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REPORT OF THE ICRISAT MISSION TO SOUTHERN AFRICA

(8 Nov - 3 Dec 1980)

PART 1 - MAIN REPORT

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics
ICRISAT Patancheru P.O.
Andhra Pradesh 502 324, India

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1. SUMMARY

1. The Southern African Heads of Governments at their Lusaka Summit in April 1980 urged ICRISAT to set up a Regional Center in Botswana to serve the nine Southern African Development Coordination Conference (SADCC) member countries -- Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe. ICRISAT responded by sending, in November 1980, a fact-finding mission to examine the existing production, production constraints, and status of research and development on the ICRISAT mandate crops -- sorghum, pearl millet, groundnut, pigeonpea and chickpea -- and the potential for ICRISAT's input for their improvement. The Mission visited all the SADCC countries except Angola, and gathered detailed information on the ICRISAT crops in each country.

2. The main findings of the Mission were as follows:

(a) There is considerable potential for an input by ICRISAT under the aegis of SADCC for work on three of the five crops in ICRISAT's mandate, namely sorghum, pearl millet and groundnut. There is additionally a need for an in depth examination of the best method of input into the farming systems area. There is little scope currently for work on pigeonpea and chickpea.

(b) There is considerable scope for a major input by other crop based CGIAR Centers, in assisting with strengthening research on the major food crops of the SADCC countries. These include maize, dry beans and cassava.

(c) It was recommended that Centers input into agricultural research in the SADCC countries should be through small multi-disciplinary teams functioning on existing national research stations. However there was a need for a coordinating cell to liaise effectively between countries in SADCC, the International Centers and other Regional and International programs. In line with the recommendations of the Heads of State this should be based in Botswana. The Mission drew attention to the ongoing negotiations on groundnut research between ICRISAT and the Government of Malawi and reaffirmed the importance of continuing the ICRISAT effort on cereal breeding in Tanzania.

(d) With specific reference to the groundnut, pearl millet and sorghum improvement and considering their importance in the SADCC countries the mission noted the considerable yield gap between yields of these crops on farmers fields (about 500 kg) compared to those on research stations (about 3-4000 kg) in the concerned countries, the following were identified as major constraints to increased production.

Groundnut	Cultural practices Drought Diseases	Soil fertility and "pops" Varieties
Sorghum	Bird pests Drought Varieties	Draught power Insect pests Soil fertility
Pearl millet	Bird pests Drought Varieties	Draught power Soil fertility

Individual country research efforts on sorghum and pearl millet have been minimal. However, interest has increased over the past two or three years and five countries now have research programs concentrating on variety trials. These programs are poorly staffed and funded. Groundnut research has been spasmodic in most countries except Malawi and Zimbabwe where the programs are successfully contributing to the improvement of the crop.

The Mission concluded that ICRISAT could have an immediate role in catalysing research in these constraints by provision of germplasm, information and research technology. This would best be effected initially by posting highly qualified staff to the SADCC countries. It was stressed that a major element in strategy should be identification and training of national scientists to ensure long term continuity and follow through on the crops and systems associated with production.

(e) The Mission recommended development of regional projects on food crops with a view to seeking sources of funding. Project proposals should be developed by the SADCC coordinating unit in consultation with the CGIAR Centers.

(f) An outline staff proposal and budget arising from recommendations made in the report is given in Annex I.

(g) Detailed documentation on the status of production and research of all five ICRISAT crops was obtained and is available to individual countries in SADCC.

II. INTRODUCTION

The declaration on Development Cooperation adopted by the Southern African Heads of Governments at their Economic Summit held in Lusaka in April 1980 urged that the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) set up a Regional Center in Botswana to serve the member countries of the Southern African Development Coordination Conference (SADCC). The SADCC countries are Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe.

The reason for urging ICRISAT's involvement in agricultural research in Southern Africa was the high priority which the Lusaka Summit gave to agricultural research and development as a means of solving the problems of inadequate food supply and poor nutrition in the region, and the increasing reliance on food imports from South Africa. In recent years the fragile food supply and security situation has been aggravated by recurrent drought cycles.

In response to a formal request made by Botswana, on behalf of the SADCC countries, in August 1980, ICRISAT sent a fact-finding Mission to Southern Africa in November 1980. The Mission's terms of reference were to examine the existing situation regarding ICRISAT mandate crops (sorghum, pearl millet, groundnut, pigeonpea and chickpea), production constraints, status of research and development of these crops, and the potential for further involvement of ICRISAT in cooperative research on these crops in the SADCC countries. The Mission, consisting of

Dr.L.K. Mughogho, Dr.M.B. Boling, Dr. J.H. Williams, Dr. S.Z. Mukuru, Dr. W. Reed, and Dr. G. Gunasekera, divided into two groups so as to adequately cover all countries within the time constraints. The first three members of the team visited Malawi (10-15 November), Zimbabwe (15-20 November), Swaziland (20-23 November), and Lesotho (24-26 November). The other three members visited Tanzania (8-15 November), Mozambique (15-22 November) and Zambia (22-27 November). Both groups met in Botswana (27 November-3 December) and held discussions with the Botswana authorities who have overall responsibility for coordination of SADCC activities in agricultural research. It was not possible for the Mission to visit Angola owing to communication difficulties in obtaining the necessary clearances.

The first group of the Mission was joined in Zimbabwe by Dr. R.B. Contant, representing the International Service for National Agricultural Research (ISNAR). ISNAR has recently been established by the Consultative Group on International Agricultural Research (CGIAR) with the mandate to help strengthen national agricultural research capabilities in developing countries. In view of the relevance of this mandate to ICRISAT's activities, ISNAR was invited and readily agreed to participate in the Mission.

A questionnaire was distributed to all countries to facilitate discussions listing data which was essential for carrying out the team's mandate. Unfortunately this list did not reach the concerned departments in all countries in time for them to gather the required data. (Sample proforma given as Annex in Part II of Report).

The Mission's report is presented in two parts: Part 1 is the Main Report containing the findings and recommendations and Part II contains the detailed individual Country Reports.

The Mission was well received in all the countries visited and discussions held very fruitful. We are greatly indebted to all those who found time to give us the information contained in the reports.

III. BACKGROUND INFORMATION ON THE REGION

Location, Area and Development Indicators

The region covered by SADCC is very large and diverse. The region lies between the Atlantic (11°E) and Indian Oceans (41°E) and stretches from near the equator to about 30°S, and has a total area of 4.9 million km^2 (Map 1). The elevation ranges from sea level to highlands of over 3,500 meters. Most of the region is an elevated plateau lying between 900 and 3,000 meters. Although 95% of the region is in the tropics, the whole of Lesotho and Swaziland, one third of Botswana and a small portion of Mozambique lie outside the tropics. These differences in location and physiography are reflected in the wide range of climates, soils and photoperiods found within the region. Well over 75% of the region is semi-arid as defined by ICRISAT.

