AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 76

1. SUBJECT CLASSIFICATION
A. PRIMARY: Food production and nutrition — AF00-0000-G136
B. SECONDARY: Plant production--Ethiopia

2. TITLE AND SUBTITLE
An implementation plan for a seed improvement program in Ethiopia

3. AUTHOR(S)
(101) Experience,Inc.,Minneapolis,Minn.

4. DOCUMENT DATE: 1972
5. NUMBER OF PAGES: ~~112p.~~ 114p.
6. ARC NUMBER: ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Experience

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)
(Rpt.no.3)

9. ABSTRACT

10. CONTROL NUMBER
PN-AAF-164

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Ethiopia
Improvements
Marketing
Project implementation
Project planning
Seed production
Seeds

13. PROJECT NUMBER

14. CONTRACT NUMBER
AID/afr-752 GTS

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

E. I. Contract No. 626
May 1972

REPORT NO. III

AN IMPLEMENTATION PLAN FOR A SEED IMPROVEMENT PROGRAM IN ETHIOPIA

Prepared for:

Planning and Programming Department
The Ministry of Agriculture
Imperial Ethiopian Government

The United States Agency for International Development
participated in the funding of this contract.

PREFACE

This report is one of several prepared under Contract No. 626 between Experience, Incorporated and the Ministry of Agriculture of the Imperial Ethiopian Government. The United States Agency for International Development was also involved in this program through participation in the funding of the contract. Field work on the project was initiated in October 1971 and continued through March 1972. In the course of work, eleven specialists were in Ethiopia for varying periods of time.

Initially, the purpose of the project was to conduct a reconnaissance survey to establish the export potential of feed grains (maize, sorghum, barley) and pulse crops. That particular activity made up Phase I of the contract program. Phase II involved the more detailed study of several aspects of the production and marketing of certain grains and pulses. It was determined that attention in Phase II should be focused particularly on the planning of a project through which production of pulses for export will be increased substantially. Other focal points in the second phase included multiplication and distribution of improved seeds (grains and pulses), outlook for the marketing of malting barley, and the prospects for export of durum wheat.

In conducting the field work in Ethiopia, the Experience, Incorporated specialists were assisted importantly by local counterpart personnel assigned temporarily to work on the contract program. Without the help of these persons it would not have been possible to complete the assignment effectively or on time. The contract program was attached to and received logistic support from the Planning and Programming Department of the Imperial Ethiopian Government Ministry of Agriculture where Ato Mulugetta Bezzabeh, Department Head, and Ato Ketema Desta, Project Coordinator, were especially helpful. Policy guidance and useful suggestions on procedure and findings were provided by the United States Agency for International Development staff, and by an Inter-Agency Steering Committee chaired by Ato Mulugetta Bezzabeh.

Experience, Incorporated staff members resident in Ethiopia at various times during the course of this contract program were:

Allan Q. Moore, Project Leader (Phase I) and Grain Marketing Specialist

E. R. Duncan, Project Leader (Phase II) and Extension Specialist

Herman T. Holmes, Seed Marketing Specialist

Norton C. Ives, Agricultural Engineer

Ray A. Pendleton, Cereal Grains Agronomist

Charles W. Peters, Agricultural Economist (General)

John B. Schneider, Agricultural Economist (Marketing)

James R. Snitzler, Transportation Economist

Gayatri P. Tewari, Seed Production Agronomist

Bruno Utelli, Pulse Marketing Specialist

Peter H. van Schaik, Pulse Agronomist

In addition, several members of the Experience, Incorporated home staff in Minneapolis, Minnesota were involved in the project.

Counterpart Imperial Ethiopian Government personnel assigned to the contract program included particularly:

Ato Getachew Haile, Ministry of Agriculture

Ato Ghiorghis H. Mariam, Ministry of Agriculture

Ato Mamo Desta, Ethiopian Grain Corporation

Ato Hiruy Belayneh, Institute of Agricultural Research

Ato Wolde Yohanis Woldayes, Ministry of Agriculture

Reports prepared under auspices of this contract are:

A. Field Reports (prepared and presented in Ethiopia by field staff)

1. Production and Marketing of Pulse Crops in Ethiopia, Final Report, Phase I, December 1971

2. Production and Marketing of Feed Grains in Ethiopia, Final Report, Phase I, December 1971

3. Ethiopian Malting Barley, Draft Report, February 1972

4. Pulse Production Project, Ethiopia, Draft Report, February 1972

5. A Seed Improvement Program Proposal for Ethiopia, Draft Report, March 1972

B. Final Reports (submitted upon completion of the project work program)

1. The Feasibility of Producing Pulse Crops for Export Markets, Report No. I, May 1972

2. The Feasibility of Producing Cereal Grain Crops for Export Markets, Report No. II, May 1972

3. An Implementation Plan for a Seed Improvement Program in Ethiopia Report No. III, May 1972

4. The Transportation, Processing, and Storage of Ethiopian Grains and Pulses for Domestic and Export Markets, Report No. IV, May 1972

NOTE: Throughout the final reports the exchange rate used is Eth. $2.50 = US$1.00. Except where specifically stated otherwise, all monetary expressions refer to Ethiopian dollars. Tons are in the metric system = approximately 2,200 pounds. Feed grains are defined to include barley, maize, and sorghum; in Ethiopia, however, all grains are considered "food" grains.

TABLE OF CONTENTS

		Page
I.	SUMMARY AND RECOMMENDATIONS	
	A. Summary	1
	B. Recommendations	2
II.	INTRODUCTION AND GENERAL BACKGROUND	
	A. Introduction	4
	B. General Background	4
	C. Farm Pattern	5
	D. Agricultural Production	5
	E. Farm Income and Tenure	6
	F. Organization for Agricultural Development	6
III.	TECHNICAL ANALYSIS	
	A. Program Description	8
	B. Organization and Management	10
	C. Status of Major Crops and Projected Seed Needs	22
	D. Production and Processing of Improved Seed (Not Certified)	33
	E. Seed Processing and Storage	36
	F. Proposed Locations for Seed Processing Facilities	38
	G. Impact of the Project on the Environment	40
IV.	SEED MARKETING, DISTRIBUTION, AND SALES	
	A. Imperial Ethiopian Government Policies and Regulations Will Influence Seed Marketing	42
	B. Marketing Constraints	43
	C. Seed Distributing and Marketing Channels	45
	D. Costing, Pricing, and Profits from Improved Seed	48
	E. Summary	50
V.	SEED IMPROVEMENT PROJECT FUNDING	
	A. Introduction	52
	B. Estimated Funding Required	52

Page

VI. ECONOMIC ANALYSIS

A. Project Evaluation Procedure 62
B. Estimated Production Gains Attributable to the Project 62
C. Cost of Producing Incremental Gains 63
D. Benefit/Cost Analysis 65
E. Direct Finding of the Seed Improvement Project 69

TABLES AND FIGURES

TABLE 1. SEEDING RATES IN KILOGRAMS PER HECTARE 23

TABLE 2. ESTIMATED HECTARAGE OF SELECTED CROPS, TOTAL AND IMPROVED SEED NEEDS FOR THE EMPIRE 24

TABLE 3. YIELD COMPARISONS FOR SELECTED MAIZE VARIETIES - 1970 29

TABLE 4. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN SEED COUNCIL 53

TABLE 5. ESTIMATED FUNDING REQUIRED FOR THE TECHNICAL ASSISTANCE CONTRACT - SEED IMPROVEMENT PROGRAM 54

TABLE 6. ESTIMATED FUNDING FOR RESEARCH SERVICES FOR THE SEED IMPROVEMENT PROGRAM 55

TABLE 7. ESTIMATED FUNDING FOR THE SEED LAW ENFORCEMENT UNIT NECESSARY FOR THE SEED IMPROVEMENT PROGRAM 56

TABLE 8. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF FOR THE AWASA SEED FARM 57

TABLE 9. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF FOR THE AWASA SEED PROCESSING FACILITY 58

		Page
TABLE 10.	ESTIMATED FUNDING FOR THE ETHIOPIAN STAFF, BY YEARS, FOR THE FOUR SEED FARMS - TIME PHASED	59
TABLE 11.	ESTIMATED FUNDING FOR THE ETHIOPIAN STAFF, BY YEARS FOR FOUR SEED PROCESSING FACILITIES - TIME PHASED	60
TABLE 12.	TIME PHASED FUNDING REQUIRED FOR SEED PRODUCTION AND SEED PROCESSING FACILITIES - SEED IMPROVEMENT PROGRAM 1973 - 1982	61
TABLE 13.	ESTIMATED PRODUCTION GAINS ATTRIBUTABLE TO THE SEED IMPROVEMENT PROGRAM FOR ETHIOPIA, 1973 - 1992	64
TABLE 14.	ESTIMATED COST OF PRODUCING THE INCREMENTAL GAIN IN CROPS ATTRIBUTABLE TO THE SEED IMPROVEMENT PROGRAM FOR ETHIOPIA, 1973 - 1992	66
TABLE 15.	SUMMARY OF COSTS RELATED TO EXPECTED BENEFITS DERIVED FROM THE SEED IMPROVEMENT PROGRAM IN ETHIOPIA, 1973-1982	67
TABLE 16.	RELATIONSHIP OF ESTIMATED INCOME DERIVED AND COSTS INCURRED IN THE SEED IMPROVEMENT PROGRAM IN ETHIOPIA	68
TABLE 17.	SUMMARY OF DIRECT FUNDING REQUIRED TO IMPLEMENT A SEED IMPROVEMENT PROGRAM IN ETHIOPIA, 1973-1882	70
FIGURE 1.	PROPOSED ADMINISTRATIVE PLAN FOR A SEED IMPROVEMENT PROGRAM-ETHIOPIA	11
FIGURE 2.	MAP	16

APPENDIX A

TABLES

TABLE A-1. PRODUCTION OF CEREALS AND PULSES IN ETHIOPIA, 1960/70

TABLE A-2. AREA OF CEREALS AND PULSES IN ETHIOPIA, 1960/70

TABLE A-3. YIELD OF CEREALS AND PULSES IN ETHIOPIA, 1960/70

TABLE A-4. QUANTITY OF PULSES EXPORTED FROM ETHIOPIA, 1965/70

TABLE A-5. IMPORTS OF CEREALS BY ETHIOPIA, 1966/70

TABLE A-6. NATIONAL SEED INVENTORY FOR 1972-73

TABLE A-7. FIELD POWER AND MACHINERY FOR A 400-HECTARE SEED FARM

TABLE A-8. BUILDINGS FOR SEED FARM, SEED PROCESSING, AND SEED STORAGE

TABLE A-9. SEED PROCESSING EQUIPMENT

TABLE A-10. RECOMMENDED ANNUAL AMORTIZATION

APPENDIX B

PROJECTED EFFECTS OF THE MINIMUM PACKAGE PROGRAMS ON IMPROVED SEED

A.	Haricot Beans	1
B.	Maize	1
C.	Barley	2
D.	Sorghum	2
E.	Wheat	3
F.	Teff	3

APPENDIX C

ESTIMATED FUNDING

TABLE C-1. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF - THREE SEED FARMS - TIME PHASED

TABLE C-2. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF - THREE PROCESSING PLANTS - TIME PHASED

TABLE C-3. ESTIMATED POWER, MACHINERY AND LABOR COSTS FOR PRODUCING MAIZE AND BEANS

TABLE C-4. ESTIMATED COST OF PRODUCING IMPROVED MAIZE, BEANS, AND WHEAT

TABLE C-5. ESTIMATED COST OF PROCESSING IMPROVED SEED OF MAIZE, BEANS, AND WHEAT

TABLE C-6. ESTIMATED COSTS OF MARKETING MAIZE

TABLE C-7. ESTIMATED RETAIL PRICE PER QUINTAL OF IMPROVED SEED

APPENDIX D

NOTES FROM PREVIOUS SEED PROGRAM STUDIES

I. SUMMARY AND RECOMMENDATIONS

A. Summary

The only available statistics indicate that approximately ten million of Ethiopia's 122 million hectares are in crops. Land area in crops appears to have remained relatively constant for the past ten years. National yield averages have not changed significantly during the same period. If more accurate figures were available, it is possible that specific changes could be identified. Yields and quality of the cereal and pulse crops are low by any standards. Cultural practices and farming methods for most farmers have changed very little over many years.

Research data assembled by the Institute of Agricultural Research and yields from a few modern commercial farmers show that high yields are possible. Ethiopia's soils and climate provide an environment in which crop yields can rival any in the world. New crop varieties, with greater genetic potential, and high-quality seed are essential to achieve these higher yields.

Removal of the many production constraints in agriculture could change total production in a relatively short time. A high priority should be given to production, processing, and widespread use of improved seed. This would remove one of the main constraints to higher cereal and pulse yields. A functional seed law is one of the first items of importance in developing an improved seed industry.

A slight restructuring in the Ministry of Agriculture would enable placing all seed law enforcement under one governmental unit. This would result in greater efficiency and, possibly, appreciably lower total enforcement costs.

An addition to the Ministry of Agriculture will be required to supervise and direct the several new activities that will be needed for a viable and functional improved seed program. This new unit will be called the Ethiopian Seed Council, and it will give guidance to most of the activities relating to the improved seed program.

A plan for improved seed production, processing, and marketing, and certain alternative schemes, are presented in this report. The importance of private enterprise in an improved seed program is emphasized. A proposal for a seed law enforcement unit is also discussed.

B. Recommendations

We assume that it is desirable for Ethiopia to:

1. Be self sufficient in cereals, pulses, oilseeds, cotton, vegetables, and fruits;

2. Be able to export certain agricultural commodities to improve the Empire's balance of trade;

3. Produce agricultural commodities at a profit and sell these commodities at a price consumers can afford to pay.

If these assumptions are valid, Ethiopia must have a strong agricultural research program, which will provide a continuous source of improved seed to the seed producer, who will multiply the improved seed for farmers.

Our recommendations to the Imperial Ethiopian Government, through the Ministry of Agriculture, include:

1. That the IEG put into effect a Seed Law that will establish functional limits for domestic and imported seed quality;

2. That the IEG establish and fund a National Seed Testing Laboratory which will be equally available to the seed law enforcement unit, the IAR, the seed industry, and farmers of the Empire;

3. That the IEG provide funds for an expanded IAR program, which will develop new improved varieties, and identify adaptation zones for all improved varieties sold in the Empire;

4. That the IEG establish, in the Ministry of Agriculture, and provide funds for:

a. A seed law enforcement unit, which will be responsible for all seed law enforcement;

b. An Ethiopian Seed Council, which will administer and be responsible for:

(1) Improved Seed Production farms, seed processing facilities, and distribution of the improved seed,

(2) A National Seed Testing Laboratory,

(3) A Certified Seed Scheme,

(4) Publication of an annual improved variety list;

(5) General promotion of improved seed;

5. That the Ministry of Agriculture establish at least four seed production farms and improved seed processing facilities for cleaning, sizing, and otherwise preparing improved seed for planting. These facilities will be self-supporting. The first facility should be established near Awasa. Other units to follow are suggested for Nazaret, Alemaya, and Alamata, or an equally satisfactory location in the same general areas:

6. That improved seed use be encouraged at all levels and by all ministries of the Imperial Ethiopian Government;

7. That the IEG, through an appropriate agency (IHA or otherwise), provide more farm-to-market roads so that marketing costs can be reduced and distribution facilitated;

8. That the IEG (through appropriate agencies) encourage the provision of production credit on an organized basis to improve the efficiency of both production and marketing;

9. That the IEG, through the Ethiopian Standards Institution, establish grain standards that describe quality standards and that render suitability to national, as well as domestic, trade.

Existing political structures and units have been considered and used when it appears these entities can serve a useful purpose. When existing entities did not appear suitable, a temporary structure has been recommended and should be used until permanent political units can be organized, staffed, and funded.

II. INTRODUCTION AND GENERAL BACKGROUND

A. Introduction

During the 1960's Ethiopia experienced a steadily declining balance of trade, which reached an extreme negative position of over Eth. $166 million in 1968; in 1969 and 1970 it was moderately less unfavorable. In these circumstances, there has been increasing interest in the possibility of producing substantially greater quantities of goods for export. Historically, exports from Ethiopia have almost entirely been agricultural products (over 90 percent) and there is little prospect of this situation changing materially in the near future.

A recently completed feasibility study of producing pulses for export states that the outlook is promising for both production and export of considerably larger quantities of the pulse crops. 1/ Another study completed earlier indicated substantially the same finding on prospects for pulse exports. 2/ The findings reported in these studies plus the considered opinions of both IEG and outside observers have led to a recommendation that definitive plans be made immediately to increase the production of pulse crops for export from Ethiopia.

It is hardly reasonable to expect the agricultural sector of Ethiopia to correct the balance of trade and at the same time improve the level of living for perhaps 75 percent of the population who now live at a basic subsistence level. It is not, however, unreasonable to expect the agricultural sector to improve its efficiency and increase production to the point of self-sufficiency, with possibly a substantial export level for certain commodities as well.

This report will consider one method of improving agricultural production that has proven effective in many parts of the world -- the production of improved seed from superior crop varieties and making them available to farmers of the Empire.

B. General Background

Ethiopia is almost totally an agricultural country with a land area of 1,221,900 square kilometers, or over 122 million hectares. Agricultural land is estimated to total 84 million hectares, of which 66 million are in

---

1/ "The Feasibility of Producing Pulse Crops for Export Markets". Report No. I (see Part B). Experience, Incorporated, Minneapolis, Minnesota, May 1972.

2/ "Ethiopia's Export Trade in Major Agricultural Commodities", Report No. 6. Stanford Research Institute, Menlo Park, California, January 1969.

pastures. Crop land totals about ten million hectares, but probably as much as 33 million hectares of pasture land could be cultivated. About eight million hectares are used for cereal grains and pulse production. The potential for increased crop production is generally believed to be great.

C. The Farm Pattern

There are about four million farm units in Ethiopia, and 90 percent of the total population is rural. Farm units are the subsistence type, with 75 percent or more of the output consumed at home; this is especially true of the cereals that form the mainstay of the Ethiopian diet. Traditionally, cereal grains are used exclusively for human consumption and not as animal feed. There are very few large commercial farms,and their contribution to the total farm production is not known.

Farms in Ethiopia are heavily concentrated in the highland areas, where cereals and other crops such as coffee and pulses are the major enterprises. Topography and weather conditions vary greatly from place to place, often within a very short distance, and contribute to transportation and communication problems. The bulk of Ethiopian farmers do not have ready access to roads of any kind. This complicates marketing.

D. Agricultural Production

Based on Imperial Ethiopian Government estimates, more than 75 percent of the crop lands are devoted to cereals,with teff and barley occupying the largest areas. Sorghum, wheat, and maize are the other major grain crops. Production data are in Tables A-1 through A-3 of the Appendix.[3/]

With fewer than 250 extension agents and less than half in the field, communicating improved technology is slow and difficult. Other major constraints to increased output include limited availability of improved seed and fertilizer, lack of adequate credit, a limited marketing system, and transportation difficulties.

3/ Official IEG statistics on production, plantings, and yields are not believed to be an accurate indication of actual conditions prevailing in Ethiopia; however, they are the only comprehensive series of estimates currently available and they do provide a useful order of magnitude in evaluating the agricultural situation. The year-to-year pattern of area and yields from which production is derived does not show normal deviations due to weather and response to price variations, thus confirming the question of validity of the official statistics.

