, cassava, wheat and sugarcane. Sorghum, millet and cassava are grown by smallholders in drought-prone areas. Wheat is produced mainly on commercial farms but the crop is in decline.

There are 12.9 million cattle in the country, most of which are owned by smallholders, but livestock are held for other than commercial purposes. The annual beef production of 180,000 T is inadequate to meet demand. Other livestock holdings include goats, sheep and poultry. The available fishing resources are exploited only to a limited extent.

There are five principal agricultural production systems. The first consists of peasant farmers with up to 10 ha, who engage in subsistence farming using family labour. Medium-scale commercial farmers with up to 100 ha and large-scale commercial farmers with over 100 ha make up the second and third, employing hired labour and purchased inputs: this group, however, is in decline as a result of the government's policies. The fourth system is comprised of private estates, which grow tea and sisal, and the fifth of public estates, which grow wheat, rice, sugar and sisal: both types of estates are largely mechanised.

Agricultural marketing is entirely the responsibility of parastatals that buy, process, distribute, import and export products and inputs, although a share of the food is sold locally outside the regulated structure. Input usage is limited by the foreign exchange crisis. Credit for small farmers is provided through the Tanzania Rural Development Bank, but widespread loan defaults have led to severe restrictions on credit. The National Bank of Commerce provides credit for crop financing.

## 2. Agricultural institutions

### a. Research

Agricultural research in Tanzania is accomplished by one government research institution and six research parastatals funded by the government. These institutions employ 353 professionals (20 percent expatriates; 18 percent female) and had a budget of US\$ 12.9 million in 1983-84.

#### (1) The Directorate of Agricultural Research

The Directorate of Agricultural Research (DAR) of the Ministry of Agriculture and Livestock Development (MOALD) coordinates research policy and the activities of the various ministries and research organisations. There are three research stations associated with the DAR which focus on rice, horticulture and coconuts. The DAR's staff consists of 181 people including 51 professionals, of whom 29 are expatriates. There were 48 vacant professional positions in 1983-84 and no nationals in training. The Directorate's facilities include 935 ha of land, a few buildings, staff housing at the stations and one laboratory for coconut research. The rice and coconut research stations are under construction. The DAR's staff use the MOA library which has 30,000 books and receives ten periodicals. The 1983-84 operating budget was US\$ 2.64 million, of which 25 percent was spent on research programmes and the rest on wages and maintenance.

## (2) The Tanzania Agricultural Research Organisation

The Tanzania Agricultural Research Organisation (TARO) is a semi-autonomous institution established to conduct and coordinate all crop research in Tanzania. It does this both at its headquarters in Dar es Salaam and at 12 research stations. Its emphasis is on the major food and cash crops, with 19 research programmes in commodities, soils and farming systems each headed by a national coordinator. There are 1,934 people on the research staff, about half of all staff working on agricultural research in Tanzania. Of the 139 professionals, 46 are expatriates. There were 51 people in training in 1983-84. TARO has a five-year plan to train more professionals and technicians.

The land available at the stations varies, amounting to a total of 8,356 ha of which half is cultivated. Commercial production accounts for two-thirds of the cultivated land; the remaining third is used for experimental plots and seed multiplication. Facilities at most of the stations are good and include offices, laboratories, meeting rooms, staff houses and maintenance workshops. None of the stations has expensive equipment; only one has an Apple II computer. A documentation and publication section is being developed at headquarters to coordinate journal and book purchases for the stations' libraries, which currently hold 6,000 books. TARO also has access to other libraries within and outside the country. Its linkages with other research and extension agencies are through representation on coordinating committees and through informal cooperation with extension workers in establishing on-farm trials. In 1983-1984, TARO's operating budget was US\$ 3.6 million.

## (3) The Tanzania Livestock Research Organisation

The Tanzania Livestock Research Organisation (TALIRO) is a semi-autonomous institution that directs livestock research under its Director General who reports to the Minister of Agriculture and Livestock. TALIRO's headquarters are at Dar es Salaam; there are three research stations and additional substations. The focus is on applied livestock research to help develop Tanzania's livestock industry. Its programmes include livestock breeding, range and pasture development, animal nutrition, vaccine production, and pest and disease control.

TALIRO is the second largest research institution in the country. Its 820 staff members include 60 professionals, of whom only one is an expatriate. There were only two vacancies at the professional level in 1983-84 and 15 professionals in training. TALIRO has a total of 10,043 ha of pasture land at all three stations. Office facilities are limited, but there are laboratories for toxicology, nutrition and Foot and Mouth Disease, as well as stores, workshops and livestock facilities. Its specialised equipment includes an atomic absorption spectrometer. The research staff have access to the MOA Library. Formal and informal linkages exist with other research and extension

agencies, and TALIRO cooperates in the Sokoine Agricultural University's training of advanced degree students. The operating budget for 1983-84 was US\$ 2.7 million.

#### (4) The Uyole Agricultural Centre

The Uyole Agricultural Centre (UAC) is a research and training institution focussed on the agricultural and livestock production problems of the southern highlands. Its headquarters are at Uyole, and there are eight subcentres with applied research programmes in crop and livestock production and in soils.

The staff of 357 includes 39 professionals, one of whom is an expatriate. Eleven people were in training in 1983-84; the UAC has a five-year plan to train more. The UAC has 4,095 ha of land in four different agro-ecological zones. About a fifth of the land is cultivated; a tenth of this is for experimental plots and the rest is for seed multiplication or commercial production. Two-fifths is pasture or rangeland. Facilities for offices, laboratories, greenhouses and workshops are adequate; the library at the main centre has 3,000 books and 40 periodical titles.

The UAC is the only research institution with an extension section and an extension specialist who cooperates with the regional extension services in organising meetings, demonstrations and on-farm trials. Linkages also exist with other institutions. In 1983-84 operating expenses were US\$ 2.3 million, of which one-third went into the research programmes. About 30 percent of revenues come from outside agencies; the rest was drawn from the government and the institution's own earnings.

#### (5) The Tropical Pesticides Research Institute

The Tropical Pesticides Research Institute (TPRI) is a specialised organisation for pesticides research, with a main station at Arusha and two substations for mosquito and tsetse research. Its 14 research programmes include research on entomology, plant quarantine services and pesticide regulation. The TPRI's total research personnel number 296, of whom 32 are professionals. Eight staff members are in training. Since field research is limited, the TPRI has only 23.5 ha of land, but it has modern research buildings, laboratories and greenhouses as well as specialised field and laboratory equipment. The library at the main station has 750 books and 100 periodical titles. The TPRI cooperates with the bird and pest control units and with other agencies both inside and outside the country. The 1983-84 operating budget was just under US\$ 1 million.

#### (6) Other research institutes

The Tanzania Fisheries Research Institute (TAFIRI) has three freshwater research stations and one marine research station

in Dar es Salaam. They all have programmes in stock assessment, statistics and biology; the marine station also does research in aquaculture. There are 12 professionals among the total staff of 136, and four professionals are in training. TAFIRI has 20 offices, a meeting room, a laboratory, shops, fish processing facilities, and libraries at all stations with a total of 1,000 books. It also has boats, cold rooms and vehicles. It collaborates with the fisheries extension staff, and with agricultural education institutions in training students. The 1983-84 operating budget amounted to US\$ 320,000.

The Tanzania Forest Research Institute (TAFORI) has its headquarters in Dar es Salaam and two stations for research in silviculture and utilisation. It has 13 programmes and a research staff of 20 professionals. TAFORI's land holdings are limited, as is its office space. Its equipment includes deep freezers for seed storage, timber testing equipment and vehicles. The libraries at the stations have 1,000 books. The operating budget for 1983-84 was US\$ 345,000.

TAFIRI and TAFORI are semi-autonomous research institutes in the Ministry of Land, Natural Resources and Tourism (MLNRT).

#### b. Training

Technical agricultural and veterinary training are the responsibility of the Directorate of Training of the MOALD; technical training in fisheries and forestry are the responsibility of respective directorates in MLNRT; degree-level training is done at the Sokoine University of Agriculture which falls under the aegis of the Ministry of Education. These institutions employ 256 professional staff, about 25 percent of whom are expatriates and 10 percent females.

##### (1) The Directorate of Training

Technical training is provided through the Directorate's nine Ministry of Agriculture Training Institutes (MATIs) and five Livestock Training Institutes (LITIs). The MATIs offer certificate courses in general agriculture and specialised diploma courses in a variety of fields; the LITIs offer certificates in veterinary and dairy science and diplomas in various fields of animal production. Both certificate and diploma courses last two years, but their admission requirements differ. Between 1980-82 the average numbers of certificate graduates were 392 in agriculture and 221 in livestock; diploma graduates averaged 333 in agriculture and 143 in livestock. The Directorate had 108 professionals of the total training staff of 1,076 and 36 vacant professional positions.

Land available for training at the Institutes amounts to 3,563 ha. There are ten office blocks, with conference rooms, meeting rooms, lecture rooms, teaching laboratories and student hostels.

Other facilities include workshops, dairy units, and poultry and pig units. The Institutes have their own libraries, as well as access to the MOA Library. The MATI and TARO, and the LITI and TALIRO facilities often share the same locations which encourages cooperation between them. The Institutes give courses for the extension staff, and their students obtain practical experience by working with the extension units. The operating expenses amounted to US\$ 310,176 in 1983-84.

## (2) The Directorate of Fisheries

Diploma- and certificate-level training is provided by the Directorate's Training Section which has a main campus at Dar es Salaam and two other campuses. The certificate course is in general fisheries, and lasts two years. The diploma course lasts three years and offers specialisation in boat building, marine engineering, nautical science and fish processing. In 1980, 48 diplomas were awarded. The average number of graduates obtaining certificates in general fisheries between 1980 and 1982 was 55.

The fisheries training staff numbers 150 people with 22 professionals. Facilities include 29 offices, three assembly halls, eight classrooms, five laboratories, shops and workshops. There are also specialised facilities for fisheries such as cold rooms, a processing room and field equipment such as boats. The libraries have 3,000 books and five periodicals. The Directorate collaborates with TAFIRI on marine resources assessments, with the extension services for student practicals, and with other agencies. The operating budget for 1983-84 was US\$ 1.5 million, of which 64 percent was from NORAD.

## (3) The Directorate of Forestry

The Directorate gives training in forestry at two campuses (Olmotonyi and Moshi) and has its headquarters in Dar es Salaam. There are two diploma courses, one of which is for in-service training. Certificate-level courses are also offered, as well as short courses in subjects like logging, carpentry, and wood-based panels. The Olmotonyi campus graduated 90 certificate-holders and 19 diplomates in 1982. The Moshi campus has enrolled 64 students each year since 1980. The training staff consists of 46 people, including 17 professional Forestry Officers. There are two expatriates, one each in the professional and technical categories. Student practical training is conducted on 180 ha of forests. Other facilities consist of 13 offices, one conference room, seven classrooms, one laboratory, a shop and one library at Olmotonyi Institute that has 10,000 books and 100 periodicals. The Directorate collaborates with TAFORI and with the Village Forestry Extension Services. The operating budget for 1983-84 was US\$ 520,000, a third of which was contributed by SIDA.

#### (4) The Sokoine University of Agriculture

The Sokoine University of Agriculture started as the Faculty of Agriculture in the University of Dar es Salaam to give degree-level training in agriculture. Divisions of Forestry and Veterinary Science were added later; in 1983-84 the Faculty was given the status of a university and renamed Sokoine University of Agriculture. Three-year Bachelor's degree programs are offered in agriculture and forestry, and four-year programs are offered in veterinary science and agricultural engineering. Master's and doctoral degrees are offered in the same fields. In 1982, the University graduated one PhD, 12 master's and 105 bachelor's degree students.

The staff consists of 163 people, with 119 professionals including 37 expatriates. Thirty-nine professionals were in training; long-term plans exist for additional training for the staff at all levels. The University has 2,300 ha of land which are used for food grains production, horticulture, pasture, forests, and experimental plots. Buildings include offices, a conference room, classrooms, 14 laboratories, three greenhouses, workshops and hostels. There are also facilities for livestock and dairying, as well as a forest nursery and a crop museum. The library has 44,000 books and 1,000 periodicals. The University collaborates with research institutions and seed farms, and individual professors conduct joint research with scientists from other institutions. The operating budget in 1983-84 was US\$ 3.4 million, of which US\$ 3.2 million was allocated by the government and the rest contributed by donor agencies like IDRC, SAREC, and the Ford Foundation.

#### c. Extension

##### (1) The Directorate of Extension and Technical Services

The Directorate of Extension and Technical Services (DETS) of MOALD has two divisions: Agricultural Extension Services and Agricultural Technical Services. The Extension Service introduces farmers to improved methods, particularly through the fertiliser and seed multiplication programmes. Technical Services focusses on plant and crop protection services through programmes that include pest control measures and produce inspection. There are 20 regional offices throughout the country, each headed by a Regional Agricultural Development officer.

The DETS' staff consists of 5,678 people, including 147 professionals of whom 28 are expatriates. Currently, 96 people are in training; there is a six-year training programme. Building facilities include administrative offices at headquarters and regional and district offices. The DETS also has some seed multiplication farms and nurseries, vehicles, equipment and access to the MOA Library. It publishes a monthly extension magazine. The DETS collaborates with

demonstrations and farming systems research. It also exchanges extension information with other developing countries such as India and China. In 1983-84 the operating budget was US\$ 12.84 million.

## (2) Other extension institutions

Livestock extension is provided by the Directorate of Animal Production and Veterinary Services of MOALD through Development Officers at the regional and district levels, and by specialists in activities such as artificial insemination, meat hygiene, range management, dairy development and disease control.

The Directorate of Extension for Fisheries (DEF) provides traditional fishermen with information to help increase their catch. There are offices in each of the 20 regions with programmes in marine and freshwater fisheries, as well as one regional programme in small-scale fish farming. The extension staff numbers 1,415. The DEF has an established training programme, through which 58 people were trained in 1983-84. Facilities include offices at headquarters in Dar es Salaam and in the regions and districts, and libraries at the head office and in three regions. Publications include extension reports and monographs. The DEF has close linkages in Tanzania with TAFIRI and with the training institutions and externally with FAO, DANIDA and NORAD. The operating budget for the last financial year was US\$ 0.98 million.

The Directorate of Extension's Village Forestry Service (VFS) does extension at the village level by establishing forest nurseries, transporting planting materials and establishing forests in cooperation with the villagers through an agro-forestry programme. The extension staff numbers 927. Facilities include nurseries and offices in each of the regions, and visual aid equipment; however, VFS has no library. There is close collaboration with TAFORI in the establishment of seed nurseries, with TARO and TALIRO in agro-forestry and farming systems, and with Sokoine University. The operating budget last year was US\$ 3.6 million.

## 3. Constraints to agricultural production and production potential

### a. Food crops

Maize is grown almost entirely by smallholders and is often intercropped with legumes, cassava and vegetables. Production and marketing are greatly affected by government policy which aims to keep consumer prices low. This results in very unattractive prices for farmers who often sell in the unofficial market and compel the government to make up its shortfall through imports. Besides price policies, the other constraints to greater production are the lack of suitable drought- and streak-resistant



varieties for low- and medium-altitude areas, large post-harvest losses from inadequate storage, lack of credit and poor input supply.

Current yields of sorghum and millet are 700 kg/ha. They could be as high as 3,000 to 3,500 kg/ha with the proper management and input usage. The main constraints to improved production are losses due to birds, lack of high-yield varieties that are also bird- and drought-resistant, and poor storage facilities. Most rice is grown by smallholders for consumption in urban areas: Small farm yields are 900 to 1,000 kg/ha; with the application of improved technological packages, however, yields could be as high as 4,000 kg/ha. The chief constraints to increased production are lack of high yielding varieties and irrigation and the unavailability of good seeds and fertilisers.

Legumes such as beans, cowpeas, and pigeon peas are grown by smallholders whose yields average 500 kg/ha. Demand for legumes, especially in urban areas, is high. There is great potential to increase productivity with improved research in breeding short-cycle and disease-resistant varieties and by identifying optimal intercropping patterns. Cassava is the most important root crop grown by smallholders; it is intercropped with cereals and legumes. Constraints to production include the lack of pest/disease-resistant and more palatable varieties.

#### b. Commercial crops

Coffee is grown mostly by smallholders whose average yields are 250 kg/ha. Recently, production and quality have declined, farmers being constrained by unattractive producer prices, poor extension services, inadequate disease and pest control, lack of machinery and spare parts on estates, poor management of the nationalised estates, and inadequate processing and marketing facilities. Cotton production is also in decline, due to the combination of low producer prices and better prices for food crops sold in the open market, poor rainfall, and the lack of innovative, labour-saving technological packages.

#### c. Livestock and livestock products

Despite having the largest livestock herds in Africa, Tanzania does not produce enough animal products to meet domestic demand. Both transhumance and sedentary cattle-raising are practiced by smallholders, but the distribution of the cattle population is uneven. Thus, some areas are overgrazed while others are underutilised or not utilised at all because of tsetse infestation. Another main constraint to increased beef and milk production is that cattle traditionally have not been held for producing income.

Similarly, little attention is paid to developing meat and milk products from goats, sheep and pigs. Although it is common for people to have poultry, and demand is high, there are constraints to increased poultry production such as poor cost/quality ratios of

balanced feeds and shortages of day-old chicks of improved breeds. The communal land tenure system also acts as a constraint that operates to prevent individual farmers from adopting improved management practices. The lack of availability of consumer goods and agricultural inputs also may be factors reducing incentives for increased production.

#### 4. Staff assessment of institutions

The main institutional constraints identified were shortages of recurrent budgets, foreign exchange difficulties, lack of training opportunities for staff, inadequacy of laboratory equipment, lack of transportation, staff dissatisfaction with housing facilities, and the lack of opportunities for just rewards and promotions. The training institution staff were particularly concerned with the lack of laboratories and equipment, transport, libraries and offices. Among extension staff the main concern is with inadequate transport facilities and the lack of recognition and appropriate rewards for work done in remote locations.

#### 5. Conclusions and recommendations

##### a. Agricultural institutions

The strategies recommended to improve agricultural research institutions include the following:

- o Development of programmes, based on the major agro-ecological zones of the country, which are closely related to the technical and socioeconomic problems confronting farmers. For the agro-ecological zone approach to be successful, the number of research institutes should be reduced and efforts concentrated in a few well-equipped institutions. Improved coordination resulting from such unification is likely to attract increased international collaboration and support;
- o Increased budgetary allocations;
- o Improved linkages between research and extension, and better coordination at the international and national levels;
- o Establishment of a library and publications service, and initiation of a national agronomy journal; and
- o Establishment of a data base of agricultural research information at the central library and publication unit.

The training provided at Sokoine University is very good; however, its current capacity is insufficient to meet the need for more trained graduates, since only 100 students per year are admitted to its programmes. The MATIs and the LITIs which offer diploma- and certificate-level training have a larger capacity, but their standards

are not as high, the chief constraints being shortage of funds, a lack of specialised facilities and poorly-qualified staff. It is recommended that efforts be concentrated in fewer, more efficient units.

The performance of agricultural extension services is very poor. The decentralisation policy introduced in 1972 resulted in disorganisation, misallocation of manpower, inadequate personnel training, lack of transportation and absence of effective linkages with research agencies. Following recentralisation in 1983, the foci should be on staff training and transportation improvements.

b. Agricultural productivity

Strategies proposed to reduce production constraints include the following:

- o Marketing and price policies: Low purchase prices paid to commercial crop producers should be adjusted to give them better returns. The Marketing Development Bureau recommendations should be given greater attention. The policy of consumer price subsidies on food should be reviewed. In order to prevent losses incurred by parastatals on the costs of transporting food commodities between regions, consumption should be encouraged in the areas where the goods are produced;
- o Processing and storage: Processing and storage facilities are needed in areas of agricultural production to reduce losses and lower transport costs for farmers;
- o Roads and transport: The development of an effective road network is vital, not only to agriculture for improved input and output marketing, but also for general development;
- o Land tenure: The lack of a clear land tenure system is a serious hindrance to land use planning and management. The emphasis should be on developing policies that will provide farmers with title deeds guaranteeing the use of the land for long periods;
- o Irrigation: Tanzania's large water resources offer a vast potential for development of irrigation systems, which would help improve agricultural production by making farmers less dependent upon the erratic rainfall;
- o Poultry industry: Poultry production in Tanzania is low, while demand and price are high, and development of the industry offers a means to rapidly increase animal protein availability. Cooperatives could be established to centralise services for hatcheries and procure nucleus feed for small farmer poultry production development. Research

could be focussed on developing better local breeds and improving the feed industry; and

- o Input allocation: Agriculture provides most of the hard currency that enters the country, but a very small share is returned to agriculture in the form of inputs. The result has been poor performance in the agricultural sector and lower-quality export production. It is important that export-oriented farms be allocated machinery, spare parts, chemicals and fuel in proportion to their sales and without discrimination between the public, private and cooperative sectors.

## H. Zambia

### 1. Background

#### a. Country description and economic overview

Zambia is a landlocked country of about 750,000 km<sup>2</sup> in the centre of southern Africa. The country may be divided into four major agro-ecological zones: the northern high-rainfall zone, which favours perennial crop production such as tea and coffee; the western semiarid plains zone, which primarily is covered by infertile Kalahari sands; the Luangwa-Zambezi rift valley, which is the driest zone, with shallow, sandy soils that are marginal for agriculture; and the central, southern and eastern plateau area which, with fertile soils suitable for growing maize, groundnuts, tobacco and cotton, is Zambia's most populous region and the one in which most of the commercial and mechanised farming is done.

Mean annual rainfall ranges between 1,200 mm in the north to 700 mm in the south. Recently, however, there have been abnormal seasonal distributions. Over the past three years, the areas of lowest rainfall have received 40 percent less rainfall than the long-term average. This has resulted in total crop failure and severe water shortages.

Zambia's population is 5.68 million, and is growing at the rate of 3.3 percent annually. In 1980, 67 percent of the labour force was engaged in agriculture, 11 percent in industry and 22 percent in services. Migration of males from rural to urban areas affects many rural households, 30 percent of which are headed by females, and results in labour shortages for agricultural production. About 44 percent of the population live in urban areas, making Zambia the most urbanised of SADCC countries.

As a result of its dependence upon copper exports whose prices have been declining, the Zambian economy has suffered greatly. Real GNP in Zambia fell 23 percent between 1971 and 1981; the country has a balance of payment problem. Agriculture contributes about 13 percent to the GDP. Mining and quarrying represent a larger but

declining share, accounting for 21 percent in 1981. Services contributed 34 percent. Zambia's efforts to diversify by expanding agricultural production has begun to bear fruit as is evidenced by the fact that agriculture's share in output grew by two percentage points from 1975 to 1981. In the 1981 and 1982 cropping seasons, agricultural output actually declined because of drought. Nevertheless, agriculture remains the most feasible alternative for restructuring the economy away from the declining mining industry.

b. Agriculture in Zambia

Only 16 percent of Zambia's arable land is currently being utilised. One of the three categories of land is state lands, which comprise 6.5 percent of total land area and are controlled by the President; long-term leases are granted for state lands. Reserve land is public land set aside for game preserves and forests. Trust land, which covers more than half the country, may be occupied and used in accordance with customary law without lease or formal occupancy rights.

There are four categories of farmers. Large-scale commercial farmers, numbering 700, have an average farm size of 80 ha; they employ hired farm labour and high input technologies. Medium-scale commercial farmers number 21,000. Their farm size ranges between 10 ha and 40 ha, and animal draught power and family labour are used. Small-scale commercial farmers number 122,000. With an average farm size of three ha, they produce 60 percent of marketed maize and 35 percent of all staples. The largest group, with 460,000 families, consists of subsistence producers whose average farm size is two ha.

Among major food crops, maize output and yields have been relatively static since 1975, while wheat and oilseed production and yields have increased. Cassava is grown extensively by small farmers; yields are higher than the current African average of 6.4 MT/ha, and the domestic demand outlook is favourable. Tobacco is the traditional export crop, but output has been declining since 1975. Livestock accounted for 11 percent of total agricultural output in 1981. Of the 2.1 million head of cattle, only 16 percent are held in the commercial sector which produces 37 percent of the beef. Milk is produced by small farmers for their own needs and by medium-scale and commercial or state farms for market. Commercial milk production has, however, declined since 1965. Poultry is raised by small farmers, as well as on a commercial scale for both meat and eggs. Although poultry meat production has declined recently, egg production increased significantly up to 1981.