Some indicators of the present level of agricultural development of the SADCC countries are given in Table 1. The following points are noteworthy:

(a) Over 70% of the population is engaged in agriculture and live in the rural areas.

(b) The population growth rate is high, about 3% a year, while the annual increase in cereal production is 2.3%.

(c) The region imports an average of 16% of its total cereal consumption. This figure is most probably much higher currently as a result of persistent droughts since 1977. In fact Zimbabwe,

which was previously an exporter of grain, imported a substantial amount of grain in 1980.

(d) Five countries in the region, namely Botswana, Lesotho, Malawi, Mozambique and Tanzania, are among 52 "crisis" countries in the world which have been designated for special attention by international agencies.

In general the low rate of growth in agricultural production combined with high population growth rate has led to inadequate or poor nutrition for the population, an increasing reliance on food imports, mainly from South Africa, and low financial contributions to development.

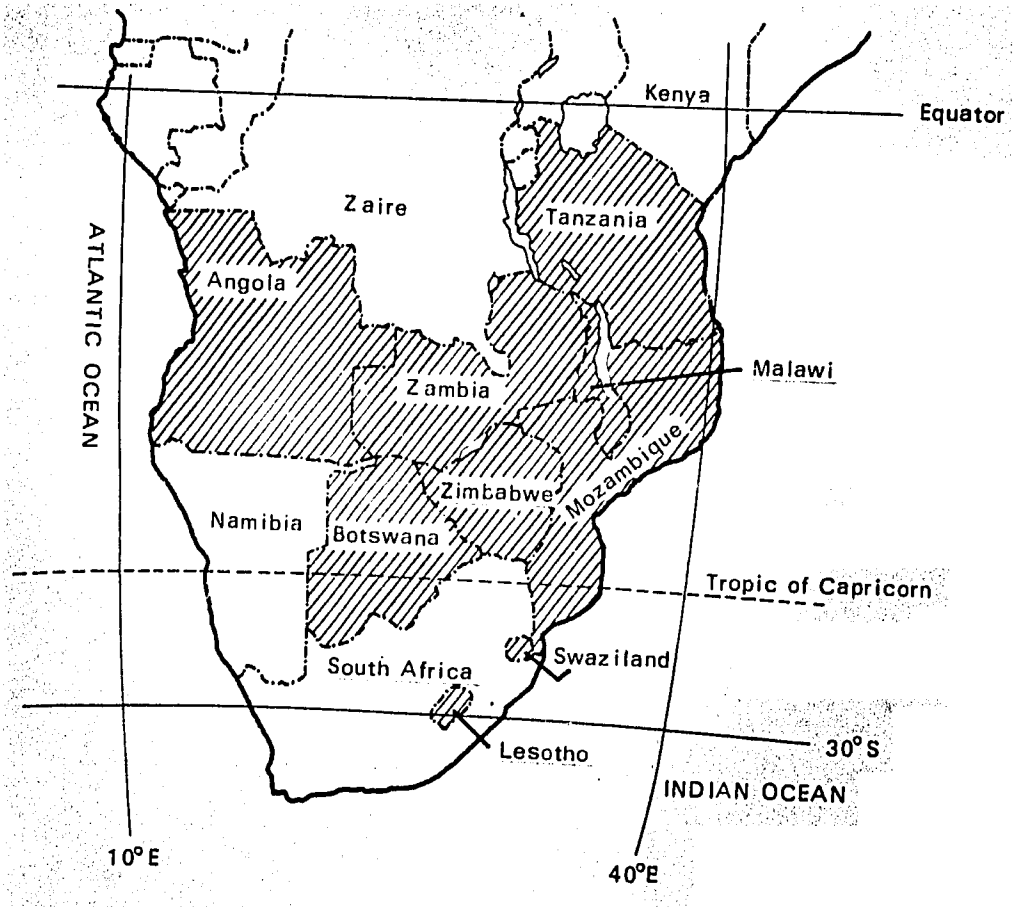
Important Food Crops

Table 2 gives the 1978 FAO production data for the main food crops in the SADCC countries. The dominant cereal crop for the area is clearly maize, the production of which far outstrips all other food crops, except cassava. In none of the countries does production of the next most important cereal, sorghum exceed that of maize. Nevertheless sorghum is a significant cereal crop in most of the SADCC countries. Although pearl millet production data are not given in the FAO report, the crop is important in Zimbabwe, Tanzania and Angola.

Groundnut is grown in all countries except Lesotho and is important in Zimbabwe, Malawi, Mozambique and Tanzania.

Chickpea and pigeonpea, the two remaining ICRISAT mandate crops are either not grown or produced in relatively small amounts and generally constitute a negligible proportion of the food requirements of the population.

Other important food crops are cassava, rice, wheat and *Phaseolus* beans.



Map 1. Member Countries of the Southern African Development Coordination Conference (SADCC)

Table 1. Some Indicators of Agricultural Development of the Southern African Development Coordination Countries

	Angola	Botswana	Lesotho	Malawi	Mozambique	Swaziland	Tanzania	Zambia	Zimbabwe	Total/ Mean
Least developed countries a/		X	X	X			X			
Most seriously affected countries b/			X		X					
Food priority countries c/			X	X	X		X			
Priority food deficit countries d/							X			
Area (000 km^2)	1,251	600	31	119	783	17	940	757	390	4,888
Population: 1979 total (millions)	6.9	0.7	1.3	5.9	10	0.5	17	5.6	7.2	66
Density/km^2	5.5	1.2	42	49.6	12.8	29.4	18.1	7.4	18.5	21
Growth rate (% per year)	2.4	3.4	2.4	3.2	2.8	2.8	3.0	3.0	3.4	2.9
In agriculture (1977%)	60	82	86	86	67	75	83	69	60	74
Cereal output (million tons) Avg 1975-77	0.6	0.1	0.2	1.3	0.6	0.1	1.5	1.2	1.8	7.4 (0.8)
Annual change cereal output (%) Avg 1969-71 VS 1975-77	-0.5	9.4	-1.0	1.3	-0.4	3.2	1.2	3.0	5.1	2.3
Cereal consumption per caput (kg/year) Avg 1975-77	102	186	222	253	90	233	113	252	266	190
Import content in cereal consumption (%) Avg 1975-77	14	32	23	2	23	11	13	10	Exporter	16

Source: Agricultural Development Indicators. A Statistical Handbook. 1980. International Agricultural Development Service, New York.

a/ Designation by the UN Economic and Social Council

b/ Designation by the UN General Assembly

c/ Designation by the UN World Food Council

d/ Designation by the Consultative Group on Food Production and Investment

Table 2. Production (in 1000 tonnes) in 1978 of ICRISAT Mandate Crops and Other Important Food Crops in Southern Africa

