

SORGHUM IMPROVEMENT (ETHIOPIA):

AN EVALUATION

Phase I - 3-P-72-0095

Phase II - 3-P-74-0023

RECIPIENT INSTITUTION: Ethiopia Sorghum  
Improvement Program  
Nazreth, Ethiopia

DURATION: Phase I - May 1973 to Dec. 1975  
Phase II - Jan. 1976 to Dec. 1978

IDRC CONTRIBUTION: Phase I - \$195,000  
Phase II - \$560,000

October 1978

## 1. THE RESEARCH PROBLEM

### 1.1 Background

Sorghum is the most widely grown food crop in Ethiopia. It thrives in a range of agro-climatic zones including high and low altitudes. High altitude sorghums grow satisfactorily at altitudes as high as 2,500 meters where mean temperatures range from a minimum of 14°C to 26°C. In general, sorghum yields have been relatively low in Ethiopia. In 1976 approximately 1 million hectares of sorghum were under cultivation. Average yield was 1 ton per hectare. About 90 per cent of the production is consumed as 'injera', a staple food in Ethiopia. Sorghum is also used in home brewed beverages; and sorghum stocks and leaves are used as fuel, as building materials and as feed for livestock.

Ethiopia is probably the original home of sorghum and is the source of many wild and cultivated forms adapted to a wide range of growing conditions. Consequently Ethiopia is a valuable reservoir of diverse genetic material for sorghum breeders throughout the world.

Sorghum research began in Ethiopia in the mid 1950s at the Alemaya College of Agriculture. Local collections and U.S. introductions were screened for high yield and adaptability to highland environments by a team from Oklahoma State University who had developed the College under a grant from the United States Agency for International Development (USAID). In the late 1960s the Ministry of Agriculture formed the National Crop Improvement Committee (NCIC), and delegated the national responsibility for sorghum improvement to the Alemaya College of Agriculture. This national responsibility entailed organizing the annual sorghum National Yield Trials (NYT) for all experimental stations. Although Alemaya served well in identifying suitable cultivars for highland areas, NYT results confirmed that it was impossible to develop and screen suitable varieties for lowland and low rainfall conditions at Alemaya. It became evident that a national sorghum improvement program was required to cater to the needs of all the sorghum growing zones of Ethiopia.

### 1.2 Recipient Institution

In 1971, the East Africa Cereals Research Conference was held at the Alemaya College of Agriculture. Soon after IDRC was approached by the Dean of the Faculty of Agriculture at Alemaya College concerning support for a national sorghum improvement program. It was envisaged that IDRC support would establish a national sorghum improvement program and that Ethiopia would become a major participant in the proposed international sorghum network to be co-ordinated by the Institute for Crops Research in the Semi-Arid Tropics (ICRISAT) in India.

Phase I of the project was initiated in 1973. The Alemaya College of Agriculture of Haile Selasse University (now Addis Ababa University, AAU) was chosen as the recipient institution because:

- a) the College had national responsibility for sorghum improvement;
- b) a very competent Ethiopian plant breeder was on staff at the College;
- and c) the College could provide research assistants and trainees;
- d) essential research facilities and administrative support could be provided.

In Phase II, the Ethiopian Sorghum Improvement Program (ESIP) was established. This is a semi-autonomous research institution which has been given the national responsibility for sorghum improvement research. ESIP is administratively linked to AAU, since the IDRC agreement is with the University. ESIP is operationally linked to the Institute of Agricultural Research (IAR), which has the national responsibility to coordinate agricultural research and maintains an overview of the ESIP research program. IDRC has been the exclusive financier of ESIP, and in this way ESIP has remained independent of the Government structure. ESIP was conceived by the project leader in Phase I. Two key factors which allowed the development of the institution in Phase II were:

- a) the project leader was released from his responsibilities as Head of the Plant Sciences Department at the College; and
- b) the Institute of Agricultural Research (IAR) provided the program with experimental sites at six research stations throughout the country.

ESIP has established headquarters at Nazreth, situated in a lowland zone about 50 miles southeast of Addis Ababa. There is a staff of 25 consisting of the project leader, a professional agronomist, an administrator, a secretary and research assistants (see Graph 1). Altogether there are seven research sites, four of which are located in lowland zones and three in the highland zones.