Freshwater fishing in Lakes Tanganyika, Kariba, Mweru and Bangweulu employs 20,000 fishermen, for whom fish are an important source of income. There is a high consumer demand for fish, but less than 60 percent of potential demand is met. Average fish production is 54,000 MT per annum, although a sustainable yield of 85,000 MT is feasible.

Agricultural input and product marketing and provision of credit are handled primarily by parastatals and cooperatives. Large commercial farmers are served by commercial banks, the Development Bank of Zambia and the Zambia Agricultural Development Bank.

## 2. Agricultural institutions

### a. Research

Agricultural research in Zambia is conducted by seven institutions: three departments of the Ministry of Agriculture and Water Development (MAWD), the National Council for Scientific Research, two programmes of the University of Zambia, and the Forestry Department of the Ministry of Lands and Natural Resources. The institutions altogether employ 28 administrative, 212 professional (of whom 100 are expatriate), 135 technical and 349 support staff. All administrative positions are held by Zambians, but 47 percent of the professional positions are held by expatriates. In 1983-1984, research expenditures amounted to US\$ 12.6 million, of which two-thirds was contributed by donor agencies.

#### (1) Department of Agriculture

The MAWD's Department of Agriculture (DOA) is responsible for research, and extension in crops, breed improvement, nutrition, pasture and land use services. The Research Branch of the DOA is headed by an Assistant Director of Agriculture at the Lusaka headquarters, and by a Chief Agricultural Research Officer at the Central Research Station outside Lusaka where research is conducted. It is also carried out at nine regional stations and 13 testing fields. Research priorities are determined by the objectives of the Third National Development Plan, and include achievement of food self-sufficiency, increased production for export and creation of new employment and income opportunities.

For organisational purposes, the Agricultural Research Branch is divided into Commodity and Specialist Research Teams, which focus on commodity research, and the Adaptive Research Planning Teams, which apply the farming systems approach and conduct on-farm trials. Programmes emphasise cereals research to develop improved varieties of maize, sorghum, millet, wheat and rice. Research is also done on other crops, including: oilseeds such as sunflower, groundnuts, soybeans; grain legumes; cotton; other food crops such as roots and tubers; vegetables; and tree and plantation crops. Animal research emphasises nutrition, breed improvement and pasturage improvement. Soil productivity, plant protection and food conservation and storage are also parts of the research programme.

The DOA's staff consists of 321 people, of whom 117 are professionals and 11 administrators, the rest being technical and support staff. There are 55 expatriates on the staff. Office and

laboratory facilities at the research stations are inadequate; each has sufficient land for annual field crop research. Financing comes from the MAWD and some external donors. In 1983, the budget for research was US\$ 3.2 million.

(2) Department of Veterinary and Tsetse Control Service

The MAWD's Department of Veterinary and Tsetse Control Service conducts research through the Central Veterinary Research Institute (CVRI), with the participation of several international organisations such as FAO/UNDP, DANIDA, EEC and Dutch Technical Aid. The CVRI's activities include: diagnoses of animal diseases; epidemiological surveillance and disease investigations; production of vaccines; conduct of applied research; and dissemination of scientific and technical information to the field services. Among the diseases being evaluated are East Coast Fever, trypanosomiasis, Foot and Mouth disease, and African Swine Fever. There are 12 professional, three administrative, ten technical and 69 support staff at the CVRI. Of the administrative and professional staff, 13 are expatriates; eight of these are funded by donor agencies such as FAO, DANIDA, EEC and UNDP. The research centre has ten administrative offices, well-equipped laboratories, 2,000 ha of land to raise research animals, a conference room, a garage, a shop and animal sheds. Its estimated recurrent expenditure for 1984 was nearly US\$ 1 million, a large proportion of which was provided by donor agencies.

(3) Department of Fisheries

The MAWD's Department of Fisheries has its headquarters at Chilanga outside Lusaka. It also operates seven field stations at major fishing waters. Research programmes include production studies of new man-made lakes, investigation of phytoplankton periodicity, and studies of zooplankton. The research staff consists of nine professionals (five of whom are expatriates), 16 technicians, four administrators and 95 support staff. Its facilities include three office blocks, a research laboratory, a library and a fisheries museum at Chilanga. The 1984 budget amounted to US\$ 210,000 for salaries and wages and US\$ 53,000, for operating costs.

(4) University of Zambia

The University of Zambia's School of Agricultural Sciences offers a five-year programme leading to the BSc degree. It also does research through various departments, including research on: improved varieties of cereals; development of stockfeeds from locally produced ingredients; fruit and vegetable production; soil and water conservation; irrigation; and rural technology. The School's staff consists of 32 professionals, 18 of whom are expatriates, and nine technical personnel. Only a fourth of the personnel are engaged in

research. Its facilities include 20 offices, a field station with animal sheds and stores, a production/research farm and three laboratories. The laboratory space is inadequate. The total operational budget for 1984 was US\$ 216,000. The University allocates US\$ 14,600 to the School for research; donors also contribute to the research budget.

The Rural Development Studies Bureau (RDSB) of the University conducts policy-oriented research on rural development issues. It constitutes the Zambian component of the Centre on Integrated Rural Development for Africa. The RDSB's projects include demographic and socioeconomic surveys and studies of input utilisation.

#### (5) National Council for Scientific Research

The National Council for Scientific Research (NCSR) advises the government on research policy; it also coordinates and promotes scientific research. The Livestock Pests and Disease Control Centre of the NCSR conducts research on livestock pests and diseases, livestock infertility and nutrition, tsetse fly eradication and tick-borne diseases. The NCSR food technology research unit is concerned with developing low-cost food processing technologies to develop small-scale industries among low-income families. Some new products have been developed, such as fruit juice concentrates, squashes, cereal-legume composite flours for infant formulas and biscuits. The Livestock Pests and Disease Control Centre has modern laboratory facilities and field equipment. Its staff consists of 23 professionals, of whom two are expatriates. Nine people have PhD, ten have MSc, and four have BSc degrees. Its estimated recurrent costs for 1984 amounted to US\$ 58,400, excluding salaries, wages and donor funding. Funding is generally by the Government through the Ministry of Higher Education.

#### (6) Forestry Department

Within the Forestry Department of the Ministry of Lands and Natural Resources, research is conducted by the Forest Research and Forest Products Research Divisions. Both divisions are located at Kitwe. The former focusses upon producing healthy trees; the latter deals with their utilisation. The Forest Research Division's work is in the areas of forest pathology, entomology and genetics. It maintains an herbarium, a seed store and a soil testing laboratory. Of the seven professionals on the staff, four are donor-funded expatriates. The recurrent and capital budgets for 1984 were US\$ 182,500 and US\$ 219,000, respectively. The research programmes of the Forest Products Division include sawmilling, preservation, seasoning and strength testing. There are six professionals (including three expatriates) and seven technicians on the staff. The recurrent budget for 1984 is US\$ 146,000, which is supplemented by an equal amount from the FINNIDA project.



## b. Training

The University of Zambia through its School of Agricultural Sciences offers the bachelor's degree in agriculture with specialisation in five subject matter areas. The five-year course consists of two years of general science study, followed by two years of study in agriculture and a fifth year of specialised study. The curriculum also includes farm practicals, tutorials and seminars; vacation time is used for 30 weeks of practical training on farms and at agricultural institutions. The staff consists of 30 professionals and 12 technicians, 25 of whom are expatriates. Six have PhD degrees, 18 have MScs and 5 have BScs. Twelve people are abroad studying for the PhD and four for the MSc degree. The School has offices, classrooms and a largely undeveloped farm of 600 ha. The total budget for 1983 was US\$ 682,000.

The Natural Resources Development College is under the training wing of the MAWD. It offers a three-year diploma course, underwritten by the University of Zambia, with specialisation in a number of areas. Emphasis is given to practical training in laboratories and workshops and on the farm. Students are also expected to get field experience during a long vacation. Two categories of students are admitted: direct entry and in-service students. The latter are those who have worked for some time and are recommended by the heads of departments for further study. Of the 29 professionals on the staff, 18 are expatriates. The College is located at a 300 ha teaching farm, with an irrigated area and swine, poultry and dairy units. The college, in addition, has a 1500 ha ranch for cattle, sheep and goats. The Government of the Republic of Zambia (GRZ) budget in 1983 was US\$ 1,864,000, an additional amount was provided by donor agencies.

The two campuses of the Zambia College of Agriculture are engaged mostly in training people employed by the Department of Agriculture in field extension work. They provide a two-year certificate course in agriculture, for which fields of study include crop and animal production, home economics, farm machinery, farm management and extension. Of the 14 professionals on staff, about half are donor-supported expatriates. The College's facilities include modern classrooms, offices, a library, laboratories and workshops. In 1983, capital expenditures amounted to US\$ 657,000, but they are expected to be half that amount in 1984.

The Zambia Institute of Animal Health trains field-level staff to help farmers institute disease prevention and control measures. Students are accepted, after they have completed a year of general agricultural training at the College of Agriculture, for a year-long certificate programme in animal health. The facilities include good laboratories, three classrooms, an office block and a library. The Institute's capital expenditures in 1983 amount to US\$ 73,000. The Zambia Forest College trains foresters to the diploma and certificate levels. Its enrollment capacity is 50 students per year. The curriculum emphasises practical experience in the use of various

tools, equipment and machinery; logging operations, nursery and plantation techniques are also taught. There are six professional staff members. Its practical training facilities, machinery and equipment are modern. The recurrent budget in 1983 was US\$ 48,000, and was provided by the government. The MAWD also operates five farmer training colleges offering one- or two-year programmes and short courses that are production-oriented.

While the training institutions have adequate Zambian administrative and technical staff, 62 percent of the professional staff are expatriates. In 1983, the total recurrent costs amounted to US\$ 1.2 million, and capital costs were US\$ 1.3 million. Donor grants from SIDA, the Netherlands and the EEC financed US\$ 1.02 million of the capital costs.

c. Extension

The Department of Agriculture's Extension Service was created to promote the adoption of improved agricultural practices and the efficient use of inputs among smallholder farmers, and to provide research solutions to farmers. The Extension Service has several programmes in crop and animal husbandry, horticulture, agricultural mechanisation, home economics and youth extension. Its Training and Visit Programme is aimed at increasing the frequency and efficiency of extension worker/farmer contact and providing continuous in-service training for extension workers. Although the programme was implemented in every province, transport and housing problems have reduced effectiveness except in the eastern and southern provinces.

The LIMA programme is designed to deliver a farm input package for use by smallholder farmers on land units as small as one-fourth ha. The extension work involves demonstrations on farmer fields. A related programme is designed to minimise the operating costs of training extension workers and farmers engaged in the LIMA project.

Three projects for women, run by the Home Economics Section and funded entirely by SIDA, focus on getting women involved in income-generating activities. Overall, the extension programmes have not been entirely satisfactory for a variety of reasons that are specific to each one.

The Extension Service is headed by an Assistant Director of Agriculture supported by a team of sectional heads known as Subject Matter Specialists followed by Senior Specialists. The Service is organised into similar posts at the provincial, district and field levels. Each of the nine provinces is managed by a Provincial Agricultural Officer, assisted by Provincial Subject Matter Specialists who are responsible for supervision of district and field staff. The District Agricultural Officer heads the district extension service, and is assisted by a technical staff of Agricultural Supervisors. The field staff at the Block level are Senior

Agricultural Assistants, Agricultural Demonstrators and Commodity Demonstrators. There are 71 professionals in the extension service, 27 of whom are expatriates. There are 1,645 technical staff who have been trained to the diploma or certificate level, and 131 administrative and support staff.

The Extension Services facilities include national, provincial and district offices. In addition, each province has a farm institute and at the district level there are farmers' training centres. They also have vehicles, most of which are not in service. The total budget is estimated at US\$ 12.3 million for 1984, a considerable amount being provided by donor agencies.

The Field Services Branch of the Department of Veterinary and Tsetse Control Services provides extension services to farmers on animal disease prevention and control. It is managed by an Assistant Director at national headquarters and nine provincial officers. Through its programmes, the Branch has been successful in containing animal diseases to particular areas. Veterinary field services are headed by Provincial Veterinary Officers. There is close cooperation between the Field Services Branch and the animal husbandry section of the Department of Agriculture's extension service. There are 33 professionals of a staff of 334. The Branch's facilities include offices at provincial and district headquarters, and laboratories at provincial headquarters. Its 1984 budget was estimated at US\$ 876,000 million.

The Extension and Development Division of the Fisheries Department collects statistical data, monitors fish conservation, implements better management practices, and carries out extension education through training centres and radio broadcasts. The staff is entirely Zambian and consists of a Chief Fisheries Officer, 19 Assistant Fishery Development Officers and 212 Fish Scouts who are the primary contacts with fishermen. The Division's facilities include offices at national and provincial headquarters, and field fishery stations. Equipment includes boats and fishing nets and vehicles for ground transportation. The recurrent expenditure for 1984 is US\$ 285,000.

The Extension Division of the Department of Forestry consists of a chief extension officer, a senior forester and a forester. At the provincial and district levels there are no special extension staff; the work is assigned to foresters in addition to their other duties. The Publicity Section publishes information on forestry, conducts seminars, and produces radio and television programmes. There is large-scale deforestation in Zambia which results in a shortage of fuelwood and in soil erosion. In order to combat this, a strategy of promoting community forestry has been proposed and efforts have been made to encourage tree planting by providing free and reduced cost seedlings and fertilisers. The forest extension staff consists of one professional person and eight technical people. Facilities consist of those available for the department headquarters. For 1984, recurrent

and capital expenditures amounted to US\$ 43,800, a large proportion of which was provided by a FINNIDA grant.

The staff available to perform the work of the extension institutions is limited, particularly in fisheries and forest extension. Nevertheless, the extension institutions have no training programmes to upgrade and increase the staff. The total expenditure of US\$ 18.5 million for the extension institutions was considered inadequate.

### 3. Constraints to agricultural production and production potential

Most of the food crops in Zambia are produced by small-scale farmers on farms that average three ha. Average yields of the major crops have increased over the past ten years, but they are still lower than those obtained by commercial farmers and by research stations. Low rainfall is one of the major physical constraints to productivity, affecting maize yields more than other cereals. Soil degradation constitutes another constraint to production of maize, sorghum, cassava and other crops as well. Weeds also affect yields, because there is insufficient farm power to keep the fields adequately weeded.

Plant diseases and pests restrict yields of sorghum and cassava more than those of maize, because disease-resistant varieties of the latter are used. However, the high-yielding hybrid maize varieties used are less adaptable to low and short duration rainfall, but unimproved varieties of sorghum and cassava are used because research in these crops has been minimal. Finally, lack of farm power is a constraint to production of all three cereal crops. Even where animal power is available, there is a serious labour shortage in periods of high demand during the cropping season. In other areas, where there is no tradition of keeping livestock, lack of animal power is a critical constraint.

Among the economic constraints are inadequate incentive pricing for output, late payments by marketing agencies, delayed supply of critical inputs to farmers, transportation difficulties in marketing crops, and the unavailability of short-term credit for small-scale farmers. The inability of the research, training and extension institutions to meet real needs of small farmers also constrains productivity.

Livestock commodities produced in Zambia include beef, poultry and dairy products, although data were only available for beef production for this study. The total cattle herd numbers 2.1 million, of which 1.8 million are in the traditional sector and the rest in the commercial sector which, however, accounts for 37 percent of beef production. Unavailability of fodder is the most serious constraint to livestock production, followed by climate, rainfall, water supply,

animal diseases and pests. The economic constraints include availability of inputs, marketing and long-term credit. Poor herd and range management are also important constraints.

#### 4. Staff assessment of institutions

Staff at each of the research, training and extension institutions considered inadequacies, delays and inconsistencies in funding to be major constraints. They identified foreign exchange difficulties as contributing to the problems of inadequate maintenance of vehicles and equipment. Lack of staff training opportunities, inadequate laboratory facilities and inadequate transportation were also cited as important constraints. Staff at all institutions indicated some dissatisfaction with some terms of service, including shortages of housing, relatively low salaries and inadequate staff evaluation procedures. The housing and transportation shortages were seen as particularly restrictive for the extension services.

#### 5. Conclusions and recommendations

##### a. Agricultural institutions

The proposed strategies for the research institutions include more emphasis upon funding research that will help small-scale farmers, and a continuation and expansion of present bilateral and multilateral funding of research programmes. Since there is a shortage of foreign exchange to purchase and repair research equipment, it is recommended that cost-effective central repair facilities be set up for all the research institutions. It is also recommended that each research institution establish a five- or ten-year staff training programme to upgrade the professional, technical and support staff capability of Zambians. New policies should be devised for meeting the vehicle and housing shortages. In order to improve staff evaluation procedures, an evaluation committee should be set up in each institution.

The above recommendations also apply to the training institutions. In addition, the training institutions should focus more on small farmers and on farming systems. In order to increase the number of district and field extension staff, it is recommended that increased housing be provided. Funding for vehicles should also be increased and the in-service training programme improved. Strengthening of rural information services, which include radio and farm publication, is needed.

##### b. Agricultural productivity

Improved varieties of the major food crops should be developed that are higher-yielding, more disease and pest resistant, and better adapted to varying rainfall and soil conditions. Special attention must be given to the role of women both in agricultural production and professional positions. More funds should be available

for oxen training and for medium-term loans to help farmers acquire livestock. It is recommended that a region-wide company should be developed that could supply low-energy equipment such as hand planters, hand weeders and cultivators to small-scale farmers. Other recommendations to improve productivity include: higher producer prices; development of a better marketing system and more efficient input delivery; research on the industrial uses of cassava and sorghum; and greater credit availability. The institutions' emphasis should be on the establishment of programmes in accord with current national development objectives which contain evaluation and monitoring mechanisms.

The recommendations to improve livestock productivity are development of improved pasturage, research into cheaper sources of supplementary feeds, dam construction to improve water supply in low rainfall areas and improved veterinary services. Construction of abattoirs that reduce the cost of production could lower prices, raise demand and increase the off-take rate from the traditional herd.

## I. Zimbabwe

### 1. Background

#### a. Country description and economic overview

Zimbabwe, which is situated in south-central Africa, has a total area of 390,245 km<sup>2</sup>. There are five major agro-ecological zones whose productivity varies chiefly according to amount and distribution of rainfall. Thus, Region I is a specialised and diversified farming region which produces beef and dairy products, coffee, tea and orchard crops. Region II is intensively farmed and produces grain, cash and mixed crops such as tobacco, maize and cotton, and beef and dairy products. There is some cash crop production of cotton and maize, and fodder crop production for semi-intensive livestock production in Region III. In Region IV only drought-resistant cash crops can be produced along with some livestock; Region V is suitable only for extensive beef ranching.

Zimbabwe ranks as a middle-income developing country and had a per capita income of US\$ 850 in 1982. Sectoral contributions to GDP were 25 percent from manufacturing, 15 percent from agriculture and forestry and 14.7 percent from services. Between 1979 and 1981 GDP in Zimbabwe rose from US\$ 2,508 million to US\$ 3,918 million at factor cost. Zimbabwe receives aid from both Eastern and West European countries in the form of commercial loans, technical assistance and commercial trade which is usually barter. In 1982, the population was 7.5 million, of which 25 percent lived in urban areas and the rest in the rural areas where they were predominantly employed in agriculture. The animal population growth rate since 1969 has averaged 3.1 percent. Until 1981, Zimbabwe was self-sufficient in

food, but since then it has had to import cereals as a result of droughts. It has also received food from donor agencies and foreign governments.

b. Agriculture in Zimbabwe

There are two different agricultural systems in Zimbabwe: the modern commercial sector, run by persons of European descent and communal or subsistence agriculture, where production is by Africans. The communal sector produces most of the food consumed by the rural and urban black population, generally on less favourable soils and with limited inputs. Land is currently owned by the state and privately. In communal areas, farmers are entitled to cropping on the land allocated by their chiefs but they do not have title deeds to it.

The principal crops produced are maize, wheat, cotton, tobacco and sugarcane. Irrigation availability is enabling crop production to be done throughout the year. Major winter crops are wheat, potatoes, seed beans and vegetables. Maize is the staple food; some was exported until the recent drought. Maize is cultivated throughout the country, but yields are highest in the high rainfall regions of the north. Other important crops are tea, coffee, citrus, and other fruits, groundnuts and soybeans. Tobacco is the major export earner.

Livestock holdings amount to five million head of beef cattle, for which the government's Cold Storage Commission provides an assured market at fixed seasonal prices. Zimbabwe is virtually self-sufficient in dairy production; it is served by the Dairy Marketing Board which guarantees prices and undertakes distribution and processing. Private entrepreneurs under government regulation carry out commercial fishing in lakes and rivers. There is also a thriving crocodile ranching industry.

Agricultural marketing is highly organised. Handling, processing and delivery of agricultural products are the responsibility of five parastatals and a cooperative. The commercial sector uses large amounts of purchased inputs such as fertilisers and improved seed varieties. Zimbabwe produces its own nitrogen and phosphate fertilisers and seeds, but small farmers access to these inputs is limited due to lack of transportation and distribution outlets. While credit is available for the commercial sector through a variety of institutions, lack of collateral prevents lending to small farmers.

2. Agricultural institutions

a. Research

There are a large number of institutions involved in agricultural research in Zimbabwe, including four government research organisations in various ministries, and six statutory bodies and private organisations. There are 222 professionals employed in

agricultural research. Total budgetary resources committed in 1983-1984 from national government and private sources amounted to US\$ 25.5 million and an additional US\$ 8.3 million from donors. Some of these organisations are reviewed below.

(1) Government agricultural research institutions

(a) The Department of Research and Specialist Services

The Department of Research and Specialist Services (DR&SS) in the Ministry of Agriculture (MOA) conducts crop, livestock and pasture research. It consists of three research divisions which are further subdivided into institutes and sections or units by functional disciplines. Its emphasis has been on applied and problem-oriented research for the commercial farming sectors but, with recent national policy changes, the Department intends to shift its focus to small farmer needs in the communal areas. The DR&SS's research programmes for 1984 emphasise food crops, such as maize, sorghum/millet, pulses, wheat, vegetables, fruit, cassava and rice, and commercial crops, such as cotton, coffee and livestock. Its multidisciplinary programmes focus on irrigation and farm storage research.

The Department has 1,624 staff members, of whom 128 are professional and 167 are technical. This is the largest number of agricultural research staff of any institution in Zimbabwe; a further increase is anticipated with the expansion of the communal area programme. The greatest professional effort is concentrated on beef cattle research, followed by cotton, maize, pulses and pasture management. Six staff members are in training for their doctoral degrees and 13 for the master's degree. The DR&SS has long-term staff development plans including training 40 people to the doctoral level and 85 to the master's. Plans for improving technicians' skills are based on in-service training to be done at local colleges.

The Department conducts its work at 17 substations, institutes and units. Some of these are based in Harare, but the research is done on farms and stations. The subdivisions include the Matopos Research Station located 35 km south of Bulawayo, the Lowveld Research in the southeastern part of the country, the Agronomy Institute, the Dairy Service and the Seed Services with headquarters in Harare. Most of the divisions are equipped with offices, laboratories, and appropriate research equipment; some also have staff houses and vehicles. The DR&SS has no central library at headquarters, but each research station, institute and unit has its own library, with a department-wide total of 16,785 books and 740 periodicals.

The Department's total budget for 1983-1984 was US\$ 9.98 million, of which US\$ 9.48 million was for recurrent expenses and US\$ 498,525 for capital expenses. The government provided over



US\$ 8.5 million for recurrent expenses and donor agencies such as the World Bank, the IDRC and the ODA made small contributions.

(b) The Department of Agricultural Technical and Extension Services

The primary role of the Department of Agricultural, Technical and Extension Services (Agritex) is its function as the extension department of MOA, but some of its branches, such as the Agricultural Engineering Branch and Management Services Branch, also conduct research. The Agricultural Management Services Branch was formed recently to support the DR&SS's extension work in the communal and resettlement areas by doing social, psychological, cultural and economic research. The Management Services Branch is based at Agritex headquarters in Harare.