Country	ICRISAT Crops					Other Important Food Crops				
	Sorghum	Pearl Millet	Groundnut (in shell)	Chick-pea	Pigeon-pea	Maize	Rice	Wheat	Beans	Cassava
Angola	GNR	39	20	NG	GNR	400	20	10	65	1,700
Botswana	55	5	7	NG	GNR	45	NG	1	GNR	GNR
Lesotho	50	NG	NG	NG	NG	100	NG	60	10	NG
Malawi	110	GNR	100	GNR	GNR	1400	43	1	5	40
Mozambique	200	GNR	80	GNR	GNR	400	35	3	GNR	2,450
Swaziland	2	NG	GNR	NG	NG	90	5	1	1	NG
Tanzania	250	64	74	8	GNR	1000	260	65	160	4,076
Zambia	50	1	31	GNR	GNR	850	3	6	GNR	173
Zimbabwe	50	191	120	NG	GNR	1400	5	90	GNR	GNR
Total	767	300	432	8	-	5685	371	237	241	8,439

NG: Not grown

GNR: Grown but not reported.

Source: FAO Production Yearbook. 1978. Volume 32, except for data on pearl millet production, which are ICRISAT estimates for 1978.

IV. GROUNDNUT

Production

The most important producing countries, with substantial surpluses for export are Malawi and Zimbabwe. The crop is grown mainly by small farmers and yields are about 500 kg/ha, very low when compared with experimental yields of over 4,000 kg/ha obtained in Malawi and Zimbabwe. There is great potential for increasing the yield and hence total production in the region. The recent world shortage of vegetable oils and likely shortfalls in the mid 1980's make it highly desirable to do this as soon as is practicable.

In most groundnut-producing countries visited there was the desire to encourage production of both confectionery varieties for export and oil varieties to supply local markets, since vegetable oils are currently imported utilising scarce foreign exchange. Zimbabwe is interested mainly in the confectionery varieties as it already exports edible oils.

Production Constraints

The major constraints to groundnut production are given in Table 3 in the order of priority as assessed by the scientists in countries visited.

Cultural practices. Poor cultural practices, particularly late planting, low plant populations and poor weed control, are the major constraints to yield and contribute to the low production levels of groundnuts in most countries of the region.

Table 3. Major constraints to groundnut production in SADCC countries

Country	Constraint
Angola	Not visited
Botswana	1. Soil texture 2. Drought 3. Varieties
Lesotho	Crop not grown
Malawi	1. Cultural practices 2. Diseases 3. Pops 4. Labour
Mozambique	1. Varieties 2. Diseases 3. Drought
Swaziland	1. Pricing structure 2. Cultural practices 3. Diseases
Tanzania	1. Varieties 2. Cultural practices 3. Drought 4. Diseases
Zambia	1.Cultural practices 2. Pops 3. Diseases
Zimbabwe	1. Cultural practices 2. Soil fertility 3. Drouhgt 4. Diseases

Groundnuts are usually planted late, usually about 2 to 3 weeks after the arrival of rains, resulting in substantial yield reductions. The reasons for late planting vary from country to country, but in generally farmers sow late because groundnut takes second place to the staple grain crops. Low plant populations, a common feature of groundnut cultivation, are due to insufficient seed rate and/or failure to use seed dressings to prevent fungal attack. Consequences of low plant populations are increased incidence of rosette virus disease and weed control problems. With low plant populations and late planting there is little or no yield response to control of leaf diseases by chemical application (50 kg/ha in Malawi) and this is clearly uneconomic.

Where good cultural practices are followed, a different set of constraints applies, and drought and leaf diseases are usually comparatively more important. Weed control can be a serious constraint, particularly in the case of small farmers who rely on hand cultivation

Soil fertility. Soil problems which affect groundnut production are low pH and general nutrient exhaustion in continuously cropped soils. Where rainfall is reliable and sufficient, soils are often leached and pH's are low which may induce seed abortion (pops) and poor growth. Although this problem can be rectified by applications of lime and gypsum, this is beyond the means of small farmers. The problem of 'pops' becomes less serious in the drier areas of the region where water availability becomes the major yield constratint.

In general, nodulation is not a problem in the region but general soil exhaustion caused by over cropping is. This will become more important in the future, particularly as human populations increase.

Varieties. Lack of suitable varieties for different agro-ecological areas is a constraint to groundnut production in all countries except Malawi and Zimbabwe, where good varieties have been released. In Botswana and Swaziland the varieties grown are of South African origin and have high yield potential when well managed. In Zambia there is some doubt about the purity of the released varieties which are also very prone to produce 'pops'. The situation in Tanzania is that the previously released varieties have usually become mixed and the research program is currently trying to re-establish seed purity. In Mozambique no recognized improved varieties exist.

Throughout the region, the lack of short season dormant varieties limits groundnut production.

Drought. The relative importance of drought as a factor limiting groundnut production varies. In Malawi and Zambia it is of least importance. In most countries the total rainfall is not limiting, but the variability is. Mid-season droughts of 2 to 3 weeks are not uncommon in the region and it is thought to increase the problem of "pops" in soils of low pH.

Diseases. All countries, except Botswana, listed diseases as a major constraint to groundnut production. The most important and widespread diseases are the two leaf spots caused by *Cercospora arachidicola* and *Cercosporidium personatum* and the aphid transmitted rosette virus disease. Pod rots caused by various species of *Aspergillus* and *Fusarium*, and *Phoma* leaf spot are becoming important, as is bacterial wilt (*Pseudomonas salanacearum*) in Malawi. Rust (*Puccinia arachidis*) occurs in the region but is not yet a serious problem.

Labour and power. Labour and draught power act as constraints to production in several ways. Where hand tillage is practiced, the dry hard soil precludes early preparation and this can be done only after the first rains. This situation is even worse where animal draught power is used since the animals have to recover condition lost during the long dry season before they are able to plough. Weeding and harvesting are other labour intensive operations in groundnut production which, if not done on time, lead to decreased yields.

As small farmers usually consume most of their groundnut production, little cash income is generated to hire labour. This situation is aggravated by the agricultural minimum wages established in most countries of the region, which force farmers to rely on family labour which is used on a priority basis for staple foods.

Economics and marketing. In the major groundnut producing countries, groundnut prices at official markets are very much lower than those prevailing in the local village markets. This is most pronounced in those countries where marketing policies are aimed at satisfying the edible oil requirements of the country, and least where the marketing is geared to the confectionery trade. The low prices offered make groundnuts an unattractive crop in terms of the labour input, and farmers generally respond by selling their surplus through unofficial markets. It is estimated that official marketing organizations attract no more than 10% of the total crop.