### 1.3 Objectives

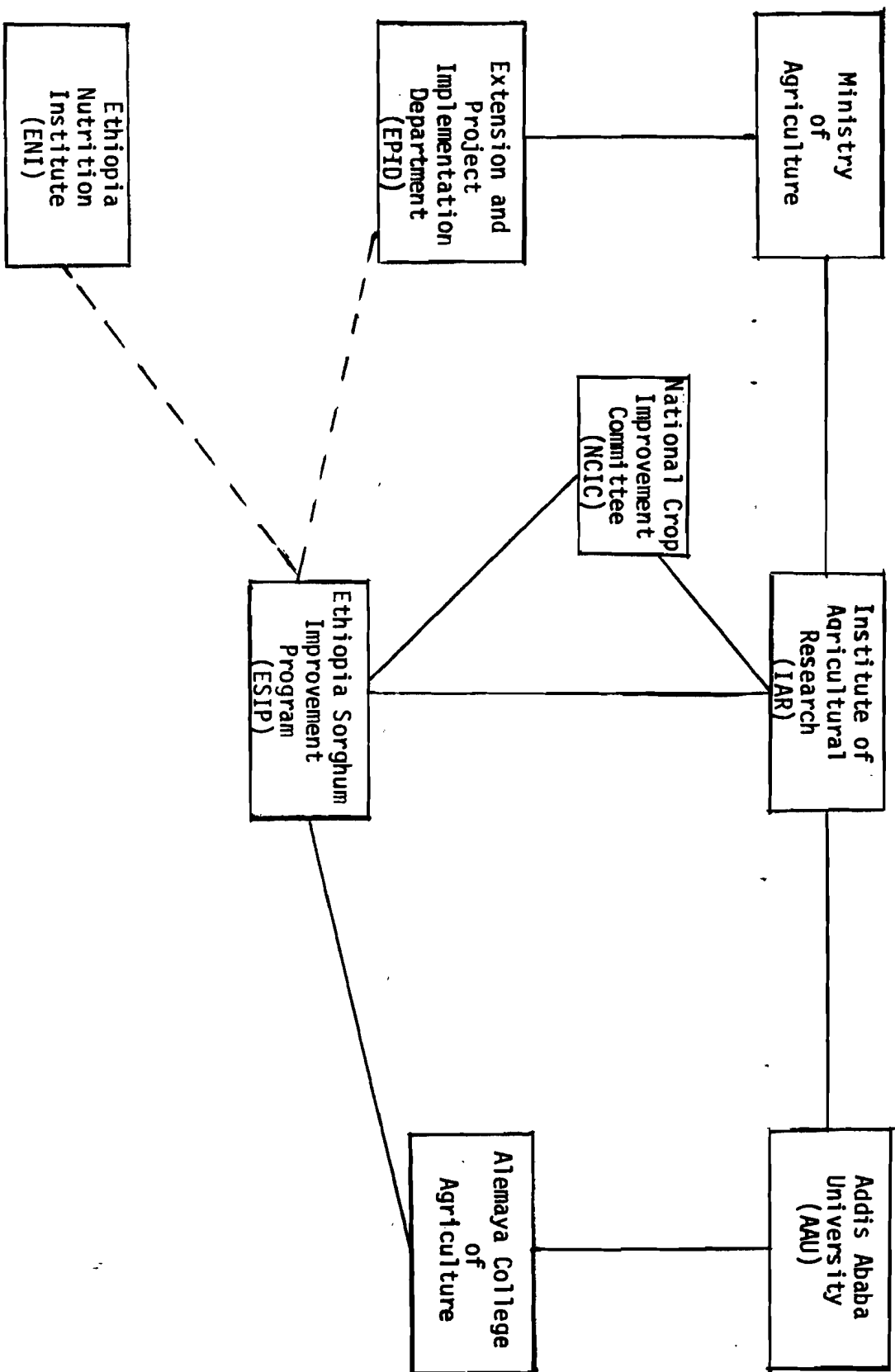
In Phase I, the project was limited to improving sorghum varieties in the highland zones because of the location of the Alemaya College of Agriculture.

The objectives of the project were:

- a) to screen the existing sorghum collection in order to identify the best types and to add to this collection as opportunity offers; and

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P R O J E C T   M A N A G E M E N T   S T R U C T U R E



b) to intercross identified superior types, and also to cross these with elite lowland types from other countries in order to obtain sorghums which combine better yield and plant type with acceptable grain quality for the highland areas of Ethiopia.

In Phase II, the objectives were considerably expanded to include improvement of both highland and lowland sorghum varieties. The specific objectives were:

a) to systematically collect, classify and screen the valuable indigenous sorghum germ plasm for its suitability as breeding material in better Ethiopian sorghums;

b) to screen and test improved sorghums in the various ecological zones of Ethiopia;

c) to continue and expand studies on crop agronomy and the determination of optimum inputs needed to provide maximum gain to the small farmer;

d) to initiate trials conducted by farmers in their own fields;

e) to develop resistant varieties and crop protection technology to control pests, diseases, and the parasitic witchweed *Striga*;

f) to evaluate for their quality as a source of 'injera' (the local food) those sorghum lines which perform well under trial;

g) to provide continued training of local personnel; and

h) to develop a test cooking and quality control facility.