The Agricultural Engineering Branch has programmes in five major areas: tillage research; renewable energy technology, including wind energy for water pumping, solar energy and biomass fuels; appropriate technology; testing and development; and soil and water engineering. The Branch collaborates extensively with institutions within Zimbabwe (especially the University of Zimbabwe and the DR&SS) and with international research agencies. Research is done at an experimental farm near Harare where the Branch has a laboratory and a workshop. Its holdings consist of three trucks and other equipment and a library containing 1,400 books and 35 periodicals.

(c) The Department of Veterinary Services

The MOA's Department of Veterinary Services has two subdivisions: Field Services and Technical Services. Its Research Branch, based at a central laboratory in Harare, does research on animal health as related to tick-borne diseases and tsetse control. Beef cattle research receives the greatest effort, followed by pig and goat research. The Department has six stations around the country which undertake diagnostic work and disease surveys, and conduct experiments with all types of livestock and research on the economics of tick and tsetse control. The library is located in Harare and has 1,500 books and 95 periodicals.

(d) The Department of National Parks and Wildlife

The Department of National Parks and Wildlife falls under the aegis of the Ministry of Natural Resources and Tourism. Its Branches of Terrestrial Ecology and Fisheries conduct research on ecosystems, organisms and fisheries resources with the objective of enhancing their conservation, development and better management. Programmes include studies of various aspects of inland fisheries development; range management and plant ecology; game ranching as a means of better management of large herbivores; wildlife management and conservation; and a multidisciplinary programme for wildlife management and integrated land use planning in the communal

areas. Inland fisheries development receives the most attention, followed by wildlife management.

The Department's facilities for research include 13 stations around the country and a library in Harare with 1,804 books and 120 periodicals. The staff publishes an annual report, as well as papers on various biological/ecological topics. The recurrent budgets of the Terrestrial Ecology and Fisheries Branches amounted to US\$ 419,707 in 1983-84.

## (2) Statutory bodies

The Tobacco Research Board (TRB) consists of three centres that supplement governmental research. Representatives of the flue-cured tobacco growers, air-cured tobacco growers and tobacco buyers determine the Board's policy. The TRB's research programmes include tobacco agronomy, sucker control, the entomology of the tobacco aphid and the cigarette beetle, communication of research results to growers, nematology, development of disease-resistant varieties and plant pathology. Each of the three research centres has cultivated land and experimental plots. The headquarters at Kutsaga has offices, a lecture theatre, laboratories, specialised equipment and a library with 10,300 books. The TRB produces annual reports and scientific and topical papers. The total budget in 1983-84 was US\$ 577,925.

Agricultural research at the University of Zimbabwe is conducted by the Faculties of Agriculture and Veterinary Sciences. The Faculty of Agriculture consists of the Departments of Land Management, Crop Science and Animal Science. The Department of Land Management is concerned with soil fertility, conservation and land and agricultural policy. Research programmes include farming systems, studies of dryland agriculture, soil classification, smallholder irrigation development and appropriate technology development. Its facilities include a farm, classrooms, teaching laboratories, a livestock laboratory and field equipment. The Department of Crop Science is engaged in research and teaching on issues related to the production, physiology, breeding and diseases of major crops. Research programmes of the Department of Animal Science include the nutrition, productivity and endocrinology of beef cattle, dairy cattle nutrition and cattle diseases. The three Departments use the University's library; the Faculty of Agriculture as a whole produces an annual report and working papers.

The Faculty of Veterinary Sciences was established in 1982 and is currently focussed on training. Its research programme is being developed.

The Pig Industry Board is concerned with improving pig production through long-term research. Projects include genetic improvement, nutrition, housing, management and reproductive physiology. Its

funding is derived from proceeds from the 129 ha research farm. The Board also has one laboratory, a workshop and a small library.

The Forestry Commission differs from other statutory bodies in that it is not a state monopoly and competes with the private sector through commercial activities carried on at two plantations and a sawmill. It is also engaged in non-commercial activities such as forest conservation, research and afforestation. The Research Division aims to increase production from trees for multiple uses. Its major projects include: species introduction in the semiarid areas; breeding of main commercial tree varieties, such as pine and eucalyptus; wood technology development; and agroforestry. The administrative centre for forestry research in Harare has 25 ha for experimental plots and seed multiplication. Its facilities also include greenhouses, laboratories, cold rooms, workshops and a library with 1,000 books. The total budget for 1983-84 was US\$ 546,411.

### (3) Private research institutions

The Rattray Arnold Research Station was established by the Zimbabwe Seed Maize Association. Its objectives are to supplement government research by testing seed varieties of all major food crops and to enable the Seed Cooperative to carry out plant breeding programmes. The major effort is in maize research. The station's facilities include a maize work room, a cold room for seed storage, a 330 ha farm, training facilities for day-long courses on the use of improved crop varieties, and a library with 100 books. The budget for 1983-84 was US\$ 247,072.

The Zimbabwe Sugar Association is financed by the sugar industry to study problems associated with irrigated sugarcane production. Projects include testing of a comprehensive range of sugarcane varieties introduced from other countries, conduct of a variety breeding programme, fertiliser and cane physiology studies, and cane disease studies. Its facilities include an experimental farm, two laboratories and a library with 300 books. The budget in 1983-84 was US\$ 485,385.

### (4) Summary of research efforts

In general, tobacco research receives the greatest attention, followed by beef cattle, sugarcane, irrigation and cotton. Projects of importance to the communal areas such as poultry, goat and pasture management, sorghum and millet, and farm power receive less effort. The demand for technically skilled professionals far exceeds the supply; this is the main reason for staff shortages at the professional and technical levels. However, most government agencies have plans to increase professional staff availability by providing training to the masters and doctoral levels. Staff dissatisfaction with regard to salaries and conditions of service are factors that also need to be addressed.

## b. Training

As with research, agricultural training in Zimbabwe is carried out by different types of institutions and in both formal and informal structures. Formal training results in granting of degrees, diplomas and certificates; nonformal training may take the form of in-service training for staff and farmers.

The Branch of Agricultural Education (BAE) of the MOA has two diploma-level colleges and four certificate-level institutes and offers diplomas and certificates in agriculture. It trains students in the theory and practice of crop and animal husbandry, farm management and agricultural engineering. Since Independence, the BAE has shifted its focus to certificate-level training in small-scale agricultural production. Entry requirements for the certificate programme are two years of secondary education. The government provides 90 percent of the funds for student training, which amounts to US\$ 3,780 per annum for the certificate level. The BAE organises a variety of short- and long-term training courses for the staff of various agricultural and educational institutions. Its facilities and equipment are adequate and it has over 6,000 ha of land for student practical training. The BAE's capital expenditure in 1983-84 was US\$ 6.47 million.

The Natural Resources College offers a two-year diploma in wildlife and protected area management. It has a capacity for 35 students; in 1983 it produced its first 18 graduates who found employment with the Department of National Parks and Wildlife, the agency which administers the College. Practical training is emphasised, and students are fully supported by the government. The College also offers short courses on conservation and wildlife ecology for the community. There are only two professionals on the staff. The College has 12,900 ha of land which are maintained as a wildlife sanctuary. The budget for 1983-84 was US\$ 81,270.

Among the training institutions are the University of Zimbabwe's Faculties of Agriculture and Veterinary Sciences and the Zimbabwe College of Forestry. The Faculty of Agriculture provides undergraduate and graduate-level training ( BSc, MSc and PhD) through the Departments of Animal Science, Crop Science and Land Management. In 1984, 214 students were enrolled. About 50 percent of the enrolled students graduate. All of the undergraduate and 70 percent of the postgraduate students are sponsored by the government. Most of the lecturers are nationals; some of the teaching staff are currently in training for doctoral and master's degrees as part of a long-term training plan. Student practicals are conducted at the University of Zimbabwe farm. USAID has given the Faculty of Agriculture US\$ 10 million for expansion over a five-year period. The Faculty's total budget for 1983-84 was US\$ 5.81 million.

The Faculty of Veterinary Sciences was recently established and has not yet produced any graduates. It fills a great need in Southern Africa because there is no other such institution in the region except in the Republic of South Africa. There were 23 students enrolled in 1984. Seventy percent of the students are sponsored by the government. Four of nine of the teaching staff are nationals; the rest are expatriates. The building programme scheduled for completion in 1985 will result in 63 offices, four conference rooms, four lecture rooms, six teaching laboratories, a workshop and a hospital.

The Zimbabwe College of Forestry offers a one-year certificate and a two-year diploma in forestry. Student enrollment is low; altogether, 15 diplomates and 115 certificate-holders have been produced since 1980, all of them being employed by the Forestry Commission as Forest Rangers or Officers. No nationals are currently employed as lecturers, although five nationals are employed in a technical capacity. The College has three classrooms, audio-visual teaching equipment and a library with 600 books. The budget for 1983-84 was US\$ 1.05 million.

The Tobacco Training Institute is a private training institution offering a one-year diploma in tobacco culture and short courses to farmers.

Government nonformal training institutes include the Veterinary Training Institute which trains veterinary extension agents for work in the communal areas through nine months of in-service training. The Agritex Training Branch also provides in-service training for field and extension workers and for farmers, 40,000 of whom have been trained under this scheme. An Agricultural Engineering Training Centre is being built to train extension workers in the use of farm machinery. As a part of the government's overall strategy to combine practical and academic training, schools and colleges are being encouraged to develop integrated programmes; some special schools are being built under a scheme known as the Zimbabwe Foundation for Education with Production. The Ministry of Youth, Sport and Culture has 14 training centres aimed at developing a cadre of youth trained to work on cooperative farms.

The Pig Industry Board and the Agricultural Rural Development Authority are examples of parastatals involved in nonformal training for their staff and for farmers. Private organisations involved in nonformal training include the Cotton Training Centre, which trains and gives advisory services to cotton producers through short courses of varying lengths on subjects such as production, pest management and cotton picking. Silveira House is a religious organisation that also provides informal training to communal area farmers. In 1983, 524 farmers were trained at Silveira House.

In general, there is a serious shortage of professionals to provide training in specialised disciplines, but there are plans to train a large number of people to the master's level.

c. Extension

Four government institutions and six parastatal and private organisations are engaged in extension. Agritex, in the Ministry of Agriculture, is the largest extension organisation in Zimbabwe. Its Field Division operates through extension officers, subject matter specialists and teams of fieldworkers at the provincial and regional levels. The focus is to expand extension services to communal area farmers; however, the ratio of one extension worker to 800 farmers is not conducive to this. Agritex's programmes are crop and animal production, land use planning, conservation and irrigation. Improved maize production receives the greatest attention, followed by cotton, farming systems, land and water conservation, and beef cattle production. The budget for 1983-84 was US\$ 19.67 million, of which US\$ 16.6 million was for recurrent costs and US\$ 3.07 million for capital expenditures.

The Department of Veterinary Services' Field Branch is focussed on its primary functions of animal disease prevention and increased livestock production. Its extension programmes include dipping, vaccinations, livestock post mortems, tsetse eradication and meat inspection. At present, there are not enough veterinarians in Zimbabwe but some are in training. The Department's 1984 budget was US\$ 15.12 million; the specific allocation for the Field Branch was not available.

The Training Branch of the Department of National Parks and Wildlife regularly does extension work, but all officers of the Department are expected to participate in promoting public awareness of the country's natural resources and wildlife. The major extension programmes are in wildlife management, conservation range management and fisheries. The total budget for extension in 1984 was US\$ 60,258. The Department of Natural Resources does extension work in land conservation. Its land inspectors educate farmers and have the power to prosecute those who do not cooperate in proper conservation measures.

The Tobacco Research Board, the Forestry Commission and the Pig Industry Board are parastatals. Although the Tobacco Research Board has no formal extension service, it is often the sole source of information on tobacco cultivation for small-scale farmers. The other two provide advisory services to farmers as well.

Private institutions engaged in extension include the Zimbabwe Sugar Association. Workers make regular visits to growers and circulate reports and bulletins on new developments in improved sugar production. In addition, a number of agro-chemical and fertiliser companies provide technical advice to commercial farmers as a way of promoting their products.

Nongovernmental organisations such as the Lutheran World Federation provide extension services in the resettlement areas. Silveira House runs joint training and extension programmes in improved production of maize, sorghum, millet, vegetables, groundnuts and cotton.

The three main agricultural extension institutions of Zimbabwe (Agritex, Department of Veterinary Services and the Department of National Parks and Wildlife Management) employ 371 professionals of a total staff of 4,101.

There are fewer vacancies in the extension institutions than in the research and training institutions but, as in the latter two, the largest number of vacancies in extension are in the professional and technical categories. At present, 33 staff members are in diploma training; three are in training for bachelor's degrees and one for the master's degree.

### 3. Constraints to agricultural production and production potential

#### a. Food crops

Crop yields vary greatly between the commercial and communal areas, being much lower and more variable in the latter. This is due to differences in agro-ecological location, level of mechanisation and management systems. The focus of this section is on the constraints to production in the communal areas as reflected in the results of the ARRA survey.

Rainfall distribution and soil degradation are the most serious physical constraints to increased productivity in all crops. These are particularly significant factors because small-scale farming is primarily done in areas of marginal rainfall and on degraded soils often classified as being unsuitable for production.

Among the biological constraints, weeding is a serious constraint and one which is difficult to overcome, because it is a labour-intensive task and there is often a labour shortage at critical times. Insects and other pests constitute a constraint and, for communal area farmers, their control is difficult; chemical pesticides are unaffordable for smallholders and there are no effective substitutes. The crop varieties used are low-yielding, particularly of sorghum and millet, and the maize varieties are unsuitable for short rainfall periods that occur in the communal areas. Shortage of draught animals and their weak physical condition are also critical factors that cause delays in planting and necessitate the use of lower-yielding varieties of crops.

The economic constraints to increased production include low prices, an ineffective marketing structure in the communal areas, and lack of credit facilities. Population pressure in the communal areas

has caused land to be subdivided into holdings of uneconomic size in regions that require extensive rather than intensive cultivation. A lack of education affects farmers' ability to use new technologies and services; the situation is worsened by land mismanagement and, hence, soil degradation. Human labour is used intensively within the five months of the rainy season. This is another constraining factor, because the shortages which arise delay farming operations and adversely affect productivity.

Among the institutional constraints are a research focus more appropriate for the commercial rather than the communal sector and the lack of training for all types of agricultural workers and farmers. Extension services to communal areas are inadequate in quality and focus, and the ratio of extension agents to farmers is unfavourable. As the result of a lack of coordination and planning, there is some duplication of efforts among institutions engaged in rural development, and confusion on the allocation of responsibilities between particular programmes and projects.

#### b. Livestock and livestock products

A major physical constraint to cattle production is poor annual rainfall. The lack of forage is a constraint to livestock production, but not for poultry; the lack of water supply also is a problem, especially in cattle production. Lack of disease control methods and insects and other pests further limit productivity. The economic constraints in the livestock sector include a lack of effective demand in local markets and the lack of infrastructure for long-distance marketing. Overstocking is also a problem.

#### 4. Staff assessment of institutions

At governmental institutions, low salaries and inadequate benefits were regarded as serious constraints to the recruitment and retention of professional and technical staff, particularly because there are more attractive salaries in the public sector. Lack of uniform promotion structures was an additional cause for dissatisfaction. Retirement benefits were considered unsatisfactory, as were the lack of medical benefits for the junior staff.

Among the physical constraints considered to be hampering work at the agricultural institutions were lack of transport, insufficient or poorly maintained or damaged equipment, and inadequate office and laboratory facilities. Recurrent budgets were reported to be inadequate especially in light of the Antended work expansion in the communal areas. Foreign exchange difficulties compounded problems such as vehicle and equipment purchase and repair.

Recurrent expenses were not generally viewed as a problem at private and parastatal institutions; their facilities and equipment are adequate and of high quality except to the extent that they are affected by foreign exchange problems.



## 5. Conclusions and recommendations

### a. Agricultural institutions

Because successful implementation of development programmes requires so many different agencies, good coordination at the national, provincial, district, and local levels is vital to identify, plan and implement strategies, to monitor and evaluate activities, and to oversee the pace and direction of development. For this purpose, a planning and coordination body is required at the national level which would oversee all rural development programmes of the various agencies.

The planned shift in the national development policy emphasis from commercial to communal area farming has resulted in policy adjustments at the institutional level. However, research activities still benefit the commercial sector and projects designed for the communal areas still need to be expanded further. There thus is a need to reorient research, training and extension work towards the communal areas and to train farmers in these and the resettlement areas.

Flexibility in the administration of the recurrent budget is required to facilitate solutions of ad hoc problems which are often encountered in communal areas. Recurrent budgets should be increased and appropriately adjusted to allow for the proposed expansion of programmes in the communal areas. It is necessary to seek short-term solutions to foreign exchange difficulties until the economic climate improves.

Institutional planning is required to ensure adequate transportation and staff subsistence allowances, both of which are vital for extension work. It is important to develop better communication between researchers and extension workers and between all staff and the farmers. There is also a need to coordinate programmes between the research and extension units so that they can be mutually supportive. Field extension workers require multidisciplinary, in-service training in technical, socioeconomic and communication skills, in order to be more effective.

The important role of women in agriculture must be acknowledged and they must be provided with the appropriate skills, training and facilities to enable them to achieve maximum productivity.

### b. Agricultural productivity

Soil reclamation and water conservation are two vital issues that deserve special attention from the appropriate agencies and require solutions that are acceptable to small farmers. In order to deal effectively with weed and pest control problems, it is necessary to expand and decentralise extension services so that they are more effectively rendered to the communal areas.

Removal of the constraints created by labour shortages will require development of appropriate technologies to expedite activities and reduce

the need for human labour. An alternative to draught animal power should be sought as well.

Solutions are needed for the economic constraints which will ensure that commodity prices are linked to the costs of production. Marketing infrastructural problems also require solution. The government is taking steps to alleviate the land shortage problem. It is also necessary to reorganise settlements to facilitate crop and livestock improvement programmes. For example, communal grazing must be replaced with fenced pastures to permit improvement in livestock grazing.

ANNEX 1

Description and Characteristics of the SADC Region

## ANNEX I

### Description and Characteristics of the SADCC Region

The nine countries of the Southern African Development Coordination Conference (SADCC) agreed at Lusaka in April 1980 to work together to promote the economic and political development of the region, and to reduce their economic dependence on the Republic of South Africa. The organisation of SADCC has its roots in the efforts of Angola, Botswana, Mozambique, Tanzania, and Zambia in the 1970s to promote the independence of Zimbabwe and Namibia. They were joined by Lesotho, Malawi, Swaziland and, after its independence, Zimbabwe. The majority-ruled countries formalised their intent to cooperate regionally for self-reliant development in the Lusaka Declaration.

SADCC operates through summit meetings of the heads of state, meetings of the Council of Ministers comprised of the the Ministries of Economic Planning and Development and Ministries responsible for each country's sector, an executive secretariat established in Gabarone, and through technical committees whose work is coordinated by different member states as follows:

Angola:	Energy;
Botswana:	Agricultural research and animal disease control;
Lesotho:	Soil conservation and land utilisation;
Malawi:	Fisheries, wildlife and forestry;
Mozambique:	Transportation and communications;
Swaziland:	Manpower development and training;
Tanzania:	Industrial development;
Zambia:	Mining; and
Zimbabwe:	Food security.

The sections that follow provide a brief description of this region, including physical characteristics (geography, climate and rainfall), population and socioeconomic data, and information about agricultural production.

#### A. Physical Characteristics

The countries form a contiguous area south of the Equator, spanning the continent from the Atlantic to the Indian Ocean. To the north lie Zaire, Burundi, Rwanda, Uganda and Kenya; to the south is the Republic of South Africa. Namibia is located in the southwest.

## 1. Geography

The SADC countries extend from longitudes 12° to 40° East and from latitudes 2° to 30° South. Approximately 95 percent of the region is north of the Tropic of Capricorn. The total land area is 4.9 million km<sup>2</sup>.

Six of the countries (Botswana, Lesotho, Malawi, Swaziland, Zambia and Zimbabwe) are landlocked. For these inland states, the vast majority (95 percent) of whose trade is overseas, transportation to the sea for export and import is generally time-consuming, complex and costly. One of SADC's objectives is to promote more intra-regional trade through improved transportation and communications.

Surface water resources are abundant in many of the countries, accounting for nearly 3 percent of the total area. The major lakes include: Lake Victoria, Lake Tanganyika, Lake Rukwa, Lake Bangweulu, Lake Malawi, Lake Chilwa, and Lake Kariba. They are of great importance for hydropower, irrigation, fishing and, to a lesser extent, transportation. The many river systems include the Limpopo, Zambesi, Congo/Zaire, Cuando, Cubango, Shire, Ruvuma, and Luangwa Rivers.

Most of the land lies at elevations of from 600 to 1600 m. Lowlands are restricted mainly to the coastal areas of Angola, Tanzania and Mozambique, and to relatively limited inland areas such as the Lower Shire Valley in Malawi and the Zambesi Valley. Another principal geographic feature is the Kalahari Desert, which covers over half of Botswana.

Agricultural farming and grazing lands are extensive. The FAO estimates that the total arable land consists of about 23 million ha, with a cropping intensity of about 52 percent (the ratio of area harvested annually to total arable area in use). The FAO also projects that this arable area could be expanded by five million ha, and that a 15 percent increase in cropping intensity is also feasible. FAO estimates that there are 195 million ha of permanent pasture land in the region. (See Table 2-3.)

## 2. Climate and rainfall

Although most of the region lies in the tropics, the climate is greatly influenced by altitude and other factors as well. (See Table 2-4.) In the lowland areas along the Indian and Atlantic Oceans in Tanzania, Mozambique and Angola, the weather is hot and humid, following the tropical pattern. This same pattern is also found inland in some low-lying areas.

A considerable portion of the region is arid, with rainfall under 600 mm (the Kalahari Desert zone), or semiarid. Estimates of the extent of these areas vary. The FAO has estimated that one-third of the region is subject to low rainfall, seriously limiting agricultural production. In addition, roughly another fifth of the region lies in the 600 to 800 mm rainfall, or semiarid, zone.

Throughout most of the region, the hot, rainy season extends from October or November to March or April. The cooler, dry season is prevalent from May to September or October. In some highland areas rainfall may occur during most months of the year. The pattern of rainfall is shown in Figure 3. As demonstrated by the severe droughts of the past four years, variability of rainfall between and within seasons is more critical than the average total amount of rainfall. In many areas of lower rainfall, dry spells lasting several weeks are common, even in years of plentiful rainfall. These dry periods may be localised or more widespread in drought years. In some areas such as Lesotho and Swaziland, the monsoon rains may come in violent storms causing substantial erosion due to run-off and flooding.

With the exception of the hot and humid lowlands and some very high areas, temperatures are comfortable. It is estimated that more than 90 percent of the region has no temperature limitations for crop production. Even the humid lowlands and the high elevations are suitable for production of certain agricultural crops.

## B. Population

The region's total population increased from 42.5 million persons in 1968, to 55.3 million in 1979, to 67 million persons in 1984. It is growing at annual rates ranging from 2.1 to 3.4 percent. The region is expected to experience continued high growth, to reach a total population of 108 million by the year 2000. (See Table 2-5.) The rapid increase in population has far-reaching consequences for the economies of the SADCC nations with respect to meeting food requirements, providing health, education and other public services for a growing population, overcoming widespread poverty, and meeting the challenge of employment generation.

Just over 70 percent of the region's population in 1980 lived in rural areas and depended on agriculture. (See Table 2-6.) However, the current rapid urbanisation is as significant as the overall growth in population. The urban population is growing more rapidly than total population in most countries, averaging from 6 to 8 percent per year. There is little likelihood that these rates will decline. The region's urban population may be estimated to grow from 16.6 million persons in 1980 to 53.2 million by the year 2000, based on an expected annual increase of 6 percent. Thus the rural population is likely to decline from about 71 percent of the population in 1980 to about 50 percent in the year 2000, while the urban population will increase from about 29 to 50 percent.