Present Research Programs

In the countries where production estimates are in the region of 75,000 t/annum, or above, there are research programs on groundnut improvement. The largest program is in Malawi where the crop is of greater significance to the economy than in the other countries. This program, and that of Zimbabwe, have been maintained for a long time

and continue to contribute to the improvement of the crop. Although Zambia and Tanzania have a past history of research these had lapsed and have only recently been restarted with assistance from FAO and ODA, respectively. A new program has also been initiated in Mozambique with IDRC funding. A list of current groundnut research projects in the SADCC countries is given in Table 4.

Table 4. Groundnut research projects in SADCC countries

Country	Research projects
Botswana	Variety trials
Lesotho	Crop not grown
Malawi	Breeding, Pathology, Agronomy, Physiology
Mozambique	Variety trials
Swaziland	None
Tanzania	Variety trials, Agronomy
Zambia	Variety trials
Zimbabwe	Breeding, Pathology, Agronomy, Microbiology

The long standing programs have a breeding component, and pathology and agronomy inputs, and produce improved varieties and better agronomic practices for test. Active breeding for improved drought resistance/tolerance is not in progress in the region, although the breeders are aware of the problem and use natural droughts to gather information on the reaction of the material under test. Some promising drought tolerant material is currently being tested in Zimbabwe. Groundnut prices are highest in the confectionery grades, and therefore considerable emphasis in the breeding programs is placed on quality characteristics.

In those countries restarting research, testing of varieties from both local and external sources (ICRISAT and neighbouring states) has begun, and some agronomic trials are being conducted to establish techniques and yield potentials for different levels of inputs likely to be applied by the farmers. The germplasm collections made in many countries have, with the exception of Malawi and Zimbabwe, been lost.

Potential for Improvement

There is considerable scope for improvement of groundnut production at the farmers' level based on existing technology in the region. Increased production could be achieved by improved extension services and the provision of seed and other inputs.

If the adoption of existing tested technologies can be achieved, there are possibilities of further improvement in production by the development of a) varieties tolerant to low pH for areas with the "pops" problem, and drought,

b) varieties resistant to leaf diseases and rosette virus disease,

c) dormant short season varieties for areas where the seasons are short, and

d) labour efficient technologies for timeliness of land preparation, planting, weed control and harvesting.

The potential for research based production increases depend upon concerted efforts are made to improve the profitability of the groundnut crop through marketing and price incentives.

V. SORGHUM

Production

Sorghum is grown in all the countries visited; Tanzania, Mozambique and Malawi are the largest producers. However, as a percentage of total cereal production in each country (Table 2) sorghum becomes the most important cereal crop in Botswana at 52% followed by Mozambique, Lesotho and Tanzania at 31, 24 and 14%, respectively.

Most of the sorghum produced is used locally for food and home brewing of beer, and only small amounts enter the market. Traditionally sorghum beer is regarded as an important "food" item in the rural areas. Average yields obtained by small farmers are low and range from 300 to 700 kg/ha comparing unfavourably with yields of about 2,500 kg/ha obtained by commercial farmers in Zimbabwe. The figures illustrate the potential for increased yield that exists in the region. The potential for the expansion of the area under sorghum also exists as most semi-arid areas with low unreliable rainfall currently producing poor crops of maize are better suited to sorghum.

In all countries visited, except Swaziland, there was interest and in instances actual plans to encourage sorghum production in the semi-arid and traditional sorghum areas, in order to provide increased food supplies.

Production Constraints

The major constraints to increased sorghum production are listed in Table 5 in the priority order as determined in the countries visited.

Table 5. Major constraints to sorghum production in the SADCC countries

Country	Constraints
Botswana	1. Drought 2. Bird pests 3. Draught power 4. Soil crusting
Lesotho	1. Draught power 2. Soil fertility 3. Short season
Malawi	1. Drought 2. Bird pests 3. Draught power 4. Stemborer
Mozambique	1. Bird pests 2. Varieties
Swaziland	1. Bird pests 2. Stemborer
Tanzania	1. Drought 2. Bird pests 3. Varieties 4. Draught power
Zambia	1. Bird pests 2. Drought 3. Varieties 4. Stemborer
Zimbabwe	1. Bird pests 2. Drought 3. Soil fertility 4. Varieties

Drought and bird pests. Drought or bird pests are considered to be the main constraints to sorghum production. In most years the total rainfall is adequate for good production, but distribution is often erratic, resulting in drought periods of two to four weeks during the growing season Bird pests, primarily *Quelea quelea* are an important factor encouraging maize sowing in traditional sorghum areas. These areas have insufficient rainfall for dependable maize crops,and crop failure is regular.

Soil fertility. Soil fertility was listed as a production constraint in Zimbabwe and Lesotho. Soils in all the sorghum-growing areas are reported to be generally lacking in one or more of the primary nutrients, but this is corrected in some countries by the addition of moderate quantities of farmyard manure or commercial fertilizers. Soil crusting, resulting in poor seedling emergence is a major problem in the hardveld soils of Botswana.

Insect pests. Of a large number of insect pests recorded on sorghum, the most widespread and important pests are the stemborers (*Chilo partellus* and *Busseola fusca*). Other pests of importance are shootfly (*Atherigona* spp.), midge (*Contarinia sorghicola*), bollworm (*Heliothis armigera*) and armyworm (*Spodoptera* spp.). Shootfly and midge cause considerable damage on late-planted sorghum. As a rule, insecticide application for pest control is uneconomic and is therefore not practiced by farmers.

Draught power. Inadequate draught power was given as a serious production constraint in four of the countries visited. Many farmers do not have enough draught animals and those that do, often have to delay ploughing and planting at the beginning of the rains in order to allow oxen to graze on new pasture growth to regain strength lost during the dry season.

Varieties. Lack of suitable varieties was also given as a major production constraint in four countries. The wide range of local cultivars currently grown are tall, late-maturing, and have small hard grains. Improved varieties with high yield potential have not

been attractive to the traditional sorghum growers and consumers for several reasons including poor palatability and great susceptibility to insect damage in storage than local cultivars.

Diseases. In most countries several potentially serious diseases of sorghum have been recorded but they seldom do much damage to local cultivars, except in localized areas and seasons. The most widespread diseases are grain molds, smuts, grey leaf spot. leaf blight, rust, anthracnose and sooty stripe.

Witchweed. The parasitic weed *Striga asiatica* causes heavy losses of sorghum in some areas of Botswana, Malawi, Tanzania and Zimbabwe. *S. hermonthica* is a serious problem in parts of Tanzania. In some countries land that was heavily *Striga* infested was reported to have been abandoned.

Marketing and prices. Official marketing organisations provide no price incentives for sorghum production. In general prices for sorghum paid to farmers are well below those offered for maize. This is a disincentive for sorghum production and forces farmers to grow maize in areas better suited to sorghum. In Tanzania where the consumer price of maize is heavily subsidized while that of sorghum is not, there is a disincentive not only to production but also its use as a staple cereal.