## 2. PROJECT PERFORMANCE

### 2.1 Technical Achievements

Technical achievements deal with results from the first five objectives outlined above. In addition, work has been initiated on quality evaluation of sorghum as a source of 'injera' and the test cooking facility, however, no reports are available to document the results.

The technical achievements are summarized below.

a) Two high-yielding cultivars, Alemaya 70 and Awash 1050, were identified and released to farmers for use in the high and intermediate altitude zones. Both substantially out yield farmers' present cultivars. In the low rainfall areas these new varieties give approximately 5.0 tons/ha and in the high rainfall areas they

give in the neighbourhood of 8.0 tons/ha. Both values are under experimental conditions and compare to an average on-farm yield of 1 ton/ha.

For lowland areas, suitable maturing varieties are almost absent. One variety Kobomash 76 has been released due to a crisis situation resulting from the drought. Kobomash 76 is a variety which has performed well in other parts of the world but has not been tested extensively under Ethiopian conditions. In 1976 it had yielded 3.5 tons/ha under experimental conditions.

b) Work has been done to determine the relationship between population density and yield. A trial conducted in 1973 using Alemaya 70 at seven plant densities indicated the superiority of 75 cm by 15 cm spacing which gave 90,000 plants/ha. A second trial showed declines in yield when row spacing below 20 cm. In 1974, a further trial using four varieties at six population densities showed that under adequate moisture and fertilizer conditions, tall varieties (e.g. Alemaya 70) gave a positive response in terms of yield to higher populations (166,000 plants/ha).

c) With respect to rates of fertilization, it was found that there is a positive response to increased applications of phosphorous but not for nitrogen when applied to the highland varieties. So far the optimal application rates appear to be 46 kg of nitrogen per hectare and 48 kg of phosphorous per hectare.

d) Intercropping trials, though limited, indicate that total yields were increased by less than 15 per cent when sorghum was intercropped with Ethiopia 10 haricot beans. In some cases, a poor choice of intercrops, such as cowpea, resulted in decreased yields of as much as 40 per cent. This is apparently due to the vigorous competition on the part of the cowpea for soil nutrients.

e) An important part of the research program has been to determine the major diseases and pests of sorghum in Ethiopia along with the most commonly found weeds, and to develop methods for their control. Surveys have shown that weed control is important since losses from weeds can reduce yields by 25 per cent. Tests conducted on the major broad leaf weeds, indicate that atrazine-based herbicides are the most effective form of control. A major unsolved problem is the development of a control for striga. It is believed that if the weed can be effectively controlled, a major hurdle will be overcome in increasing Ethiopian sorghum output. A limited striga control program is presently being undertaken in the project.

The surveys have also identified 12 major sorghum diseases and 13 types of pests, which have been classified into general, highland or lowland specific, and/or high rainfall-low rainfall specific. This classification allows researchers to estimate the frequency of occurrence of the various pests and diseases by region, and to concentrate their control efforts in those areas.

f) One of the objectives of ESIP has been the collection of Ethiopian sorghums. As of the 1977 crop season there was a collection of Ethiopian sorghum varieties numbering over 5,700. This collection has been made freely available to other cooperating national programs and to ICRISAT. The varietal development program has concentrated on pure line selection, the pedigree method and hybridization. For pure line selection, ESIP has been gathering between 500 to 1,000 new Ethiopian sorghums every year and growing them out for evaluation purposes. The pedigree method is the crossing program involving Ethiopian and exotic varieties. In total there are 137 parents involved in 11 major combination blocks. A hybrid program started in 1977, and is based on 10 male sterile lines and 163 pollinators. Combinations were made in the off season nursery and 1,630 different  $F_1$  hybrids were planted for yield trials in 1977.

## 2.2 Institutional and Personnel Development

ESIP is a unique research institution in Ethiopia, because of its semi-autonomous structure. This structure has facilitated the rapid expansion in the research program because program decisions made by the project leader have been implemented immediately without bureaucratic delay.

The opinion of staff and the rapid expansion and accomplishments of the program suggest that the semi-autonomous structure has been an effective method of running the program. At the same time, this structure can only be maintained in its present form if external funding continues. ESIP will probably have to become formally associated with IAR, if it intends to secure government funds for future operations.

Before 1973, there were no Ethiopian scientists working full-time on sorghum improvement. During this project, four Ethiopian students, who had obtained undergraduate degrees in plant science from the Alemaya College of Agriculture and worked on the project for one year, have completed M.Sc. degrees in North America. Three of the trainees were funded directly from the project and one candidate was able to obtain an independent scholarship. Prior to the graduate training, two of the candidates had taken short training courses (4 months) at ICRISAT to acquaint them with the operation of a crop improvement program.

Due to the political situation in Ethiopia, one of the four students has returned to Ethiopia and is working as the agronomist on the project. The other three are continuing their studies at the Ph.D. level in North America and plan to return to Ethiopia when the political climate becomes more favourable. It is hoped that future graduate training can be obtained at a university close to ICRISAT to enable students to combine course work with practical experience.