E. Farm Income and Tenure

Agriculture is credited with some 55 percent of Ethiopia's GDP, which reached Eth. $3,860 million in 1969.[4/] On this basis alone, it appears that the rural population, particularly the smaller, subsistence-type farmer, is a disadvantaged sector, with a total per capita income of less than Eth. $100 annually. The national average is closer to Eth. $150, which is indicative of the considerable disparity between rural and urban levels of living. Lately, however, the terms of trade appear to have shifted somewhat in favor of agriculture. This is primarily the result of a marked rise, both absolute and relative, in the price of certain agricultural products. For example, cereal prices, sparked by a drought in 1965-66, increased to levels considerably above world prices, and domestic prices of these important food products have remained import-oriented in the past two years. Starting in January, 1972, however, the price trend for crops such as maize and sorghum has been reversed but has not approached world price levels.

Development of agriculture in Ethiopia is seriously handicapped by the tenure situation, which is an important disincentive to adoption of improved practices by farm operators. Small holdings, periodic redistribution, sharecropping and communal ownership characterize this situation. Land tenure reform has been proposed and if undertaken, will obviously require exceptionally strong administrative action by the IEG if the program is to be effective.

F. Organization for Agricultural Development

At the present time, the principal mechanism being employed to strengthen Ethiopian agriculture is the "package" program and area development schemes such as CADU, WADU, and Ada. In these programs, which vary somewhat in their makeup, the basic technique is to concentrate inputs, technical services, and auxiliary services in a limited area to achieve maximum impact. Aside from the increased output, and presumably improved level of living resulting from these regional projects that have only limited area coverage, there will be substantial multiplier effect through the demonstration of gains to be made through adoption of the new production methods. Most production for increased exports will come from commercial-scale farms.[5/]

4/ CSO Statistical Abstract 1970, IEG, Addis Ababa.

5/ For purposes of this project, neither commercial nor subsistence-scale farms have been suitably described previously. This report will use the following definitions:
Subsistence Farm--Any farm unit selling 25% or less of its produce for cash or barter.
Commercial Farm--Any farm unit selling more than 25% of its produce for cash.
Large Commercial Farm--Any farm unit with more than one gasha (40 hectares) of cultivated land, and operated without tenants.

One of the serious agricultural supply deficiencies up to now has been the lack of improved crop varieties and seed. The CADU has included this input in their development plan. There appears to be a significant need for improved seed if agricultural production, including haricot beans, is to be increased. We recognize that the commercial farming sector will utilize this technology much more quickly than the subsistence sector. In the longer term, both sectors must be able to share in any improved technology; possibly complete mechanization would be an exception.

In this Seed Improvement Program, plans are presented to provide seed to all classes of farmers who have need for and desire improved seed.

III. TECHNICAL ANALYSIS

A. Program Description

The primary objective of this study is to develop a viable Seed Improvement Program for Ethiopia that will result in continued development of improved, superior varieties and make seed of these varieties available to all farmers of the Empire at realistic prices. We recognize that many commercial farmers will purchase improved seed immediately because they will be the first to recognize the value of better seed. Improved seed will, however, be made available immediately to small farmers in the Minimum Package areas. Production of improved seed will center on maize, wheat, and haricot beans in the beginning, as improved varieties of these crops are available and in part because yield increases from these improved varieties are generally recognizable. There are presently no improved varieties of sorghum or barley that will give recognizable yield increases over a wide range of environmental conditions.

Improved varieties of haricot beans are necessary to obtain the needed export quality of beans, and there is no alternative. Improved wheat varieties can be expected to give yield increases of approximately eight quintals per hectare, and improved maize varieties will give average yield increases of six quintals per hectare. We believe that within ten years there will be a minimum demand in all of Ethiopia for improved maize seed of 1,000 metric tons, for haricot beans over 5,000 metric tons, and for wheat over 3,000 metric tons.

We recommend that the first seed production and seed processing facilities should be established at Awasa. The demand for improved seed already exists in the area, so facilities at this location are needed and can be profitable immediately. Soil and weather conditions are favorable and good yields are essentially assured. The Awasa Experiment Station has an excellent staff of knowledgeable and interested scientists, thus technical skills are available in the area. The Ministry of Community Development has excellent training facilities at Awasa. This first seed production and processing center will serve as a pilot facility and training center. Development of subsequent locations will follow as justified,based on experience gained at the Awasa facilities.

A number of closely coordinated efforts must begin immediately to implement this Seed Improvement Program. Some of the components of this program include:

1. A seed law that will establish functional limits for seed quality; guidelines for an administrative framework and provisions for enforcement of the "law" under Ethiopian conditions. This report assumes that a seed law will be enacted within one year.

2. A functional organization structure is presented, through which most of the activities of the Seed Improvement
A semiautonomous Ethiopian Seed Council (ESC) will be established for this purpose. The director of the ESC will carry out the policies initiated by the ESC and will be directly responsible to the Ministry of Agriculture.

3. An intensive research effort will be required to generate new varieties, test them for adaptation and value, and produce foundation seed. The Institute of Agricultural Research (IAR) will provide the research inputs, with guidance and funding from the ESC during the first ten years.

4. A National Seed Testing Laboratory will be established to provide seed testing and analysis services for the seed law enforcement unit, the IAR, the proposed seed certification unit, and the farmers of the Empire.

5. Pilot seed production and seed processing facilities will be established immediately to provide needed improved seed and to train personnel for similar additional facilities. Four production and processing units are anticipated within ten years.

6. A Seed Certification Scheme will be forthcoming, which whould be a satisfactory goal for the IEG, the seed trade, and Ethiopian farmers. The scheme will be equally suitable for controlling seed quality for domestic use and for possible seed exports.

7. An improved seed marketing proposal is presented with suggestions for reaching different groups of farmers. We believe improved seed can and must be marketed through existing organizations.

All subsistence and most commercial farmers plant seed that is similar to grain used on the farm for food or sold in the market. This seed tends to be a mixture of varieties or strains, has low germination due to unfavorable storage conditions, commonly has insect damage, and is seldom cleaned. For these reasons, improved seed is more desirable than that commonly planted.

There is substantial evidence that improved seed adapted to location results in higher yields under favorable, as opposed to totally unfavorable, production conditions. National yield trials [6/] are conducted each year at up to eight locations for maize, wheat, barley, and sorghum. Recognizing the limitations of projecting yields of small experimental plots, it is still apparent that under favorable production conditions, some of the improved varieties can produce twice the yield than that of the best local varieties. At some locations, local maize selections performed very well; but, even now, they are no more commonly used than improved varieties.

6/ Institute of Agricultural Research Annual Reports.

A new seed marketing concept is needed for Ethiopia. We believe a new concept must include some of these ideas:

1. Improved seed is a product developed or selected (usually through research) for the purpose of improving the situation of those who purchase the seed. This improvement may be a result of better yields, more profit, better nutrition, or simply easier farming.

2. Improved seed is of no value unless a farmer can be persuaded to buy and use it; this requires education. If the farmer does not plant the improved seed, the investment in research, production, processing, and the storage of seed is essentially lost.

3. Improved seed has a close relationship to people; e.g., people recognize and manipulate the genetic characters of the seed. They sell, produce crops, and also consume the product. The product can, of course, be consumed directly as human food or indirectly as animal food. Consumption, in the final analysis, determines the value of the seed.

4. The marketing of improved seed can significantly encourage the development of Ethiopian agriculture. It will conceivably change the present farming pattern as described in another Experience, Incorporated report.[7/]

5. A successful marketing program for improved seeds, based on an intensive education program, can improve the position of subsistence farmers. It will permit increased grain consumption on the farm for better nutrition, and can provide additional income for the rural family. Grain production beyond subsistence needs will provide more and possibly a better quality grain for the urban Ethiopian, and the added output will aid the Ethiopian economy.

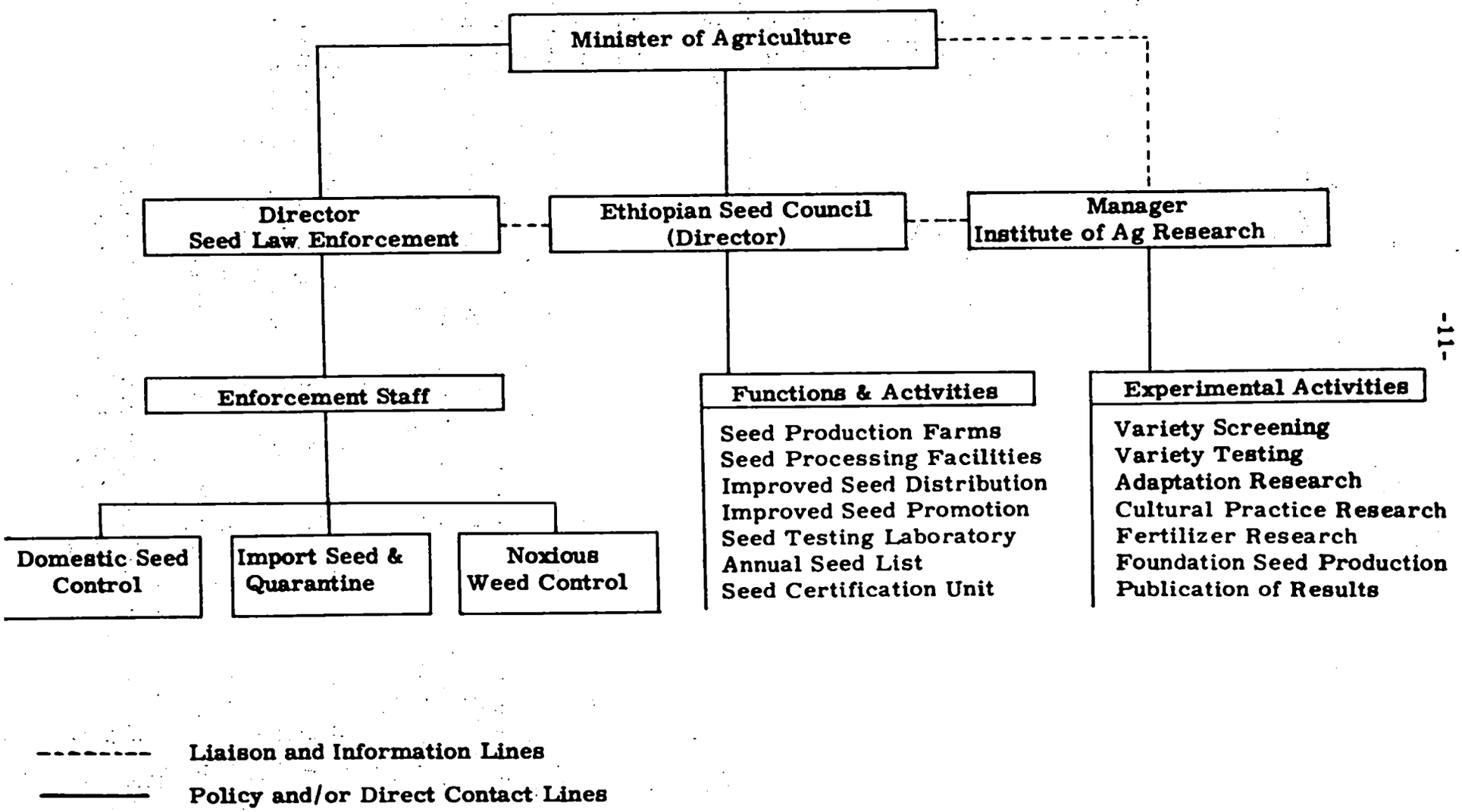
B. Organization and Management

The components which must be included in a complete seed improvement program for Ethiopia are shown in Section III-A. These components must be carefully organized for efficient and effective management.

Figure 1 shows the proposed administrative structure of the three essential administrative units that will be required for the Ethiopian Seed Improvement Program.

7/ "The Feasibility of Producing Cereal Grain Crops for Export Markets". Report No. II. Experience, Incorporated, May 1972.

FIGURE 1. A PROPOSED ADMINISTRATIVE PLAN FOR A SEED IMPROVEMENT PROGRAM - ETHIOPIA



1. Policy and Coordination

The recommended administrative structure, in order to handle the several essential and complementary components of the Seed Improvement Program for Ethiopia, essentially requires the establishment of two new "departments" in the Ministry of Agriculture, and strengthening the Institute of Agricultural Research. All three elements will be directly or indirectly responsible to the Minister of Agriculture.

The IAR is an autonomous IEG institute with a general manager as its principal officer. It is a functioning and effective organization. Its primary shortcomings result from limited staff, their level of training, and inadequate funding.

The proposed Ethiopian Seed Council (ESC) will be a semiautonomous unit, with a director to implement the decisions of the ESC. The director will be administratively responsible for all functions assigned to the ESC, including the proposed National Seed Testing Laboratory, the Seed Certification Unit, and the distribution of foundation and improved seed.

The Seed Law Enforcement Unit will have a director, who will be provided with an effective enforcement staff. This unit will be responsible for seed inspection, including quarantine measures for imported seed, and for seed law enforcement relating to all seed sold in the Empire.

2. Research Services - Institute of Agricultural Research (IAR)

The key to the success of a Seed Improvement Program for Ethiopia will be the development and release of superior, adapted varieties. In many of the developed nations, private seed companies play a major role in improved variety release. We believe that in Ethiopia the role of privately developed varieties, with the possible exception of maize, will not be significant in the near future. For this reason, plus its role in variety testing, the IAR 8/ must be considered essential to a Seed Improvement Program.

a. Variety Research in Progress. It is a credit to the IEG, the Ministry of Agriculture, and the several supporting organizations, that a well-managed research organization is already in operation. The IAR recognizes the importance of providing both superior varieties and improved seed to the farmers of the Empire. This organization is also aware of its personnel and funding limitations.

8/ In the context of this discussion, the IAR is interpreted to mean all IEG, or outside government-supported agronomic research, conducted for the benefit of the Empire.

Variety improvement work, at present, consists largely, but not entirely, of screening, selection, and testing,which is being carried on at 14 locations in the Empire. These locations, with the principal crops involved, include:

(1) Gambela Research Station	Maize, sorghum cotton, groundnuts, sesame
(2) Gode Research Station	Cotton, groundnuts, sesame, maize, oilseeds
(3) Holetta Research Station	Barley, wheat, rape, linseed, pulses, teff, triticale
(4) Melka Werer Research Station	Cotton, groundnuts, maize, sesame, citrus, vegetables
(5) Jimma Research Station	Coffee, maize, teff, soybeans, beans, sunflower
(6) Alemaya (HSIU) College of Agriculture	Sorghum, millet, wheat, barley, vegetables, maize
(7) Debre Zeit (HSIU) Research Station	Teff, wheat, enset, chick peas, vegetables
(8) Awasa Research Station	Maize, pulses, wheat, peppers, oil crops, (sunflower, rape)
(9) CADU Research Station	Wheat, barley, maize, pulses, oilseeds, soybeans
(10) Bako Ethio-German Research Station	Maize, sorghum, peppers, vegetables
(11) Eritrean Research Stations	Wheat, sorghum, millet, teff, barley
(12) Setit Humera Research Station	Sorghum, maize, sesame
(13) Tendaho Plantation	Groundnuts, cotton, wheat, rice, beans, oil crops
(14) WADU	Maize, sorghum, sesame, cotton

In addition to other activities, most of these stations also plant one or more of the national yield trials.

Due to the great environmental diversity in the Empire, it is apparent that screening sites for preliminary variety evaluation are essential before starting variety selection. A similar vigorous final evaluation will be necessary before varieties are released. The location of these screening sites must be carefully selected so that the range of ecological conditions is reasonably well represented.

Acquiring sites, site preparation, equipping facilities and providing personnel is logically the responsibility of the IAR. The IAR must also recruit, train, supervise, and provide facilities for staff at these locations. Obviously, additional funding must be obtained for these proposed facilities and staff, as the added responsibilities recommended for the IAR are beyond the scope of its present staff and funding capacity. This funding may be provided directly, or through contractual arrangements between the IAR and the ESC.

b. Additional Related Research Needed. Considering the budget size and training level of the IAR staff, one must conclude that excellent progress has been made on development of improved varieties. With the import situation of wheat and the export opportunities with certain pulses, plus the interesting opportunities for durum wheat, malting barley, sorghum, peppers, and certain vegetables, the time may be opportune for a reconsideration of research allocations. There are seldom adequate research resources to pursue all desired activities with equal vigor. A wiser use of funds might be to concentrate efforts on the near-term "important" crops, while carrying on a minimal program of less pressing activities. Properly time-phased and programmed, this type of effort might well yield outstanding returns.

The discussion that follows will assume the importance of a major "adaptation screening" of germplasm that is available in Ethiopia and from other countries, with potential use in the Empire.

Recommendations for expanded screening and testing of germplasm and for research on associated cultural practices for use with pulses have been made.[9/] A similar effort should be made on wheat, durum wheat, sorghum, malting barley, and pulses other than those suggested. Significantly more work has already been done on wheat and malting barley. Additional screening and location testing is, however, still essential. Some of the proposed testing locations for haricot beans can be expanded to include some of these crops. We believe that three additional screening research facilities beyond those recommended in Report No. I will be

---

9/ "The Feasibility of Producing Pulse Crops for Export Markets." Report No. I, Experience, Incorporated, Minneapolis, Minnesota, May, 1972.

needed, bringing the total to nine. Additional locations should include the Asmara area, the Nekemte-Bako area, and the Debre-Marcos area. Figure 2 shows the nine locations that will be considered for funding; these include the six which have been proposed for funding in the Pulse Development Project, Report No. I.

In concurrence with the screening program, there should be cultural agronomic studies to solve the problems of:

(1) Seeding rates and plant spacing

(2) Seed bed preparation methods

(3) Time of planting

(4) Methods of planting

(5) Fertilizer rates and use

(6) Weed control (hand, mechanical, and chemical)

(7) Insect control methods

(8) Disease control methods

After four or five years, basic information should have been generated and major efforts and resources can be shifted to more pressing problems.

We believe it is highly important to have as complete information as possible at any location before establishing production and processing facilities. These facilities should be established in order of their readiness and probability of success. Figure 2 takes these factors into account.