Present Research Programs

Most countries have had minimal research efforts on sorghum,

except in Botswana, Zimbabwe and Tanzania, which have had research projects for some time. Recently in the past two to three years interest in sorghum research has increased. Table 6 gives a list of current sorghum research projects.

Table 6. Sorghum research projects in SADCC countries

Country	Research projec
Botswana	Variety trials, Physiology
Lesotho	Variety trials
Malawi	Breeding, Variety trials
Mozambique	None
Swaziland	None
Tanzania	Breeding, Variety Trials
Zambia	None
Zimbabwe	Variety and agronomy trials

All the existing research programs are poorly staffed and funded; and usually the only scientist (breeder or agronomist) working on the crop has responsibility for several crops. Thus only a small proportion of research time and effort is spent on sorghum.

The Tanzanian sorghum research program is located at Ilonga where the environment is not representative of the sorghum-growing areas of the country. The Mission was informed that the Ministry of Agriculture is convinced of the need to site the sorghum research program at a suitable location and that appropriate action is under consideration.

Mozambique and Zambia have made requests to FAO and USAID, respectively, for financial and technical assistance to initiate their own research programs. After the Lusaka Declaration, Mozambique also made a request for direct ICRISAT assistance in sorghum improvement.

Potential for Improvement

There is great potential for sorghum improvement in the SADCC countries. Any improvement program based in the region would have the difficult task of developing sorghums for a number of adaptation zones ranging from equatorial in the north to temperate in the south.

The following main research topics need to be incorporated in the program of improvement:

a) Yield stability under drought and low soil fertility conditions
b) Resistance to stemborers and leaf diseases
c) Cultivars with desirable food qualities
d) Cultivars suitable for different season lengths and photoperiods, and
e) Cold tolerance, particularly in Lesotho.

There is probably little that a crop improvement program can do about the bird pest problem. Previous work in the region has emphasized the need for coordinated and cooperative international and regional action by all countries, including those immediately outside the SADCC countries, if the *Quelea* problem is to be solved.

VI. PEARL MILLET

Production

Pearl millet is grown in all SADCC countries except Lesotho and Swaziland. The major producers are Zimbabwe, Tanzania, and Angola. Zimbabwe is the largest producer of pearl millet in Africa south of the equator.

Pearl millet is grown by small farmers for food and home brewing and yields range from 400 to 500 kg/ha. Yields of upto 5,000 kg/ha have been obtained in experiments in Zimbabwe and Malawi. This wide yield gap between small farm and experiment yields is evidence of the great potential that exists for improving production of pearl millet in the region.

The Mission was informed that the present pearl millet area could be substantially expanded and production increased, particularly in Tanzania, Zambia and Zimbabwe, where large tracts of uncultivated, very low rainfall areas are suitable for the crop. However, these areas are currently utilized for cattle production and the relative economic benefits of the two systems of land use need close examination.

Production Constraints

Production constraints for pearl millet are essentially similar to those for sorghum. The major constraints listed in the order of priority as reported to the Mission are given in Table 7.

Table 7. Major constraints to pearl millet production in SADCC countries

Country	Constraints
Botswana	1. Bird pests 2. Drought 3. Draught power 4. Varieties
Lesotho	Crop not grown
Malawi	1. Drought 2. Bird pests 3. Human power 4. Varieties
Mozambique	1. Bird pests 2. Varieties
Swaziland	Crop not grown
Tanzania	1. Drought 2. Bird pests 3. Varieties
Zambia	1. Bird pests 2. Drought 3. Varieties
Zimbabwe	1. Bird pests 2. Drought 3. Soil fertility 4. Varieties

Drought and bird pests. As for sorghum. (Page 18)

Varieties. Lack of suitable varieties was mentioned more often as a constraint to increased pearl millet production than for sorghum production. The cultivars of pearl millet grown are tall, late maturing, bristled and low yielding landraces. Improved cultivars have been introduced and tested in Botswana and Malawi, but these have not shown promise.

Diseases. Several potentially serious diseases of pearl millet have been observed, but seldom appear to do much damage to the local

cultivars. The situation could change with the introduction of improved cultivars and the adoption of improved production practices. Ergot (Claviceps fusiformis) is the most widespread disease in the region and sometimes causes heavy damage to the crop. Downy mildew, rust and smut also occur commonly in the region.

Insect pests. Little is known about insect pests of pearl millet. It appears that the crop suffers little damage.

Markets and prices. Most countries have no official markets or pricing policies for pearl millet. Consequently the crop does not enter into "official" trading. This is a disincentive to growers and in general marketing policies do not encourage production.

Present Research Programs

No research on Pearl millet has been conducted in the past in countries where the crop is grown, but interest is now increasing. A list of current research projects in the region on pearl millet is given in Table 8.

Table 8. Pearl millet research projects in SADCC countries

Country	Research Projects
Botswana	Variety trials
Lesotho	Crop not grown
Malawi	Breeding, Variety trials
Mozambique	None
Swaziland	Crop not grown
Tanzania	None
Zambia	None
Zimbabwe	Breeding, Variety trials

...../

The programs in Botswana, Malawi and Zimbabwe are 2 to 3 years old, and suffer from insufficient staff and funds. Tanzania expressed strong interest in the crop and plans to initiate an improvement program in 1981 with assistance from USAID and ICRISAT. Mozambique and Zambia have no research plans and appear to have no interest in the crop.

Potential for Improvement

Pearl millet has received little research attention in the past and a great deal of varietal improvement work will be required for the different agroecological areas of the region. Improvement in yield potential, food quality, resistance to ergot and downy mildew, and drought tolerance are the main areas where improvements would be beneficial. There is also need for the development of short stature and short season cultivars.

The problem of bird pests, particularly the migratory *Quelea quelea* is very difficult. It would require, as for sorghum, action by all countries in the region, possibly under the umbrella of the SADCC.

VII. PIGEONPEA

Production

Pigeonpea is grown as a minor crop in most SADCC countries. Data on yields and total production were not available in any of the countries visited. However, the existence of a small export trade in Malawi and of surplus pigeonpea stocks with the marketing board in Tanzania indicates that only in these countries is the crop of any significance. Malawi was the only country which showed positive interest in encouraging increased production of pigeonpea. In several of the countries, however, pigeonpea is a common backyard or hedge crop and it contributes to farmers' diets, particularly during the long dry season.

Production Constraints

The major production constraint in most of the countries visited appeared to be a lack of demand for this crop. In Tanzania there was over production as a result of a generous price paid to farmers over the previous two years. Tanzania is actively seeking an export market for its considerable surplus. In Malawi there is a thriving market for pigeonpea both for local consumption and export. In the other countries there appeared to be no organized marketing of this crop.