Corresponding societal transformations taking place include changes in living patterns and employment. The tripling of the urban population in this relatively brief period has many implications for policy-makers, including:

- o Increased public services which will be required for the growing urban population, with the possibility of providing such services at lower per capita costs;
- o Increased demand for cereals, other foods, and consumer products, most of which are currently being imported. This demand could be met by increased production which could also provide employment; and
- o Possible slowing of growth rates, based on the fact that urban dwellers throughout the world tend to have smaller families than do rural populations.

### C. Economic Overview

The nations and people of the region are poor. Average per capita income for the region does not exceed \$600, and income disparities within countries are high. The majority of people live on very small holdings, using traditional methods of production in a mainly subsistence economy with only limited production for market. Over two-thirds of the population are dependent on agriculture and receive about one-third of the income. Three of the nations (Malawi, Tanzania and Mozambique) are ranked by the United Nations among the thirty-five poorest and least developed countries in the world. Five are characterised by the World Bank as middle-income, oil-importing, developing countries (Botswana, Lesotho, Swaziland, Zambia, and Zimbabwe), one as a middle-income, oil-exporting country (Angola). Basic socioeconomic indicators are shown in Table 2-7.

The region is highly dependent on exports of primary products, agricultural goods and minerals, to finance imports of capital, manufactured and other consumer goods. Prices of primary products fluctuate much more widely on world markets than do those of manufactured and processed goods. In times of world economic recession, the incomes received by SADCC countries for their exports tend to decline more than the volume of exports, while the prices of imports increase. The large increase in the volume of cereal imports in recent years has aggravated the balance of payments situation.

The principal export commodities for each country are as follows:

Angola:	Oil, coffee, diamonds, iron ore, fishmeal, cotton, sisal;
Botswana:	Diamonds, meat and meat products, hides and skins, copper, nickel;
Lesotho:	Mohair wool, cattle products, diamonds, peas, beans;
Malawi:	Tobacco, sugar, tea, groundnuts, cotton, maize;
Mozambique:	Cashew nuts, shrimp, cotton, sugar, tea;
Swaziland:	Sugar, fertiliser, wood and wood products, asbestos, meat, citrus, canned fruit;
Tanzania:	Cotton, sisal, coffee, cloves (Zanzibar), tobacco, animal products, cashew nuts, diamonds;
Zambia:	Copper, cotton, zinc, lead, cobalt, gold, silver, tobacco and forestry products; and
Zimbabwe:	Tobacco, maize, chromite, ferrochrome, nickel, asbestos, copper, pig iron, livestock products, tobacco, cotton.

The dominant economic position of the Republic of South Africa (RSA) is of considerable importance in Southern Africa. The transportation and communication network of the RSA exercises great influence on commerce throughout Southern Africa. Neighboring states to the RSA (Lesotho, Botswana, Zimbabwe, Mozambique) import approximately three-fourths of their machinery, equipment, chemical, plastics and rubber products, and transportation machinery through the RSA. In addition, several hundred thousand workers from the SADCC countries (principally Lesotho, Swaziland and Botswana) work in the RSA, mainly in the mines. Their remittances are an important factor in the balance of payments situation and in the total GDP of these countries.

Despite the many constraints to development, the countries have made substantial progress in the past 20 years. Furthermore, a substantial resource base exists for further development in agriculture, industry and manufacturing, and in other sectors of their economies. The development effort will require the continued assistance of the international community. It will also require the right mix of public policies, private and public investment, national programmes and regional cooperation. The gradual increase of economic exchange among the nations of the region can only spur its growth and alleviate the current difficulties in trading and development.



#### D. Agriculture and Food Production

Agricultural production has not kept pace with the region's rapid population growth. The recent World Bank report, Toward Sustained Development in Sub-Saharan Africa, noted that in the period from 1970 to 1982, only Malawi and Swaziland registered an increase in per capita agricultural production. Indices based on FAO production data show that for the region as a whole, per capita agricultural output in 1980-1982 was 17 percent below that of the 1974-1976 period. (See Table 2-8.) Considering the drought and poor harvests which have affected the whole region in 1983 and 1984, excepting Malawi, it appears that the region's overall production over the past ten years has registered a per capita decline on the order of 20 to 25 percent.

As a result, food imports, including food aid, have increased dramatically. In 1984, the provisional estimate for cereal import requirements in the region is 2.4 million MT. (See Table 2-2). By contrast, cereal imports into the region averaged under one-half million MT annually from 1966 to 1976 and about 1.1 million MT annually from 1977 to 1980. In its study entitled SADCC-Agriculture Towards 2000, the FAO calculated that if present trends continue, annual cereal import requirements for the region by the end of the century will increase to over 7 million MT.

The problem of food supply is compounded by the fact that nutritional levels in the region do not meet minimum requirements for the health of the population. Table 2-9 shows that from 1978 to 1980, the average caloric intake in all the countries, with the exception of Lesotho and Swaziland, was well below the minimum requirements of about 2400 calories per person per day. Although these data are not precise measures of food consumption, they point to deficiencies in most of the countries on the order of 15 to 20 percent. Deficiencies of this order strongly suggest that the consumption levels of large segments of the population are even lower than this average.

The challenge for the SADCC region is to establish the policies, support services, incentives, marketing and distribution mechanisms, and intra-regional trade to reestablish its food self-sufficiency and meet the needs of its people.

ANNEX 2

Statistical Data on the SADCC Countries

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-1: Cereal Production in SADCC Countries<sup>a</sup>

<u>Year</u>	<u>Total Population</u> (000)	<u>Total Production</u> (000 MT)	<u>Per Capita Production</u> (kg)
1966	40,393	6,399	158
1967	41,361	6,885	166
1968	42,478	5,825	137
1969	43,652	6,747	155
1970	44,860	5,780	129
1971	46,158	7,535	163
1972	47,538	8,358	176
1973	48,981	6,732	137
1974	50,348	7,942	158
1975	51,475	7,279	141
1976	52,857	7,378	140
1977	54,809	7,578	140
1978	56,208	7,639	139
1979	57,910	6,577	114
1980	59,865	7,091	118
1981	61,784	9,288 <sup>b</sup>	150 <sup>b</sup>
1982	63,703	8,074	127
1983 <sup>c</sup>	65,602	6,635	101
1984 <sup>d</sup>	67,954	6,991	103

<sup>a</sup>Cereal production is composed primarily of maize, sorghum, and millet, with some wheat and rice.

<sup>b</sup>Figures are high due to large maize production increases in Tanzania and Zimbabwe.

<sup>c</sup>Estimates

<sup>d</sup>Projections

Sources: USDA Economic Research Service, International Agricultural Division, Data Base for Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe, 1984; USDA, World Food Aid Needs and Availabilities (Washington, D.C., U.S. Government Printing Office, 1984).

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Table 2-2: Cereal Imports in SADCC Countries<sup>a</sup>

<u>Year</u>	<u>Total Population</u> (thousands)	<u>Total Imports<sup>b</sup></u> (1000 MT)	<u>Per Capita Imports</u> (kg)
1966	40,393	375	9
1967	41,361	271	7
1968	42,478	376	9
1969	43,652	384	9
1970	44,860	561	13
1971	46,158	684	15
1972	47,538	537	11
1973	48,981	419	9
1974	50,348	601	12
1975	51,475	610	12
1976	52,857	512	10
1977	54,609	931	17
1978	56,208	795	14
1979	57,910	1,263	22
1980	59,865	1,976	33
1981	61,784	1,682	27
1982	63,703	1,455	23
1983 <sup>c</sup>	65,602	1,935	29
1984 <sup>d</sup>	67,954	2,413	36

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<sup>a</sup>Imports include wheat, maize, sorghum, rice and millet.

<sup>b</sup>Based on market years; e.g., 1966 figure is based on the 1966/1967 market year.

<sup>c</sup>Estimates

<sup>d</sup>Projections

Source: USDA Economic Research Service, International Agricultural Division, Data Base for Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe, 1984.

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Table 2-4: Overview of Ecological Characteristics of SADCC Countries

<u>Country</u>	<u>Geography</u>	<u>Climate</u>	<u>Rainfall</u>	<u>Agro-Ecological Zones</u>
<u>Angola</u>	<p>Angola is bounded by the Atlantic on the west, Namibia on the south, Zambia and Zaire on the east and northeast. It is a land of many rivers flowing in all directions from the watershed on the great central plateau. Some flow into the Atlantic providing water for industry and irrigation on the coastal plain. The Quanza River in central Angola, navigable 225 kms upstream, is a major source of hydropower and irrigation. The Cunene River, forming 322 kms of the border with Namibia, also is a source of irrigation. About two-thirds of the country is a plateau with altitudes of 1,050-1,300. The lower Guinea Mountain Range separates the coastal plains from the interior basin plateau. The Namib Desert occupies the coastal plain in the south. The Kalahari Desert occupies the southeast.</p>	<p>Angola's climate ranges from tropical rain forest in the north to arid desert in the south. Temperatures range from a maximum of over 38° C in the northern interior to below freezing at higher elevations in the south; on the interior plateau, mean daily temperatures vary from 30° C in December-February to 10° C in June-August. On the coast mean annual temperatures range from 16° C in the south to 23° C in the north. The daily range and monthly variances do not exceed 6° C.</p>	<p>The rainy season, longer in the north, shorter in the south, runs from about November-April. The May-October dry season is virtually without rain. Rainfall varies considerably from year to year. It often comes in heavy thunderstorms. The rainfall varies from 1300-1600 mm in northeast Angola to about 600 mm along most of the southern border, to under 200 mm on the southern coast.</p>	<p><u>Coastal zone:</u> Varies in width up to 300 km. Cultivation restricted by aridity and erratic rainfall but irrigation potential exists.</p> <p><u>Southern zone:</u> Semiarid to arid belt about 300 km wide, with an elevation of 1000-1200 m. Irrigation possible from the Cunene, Cubango and Cunando Rivers.</p> <p><u>Eastern zone:</u> Elevations of 600-1200 m and rainfall of 1000-1400 mm. Low population density.</p> <p><u>Northern zone:</u> Mountainous with numerous plateaus at 900-1300m. Rainfall up to 1500mm over an 8 months period. Intensive cultivation of coffee.</p> <p><u>Central zone:</u> Highland area with temperate climate and average rainfall of 1000-1400 mm and irrigation potential. Densely populated. Excellent agricultural potential.</p>
<u>Botswana</u>	<p>Landlocked. Botswana is bound 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. The country is a large plateau, relatively flat with a mean altitude of close to 1000 meters. The Kalahari Desert in the south and west covers 60 to 70 percent of the land area. A major feature is the Okavango Delta in the northwest. Apart from the delta and the associated Makarikari Marshes in the northeast, surface water is rare. As a result, ground water systems play a critical role in meeting water needs. However, the Limpopo River forms the southeast border with South Africa.</p>	<p>Botswana's climate is arid and semiarid. Winters are cold and dry. Even during the summer rainy season (November to March), country-wide and local dry spells often occur. Summer temperatures average 23 to 28° C; winter temperatures average between 15-20° C, falling sharply at night. No part of the country is entirely free from frost, although it is rare in the Northeast.</p>	<p>Average rainfall ranges from less than 250 mm in the southeast to more than 600 mm in the northeast. Seasonal variability is as much as 80 percent in the southeast, but under 25 percent in the northeast. Rainfall distribution varies greatly both between and within areas and seasons.</p>	<p><u>Eastern belt:</u> Semiarid area along eastern border, most favourable for agriculture and most populated. averages 400-600 mm of rainfall each year.</p> <p><u>Okavango Delta:</u> More abundant, though seasonal, moisture and some surface water. Troubled by trypanosomiasis and provides natural habitats for tsetse-resistant wildlife.</p> <p><u>Kalahari (Kgalagadi) Desert:</u> Covers about two-thirds of country. Has sandy soils, not generally arable or suitable for grazing, except for isolated pockets of productive rangeland.</p>

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Table 2-4: Overview of Ecological Characteristics of SADCC Countries (cont.)

<u>Country</u>	<u>Geography</u>	<u>Climate</u>	<u>Rainfall</u>	<u>Agro-Ecological Zones</u>
<u>Lesotho</u>	Landlocked, Lesotho is located in the east-central part of the Republic of South Africa. A mountainous country, it is the only nation in the world whose entire area lies 1000 meters or more above sea level. The land rises from about 1500 m in the west to about 3000 m in the Drakensberg Mountain Range which forms the eastern border with South Africa's Natal Province. The mountains of Lesotho form a major watershed and include the Orange River flowing westward into South Africa's Orange Free State, and the Tugela River flowing eastward into Natal. The Calderon River forms the north-western boundary.	Lesotho is warm in the summer (October-April) and cold in the winter (May-September). In the lowlands temperature ranges from 32° C in the summer to -6° C in the winter. In the highlands, temperatures sometimes drop to below -18° C. Snow falls in the winter, at higher elevations.	The climate is semiarid. Rainfall usually occurs in heavy thunder storms of high intensity. Heavy hail storms are also common. The rainy season begins in October and extends into April.	<p><u>Lowlands:</u> Including Orange River Valley. Contains 25 percent of Lesotho's area and most of the arable land. Elevation of 1500-1850 m in the west.</p> <p><u>Foothills zone:</u> Elevation of 1850-2100 m. Cool climate suitable for crop production, livestock farming and dairying.</p> <p><u>Mountain zone:</u> Comprised of two sub-zones which contain about two-thirds of Lesotho's land area. Upper zone, above 2550 m severe erosion problems on steep slopes suitable only for small stock grazing. Lower zone ranges between 2100 and 2550 m, and is suitable for a variety of temperate climate crops as well as grazing.</p>
<u>Malawi</u>	Landlocked. Malawi follows Lake Malawi from north to south and continues south in the Shire River Valley. Although Lake Malawi lies in the in the great rift depression, 75 percent of Malawi is on an elevated plateau averaging 800-1600 meters in altitude. Tanzania lies to the north and east, Mozambique to the south and east, Zambia on the west. Nearly 20 percent of the country's area is taken up by the lake.	The climate is tropical on the shores of the lake and in the Shire Valley. It ranges from semiarid to subtropical in the central plateau. The rainy season starts in November and lasts until April. The dry season runs from May to October. In the highlands, rainfall ranges up to 1600 mm and may fall almost throughout the year.	Rainfall averages under 750 mm along the Lake and in the Shire Valley. It averages considerably more in the central plateau and highlands areas.	<p><u>Lower Shire Valley:</u> Averages under 250 m in elevation. Semiarid with average rainfall under 750 mm.</p> <p><u>Upper Shire Valley and Lake Littoral:</u> Altitude ranges from 300-600 m. Semiarid, with average rainfall under 750 mm.</p> <p><u>Medium Plateau:</u> Altitude ranges from 800-1600 m. Covers up three-quarters of the country, occupying the central and northern part of Malawi.</p> <p><u>The Highlands:</u> Elevations exceed 1800 m, constituting 8 percent of the country's area. Generally high rainfall.</p>

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Table 2-4: Overview of Ecological Characteristics of SADOC Countries (cont.)

<u>Country</u>	<u>Geography</u>	<u>Climate</u>	<u>Rainfall</u>	<u>Agro-ecological Zones</u>
<u>Mozambique</u>	<p>In southeast Africa, on the Indian Ocean, Mozambique shares its northern border with Tanzania, its northwestern border with Zambia and Malawi, and its western border with Zimbabwe, and southwestern border with Swaziland, South Africa and Swaziland.</p> <p>The country is divided by the Zambezi River bridged by the Cabora Bassor Dam. Numerous other rivers flow through Mozambique into the Indian Ocean. The terrain varies from lowlands to high plateau.</p>	<p>The climate varies from tropical to subtropical everywhere except in the high mountains and plateaus. The rainy season runs from November to April when warmer temperatures prevail.</p>	<p>Rainfall is irregular. The south central and western areas are semiarid. Tete Province has been particularly affected by the recent drought.</p>	<p><u>Lowlands:</u> Consist of the coastal areas, up to 180 m in elevation. Comprise over 40 percent of the country.</p> <p><u>Central plateau:</u> Ranges from 180 to 540 m and covers about 20 percent of the land area.</p> <p><u>High plateau:</u> Ranges from 540 to 900 m and covers 25 percent of the country.</p> <p><u>Mountains:</u> Located along the western frontier with Zimbabwe.</p>
<u>Swaziland</u>	<p>Landlocked. Southeastern Africa. Second smallest country in Africa. Surrounded by South Africa with the exception of a narrow border on the east with Mozambique. Four rivers traverse the country en route to the Indian Ocean.</p>	<p>The climate varies from near temperate to subtropical and semiarid. The mountainous highveld in the west has a humid, near temperate climate. The middleveld and Lubombo plateau in the central and extreme east are subtropical and drier. The lowveld is subtropical and semiarid. Temperatures vary with elevation from an annual mean of 22° C in the lowveld to 16° C in the highveld.</p>	<p><u>Highveld:</u> Ranges between 1,000 and 2,300 mm of rainfall, mostly in summer (October to March); averages 1,270 mm.</p> <p><u>Middleveld:</u> Annual rainfall is between 750 and 1150 mm and averages 940 mm.</p> <p><u>Lowveld:</u> Ranges between 500 and 900 mm per year; averages 660 mm. Highly variable rainfall.</p> <p><u>Lubombo Plateau:</u> Averages 780 mm of rainfall per year.</p>	<p><u>Highveld:</u> A mountainous region in the west which covers 29 percent of Swaziland's area. Very limited agricultural potential due to highly weathered soils and steep slopes.</p> <p><u>Middleveld:</u> Hilly region, with several large valleys, just to the east of the Highveld. Good to fair arable soils. Covers 26 percent of the country's area.</p> <p><u>Lowveld:</u> Gently rolling country. About thirty percent of area has good to fair arable soils but drought hazard is great. Overgrazing is a problem. Some land is irrigated. Covers over one-third (37 percent) of land area.</p> <p><u>Lubombo Plateau:</u> A plateau along eastern frontier with climate similar to the Middleveld. Small areas of deep cultivable soils. Covers 8 percent of Swaziland's area.</p>



Table 2-4: Overview of Ecological Characteristics of SADC Countries (cont.)

<u>Country</u>	<u>Geography</u>	<u>Climate</u>	<u>Rainfall</u>	<u>Agro-Ecological Zones</u>
<u>Tanzania</u>	Tanzania lies on the Indian Ocean with 800 km of coast and excellent ports at Dar es Salaam, Mtwara, and Tanga. About 52,000 sq km of its territory are taken up by Lakes Victoria, Tanganyika, Rukwa and Malawi. Its neighbors are Kenya and Uganda on the north; Rwanda, Burundi and Zaire on the west; Zambia on the southwest; and Mozambique and Malawi on the south and southwest. The islands of Zanzibar, Pemba and Mafia lie a short distance off the coast. Several major rivers flow through the territory (Rufiji, Ruvuma, Rungwa). There are four mountain systems including Mt. Kilimanjaro, and three plateaux (the southeast plateau, the Masai Plateau and the Great Central Plateau. Two rift valley systems, the eastern and the western, cut through the country north and south.	The climate varies from tropical to semiarid to temperate. Temperatures depend more on altitude than latitude. Dar es Salaam and the coastal plains are hot and pleasant. The evenings are mostly cool, especially from May to October. Pemba, Mafia and Zanzibar are tropical and humid, as are the coastal areas.	Southern Tanzania has rainfall from December to March while the northern part of the country continues in the dry period. The main rainy season for the central and northern regions is from March to mid May. From June to September there is little or no rain in the country. October to November may produce erratic rainfall, especially in the north.	<p><u>Coastal plains:</u> Hot, humid areas with over 800 mm of rainfall. In northern part, up to 1500 mm falling in two rainy seasons.</p> <p><u>Central plateau:</u> Hot, arid and semiarid zones, with rainfall ranging between 200 and 750 mm per year.</p> <p><u>Lake regions:</u> Higher elevation areas along the major lakes, receiving 750-1000 mm of well-distributed rainfall annually.</p> <p><u>Highlands:</u> Temperate regions receiving 750-1250 mm of rainfall per year.</p>
<u>Zambia</u>	Landlocked. Central South Africa. Shares borders with eight countries: Zaire and Tanzania on the north; Malawi on the east; Zimbabwe and Botswana on the south; Mozambique on the southeast; Angola and Namibia on the west. The Zambezi River with Lake Kariba forms the southern and southwestern borders with Namibia, Botswana and Zimbabwe. Altitude averages 1000 m reaching 2500 m on the border with Malawi.	Zambia lies in the tropics but because of elevation enjoys a pleasant subtropical climate. Temperatures are moderate, highest in October and lowest in July. There are three main seasons: a rainy warm season (November-March), a dry cool season (April-July) and a dry hot season (August-October).	The rainy season varies from as little as 90 days in the south to up to 190 days in the north. Usually the main rains—derived from oceanic air—occur late in November and continue into March or further north into April. The southern quarter of the country stretching from Angola to Mozambique is semiarid. During the recent drought 1981-84, the rift valley has received only about 400-500 mm of rain, 40% below the long-term average (600-800).	<p><u>Northern High Rainfall Zone:</u> Receives between 1,000 and 1,500 mm of rainfall annually. Highly leach sandy soils of low fertility predominate. Many hours of cloud cover.</p> <p><u>Western Semiarid Plains Zone:</u> Rainfall varies from 600 to 1,000 mm. Large areas covered by infertile Kalahari sands. Wide fluctuations in temperature, with frost in some areas.</p> <p><u>Central Southern, and Eastern Plateau Zone:</u> Rainfall average 800-1,000 mm per year. Has most fertile soils in Zambia and highest population density.</p> <p><u>Luanza Zambezi Rift Valley Zone:</u> Hottest and driest zone, with shallow sandy soils. Of marginal value for agriculture.</p>

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Table 2-4: Overview of Ecological Characteristics of SADCC Countries (cont.)

Country	Geography	Climate	Rainfall	Agro-Ecological Zones
<u>Zimbabwe</u>	<p>Landlocked in South-central Africa, lying between the Zambezi River on the northwest and the Limpopo on the south. Its neighbors are Zambia to the north, Mozambique on the north and east, South Africa and Botswana on the south. Zimbabwe is mostly high plateau country with 75 percent of its territory at elevations ranging from 600 to 1500 meters.</p> <p>A higher plateau, the "highveld" traverses the country from SW TONE at altitudes ranging from 1200 to 1500 m. The Nyanga Mountain range lies on the eastern border.</p>	<p>Although in the tropics, Zimbabwe has agreeable subtropical weather. Temperatures vary with altitude ranging from 3° in the winter (May-August) to a maximum of 27-35° C in the summer (September-March). The south and southwestern quarter of the country is semiarid with annual rainfall averaging well under 600 mm, and only about 300 mm in the Limpopo-Sabi River area.</p>	<p>Rainfall averages 635-670 mm throughout the country, with less in the southern semiarid zone and more in the central plateau. The rainy season extends from October/November into March/ April. The rains last no more than 5 months (150 days). Variability is high both inter-annual and inter-meses.</p>	<p><u>Natural Region I:</u> A specialised and diversified farming region in the east. High rainfall (over 1050 mm per year). Covers about 2 percent of Zimbabwe's land area.</p> <p><u>Natural Region II:</u> Intensive farming (grain/mixed crop and livestock) region in central and northeastern Zimbabwe. Receives 700-1050 mm in a summer season.</p> <p><u>Natural Region III:</u> A semi-intensive farming region with fodder crop and cotton/maize production in central and western portions of country. Receives 500-700 mm of rainfall each year. Covers about 18 percent of land area.</p> <p><u>Natural Region IV:</u> Semi-intensive livestock, and some drought-resistant cash crop production in southwest and northeast. Receives 450-600 mm of rain per year. Covers over third (33 percent) of land area.</p> <p><u>Natural Region V:</u> An extensive cattle raising region in the south and southeast. Rainfall under 500 mm. Covers about one-quarter (26.2 percent) of Zimbabwe land area.</p>

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Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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Table 2-5: Population Projections up to the Year 2000 in the SADCC Countries  
(millions)

<u>Country</u>	<u>1979</u>	<u>1984<sup>a</sup></u>	Percent of		<u>Annual Growth</u> <u>Rate</u> (%)	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
			<u>Total</u>	<u>1984</u>									
Angola	6.9	7.8	11.6		2.5	8.0	8.2	8.4	8.6	8.8	9.0	10.2	11.5
Botswana	0.7	1.0	1.5		3.0	1.0	1.1	1.1	1.1	1.2	1.2	1.4	1.6
Lesotho	1.3	1.5	2.2		2.2	1.5	1.6	1.6	1.6	1.7	1.7	1.9	2.1
Malawi	5.9	6.9	10.3		3.4	7.1	7.4	7.6	7.9	8.1	8.4	9.9	11.7
Mozambique	10.2	13.4	19.9		2.8	13.8	14.2	14.5	15.0	15.4	15.8	18.1	20.8
Swaziland	0.5	0.6	0.9		2.2	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8
Tanzania	17.0	21.1	31.4		3.2	21.8	22.5	23.2	23.9	24.7	25.5	29.9	35.0
Zambia	5.6	6.6	9.8		3.1	6.8	7.0	7.2	7.5	7.7	7.9	9.3	10.8
Zimbabwe	<u>7.2</u>	<u>8.3</u>	<u>12.4</u>		3.3	<u>8.6</u>	<u>8.9</u>	<u>9.1</u>	<u>9.4</u>	<u>9.7</u>	<u>10.1</u>	<u>11.8</u>	<u>13.9</u>
TOTAL	<u>55.3</u>	<u>67.2</u>	<u>100.0</u>			<u>69.2</u>	<u>71.5</u>	<u>73.3</u>	<u>75.7</u>	<u>78.0</u>	<u>80.3</u>	<u>93.3</u>	<u>108.2</u>

<sup>a</sup>Populations for 1985-2000 estimated and calculated on a straight line basis by Devres.