In addition, ESIP has trained a total of 16 research assistants. The trainees are high school graduates who receive on-the-job

training which enables them to undertake the majority of ESIP field and laboratory studies. For one month the research assistants undergo a training seminar at Nazareth which reviews the technical activities of the year and prepares the research program for the new year. With only two professional scientists on staff, the research assistants have made an important contribution to the project. There is also a training program for 20 young female high school students who take a short course every year at Nazareth to train in the techniques of sorghum emasculation.

An agronomist trainee, who returned to ESIP following an M.Sc. course in Canada provided the following assessment of the training program. First, it was valuable to have worked in the project for a year prior to the start of the post-graduate training (a normal policy of the Ethiopian Government). Next, the guarantee of a permanent job in the project following the training program provided an incentive to return to the project, and finally that it would be valuable if postgraduates were allowed to spend time at an International Agricultural Research Centre (IARC) to gain up-to-date information on recent advances in their field of interest.

### 2.3 Management and Program Planning

Because ESIP is a small organization, there has been no management or advisory committee established in the project. The project leader is responsible for decision making and project operation. Staff turnover has been very low, and the project leader and IAR staff stated that the morale and enthusiasm of ESIP staff has been consistently high. These indicators suggest that the management has been successful.

ESIP program planning and review is the direct responsibility of the project leader. In the national context the IAR has established the National Crop Improvement Committee (NCIC) which reviews all agricultural research programs annually. For each of the main crops there is a subcommittee and coordinator. In the case of sorghum, the leader of ESIP is the coordinator of the sorghum subcommittee and reports on ESIP's activities to the NCIC. This formal linkage with the NCIC has kept the IAR and the Government fully aware of ESIP's activities and program.

Program planning and evaluation also results from contacts with external organizations through exchange visits, workshops, field days, etc. For example, the ESIP workshop in October 1977, had invited guests from ICRISAT and Texas A & M University who discussed the ESIP program thoroughly with the staff.

The only written record of ESIP's activities appears in the four Progress Reports which have been prepared for IDRC, and in the proceedings of the October workshop.



## 2.4 Administrative and Financial Problems

With the establishment of ESIP in Phase II, an integral administrative system was developed. Problems in the project include the following:

a) Since ESIP is not legally constituted, all financial transactions between IDRC and ESIP must be transferred through AAU and the Alemaya College of Agriculture. This procedure creates delays for receiving funds of up to one month.

b) AAU requires financial statements from ESIP every two months before funds will be released. These statements are structured differently from those by IDRC which has forced ESIP to write two different accounting reports, one for AAU and one for IDRC.

c) Expenditures have not occurred at the rate outlined in the original budget. On a cumulative basis (1973-1977) 69 per cent of the budgeted funds were spent. The rate of expenditure has varied from 39 per cent to 172 per cent of budget levels. (See Appendix 'A'). Two items for which actual expenditures have not met the planned budget are training and capital purchasing.

i) The training program did not become operational in Year 1 of the project because of a government regulation which required the students to undertake on-the-job training for one year.

ii) All local purchases have been made by the ESIP Administration. There have been continuous problems with the purchase of foreign items because it is difficult to obtain clearance for foreign exchange expenditures; suppliers have been reluctant to ship supplies to Ethiopia; and agricultural research equipment has a low priority for customs clearance and handling.

d) ESIP has recruited and hired staff independent of IAR or AAU. However, no terms of service or personnel policies have been developed. ESIP has not provided for superannuation or insurance for personnel. These basic procedures are requirements of Ethiopian law and it is difficult to determine how ESIP has operated without abiding by these regulations. Arrangements are currently being worked out with IAR to account for these procedures.

e) The project leader estimates that he spends up to 25 per cent of his time on administration, financial reports and equipment purchasing. The procedure of hiring an administrative assistant has released the project leader from many of the administrative duties allowing him to devote more time to the research program.

## 2.5 National Linkages

ESIP has established an informal association with the Ethiopia Nutrition Institute (ENI). In Phase II, ESIP approached

ENI for assistance by testing high lysine sorghum varieties for nutritional quality and acceptability. Five high lysine varieties have been tested at three intervals.

In Phase II, ESIP also established a kitchen in Alemaya which tests improved varieties with village women for cooking, taste and visual qualities. The kitchen is run by a high school graduate with training in home economics. IDRC has provided technical advice on the operation of the test kitchen. In both of these cases it is difficult to determine progress achieved because no reports have been made available of the test results.

ESIP recognizes the importance of testing sorghum varieties for nutritional quality and acceptability amongst consumers and to this end they have developed an association with ENI. It was the impression of IDRC staff that formal liaison should be developed between ESIP and ENI. ENI's input into the operation and management of ESIP's test kitchen would be a logical point for association, however, ESIP would have to make resources available to allow ENI to become involved in the project.