As there was little government interest in pigeonpeas, the agricultural staff in most countries had paid little attention to this

crop and few people knew anything of the factors limiting productivity. Insect pod borers, presumably Heliothis armigera and other lepidopteran larvae, were said to be common. Fusarium wilt disease and root knot nematodes were known to be important in Malawi. There was said to be a demand for high yielding, early maturing cultivars that could replace the late maturity landraces grown in Malawi.

Present Research Programs

There are no major active research programs on this crop in any of the countries visited. In Malawi and in Zambia this crop is included in research programs on "grain legumes", but with little or no particular emphasis up to now. It is possible that there will be an increased interest in the research on this crop in Malawi. When the research stations in northern Mozambique are fully staffed some research attention may be given to pigeonpea for it is widely grown as an intercrop in that region.

Potential for Improvement

There is little doubt that very good crops of pigeonpea could be grown, particularly in Tanzania, Malawi, Zimbabwe, Mozambique and Botswana. The drought resistance of this crop makes it particularly suited to the semi-arid areas of these countries. Malawi reports yields of "about 900 kg/ha" without the use of any purchased inputs. Farmers in Tanzania produced good crops in response to a good price structure. In most urban areas this crop is not a commonly preferred

food; over much of the area *Phaseolus vulgaris* beans and cowpeas are much more commonly grown and marketed and there is increasing interest in soya beans. Pigeonpea tends to be a backyard crop or a minor component of intercrops, with most of the green peas and dried seeds consumed by the farmer and his family. Unless major export markets are opened up or the dried seeds are popularised among the urban populations, there would appear to be a very limited potential for the expansion of this crop in the countries visited.

Potential for ICRISAT Inpu

There appears to be no demand for a major research effort on this crop in any of the countries at this time. However, ICRISAT pulse scientists should continue to keep in touch and cooperate with the interested research workers in national programs, particularly in Tanzania, Malawi and Mozambique and supply materials and information on request.

VIII. CHICKPEA

Production

Chickpeas are grown in Malawi, Mozambique, Tanzania and Zambia; but in very small quantities. In Tanzania there has been limited production of 'desi' types from the black soils in Sukumaland where the crop is commonly sown at the end of the rains Production has been mainly near the cotton ginneries where the Asian workers who supervised the machinery, were enthusiastic consumers of this crop.

Production Constraints

Except in Tanzania, the major constraint appeared to be a lack of familiarity of utilisation of the crop among the bulk of the population resulting in its almost complete absence in the markets. In Malawi there is a small demand, both for local consumption and export. In Mozambique there is an apparent demand for this and other pulses, but there is little production.

There was no readily available information on the agronomic or disease and pest limitations of this crop in any of the countries visited except in Malawi where rust, bacterial leaf spot and wilt were said to be damaging.

Present Research Programs

There are no major active research programs on this crop in any of the countries visited. Some research has been conducted in

Tanzania and Zimbabwe where ICRISAT variety trials have been grown in recent years.

Potential for Improvement

Good crops of chickpea could undoubtedly be grown over large areas of most of the countries visited, if there was a demand for the produce. There is a wide range of germplasm and breeding material in the ICRISAT and ICARDA (International Center for Agricultural Research in Dry Areas) collections from which cultivars suited to the specific climates within this wide ranging region could be rapidly selected. There are unlikely to be any major constraints to yield that would be peculiar to this region, so the materials and experience already available elsewhere could probably be readily adopted.

Potential for ICRISAT Input

There appears to be no major market or demand, specifically for this crop at this time. ICRISAT should encourage national legume research workers to at least test a range of the available cultivars as a post-rainy season crop, either on heavy soils which cannot be cropped during the rains or, as a second crop after early maturing rainy season crops. Unless and until this crop finds a consumer demand in the region there would appear to be little scope for it to be allocated any major research effort, manpower or funding.

IX. FARMING SYSTEMS

The complexity and location specificity of farming systems meant that the Mission required more time, than was available, to gather information. The subject is one which therefore requires additional study. Most of the information collected relate to the cropping aspects associated with ICRISAT crops.

Present Farming Systems

Both traditional and improved modern systems of farming are found in the SADCC countries. In most countries most of the land is cultivated by small farmers in small subsistence units in accordance with traditional systems. In Table 9 are given some cropping practices associated with ICRISAT crops. Some of these practices have already been described under the individual crop headings in sections IV to VIII.

The old system of shifting cultivation has been largely replaced, due to population pressure, by continuous cropping. Sole cropping has replaced mixed cropping in some areas although the latter is still predominant. Crops are grown with minimal inputs. Mineral fertilizers are seldom used or used in inadequate quantities. Livestock, particularly cattle, are an important part of the farming system and play a major role in the economy and social life of small farmers in Botswana, Lesotho, Swaziland and Zimbabwe where they provide draught power for cultivation and transport, manure for crop nutrition as well as a cash source. Where cattle are not available or not used for draught power, all tillage and cultivation operations are by hand using a hoe.

Farming Systems Research

There is great interest in farming systems research at the farm level in all the SADCC countries, as this is seen as a means of transforming traditional agriculture. Research plans are in various stages of implementation. The most comprehensive program is in Lesotho where a USAID grant of $ 8.3 million for 5 years is supporting a team of 13 scientists conducting research at the farm level (in three prototype areas) in agronomy, weed control, fertilizer use, farm equipment and tools, livestock and range ecology, economics, extension communications, and village beliefs and social organization. In Swaziland a cropping systems research project to be funded by USAID has been identified, while in Malawi the USAID funded agricultural research project includes research on farming systems analysis. In Botswana the ODA funded project on the evaluation of farming systems and agricultural implements has been in operation for some time. In addition a USAID farming systems project identification team was in the country at the same time as the ICRISAT Mission.

All the existing or planned farming systems research programs do not include land and water management aspects and very little on economic studies for systems development.

Potential for ICRISAT Input in Farming Systems

The Mission is unable to give an assessment of the potential for ICRISAT input in farming systems research in the region because of the

incomplete data that was collected on the subject. An in depth investigation of existing farming systems and problems at the farm level involving national scientists and scientists working on existing programs would be necessary for a realistic evaluation of research needs.