Source: Population Reference Bureau, Inc., World Population Data Sheets (Washington, D.C.: PRB, Inc., 1979 and 1984).

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Table 2-6: Total Population, Agricultural Population and Economically Active Population, 1980

	Population			Economically Active Population		
	<u>Total</u> (millions)	<u>In Agriculture</u> (millions)	<u>Percent of Total</u>	<u>Total</u> (millions)	<u>In Agriculture</u> (millions)	<u>Percent of Total</u>
Angola	7,070	4,066	57.5	1,845	1,077	58.4
Botswana	807	647	80.2	375	362	96.5
Lesotho	1,341	1,123	83.7	703	500	71.1
Malawi	6,167	5,159	83.7	2,744	2,249	82.0
Mozambique	10,473	6,746	64.4	3,952	2,546	64.4
Swaziland	557	464	83.3	254	164	64.6
Tanzania	17,934	14,532	81.0	7,315	5,926	81.0
Zambia	5,766	3,842	66.6	2,092	1,394	66.6
Zimbabwe	<u>7,396</u>	<u>4,338</u>	<u>58.7</u>	<u>2,427</u>	<u>1,424</u>	<u>58.7</u>
TOTAL	<u>57,511</u> =====	<u>40,917</u> =====	<u>71.1</u> =====	<u>21,707</u> =====	<u>15,642</u> =====	<u>72.1</u> =====

Source: FAO, Production Yearbook, Vol. 36 (Rome: Food and Agriculture Organization, 1982).

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Table 2-7: Socioeconomic Indicators of the SADCC Countries

Country	Physical Quality of Life Index (POLI) <sup>a,b</sup>	Population mid-1982 <sup>c</sup> (millions)	Pop. <sup>c</sup> Per km <sup>2</sup>	Birth Rate Per 1,000 <sup>c</sup>	Death Rate Per 1,000 <sup>c</sup>	Life Expectancy at Birth <sup>c</sup> (years)	Infant Mortality Per 1,000 Live Births <sup>c</sup>	Literacy <sup>a,d</sup> (percent)	Per Capita Public Education Expend's 1983 <sup>a</sup> (US\$)	Per Capita (NP 1982 <sup>c</sup> ) (US\$)	Per Capita (NP (Real) Growth Rate 1970-81 <sup>d</sup> ) (percent)
Angola	21	8.0	6.4	49	22	43	165	5	17	79 <sup>f</sup>	-8.4
Botswana	44	0.9	1.5	51 <sup>a</sup>	18 <sup>a</sup>	60	83 <sup>a</sup>	33	58	900	8.5
Lesotho	49	1.4	46.7	42	15	53	94	50	23	510	7.8
Malawi	31	6.5	55.1	56	23	44	137	25	5	210	2.3
Mozambique	38	12.9	16.1	49	16	51	105	28	3	240 <sup>a,e</sup>	-6.2
Swaziland	45	0.7	41.2	48 <sup>a</sup>	19 <sup>a</sup>	54	135 <sup>a</sup>	55	39	940	3.5
Tanzania	58	19.8	21.0	47	15	52	98	74	14	280	1.6
Zambia	46	6.0	8.0	50	16	51	105	44	26	640	-2.6
Zimbabwe	63	7.5	19.2	54	12	56	83	71	22	850	-1.5

<sup>a</sup>Overseas Development Council, U.S. Foreign Policy and the Third World—Agenda 1983 (New York: Praeger Publishers, Inc.), 1983.

<sup>b</sup>Physical Quality of Life Index (POLI) is based on an average of life expectancy at age one, infant mortality, and literacy.

<sup>c</sup>The World Bank, World Development Report 1984 (New York: Oxford University Press), 1984.

<sup>d</sup>Literacy data are the latest estimates available and generally represent the proportion of adult population (15 years of age or older) able to read and write, although no uniform definition of literacy has been used.

<sup>e</sup>Figure is for 1981.

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Table 2-8: Trends in Per Capita Agricultural Production in the SADCC Countries, 1977-81

	<u>Indices of Agricultural Production</u> (1974-76 = 100)		<u>Indices of Population Growth</u> (1975 = 100)	
	<u>1977-79</u> <u>Average</u>	<u>1980-82</u> <u>Average</u>	<u>1978</u>	<u>1981</u>
Angola	83.9	83.1	106.7	120.0
Botswana	89.3	84.5	100.0	112.5
Lesotho	103.7	94.1	108.3	116.7
Malawi	115.9	125.2	109.6	119.2
Mozambique	93.4	95.3	108.5	117.9
Swaziland	107.2	134.7	100.0	120.0
Tanzania	106.3	108.2	109.4	120.8
Zambia	97.4	91.2	108.0	120.0
Zimbabwe	<u>99.6</u>	<u>103.6</u>	<u>107.6</u>	<u>119.7</u>
TOTAL	98.5 <sup>a</sup> =====	98.8 <sup>a</sup> =====	108.3 =====	119.5 =====
Per Capita	90.4 <sup>b</sup>	83.0 <sup>b</sup>		

<sup>a</sup>Averages weighted by arable land, including permanent crops, reported by FAO in 1980.

<sup>b</sup>Per capita average calculated by adjusting the regional average by regional population since 1975.

Sources: FAO, Production Yearbook, Vol. 36 (Rome: Food and Agriculture Organization, 1982);  
USDA, S&V Format 3 Tables, 1984.

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Table 2-9: Trends in Average Calorie Intake, 1966-1980

	<u>1966-68</u>	<u>1969-71</u>	<u>1975-77</u>	<u>1978-80</u>
Angola	1,938	2,038	2,131	2,110
Botswana	1,952	2,009	2,039	2,181
Lesotho	2,079	2,050	2,152	2,442
Malawi	2,097	2,293	2,242	2,219
Mozambique	2,033	2,094	1,954	1,891
Swaziland	2,080	2,206	2,314	2,499
Tanzania	2,066	2,023	2,109	2,028
Zambia	2,119	2,158	2,188	1,992
Zimbabwe	2,120	2,097	2,109	1,911

Source: FAO, Production Yearbook, Vol. 36 (Rome: Food and Agriculture Organization, 1982), Tables 103, 104.

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Table 2-10: Composition of Caloric Consumption by Country, 1978-80

	Calories			Protein (Grams Per Day)
	Total	Vegetable	Animal	
Angola	2,110	1,936	174	41.4
Botswana	2,181	1,786	396	71.5
Lesotho	2,442	2,282	160	72.6
Malawi	2,219	2,126	92	66.8
Mozambique	1,891	1,828	63	33.4
Swaziland	2,499	2,160	339	63.8
Tanzania	2,028	1,825	202	48.1
Zambia	1,992	1,865	127	54.5
Zimbabwe	1,911	1,747	164	51.0

Source: FAO, Production Yearbook, Vol. 36, (Rome: Food and Agriculture Organization, 1982), Tables 103, 104.

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## SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-11: Total Agricultural Research Staff, by Level and by Country, 1984

Staff	Country								Total
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania <sup>d</sup>	Zambia	Zimbabwe	
<u>Administrative</u>									
Positions vacant	2	0	1	11	0	106	0	3	123
Staff in training	0	0	0	0	0	9	0	4	13
Nationals in posts	12	3	14	57	1	837	27	92	1,043
Expatriates	<u>3</u>	<u>0</u>	<u>8</u>	<u>3</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>17</u>
Subtotal, Administrative Staff	<u>15</u>	<u>3</u>	<u>22</u>	<u>60</u>	<u>2</u>	<u>838</u>	<u>28</u>	<u>92</u>	<u>1,060</u>
<u>Professional<sup>b</sup></u>									
Positions vacant	1	0	37	14	1	58	0	31	142
Staff in training	14	12	39	0	0	46	29	32	172
Nationals in posts	17	6	147	15	8	276	112	196	777
Expatriates	<u>29</u>	<u>9</u>	<u>30</u>	<u>68</u>	<u>16</u>	<u>77</u>	<u>100</u>	<u>26</u>	<u>355</u>
Subtotal, Professional Staff	<u>46</u>	<u>15</u>	<u>177</u>	<u>83</u>	<u>24</u>	<u>353</u>	<u>212</u>	<u>222</u>	<u>1,132</u>
<u>Technical<sup>c</sup></u>									
Positions vacant	2	0	38	28	2	52	0	32	154
Staff in training	0	2	8	1	0	68	9	9	97
Nationals in posts	32	28	120	222	34	793	133	234	1,596
Expatriates	<u>0</u>	<u>0</u>	<u>0</u>	<u>10</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>16</u>
Subtotal, Technical Staff	<u>32</u>	<u>28</u>	<u>120</u>	<u>232</u>	<u>34</u>	<u>794</u>	<u>135</u>	<u>237</u>	<u>1,612</u>

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-11: Total Agricultural Research Staff, by Level and by Country, 1984 (cont.)

Staff	Country								Total
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania <sup>d</sup>	Zambia	Zimbabwe	
<u>Support</u>									
Positions vacant	17	0	210	145	0	126	0	206	704
Staff in training	0	0	1	3	0	3	0	4	11
Nationals in posts	58	21	659	583	6	2,003	349	2,462	6,141
Expatriates	4	0	0	7	0	20	0	0	31
Subtotal, Support Staff	<u>62</u>	<u>21</u>	<u>659</u>	<u>590</u>	<u>6</u>	<u>2,023</u>	<u>349</u>	<u>2,462</u>	<u>6,172</u>
TOTAL	<u>155</u>	<u>67</u>	<u>978</u>	<u>965</u>	<u>66</u>	<u>4,008</u>	<u>724</u>	<u>3,013</u>	<u>9,976</u>

<sup>a</sup>In some cases, staff in training also are counted in authorized posts.

<sup>b</sup>Professional = BSc or above.

<sup>c</sup>Technical = diploma, except for Lesotho, Mozambique, Zimbabwe where technical = diploma and certificate. .

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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## SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-12: National Professional Staff Currently Posted in Agricultural Research Institutions, by Field of Study and by Country, 1984<sup>a</sup>

Field of Study	Country								Subtotal	Percent of Total
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania <sup>b</sup>	Zambia	Zimbabwe		
<u>Crop and Soil Science</u>										
BSc	12	2	58	9	5	106	33	45	270	29.7
MSc	7	1	25	1	2	96	26	47	205	22.5
PhD	<u>0</u>	<u>0</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>25</u>	<u>4</u>	<u>19</u>	<u>57</u>	<u>6.3</u>
Subtotal, Crop/Soil Science	<u>19</u>	<u>3</u>	<u>92</u>	<u>10</u>	<u>7</u>	<u>227</u>	<u>63</u>	<u>111</u>	<u>532</u>	<u>58.5</u>
<u>Animal Science and Veterinary</u>										
BSc	3	0	4	4	0	28	5	22	66	7.2
MSc	1	0	1	0	0	18	12	16	48	5.3
PhD	<u>0</u>	<u>0</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>6</u>	<u>12</u>	<u>28</u>	<u>3.1</u>
Subtotal, Animal/Veterinary Science	<u>4</u>	<u>0</u>	<u>13</u>	<u>4</u>	<u>0</u>	<u>48</u>	<u>23</u>	<u>50</u>	<u>142</u>	<u>15.6</u>
<u>Economics and Social Sciences</u>										
BSc	1	3	14	0	0	8	4	7	37	4.1
MSc	3	2	6	0	1	4	3	4	23	2.5
PhD	<u>0</u>	<u>0</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>9</u>	<u>1.0</u>
Subtotal, Economics/Social Sciences	<u>4</u>	<u>5</u>	<u>24</u>	<u>0</u>	<u>1</u>	<u>12</u>	<u>7</u>	<u>16</u>	<u>69</u>	<u>7.6</u>
<u>Agricultural Engineering</u>										
BSc	1	0	1	0	0	3	1	5	11	1.2
MSc	0	0	1	0	1	6	1	4	13	1.5
PhD	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>.2</u>
Subtotal, Agricultural Engineering	<u>1</u>	<u>0</u>	<u>3</u>	<u>0</u>	<u>1</u>	<u>9</u>	<u>2</u>	<u>10</u>	<u>26</u>	<u>2.9</u>

## SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-12: National Professional Staff Currently Posted in Agricultural Research Institutions, by Field of Study and by Country, 1984<sup>a</sup> (cont.)

Field of Study	Country								Subtotal	Percent of Total
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania <sup>b</sup>	Zambia	Zimbabwe		
<u>Fisheries and Forestry</u>										
BSc	0	0	0	0	0	16	11	7	34	3.8
MSc	0	0	0	0	0	13	3	2	18	2.0
PhD	0	0	0	0	0	3	0	0	3	.3
Subtotal, Fisheries/Forestry	0	0	0	0	0	32	14	9	55	6.1
<u>Food Processing and Preservation</u>										
BSc	0	0	1	0	0	1	0	1	3	.3
MSc	0	0	0	0	0	0	0	2	2	.2
PhD	0	0	1	0	0	0	0	0	1	.1
Subtotal, Food Processing/ Preservation	0	0	2	0	0	1	0	3	6	.6
<u>Other</u>										
BSc	1	1	7	0	0	13	3	16	41	4.5
MSc	0	0	12	0	0	10	3	9	34	3.7
PhD	0	0	2	0	0	1	1	0	4	.5
Subtotal, Other	1	1	21	0	0	24	7	25	79	8.7
TOTAL	29	9	155	14	9	353	116	224	909	100.0

<sup>a</sup>Classification is based on highest academic degree held by citizens who are currently in agricultural research professional staff posts.

<sup>b</sup>Data from Tanzania includes both nationals and expatriates. Of the grand total, approximately 78.5 percent are nationals.

Note: It should be recognized that, in several of the countries, universities made contributions to research, but it is generally minimal throughout the region.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

## SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-13: National Professional Staff of Agricultural Research Institutions Currently in Training, by Field of Study and by Country, 1984<sup>a</sup>

Field of Study	Country								Subtotal <sup>c</sup>	Percent of Total <sup>c</sup>
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania	Zambia	Zimbabwe <sup>b</sup>		
<u>Crop and Soil Science</u>										
BSc	3	2	4	NA <sup>a</sup>	1	69	0	-	79	22.8
MSc	5	4	15	NA	4	32	6	-	66	19.0
PhD	<u>2</u>	<u>1</u>	<u>8</u>	<u>NA</u>	<u>0</u>	<u>15</u>	<u>8</u>	-	<u>34</u>	<u>9.8</u>
Subtotal, Crop/Soil Science	<u>0</u>	<u>7</u>	<u>27</u>	<u>NA</u>	<u>5</u>	<u>116</u>	<u>14</u>	-	<u>179</u>	<u>51.6</u>
<u>Animal Science and Veterinary</u>										
BSc	2	1	1	NA	0	36	0	-	40	11.5
MSc	0	2	3	NA	0	30	5	-	40	11.5
PhD	<u>2</u>	<u>0</u>	<u>2</u>	<u>NA</u>	<u>0</u>	<u>13</u>	<u>3</u>	-	<u>20</u>	<u>5.8</u>
Subtotal, Animal/Veterinary Science	<u>4</u>	<u>3</u>	<u>6</u>	<u>NA</u>	<u>0</u>	<u>79</u>	<u>8</u>	-	<u>100</u>	<u>28.8</u>
<u>Economics and Social Sciences</u>										
BSc	0	0	0	NA	0	0	0	-	0	0
MSc	0	1	7	NA	0	0	0	-	8	2.3
PhD	<u>0</u>	<u>0</u>	<u>2</u>	<u>NA</u>	<u>0</u>	<u>0</u>	<u>1</u>	-	<u>3</u>	<u>.9</u>
Subtotal, Economics/Social Sciences	<u>0</u>	<u>1</u>	<u>9</u>	<u>NA</u>	<u>0</u>	<u>0</u>	<u>1</u>	-	<u>11</u>	<u>3.2</u>
<u>Agricultural Engineering</u>										
BSc	0	0	0	NA	0	0	0	-	0	0
MSc	0	0	2	NA	0	0	0	-	2	0.6
PhD	<u>0</u>	<u>0</u>	<u>0</u>	<u>NA</u>	<u>0</u>	<u>0</u>	<u>0</u>	-	<u>0</u>	<u>0</u>
Subtotal, Agricultural Engineering	<u>0</u>	<u>0</u>	<u>2</u>	<u>NA</u>	<u>0</u>	<u>0</u>	<u>0</u>	-	<u>2</u>	<u>0.6</u>

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-13: National Professional Staff of Agricultural Research Institutions Currently in Training, by Field of Study and by Country, 1984<sup>a</sup> (cont.)

Field of Study	Country								Subtotal <sup>c</sup>	Percent of Total <sup>c</sup>
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania	Zambia	Zimbabwe <sup>b</sup>		
<u>Fisheries and Forestry</u>										
BSc	0	0	0	NA	0	2	0	-	2	.6
MSc	0	0	0	NA	0	5	0	-	5	1.4
PhD	0	0	0	NA	0	4	0	-	4	1.2
Subtotal, Fisheries/Forestry	0	0	0	NA	0	11	0	-	11	3.2
<u>Food Processing and Preservation</u>										
BSc	0	0	0	NA	0	0	0	-	0	0
MSc	0	0	0	NA	0	4	0	-	4	1.1
PhD	0	0	0	NA	0	3	0	-	3	.9
Subtotal, Food Processing/ Preservation	0	0	0	NA	0	7	0	-	7	2.0
<u>Other</u>										
BSc	0	1	0	NA	0	17	4	[10]	22	6.3
MSc	0	1	0	NA	0	8	1	[23]	10	2.9
PhD	0	0	0	NA	0	3	2	[17]	5	1.4
Subtotal, Other	0	2	0	NA	0	28	7	50	37	10.6
TOTAL	14	13	44	NA	5	241	30	[50]	347	100.0

<sup>a</sup>NA = Not Available.

<sup>b</sup>Disciplines to be trained not reported.

<sup>c</sup>Does not include Mozambique or Zimbabwe data.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

Table 2-14: Total Agricultural Extension Staff, by Level and by Country<sup>a</sup>

Staff	Country								Total
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania	Zambia	Zimbabwe	
<u>Administrative</u>									
Positions vacant	0	8	1	NA <sup>b</sup>	0	16	0	12	37
Staff in training	0	0	4	NA	0	2	0	0	6
Nationals in posts	41	37	25	NA	5	48	57	196	409
Expatriates	0	2	1	NA	0	0	0	0	3
Subtotal, Administrative Staff	41	39	26	NA	5	48	57	196	412
<u>Professional<sup>c</sup></u>									
Positions vacant	19	28	38	NA	3	21	17	61	187
Staff in training	22	16	15	NA	0	23	9	4	89
Nationals in posts	20	31	114	NA	23	171	56	358	773
Expatriates	17	18	10	NA	6	31	51	13	146
Subtotal, Professional Staff	37	49	124	NA	29	202	107	371	919
<u>Technical<sup>d</sup></u>									
Positions vacant	59	207	622	NA	22	141	0	134	1,185
Staff in training	51	34	3	NA	0	135	38	0	261
Nationals in posts	446	883	3,029	NA	325	5,863	2,008	1,480	14,034
Expatriates	1	1	0	NA	0	0	3	0	9
Subtotal, Technical Staff	447	884	3,033	NA	325	5,863	2,011	1,480	14,043
TOTAL	525	972	3,183	NA	359	6,113	2,175	2,047	15,374

<sup>a</sup>Does not include support staff.

<sup>b</sup>NA = Not available.

<sup>c</sup>Professional = BSc or above.

<sup>d</sup>Technical = diploma and certificate.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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Table 2-15: Total Agricultural Training Staff, by Level and by Country<sup>a</sup>

Staff	Country								Total
	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania	Zambia	Zimbabwe	
<b>Administrative</b>									
Positions vacant	3	0	0	NA <sup>b</sup>	0	17	0	3	23
Staff in training	0	1	0	NA	0	2	0	0	3
Nationals in posts	5	4	11	NA	1	101	18	29	169
Expatriates	0	0	0	NA	0	1	2	0	3
Subtotal, Administrative Staff	<u>5</u>	<u>4</u>	<u>11</u>	<u>NA</u>	<u>1</u>	<u>102</u>	<u>20</u>	<u>29</u>	<u>172</u>
<b>Professional<sup>c</sup></b>									
Positions vacant	28	4	21	NA	0	127	2	15	197
Staff in training	6	4	20	NA	6	49	21	8	114
Nationals in posts	18	10	76	NA	11	192	31	47	385
Expatriates	10	5	18	NA	13	64	51	12	173
Subtotal, Professional Staff	<u>28</u>	<u>15</u>	<u>94</u>	<u>NA</u>	<u>24</u>	<u>256</u>	<u>82</u>	<u>59</u>	<u>558</u>
<b>Technical<sup>d</sup></b>									
Positions vacant	2	0	11	NA	2	16	0	25	56
Staff in training	1	3	1	NA	0	61	4	1	71
Nationals in posts	20	9	25	NA	17	282	80	105	538
Expatriates	0	1	0	NA	0	4	3	0	8
Subtotal, Technical Staff	<u>20</u>	<u>10</u>	<u>25</u>	<u>NA</u>	<u>17</u>	<u>286</u>	<u>83</u>	<u>105</u>	<u>546</u>
TOTAL	<u><u>53</u></u>	<u><u>29</u></u>	<u><u>130</u></u>	<u><u>NA</u></u>	<u><u>42</u></u>	<u><u>644</u></u>	<u><u>185</u></u>	<u><u>193</u></u>	<u><u>1,276</u></u>

<sup>a</sup>Does not include support staff.

<sup>b</sup>NA = Not Available.

<sup>c</sup>Professional = BSc or above.