## 2.6 The Beneficiary

One area of ESIP's program which has developed slowly relative to the improvement program is the relationship between research, extension and the beneficiary. Sorghum is an important subsistence crop and there is no doubt that sorghum production will be increased if an effective extension service is able to work with the farmers.

The importance of links with the extension services were recognized by the project leader at the beginning of the project. Although there was no direct relationship between the College of Agriculture and the Extension and Implementation Department (EPID) of the Ministry of Agriculture, the project organized demonstration plots on farmers' fields within easy reach of Alemaya showing the advantages of new varieties with little fertilizer and good agronomic practices.

Over the life of the project the amount of work which has taken place directly between ESIP and farmers has been limited because:

- a) ESIP has had few varieties ready to be released; and
- b) there is no effective extension unit or seed multiplication system in Ethiopia.

Despite these problems, in 1977 ESIP released improved varieties and worked directly with farmers in the following ways:

a) The Alamake Ikobo Regional Development Project for the Relief and Rehabilitation Commission has planted about 17 hectares of Kobomash 76 in the Kobo region for seed multiplication. The seed will be released to farmers in the region as soon as it is available.

b) ESIP is cooperating with a government farm in the Chercher Highlands by providing sorghum seed for multiplication. Thirty hectares of Alemaya 70 and Awash 1050 were planted on this farm for distribution to farmers in the region.

c) ESIP has encouraged IAR research stations participating in the sorghum National Yield Trials (NYT's) to release seed from the experimental plots of the varieties which perform best at the station.

d) ESIP provided seed to EPID in the Naza Area which was subsequently multiplied and distributed to about 40 farmers. The harvest for 1977 has not been completed and therefore results are unavailable.

e) Research assistants have been working directly with farmers at the research stations. Farmers have been coming to the station inquiring about improved varieties and management techniques.

f) Cooking, taste and visual testing of sorghum varieties have been carried out with village women at the ESIP test kitchen in Alemaya.

## 2.7 The Delivery System

In future ESIP will have to consider mechanisms which ensure a firm relationship is established between ESIP staff, the farmers and users of sorghum. To this end, ESIP should continue to develop relationships with EPID staff by providing information on ESIP varieties and by making seed available. ESIP should also encourage the development of complementary mechanisms to EPID. The following have been discussed:

a) The Food and Agricultural Research Sub-Council of the Ethiopian Science and Technology Commission has in conjunction with IAR and EPID developed a program in six pilot villages whereby the farmers, extension workers and scientists will work together in defining the requirements and constraints of farmers, and developing methods that will make technology available to the farming community. The results of this work could have a dramatic effect on the future structure of EPID.

b) A National Seed Council (NSC) has been established to recommend a policy to the Government on the multiplication of seed for release to farmers. The suggestion is to encourage peasant associations to grow seed in large quantities. The NSC will buy the seed and distribute it to farmers through EPID. The process of seed

multiplication is very complex and it is unlikely that a program will be implemented in the near future.

These mechanisms to strengthen the linkage between the research and the beneficiary are longer term propositions. In the short term ESIP will be required to expand their mandate to include the multiplication and distribution of improved seed to farmers. In fact, ESIP has planned that one of the returning graduate students will take the position of Farm Trials Officer to improve the relationship between ESIP and the farmers.

## 2.8 Regional Linkages

ESIP has developed strong links with regional programs and international institutions. The strongest international linkage has developed with ICRISAT, and includes seed exchange, exchange of technical information, workshops, and short training courses.

In the past, ESIP cooperated with the Arid Land Agricultural Development (ALAD) Program (now ICARDA) by providing ALAD with the facilities and support for an off-season nursery. Other seed exchange programs have developed between ESIP and Texas A & M University, Nebraska University, Purdue University, FAO Near East and North Africa Regional Project on Field Crops, and the CIMMYT Cold Tolerant Sorghum Program.

At the regional level, ESIP represents Ethiopia at the Semi-Arid Food Grain Research and Development (SAFGRAD) Project located in Ouagadougou, Upper Volta. Seed exchange programs also exist with the following national programs: Sudan, Kenya, North Yemen, India, Zambia, Rwanda and Nigeria. Finally, it is proposed that a regional program devoted to high altitude sorghum improvement will be established with ESIP as the principal coordinating centre.

## 3. IDRC'S ROLE AND INVOLVEMENT

It was evident from discussions with ESIP staff that the philosophy of IDRC was well understood and appreciated. It was not unusual to hear the comment, "we are always encouraged by IDRC".

Over the five year life of the project, there have been 13 visits by 7 IDRC staff members and consultants. ESIP staff did not feel that all of these visits were critical to the continued operation of the ESIP research program. The important visits were the ones associated with developing the Phase II of the project. The number of visits by IDRC staff (2.6 per year) is higher than the norm of 2 monitor visits to projects per year, however, not all of the visits were directly related to the operation of the project.