Table 9. Some characteristics of small farmer cropping systems associated with ICRISAT crops in the SADCC countries

Country	Tillage & Weeding	Sowing on flat, beds or ridges	Sole or mixed cropping	Rotation	Mineral fertilizer use	Soil conser-vation	Crop residues	Fallow or continuous cropping
Botswana	Draught oxen	Flat	Mixed	Not fixed	Nil	Nil	Grazed	Continuous cropping
Lesotho	Draught oxen	Flat	Sole	Not fixed	Low	Nil	Grazed or removed for stock feed	Continuous cropping
Malawi	Predomi-nantly by hand	Ridges or flat	Sole groundnut others mixed	Not fixed	Nil	Nil	Grazed or burnt	Continuous cropping
Mozambique	Predomi-nantly by hand	Flat	Mixed	Not fixed	Nil	Nil	Grazed or burnt	Fallow & con-tinuous cropping
Swaziland	Draught oxen	Flat	Sole	Not fixed	Low	Nil	Grazed or removed for stock feed	Continuous cropping
Tanzania	Predomi-nantly by hand	Flat	Mixed	Not fixed	Nil	Nil	Grazed or burnt	Continuous cropping and some fallow
Zambia	Predomi-nantly by hand	Flat, rid-ges and mounds	Mixed, some sole cro-pping	Not fixed	Nil	Nil	Grazed or burnt	Fallow and continuous cropping
Zimbabwe	Draught oxen and hand	Flat	Sole and mixed	Not fixed	Low	Nil	Grazed	Continuous cropping

X. COOPERATION IN AGRICULTURAL RESEARCH BETWEEN THE SADCC COUNTRIES

There have been close technical links in agricultural research between all SADCC countries (except Tanzania) through their common membership of the Southern African Regional Commission for the Conservation of the Soil (SARCUSS), which has its headquarters in Pretoria, South Africa. Since its inception in 1950 SARCUSS has promoted and facilitated (a) a continuous interchange of technical and scientific information expertise and know-how between its members; (b) regional conferences of a specialist or general nature; (c) exchange of visits by research staff to member-countries; (d) studies of problems common to several or all member-countries and the initiation of a coordinated, cooperative resolution of such problems. In crop production SARCUSS was particularly active in (a) the exchange of information from research work in progress in the member states, through regular meetings and conferences of research workers (b) exchange of plant material, including breeding material between member states, and (c) the establishment of a cooperative network of regional crop evaluation trials.

Zambia ceased to be a member of SARCUSS in the 1960's while Angola and Mozambique stopped participating in 1975. With the recent withdrawal of Zimbabwe, active participation in SARCUSS by the remaining members is dubious.

Tanzania had strong agricultural research cooperation with Kenya and Uganda through the East African Agricultural and Forestry Research Organization of the East African Community. The break-up of the community in 1977 ended links and cooperation between these three countries.

The Mission was informed that the SADCC countries had agreed in September 1980 to convene a meeting of officials to assess the need for, and feasibility of, an organisation concerned with technical cooperation in agricultural research and development. The Mission believes that such an organisation promoted by the independent countries themselves would improve communication and transfer of technology among the countries of the region and between these countries and International Organisations.

XI RECOMMENDATIONS FOR ICRISAT INPUT IN SOUTHERN AFRICA

1. Regional Center

The proposal that ICRISAT should set up a Southern Africa Regional Center to serve the SADCC member countries was critically examined in the light of the information obtained to determine whether this would provide the most useful and cost-effective development when compared with possible alternatives.

A "Center" that could adequately cover the ICRISAT objectives and crops for this region would require a site with land, buildings and facilities. Selection of such a site to cover all the crops in ICRISAT's mandate and to serve the very varied agroclimatological situations reported would be impractical.

The SADCC countries range from near the equator (Tanzania) to about 30°S (Lesotho) covering a very wide range of climates, photoperiods and soils. A single "Center", particularly if sited in Botswana, would appear to be of limited utility in serving such an area, particularly since the countries with large semi-arid tracts and potential for more than one of the ICRISAT mandate crops (Malawi, Mozambique, Tanzania, Zimbabwe and Zambia) are all situated to the north of Botswana.

The expense of setting up a "Center" with its attendant services and infrastructure was weighed against the likely benefits and against the existing research infrastructure in countries of concern. ICRISAT has a well equipped center in India at which the germplasm of

the mandate crops are maintained and utilised in breeding programs that aim to produce selections with resistance to the specific biotic and abiotic production constraints, new genetic combinations and segregating material with wide ranging variability. The materials generated from this center are distributed, to scientists in regional and national programs, for local selection and adaptation. ICRISAT is also planning a Center at Niamey in Niger which will be relatively small but will supplement the efforts of the main ICRISAT Center with particular emphasis on the problems of the Sahel. These Centers are situated at 17° and 13°N and with the range of options available in India can produce genetic materials particularly suited to the photoperiods, and partially for the climates, of much of the central areas of the SADCC countries.

On mature reflection, the Mission concluded that a 'Center' would not appear to be the best vehicle for ICRISAT input in the SADCC countries. This conclusion appears to have the concurrence of agriculturalists and administrators in the countries visited. There was a unanimity of views that CGIAR Centers, including ICRISAT could play an important role in coordinating advances in agricultural research and development, as requested by the Heads of Governments in the Lusaka declaration.

2. Regional Research Teams/Units

The Mission is convinced that the CGIAR Institutes, including ICRISAT, can play a major and constructive role in agricultural research

and development for the SADCC countries. In view of the range of food crops of the SADDC countries and the diversity agriculturally, socioeconomically and agroclimatologically of these countries, as revealed in the detailed study of the area carried out by the Mission, it is recommended that the CGIAR be approached to involve the principal institutes concerned in crops of concern to the area. These are CIMMYT for maize and wheat, ICRISAT for sorghum, pearl millet and groundnuts and CIAT/IITA for maize, beans and cassava. Clearly there are crops and areas where immediate inputs of relevance to the SADCC countries can be made by all the Institutes named and it is advisable to consider the agricultural system as a whole, as far as practicable. There is a significant amount of available research information and this must be fully eavluated and utilised in formulating future research plans.

Following on Recommendation 1, the Mission further advises that the most cost effective method of achieving an impact will be by location of small research teams at national research station. These teams would have a tripartite role - firstly to assist in strengthening research effort nationally, secondly to strengthen and conduct research regionally and to disseminate information and germplasm and thirdly to liaise internationally with Center programs. An extremely important function of the research teams would be to assist with identification of local researchers for further general and specialised training either locally or at the Centers. Since sound, well staffed and well trained scientists in the national programs are vital to ensure the necessary long term and short term commitment and improvement in

agricultural research in the SADCC area, countries themselves should as a priority appoint national scientists as contact men for each of the crops considered to be important. There will of necessity, have to be a coordinating mechanism to ensure proper interaction between countries, institutes and the research teams.

3. Coordination of Effort

The exact mechanism of ensuring full and adequate coordination of effort in research in the major food crops of the area will need further indepth discussion. The Mission is not qualified to do this. However a significant step has been taken by the Heads of State in designating Botswana as the Coordinating country for agricultural research. This will facilitate the operations and program of International Centers, since agreements on work plans could be made with the central coordinating unit. It will be necessary to appoint a coordinator of research from one of the crop based research centers, who should be based in Botswana to liaise adequately with the SADCC coordinating body. Research plans for the region together with the program of work should be discussed annually before each crop season at a coordinating meeting held initially Gabarone and later on a rotational basis in other SADCC countries. This meeting would involve a least one senior Research scientist from each participating country and center scientists involved in regional or country programs.