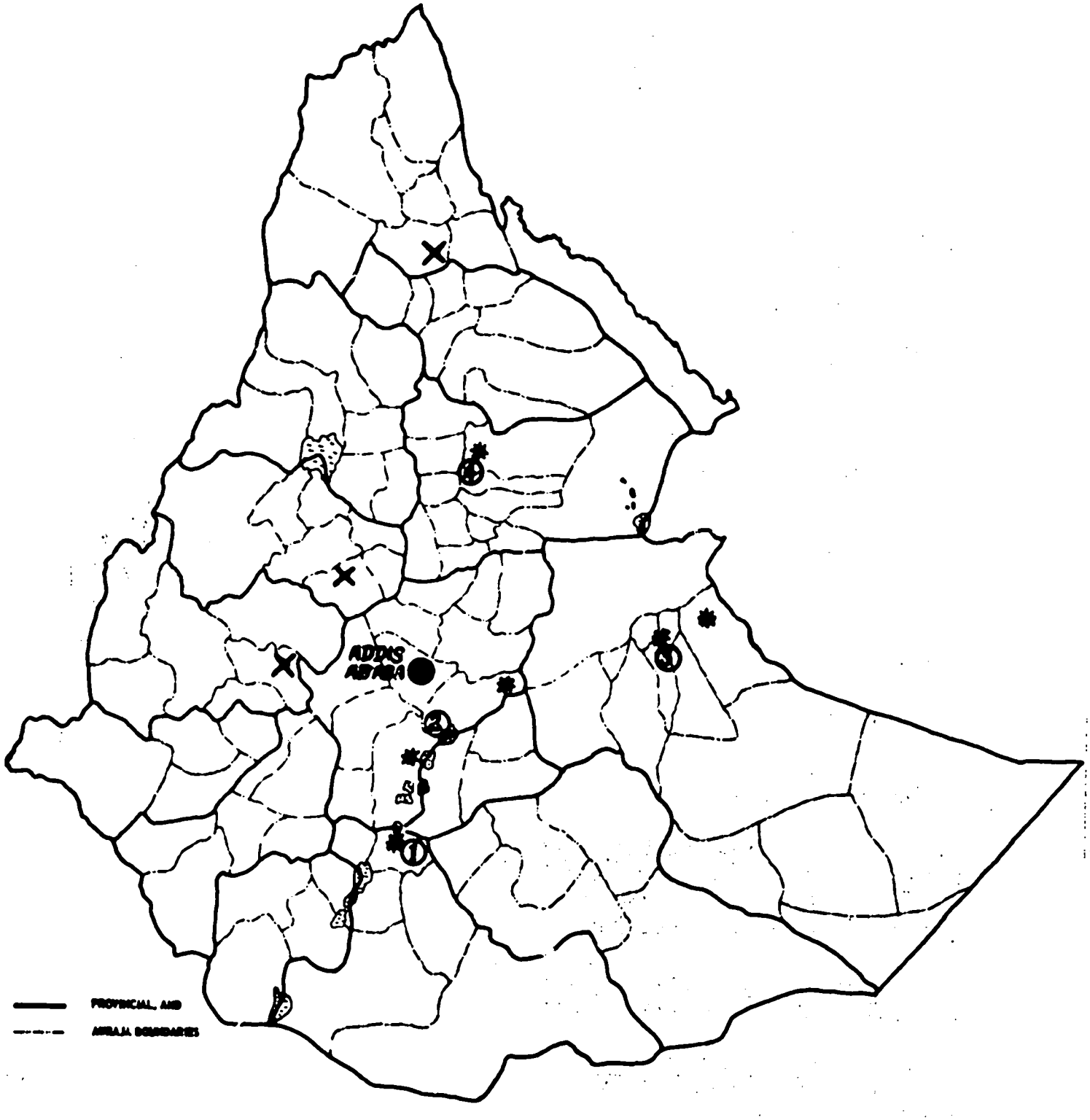
c. Proposed Additional Personnel for the Institute of Agricultural Research. To meet the needs of this proposed research effort, the following additional research personnel are suggested, including those recommended in the pulse proposal:

(1) One expatriate wheat breeder for no more than five years. This man will be provided by the technical assistance contract.

(2) One Ethiopian wheat breeder, trained at the M.S. level. The first three to five years he will work primarily on the general wheat program and then shift emphasis to screening, selection, testing and breeding of durum wheat to fully explore its potential to the Empire.

(3) Two Ethiopian research agronomists (crop and soil training). These men will be responsible for preparing plans for research to be carried out at the proposed screening locations and providing logistic support. They will also be funded under the research services.

FIGURE 2.



✕ New screening locations needed for the Seed Improvement Program

✱ Screening locations proposed for the Pulse Development Program

○ Approximate locations of seed farms and seed processing facilities

1. Awasa Facilities
2. Nazaret Facilities
3. Dire Dawa - Alemaya Facilities
4. Alamata Facilities

(4) One expatriate agricultural climatologist, with strong training in plant physiology, for no more than five years. He will be responsible for reviewing crop-weather relationships and for establishing functional weather stations at all experiment stations and testing sites. He will be funded under the technical assistance contract.

(5) One Ethiopian counterpart to the agricultural climatologist, trained to the M.S. level in agricultural climatology (not meteorology). He will be responsible for assisting in the establishment of weather stations, analyzing the results, and for preparing himself to take over this essential activity. This man will be funded under the research services.

A total of nine research tenchicians will be required under this program to carry out the research outlined for the IAR. These men will do the planting, take notes, make reports, and perform other needed research functions. These research technicians will be funded under the Research Services.

3. The Ethiopian Seed Council

The recommended Ethiopian Seed Council will be a semiautonomous unit, with a director to carry out the decisions of the council. This council will function in much the same manner as a board of directors. It will propose policies for the activities and units under its jurisdiction and provide advice to the Minister of Agriculture relating to improved seed matters.

The ESC must be constituted to represent not only the government sector but also the functioning and prospective private sector concerned with improved seed . We believe that the long-term success of a viable, improved seed industry must include the private sector.

a. Membership. We recommend that membership of the ESC include:

(1) The Chairman of the Ministerial Liaison Committee for Development Projects, or the Vice Minister of Agriculture

(2) The General Manager of the Institute of Agricultural Research

(3) The Head of the Extension and Project Implementation Department

(4) The manager of a recognized supply cooperative

(5) The manager of a recognized seed marketing organization

(6) A producer of certified or improved seed

(7) The Director of Seed Law Enforcement in the Ministry of Agriculture

(8) The Director for the ESC, who will preside at the meetings and be exofficio, except that he will cast the deciding tie-breaking vote of the members.

Technical specialists may be invited to meetings at any time, as their advice and counsel can be helpful to the ESC.

Experience, Incorporated recognizes that there may not be a generally "recognized" supply cooperative functioning in Ethiopia in the early stages of this program. We emphasize that small,local supply cooperatives should not be considered as generally recognized. Until such time that an appropriate man is available, the position will remain vacant.

We also recognize that there are very few seed marketing organizations in the Empire. Until a suitable person can be found, the position will remain vacant.

At this time, there are few, if any, commercial producers (Experiment Stations are not eligible) of improved or certified seed. Until a suitable person can be found, the position will remain vacant.

During the first three years of operation of the ESC, and before the three above positions are filled, it would be advantageous to have a representative of the Agricultural and Industrial Development Bank as an interim member of the ESC.

Each of the three nongovernment positions will be filled by the Director,in consultation with the Minister of Agriculture, from a list of three candidates for each position. The terms of office for these positions will be three years from the time of appointment.

The nongovernment ESC members will be eligible for a per diem allowance for meetings attended, when called by the Director. The ESC members will not be otherwise reimbursed for their services.

We consider it essential that the ESC establish and maintain a close working relationship with the seed industry and others interested in production, identification, certification, testing, distribution, and use of certified or commercial seed of improved varieties.

The ESC will meet at least six times each year, with 30 days notice given to members, along with a proposed agenda, before each meeting. Special meetings may be called on shorter notice. Appreciably more meetings will be held during the organization period.

b. Responsibilities of the ESC will include the following, but not be limited to these considerations.

(1) Advise the Minister of Agriculture on conditions of and policy matters relating to the seed industry.

(2) Cause a National Seed Testing Laboratory to be established, funded, equipped, and staffed, and be responsible for its operational policy (see Figure 1).

(3) In cooperation with the Ethiopian Standards Institution, establish import quality standards for seeds and propagation materials imported into the Empire.

(4) Be responsible for the annual publication of a "recommended crop variety list," by adaptation zones. The list will include both certified and noncertified varieties which have been suitably tested by the IAR. This list is intended as a guide for farmer choice of improved seed.

(5) Cause to be established and funded, and provide operational policy for seed production farms and seed processing facilities as needed.

(6) In cooperation with the IAR, be responsible for distribution policy, and production and distribution of foundation seed. Further, be responsible for promotion of and solicitation of distributors for improved seed produced and processed at ESC controlled facilities.

(7) Be responsible for implementing a seed certification program and policies relating to it; when it is deemed appropriate to activate such a program (see Figure 1).

(8) Perform such other duties as may be assigned by the Minister of Agriculture.

(9) Responsibilities not detailed in this report: An FAO consultant assigned to work on certain phases of the Seed Improvement Program proposal was given the responsibility for providing:

(a) Plans, funding estimates, and staffing requirements for a National Seed Testing Laboratory; and

(b) A proposal with staffing and funding requirements for a Seed Certification Scheme.

This report was to include these inputs, but they were not made available by FAO for inclusion in the final report.

Experience, Incorporated believes that a National Seed Testing Laboratory must be available as soon as a seed law is passed and law enforcement personnel become available. An interim alternative to immediate construction and equipping of recommended facilities is to contract with an organization such as the IAR to do the testing. It is not only important, but essential that a suitable seed testing facility be available in Ethiopia to protect the Empire from becoming a "dumping ground" for undesirable plant seeds and materials. Such a facility will be used not only for seed law enforcement, but also by the IAR, Minimum Package activities, producers and sellers of domestic seed, and by farmers of the Empire.

A competently directed, staffed, and adequately equipped seed testing laboratory is essential for successful seed law enforcement.

A laboratory for handling domestic seed control could be relatively simple in the early stages of law enforcement. The essential tests would be limited to germination and purity (analysis for percent of weed and other crop seed and foreign material). Tests to implement the import seed control would be more sophisticated including identification of diseases, insects, and a much closer inspection of off-type seed. As plant breeding techniques become more sophisticated in Ethiopia, the laboratory would be expected to provide other tests to meet the needs of seed improvement.

This laboratory must be available to all who require its services, and we recommend this be done on a fee basis. After the initial start-up costs, including the laboratory and equipment, and the training of the technicians, the laboratory is expected to be self-supporting. The FAO report did not include costs or income for operating a seed testing laboratory. Therefore, these figures are not available for this report. However, the concept of a self-supporting laboratory is valid in other countries. At this time, it would be impossible to project the use level of the laboratory, and, therefore, it is difficult to determine when it will become self-supporting.

A successful laboratory must have the confidence of all who use it. Without this confidence, neither the laboratory nor the seed law can be successful.

Experience, Incorporated believes that seed certification guidelines should be established as quickly as possible so that any interim actions will phase into a certification plan. We believe, however, that a Seed Improvement Program for Ethiopia can be initiated with positive and favorable results without a Seed Certification Scheme. We believe that Ethiopia is not ready for, nor does it need, a full-scale certification program in the near term. Eventually, and perhaps within the ten-year program scope, a Seed Certification Scheme can and should be initiated.

c. The Ethiopian Seed Council Staff. This staff will include, at its inception, the following personnel:

(1) One expatriate seed specialist, who will function as interim director for the ESC. He will function as director until his Ethiopian Deputy Director is able to assume the responsibilities and then he will function as an advisor. He must have knowledge of plant breeding techniques, seed testing laboratory procedures, production and marketing of seed, seed certification procedures, and have had successful administrative experience. He will be employed for not more than five years and not necessarily on a continuous basis. He will be funded under the technical assistance contract.

(2) One Ethiopian Deputy Director, who will have, or obtain, qualifications similar to those of the interim director and will assume the director's responsibilities within five years. His responsibilities will be primarily administrative, but he will be responsible for all ESC financing.

(3) An Ethiopian Assistant Director, who will have primary responsibilities relating to the government seed farms and processing facilites, and whole-sale distribution of foundation and improved seed generated by the ESC-controlled facilities associated with the Seed Improvement Program. His responsibilities also include educational and promotional activities.

(4) One Administrative Assistant, whose primary function will be that of a fiscal officer for the ESC activities.

(5) Two secretaries, one with the ability to handle day-to-day office management and minor disbursements, the other a bilingual secretary with editing skills.

Positions (2) through (5) will be funded in the ESC budget.

4. Seed Law and Seed Law Enforcement

An FAO consultant assigned to work on certain phases of the Seed Improvement Program proposal was given the responsibility for providing a draft proposal of a seed law for Ethiopia. This proposal was to have been included as an appendix to this report. The proposal was forwarded to Experience, Incorporated by the IEG planning division but arrived after the final draft of this report had been completed and submitted for approval. Funding suggestions were not included in the proposal and the proposed seed law was not compatible with the Experience, Incorporated suggestions and recommendations for a Seed Improvement Program for Ethiopia. There were no opportunities for conferences on this important matter, so a specific seed law proposal is not presented in this report. Minimum personnel salaries, maintenance and equipment for seed law enforcement that Experience,Incorporated believes is needed are funded as shown in Table 7.

Experience, Incorporated believes that an effective seed law, suited to the needs of the Empire is essential and should receive the highest priority attention by the IEG. Since there is widespread interest in and support for an improved seed program in Ethiopia, it is assumed a seed law for control of domestic and imported seed quality will be provided. We have taken into account and provided funds in the technical assistance contract for short-term consultants and recommend that the IEG avail itself of consulting services for developing a suitable seed law.

Seed law enforcement should be the responsibility of the Ministry of Agriculture, and only that ministry. There are numerous reasons why the responsibility should rest there, including interest in and

responsibility for suitable seed, knowledge of seed and seed needs, and greater efficiency through eliminating duplications.

To implement the seed law, we recommend a staffing pattern involving a minimum beginning staff. A director for seed law enforcement should be appointed by the Minister of Agriculture and be responsible only to him. In the existing structure of the Ministry of Agriculture, the present Plant Production and Protection Division could be reorganized to accommodate the seed law enforcement responsibilities (see Figure 1).

In the early operating stages of the unit, ports and other points of entry into Ethiopia should be the first points of enforcement. This would protect the Empire and its farmers from possible entry of undesirable weeds, and assure entry of desirable seed that is properly labeled and true to the label.

As trained staff and funds become available, domestic enforcement can be started. We believe that provinces with the largest volume of seed sales should receive first priority in seed law enforcement.

C. Status of Major Crops and Projected Seed Needs

1. Barley

Barley is the second most widely grown cereal crop in Ethiopia, with only teff planted on a larger hectarage. Table A-2 shows that barley has been planted on approximately 1,700,000 hectares in each of the past five years. The reported yields have ranged around 8.5 quintals per hectare during the same period. As pointed out, there are reasons for questioning the accuracy of the reported figures, but hopefully they relate one crop to another in a reasonable order of magnitude.

As previously reported[10/] most Ethiopian barley is produced in the central highlands at elevations of about 2,000 meters. It is used as food and for making the local "beer" (Talla).

There are very few large-scale commercial farmers in the central highlands, so their contribution to barley production is minimal. Unless there is significant varietal improvement which can be reflected in higher yields, the production of feed-type barley is expected to be confined to the subsistence farming sector.

10/ "The Feasibility of Producing Cereal Grain Crops for Export Markets". Report No. II. Experience, Incorporated, May 1972.

All barley grown in Ethiopia can be classified as "local" varieties which vary from community to community. Most, if not all, of the seed is a mixture of varieties or strains and frequently contains other crop and weed seeds. The fact that nearly 1,500 strains of barley have been identified in Ethiopia testifies to the probable mixture. The IAR group at the Holetta Station have selected improved varieties of both feed and malting-type barley.

It is difficult, if not impossible, to obtain accurate production costs for barley. Estimates from various sources have ranged from Eth. $200 to Eth. $300 per hectare. Mr. F. Pinto of the Holetta Station has estimated that production costs will range from Eth. $250 to Eth. $260 per hectare.

Table A-5 shows that a small amount of barley has been imported into Ethiopia each of the past four years. These imports may have been malting barley, but were not so designated. Apparently, no barley was exported during these years.

The total seed requirements for planting the present estimated 1,700,000 hectares of barley is most impressive. Research studies at the Holetta Research Station show that broadcast seeding rates of high germinating seed should be at least 100 kilograms per hectare. It is believed that peasant farmers probably plant 130 to 150 kilograms per hectare. This would amount to about 240,000 metric tons of seed. Using the yields shown in Table A-3, the estimated seed requirement would be more than 16 percent of the total production. Table 1 shows seeding rates for different crops, and Table 2 shows both estimated projected hectarage and seed needs by years.

TABLE 1. SEEDING RATES IN KILOGRAMS PER HECTARE

Crop	Estimated Broadcast Seeding Rates (Peasant Farmers)	Average Rate Used at Experiment Stations(1972)	Recommended Rate	
			Row Planting	Broadcast Planting [a]
Wheat	130-160	80-120	100	120
Barley	120-140	80-100	90	110
Maize	30-35	25	20	25
Sorghum	20	10-15	8	15
Haricot Beans	--	60-80	60	70
Teff	25-30	20-25	--	25

[a] The seeding rate used by the subsistence farmers is usually at least 15 percent higher than the recommended rate.

TABLE 2[a] ESTIMATED HECTARAGE OF SELECTED CROPS, TOTAL AND IMPROVED SEED NEEDS FOR THE EMPIRE

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
HARICOT BEANS:										
Total Hectares	21,000	27,000	35,000	47,000	58,000	68,000	81,000	97,000	109,000	115,000
Total Seed Needs(70kg/ha)mt	1,500	1,900	2,400	3,300	4,100	4,800	5,200	6,800	7,630	8,050
Improved Seed Needs(60kg/ha)mt	1,300	1,600	1,900	2,500	2,800	3,100	3,700	4,400	4,900	5,200
MAIZE:										
Total Hectares	850,000	850,000	875,000	875,000	900,000	910,000	940,000	950,000	980,000	1,000,000
Total Seed Needs(30kg/ha)mt	25,500	25,500	26,200	26,200	27,000	22,700	23,500	23,700	24,500	25,000
Improved Seed Needs(25kg/ha)mt	300	400	500	600	700	600	700	900	1,000	1,000
BARLEY:										
Total Hectares	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,450,000	1,450,000	1,400,000	1,400,000	1,300,000
Total Seed Needs(120kg/ha)mt	180,000	180,000	180,000	180,000	180,000	174,000	174,000	168,000	168,000	156,000
Improved Seed Needs(100kg/ha)mt	20	37	60	70	70	270	470	670	670	670
SORGHUM:										
Total Hectares	1,000,000	1,000,000	1,100,000	1,100,000	1,200,000	1,200,000	1,300,000	1,400,000	1,500,000	1,600,000
Total Seed Needs(20kg/ha)mt	20,000	20,000	22,000	22,000	24,000	24,000	26,000	28,000	30,000	32,000
Improved Seed Needs(10kg/ha)mt	0	0	0	0	10	100	200	400	800	900
WHEAT:										
Total Hectares	1,100,000	1,100,000	1,150,000	1,150,000	1,200,000	1,200,000	1,250,000	1,250,000	1,300,000	1,300,000
Total Seed Needs(150kg/ha)mt	165,000	165,000	172,500	172,500	180,000	180,000	175,000	175,000	182,000	169,000
Improved Seed Needs(125kg/ha)mt	2,000	2,000	2,200	2,200	2,300	2,400	2,800	3,000	2,800	3,100
TEFF:										
Total Hectares	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000
Total Seed Needs(25kg/ha)mt	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500

a/ Assumptions used in arriving at hectares and seed needs are shown in Appendix B.

At first glance, there would appear to be an excellent opportunity for sale of improved seed. There are, however, reasons why improved seed would be difficult to sell in large quantities. The principal deterrents are:

1. Most producers of barley are subsistence farmers;

2. The seed needs for each farmer would be small;

3. Credit would be needed by most purchasers;

4. A very large segment of growers live in inaccessible areas;

5. Subsistence farmers are suspicious of seed with which they have not had experience.

Yields of improved barley varieties are not consistently favorable nor are similar yields possible at different locations. The results of the National Barley Yield Trials 11/ conducted at eight locations in 1969 showed that the "local variety" averaged 19 quintals per hectare. The yoelds of the 15 "improved varieties" ranged from 56 to 126 percent of the local variety. Adaptation of improved varieties must be carefully researched. Yields of feed barley on the red soils of the Holetta Station in 1969 ranged from 11 to 46 quintals per hectare, with the local variety yielding 15 quintals per hectare. Malting barley yields on the same soils ranged from 23 to 35 quintals per hectare. Production on the black soils has been much less impressive.