Specific comments from ESIP staff on IDRC's style of operation follow:

a) The Project Agreement was signed with AAU. This had led to long time delays for transferring funds. In the future, it has been suggested that an agreement with IAR would reduce this type of delay.

b) Progress Reports should only be required one per annum, preferably at the end of the harvest season in February/March.

c) Financial statements should coincide with the financial year of the recipient institution.

d) In some cases it may be expedient for IDRC to purchase equipment on foreign markets.

In general, ESIP found that IDRC was able to respond quickly to requests for administrative support. ESIP considered the lack of interference by IDRC in the operation of the program to be an important factor in the rapid expansion of the program.

A project advisor was attached to the project in Phase I to assist the project leader with the development and operation of the program while graduate students were on training programs overseas. The advisor was a young Canadian plant breeder with the Canadian University Service Overseas (CUSO) program. The role of the project advisor was to act as an assistant to the project leader. Initially, the Ethiopians expressed disappointment that the advisor was not an older and more experienced scientist. However, at the termination of Phase I, it was concluded by IDRC, the project advisor and ESIP staff that this arrangement had worked well. The project advisor joined the project at the same time as the four graduate students from the Alemaya College of Agriculture with whom he worked directly during the first year. In the second year when the four departed for overseas studies, the project advisor and the project leader were left to operate the program with the help of local research assistants. The project advisor terminated his contract on schedule and left the project in the third year. At that time no trainees had returned leaving an apparent gap in the continuity of the project. Fortunately, no collapse occurred with the departure of the project advisor. In fact, by this stage the research assistants had been sufficiently trained to provide the project leader with the assistance required to carry on the project. Project continuity was maintained and a returning graduate student was placed into the project with no difficulty.

In summary, the ESIP staff appeared very conversant with, and appreciative of, IDRC's philosophy and style of operation. Monitor visits by IDRC staff were important, especially the technical and scientific inputs into the program at the time of the review and development of Phase II of the project.

#### 4. DEVELOPMENT IMPLICATIONS

The most significant accomplishment of this project has been the establishment of a national Ethiopian research unit responsible for the improvement of sorghum.

The single most important reason for success has been that the project developed under the very strong, capable and committed leadership of the project leader. He has motivated a competent team of researchers and as a result ESIP has been established as an independent research unit which is not formally responsible to any Ministry or parastatal institution but has nevertheless developed very close linkages with these Ethiopian organizations.

Aside from the technical achievements, the project has achieved substantial progress in the following areas:

- a) A core of scientific expertise on sorghum improvement has been established.
- b) ESIP has gained national respect and become an important component of Ethiopian agricultural research.
- c) ESIP has also gained international recognition and forms an essential part of the global sorghum network.
- d) To a limited extent, ESIP has initiated work with farmers.

It is the opinion of both ESIP and IDRC staff that in the future ESIP will have to address itself to the following:

- a) ESIP will have to work closely with farmers and consumers of sorghum to determine the requirements and constraints of the beneficiary. Formal liaison with institutions in Ethiopia should be formed. ESIP should also develop within its structure, an extension unit under a Farm Trials Officer.
- b) As the ESIP program matures, it should become systems oriented. Besides the improvement program, research should include storage and milling problems for the small farmer and utilization of sorghum in traditional and new foods.
- c) To date, ESIP has been totally financed from external sources.