4. Tentative Plans for ICRISAT involvement.

Groundnut.

The urgent and special need for ICRISAT involvement in South

Central Africa on groundnut research was recognised by the ICRISAT Governing Board and the Quinquennial Review Committee of ICRISAT in 1978. Negotiations for the establishment of a small regional research unit consisting of a groundnut breeder and pathologist were therefore well in hand at the time of the Lusaka Declaration. Malawi was chosen as a base in view of the well established and continuing groundnut research effort in that country. The details of a draft agreement with the Government of Malawi are being finalised. Our view is that this unit would act as a channel for exchange of germplasm and information between ICRISAT Center and between countries of the region. We are conscious of the ongoing international and bilateral programs in the area already in operation and of plans for other such schemes. The unit could assist greatly in establishing regional trials and serve as back up support to national programs. Bilateral funding is being sought and a project proposal is currently being considered by IDRC. The unit could serve as a model for linkages between ICRISAT and SADCC and is essentially similar to the model which is serving very well in W. Africa. It does not preclude the posting of additional staff in other disciplines in groundnut research or the posting of staff to other areas within the region which have potential in furthering the aims of regional groundnut improvement.

Sorghum and Pearl Millet

There is a definite interest and clear need to increase the amount of research in the SADCC countries on these crops. The recent and conti-

nuing droughts experienced in several countries underline the importance of encouraging farmers to sow these crops in areas which are marginal for maize to stabilise food suppy, particularly in adverse agricultural seasons. However, higher yielding cultivars with stress resistance and acceptable quality characteristics need to be developed. With the existing germplasm pool and know how developed over the past few years in ICRISAT's programs both in Africa and in India, the Institute is ideally and possibly uniquely placed to assist. The Mission considers that the area would best be served by a small research team with high mobility and ability to respond to national and regional needs posted in Zimbabwe in the main sorghum/millet producing area. A very important feature of the working feature of the working arrangement must be identification of local national scientists who are able to move between countries to select material which appears suitable for their particular location. These scientists should receive initial training at ICRISAT Center or in ICRISAT's African locations and be able to concentrate specifically on these two crops to enable them to develop the necessary familiarity with the germplasm and ongoing breeding programs. An important feature of the team approach would be development of regional nurseries and joint assessment of performance and results.

The Mission comments favourably on the existing infrastructure in Zimbabwe which would enable rapid establishment of sorghum and millet research teams. Discussion is required on the siting of the

regional unit and this would involve consideration by the SADCC coordinating unit of the established criteria which are used by ICRISAT in establishing research teams.

The Mission recommends that the Sorghum and Millet Teams should have independent breeders, physiologists, and pathologists for the two crops, but that initially the entomologist should be common to both crops. In proposing this previous research results in the area are taken into account. Discussion on the advisability of having research teams for both groups at one location is needed. The existing pattern and potential for expansion of production of both crops must be fully taken into account in finalising the site/ sites.

There are pressing and in the opinion of the team important reasons why the existing ICRISAT input into cereal research in Tanzania should continue. Analysis of available agroclimatological data shows that Tanzania differs significantly in several respects from the other countries in SADCC growing sorghum and millet.

Farming Systems

The Mission appreciated the considerable input into agronomic research now occurring in the region. The location specificity of farming systems research and diversity of the area make a firm recommendation on involvement of ICRISAT difficult. In the opinion of the team there are several potential areas of input. The active interest in Botswana in soil and water management involving man, animal and mechanical cultivation was noted and there is scope for research on utilisation

of small scale water catchments of the type currently being done at ICRISAT Center in well defined SAT regions. Such a scheme could be extremely useful in introducing the concepts regionally and in performing a training function. Another important area is research on intercropping and use of leguminous plant species in the rotation. More detailed study by a working group of specialist farming systems scientists from the SADCC and ICRISAT is required to determine both possibility and priorities for cooperation. The Mission strongly recommends that a small working group be constituted for this purpose.

Pigeonpea and Chickpea

The Mission assesses that interest in these crops currently in the SADCC countries is minimal. However they are conscious of the value of these crops both as protein foods and as contributors to soil fertility, by virtue of their nitrogen fixing ability. They recommend that the SADCC countries and ICRISAT encourage interest in these crops, in particular pigeonpea, in the context of intercropping, since this provides a useful strategy for yield stabilisation in semi-arid areas. Additionally this crop with its deep rooting has important drought tolerant characteristics. More information should be made available on utilisation and preparation of these pulse crops. ICRISAT will continue to provide germplasm and information to scientists and programs in the SADCC areas who express interest.

5. Funding of Research

The Mission recommends that the SADCC countries begin approaches

to Donor Agencies for funding of research in Food Crops. As an initial step in this direction it is proposed that SADCC countries after consideration of the Report of the Mission determines areas of priority and that subsequently joint working groups of SADCC and concerned CGIAR Centers are designated to develop project proposals for seeking funding. The Mission recommends that funding be sought on a SADCC regional rather than bilateral basis to ensure rapid impact on agricultural research in the area and to strengthn the concept of SADCC regional effort.

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ANNEX I

Tentative Budget Proposals for Staff Costs (Current, Annual)

	in US $		
	Principal	Technical	Support
COORDINATING UNIT			
Scientific Coordinator	60,000		
Office Administrator		12,000	
Secretarial		8,000	
	60,000	20,000	
GROUNDNUT RESEARCH TEAM			
Breeder	60,000(1)		
Pathologist	60,000(1)	8,000(2)	12,000(6)
Secretarial		8,000(1)	
	120,000*	16,000*	12,000*
Agronomist/Physiologist	60,000(1)		
Microbiologist	60,000(1)	8,000(2)	12,000(6)
	120,000	8,000	12,000

* Funding already requested from IDRC directly by ICRISAT

SORGHUM RESEARCH TEAM			
Breeder	60,000(1)	4,000(1)	4,000(3)
Physiologist	60,000(1)	4,000(1)	4,000(3)
Pathologist	60,000(1)	4,000(1)	4,000(3)

	in US $		
	Principal	Technical	Support
Entomologist	60,000(1)	4,000(1)	4,000(3)
Secretarial		8,000(1)	
Clerical			4,000(2)
	240,000	24,000	20,000
MILLET RESEARCH TEAM			
Breeder	60,000(1)	4,000(1)	4,000(3)
Physiologist	60,000(1)	4,000(1)	4,000(3)
Pathologist	60,000(1)	4,000(1)	4,000(3)
Clerical/Secretarial		8,000(2)	
	180,000	20,000	12,000

Comments:

Principal post includes an element for house rent and travel to and from appointment.

Operational costs will need to be assessed depending on siting of the program and work plan agreed.

Numbers in brackets indicate the number of positions in each category.

Farming Systems budget not included since no specific recommentations are yet formulated.