A study 12/ is underway (Experience, Incorporated in cooperation with the IAR and the Technical Agency) to determine the feasibility of producing barley for malt and constructing a malt house to serve Ethiopian breweries. Preliminary figures indicate that approximately 5,000 metric tons of malting barley could be used in 1973 and up to 10,000 metric tons in 1982. If such an enterprise were to materialize, from 250 to 300 metric tons of improved, and preferably certified, malting barley seed would be needed immediately.

The seed needs of the peasant farmer are not large. Most of this seed would be expected to move in the Minimum Package areas of the EPID. Interest in and purchase of improved seed by the peasant farmers will come about largely as a direct result of the educational efforts of extension workers. The prospects in the near term of a significant demand for improved barley seed are not bright in this farming sector. Malting barley will be produced primarily by the commercial farming sector when the malting facilities are completed.

11/ Progress Report for the period, April 1969 - March 1970, IAR, Holetta. May 1970.

12/ "The Feasibility of Producing Cereal Grain Crops for Export Markets". Report No. II. Experience, Incorporated, May 1972.

2. Haricot Beans

Haricot beans are presently produced on a smaller hectarage than any of the commonly grown pulse or cereal crops. Less than 100,000 hectares were reported grown as late as 1970. Table A-2 shows the estimated area devoted to haricot beans by years.

Haricot beans are not generally used for domestic consumption in Ethiopia, so the output moves primarily into export trade. It is apparent that most haricots are produced by small and large-scale, commerical farmers. Exports have ranged from 16.7 to 19.7 thousand metric tons during the past five years. Beans from principal production areas are marketed in Nazaret, Shashemene, Awasa, and lesser amounts in Dire Dawa.

Historically, the beans produced in Ethiopia and designated as "haricots" have been a mixture of sizes and colors. In recent years, The Awasa Research Station has tested several varieties of haricot-type beans and has produced seed of the Michigan Pea Bean for use at the station and by farmers in the Awasa area. It has been the normal procedure for buyers of haricot beans for export to hand-sort them to remove "off color" beans and foreign material. They do not, however, sort for size. Farmers usually do not remove off-color seed before planting, which perpetuates the undesirable mixture.

Since 1969, the price of haricot-type beans has advanced to a relatively high level and this has resulted in appreciable interest in the growing of this crop by commercial farmers.

In a recent report 13/ prepared for the Ministry of Agriculture, the demand for haricot beans (for export) and for improved seed was considered in detail. Table 2 shows the estimated seed needs for haricot beans of the Michigan Pea Bean-type assuming that the Pulse Development Project becomes a reality. All of this seed will be of the improved type, which was not available in Ethiopia in 1971 except for a few quintals.

After 1975, the seed needs, other than being adjusted for increasing hectarage, will be reduced by 10 to 25 percent each year to obtain annual seed needs expected to be purchased off-the-farm. This will allow for 10 to 20 percent replanting and for the expectation that "new" seed will not be purchased by farmers more frequently than once in four years. If suitable seed storage is not available on farms and suitable germination cannot be maintained, or undesirable mixture of sizes occurs, then the improved seed needs will be above those indicated in Table 2.

13/ "The Feasibility of Producing Pulse Crops for Export Markets". Report No. I. Experience, Incorporated, Minneapolis, Minnesota, May 1972.

The export market in Europe requires a specific shape and size of bean. This market can be supplied by improved seed varieties such as the Michigan Pea Bean, Mexican 142, and Tenguru 16. These varieties have been tested by the IAR, found to be satisfactory, and are ready for seed increase when needed.

3. Maize

Maize is planted on fewer hectares than any of the principal cereal crops; less than 850,000 hectares through 1969-70. There is reason to believe that the hectarage may be underestimated, compared to other cereals, because maize is grown by many of the commercial farmers who are not included in the CSO reports. Table A-3 shows that maize yields have been above ten quintals per hectare since 1965-66, which is 20 percent or more than for any other cereal crop. Commonly reported yields by large-scale, commercial farmers are 30 quintals per hectare or higher, and these yields are often obtained with locally selected seed.

A recent report 14/ showed that most of the maize is grown at elevations between 1,500 and 2,000 meters, and is concentrated in the southwest part of Ethiopia. In recent years, increased plantings of maize are being made in the lower irrigated valleys. As higher yielding, short-season maize varieties become available, double cropping of cotton and maize can be expected to increase. Maize is well suited to mechanized production practices, and it is anticipated that in the near term, most of the increase in production will occur on the large-scale, commercial farms.

Maize is used, but not preferred, for human food principally as a type of injera, or a type of porridge (genfo). Maize seed used by most peasant farmers is no different from the grain used for food or sale. In some cases, it is apparently not as good. 15/ A small percentage of farmers may save seed from their better fields, but even more sell their better quality grain because it commands a higher price. A few farmers have selected seed carefully over a period of years. This seed is relatively "true-to-type" and the resulting plants have superior agronomic and yield qualities.

Very little maize has been imported into Ethiopia during the past four years, while export figures 16/ show that up to 1,000 metric tons

---

14/ "The Feasibility of Producing Cereal Grain Crops for Export Markets." Report No. II, Experience, Incorporated, May, 1972.

15/ Private communication from Dr. Kenneth W. Eubanks based on February, 1972 market survey observations.

16/ "The Feasibility of Producing Cereal Grain Crops for Export Markets." Report No. II, Experience, Incorporated, May, 1972.

may have been exported in each of the last five years. Apparently, as much as 150 to 300 metric tons of improved seed, much of it hybrid, was imported into Ethiopia during 1971 and 1972. The cost has ranged above Eth. $100 per quintal. Most of this seed has been planted by large-scale, commercial farmers.

Costs of production estimates from peasant farmers are not reliable. Reports[17/] from nonirrigated, large-scale, commercial farmers suggest that costs will range between Eth. $200 to Eth. $300 per hectare. Production costs on irrigated land will usually range above Eth. $350 per hectare.

The total seed needs for the estimated 850,000 hectares planted to maize in Ethiopia are large and may represent the greatest potential outlet for improved seed among the cereal crops. Recommended seeding rates[18/] for improved maize seed are 20 kilograms per hectare when planted in rows and 25 kilograms per hectare when the seed is broadcast. These recommendations are for farmers who use other improved practices. It is believed that the average seeding rate for peasant farmers is at least 30 kilograms per hectare and may even be higher. Since most of the reported hectarage is planted by the peasant farmers, it is estimated that approximately 25,000 metric tons of maize seed would be needed annually. This would require less than three percent of the annual production at the present yield level. As row planting becomes more widely used, along with the anticipated higher yields, the percentage of production needed for seed would be sharply reduced.

Yields from improved varieties (hybrid, synthetics, and local selections) have been compared with various local varieties. Some of these comparisions from the National Yield Trials reported for 1970 are shown in Table 3.

These data (Table 3) show that under favorable cultural conditions, certain hybrids will produce 20 to 30 percent higher yields than local selections. These data also show that the same varieties do not perform equally well at all locations. Much more screening and testing is necessary before recommendations for specific varieties can be made with confidence and before seed multiplication for a particular variety should be undertaken in anticipation of wide sales distribution.

17/ Central Statistical Office, IEG; and Annual External Trade Abstracts, IEG, Ministry of Finance, Addis Ababa.

18/ Table 1 is summarized from experiment stations' reports, observations, and discussions with farmers.

TABLE 3. YIELD COMPARISONS FOR SELECTED VARIETIES - 1970

Variety	Test Locations & Yield (q/ha)			
	Jimma	Awasa	Bako	Melka Werer
H613B (Kenya hybrid)	88	126	101	50
H632 (Kenya hybrid)	86	133	98	68
H611 (Kenya hybrid)	80	136	111	10
H511 (Kenya hybrid)	79	109	86	57
Jimma - Awasa Sel.	62	105	88	51
Jimma Sel.	62	-	86	52
Local Sel.	61	92	81	-
Local White	-	-	-	61
NY 157 (Israel hybrid)	-	-	-	58
NY 170 (Israel hybrid)	-	-	-	76
NY 182 (Israel hybrid)	-	-	-	74

Based on the haricot bean hectarage expected in the Awasa area, a projected 50,000 hectares of maize will also be planted there within ten years. This land will be farmed mostly by large-scale, commercial farmers who are immediate potential users of improved maize seed. The potential seed demand in this area alone, based on a seeding rate of 20 kilograms per hectare, would represent a seed need of 1,000 metric tons. If a 40-percent adoption of improved seed is assumed within ten years, this would represent an annual demand of 40 metric tons for "off-the-farm" seed. This is a sufficient operational size for a commercial maize seed producer.

It is anticipated that efforts in the Area Development and Minimum Package programs will also generate a demand for improved maize seed, which would increase the attractiveness of an immediate seed production facility in the Awasa area.

4. Sorghum

Sorghum is grown on more hectares in Ethiopia than either maize or wheat. Since sorghum is grown by subsistence farmers in the highlands and commercial-scale farmers in the lowlands, the 1969-70 hectarage report shown in Table A-2 may be underestimated (IEG statistics generally omit the large commercial farms). Yields of sorghum (see Table A-3) are similar to barley but greater than teff or wheat. The recently reported yields suggest that sorghum produces relatively

well under low levels of management and in regions of less favorable environmental conditions. Yields among large-scale, commercial farmers range from 8 to 16 quintals per hectare, depending on rainfall.

A recent report[19/] shows that sorghum is widely grown in Ethiopia, but tends to be concentrated in upland areas of limited rainfall (500 to 900 millimeters per year) and in the lowlands. As more suitable varieties are developed, appreciable increases in hectarage are expected in the large, undeveloped areas in the northwest lowlands and around Jijiga. As the western, southwestern, and southeastern regions of Ethiopia are developed, sorghum production can be expected to expand there also.

Varieties of sorghum presently grown in Ethiopia are not suited to mechanical harvesting. Shorter, early maturing varieties can be expected from screening and selection efforts in the next few years. These varieties could convert Ethiopia to a significant exporter of sorghum. Sorghum is widely used for human food and can serve as a substitute for teff in making injera. Most sorghum is consumed in or near its area of production. Sorghum is believed to be indigenous to Ethiopia and the wide diversity of plant and seed types tends to verify this. The seed planted is variable, often having poor germination, and the seed bed is commonly unfavorable for suitable stands.

As with other crops, it is impossible to obtain production costs on peasant farms with any degree of accuracy. Cost figures obtained from a few commercial farmers ranged from Eth. $245 to Eth. $270 per hectare. In the marginal rainfall areas, costs were reported at nearly Eth. $20 per quintal over a period of years. Either these costs are inaccurate or they must be reduced if these farmers are to remain competitive.

The annual external trade statistics indicate that about 1,200 metric tons of sorghum may have been exported each year for the past three years, while essentially no sorghum nas been imported during the past two years.

Increased yields can be obtained through better cultural practices such as better seed beds, more effective weed control, and use of fertilizer where needed. Improved varieties, however, appear to offer the greatest opportunity for improved yields.

The approximate 1,200,000 hectares of sorghum planted each year require an estimated 24,000 metric tons of seed (assumed seeding rate of 20 kilograms per hectare). Most of this area is planted by subsistence farmers and adoption of improved seed would be expected to be slow, even if such seed is of superior improved varieties. There is expected to be a

---

19/ "The Feasibility of Producing Cereal Grain Crops for Export Markets." Report No. II, Experience, Incorporated, May, 1972.

significantly increased hectarage developed in areas not now farmed. Most of this development would be mechanized and as varieties suited to mechanization become available, an immediate demand for improved seed would be expected from these large-scale farms. The continued demand will be determined by the superiority of improved seed over farm produced grain for seed.

Recommended seeding rates for sorghum range from 8 kilograms per hectare when planted in rows to 15 kilograms per hectare when broadcast. In the drier regions, the broadcast seeding rate would be reduced to 10 kilograms per hectare or even less. Commercial-scale farmers are more likely to adopt row-planting technology because it can be readily mechanized. If costs can be reduced through lower seed prices and easier, less expensive weed control, and yields increased through more efficient use of soil moisture, row planting will be adopted rapidly. The principal problem at this time is lack of a satisfactory variety to allow full mechanization of the crop. This requires a very short variety (not more than one meter tall), and peasant farmers would discriminate against such a variety because they use the sorghum stem for fuel, livestock feed, and building purposes.

In spite of the wide range in yields among varieties tested at the experiment stations, none have shown consistent superiority under field conditions. Additional screening and research work will undoubtedly uncover some varieties or strains that will prove superior for specific locations. Until such varieties are found, particularly an adapted dwarf variety with superior yield characteristics, there appears to be little justification for sorghum seed multiplication.

5. Wheat

Wheat is produced on slightly more than one million hectares. The domesitc price has held a firm import level into 1972, and both flour and wheat are being imported. In spite of this, there is no evidence of a rapid expansion in hectarage of wheat. Historically, low yields may be an important consideration. Except in the CADU region and to a limited extent in the irrigated, lower Awash Valley, most wheat is grown by subsistence and small-scale commerical farmers. Yields shown in Table A-3 indicate little improvement in the past five years, with an average in the Empire of about 7.5 quintals per hectare.

Ethiopia has been an importer of flour in each of the past five years. Tonnage has ranged from 16,000 to nearly 30,000 metric tons annually. Wheat grain imports have varied from 7,000 to more than 30,000 metric tons in the past five years, as shown in Table A-5. Import estimates 20/ for 1971 indicate that flour has been imported at lower prices

20/ Private communication with customs office, based on the first eight months of 1971.

per metric ton than wheat grain. There is a general feeling than consumption of wheat flour bread in the cities is increasing more rapidly than teff ingera. Evidence is not clear, but it appears that if local wheat prices (Eth. $20 to Eth. $21 per quintal in March, 1972) remain firm, wheat production can be expected to increase. The increase will likely come from the commercial farmers who are more price responsive.

Most of the wheat is grown at elevations ranging from 1,600 to 2,200 meters. Experience at the Tandaho Plantation in the Awash Valley indicates that favorable yields are possible at lower elevations. The CADU area has been especially active in working on improved wheat production practices and improved seed. They have, however, found serious rust problems where large, contiguous areas of wheat are grown year after year. They believe it may be necessary to plant a new, more resistant variety every three years if the rust problem is to be controlled. It will be difficult to achieve this level of variety generation without a more extensive wheat breeding effort.

The CADU project has been producing improved wheat seed for its project area for several years. The experiment stations at Alemaya, Awasa, Debre Zeit, and Holetta also produce and sell a small amount of wheat seed each year. Generally, wheat used for seed by the subsistence farmers is synonymous and interchangeable with market grain. A small percentage of farmers do a rough job of cleaning and "picking over" the seed they plant.

There is no reason to believe that costs of producing wheat should be significantly different from that of barley. There are improved varieties of wheat seed available in limited quantities, but demand has not been strong. The problems of "selling" improved wheat seed are similar to those of barley. Experiences in the Chilalo Agricultural Development Unit (CADU) offer the best observations available on the farmer's willingness to purchase improved seed. With a well-organized and intensive educational effort over the last five-year period, it is estimated that 32 percent of the wheat currently planted is with improved varieties. Since these varieties have shown a marked improvement in yield and agronomic characteristics, one can predict difficulties in obtaining rapid adoption of improved varieties with a less intensive educational effort.

Where disease, particularly rust, is a yield-reducing factor and experiment station personnel can continue to develop rust-resistant varieties, it can be assumed that at least the large-scale, commercial farmers will use improved seed regularly. Subsistence and small-scale, commercial farmers would be expected to have a slower rate of adoption. If disease is not a yield deterrent, farmers would be expected to save

their own seed after the first purchase of improved seed. Estimates[21/] of resupply requirements for seed are once each four to six years for self-pollinated crops such as wheat, beans, barley, etc. The conclusion must be that opportunities for sales of seed wheat, over a large part of the hectarage planted in Ethiopia, are not promising in the near term.

An apparent exception to wheat seed needs might be the emergence of durum wheat for potential grain export. If it proves feasible to produce durum wheat for export, a totally new seed supply will be reqired. In addition, since a high and specific quality of export grain will be required, a continuing seed source will be needed. Production of durum wheat appears best suited to the areas north of Dese and into Tigre and Eritrea Provinces. Information is lacking at this time to determine if it is feasible to produce durum wheat in Ethiopia for export.

A greatly expanded screening and research program for selection of wheat varieties is needed before a comprehensive estimate of need for improved seed can be made.

6. Other Crops

Ethiopian farmers grow many crops other than those discussed above. These include several pulses that have appreciable export potential--coffee, cotton, vegetables, fruit, and numerous oilseed crops, including sesame. This report excludes these crops from consideration, not because they are not considered important, but because they were not included in the terms of reference of the contract.

No estimate has been made of seed needs for crops grown in Ethiopia other than those discussed. As improved varieties or strains of any crop become available for multiplication, an estimate of total needs and anticipated sales potential must be made. It is hoped that within five years improved seed will be available for crops such as lentils, horse beans, chick peas, teff, sorghum, sesame, and possibly soybeans.

D. Production and Processing of Improved Seed (Not Certified)

1. General Plan and Proposals

Seed production and seed processing facilities are key components of a viable and effective seed multiplication program. If an effective and efficient Seed Improvement Program is to be established, it is essential that steps be taken to provide the necessary facilities for improved seed production.

21/ Seed Program Development Contract, AID/CS and 1203 Seed Technology Laboratory, State College, Mississippi.

Availability of improved seed is not enough to bring about higher yields and better quality crops. Other inputs such as fertilizer, pesticides, herbicides, and improved cultural practices must be available to and used by farmers.

We believe there is, and will continue to be, a demand for improved seed in Ethiopia. Farmers may not buy improved seed each year as they tend to save their own seed for planting. They will buy improved seed if severe disease problems occur in their crops or if improved varieties, definitely superior to the ones used, become available.

Area Development Units and the Mininum Package Program have shown that subsistence farmers will buy a limited amount of improved seed if credit is made available. Creating an awareness of improved seed value among the farmers, through accelerated and intensified extension and educational activities, is needed.

Establishing seed production and processing facilities at several locations in Ethiopia is desirable. The EPID advocates seed production on a modest scale within the Minimum Package areas. This may be an attractive proposal in terms of the moderate cost, but it will serve only a small segment of the farmers of the Empire.

We recommend that necessary steps be taken now to establish four seed farms and four seed processing plants, on a time-phased basis, during the next ten-year period (1973-82). It would be more appropriate for the private sector to undertake the establishment of these facilities, but taking into account the current economic and business climate in the Empire, this does not appear feasible. We are recommending that the proposed Ethiopian Seed Council of the Ministry of Agriculture cause these seed farms and processing facilities to be established and supervise their operations. We also recommend that the private sector be encouraged and assisted in establishing similar facilities. The IEG should take necessary steps to relinquish control of the seed production and processing facilities by the end of the project period.

The seed production and seed processing facilities in each area should be established close together. Overall operation costs are reduced when equipment, personnel, storage, and other elements can be shared. If the two facilities are located too far apart, poor roads and the cost of moving seed from the farm to the processing plant, along with poor communications, may create problems.

At present, no well-equipped and organized seed production farms exist in the country. This alone justifies a proposal for the establishment of seed farms. We recommend four seed farms be established and that each farm should be about 400 hectares in size. The justifications for this size unit include:

1. The establishment of a modern and well-equipped farm is expensive. A farm larger than 400 hectares would be difficult to justify in terms of present seed needs, and a smaller unit would be less economical.

2. Additional hectarage can be added later to a unit this size without much difficulty.

2. Facilities Needed - Seed Farm[22/]

The funding estimates in this report are computed for a 400-hectare farm, but much of the equipment will have the capacity for a larger hectarage. If additional hectarage is to be added, it will cost proportionally less than the initial per-hectare outlay.