<sup>d</sup>Technical = diploma, except for Lesotho, Tanzania and Zimbabwe where technical = diploma and certificate.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment



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Table 2-16: Staff Assessment of Research Institutions in Four Countries

Problems/Criteria	Degree of Seriousness <sup>a</sup>					Number of Respondents			
	Lesotho	Tanzania	Zambia	Zimbabwe	Average	Lesotho	Tanzania	Zambia	Zimbabwe
<u>Budget</u>									
Consistency of support	3.9	4.1	3.9	3.6	3.9	15	16	15	40
Level of funding	4.1	4.7	4.5	4.2	4.4	15	16	15	40
Release of funds	3.8	3.6	4.3	3.3	3.8	15	16	15	40
<u>Foreign Exchange Difficulties</u>									
For purchase of parts	3.4	4.7	4.1	3.8	4.0	15	16	15	39
For purchase of equipment	3.6	4.8	4.3	4.4	4.3	15	16	15	40
For purchase of books/journals	2.6	4.6	3.3	3.4	3.5	14	16	15	41
For purchase of special supplies	3.8	4.6	4.2	3.6	4.1	14	16	15	40
<u>Senior Staff</u>									
Lack of training opportunities	3.8	4.0	2.4	2.9	3.3	15	16	14	41
Lack of interest in further training	1.7	2.2	1.3	1.6	1.7	15	16	15	40
Lack of experience/background	3.9	3.0	2.7	3.2	3.2	14	16	15	40
Lack of motivation	3.5	3.1	2.8	2.4	3.0	15	16	15	39
Lack of leadership	4.2	2.5	2.8	2.5	3.0	15	16	15	40
<u>Junior staff</u>									
Lack of training opportunities	4.5	3.6	3.2	3.1	3.6	15	16	15	40
Lack of interest in further training	1.5	2.1	1.6	1.8	1.8	15	16	15	40
Lack of experience	3.4	3.1	2.9	3.0	3.1	15	16	15	41
Lack of motivation	3.6	3.1	3.0	2.4	3.0	15	16	15	41
<u>Support Staff</u>									
Lack of training opportunities	4.4	3.2	3.9	2.8	3.6	15	16	15	41
Lack of interest in further training	1.9	2.5	1.9	2.0	2.1	15	16	15	41
Lack of experience	3.6	3.0	2.4	2.8	3.0	15	16	15	40
Lack of motivation	3.9	2.8	2.8	2.3	3.0	15	16	15	39
<u>Conference/Meeting Rooms</u>									
Number of conference rooms	2.8	2.3	2.3	2.4	2.5	16	16	15	38
Capacity of conference rooms	2.9	2.2	2.6	2.2	2.5	16	16	15	38
Adequacy of conference rooms	3.0	2.5	3.1	2.4	2.8	16	16	15	38
<u>Laboratories</u>									
Number of laboratories	3.3	-	2.9	2.5	2.9	15	-	15	38
Capacity of laboratories	2.9	-	3.6	2.8	3.1	15	-	15	39
Adequacy of laboratories	3.2	-	3.9	2.4	3.2	15	-	15	39

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Table 2-16: Staff Assessment of Research Institutions in Four Countries (cont.)

Problems/Criteria	Degree of Seriousness <sup>a</sup>					Number of Respondents			
	Lesotho	Tanzania	Zambia	Zimbabwe	Average	Lesotho	Tanzania	Zambia	Zimbabwe
<u>Offices</u>									
Number	3.8	2.8	3.1	2.7	3.1	16	16	15	39
Capacity	3.4	2.4	2.3	2.2	2.6	16	16	15	40
Adequacy	3.6	2.2	2.4	2.0	2.6	16	16	15	40
<u>Equipment</u>									
Insufficient number/Obsolescence	4.1	4.0	4.5	3.6	4.1	16	16	15	39
Lack of repair/Maintenance	4.1	4.7	4.7	3.5	4.3	16	16	15	40
Funds for essential equipment	4.4	4.5	4.7	4.1	4.4	16	16	15	40
<u>Transportation</u>									
Budget for operations	4.1	3.7	4.4	3.3	3.9	13	15	15	41
Availability/Access	3.9	3.7	3.6	2.7	3.5	16	15	15	39
Maintenance/Care	3.6	3.9	4.1	3.0	3.7	16	15	15	39
Number of vehicles/bicycles	3.7	4.7	4.2	3.1	3.9	16	15	15	40
<u>Staff Housing</u>									
Number of houses	4.3	4.4	4.5	3.2	4.1	15	16	15	37
Adequacy of staff housing	3.0	3.8	3.6	2.9	3.3	15	16	15	36
<u>Salary Scales/Levels</u>									
Not sufficient to hold staff	4.4	3.9	4.3	4.6	4.3	16	16	15	41
Competition from the public sector	3.6	2.9	2.3	3.0	3.0	16	16	15	40
Competition from the private sector	3.9	3.4	4.6	4.7	4.2	15	16	15	41
<u>Promotion System</u>									
Promotion schedule	4.7	3.8	4.2	3.6	4.1	14	16	15	40
Rewards for superior service	4.3	4.0	4.3	3.8	4.1	15	16	15	40
Staff evaluation procedure	3.6	4.0	4.2	3.2	3.8	15	16	15	40
Tenure security rules	2.8	2.7	1.5	2.4	2.4	14	15	15	38
<u>Other Benefits</u>									
Leaves of absence schedule	2.3	2.3	1.5	1.9	2.0	14	16	15	39
Health benefits	4.4	2.8	2.9	2.7	3.2	12	16	15	38
Retirement benefits	3.7	3.2	3.1	3.4	3.4	13	16	15	39

<sup>a</sup> Weighted average of respondent rankings: 1 = Not serious, 5 = Very serious.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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Table 2-17: Staff Assessment of Training Institutions in Four Countries

Problems/Criteria	Degree of Seriousness <sup>1</sup>					Number of Respondents			
	Lesotho	Tanzania	Zambia	Zimbabwe	Average	Lesotho	Tanzania	Zambia	Zimbabwe
<u>Budget</u>									
Consistency of support	4.3	3.4	4.4	3.1	3.8	14	15	15	15
Level of funding	4.2	4.2	4.4	3.1	4.0	14	16	15	15
Release of funds	3.4	3.0	4.5	2.9	3.5	14	15	15	15
<u>Foreign Exchange Difficulties</u>									
For purchase of parts	2.6	4.6	3.9	4.2	3.8	10	16	15	15
For purchase of equipment	2.9	4.9	4.3	4.3	4.1	11	16	15	15
For purchase of books/journals	3.0	4.7	3.6	3.3	3.7	10	16	15	16
For purchase of special supplies	2.5	4.2	3.4	3.5	3.4	10	16	15	14
<u>Senior Staff</u>									
Lack of training opportunities	4.3	4.0	4.1	3.1	3.9	15	16	14	14
Lack of interest in further training	1.4	1.6	2.4	2.5	2.0	14	16	15	14
Lack of experience/background	3.5	2.4	3.2	3.4	3.1	14	16	15	14
Lack of motivation	3.4	3.6	3.9	2.7	3.4	14	16	15	14
Lack of leadership	3.1	2.4	3.0	2.7	2.8	14	16	15	14
<u>Junior staff</u>									
Lack of training opportunities	4.3	3.2	4.6	3.4	3.9	15	16	15	16
Lack of interest in further training	1.6	1.8	2.4	2.6	2.1	14	16	15	14
Lack of experience	2.8	3.2	3.1	3.0	3.0	14	16	15	15
Lack of motivation	3.5	3.4	3.9	3.4	3.6	14	16	15	15
<u>Support Staff</u>									
Lack of training opportunities	3.9	2.9	4.2	2.5	3.4	14	16	15	14
Lack of interest in further training	1.5	2.5	3.4	3.2	2.7	14	16	15	13
Lack of experience	3.4	2.7	2.9	3.3	3.1	14	16	15	14
Lack of motivation	3.6	3.5	3.2	2.7	3.3	14	16	15	13
<u>Classrooms</u>									
Number of classrooms	2.2	2.8	3.2	2.5	2.7	15	16	14	13
Capacity of classrooms	1.6	2.9	3.1	2.2	2.5	14	16	14	13
Adequacy of classrooms	2.1	2.6	3.1	2.1	2.5	14	16	15	12
<u>Laboratories</u>									
Number of laboratories	3.6		3.6	2.7	3.3	14		15	13
Capacity of laboratories	3.3		3.3	2.6	3.1	15		15	13
Adequacy of laboratories	3.4		3.4	2.6	3.1	14		15	13

Table 2-17: Staff Assessment of Training Institutions in Four Countries (cont.)

Problems/Criteria	Degree of Seriousness <sup>a</sup>					Number of Respondents			
	Lesotho	Tanzania	Zambia	Zimbabwe	Average	Lesotho	Tanzania	Zambia	Zimbabwe
<u>Offices</u>									
Number	2.9	3.8	3.8	3.8	3.6	15	15	15	15
Capacity	2.6	3.6	3.4	3.4	3.3	14	15	14	14
Adequacy	2.1	3.6	3.1	3.1	3.0	14	15	14	14
<u>Equipment</u>									
Insufficient number/Obsolescence	3.6	4.3	4.2	4.2	4.1	14	14	14	14
Lack of repair/Maintenance	3.9	4.7	4.8	4.8	4.6	14	14	14	14
Funds for essential equipment	4.3	4.9	4.9	4.9	4.8	15	15	15	15
<u>Transportation</u>									
Budget for operations	4.0	4.3	4.0	4.0	4.1	14	14	14	14
Availability/Access	3.5	4.4	4.5	4.5	4.2	15	15	15	15
Adequacy of allocation	3.6	3.1	4.4	4.4	3.9	14	15	14	14
Maintenance/Care	3.2	4.1	4.1	4.1	3.9	13	13	13	13
Number of vehicles/bicycles	3.6	4.6	4.9	4.9	4.5	14	14	14	14
<u>Staff Housing</u>									
Number of houses	3.9	4.6	4.5	3.2	4.1	14	15	15	15
Adequacy of staff housing	3.5	4.0	3.6	2.9	3.5	13	15	15	15
<u>Salary Scales/Levels</u>									
Not sufficient to hold staff	4.6	4.8	4.3	4.6	4.6	15	15	15	15
Competition from the public sector	3.0	3.6	2.3	3.0	3.0	14	15	15	15
Competition from the private sector	4.1	3.9	4.6	4.7	4.3	14	15	15	15
<u>Promotion System</u>									
Promotion schedule	6.2	3.9	4.2	3.6	4.5	14	15	15	15
Rewards for superior service	4.3	4.2	4.3	3.8	4.2	14	15	15	15
Staff evaluation procedure	4.4	4.1	4.2	3.2	4.0	15	15	15	15
Tenure security rules	3.1	2.6	1.5	2.4	2.4	14	15	15	15
<u>Other Benefits</u>									
Leaves of absence schedule	2.3	2.2	1.5	1.9	2.0	15	15	15	15
Health benefits	4.2	3.5	2.9	2.7	3.3	13	15	15	15
Retirement benefits	3.8	3.6	3.1	3.4	3.5	14	15	15	15

<sup>a</sup> Weighted average of respondent rankings: 1 = Not serious, 5 = Very serious.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

Table 2-18: Staff Assessment of Extension Institutions in Four Countries

Problems/Criteria	Degree of Seriousness <sup>1</sup>					Number of Respondents			
	Lesotho	Tanzania	Zambia	Zimbabwe	Average	Lesotho	Tanzania	Zambia	Zimbabwe
<u>Budget</u>									
Consistency of support	4.8	4.6	4.2	4.1	4.4	15	16	16	27
Level of funding	4.6	4.6	4.7	4.0	4.5	15	16	16	28
Release of funds	4.6	4.0	4.6	3.2	4.1	15	16	16	26
<u>Foreign Exchange Difficulties</u>									
For purchase of parts	3.2	4.9	3.7	3.4	3.8	15	16	16	26
For purchase of equipment	4.2	4.8	3.8	3.8	4.2	15	16	16	26
For purchase of books/journals	3.5	3.9	2.9	2.9	3.3	14	16	16	27
For purchase of special supplies	3.4	4.4	2.9	3.3	3.5	14	16	16	27
<u>Senior Staff</u>									
Lack of training opportunities	4.4	3.5	3.6	3.8	3.8	15	16	16	29
Lack of interest in further training	2.2	2.3	2.2	2.6	2.3	15	16	16	29
Lack of experience/background	3.6	2.8	3.1	3.9	3.4	14	16	16	28
Lack of motivation	2.2	4.1	3.7	3.1	3.3	15	16	15	29
Lack of leadership	3.7	2.8	2.9	2.9	3.1	15	16	16	29
<u>Junior staff</u>									
Lack of training opportunities	4.9	3.6	4.3	3.7	4.1	15	16	16	29
Lack of interest in further training	2.6	2.5	2.3	2.4	2.5	15	16	16	29
Lack of experience	3.2	3.1	3.1	3.3	3.2	15	16	16	29
Lack of motivation	2.9	4.3	4.1	2.7	3.5	15	16	16	29
<u>Support Staff</u>									
Lack of training opportunities	4.4	3.6	3.8	3.4	3.8	15	16	15	29
Lack of interest in further training	2.2	2.5	2.1	2.2	2.3	14	16	15	28
Lack of experience	2.9	3.3	3.0	3.5	3.2	15	16	15	26
Lack of motivation	2.8	3.9	3.0	2.6	3.1	15	16	15	29
<u>Conference/Meeting Rooms</u>									
Number of conference rooms	1.9	3.2	3.3	2.7	2.8	16	16	15	28
Capacity of conference rooms	1.8	3.3	2.9	2.9	2.7	16	16	15	28
Adequacy of conference rooms	2.4	3.4	2.8	2.9	2.9	16	16	15	27

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Table 2-18: Staff Assessment of Extension Institutions in Four Countries (cont.)

Problems/Criteria	Degree of Seriousness <sup>a</sup>					Number of Respondents			
	Lesotho	Tanzania	Zambia	Zimbabwe	Average	Lesotho	Tanzania	Zambia	Zimbabwe
<u>Offices</u>									
Number	2.4	4.1	4.0	3.2	3.4	19	16	16	29
Capacity	2.2	4.2	3.0	2.9	3.1	18	16	16	29
Adequacy	2.4	4.2	2.5	3.1	3.1	18	16	16	29
<u>Equipment</u>									
Insufficient number/Obsolescence	4.0	4.5	4.3	3.5	4.1	20	15	15	28
Lack of repair/Maintenance	4.3	4.7	4.2	3.4	4.2	19	15	15	29
Funds for essential equipment	4.4	4.4	4.6	4.0	4.4	19	15	15	28
<u>Transportation</u>									
Budget for operations	4.5	4.0	4.3	4.1	4.2	18	15	15	28
Availability/Access	4.2	4.9	4.4	3.9	4.4	18	15	15	28
Adequacy of allocation	3.6	4.5	4.7	4.2	3.5	18	14	14	29
Maintenance/Care	3.3	4.1	4.2	3.2	3.7	18	15	15	28
Number of vehicles/Bicycles	3.7	4.9	4.6	4.4	4.4	20	15	15	28
<u>Staff Housing</u>									
Number of houses	4.7	4.7	4.9	4.0	4.6	19	15	15	28
Adequacy of staff housing	4.5	4.6	4.4	3.8	4.3	19	15	15	29
<u>Salary Scales/Levels</u>									
Not sufficient to hold staff	4.6	4.1	4.3	3.9	4.2	20	15	15	28
No differentiation for remote posts	4.8	4.6	4.5	4.5	3.5	18	15	16	29
Competition from the public sector	4.2	3.7	3.9	3.6	3.9	18	15	16	28
Competition from the private sector	3.1	3.8	3.3	3.3	3.4	18	15	16	29
<u>Promotion System</u>									
Promotion schedule	3.2	4.5	4.7	4.5	4.2	18	14	16	29
Rewards for superior service	4.8	4.0	4.4	3.7	4.5	19	15	16	29
Without higher training certificate	4.4	4.0	4.4	3.8	3.5	19	15	16	29
Staff evaluation procedure	4.8	4.1	4.2	3.3	4.1	20	15	16	29
Tenure security rules	4.2	3.4	4.2	3.2	3.5	19	15	15	29
<u>Other Benefits</u>									
Leaves of absence schedule	2.7	2.4	2.8	2.9	2.7	19	15	16	26
Health benefits	2.3	3.4	2.1	1.9	2.4	19	15	15	28
Retirement benefits	4.4	3.6	3.1	3.2	3.6	20	15	16	28

<sup>a</sup>Weighted average of respondent rankings: 1 = Not serious, 5 = Very serious.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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## SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-19: Amount and Sources of Funding of Agricultural Research by Country, 1983-1984 Fiscal Year  
(US\$)

Country	National Sources			International Donor Sources	Total All Sources	Percent Donor Funded
	Government	Private	Total			
Botswana	2,885,270	-	2,885,270	136,129	3,021,399	4.5 <sup>a</sup>
Lesotho	403,369	-	403,369	1,811,893	2,215,262	81.8
Malawi	2,756,146	1,196,923	3,953,069	4,611,900 <sup>b</sup>	8,564,969	53.8
Mozambique	3,431,737	-	3,431,737	8,229,843 <sup>b</sup>	11,661,580	70.6
Swaziland	625,583	107,900	733,483	2,336,301	3,069,784	76.1
Tanzania	11,290,103	1,040,196	12,330,299	5,191,360	17,521,659	29.6
Zambia	4,039,000	-	4,039,000	8,569,300 <sup>b</sup>	12,608,300	68.0
Zimbabwe	<u>22,266,344</u>	<u>3,210,312</u>	<u>25,476,656</u>	<u>8,324,279<sup>b, c</sup></u>	<u>33,800,935</u>	<u>24.6</u>
TOTAL	47,697,552 =====	5,555,331 =====	53,252,883 =====	39,211,005 =====	92,463,888 =====	51.1 <sup>d</sup> =====

<sup>a</sup>Current figure is not typical because several major projects have been recently completed and proposed projects have not yet been funded. Data for Botswana is for 1984 to 1985.

<sup>b</sup>Estimated annual funding based on projected project duration.

<sup>c</sup>Excludes regional sorghum/millet project of \$13.3 million (five years) by various donors, and regional foot and mouth control project of \$7.9 million funded by EEC.

<sup>d</sup>Average percent donor payment for all SADCC countries (excluding Angola).

Source: Original data collected from DEVRES/SADCC Agricultural Research Resource Assessment questionnaires, 1984; supplemented by other sources such as the United Nations Development Program and various Ministries of Finance. Therefore, comparability and completeness cannot be assured in all instances.

SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-20: Constraints to Achieving Higher Yields of Major Food Crops<sup>a</sup>

Constraints	Maize	Sorghum/ Millet	Root Crops	Grain/ Legumes	Pulses	Rice	Fruits/ Vegetables	Wheat	Average
<u>Physical/Biological</u>									
Climate	3.2	3.3	2.2	3.0	3.1	3.2	3.4	3.0	3.1
Annual rainfall	3.1	3.5	2.5	3.4	2.8	3.2	3.5	3.6	3.3
Rain distribution	4.1	4.3	2.8	3.6	3.3	3.7	3.7	4.0	3.7
Soil suitability	3.1	2.8	2.2	3.0	2.3	2.9	2.6	3.4	2.8
Soil degradation	3.5	3.3	2.8	2.9	2.9	2.9	3.1	3.6	3.2
Soil topography	2.6	2.3	2.5	3.0	2.6	2.8	2.6	3.0	2.7
Weeds	3.9	2.1	3.7	4.0	4.6	4.4	3.4	3.7	3.8
Plant diseases	2.6	2.7	3.3	4.2	3.1	2.2	3.7	3.1	3.2
Pests/Insects	3.1	3.6	2.8	4.1	3.2	2.5	3.8	3.0	3.3
Predators	2.2	2.9	2.9	2.4	1.1	2.9	2.7	2.6	2.5
Varieties/Species	3.7	3.4	3.3	3.6	3.0	3.4	3.0	3.6	3.4
Human power	3.6	3.6	2.9	3.0	2.7	3.4	3.3	3.4	3.3
Animal power	3.4	3.9	2.4	3.1	2.6	3.1	2.4	3.4	3.1
<u>Economic/Policy</u>									
Prices	3.9	3.5	3.7	3.5	3.6	4.0	4.0	4.4	3.9
Marketing	3.5	3.4	3.5	2.9	3.1	3.1	4.2	3.8	3.5
Short-Term credit	3.7	3.6	2.4	2.6	2.8	2.6	4.1	3.9	3.3
Long-Term credit	3.4	3.2	2.2	2.4	2.8	2.4	4.0	3.4	3.0
Government subsidy	2.5	3.1	2.2	2.2	2.5	2.5	3.2	3.6	2.8
Import policies	2.3	2.3	1.4	1.5	1.9	2.0	2.7	2.7	2.2
<u>Traditional</u>									
Land tenure	2.7	2.6	2.0	2.4	2.3	2.2	2.8	4.1	2.7
Farm size	3.1	3.6	2.4	3.5	2.5	2.9	3.7	3.8	3.2
Farm labor	4.0	4.0	3.6	4.9	4.2	4.2	3.2	3.3	4.0
Education	3.3	3.6	2.6	3.4	2.8	3.0	4.1	3.6	3.4
Role of women	3.8	3.7	3.1	3.8	3.7	4.1	4.0	3.3	3.7
<u>Institutional</u>									
Research	4.0	4.7	3.4	3.4	4.5	4.1	4.1	4.2	4.1
Training	4.1	4.4	3.9	3.6	4.4	4.0	4.0	4.2	4.1
Extension	4.4	4.5	4.0	4.6	4.3	4.4	4.3	4.5	4.4

<sup>a</sup>Weighted average of respondent rankings (1 = Not serious, 5 = Very serious) in seven countries, the SADCC countries participating in ARRA except Mozambique.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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## SADCC: AGRICULTURAL RESEARCH RESOURCE ASSESSMENT

Table 2-21: Constraints to Achieving Higher Yields of Commercial Crops<sup>a</sup>

Constraints	Coffee	Cotton	Ground-Nuts	Tobacco	Average
<u>Physical/Biological</u>					
Climate	3.6	2.9	2.6	2.8	3.0
Annual rainfall	3.4	2.8	2.8	3.0	3.0
Rain distribution	4.1	3.9	3.6	3.8	3.9
Soil suitability	3.0	2.2	3.1	3.2	2.9
Soil degradation	3.9	3.2	3.1	3.5	3.4
Soil topography	2.8	2.3	2.2	2.9	2.6
Weeds	3.3	4.6	3.8	4.2	4.0
Plant diseases	5.0	2.8	3.2	3.3	3.6
Pests/Insects	4.1	4.2	3.1	3.1	3.6
Predators	2.1	2.4	2.3	1.7	2.1
Varieties/Species	4.0	2.5	3.4	2.5	3.1
Human power	3.6	3.8	3.3	3.3	3.5
Animal power	2.1	3.6	3.6	3.1	3.1
<u>Economic/Policy</u>					
Prices	4.5	4.0	3.9	3.7	4.0
Marketing	3.8	3.1	2.9	2.9	3.2
Short-Term credit	3.5	3.4	3.7	3.6	3.6
Long-Term credit	2.8	3.2	3.3	3.6	3.2
Government subsidy	2.5	2.5	2.0	2.6	2.4
Import policies	3.9	2.3	2.5	1.5	2.6
<u>Traditional</u>					
Land tenure	2.0	2.5	1.8	2.6	2.2
Farm size	3.5	3.0	3.2	2.9	3.2
Farm labor	4.0	4.5	4.6	4.1	4.3
Education	3.8	3.4	3.4	2.9	3.4
Role of women	3.6	4.1	4.0	3.8	3.9
<u>Institutional</u>					
Research	4.6	4.1	3.8	3.6	4.0
Training	4.2	4.1	4.8	4.4	4.4
Extension	4.6	4.5	4.7	4.7	4.6

<sup>a</sup>Weighted average of respondent rankings (1 = Not serious, 5 = Very serious) in seven countries, the SADCC countries participating in ARRA except Mozambique.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

Table 2-22: Constraints to Achieving Higher Productivity of Livestock<sup>a</sup>

Constraints	Beef Cattle	Dairy Cattle	Goats/ Sheep	Pigs	Poultry	Average
<u>Physical/Biological</u>						
Climate	3.5	3.3	2.7	2.3	2.4	2.9
Annual rainfall	3.1	2.9	2.7	2.5	2.2	2.7
Rain distribution	3.7	3.5	3.2	2.4	2.3	3.1
Soil suitability	2.2	2.2	1.9	2.2	1.6	2.1
Soil degradation	2.6	3.4	3.2	2.0	1.9	2.7
Soil topography	2.0	2.5	2.7	2.1	1.9	2.3
Natural forage supply	4.2	4.2	3.9	2.3	2.1	3.4
Fodder supply	4.2	4.9	3.8	2.7	2.9	3.8
Other fodder supply	3.9	4.2	3.5	3.4	2.9	3.6
Water supply	3.7	4.2	3.3	3.2	3.5	3.6
Water access	3.6	4.5	2.9	3.7	3.7	3.7
Disease prevention	4.0	3.8	3.7	4.0	4.5	4.1
Curative problems	4.1	4.0	3.4	3.6	4.2	3.9
Pests/Insects	4.0	3.3	3.3	3.4	3.2	3.5
Predators	2.5	2.5	2.5	2.3	3.2	2.7
Species/Breeds	3.0	4.4	3.8	4.4	4.1	4.0
<u>Economic/Policy</u>						
Input prices	4.0	4.3	3.2	4.0	4.6	4.1
Animal prices	3.5	4.0	3.3	3.3	4.1	3.7
Marketing	3.4	3.8	4.0	3.5	4.0	3.8
Short-Term credit	3.5	3.2	2.8	3.6	3.7	3.4
Long-Term credit	3.7	3.3	2.8	3.7	3.3	3.4
Government subsidy	2.5	3.2	2.4	2.5	2.6	2.7
Import policy	2.4	3.2	1.9	2.3	2.6	2.5
<u>Traditional</u>						
Land tenure	3.3	3.4	3.0	2.1	1.7	2.8
Farm size	3.4	3.5	2.9	2.3	1.8	2.8
Farm labor	3.0	3.4	2.2	3.3	2.8	3.0
Education	3.3	3.4	3.4	3.2	3.3	3.4
Role of women	2.3	2.2	2.4	1.8	3.0	2.4
<u>Management Factors</u>						
Herd management	4.4	4.0	3.7	4.8	3.6	4.2
Range management	4.6	4.3	4.5	2.8	2.2	3.7
Health management	4.3	3.9	3.6	4.6	4.4	4.2

<sup>a</sup>Weighted average of respondent rankings (1 = Not serious, 5 = Very serious) in seven countries, the SADCC countries participating in ARRA except Mozambique.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984.