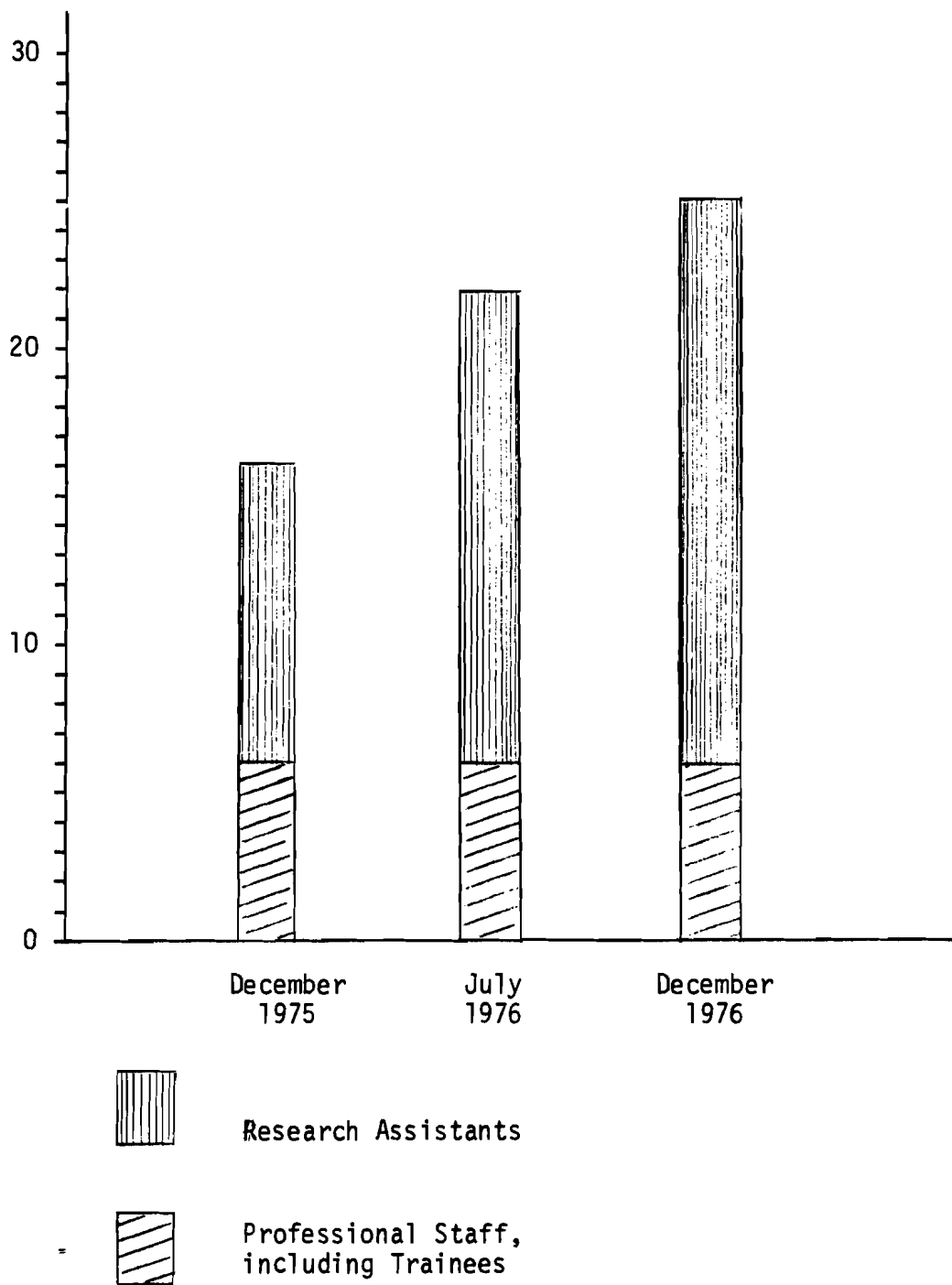
In the future, ESIP will have to become formally linked to the IAR; if it intends to obtain government financing. Therefore, any proposed agreement between ESIP and IDRC should be arranged with IDRC and IAR.

In conclusion, the project leader suggested that it would have taken at least 10 years to accomplish what has been done at ESIP in five years under normal circumstances.