3. Staffing Requirement - Seed Farm[23/]

To operate a basic seed production unit of 400 hectares, we believe it is necessary to have, in addition to the technical contract staff:

1. An Agronomist-Manager
2. A Seed Farm-Foreman
3. Eight (8) subordinate permanent staff members

Additional labor can be hired on a temporary basis as needed. Estimated costs of the technical contract staff are shown in Table 5.

a. Job Description and Qualifications for the Personnel. The Agronomist-Manager will have charge of the overall administration and operation of the seed farm. He will be responsible for all technical aspects of seed production, such as cultural practices, planting, and harvesting. He will also advise on and assist in the establishment of other seed farms, including the training of personnel needed for staffing these farms.

He should have a Master of Science degree or equivalent in agronomy and a minimum of two years of farm management experience. He should also have some administrative ability.

The Seed Farm-Foreman will be responsible for assisting the agronomist in day-to-day operation of the farm, including the repair and maintenance of the equipment and facilities on the farm. He should have a Bachelor of Science degree in general agriculture, with specialization or additional training in farm mechanics.

22/ Details are provided in Tables A-7 and A-8.

23/ Estimated funding requirements are shown in Tables 8 and 10.

E. Seed Processing and Storage

1. Review of Known Facilities in Ethiopia

According to information compiled by the FAO in 1968, several of the experiment stations had some facilities for seed processing and storage.

A seed processing unit with a capacity of five metric tons per hour and a 300-metric ton storage facility is available at Holetta. The Ethio-German Agricultural Experiment Station at Bako has a seed processing plant and metal silos with storage capacity of 300 metric tons. The Chilalo Agricultural Development Unit at Kalumsa has a seed processing unit and a 500-metric ton storage facility. The Awasa Experiment Station has a seed cleaner and storage capacity for about 500 metric tons. Ordinary storage of 600 square meter size exists at the Experiment Station at Setit Humera in Begemidir Province. Ordinary storage of 300 square meters is also available for seed at Araka.

In addition to these facilities, there is a coffee processing plant at Jimma.

2. Crop Seeds to be Processed

During the initial five-year period, improved seed production will be mainly of maize, haricot beans and wheat. We anticipate a marked increase in sorghum hectarage over the next ten years. This will come about as a result of the development of improved varieties. It is assumed that demand for improved sorghum seed will be evident by 1978 and will increase appreciably from then on.

Based upon the current status of barley production in Ethiopia, there will be no appreciable demand for improved barley seed before 1979. Ethiopia is considering construction of a malt plant to be operative in 1978. Such a facility will generate a demand for improved malting barley seed. We have phased some demand for malting barley into this program in 1978.

3. Proposed Types of Facilities

a. Degree of Specialization and Capacity. The following two types of facilities are recommended in this report:

(1) Seed processing units.[24/] Four such facilities have been recommended on a time-phased basis. Each of these units will have the capacity to process production from a 400-hectare farm, but can process more if the need arises.

[24/] Details are shown in Tables A-8 and A-9.

Seed processing is an integral part of the overall Seed Improvement Program, as it is the next most important step after the production of seed. Seed must be processed to meet the minimum quality standards for marketing. The final price of seed is determined, in part, by the quality of seed offered for sale.

We believe that a significant volume of crop seed will eventually be produced in Ethiopia for domestic use and possible export. This could require the establishment of several additional processing facilities.

(2) Seed processing facilities for the Minimum Package Areas. Needs of a Minimum Package Program have been considered. Simple facilities are all that can be justified for these areas, some of which will produce improved seed (see Appendix B).

Based upon the estimates of seed requirements for each area, the following facilities would be adequate to process and store seed of the different crops likely to be grown.

(a)	One Seedburo (No. RX-10 Tyler) Hand operated sieve shaker	Eth. $160
(b)	One maize sheller (Capacity 2 to 4 quintal per hour)	Eth. $ 60
(c)	One seed storage building	Eth. $150/m^2

Each package area will have different storage requirements, and cost will be determined by size of storage unit. No storage building size is shown, but the estimated construction cost indicates a structure that will maintain seed quality.

4. Staffing Requirement - Seed Processing[25/]

Operation of a processing unit having a capacity of 400-plus tons will require, in addition to the technical contract personnel:

1. A Seed Plant Manager
2. Five (5) subordinate permanent staff members

a. Job Description and Qualifications for Ethiopian Personnel. The Seed Plant Manager will have administrative and operational responsibilities for the seed plant. His duties will include both management and technical aspects of seed processing and storage including cleaning, grading, treating, bagging, storage, and inventory control. He will also train personnel who will staff other ESC plants.

25/ Estimated funding requirements are shown in Tables 9 and 11.

He should have a Bachelor of Science degree in agricultural engineering with emphasis on machinery management. His Master of Science level work will be done in seed processing and storage. He will also obtain some practical experience in operating a seed processing plant.

F. Proposed Locations for Seed Processing Facilities

The processing units should be located in agriculturally important areas where there is a demand for improved seed of several crops. There must be effective and efficient communication and transportation services available.

1. Awasa

We recommend that the first processing unit be established in the Awasa area. Land purchase and matters concerning this installation should be completed in 1973. The unit will process the 1974 seed crop.

The expatriate agronomist and agricultural engineer included in the technical assistance contract will be responsible for establishing the seed farm, including the purchasing of farm machinery and equipment and training of local personnel, as necessary. Subordinate staff will be hired by the regular staff in consultation with the contract personnel. The expatriate seed processing expert and agricultural engineer will be fully responsible for the establishment of the seed processing plant, including purchase and installation of equipment.

We believe the Awasa area is an ideal location for improved maize and bean seed production. The Ministry of Community Development owns approximately 6,000 hectares of land in this area. It is estimated that out of this total, 500 hectares could be immediately available for seed production and also a considerable amount of land, now in sisal, may be available for future use. Most of the sisal is over age, uneconomical, and should be eradicated. The estimated cost of clearing the land currently in sisal is approximately Eth. $100 per hectare. This cost can be reduced considerably, however, by using suitable machinery in combination with manual labor. With cooperation among the IEG ministries and local farmers, there is sufficient land available near Awasa for the current needs and expansion in the future.

Yield trials conducted at the Awasa farm indicate that the soil and environmental conditions in this area are suitable for the production of maize, beans, and possibly wheat. The projected 25,000 hectares of beans in the Awasa area will require approximately 17,500 quintals of seed. This seed can be produced on 875 hectares, assuming a seed yield of 20 quintals per hectare.

2. Nazaret

We recommend that the second seed farm and seed processing facility be established near Nazaret. The land should be acquired in 1976 so the first seed crop can be grown and processed in 1977. Members of the technical assistance contract team will be responsible for establishing the production and processing facilities.

The Nazaret center can supply the Ada project, the Upper and Middle Awash, and the Rift Valley to Lake Langano and south. There is no large experiment station at Nazaret, but there is a limited area at the Horticulture Station that could serve for small-scale screening trials and for foundation seed increase. The HSIU Station at Debre Zeit can provide land for foundation seed production.

Within a short distance of Nazaret, Ato Isaac Kifle has a large farm, a portion of which is being developed for irrigation. Such a facility could be suitable for contract seed multiplication. In the Middle Awash, the Abadir and Montenari Ranches might also be interested in irrigated, contract seed production. The Melka Werer Station on the Middle Awash will be used for further research work.

The Nazaret center will be used primarily to produce and process maize and haricot bean seed.

3. Alemaya - Dire Dawa

Experience, Incorporated recommends that the third production and processing facility be in the Alemaya-Dire Dawa area. Land purchase should be completed in 1977 and production started in 1978. The seed processing facility should also be established and be ready to process the seed produced from the farm in 1978. The expatriate staff, in cooperation with the overseas-trained Ethiopian personnel, will be responsible for establishing these facilities.

The Chercher Plateau is a large and established sorghum-growing area in which beans are grown as an interplanted crop. Farther east, near Jijiga, there is a large commercial farming area planted primarily to sorghum. We believe it is possible to produce beans and wheat in this region. There is also a Minimum Package project near Harar. The HSIU station at Alemaya has a fairly complete collection of sorghum germplasm from which selections are being made.

The precise location of these facilities will be determined after a careful review of soils, climatic conditions, and seed needs have been made. There should be no difficulty in locating available land for both small-scale research work and large-scale seed production.

4. Alamata (Dese Area)

There is a large area of land suitable for commercial farming ventures in the Raya-Kobo Valley of northern Welo Province and in the Chercher Valley of southern Tigre Province. It seems appropriate, therefore, to recommend the establishment of an improved seed production and processing center in this area. Alamata has the advantage of being close to these valleys as well as being close to higher elevation land that would be suitable for barley, wheat, sorghum, and bean seed production. Although the altitute of this location is only about 1,700 meters, it is close to elevations of 500 to 600 meters or higher, so that barley can be produced. Durum wheat may also be a possibility for the area. Within a relatively short distance, there are up to 100,000 hectares suitable for sorghum or beans.

Purchase of land for establishing a seed production farm at this location should be completed in 1978. All arrangements should be completed to process a seed crop in 1979.

As the expatriate technical assistance staff are scheduled to leave at the end of 1977, the Ethiopian staff trained abroad in cooperation with the locally trained personnel will be responsible for establishing these facilities.

It is probable that there will be very little demand for improved sorghum seed in this area within the near term and only a nominal demand within ten years. The total area available for sorghum production within the limits of the Dese area is estimated at 60,000 hectares, of which not more than four percent will be used within the next five years for sorghum production. We project that there will be 20,000 hectares of beans in this area within ten years. Not far from Alamata, there is a large cooperative of about 600 members, which might offer contract seed production opportunities as well as an outlet for improved seed.

G. Impact of the Project on the Environment

The Seed Improvement Program is designed to protect the Empire from imported plant-attacking insects and diseases and to provide the farmers of Ethiopia with a continuing source of seed for improved crop varieties.

Recommended production locations will be on level land, so water erosion will no be a problem. Crops will be largely planted in rows.

Fertilizer use will be moderately heavy by Ethiopian standards but modest by European and United States standards. Phosphorus will be applied to the bean seed crop at less than 15 kilograms of P_2O_5 per hectare. Phosphorus applications for maize will average 20 kilograms

per hectare of P_2O_5 and not more than 40 kilograms per hectare of nitrogen. Wheat and barley will receive less than 15 kilograms per hectare of P_2O_5 and nitrogen. These fertilizer applications are below the levels that have been determined as potential problems in the United States. Land in the recommended site vicinities is level and without lakes or ponded water, so eutrophication will not be a problem under any circumstances.

Minimal use of agricultural chemicals for insects, disease, and weed control is anticipated. In the event the seed crop is attacked by insects or disease, chemicals will be used. There is neither running nor permanent standing water near any of the sites, so water contamination is not a possible problem. Furthermore, the high clay content of these soils is a natural deterrent to leaching.

Cultural practices will be such that all crop residues will be incorporated into the soil to increase organic matter content, water holding capacity, and resistance to wind erosion. This is not now a common practice in Ethiopia.

The seed processing plants are small by Western standards and such plants do not create air pollution problems in normal operations. Organic residues from the plants will either be returned to the land for incorporation or used by local residents for fuel.

Through the use of improved varieties, yields are expected to increase which, in turn, will deter erosion due to better land surface cover. The total effect of this project is expected to enhance rather than degrade the environment.

IV. SEED MARKETING, DISTRIBUTION, AND SALES

Ethiopia does not have a formal marketing structure as found in most developed nations. This is due, in part, to the high percent of people existing at or near the subsistence level and, in part, due to poor or nonexistent communication and transportation systems. For people away from the meager road system, the present informal marketing system has changed little in generations. The present system, while serving the needs of the Empire, is a greater disadvantage to the low income and subsistence population than to those with more favorable incomes.

It is only through access to advancing technology, including seed of improved varieties, that farmers can hope to improve their production and eventually their income. Without a formal marketing structure it is necessary to examine existing organizations to determine if, through simple alterations, a marketing structure can be developed for marketing of improved seed. This has been done, observations have been made, and recommendations are discussed in this report.

A. Imperial Ethiopian Government Policies and Regulations Will Influence Seed Marketing

The foundation of a strong seed industry is based upon the acceptance of standards for seed quality and uniformity as well as on laws and regulations for the protection of the producer, the seller, and the user. A seed organization (government, private, etc.) will invest time, energy, and money in the development of a seed production and/or marketing program only if it has assurance of a supply of quality foundation seed. The ESC must assure seed organizations that they will have a continuing supply of high quality foundation seed of all approved varieties.

The Ethiopian Seed Council can expect to encounter differences of opinions and pressures on any foundation seed production and distribution policy. There will also be differences of opinion on selection of new varieties, developing and maintaining purity of each improved variety, production of breeders seed, and maintenance of foundation seed. The ESC must develop and establish a fair and firm distribution policy to assure that all qualified seed producers will have equal opportunity for improved variety foundation seed.

Based on experience, observation, and field conferences, Experience, Incorporated recommends the following policies to the Ethiopian Seed Council:

1. That the ESC make foundation seed of improved varieties available on an equitable basis to all eligible purchasers.

This policy is essential for the encouragement of a developing seed industry, which will serve both the subsistence and commercial farmer.

2. That sound and practical seed laws and regulations are fundamental and must be established to assure a successful improved seed marketing program.

Seed laws will provide a basis for understanding between seed producers and marketers in the establishment of standards, and will also develop confidence between marketers and users. The user will eventually accept the standard of seed quality as indicated on the seed tag.

3. That a recommended list of improved varieties is essential and will be published annually.

A list of improved varieties can be used in selling seed, serve as a guide for the seed industry, and for the marketers of seed. The list should include adaptation zones, seeding rates, time of planting, fertilizers, weed control methods, and other specific information that will influence variety performance.

4. That an annual seed seminar, sponsored by the Ethiopian Seed Council, be conducted to provide information to the members of the seed industry and other interested parties.

Subjects to be included are recommended new varieties, reports on progress of research work, EPID progress reports, current seed list discussions, and other subjects of interest to seedsmen.

It is essential that a good relationship exist between the seed industry and the Ministry of Agriculture. The seminar will also serve as a "clearing house" for mutual concerns and problems.

B. Marketing Constraints

The task of providing a marketing system that will serve all Ethiopian farmers equally cannot be simplified. The recognized constraints of transportation, communication, and credit will be difficult to overcome.

1. Transportation

Most farmers have no roads for movement to or from the market. The opportunities for the average farmers' exposure to improved seed or other technology are extremely limited.

2. Communication

Any marketing effort has few methods of product exposure when approximately 95 percent of the rural Ethiopians do not read or write. Conversation and demonstrations are effective. The strongest sales appeal will be what the farmer sees. Field days and tours must be used in local areas to acquaint the farmer with the use of improved farming methods, including the use of improved seeds for his own advantage. Charts, pictures, illustrated lectures, and similar material can be used effectively in selling.

Those who market seed must be aware of the need for education and communication in selling improved seed. Extension agents have found that crop and fertilizer domonstrations, model farms, and Minimum Package Programs are effective.

A more sophisticated marketing program will be required to reach the commercial farmers. This will include printed yield data, variety characteristics, profit potentials, and other related material.

3. Credit

Approximately 90 percent of Ethiopian farmers are classified as subsistence farmers. A subsistence farmer has been defined as one who sells less than 25 percent of his production in the market place. With this limited income, acceptance of improved seeds and other inputs is largely dependent on the availability of credit. Credit is an important production tool and the subsistence farmer must have a source of fair-rate, short-term credit if he is to improve his productivity.

Any credit source concerned with the well being of the borrower must be in a position to assume the role of a farm manager. The CADU program can serve as an example of the "farm manager" approach. At the CADU, before credit is given, there must be a signed lease between owner and operator, a definite record of seed, fertilizer and chemical to be used, and approval of the farm plan by the extension agent.

Progress on the number of farmers served by CADU is shown here.[26]

Year	Number of Credit Users	Value of Inputs Supplied (Eth. $)
1968/69	189	26,956
1969/70	868	212,607
1970/71	4,769	772,447
1971/72	14,146	2,007,197
1972/73	25,000	3,500,000 (Estimate)

26/ Information and statistics received through conference with Ato Hailu Solomon, Credit Manager, CADU (March 7, 1972).

The individual farmer's credit contract provides an opportunity for insistence on use of improved seed and other inputs. This is referred to as "forced selling" or "package selling." It can be an important program in dealing with both the subsistence and small commercial farmer. Credit can be a basic tool in the marketing of improved seed.

C. Seed Distributing and Marketing Channels

There are four principal channels through which improved seed and other input supplies for agriculture can be moved most effectively to farmers. They may not be equally as effective, and they are not mutually exclusive. Government policy must be structured so each channel can seek and assume its own role with a minimum of governmental interference. In this way, Ethiopian farmers will be served most efficiently in both the short and long terms.

The ESC will have the key role in marketing improved seeds; and the government-sponsored and operated seed farms will be effective in assuring a supply of quality seed. The seed farms will also eliminate the burdensome task of producing large quantities of foundation seed and commercial seed at the research stations.

The research station's seed production function is limited to producing breeders'seed and limited quantities of foundation seed for new varieties.

With the establishment of seed production farms and processing facilities, the ESC will, in effect, have ownership of the seed. This unit will become the wholesaler of the seed. The ESC Assistant Director will have the primary responsibility of funding distribution and retail outlets, and assisting in educational and promotional activities relating to improved seed. It is possible that seed farm and processing plant managers will sell at "retail" to larger users in the local area. Usually the seed will be sold at wholesale to distributors who will supply retail outlets or large individual purchasers.

We believe the ESC should strongly encourage all four types of distributors described below. Each distributor will reach a different group of farmers, thus increasing the exposure to and availability of improved seed within Ethiopia. Distributors serving the same farmers would create desirable competition.

1. Government Agencies

Government agencies offer the best opportunity for reaching the small commercial and subsistence farmers. Several agencies could perform a sales and credit function but the EPID Minimum Package Program is the most important at this time. The extension staff has technical training in agriculture, can communicate with farmers, and supply product information.

Each of the Minimum Package areas will have supply centers and can provide prompt delivery of improved seed and other input needs. These centers have personnel to handle sales, accounting, and in some cases, credit. As demand for supplies increases and additional credit becomes available, additional staff may be needed. Intensive and sound in-service training must be increased for the "sales" personnel, with emphasis on crop production practices and sales procedures.

2. Government Sponsored Organizations

The Ethiopian Grain Corporation (EGC) is an excellent example of a government organization that could serve as a distribution point and retail outlet for improved seed and other agricultural inputs. This activity would require the addition of a retail marketing division and changes in accounting procedures. The result would be more efficient staff use, and a new and needed service to farmers of the Empire.

The EGC has central control in Addis Ababa and could offer managerial assistance. Their grain warehouses in the major agricultural areas of Ethiopia should be staffed with a manager and assistant manager or comptroller. Their present operation is that of buying and selling grain and pulses, therefore, they have contact with the local farmers. The EGC personnel at the area and regional centers could be trained in sales procedures and could wholesale improved seed to dealers who sell agricultural inputs to farmers.

The EGC central control must assume responsibility for a strong marketing and distribution staff and program. This program would include sales training for all personnel in the field, product information, and sales "tools" such as demonstration plots, yield data, and illustrated charts supplied by an agronomist.

We believe that the EGC should develop a complete farm supply division in order to supply all the farm inputs needed by the improved seed user. The EGC must be in a position to make credit available to the buyer. Credit and accounting procedures for the seed and farm supply division would be absorbed into the "central control" program.