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Table 2-23: Constraints to Achieving Higher Productivity of Maize, by Country<sup>a</sup>

Constraints	Botswana <sup>b</sup>	Lesotho	Malawi	Swaziland	Tanzania	Zambia	Zimbabwe	Average <sup>d</sup>
<u>Physical/Biological</u>								
Climate	-	3.6	2.5	3.2	4.2	2.8	3.2	3.3
Annual rainfall	-	3.4	1.8	3.6	4.1	3.6	2.8	3.2
Rain distribution	-	4.2	3.9	2.8	5.0	4.8	4.0	4.1
Soil suitability	-	3.2	1.7	4.2	3.7	3.0	2.7	3.1
Soil degradation	-	4.1	2.6	3.8	3.6	3.3	3.5	3.5
Soil topography	-	3.6	1.5	3.4	3.2	2.0	3.0	2.8
Weeds	-	4.1	-	-	4.6	3.2	3.5	3.9
Plant diseases	-	3.2	1.8	2.6	3.3	2.3	2.8	2.7
Pests/Insects	-	3.7	2.3	2.6	3.9	2.6	4.0	3.2
Predators	-	2.8	1.9	2.0	2.3	1.6	2.8	2.2
Varieties/Species	-	3.5	2.8	3.8	4.1	3.5	4.3	3.7
Human power	-	4.0	2.4	4.0	4.1	3.5	3.6	3.6
Animal power	-	3.7	2.2	3.2	4.0	3.5	4.8	3.6
<u>Economic/Policy</u>								
Prices	-	4.0	2.2	5.0	4.4	3.6	4.5	4.0
Marketing	-	4.1	1.3	4.6	3.4	3.3	4.6	3.6
Short-Term credit	-	3.9	2.0	4.6	3.9	4.1	4.5	3.8
Long-Term credit	-	3.7	1.6	4.2	3.7	3.2	3.8	3.4
Government subsidy	-	3.8	1.1	1.8	3.3	3.3	1.7	2.5
Import policies	-	2.7	1.2	3.5	2.9	1.5	2.1	2.3
<u>Traditional</u>								
Land tenure	-	3.9	1.2	4.2	3.0	2.1	1.8	2.7
Farm size	-	3.9	1.3	3.8	3.6	2.1	4.1	3.1
Farm labor <sup>c</sup>	-	4.0	-	-	4.0	3.5	4.5	4.0
Education	-	4.4	1.9	3.2	3.6	3.0	4.3	3.4
Role of women <sup>c</sup>	-	3.7	-	-	4.1	3.0	4.2	3.8
<u>Institutional<sup>c</sup></u>								
Research	-	4.0	-	-	4.1	3.1	4.6	4.0
Training	-	4.6	-	-	4.1	3.3	4.6	4.2
Extension	-	4.4	-	-	4.4	4.1	4.7	4.4

<sup>a</sup> Weighted average of respondent rankings: 1 = Not serious, 5 = Very serious.

<sup>b</sup> No data on maize was collected for Botswana; severe droughts in previous years prevented cultivation.

<sup>c</sup> Question was not included in the pilot project for Botswana, Malawi or Swaziland.

<sup>d</sup> Discrepancies in averages between this table and Table 2-20 are due to rounding.

Source: Data collected from the DEMRFS/SADCC Agricultural Research Resource Assessment, 1984.

Table 2-24: Constraints to Achieving Higher Productivity of Beef Cattle, by Country<sup>a</sup>

Constraints	Botswana	Lesotho	Malawi	Tanzania	Zambia	Zimbabwe	Average <sup>b</sup>
<u>Physical/Biological</u>							
Climate	2.9	3.6	4.1	3.0	4.0	2.7	3.5
Annual rainfall	4.2	3.3	2.6	2.5	3.5	3.6	3.1
Rain distribution	4.5	3.7	3.0	4.0	4.2	3.4	3.7
Soil suitability	3.1	2.6	2.1	2.4	2.3	2.1	2.2
Soil degradation	3.6	3.2	2.0	3.2	2.3	3.0	2.6
Soil topography	1.7	2.9	2.0	2.2	2.2	1.7	2.0
Natural forage supply	4.8	4.7	4.0	3.8	4.0	4.8	4.2
Fodder supply	3.3	4.4	4.3	3.5	4.8	4.2	4.2
Other fodder supply	2.2	4.2	4.0	3.2	4.5	3.8	3.9
Water supply	4.5	3.6	3.3	3.4	4.2	4.0	3.7
Water access	4.7	4.2	3.3	4.1	4.1	3.0	3.6
Disease prevention	3.6	4.3	3.6	4.5	3.8	4.1	4.0
Curative problems	3.3	3.9	3.1	4.4	4.3	4.5	4.1
Pests/Insects	3.2	4.0	3.2	4.4	4.0	4.5	4.0
Predators	2.1	2.6	2.3	3.1	1.8	2.6	2.5
Varieties/Breeds	2.4	3.6	3.2	3.6	1.8	3.6	3.1
<u>Economic/Policy</u>							
Input prices	3.0	4.4	4.3	3.6	4.0	4.2	4.0
Animal prices	3.1	4.2	3.3	3.4	3.5	3.6	3.5
Marketing	4.0	4.4	2.3	3.2	4.0	4.2	3.4
Short-Term credit	2.6	3.4	3.1	3.8	3.0	4.0	3.5
Long-Term credit	2.8	4.2	3.0	3.9	3.8	4.2	3.7
Government subsidy	2.5	4.2	2.5	2.9	2.8	1.8	2.5
Import policy	2.3	3.5	2.2	3.0	2.7	1.8	2.4
<u>Traditional</u>							
Land tenure	4.2	3.9	2.4	4.1	3.2	3.6	3.3
Farm size	3.1	3.9	3.7	3.8	2.5	3.6	3.4
Farm labor	3.5	3.3	3.6	2.8	2.3	3.3	3.0
Education	4.2	4.4	2.3	3.8	3.4	3.8	3.3
Role of women	3.4	2.5	2.0	2.5	1.5	3.2	2.3
<u>Institutional</u>							
Herd management	-	4.1	-	4.6	3.7	4.8	4.4
Range management	-	4.9	-	4.9	4.5	4.5	4.6
Health management	-	4.4	-	4.1	4.3	4.6	4.3
Overall Average	3.3	3.8	3.0	3.5	3.4	3.6	3.4

<sup>a</sup>Weighted average of respondent rankings: 1 = Not serious, 5 = Very serious.

<sup>b</sup>Discrepancies in averages between this table and Table 2-23 are due to rounding.

Source: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1983-84.

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ANNEX 3

Agencies, Organisations, Programmes and Projects Other  
Than National Involved in Agricultural Research in Southern Africa

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## ANNEX 3

### Agencies, Organisations, Programmes and Projects Other Than National Involved in Agricultural Research in Southern Africa

Within the sub-region comprised of the SADCC countries, there is a complex network of international agencies which, either directly or more often in collaboration with the national institutions, provide significant input into agricultural research. These must be considered both in the description of the agricultural research sector and in the development of any new strategy.

The following list includes most of the agencies or organisations which are cited in the country reports. These entities have been classified as follows:

- o Southern African or African organisations;
- o Organisations associated with the United Nations;
- o The World Bank and organisations associated with the International Agricultural Research Centres; and
- o Organisations of other donors.

#### A. Southern African or African Organisations

##### 1. Southern Africa Development Coordination Conference

The Southern Africa Development Coordination Conference (SADCC) was established in April 1980 at a meeting of the heads of state of the Southern African countries. Among the several Consultative Technical Committees (CTCs) created by SADCC is one for agricultural research which is chaired by the head of agricultural research in Botswana. With membership from the technical staffs of the SADCC member countries, the CTC for Agricultural Research provides coordination with local and international donor governments in the implementation of regional projects.

##### 2. Southern African Centre for Cooperation in Agricultural Research

The Southern African Centre for Cooperation in Agricultural Research (SACCAR) was established in 1984 to provide the institutional basis for long-term research cooperation. As a secretariat for the Consultative Technical Committee for Agricultural Research (CTCAR), SACCAR will be expected to maintain a research programme inventory for the SADCC countries, provide documentation on research and development policies, disseminate research results through publications, programme reviews and workshops, and provide small research grants. It is anticipated that this Centre will be financed by CIDA, IDRC, Italy, SAREC and USAID.

3. Organization of African Unity/Science and Technology Research Committee

The Organization of African Unity/Science and Technology Research Committee (OAU/STRC) is engaged in agricultural research, both in Southern Africa and in other semiarid African countries. The OAU's coordination office is located in Ouagadougou, Burkina Faso, where the maize and cowpea efforts and farming systems research are also headquartered. The OAU provides information and technical assistance and promotes selected technologies.

B. Organizations Associated with the United Nations

1. Food and Agriculture Organization

The Food and Agriculture Organization of the United Nations (FAO) remains the major source of agricultural statistics in the sub-region. It also contributes to the dissemination of information by its Agricultural Research Information System (AGRIS), and provides technical and management personnel for certain agricultural development projects. In collaboration with the UNDP, it finances or partly finances a number of projects.

2. United Nations Development Program

The United Nations Development Program (UNDP) finances by itself or with the FAO the preparation and/or execution of agricultural development projects, including those supporting agricultural research.

C. The World Bank and Organisations Associated with the Consortium for International Agricultural Research Centres

1. The World Bank

The World Bank on the International Bank for Reconstruction and Development (IBRD) conducts economic and social studies in most of the SADCC countries. It also finances research programmes and institutions dealing with agricultural research and extension.

2. International Institute of Tropical Agriculture

The International Institute of Tropical Agriculture (IITA), with its headquarters at Ibadan, Nigeria, provides information, seed, plant material and training for research workers. For cassava and sweet potato improvement, a regional coordinator is based in Rwanda; although primarily involved in supporting researchers of eastern Africa, several SADCC countries also benefit.

3. International Rice Research Institute

The International Rice Research Institute (IRRI), with its headquarters at Los Baños, the Philippines, provides scientific information and genetic material to countries in Southern Africa.

4. International Livestock Centre for Africa

The International Livestock Centre for Africa (ILCA), with its headquarters in Addis Ababa, Ethiopia, provides scientific information and technical assistance to SADCC member countries. It has joint livestock research programmes in Botswana, Malawi and Tanzania, and collaborates on other projects in the region.

5. International Food Policy Research Institute

The International Food Policy Research Institute (IFPRI), located in Washington, DC, has started work on analysing the agricultural policies of Southern African countries, in addition to its work in other developing areas.

6. International Service for National Agriculture Research

The International Service for National Agriculture Research (ISNAR), located in The Hague, Netherlands offers its services to developing countries to analyse national agricultural research systems and to suggest means to strengthen these systems.

7. The International Crops Research Institute for the Semi-Arid Tropics

Headquartered in Patancheru, India, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) provides scientific information, genetic material and technical information to agricultural researchers of both Southern African and other semiarid areas. Its most notable contribution to the SADCC countries has been the provision of sorghum and millet varieties and hybrids to the region. The work also includes groundnuts.

Since 1982 a regional programme on groundnut improvement has operated from a base in Malawi, and provides germplasm, provides opportunities for collaborative research with SADCC country programs, and supports the exchange of information within the region through workshops, monitoring tours and a newsletter.

8. International Centre for Maize and Wheat Improvement

The International Centre for Maize and Wheat Improvement (CIMMYT), based in Mexico, develops and promotes cropping combinations and techniques designed to reduce the constraints faced by smallholders. CIMMYT is currently monitoring numerous on-farm trials of such techniques in several Southern African countries.



9. International Potato Centre

The International Potato Centre (CIP) is headquartered in Peru. It provides genetic material and technical information concerning such topics as optimum planting density and diseases to most of the SADCC member countries.

10. International Centre for Tropical Agriculture

The International Centre for Tropical Agriculture (CIAT) supports the work of several research stations by holding conferences, workshops and seminars. Tanzania and Malawi are participating in CIAT's Bean Research Project for East Africa. CIAT is headquartered in Cali, Colombia.

11. International Laboratory for Research on Animal Diseases

The International Laboratory for Research on Animal Diseases (ILRAD) is based in Muguga, Kenya and provides technical information to the veterinary and livestock divisions of SADCC member countries and others.

12. International Centre for Research in Dry Areas

The International Centre for Research in Dry Areas (ICARDA), based in Syria, makes available its reference material and other information to areas such as Southern Africa.

13. International Sorghum and Millet Project

The International Sorghum and Millet Project (INTSORMIL) is an USAID-funded Collaborative Research Support Program coordinated by the University of Nebraska. Its objectives are to strengthen linkages between institutions involved in sorghum and millet research, to mobilize and coordinate research talent, and to assist in information exchanges.

14. Bean/Cowpea Collaborative Research Support Program

The Bean/Cowpea CRSP is an USAID-funded program which receives substantial support from Canada (particularly in East Africa) and other donors. Since the Bean/Cowpea CRSP was formed, the International Centres involved in research of cowpeas and beans--the International Institute of Tropical Agriculture (IITA) and the International Center for Tropical Agriculture (CIAT)--have actively conducted workshops, facilitated the exchange of information and material, and put Bean/Cowpea CRSP projects into the context of a global plan for bean and cowpea research.

15. The International Board for Plant Genetic Resources

The International Board for Plant Genetic Resources (IBPGR) promotes the collection, evaluation, conservation and utilization of genetic resources of important species. It especially focuses on those areas where the spread of new varieties puts traditional varieties in danger of extinction.

D. Organisations and Activities Supported by Other Donors

1. International Development Research Centre

The International Development Research Centre (IDRC), financed by the Canadian government, has the objective to support applied research in developing countries, particularly research conducted by national scientists. IDRC is currently financing agricultural research in seven Southern African countries as well as the new SACCAR programme for the entire region. It is also active in the area of scientific information dissemination.

2. Canadian International Development Agency

The Canadian International Development Agency (CIDA) finances agricultural projects in Malawi, Tanzania and Zambia, and is involved in the funding of SACCAR. Canada is a member of CIDA.

3. Overseas Development Administration

The Overseas Development Administration (ODA) of the United Kingdom is responsible for all UK development assistance programmes in developing countries. These include project design, implementation and evaluation, programming and staffing. The ODA is involved directly or indirectly in agricultural research in most of the SADCC member countries.

4. United States Agency for International Development

The United States Agency for International Development (USAID) is responsible for all US development assistance programmes in developing countries as well as for food aid. It is involved directly or indirectly in the work of agricultural research in most of the SADCC member countries. Technical support given by USAID includes the provision of training, scientific information and the loaning of personnel.

5. Tropical Development Research Institute

Based in the United Kingdom, the Tropical Development Research Institute (TDRI) provides scientific and technical information to many of the SADCC countries, particularly Tanzania and Malawi.

6. Technical Cooperation for Development

The Technical Cooperation for Development (GTZ), based in and supported by the Federal Republic of Germany, provides staff and technical expertise to developing countries. The GTZ's assistance in the area of agricultural research generally entails direct linkages to research stations and stresses applied research.

7. European Economic Community

The European Economic Community (EEC) provides some general funding for the crop and livestock departments of governments in the SADCC region. Specific funding is made available as well for selected agricultural research projects and for the training of agricultural researchers.

8. International Atomic Energy Agency

The International Atomic Energy Agency (IAEA) provides radioisotopes for use in the agricultural and animal sciences. Research on tsetse fly control in Zambia is one of several projects in Southern Africa where this methodology is being utilised. The IAEA is headquartered in Vienna, Austria.

9. International Soybean Program

Varieties from worldwide soybean collections are provided to Southern African countries through the University of Illinois International Soybean Program (INTSOY).

10. Asian Vegetable Development and Research Centre

The Asian Vegetable Development and Research Centre (AVDRC) in Taiwan provides high-yielding mungbean varieties for testing currently undertaken in Malawi as to their resistance to certain foliar diseases.

11. International Centre for Insect Physiology and Ecology

The International Centre for Insect Physiology and Ecology (ICIPE) currently provides technical information on pest management to several SADCC member countries. Its headquarters is in Kenya.

12. Centre on Integrated Rural Development for Africa

Headquartered in Arusha, Tanzania, the Centre on Integrated Rural Development for Africa (CIRDAFRICA) was established by the African Ministries of Agriculture to identify means of improving rural people's production, income, living standards and nutrition through research. A national component of this organisation has been established in Zambia.

13. Swedish Agency for Research Cooperation with Developing Countries

The Swedish Agency for Research Cooperation with Developing Countries (SAREC)'s most sizeable contribution in Southern Africa is its support of the Ngamiland Agricultural Development Project along the Okavango Delta in Botswana, although some funding in support of agricultural research has been provided to Tanzania as well. It is

also supporting SACCAR. SAREC has bilateral agreements on research cooperation with five SADCC countries. In all of these programmes agricultural research projects are included. SAREC is also supporting the international agricultural research centres and SACCAR.

14. International Foundation for Science

The International Foundation for Science (IFS) in Sweden provides small grants to individual researchers and to research institutions in several SADCC countries.

15. Swedish International Development Authority

The Swedish International Development Agency (SIDA) provides financial and technical support for developing countries. The SADCC countries are major recipients of the support through the aid given to individual countries as well as support to SADCC. The assistance also includes support for agricultural research related activities.

16. Danish International Development Agency

The Danish International Development Agency (DANIPA) provides funding in support of applied agricultural research and technical personnel for several SADCC-member veterinary and livestock research centres.

17. Arab-Technical Assistance Fund

The Arab-Technical Assistance Fund (FAAT) covers the common actions of several petroleum-producing Arab countries. It finances certain agricultural research projects in Africa, including Zambia from among the SADCC member countries.

18. Yugoslavia Maize Institute

The Yugoslavia Maize Institute has technical responsibility for Mozambique's maize and research programme.

19. Scandinavian Aid Programme

The Scandinavian Aid Programme provides funding for several of Mozambique's crop research programmes.

20. The German Democratic Republic

The German Democratic Republic is currently providing funding for Mozambique's wheat research programme.

21. Other countries

Argentina, Australia, Belgium, the Democratic People's Republic of Korea, Finland, France, Italy, Japan, the Netherlands, Norway, and the Union of Soviet Socialist Republics each participate in the financing of agricultural research or in the provision of technical expertise in various Southern African countries.

ANNEX 4

Methodology of the Agricultural Research Resource Assessment and  
Creation of the Data Base

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## ANNEX 4

### Methodology of the Agricultural Research Resource Assessment and Creation of the Data Base

Among the information gathered during the course of the Agricultural Research Resource Assessment (ARRA) in eight SADCC countries are data obtained from questionnaires which were developed in consultation with researchers from the participating countries. Three of the questionnaires were designed to produce an inventory of research, training and extension institutions, collecting information about their respective programmes, projects, physical facilities, and human and financial resources. Two others were designed to elicit information about constraints to increased agricultural productivity, including those confronting smallholders producing crops and livestock, and those hampering the effectiveness of the various agricultural research, training and extension institutions.

Data collected were entered on micro-computers, and formed an important source of information for the national and the regional ARRA reports. It also is intended to serve as a data base for use by SACCAR; in this context it could be used by project planners, administrators and funders from member and donor countries to obtain information such as research programmes' foci, activities, personnel, facilities and funding. Such information will facilitate the effective design, implementation and evaluation of agricultural research projects.

The following paragraphs describe in more detail the content of the questionnaires and the use of the data base.

#### A. The Questionnaires (Documents)

The Country Reports prepared for eight SADCC countries are based on information from five survey documents. These documents were designed to collect data in three general areas: the programmes, human resources, facilities and budget of each of the agricultural research, extension and training institutions; the constraints hindering greater agricultural productivity; and staff assessment of the institutions. The specific topics covered by each document are listed in the final section of this Annex.

##### 1. Document I

Document I was used to survey the research institutions. It included a list of research programmes and projects, funding, human resources, facilities and collaborating institutions.

2. Document II

Document II was used for the survey of training institutions. It focussed on: the nature and level of instructional activity; the number of students admitted and graduated from the various agricultural training programmes; the academic preparation of the professional teaching staff; and a brief profile of the student body. It also obtained information about the financial resources and physical assets of each institution.

3. Document III

Document III, serving as the survey of extension institutions, covered the various areas of activity of the extension programmes, the human and financial resources and facilities of each institution, and the linkages with research.

4. Document IV

Document IV was used to survey knowledgeable persons about the major constraints to increased agricultural productivity of small farmers. Respondents ranked the relative importance of the various physical, biological, economic and traditional constraints for the major crops and types of livestock. There were two versions of this document, one for crops and one for livestock. The document attempted to identify the research and other actions that need to be undertaken in the short and long term to alleviate the constraints. The survey was also designed to provide an estimate of the increase in production which would occur if the constraints were eliminated.

5. Document V

Document V was administered to the staff of the research, training and extension institutions in order to determine their perception of the relative importance of the various constraints limiting the effectiveness of these institutions. This document gathered information from staff members on a variety of issues, such as staff qualifications, budget problems, physical facilities, transportation, salaries, and other terms and conditions of service. This form had three versions, one for each type of institution.

B. The Data Base and Its Uses

One purpose of the data base is to establish an inventory of research programmes and projects and of the human, financial and physical resources of the research, training and extension institutions. With an index of more than 4,000 variables, a great number of comparisons can be drawn to assist in the analysis of various topics including, for example, constraints to production. A



wide range of matrices can be created--from the very specific to the general, and covering a single country or the entire region--by writing short dBase programmes, or by using the data base management system that is being prepared.

In a synthesis of information contained in the national reports, several new analyses can be made, after the data base has been sufficiently "cleaned" and reformatted where necessary. Some examples are presented below.

1. Personnel

An analysis of institutions' human resources could include such relevant factors as the number of research workers by discipline and level of training, the need for additional personnel, the percentage of research workers who are nationals, and training needs for additional personnel.

2. Research programmes by subject and activity

Analysis of research programmes can be performed by subject and project, as well as by the number and training of research workers.

3. Budget data

The operating budget expended per research worker could be identified where the basic data is available in the questionnaires.

4. Constraints

The relative severity of a wide range of constraints to increased production can be identified, as can the research and activities proposed to relieve those constraints.

C. The Microcomputer Programme--dBase II--and Its Use

1. Programme used

The dBase II programme from Ashton-Tate was used on an Apple IIe plus two 10-megabyte Corvus units to store and handle the data obtained. This programme requires setting up the data in files, following a structured format which permits up to 32 fields in a file. The fields can be of three types:

- o Character, that is, words or letters;
- o Numeric; or
- o Logical, that is, where there are only two possibilities (e.g., yes/no, true/false).

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The length of the field must be specified, except for logical fields which have only one space. Fields may not exceed 256 spaces, but two fields may be used in sequence to provide more spaces. Each file is limited to a total of 1,000 spaces, and the number of records is limited to 65,535. Manipulation of the data is greatly simplified by the use of a hard disk which, in this case, had a capacity of ten million bytes in each of the two units.