APPENDIX A

GRAPH 1

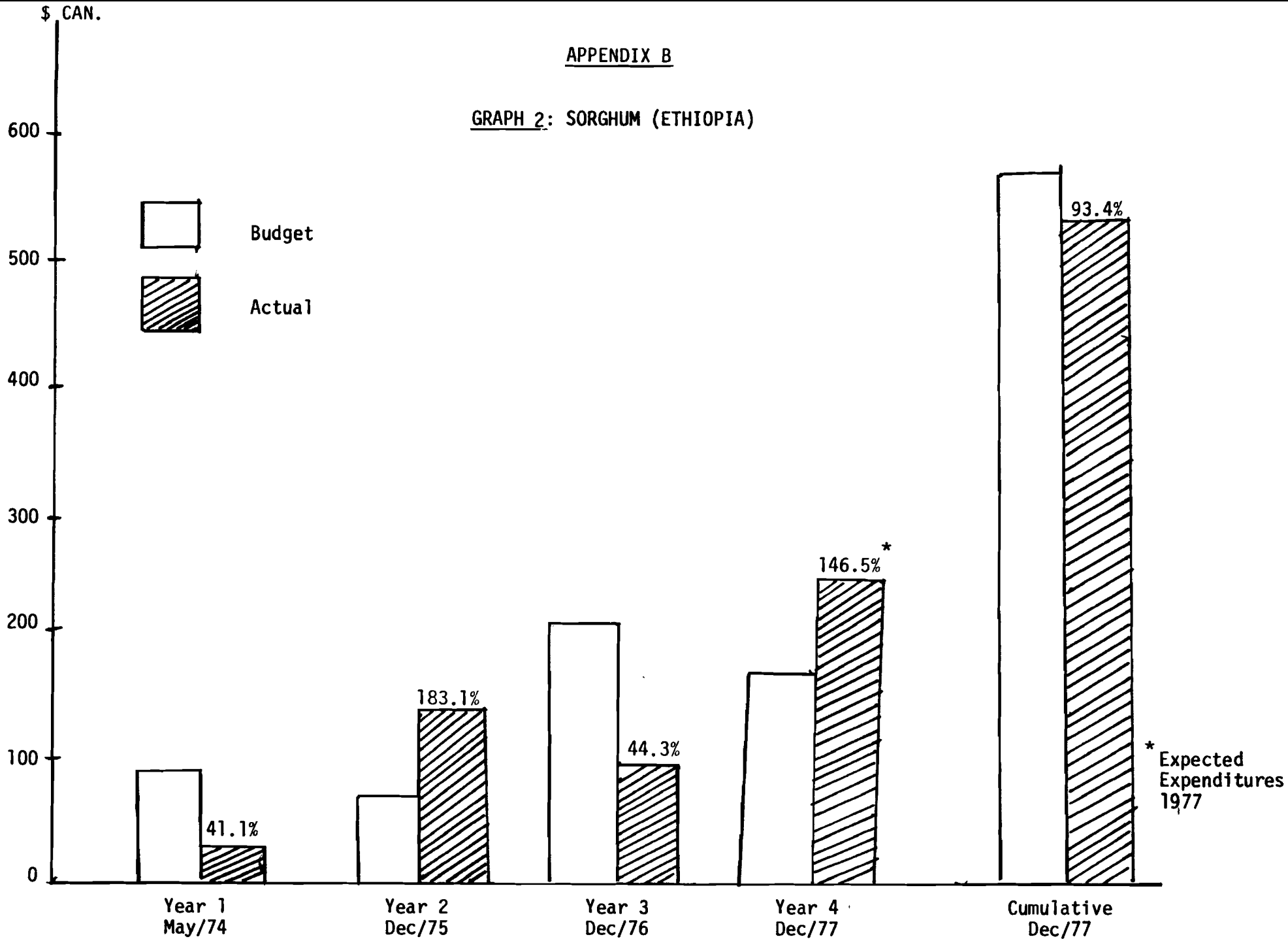
GROWTH OF ESIP STAFF





APPENDIX B

GRAPH 2: SORGHUM (ETHIOPIA)



# APPENDIX C

## Total Budget and Actual Expenditures by Year and Cumulative

### SORGHUM (ETHIOPIA)

	PHASE I						PHASE II								
	YEAR 1			YEAR 2			YEAR 3			YEAR 4			CUMULATIVE		
	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>	<u>Budget</u>	<u>Actual*</u>	<u>% Spent</u>	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>
Salaries & Allowances	55,600	32,817	59.0	49,700	65,690	132.2	73,600	39,037	53.0	85,900	85,900	100.0	264,800	223,444	84.4
Research Expenses	-	-	-	-	1,916	-	27,750	25,712	92.7	28,500	28,500	100.0	56,250	56,128	99.8
Capital Expenses	26,000	7,246	27.9	2,000	33,802	1690.1	94,000	18,696	19.9	18,000	93,400	518.9	140,000	153,144	109.4
Training	20,000	29	0.2	20,000	38,319	191.6	2,500	-	0	9,500	12,000	126.3	52,000	50,348	96.8
Publications & Workshops	-	-	-	-	-	-	-	-	-	3,000	3,000	100.0	3,000	3,000	100.0
Travel	6,000	4,146	69.1	6,000	2,568	42.8	9,500	9,335	98.3	17,000	17,000	100.0	38,500	33,049	85.8
Consultancy	-	-	-	-	-	-	3,000	360	12.0	3,500	4,500	128.6	6,500	4,860	74.8
<b>TOTAL</b>	<b>107,600</b>	<b>44,238</b>	<b>41.1</b>	<b>77,700</b>	<b>142,295</b>	<b>183.1</b>	<b>210,350</b>	<b>93,140</b>	<b>44.3</b>	<b>165,400</b>	<b>242,300</b>	<b>146.5</b>	<b>561,105</b>	<b>523,973</b>	<b>93.4</b>

\* Expected

## APPENDIX D

### Abbreviations Used

(ALAD)	Arid Land Agricultural Development Program
(AAU)	Addis Ababa University
(ENI)	Ethiopian Nutrition Institute
(EPID)	Extension and Project Implementation Department
(ESIP)	Ethiopia Sorghum Improvement Project
(IAR)	Institute of Agricultural Research
(IARC)	International Agricultural Research Centre
(ICARDA)	International Centre for Agricultural Research in the Dry Areas
(ICRISAT)	Institute for Crops Research in the Semi-Arid Tropics
(NCIC)	National Crop Improvement Committee
(NSC)	National Seed Council
(NYT)	National Yield Trials
(SAFGRAD)	Semi-Arid Food Grain Research and Development

# APPENDIX E

Map of Ethiopia with ESIP Locations