In addition to the area or regional manager and sales personnel, an agronomist is needed to provide the technical assistance for selling improved seeds and inputs. Depending upon the sales volume and number of customers served, he may serve more than one location.

3. Private Organizations

A private organization or share company with an agricultural marketing or service division would be an excellent channel for the distribution and marketing of improved seeds.

The seed supply could be from contract arrangements with ESC who will produce only for the wholesale market program directed and controlled by the ESC, or from importation of seed of recognized and proven varieties.

There are advantages in having an agriculturally oriented private company involved in the marketing of improved seeds. They have experience in the essential components of marketing--sales administration, transportation, accounting, credit, and customer services. Improved seed marketing could be readily absorbed into an organization having this knowledge. An agriculturally oriented company would normally sell the inputs, to be used in conjunction with improved seed, for a profitable crop production program.

Personnel needed for a private company to market improved seed would include:

a. An agricultural division manager

b. A sales manager who will be responsible for retail and wholesale seed marketing, and will be responsible for sales training.

c. A product information manager, preferably an agronomist, who could also serve as advertising and promotion manager. He will direct demonstration plot programs and publish results; and make product information data available in "selling" form to branch managers and salesmen.

d. A product accumulation and distribution manager who will be responsible for inventory control and seed shipments.

e. A credit manager who will arrange credit for seed buyers and be responsible for collections, working through branch managers and salesmen.

f. Warehouse or marketing center managers who could also serve as area sales managers and could direct other sales people needed in the area.

In a private company having an agricultural supply division, the additional personnel would be a trained agronomist to supply technical assistance.

A. Besse & Co (S. C.) could serve as an example of a private company and should be encouraged to expand its seed business. This company could import foundation seed for their own private brands, they could establish a research department to develop private varieties, or purchase varieties from the ESC.

This company [27] will import 300 metric tons of hybrid seed corn from Kenya for 1972 planting and have established a retail price of Eth. $104

---

[27] Conference with Ato Ahmed Maruf, Manager, Agricultural Supply Section, A. Besse & Co, March 11, 1972.

per quintal. This seed could have been produced in Ethiopia, providing the foundation seed could have been procured from the originating Kenya company. 28/

A. Besse & Co has 20 staffed branches throughout the major agricultural areas of the Empire and could do a good job of marketing and distributing improved seed. This company could also give advice and counsel to a developing seed industry in Ethiopia.

4. Cooperatives

The cooperative movement in Ethiopia is clearly evident and its potential is apparent. An established supply cooperative can also provide a good sales channel for improved seeds.

The ESC can provide improved seed for the cooperatives.

In a cooperative, the members are responsible for and will benefit from capable management. For their participation, the members should expect short-term production credit, improved seeds, farm supplies, technical assistance, and possibly a marketing service.

To increase yields and to make better per-hectare income for the members, we must assume that the cooperative will sell a supply package (fertilizer, chemicals, etc.) with the improved seed.

Eventually, the CADU project may develop a central supply cooperative. Strong cooperatives may emerge from the Minimum Package Programs. If this occurs, the cooperative should become a separate entity. The extension agents could provide technical assistance in their role of educator and advisor.

A national organization of consumer and marketing cooperatives would be desirable to stimulate the formation of other local cooperatives. The national organization could offer many services to local coops that would insure their continued success.

D. Costing, Pricing, and Profits from Improved Seed

A successful seed industry is based upon the availability of new and improved varieties of seed. The improved variety must be superior to those in common use. Before a variety is placed on the Ethiopian Seed

28/ In returning from Ethiopia, a special effort was made to contact the Kenya Seed Co at Katile, Kenya. A discussion with the management would lead one to believe that they would be interested in making arrangements for the production of seed in Ethiopia. (The Ethiopian Ministry of Agriculture and/or ESC should be encouranged to contact the Kenya Seed Co to encourage the company to develop a production program in Ethiopia.)

Council's approved seed list, it must exhibit, by test results from the IAR, superior yield and superior agronomic characteristics (see Table A-6).

Experience has shown that "costing" has become difficult due to wide ranges in seed yields, the relative relation of field yield to salable seed, time required for seed processing, germination variations between lots, etc. Alfalfa, not widely grown in Ethiopia, is an excellent example of seed yield variation. In California, USA, where most of the alfalfa is grown under irrigation, yields of some varieties will exceed others by as much as four times. This may be extreme, but obtaining twice as much seed from one variety as compared to another is not uncommon.

Hybrid maize seed shows a similar variation in yield. In the United States, three types of hybrid maize seed are produced and sold--the double cross (made by crossing four inbreds); the three-way cross (made by crossing three inbreds); and the single cross (made by crossing two inbreds). A double cross will consistently yield approximately 60 quintals of seed per hectare. Three-way cross seed yields will vary from 30 quintals to 45 quintals per hectare, and the single cross hybrid will yield approximately 15 quintals per hectare.

Variety performance in the farmer's field can determine, in part, the price. However, the price paid to seed producers for uncleaned and unprocessed field run seed will also provide a guide for pricing. This applies more to open pollinated varieties than to hybrid varieties.

This pricing chart can be used as a rough guide for pricing improved seed: 29/

	Wheat	Teff	Maize
		(Eth. $/q)	
Basic market price for unimproved seed (x)	25	35	22.5
x + 20% paid to registered grower	30	42	27
x + 20% + $13 markup, dealer selling price	43	55	40

The indicated markup is about 40 percent to cover marketing cost and profit, and on most corps, would be the very minimum. It is assumed that the transportation charges are not included. If transportation charges were equalized (as part of cost and marketing), the markup could be as high as 90 percent, resulting in a higher user cost. The percentage method of markup is difficult to use as a guide because of variation in product cost and other variables.

29/ Draft Report of the Ethiopian Projects Report No. DDC. P. 62, October, 1970.

Costing, pricing, and profits must be calculated specifically for each marketing organization. In the marketing channels previously discussed, the costing might follow this general procedure:

1. Government Agencies (Example: EPID)

   Product Cost[30/] + Marketing Cost[31/] = Selling Price

2. Government Sponsored Organizations (Example: EGC)

   Product Cost + Marketing Cost + Profit or Interest return on capital employed[32/] = Selling Price

3. Private Organizations (Example: A. Besse & Co)

   Product Cost + Marketing Cost + Profit = Selling Price

4. Cooperatives (Consumer)

   Product Cost + Marketing Cost + Planned Rebate = Selling Price

A seed production organization, without a marketing system, could supply improved seeds for any or all of the above organizations with marketing programs. Costing for this type of seed operation might be:

Product Cost + Profit = Wholesale Price

We have not prepared a marketing cost analysis because of the many variables and uncertainties. These variables include timing of the implementation of the program, sources of investment, improved variety availability rate, and policy on foundation seed supply. Improved seed is a cost of production to the farmer, and is considered in the analysis.

E. Summary

Each of these four channels for the distribution and marketing of improved seed has its advantages and disadvantages. In a nation where communication and transportation are in the developing stages, it would be logical for the government to assume leadership in a supply input program. Ethiopia is attempting to do this through the Minimum Package Program of the EPID. It should, however, recognize when it has served its principal function and relinquish its prerogatives to private or quasi-private organizations.

30/ Product cost is defined as all input costs (field production and processing) to the end seed readiness.

31/ Marketing cost is defined as all costs from the seed readiness to the end user.

32/ The old and much over simplified definition of profit, "the return upon capital and labor", is probably applicable

A semiautonomous government organization such as the EGC has many advantages as an input supplying organization. Its primary purpose is marketing and as such has many and continuing contacts with farmers. The addition of an input supply department, with provision for credit, would allow full-time employment of staff and could provide services not otherwise available. If the EGC were to sell input supplies, it would be essential that policies would not discriminate against private organizations in competition with EGC's business.

Private individuals or organizations normally enter markets when opportunity for profit has been demonstrated. An existing Ethiopian private organization has demonstrated the ability to manage a successful business and is experienced in marketing. They may have customers who will require large quantities of improved seed; thus the company could rapidly develop a large volume of sales. We believe that the government policy should encourage or at least permit private organizations to compete in the "market place" with, and under, the same rules and regulations as other seed distributors. The use of private capital should be encouraged in developing a seed industry in Ethiopia.

Agricultural cooperatives can be useful as a seed marketing channel. A government or a semi-government agency may need to offer guidance and managerial assistance particularly in the early development of a cooperative. Long term, as well as short term, loans will be needed to provide the local cooperatives with working capital to provide credit to its members. With proper management and technical guidance to its members, the cooperative could serve as an effective marketing channel for improved seeds.

The Ethiopian Seed Improvement Program will contribute substantially to the improved diet of the people. Increased farm production, resulting from an improved seed program, will stimulate both the agricultural economy and the dollar trade of the Empire.

V. SEED IMPROVEMENT PROJECT FUNDING

A. Introduction

This section shows the estimated funding requirements for personnel, equipment, and facilities. For details refer to Section III-B, Organization and Management. The overall Seed Improvement Program proposal is composed of several separate entities, which we believe must be integrated and implemented as described if the program is to be successful. Units such as the Ethiopian Seed Council, the Institute of Agricultural Research, and Seed Law Enforcement are expected to be built into the Ministry of Agriculture structure. Other units such as the Technical Assistance Contract staff (funded for five years), the Seed Production Farms and Seed Processing Facilities (assumed to be self-supporting after two years), and the National Seed Testing Laboratory (assumed to be self-supporting within five years) are phased through outside funding within ten years.

We do not recommend the perpetuation of autonomous or semi-autonomous agencies within the IEG. By phasing out certain of the activities and units, and terminating direct funding within a ten-year period, Experience, Incorporated is intentionally discouraging perpetuation of unnecessary proliferation of independent government bodies. Private industry should be encouraged to be responsible for supplying inputs to farmers to avoid long-term government participation in this phase of the enterprise.

B. Estimated Funding Required

1. Ethiopian Administrative Staff (ESC)

Table 4 shows the estimated funding required to support the professional and secretarial staff of the Ethiopian Seed Council. Included in this group are the Director, an Assistant Director, an Administrative Assistant, and two secretaries. Also included are maintenance for the staff and ESC members, equipment, and certain supplies.

Personnel, salaries, maintenance, equipment and supplies shown in Table 4 include:

1 Director	Eth. $20,000 base + 5% annual increment
1 Assistant Director	Eth. $15,000 base + 5% annual increment
1 Administrative Asst.	Eth. $10,000 base + 5% annual increment
1 Principal Secretary	Eth. $ 4,800 base + 5% annual increment
1 Secretary	Eth. $ 2,500 base + 5% annual increment
2 Automobiles @ Eth. $10,000	= Eth. $20,000 (Automobiles will be traded each fourth year. Trade-in value to be allowed as operating expenses.)

2 Per diem @ Eth. $3,000 = Eth. $6,000

3 Per diem @ Eth. $100 / day (Management ESC members) = Eth. $2,400

Education equipment and printing = Eth. $2,000/year

TABLE 4. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN SEED COUNCIL STAFF

(Eth. $1,000)

Year	Salaries[a]	Maintenance[b]	Total
1973	53	30	83
1974	55	10	65
1975	58	10	68
1976	61	30	91
1977	64	10	74
1978	67	10	77
1979	70	10	80
1980	74	30	104
1981	77	10	87
1982	81	10	91
	660	160	820

a/ Salaries of the staff include a 5% incremental raise each year. Non-government employees will require salaries ranging from 10% to 20% or higher than comparable Ministry of Agriculture employees.

b/ The Director and Assistant Director will be provided with a tax-free automobile to be traded each fourth year. Other maintenance items are listed above. General office overhead is not included.

2. Technical Assistance Contract Staff

Table 5 shows the estimated funding necessary for the technical assistance contract. The principal personnel are funded for five years though they may not all be required for the entire period.

The technical assistance contract includes a modest amount for equipment and supplies that may be required, especially in training activities. A small participant training cost is included to send Ethiopians abroad for special instruction not available through on-the-job training. This money would be largely used for short-term foreign training rather than degree work which has been funded in the tables where the participant is "job funded."

An estimated Eth. $3 million (see Table 5) will be required to fund a US contract group over the operative five-year contract period.

TABLE 5. ESTIMATED FUNDING REQUIRED FOR THE TECHNICAL ASSISTANCE CONTRACT-SEED IMPROVEMENT PROGRAM [a]

Position or Purpose	1973	1974	1975	1976	1977	Total
		(Eth. $1,000)				
Interim Director & Chief of Party	125	127.5	130	132.5	135	650
General Agronomist	120	122.5	125	127.5	130	625
Agricultural Engineer	120	122.5	125	127.5	130	625
Seed-Processing Specialist	120	122.5	125	127.5	130	625
Consultants-Short Term	120	100	-	-	-	220
Equipment & Supplies	15	15	15	10	10	65
Participant Training	25	25	25	25	25	125
	645	635	545	550	560	2,935

[a] Costs indicated include salaries, allowances, and expensed associated with posting and maintaining foreign advisors including contractor's overhead.

3. Funding for Research Services

Table 6 shows the estimated funding required for generating research information needed for a successful Seed Improvement Program. This money may be allocated to the IAR for the specific items shown or the needed research can be contracted with the IAR determining the allocation of funds.

The Research Service funding shown provides for nine research technicians at Eth. $700 per month starting salary, plus 20 percent "hardship" or housing, whichever applies. All personnel will be provided with a five-percent annual salary increase, and this is included in the funding.

The personnel, salaries, maintenance, and equipment funded in Table 6 include:

2 Research Agronomists @ Eth. $12,000 + 5% annual increment

1 Wheat Breeder @ Eth. $12,000 + 5% annual increment

1 Agricultural Climatologist @ Eth. $12,000 + 5% annual increment

9 Jeep-type pickup trucks @ Eth. $7,500

4 Passenger Jeeps @ Eth. $8,900

9 Tractors with equipment @ Eth. $20,000

9 Small threshers @ Eth. $ 4,000

9 Seed cleaners @ Eth. $1,250

The vehicles will be replaced each fourth year, less 20 percent trade-in allowance. The four research men will have Eth. $3,200 per diem allowance annually.

TABLE 6. ESTIMATED FUNDING FOR RESEARCH SERVICES FOR THE SEED IMPROVEMENT PROGRAM [a]

	(Eth. $1,000)		
Year	Salaries & Allowance	Maintenance	Total
1973	139	652	791
1974	143	-	143
1975	150	13	163
1976	158	95	253
1977	166	13	179
1978	174	13	187
1979	183	13	196
1980	192	95	287
1981	202	13	215
1982	212	13	225
	1,719	920	2,639

[a] The figures in Table 6 should be read with the understanding that if the Pulse Development Project is funded, the added cost for Research Services in 1973, for example, will be reduced by Eth. $277,000 and the total figures would read approximately: Salaries and Allowances - Eth. $840,000; Maintenance - Eth. $567,000 = Total Eth. $307,000.

The four research men are funded at Eth. $12,000 per year for two years' training abroad, preferably in the United States. We recommend that the "Agricultural Climatologist" attend Iowa State University.

The two research agronomists, the wheat breeder, and the agricultural climatologist are funded for two years of advanced training @ Eth. $12,000 each per year. The cost of training is shown in the salary column. They are phased into the project in 1975.

4. Seed Law Enforcement

The proposed FAO seed law did not include administrative and enforcement costs, however, we believe funding to be a minimum for staff and maintenance for the first ten years of effective seed law enforcement. Funding is shown to begin in 1973, but the actual date will be determined by the date of passage of the seed law. The law may stipulate quite a different pattern than assumed here, but total funding for an effective enforcement unit is expected to approximate the figures shown in Table 7.

TABLE 7. ESTIMATED FUNDING FOR THE SEED LAW ENFORCEMENT UNIT NECESSARY FOR THE SEED IMPROVEMENT PROGRAM

	(Eth. $1,000)		
Year	Salary	Maintenance	Total
1973	49	35	84
1974	51	7	58
1975	74	26	100
1976	108	40	148
1977	113	45	158
1978	119	17	136
1979	124	32	156
1980	131	40	171
1981	137	45	182
1982	144	17	161
	1,050	304	1,354

Personnel, salaries, maintenance, and equipment funded in Table 7 include:

1 Director	Eth. $20,000 base + 5% annual increment
1 Head Inspector/Domestic Seeds	Eth. $12,000 base + 5% annual increment
1 Head Inspector/Imported Seeds	Eth. $12,000 base + 5% annual increment
2 Inspectors/Imported Seeds (Starting 1975)	Eth. $10,000 base + 5% annual increment
3 Inspectors/Domestic Seeds (Starting 1976)	Eth. $10,000 base + 5% annual increment
2 Secretaries @ Eth. $2,400 (Starting 1976)	Eth. $4,800 base + 5% annual increment

1 Automobile @ Eth. $10,000

2 Passenger Jeeps @Eth. $8,900 Eth. $17,800

5 Pickup Jeeps @ Eth. $7,500
(1975 & 1976) Eth. $37,500

Per diem for Director is Eth. $2,000,and Eth. $20 per day for 100 days for each of the seven inspectors (phased in) = Eth. $14,000.

All funding is phased in based on a 1973 beginning date. If there is a delay in "start-up", the phase-in of funding will be delayed accordingly.

5. Funding for the Awasa Seed Farm

Table 8 shows the estimated funding required for the first seed farm (Awasa). This farm, in addition to being a production unit, will be a pilot farm for training personnel and for observations before establishing other similar farms.

TABLE 8. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF FOR THE AWASA SEED FARM

Year	Salaries and Allowances	Maintenance[a]	Total
	(Eth. $)		
1973	20,400[b]	-	20,400[c]
1974	40,000[b]	-	40,000[c]
1975	42,000	200	42,200
1976	44,100	200	44,300
1977	46,300	200	46,500
1978	48,600	200	48,800
1979	51,000	200	51,200
1980	53,600	200	53,800
1981	56,300	200	56,500
1982	59,100	200	59,300
	461,400	1,600	463,000

a/ Transportation is funded in the equipment requirements.

b/ Included in the salary column are two years (1973 & 1974) of foreign training costs for the agronomist manager at the rate of Eth. $12,000 per annum. In 1974, salaries of the eight subordinate staff will be phased in, and the agronomist manager in 1976.

c/ Only the funding for the initial two years of operation is considered a "cost" to the seed improvement project; after the first two years, the seed farm is to be self-supporting.

We believe it is necessary to fix the base salary of Ethiopian staff at 10 to 20 percent more than permanent employees of the Ministry of Agriculture of comparable grade.

The personnel, salaries, and maintenance funded in Table 8 include:

1 Agronomist-Manager	Eth. $12,000 + 5% annual increment
1 Farm-Foreman	Eth. $ 8,400 + 5% annual increment
8 Subordinate Staff @Eth. $1,500	Eth. $12,000 + 5% annual increment

The Agronomist-Manager will be provided with a Eth. $20 per diem for 10 days (Eth. $200 per year).

6. Funding for the Awasa Seed Processing Plant

Table 9 shows the estimated funding required for the first seed processing facility (Awasa). This facility will be a pilot unit for training of personnel and for observations of equipment and methods before other similar facilities are established.