## 2. Editing of survey data

The data have been recorded from the survey forms, and the programme provides the necessary prompts. The files can be printed out as a report, updated, reorganised or rearranged, read, counted and displayed.

Because of the different backgrounds of the interviewers who completed the forms, the questionnaires were received in varying states of completion--most were handwritten and others contained typing errors. It therefore was necessary to ensure that the operators, who were not experts in the agricultural field, could easily read the data which they had to enter into the computer.

DBase II requires the specification of the maximum field length. This was set up after receiving some of the completed forms. The total file limit of 1,000 spaces and consideration of the data storage needs required constraining the size of the fields. It was decided to comply with the constraint by editing at the collection centre, which required a considerable amount of work, rather than by requiring the interviewers to limit the length of their remarks on the forms. It was often necessary to use abbreviations to fit the information to the field size.

Although it was not explicit in the questionnaire, there was also a limit on the number of fields available for the different entries. These limits were, to some extent, implied by the limited space available for the response in the questionnaire.

In other cases, the interviewers entered what they considered to be activities within a project as individual projects. These had to be grouped and included in a common project. The section on collaborating institutions which was part of the inventory of research programmes often included a large number of institutions (in one case filling a whole page). The reply entered into the data base was limited to six domestic and four foreign institutions.

Certain subjects, such as the linkages between extension and research, were considered so important that they were entered as written, using a word processing programme.

#### D. The SADCC Database Management System

The SADCC Database Management System (SADCC DBMS) will consist of over 150 data files all interconnected by means of a series of programme files. The data base itself will contain all the data collected in the five main documents described below, plus other files containing a dictionary of all the data elements in the data base.

The SADCC DBMS will be basically menu-driven. The user will be presented with a series of menus from which he/she will be able to choose appropriate paths in order to obtain specific data pertaining to any of the countries, or to any of the types of institutions, or to any particular crop or livestock recorded in the data base.

Based on Devres' experience in the Sahel, where a similar system has been installed, the SADCC DBMS will contain a formidable amount of data which, for the first time, will be assembled together. The SADCC DBMS will be structured in such a way that subsequent updating as well as future expansion of the data base itself will be possible.

#### E. Basic Survey Information

The content of the five documents (or questionnaires) used in the survey as entered in the data base is presented in the following outline.

##### 1. Document I: Research Institutions

###### a. General background

- (1) Name of institution
- (2) Status/affiliation (government or private)
- (3) Location and activity of branch stations
- (4) Administration
- (5) Nature and level of research activity (FTEs by programme area)
- (5) Major programmes and projects

###### b. Human resources

- (1) Total staff by function/service (administrative, professional, technical, and support staff; and by national origin
- (2) Number of research professionals by discipline/field, level of degree, and sex

- (3) Number of nationals in training by level and location
    - (4) Projected training plan by level and location
  - c. Budget by source
    - (1) Current operating budget by source (government and private national sources, and donors)
    - (2) Capital expenditure budget by source
  - d. Short description of main assets of institutions
    - (1) General description of main buildings
    - (2) Equipment (including data processors)
    - (3) Library and publications
  - e. General description and use of experimental/research stations and farms
    - (1) Name of stations and characteristics
    - (2) Land and land use
    - (3) List of species of animals used in livestock research
  - f. Other outputs of the staff of research institutions
    - (1) Short courses and training offered
    - (2) Relationships within country and with other institutions
    - (3) Other activity by professional staff
2. Document II: Training Institutions
- a. General background
    - (1) Name of institution
    - (2) Status/affiliation
    - (3) Locations and level of instruction
    - (4) Administration

- (5) Nature and level of instructional activity  
(admissions, graduates by programme)
- b. Human resources
- (1) Total staff by function/service and by national origin
  - (2) Teaching professionals by discipline/field, level of degree and sex
  - (3) Number of nationals in training by level and location
  - (4) Projected training plan by level and location
  - (5) Characteristics of student body
- c. Expenditures by source
- (1) Current operating budget by source (national government and private national sources, and donors)
  - (2) Capital expenditure budget by source
- d. Short description of main assets of institutions
- (1) General description of main buildings
  - (2) Equipment
  - (3) Library and publications
- e. General description of land available for students' practical experience
- (1) Total area available and use
  - (2) Work opportunities available
- f. Other outputs and relationships of the staff
- (1) Short courses and training offered
  - (2) Relationship within country with other institutions
  - (3) Other activity by the professional staff

3. Document III: Extension Institutions

a. General background

- (1) Name of institution
- (2) Status/affiliation
- (3) Location of regional/provincial offices
- (4) Administration
- (5) Nature and level of extension activity (FTEs by programme area)
- (5) Major programme areas of extension and funding

b. Human resources

- (1) Total staff by function/service and by national origin
- (2) Number of extension professionals by discipline/field, and level of degree
- (3) Number of nationals in training by level and location
- (4) Projected training plan by level and location

c. Expenditure by source

- (1) Current operating budget by source (government and private national sources, and donors)
- (2) Capital expenditure budget by source

d. Short description of main assets of institutions

- (1) General description of main buildings
- (2) Equipment
- (3) Library and publications

e. Other outputs and relationship of the staff

- (1) Short courses and training offered

- (2) Relationships within country and with other institutions
- (3) Other activity by professional staff

4. Document IV: Constraints

Two different versions of this document were used, one for crops, and the other for livestock. They were as similar as possible in content. Their general outline was as follows:

- a. General information
  - (1) Crop/livestock name
  - (2) Production data
  - (3) Ecological regions
- b. Constraints to achieving higher yields
  - (1) Physical and biological constraints
  - (2) Economic and policy constraints
  - (3) Constraints related to rural traditions
  - (4) Institutional constraints
- c. Assumptions
- d. Research actions recommended

5. Document V: Assessment of Institutional Aspects

This form had three different versions, one each for the research, training, and extension institutions. The main purpose was to gather evaluative data on the following problems or criteria:

- a. Budget
  - (1) Consistency of support
  - (2) Level of funding
  - (3) Timing of disbursement of funds
  - (4) Foreign exchange difficulties

- b. Quality and training of staff
  - (1) Senior staff
  - (2) Junior staff
  - (3) Support staff
- c. Facilities
- d. Equipment
- e. Transportation
- f. Terms of service and benefits
  - (1) Staff housing
  - (2) Salary scales and levels
  - (3) Promotion and evaluation systems
  - (4) Job tenure
  - (5) Leaves of absence
  - (6) Health benefits
  - (7) Retirement benefits

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ANNEX 5

Current CDA-Sponsored Agricultural Research Projects

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Annex 5: Current CDA-Sponsored Agricultural Research Projects (by Country and by Type)

Country	Institution/ Project	CDA Donor	Donor Contribution— 1984 <sup>a</sup> (US \$)	Project Type				
				Crops	Livestock	Agro-Forestry	Fisheries	Farming Systems
Botswana	Department of Agricultural Research	US-Canada [includes FAO and SIDA also]	68,243	X	X			X
	o Oilseeds	France	NA <sup>b</sup>	X				
	Farm power	UK	NA					X
	Agricultural technology improvement project— Bean/Cowpea (CRSP)	US	20,175 (recurrent: 16,868) (capital: 3,307)	X				
	INTSORMIL	US	NA	X				
	Central Research Station	UK	23,366	X	X			X
	Dryland farming research scheme	UK	NA	X				
Lesotho	Farm Systems Research and On-Farm Adaptive Research	US	1,775,893 <sup>c</sup> (recurrent: 910,126) (capital: 65,767)	X	X	X	X	X
	Dairy research	Canada	NA		X			

Annex 5: Current CDA-Sponsored Agricultural Research Projects (by Country and by Type) (cont.)

Country	Institution/ Project	CDA Donor	Donor Contribution— 1984 <sup>a</sup> (US \$)	Project Type				
				Crops	Livestock	Agro-Forestry	Fisheries	Farming Systems
Malawi	Integrated Livestock Development	UK	875,000 <sup>d</sup>		X			
	Department of Agricultural Research	US	2,265,124 <sup>e</sup>	X	X			X
	Bunda College— Bean/Cowpea CRSP	US	161,278 <sup>f</sup>	X				
	Tobacco Research Authority	UK	47,656 <sup>g</sup>	X				
	Tea Research Foundation	UK	95,313 <sup>g</sup>	X				
	Bvumbwe Agricultural Research Station	UK	47,656 <sup>h</sup>	X				
	Bunda College Animal Nutrition Research	Canada	61,000				X	
Mozambique	Groundnut Research	Canada	398,953	X				
Swaziland	Inter-cropping project (Maize, Pumpkins)	Canada	58,100	X				
	Agricultural Research Division	US	2,278,201	X				X

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Annex 5: Current CDA-Sponsored Agricultural Research Projects (by Country and by Type) (cont.)

Country	Institution/ Project	CDA Donor	Donor Contribution— 1984 <sup>a</sup> (US \$)	Project Type				
				Crops	Livestock	Agro-Forestry	Fisheries	Farming Systems
Tanzania	Ministry of Agriculture (Directorate of Agricultural Research)							
	o Agricultural research <sup>i</sup>	FRG	300,080 <sup>j</sup>	X				
	o Agricultural research <sup>i</sup>	US	6,711,000 <sup>j</sup>	X				
	o Farming systems	US (includes Norway)	4,044,000 <sup>i</sup>	X				
	o Wheat agronomy and breeding	Canada	NA	X				
	o Oilseeds	UK	NA	X				
	o Farm mechanisation	Canada	NA	X				
	o Weed control	Canada	NA	X				
	o Cashew nuts (commercial)	Italy	NA	X				
	Bean/Cowpea CRSP	US	NA	X				
	Forestry	Canada	NA				X	

Annex 5: Current CDA-Sponsored Agricultural Research Projects (by Country and by Type) (cont.)

<u>Country</u>	<u>Institution/ Project</u>	<u>CDA Donor</u>	<u>Donor Contribution— 1984<sup>a</sup> (US \$)</u>	<u>Project Type</u>				
				<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>Farming Systems</u>
Zambia	Plant protection	Belgium	1,885,000 (recurrent: 1,414,000) (capital: 471,000)	X				
	Wheat research	Canada	10,570,000	X				
	Cotton breeding	France	500,000 (recurrent: 400,000) (capital: 100,000)	X				
	Provision of research scientists	FRG (via GVS)	92,000	X	X	X		
	Agricultural research and extension project	US	12,515,000 (recurrent: 9,386,000) (capital: 3,129,000)	X				
	Institute for African Studies/Kafue Fisheries	Canada	75,000				X	
	Vegetable dehydration	Canada	82,000	X				
	Demographic impact of modernization <sup>k</sup>	Canada	NA					
	Rural Inequality in Southern Province <sup>k</sup>	US	NA					
	Input Utilization in Agricultural Sector <sup>k</sup>	US	NA					

Annex 5: Current CDA-Sponsored Agricultural Research Projects (by Country and by Type) (cont.)

Country	Institution/ Project	CDA Donor	Donor Contribution— 1984 <sup>a</sup> (US \$)	Project Type				
				Crops	Livestock	Agro-Forestry	Fisheries	Farming Systems
Zimbabwe	Regional Sorghum and Pearl Millet Research and Training Program	US <sup>1</sup>	13,300,000	X				
		Canada	152,045					
	Animal Production Systems Programme	Canada	152,837		X			
	Dairy Herd Development	UK	350,000 <sup>m</sup>		X			
	Department of Research and Specialists Services	Canada	448,780 (recurrent: 424,000) (capital: 24,780).	X	X			

<sup>a</sup>Unless otherwise noted, the donor contribution is that of 1984.

<sup>b</sup>Not available.

<sup>c</sup>Expected life-of-project contribution 1978-1985.

<sup>d</sup>Expected life-of-project contribution (1981-1984), converted to US dollars at a rate of \$1.40/pound from data submitted by the British Development Division located in Malawi.

<sup>e</sup>Cumulative total contributed from 1980 through 1984 estimated at \$10,000,000.

<sup>f</sup>Expected life-of-project contribution (1981-1985) is \$550,000.

<sup>g</sup>Initial contribution made in 1982; expended over several years until funds are exhausted. Subject to renewal.

Annex 5: Current CDA-Sponsored Agricultural Research Projects (by Country and by Type) (cont.)

<sup>h</sup>1982 contribution.

<sup>i</sup>Includes equipment, buildings, staff support, and other infrastructural and administrative resources.

<sup>j</sup>Expected life-of-project contribution.

<sup>k</sup>These research projects are best classified as social science projects. Due to the very limited number of such projects reported, no specific column is designated in this table for projects of the social research type.

<sup>l</sup>Project is also supported by donors other than CDA.

<sup>m</sup>British pound figure was converted at the rate of \$1.40/pound.

Sources: Data collected from the DEVRES/SADCC Agricultural Research Resource Assessment, 1984; British Development Division in Southern Africa, Lilongwe, Malawi, August 1984; the Canadian International Development Agency, Hull, Quebec, Canada, February 1984; the U.S. Agency for International Development Board for International Food and Agricultural Development Office (BIFAD), Washington, D.C., 1984; and the AID Technical Resources Office (AFR/TR/ARD) Functional Information System, Washington, D.C., October 1984.

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ANNEX 6

Southern African Centre for Cooperation  
in Agricultural Research  
(SACCAR)

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## ANNEX 6

### Southern African Centre for Cooperation in Agricultural Research

#### A. Background<sup>a</sup>

The recently established Southern African Centre for Cooperation in Agricultural Research (SACCAR) has its roots in the formation of the Southern African Development Coordination Conference (SADCC). SADCC was established in April 1980 at a meeting in Lusaka of the heads of state of the nine majority-ruled countries in Southern Africa. Its goals are to promote coordinated development in several fields and to reduce member states' dependence on other countries, particularly on South Africa.

The Lusaka Summit accorded high priority to agricultural research as an area for regional cooperation and as a means to achieve self-sufficiency in food supply. Botswana was given the responsibility to take leadership of regional agricultural research cooperation, and Zimbabwe, responsibility for food security.

Technical committees were set up with representatives of member governments to review proposed programmes and projects. The Consultative Technical Committee (CTC) for Agricultural Research is one of three advisory committees under the SADCC Food Security Programme coordinated by Zimbabwe; the other two CTCs are for Extension and Training and Agricultural Economics and Marketing. Members of the CTC for Agricultural Research (also called the CTCAR) are the Directors of Agricultural Research of the Ministries of Agriculture of the nine SADCC member countries. They currently meet at least twice a year.

In response to a request from Botswana following the Lusaka resolution, ICRISAT sent a fact-finding mission to the SADCC countries in November 1980. Subsequently, ICRISAT and Botswana developed four regional projects which were approved in principal by the SADCC Council of Ministers at the January 1982 meeting in Maseru. These projects are: (1) the Sorghum and Millet Improvement Project, based in Zimbabwe; (2) the Grain Legume Improvement Project, based in Malawi; (3) the Land and Water Research Management Project, based in Botswana; and (4) a study to establish a Centre for Coordination of Agricultural Research in the SADCC countries. In regard to the fourth, USAID/Zimbabwe contracted the International Agricultural Development Service (IADS) to prepare a study which was completed in August 1983. Subsequently, SADCC approved the formation of SACCAR based on the recommendations in this report.

## B. Purpose

The overall goal of SACCAR is to improve agricultural research systems in the region, leading to improved agricultural productivity, more effective land use and increased farmer incomes. As a small secretariat for the CTCAR, it will provide an institutional base for long-term research cooperation. SACCAR is designed to work with national agricultural research systems of member countries and to facilitate cooperation between members, international organisations, donors and other countries outside the region. As a focal point for coordination of activities in agricultural research among SADCC members, it will: help key personnel work together; provide access to information and technical assistance for research; and provide training and educational opportunities for appropriate personnel.

Strength may be derived from regional cooperation, so that donor-financed programmes, for example, will be planned in consultation with qualified local staff, rather than solely by outside experts, because scarce resources will have been pooled.

## C. Activities

The following are the major services to be provided by SACCAR.

### 1. Promotion and coordination in agricultural research

This includes assistance to promote coordination within and between member countries and linkages with other research organisations and donors. It also includes maintaining an inventory of the research capacity of member countries, of regional research initiatives, and of natural resource information.

### 2. Workshops and training

Workshops, seminars and conferences will be sponsored and promoted to fulfill specific training needs, address high-priority problems, enhance multidisciplinary approaches and synthesise information on priority topics.

### 3. Documentation and publications

Plans are for annual updates of the ARRA inventory on national and regional research systems, a regional newsletter and agricultural research journal, and special papers.

### 4. Grants and special studies

The small research and travel grants will help promote coordination in agricultural research and career development of junior and mid-level scientists.

#### D. Organisational Structure

The SACCAR offices will be in Botswana at the Agricultural Research Station at Sebele.

SACCAR will be administered by a Director selected by the Government of Botswana (Ministry of Agriculture) in full consultation with the CTCAR. The Botswana Ministry of Agriculture and the CTCAR will approve the policies, programmes, staffing and budget of SACCAR. The SACCAR Director will work closely with the CTCAR and will be an ex officio member of it. Selection of activities will be determined by the member states themselves and agreed upon by the CTCAR. The SACCAR Director will implement activities, working with key personnel involved in national agricultural research efforts and with outside technical assistance when required. SACCAR will help to determine the priorities for activities, determine the level of resources to be used, and establish criteria for its involvement in these activities.

In conformity with the SADCC policy to decentralise activities as much as possible rather than to create new institutions, SACCAR will be a small entity. To carry out its functions, SACCAR will have a small core senior staff with backgrounds in research and research administration. The four senior personnel will be: Director, Manpower and Training Officer, Information/Publications Officer and Administrative/Accounts Officer. They will be assisted by support staff, consultants, and persons seconded from national Ministries of Agriculture as needed.

#### E. Funding

SACCAR is a regional, non-profit research support organisation. It is funded initially by CIDA and IDRC of Canada, USAID, Italian AID and SAREC of Sweden. However, it is hoped that it will be supported by other CDA members and other donors.

The IDRC is providing an interim director for SACCAR who took office in Gaborone in October 1984. During his nine-month term he will travel to the SADCC countries to implement SACCAR activities and to identify a director from within the region.

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<sup>a</sup>Up to date information on the current status of SACCAR can be obtained directly from the Secretariat at the following address: SACCAR, Private Bag 0033, Gaborone, Botswana; Telephone 52361; Cable RESAGRIC.

ANNEX 7

Simple Linear Calculation of Cereal Support Required to Keep Up  
with Projected Population Growth for Selected Years (1968-2005)

## ANNEX 7

### Simple Linear Calculation of Cereal Support Required to Keep Up with Projected Population Growth for Selected Years (1968-2005)

#### A. Background

In setting as an objective for the 20 year programme a goal of increasing agricultural production at a rate equivalent to or better than the growth in population, the question arises what will be a measure for success in achieving this objective. A related question is can some interim target be set up on which to gauge the progress of the 20 year programme?

A number of methods could be used to assist in the establishment of output targets. For the needs of this study we have chosen a simple and rapid method--the calculation of trend lines of time series data to obtain simple relationships. This procedure permits accomodating only the simplest assumptions relating to changes in the parameters affecting output changes. We believe that the illustrative data shown in Annex Table 7-1 points up dramatically the magnitude of the task ahead for the SADCC countries.

Based on a straight line projection of the cereal production required to keep up with projected population growth for the years 1985-95 and provide a per capita output of 150 Kg for the method of calculation (see Section B. Method), it is estimated that over the ten-year period (1985-1995), the cereal production would need to increase by 82 percent, or roughly 6.1 percent per year.<sup>1</sup> This is needed in order to make up for the production deficit accrued by 1985 and to keep up with the projected increase in population.

After SADCC (CTCAR and SACCAR) and the member countries have had time to vet the program suggestions, refine the priorities, and decide on the timing for implementation, it may be useful to employ more complex models which use more detailed assumptions, place values on variables that account for the impact of changes in several components of technical agricultural changes, make adjustments in prices for inputs and outputs, calculate separate trend lines for commercial and traditional sector production of major crops, include livestock, etc. This might usefully be done at the time of the first five year assessment of the proposed programme suggested for 1990.

#### B. Method

The following describes the method and sources of data utilized in preparing Annex Table 7-1:

- o Data on total population and total cereal production were taken from Annex 2, Table 2-1.

- o Trend point values for the population were based on the population estimates for 1966 and 1984 which yielded a growth rate of about 2.9 percent per year.
- o Trend point values were calculated for the cereal production using the means of the periods 1966-70 and 1980-84 thus establishing trend point values for 1968 and 1982 which yielded a growth rate of about 1.3 percent per year.
- o Trend point values were extended by five year periods beyond 1985. (Note: Calculation of simple linear trend is useful because this reduces the year to year variation in data series which are expected especially in crop production data because of the influence of weather, disease/pest outbreaks, and other factors.)
- o This approach makes possible simple comparisons between data series and permits extrapolation. (A considerable amount of caution obviously has to be exercised in the interpretation of data and in extrapolation of data, particularly beyond five years from the actual data base.)
- o The base of 150 Kg cereal production per capita was chosen for ease of calculation. It is commonly used base by international specialists in situations where the production is derived principally from the traditional sector with a minimal influence from commercial production. It happens to coincide with the actual actual per capita production for the SADCC countries for the five-year period 1966-70.
- o Trend values have been extended using the target base for the years indicated, and are shown in Column 4 of Annex Table 7-1.
- o The difference between the trend values of actual production and targeted production is shown in Column 5 of the same table and permits easy comparisons. For example, to meet targeted objectives of 150 Kg per capita production by year 2000 would require 16,185,000 M/T which is substantially larger than the trend value of actual production of 9,413,000 MT, and therefore would requires an 6,772,000 MT of additional output to meet the estimated need.
- o Column 6 shows the percentages above (+) or below (-) of the actual production from the target production in a given year.

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<sup>1</sup>This annual rate was obtained by applying the standard compound-interest formula,  $1 + r = \text{antilog} (\log (p_2/p_1)/\text{no. of years})$ .

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Table 7-1: Illustrative Linear Relationships Between Population and Cereal Production, SADCC Countries

Year	Population (1,000) (1)	Actual Cereal Production (1,000 MT) (2)	Per Capita Production of Cereals (3)	Target Production (150/Kg/c Per Cap) (4)	Difference (1000 MT) (5=2-4)	Percent of Target Production (6)
1966	40,393	6,399	158	6,059	340	+5.6
1968	42,478	5,825	137	6,372	-527	-8.6
1972	47,538	8,358	175	7,131	1,227	-17.2
1978	56,208	7,639	135	8,431	-792	-9.4
1982	63,703	8,074	126	9,555	-1,481	-15.6
1984	67,954	6,991	102	10,193	-3,202	-31.4
1985	69,946 <sup>a</sup>	<u>7,717<sup>b</sup></u>	110	10,492	-2,775	-26.4
1990	80,819 <sup>a</sup>	8,245 <sup>b</sup>	102	12,123	-2,775	-26.4
1995	93,383 <sup>a</sup>	8,810 <sup>b</sup>	94	<u>14,007</u>	-5,197	-37.1
2000	107,900 <sup>a</sup>	9,413 <sup>b</sup>	87	16,185	-6,772	-41.8
2005	124,030 <sup>a</sup>	10,328 <sup>b</sup>	83	18,604	-8,276	-44.5

<sup>a</sup>Projections are based on the population estimates for 1966 and 1984. The 1+r value obtained was 1.0293374, or a population growth rate of 2.9 percent per year.

<sup>b</sup>Projections are based on the means of actual production for 1966-70 and 1980-84 which thus established trend point values for 1968 and 1982 respectively. The 1+r value obtained was 1.0133327, or a growth rate of 1.3 percent per year.

<sup>c</sup>The base of 150 Kg cereal production per capita was chosen for ease of calculation. It is a commonly use base by international specialists in situations where the production is derived principally from the traditional sector with a minimal influence from commercial production. It happens to coincide with the actual average per capita production for the SADCC countries for the five year period 1966-70 i.e., 149 Kg.

SOURCE: Annex 2-1, DEVRES/SADCC Agricultural Research Resource Assessment, 1984.