TABLE 9. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF FOR THE AWASA SEED PROCESSING FACILITY

Year	Salaries and Allowances	Maintenance	Total
	(Eth. $)		
1973	24,000 a/	7,500	31,500 b/
1974	30,000 a/	-	30,000 b/
1975	37,800	400	38,200
1976	39,700	400	40,100
1977	41,700	7,900	49,600
1978	43,800	400	44,200
1979	46,000	400	46,400
1980	48,200	400	48,600
1981	50,700	7,900	58,600
1982	53,200	400	53,600
	415,100	25,700	440,800

a/ Included in the salary column are two years of (1973 and 1974) foreign training costs for the seed plant manager and the agricultural engineer at the rate of Eth. $12,000 per annum for each. Salaries of the five subordinate staff are phased in on July 1, 1974.

b/ Only the funding for the initial two years of operation is considered a "cost" to the seed improvement project; after the first two years, the processing plant is considered to be self-supporting.

We believe it is necessary to fix the base salary of the Ethiopian staff at 10 to 20 percent more than the permanent employees of the Ministry of Agriculture of comparable grade.

The personnel, salaries and maintenance funded in Table 9 include:

1 Seed Plant Manager	Eth. $12,000 base + 5% annual increment
1 Agricultural Engineer	Eth. $12,000 base + 5% annual increment
5 Subordinate Staff @Eth. $1,500	Eth. $7,500 base + 5% annual increment
1 Jeep-type pickup	Eth. $7,500

Professional staff will be provided with Eth. $20 per diem for 10 days each (Eth. $400/year).

The vehicle will be traded each fourth year, with a 20 percent trade-in value. It is assumed this value will serve to cover operating costs.

7. Funding for Other Seed Production and Processing Facilities

Tables 10, 11 and 12 show estimated funding needed on a time phased basis for all four of the seed farms and processing facilities. Figures from Tables 8 and 9 are repeated in these tables. We assume that comparable funding will be needed for similar facilities regardless of start-up date.

TABLE 10. ESTIMATED FUNDING FOR THE ETHIOPIAN STAFF, BY YEARS, FOR THE FOUR SEED FARMS - TIME PHASED

Year	Awasa	Nazaret	Alemaya	Alamata	Total
			(Eth. $)		
1973	20,400	-	-	-	20,400
1974	40,000	-	-	-	40,000
1975	42,200	-	-	-	42,200
1976	44,300	20,600	-	-	64,900
1977	46,500	40,800	20,600	-	107,900
1978	48,800	42,900	40,800	20,600	153,100
1979	51,200	45,000	42,900	40,800	179,900
1980	53,800	47,200	45,000	42,900	188,900
1981	56,500	49,600	47,200	45,000	198,300
1982	59,300	52,000	49,600	47,200	208,100
	463,000	298,100	246,100	196,500	1,203,700

TABLE 11. ESTIMATED FUNDING FOR THE ETHIOPIAN STAFF, BY YEARS FOR FOUR SEED PROCESSING FACILITIES - TIME PHASED

Year	Awasa	Nazaret	Alemaya	Alamata	Total
			(Eth. $)		
1973	31,500	-	-	-	31,500
1974	30,000	-	-	-	30,000
1975	38,200	-	-	-	38,200
1976	40,100	31,900	-	-	72,000
1977	49,600	31,600	31,900	-	113,100
1978	44,200	33,200	31,600	31,900	140,900
1979	46,400	34,800	33,200	31,600	146,000
1980	48,600	44,000	34,800	33,200	160,600
1981	58,600	38,400	44,000	34,800	175,800
1982	53,600	40,200	38,400	44,000	176,200
	440,800	254,100	213,900	175,500	1,084,300

TABLE 12. TIME PHASED FUNDING REQUIRED FOR SEED PRODUCTION AND SEED PROCESSING FACILITIES - SEED IMPROVEMENT PROGRAM, 1973 - 1982 [a]

(Eth. $1,000)

Year	Land	Buildings	Farm Machinery	Processing Equipment	Transportation Equipment	Generating Plant	Ethiopian Staff		Total
							Seed Farm	Proc. Plant	
1973	150	268	188	81	37	17	20	32	793
1974	-	-	-	-	-	-	40	30	70
1975	-	-	-	-	-	-	42	38	80
1976	150	268	188	81	37	17	65	72	878
1977	150	268	188	81	37	17	108	113	1,204
			188		37	17			
1978	150	268	188	81	37	17	153	141	1,035
1979	-	-	-	-	-	-	180	146	326
1980	-	-	-	-	-	-	189	160	349
1981	-	-	188	-	37	17	198	176	616
1982	-	-	188	-	37	17	208	176	626
Total	600	1,072	1,316	324	259	119	1,203	1,084	5,977

NOTE: Of the funding indicated for developing seed farms and processing plants, only the allocations to staff during the first two years of operation in each case are considered to be "costs". It is intended that all other expenditures will be recovered through sale of seed.

[a] We believe these figures cover the principal funding necessary for the four seed farms and the four processing facilities including staff and labor.

VI. ECONOMIC ANALYSIS

A. Project Evaluation Procedure

There are certain difficulties and shortcomings that are inherent in any effort to apply the usual procedures to economic analysis of the prospective worth of a Seed Improvement Program. The first problem is the fact that it is impossible to isolate precisely the gains in production to be derived from improved seed per se. Generally, seed is one element in a package of improved practices that may include such other items as fertilizer, weed control, pesticides, more timely planting, better cultivation, etc. Not only is it difficult to ascribe specific and definable benefits to seed alone, but there have been research results that indicate little or no financial gain from the use of certain improved practices, including seed. These complications have, at times, led project analysts to conclude that the usual type of benefit/cost analysis should not be used in evaluating a Seed Improvement Program. In these cases, one alternative is to outline the elements of a program to increase production with emphasis on better seeds and to relate the initiation of such a program to agricultural planning and development. This alternative has some merit but gives the policy-maker or financing agency nothing tangible on which to base decisions.

Despite the lack of complete supporting data and other problems in establishing costs and returns, it was the decision of the Experience, Incorporated team that an attempt should be made to proceed with an analysis of the Seed Improvement Program for Ethiopia that would indicate a benefit/cost ratio and the internal rate of return. The analysis that follows is believed to be a realistic guide in evaluating the relative worth of the proposed Seed Improvement Program as an element in Ethiopia's agricultural and general economic development program. In the sections that follow, heavy reliance is placed on the judgment of team members and others who have traveled extensively in Ethiopia and who have a good understanding of the local crop situation and outlook. Wherever possible, reliance is placed on applicable research results, but a number of "informed estimates" are also used at several points in the analysis. Although the analysis is based on a 20-year period, it is recognized that projections even to the 10-year level cannot be considered other than probable expectations or orders of magnitude.

B. Estimated Production Gains Attributable to the Project

In measuring benefits to be derived from the Seed Improvement Program in Ethiopia, primary attention is focused on the gain in crop production that will result from the use of improved seed. The seed produced under project auspices will itself have value, but such seed is considered a part of the production costs related to the incremental gain in crop production. Production costs, including seed, are in the benefit/cost

analysis that follows. There are a number of benefits less tangible than increased crop production, but they are not readily quantified. Among these are the increased employment opportunities and improved level of farm income that will certainly result from the project. There will also be some gain in the form of demonstration in organizing and operating an agricultural program.

There will be no gain creditable to the project in the form of increased output of affected crops during the initial two years of the Seed Improvement Program. This amount of time will be required to establish the first seed farm and processing facilities and to reach the point where seeds will actually be available for planting. Beginning in the third year, however, there will be a gradual increase in production through use of better seed (maize, wheat, barley and haricot beans) produced by seed farms sponsored under the proposed Seed Improvement Program. Table 13 shows the incremental gains anticipated, by crops and by years, over a 20-year period. Total monetary value of the added production of the four crops is Eth. $85 million during the first ten years and Eth. $205 million in the second decade.

Haricot beans are expected to contribute almost as much to the anticipated gain as all of the other three crops combined; in large part, this expectation is based on activation of an effective Pulse Production Program. Without the implementation of a program for the production of pulses for export markets similar to that proposed in Report No. I, it is very doubtful that the Seed Improvement Program, as outlined herein, is feasible. Likewise, the pulse project feasibility is dependent upon a reliable source of improved haricot bean seed from either domestic or imported sources. In the case of barley, the projection is contingent upon development of a malting industry in Ethiopia. Export markets are needed only for haricot beans; the increased quantities of cereals will be consumed domestically.

C. Cost of Producing Incremental Gains

Aside from the costs that are properly charged directly to the initiation and operation of a Seed Improvement Program, the other major "cost" that must be considered in determining net benefits is the cost of producing the added quantities of the crops resulting from the seed program. It is estimated that these production costs per unit of output will decrease materially as yields per hectare advance. It is known that the decline in costs will not be regular from year to year; for this reason, cost breaks are projected on a three to five-year basis. A limited amount of data based on cost studies are currently available for the four crops, but forward estimates are based largely on judgment.

TABLE 13. ESTIMATED PRODUCTION GAINS ATTRIBUTABLE TO THE SEED IMPROVEMENT PROGRAM FOR ETHIOPIA, 1973 - 1992

Year	Maize			Wheat			Barley			Haricot Beans			Four Crops
	Imp Seed Available (mt)	Area Planted (1000 ha)	Value Add Production (Eth. $1,000)	Imp Seed Available (mt)	Area Planted (1000 ha)	Value Add Production (Eth. $1,000)	Imp Seed Available (mt)	Area Planted 1000 ha)	Value Add Production (Eth. $1,000)	Imp Seed Available (mt)	Area Planted a/ (1000 ha)	Value Add Production (Eth. $1,000)	Total Add Production (Eth. $1,000)
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-	-	-
1975	300	12	864	2,000	16	2,560	20	200	3	500	7.7	269	3,696
1976	400	16	1,152	2,000	16	2,560	37	370	5	1,305	19.5	887	4,604
1977	500	20	1,440	2,200	17.6	2,816	60	600	8	1,770	26.6	2,234	6,498
1978	600	24	1,728	2,200	17.6	2,816	70	700	9	2,195	33	3,465	8,018
1979	700	28	2,016	2,300	18.4	2,944	70	700	9	2,795	43	6,170	11,139
1980	600	24	1,728	2,400	19.2	3,072	270	2,700	67	3,455	53.5	8,801	13,668
1981	700	28	2,016	2,800	22.4	3,584	470	4,700	117	3,845	61	11,102	16,819
1982	900	36	2,592	3,000	24	3,840	670	6,700	167	4,290	66	13,629	20,228
1983	1,000	40	2,880	2,800	22.4	3,584	670	6,700	167	4,290	66	13,629	20,260
1984	1,000	40	2,880	3,100	24.8	3,968	670	6,700	167	4,290	66	13,629	20,644
1985													
1986													
1987													
1988													
1989													
1990													
1991													
1992													
			42,336			63,488			2,055			182,847	290,726

NOTE. Improved seed available represents the quantity produced by ESC project farms. Seeding rates assumed are 25 kg/ha for maize, 125 kg/ha for wheat, 100 kg/ha for barley, and about 65 kg/ha for haricot beans. Production gain from improved seed is estimated at 6 q/ha for maize, 8 q/ha for wheat, 1 q/ha for barley, and a sliding scale of 1 q/ha to 5.9 q/ha for haricot beans. Value per quintal is assumed to be Eth. $12 for maize, $20 for wheat, $13 (1973-77), and $25 (1980-1992) for barley, and $35 for haricot beans.

a/ In this analysis, the area planted with improved seed is the incremental gain in hectares of haricot beans projected for five local production areas under the proposed pulse production project for Ethiopia (Report No. 1, "The Feasibility of Producing Pulse Crops for Export Markets", Experience, Incorporated, May 1972).

Within ten years after the Seed Improvement Program begins, costs per quintal could be reduced by at least 30 percent from present levels. Estimated costs involved in producing the gain in output of maize, wheat, barley and haricot beans, and the bases of the projection are listed in Table 14. Costs of production are purposely overestimated for this economic analysis only; for example, it was not considered practicable to adjust for the opportunity cost of labor. The net result, however, is a more conservative approach to the benefit/cost relationship.

The justifications for yields is based on published reports of the IAR and our projections from these yields. For verification of our projection, we discussed these yields with small and large-scale commercial farmers whose records showed such yields were commonly attained or supposed.

Costs are more difficult to obtain. Our costs were based on records obtained from interviews with larger commercial farmers. We have no reason to question these costs, since many of these records appeared quite concise and tended to be similar for similar-type operations. Without exception, the farm managers believed these costs could and would be reduced. Higher yields are normally reflected immediately in lower production costs per unit produced, even though the cost per hectare might increase slightly.

Our judgment on the selling price of products is based on historical data interpreted into the future. We do not believe Ethiopian prices will drop to world price levels. There appears to be little liklihood of surplus production for all of the Empire, although such may exist in limited areas. However, transfer costs of products from surplus to deficit areas are very high. Given enough years and free trade, prices should approach the world level, plus transportation to interior points. This is quite a different price from world prices.

D. Benefit/Cost Analysis

Benefits in the form of increased crop production attributable to the use of improved seeds will total Eth. $290.7 million over the 20-year period of 1973-92 (Table 13). During the same period, costs properly chargeable to (1) project operations, and (2) the incremental gain in crop production are estimated at Eth. $189.7 million (Table 15). In Table 16, the benefits and costs are related, by years, and discounted at ten percent; the result is a ratio of benefits to costs of 1.4 and a net present worth of Eth. $25.9 million. In the analysis, it is assumed that both income and costs will remain constant after 1984.

Based on this analysis, the internal rate of return in approximately 38 percent. In arriving at the ratio and rate of return, every effort was made to utilize realistic values for anticipated crop gains and adequate allowances for both program and production costs.

TABLE 14. ESTIMATED COST OF PRODUCING THE INCREMENTAL GAIN IN CROPS ATTRIBUTABLE TO THE SEED IMPROVEMENT PROGRAM FOR ETHIOPIA, 1973 - 1992

Year	Maize	Wheat	Barley	Haricot Beans	Total
			(Eth. $1,000)		
1973	-	-	-	-	-
1974	-	-	-	-	-
1975	933	2,560	5	212	3,710
1976	1,244	2,560	8	570	4,382
1977	1,555	2,816	12	1,436	5,819
1978	1,434	2,394	6	2,227	6,061
1979	1,673	2,502	6	3,085	7,266
1980	1,434	2,611	47	4,400	8,492
1981	1,673	3,046	82	5,551	10,352
1982	2,151	3,264	117	6,815	12,347
1983	2,160	2,509	97	6,815	11,581
1984	2,160	2,778	97	6,815	11,850
1985	↓	↓	↓	↓	↓
1986					
1987					
1988					
1989					
1990					
1991					
1992					
	33,697	49,264	1,253	92,446	176,660

NOTE: Production costs are based on the limited research results available and on observations and judgment of Experience, Incorporated team members. The following estimates are used (Eth. $ per quintal):

	Maize	Wheat	Barley	Haricot Beans
1973-77	13	20	20	
1978-82	10	17	17	
1983-92	9	14	14	
1973-75				27.50
1976-78				22.50
1979-92				17.50

No improved seed will be available from the seed production unit until the third year of the program.

TABLE 15. SUMMARY OF COSTS RELATED TO EXPECTED BENEFITS DERIVED FROM THE SEED IMPROVEMENT PROGRAM IN ETHIOPIA, 1973-1982

Year	Administration ESC a/	Technical Assistance b/	Seed Law Enforcement c/	Seed Farm and Processing Plants d/	Research Services e/	Costs of Producing Additional Output f/	Total Costs
			(Eth. $1,000)				
1973	83	645	84	52	791	-	1,655
1974	65	635	58	70	143	-	971
1975	68	545	100	-	163	3,710	4,586
1976	91	550	148	53	253	4,382	5,477
1977	74	560	158	125	179	5,819	6,915
1978	77	-	136	125	187	6,061	6,586
1979	80	-	156	73	196	7,266	7,771
1980	104	-	171	-	287	8,492	9,054
1981	87	-	182	-	215	10,352	10,836
1982	91	-	161	-	225	12,347	12,824
1983	91	-	161	-	225	11,581	12,058
1984	91	-	161	-	225	11,850	12,327
1985 ↓ 1992	↓	↓	↓	↓	↓	↓	↓
Total	1,730	2,935	2,964	498	4,889	176,660	189,676

a/ See Table 4 for details.
b/ See Table 5 for details.
c/ See Table 7 for details.
d/ Reflects only the amount required to defray staff costs incurred during the initial two years of operation for each farm and each processing unit (see Tables 10 and 11).
e/ See Table 6 for details. These costs will be reduced substantially if a pulse production project is initiated.
f/ See Tables 13 and 14 for details of the computation.

TABLE 16. RELATIONSHIP OF ESTIMATED INCOME DERIVED AND COSTS INCURRED IN THE SEED IMPROVEMENT PROGRAM IN ETHIOPIA a/

	Income	Costs	Net Benefits	Discount @ 10%	Discounted Income	Costs Discounted	Net Present Worth
	-------- Eth. $1,000		--------	%	---------- Eth. $1,000		----------
1973	-	1,655	-1,655	90.9	-	1,504	-1,504
1974	-	971	- 971	82.6	-	802	- 802
1975	3,696	4,586	- 890	75.1	2,776	3,444	- 668
1976	4,604	5,477	- 873	68.3	3,145	3,741	- 596
1977	6,498	6,915	- 417	62.1	4,035	4,294	- 259
1978	8,018	6,586	1,432	56.2	4,506	3,701	805
1979	11,139	7,771	3,368	51.3	5,714	3,987	1,727
1980	13,668	9,054	4,614	46.7	6,383	4,228	2,155
1981	16,819	10,836	5,983	42.4	7,131	4,594	2,537
1982	20,228	12,824	7,404	38.6	7,808	4,950	2,858
1983	20,260	12,058	8,202	35.0	7,091	4,220	2,871
1984	20,644	12,327	8,317	31.9	6,585	3,932	2,653
1985	↓	↓	↓	29.0	5,987	3,575	2,412
1986				26.3	5,429	3,242	2,187
1987				23.9	4,934	2,946	1,988
1988				21.8	4,500	2,687	1,813
1989				19.8	4,088	2,441	1,647
1990				18.0	3,716	2,219	1,497
1991				16.4	3,386	2,022	1,364
1992				14.9	3,076	1,837	1,239
Total	290,726	189,676	101,050		90,290	64,366	25,924

NOTE: Benefit/Cost Ratio- at 10%: 1.4
Internal Rate of Return: Approximately 38%
Net Present Worth: Eth. $25.9 million

a/ Refer to Tables 13 and 16 for details of income and costs by years.

E. Direct Funding of the Seed Improvement Program

To activate the Seed Improvement Program and to provide the necessary impetus in the ongoing program, a commitment of almost Eth. $14 million over a ten-year period will be required (see Table 17). These funds are not synonomous with costs for purposes of the benefit/cost analysis; this is due in part to the recoverable nature of certain expenditures required in the project. Also, costs of producing the incremental gain in the crops involved are not considered as project funding. Over 40 percent of the funds committed to the seed project are required for seed farms and processing plants in four locations. These facilities are to be self-supporting after the initial two years of operation, and income is expected to cover both recurring operating expenses and amortization of the physical plant. Technical assistance and research services are other important activities, and they are an investment that must be considered nonrecoverable. Administration of the Ethiopian Seed Council and seed law enforcement are other overhead functions necessary to program operation.

It is interesting to note the relationship of funds committed the anticipated benefits in the form of increased crop production. During the intitial ten years of the proposed project (1973-82) these benefits total almost Eth. $85 million, while direct funding is estimated at Eth. $14 million. As the program progresses, there will undoubtedly be shifts in the allocations of funds among objectives and purposes, and the actual level may be up or down. Assuming, however, that as requirements decrease for seed farms and processing units, there may be an increase for ESC administration, seed law enforcement and operation of a seed laboratory; then, after 1982, funding will probably continue at the same level. If such is the case, total direct funding over the 20-year period would be about Eth. $25 million, including the reimbursable or self-liquidating outlays. As noted, gross benefits are expected to be over Eth. $290 million.

Methods and sources of financing for the Seed Improvement Program are not considered to be within the scope of the present study; thus, the subject is not covered in this report. It is reasonable to expect, however, that the IEG itself may be able to contribute importantly to the initiation and operation of the proposed program. Outside assistance may be obtained from such bilateral or multilateral sources as US/AID, IBRD, African Development Bank, SIDA, other individual governments, etc.

In estimating the cost of imported supplies and equipment required in several phases of the project, it is assumed that the IEG will accord such commodities a duty-free status.

TABLE 17. SUMMARY OF DIRECT FUNDING REQUIRED TO IMPLEMENT A SEED IMPROVEMENT PROGRAM IN ETHIOPIA, 1973-1982

Year	Administration ESC	Technical Assistance	Research Services	Seed Law Enforcement	Seed Farms and Processing Plants	Funds Required
			(Eth. $1,000)			
1973	83	645	791	84	793	2,396
1974	65	635	143	58	70	971
1975	68	545	163	100	80	956
1976	91	550	253	148	878	1,920
1977	74	560	179	158	1,204	2,175
1978	77	-	187	136	1,035	1,435
1979	80	-	196	156	326	758
1980	104	-	287	171	349	911
1981	87	-	215	182	616	1,100
1982	91	-	225	161	626	1,103
Total	820	2,935	2,639	1,354	5,977	13,725

NOTE: Funds that must be committed to operation of the seed improvement program are listed without regard to their degree of recovery; e.g., the seed farms and processing plants are expected to be largely self-supporting. See Tables 4 through 12.

APPENDIX A

TABLES

TABLE A-1. PRODUCTION OF CEREALS AND PULSES IN ETHIOPIA, 1960/70

	1953 1960/1	1954 1961/2	1955 1962/3	1956 1963/4	1957 1964/5 a/	1958 1965/6	1959 1966/7	1960 1967/8	1961 1968/9	1962 1969/70
					(1,000 Tons)					
CEREALS:										
Barley	748.0	760.0	774.0	785.0	1,347.9	1,371.7	1,398.9	1,430.0	1,462.6	1,495.6
Maize	678.0	682.0	695.0	720.0	788.4	812.1	826.6	853.0	880.4	909.0
Sorghum	1,064.0	1,081.0	1,100.0	1,132.0	867.7	887.0	922.1	988.6	1,007.3	1,036.8
Teff	1,793.0	1,824.0	1,859.0	1,915.0	1,255.5	1,267.0	1,285.5	1,304.3	1,323.3	1,342.6
Wheat	255.0	260.0	266.0	282.0	692.9	721.7	738.9	760.0	782.0	808.0
TOTAL	4,538.0	4,607.0	4,694.0	4,834.0	4,952.4	5,059.5	5,172.0	5,335.9	5,455.6	5,592.0
PULSES:										
Chick Peas	160.0	162.2	164.7	169.5	168.4	172.0	173.9	176.7	180.5	185.3
Field Peas	110.0	111.5	113.2	116.0	114.9	117.8	119.6	121.6	123.9	126.4
Haricot Beans	60.0	60.7	61.5	62.5	63.2	64.8	66.4	68.2	70.1	72.3
Horse Beans	100.0	101.4	103.0	105.7	128.8	116.4	120.9	125.9	131.5	137.8
Lentils	90.0	91.4	92.8	95.0	95.4	99.1	99.8	101.2	103.4	106.5
TOTAL	520.0	527.2	535.2	548.7	570.7	570.1	580.6	593.6	609.4	628.3

a/ Beginning in 1964/5 (E.C. 1957) a revised base was used in estimating production of certain cereals.

SOURCE: Statistical Abstracts, Central Statistical Office, IEG.

TABLE A-2. AREA OF CEREALS AND PULSES IN ETHIOPIA, 1960/70

	1953 1960/1	1954 1961/2	1955 1962/3	1956 1963/4	1957 1964/5 a/	1958 1965/6	1959 1966/7	1960 1967/8	1961 1968/9	1962 1969/70
	(1,000 Hectares)									
CEREALS:										
Barley	935.0	950.0	967.5	960.5	1,643.8	1,652.6	1,672.8	1,693.2	1,713.9	1,734.8
Maize	744.0	757.7	772.2	776.0	800.4	812.1	820.2	828.4	837.7	847.1
Sorghum	1,329.0	1,351.2	1,375.0	1,384.0	1,071.2	1,081.7	1,129.5	1,174.0	1,188.6	1,203.2
Teff	3,260.0	3,316.0	3,380.0	3,384.0	2,110.0	2,111.6	2,132.7	2,154.0	2,175.5	2,197.3
Wheat	364.0	371.4	330.0	390.1	962.3	988.6	1,008.4	1,028.6	1,049.2	1,070.3
TOTAL	6,632.0	6,746.3	6,874.7	6,894.6	6,587.7	6,646.6	6,763.6	6,878.2	6,964.9	7,052.7
PULSES:										
Chick Peas	266.0	270.3	274.5	275.0	276.0	277.4	280.5	285.3	289.9	294.2
Field Peas	122.0	123.9	125.7	126.6	127.7	128.1	130.0	131.8	133.5	135.0
Haricot Beans	86.0	86.7	87.8	88.0	89.0	90.0	91.0	91.9	92.8	93.7
Horse Beans	110.0	112.7	114.4	115.3	124.0	126.5	131.4	136.0	140.2	144.0
Lentils	150.0	152.3	154.6	157.1	159.0	162.5	166.3	169.6	172.3	174.4
TOTAL	734.0	745.9	757.0	762.0	775.7	784.5	799.2	814.6	828.7	841.3

a/ Beginning in 1964/5 (E.C. 1957) a revised base was used in estimating production of certain cereals.

SOURCE: Statistical Abstracts, Central Statistical Office, IEG.

TABLE A-3. YIELD OF CEREALS AND PULSES IN ETHIOPIA, 1960/70

	1953 1960/1	1954 1961/2	1955 1962/3	1956 1963/4	1957 1964/5	1958 1965/6	1959 1966/7	1960 1967/8	1961 1968/9	1962 1969/70
				(Quintals per Hectare)						
CEREALS:										
Barley	8.0	8.1	8.2	8.3	8.2	8.3	8.4	8.5	8.5	8.6
Maize	9.0	9.2	9.2	9.4	9.8	10.0	10.1	10.3	10.5	10.7
Sorghum	8.0	8.1	8.1	8.2	8.1	8.2	8.3	8.4	8.5	8.6
Teff	5.5	5.6	5.6	5.7	5.9	6.0	6.0	6.6	6.1	6.1
Wheat	7.0	7.1	7.1	7.3	7.2	7.3	7.3	7.4	7.5	7.6
PULSES:										
Chick Peas	6.0	6.1	6.1	6.2	6.1	6.2	6.2	6.2	6.2	6.3
Field Peas	9.0	9.0	9.0	9.2	9.0	9.2	9.2	9.2	9.3	9.4
Haricot Beans	7.0	7.0	7.1	7.2	7.1	7.2	7.3	7.4	7.6	7.7
Horse Beans	9.0	9.0	9.1	9.2	9.1	9.2	9.2	9.3	9.4	9.6
Lentils	6.0	6.0	6.0	6.0	6.0	6.1	6.0	5.9	6.0	6.1

SOURCE: Statistical Abstracts, Central Statistical Office, IEG.

TABLE A-4. QUANTITY OF PULSES EXPORTED FROM ETHIOPIA, 1965/70

	1965	1966	1967	1968	1969	1970
	(1,000 Metric Tons)					
PULSES:						
Chick Peas	9.5	10.9	10.7	13.9	8.0	2.2
Field Peas[a/]	2.3	1.5	0.9	1.0	2.0	0.4
Haricot Beans	19.7	19.5	17.9	19.3	16.7	17.1
Horse Beans	17.8	22.4	24.7	18.5	27.4	15.6
Lentils	5.8	14.9	15.0	22.0	24.5	15.8
TOTAL	55.1	69.2	69.2	74.7	78.6	51.1

a/ Includes "dried" peas and "mixed" peas classifications.

SOURCE: Annual External Trade Statistics, IEG, Ministry of Finance, Addis Ababa.

TABLE A-5. IMPORTS OF CEREALS BY ETHIOPIA, 1966-70.

COMMODITY	1966	1967	1968	1969	1970
		(metric tons)			
Wheat	8,262	111	7	4,451	31,536
Rice	7,633	1,208	1,022	1,543	1,481
Barley	-	1,300	800	1,000	1,505
Maize	3,828	125	15	24	1,004
Oats	205	15	10	19	45
Durrah (Sorghum)	1,180	3,231	1,443	575	-
Millet	36	746	-	418	1,948
Other	6	43	20	54	-
Flour	29,794	21,234	16,316	17,698	28,851
Malt	3,087	2,082	2,644	3,261	4,213

SOURCE: Annual External Trade Statistics, IEG, Addis Ababa.

TABLE A-6. NATIONAL SEED INVENTORY FOR 1972-73.

	Estimated Total in Quintals	
	Production	For Sale
Wheat		
Cadu (Asella)	23,550	3,050
Debre Zeit	80	-
Ambo	41	-
Alemaya	150	110
Awasa	400	200
Holetta	264	230
	24,485	3,590
Barley		
Cadu (Asella)	640	-
Debre Zeit	8	3
Holetta	239	205
	887	208
Maize		
Cadu	120	-
Alemaya	40	30
Awasa	2,530	600
Bako	2,000	250
	4,690	880
Sorghum		
Alemaya	30	25
Bako	1,500	1,500
	1,530	1,525
Teff		
Cadu (Asella)	150	-
Debre Zeit	230	190
Holetta	100	75
	480	265
Haricot Beans		
Awasa (Vor. MPBT)	200	120
Field Peas		
Debre Zeit	14	10
Holetta	60	45
	74	55
Chick Peas		
Debre Zeit	28	22

TABLE A-7. FIELD POWER AND MACHINERY FOR A 400-HECTARE SEED FARM [a]

Item	Optimum Cost New [b]		Minimum Cost New [c]	
	No.	Eth. $	No.	Eth. $
Tractors (70-75 hp @ 14,000)	4	56,000	3	42,000
Plows (4-disc or mold board @ 3,500)	4	14,000	2	7,000
Tandem Disc Harrow (5m @ 6,000)	2	12,000	2	12,000
Tine Tooth Harrow (6m @ 1,500)	2	3,000	1	1,500
Tool Bar Planter with Attachments (6-row @ 4,800)	2	9,600	2	9,600
Field Sprayer (Boom-type 5m @ 1,500)	2	3,000	1	1,500
Tool Bar Cultivator (6-row @ 3,000)	2	6,000	2	6,000
Stalk Chopper (4m @ 5,000)	2	10,000	1	5,000
Combine, Self-Propelled (4m head) [d]	1	58,600	0	-
Fertilizer Spreader (4m @ 1,000)	2	2,000	1	1,000
Trailer, 4 wheel-5mt with lift (@ 3,500)	4	14,000	2	7,000
Total		188,700		92,600
Transport - Farm				
Toyota Pick-up (1-ton, 4-wheel drive with wench)	1	14,150	1	7,500
Lorry (4-ton, single bottom)	1	16,950	1	16,950
Trailer Wagons (3-ton with 6-ton hydraulic hoist @ 1,935)	3	5,800	2	3,670
Total		36,900		28,120
Generating Plant (18.5 kw)		8,500		8,500

[a] Items shown in Table A-7 should be from companies that can provide parts and service. The costs shown were obtained from suppliers in Addis Ababa. When the order is placed, some of the prices may be different from those shown, and if the equipment is ordered from one supplier the total cost could be appreciably lower.

[b] The "optimum" cost column figures reflect stand-by equipment, and that will allow for expansions of seed farm hectarage. Proper operation of a seed farm requires more equipment than a conventional farm operation; timing is of utmost importance.

[c] The "maximum" cost column reflects a supply of equipment that could operate a 400 ha seed farm with unusually competent machine operators and overall management. There would be a minimum of stand-by equipment and essentially no opportunity for expansion if timeliness was maintained.

[d] The self-propelled combine should be considered optional for both columns. The combine will not be used for either maize or haricot bean seed. Large-scale seed production of barley, wheat, soybeans and possibly teff would require serious consideration of the combine.

TABLE A-8. BUILDINGS FOR SEED FARM, SEED PROCESSING, AND SEED STORAGE a/

Building - Use	Area	Eth. $/m^2	Eth. $ Cost
Agronomist-Foreman:			
House	80m^2	200	22,000
Servant's Quarters	30m^2		
Farm-Foreman:			
House	80m^2	200	22,000
Servant's Quarters	30m^2		
Subordinate Staff:			
8 units, 30m^2 each	240m^2	130	31,200
Machine Storage:			
6m x 36m	216m^2	160	34,560
Repair Shop:			
9m x 9m	81m^2	180	14,580
Total			124,340
Seed Processing Unit:			
Processing Building	195m^2	180	35,100
Seed Dryer	32m^2	150	4,800
Seed Storage:			
Seed Storage	415m^2	200	83,000
Office (7m x 15m)	105m^2	200	21,000
Total			143,900
TOTAL BUILDING COST			268,240

a/ The building costs shown in Table A-8 are based on average costs in the Addis Ababa area. We believe that more accurate and lower cost figures will be obtained when the contract for the buildings is put out for bid.

TABLE A-9. SEED PROCESSING EQUIPMENT a/

Equipment and Size b/	Quantity	Cost New
		Eth. $
Maize Sheller (Max. capacity 200q/hr)	1	3,750
Grain Dryer - automatic controls	1	6,500
Seed Cleaner and Extra Sieves	1	5,800
Seed Treater (Max, capacity 150q/hr)	1	4,000
Seed Grader (Burrows No. 75, 20q/hr)	1	2,000
Automatic Scale and Bagger	1	700
Metal Elevator (6m, enclosed w/movable discharge)	1	10,000
Portable 6m Metal Elevator	2	4,000
Portable Inclined 16m Elevator	1	3,500
Fork Lift (5m lift, diesel power, hydraulic) c/	1	17,000
Office Equipment		3,500
Miscellaneous Supplies and Equipment (incl. moisture meter) d/		20,000
Generating Plant (18.5 kw)		8,500
TOTAL		89,250

a/ The equipment shown would be considered optimum, and the total costs can usually be reduced by ordering from a single supplier.

b/ Before an order is placed, an attempt will be made to coordinate equipment, size, and capacity. Building design will determine elevating equipment needed.

c/ As long as labor costs remain low, the need for the fork lift is doubtful.

d/ Suitable moisture meters will range in price from Eth. $1,000 to Eth. $2,000.

TABLE A-10. RECOMMENDED ANNUAL AMORTIZATION

Item	Eth. $
Building Depreciation (20-year basis)	
Building cost, Eth. $268,240	
Depreciation, 5 percent/yr	13,412
Farm Machinery (4-year basis)	
Machinery cost, Eth. $188,200	
Depreciation, 25 percent	47,050
Generating Plant (4-year basis)	
Generator cost, Eth. $17,000	
Depreciation, 25 percent	4,250
Processing Equipment (20-year basis)	
Equipment cost, Eth. $80,700	
Depreciation, 5 percent	4,035
TOTAL ANNUAL AMORTIZATION	68,747

[illegible]

[illegible] OF THE [illegible] PROGRAMS ON [illegible]

APPENDIX B

Attempting to project trends and demand for products in Ethiopia becomes almost entirely a matter of judgment. There is essentially no suitable historical base to draw on, there are no satisfactory bench marks; and there is no other country similar to Ethiopia.

The following assumptions were used as "best judgments" in developing the projected hectarage of crops and demand for improved seed. We believe the assumptions are realistic.

A. Haricot Beans

1. Hectarage shown in Table 2 is the estimated total for the Empire assuming a Pulse Development program.

2. Total seed needs assume a seeding rate of 70 kg/ha for all hectares planted.

3. Improved seed demand assumes a seeding rate of 60 kg/ha and seed planted will be improved seed, because there was no other suitable seed available in 1971. By the third year, farmers will begin to save their own seed and will repurchase not more than once each 4 years. To take this into account, the improved seed needs are reduced by 10 percent 1975, 15 percent in 1976, 20 percent in 1977, and 25 percent each year thereafter. It is possible that this improved "seed demand" is overestimated by 10 to 20 percent, even though hectarage continues to increase.

4. The Minimum Package areas are not expected to require significant amounts of haricot bean seed in the foreseeable future, so requirements are not identified separately.

B. Maize

1. It is assumed that farmers are responsive to prices and maize will not sell above Eth. $12/q over the next 10 years. Yields will continue to improve; therefore, with minor increases in hectarage, total production will still increase and keep pressure on prices.

2. It is assumed that production technology will be improved and seeding rate will be reduced to 25 kg/ha by 1978. This reduced seeding rate will, of course, be gradual, but it is shown in 1978.

3. The affects of the Minimum Package Programs on improved seed demand are projected as follows:

	1973	1974	1975	1976	1977
Number of "Effective Packages"	20	25	30	35	40
Quintals of Seed/Area	25	30	35	40	45
Improved Seed Demand, mt	50	75	105	140	180

The rate of establishment for effective, functioning Minimum Package areas is assumed to be 5 per year. This is roughly 50 percent of the scheduled rate. It is doubtful if the projected "package" establishment rate will be maintained after 1976. Farmers will also save their own seed. Experience, Incorporated would project not more than 150 to 180 metric tons of improved seed maize seed demand among Minimum Package farmers within the next 10 years.

C. Barley

1. We assume that barley yields will improve slowly and be more than 10 percent higher by 1978. This yield increase will satisfy both the "feed" and "malting" barley requirements to 1978.

2. We assume that the IEG is concerned about its balance of payments and will cause a malt plant to be established by 1978. This will result in an immediate increase in need for improved seed to plant 2,000 hectares in 1978, 4,000 hectares in 1979, and 6,000 hectares in 1980. The average yields of malting barley are estimated at 15 q/ha.

3. The only anticipated improved seed needs, beyond the malting barley, will be generated by the Minimum Package Program. No measurable increase in seed requirements, due to the Minimum Package activities, is expected after 1977.

The effects of the Minimum Package Program efforts for improved barley seed are projected as follows:

	1973	1974	1975	1976	1977
Number of "Effective" Minimum Package Areas	20	25	30	35	40
Quintals of Seed/Area	10	15	20	20	20
Improved Seed Demand, mt	20	37	60	70	80

4. We project a slowly decreasing hectarage in barley over the 10-year period.

D. Sorghum

1. The Experience, Incorporated team believes that sorghum hectarage will increase over the next 10 years. The increase will come largely from

the assumed development of short-stalked improved varieties, which will adapt to mechanization in the developing lowlands of Ethiopia.

2. Seeding rates at the present time are assumed to be 25 kg/ha among peasant farmers. We assume that farmers will adopt improved cultural practices, and that improved varieties will become available. Seeding rates will be reduced to 20 kg/ha by 1978.

3. The Experience, Incorporated team believes that the demand for improved sorghum seed will be entirely dependent on the identification of new superior varieties. It is assumed that some will be available by 1978. We also assume that farmers may purchase seed only once in 4 years.

4. As improved varieties of tall sorghum are unlikely in the near term, we have not shown the influence of the Minimum Package areas on seed movement.

E. Wheat

1. We believe that wheat hectarage will increase over the next 10 years in response to anticipated strong prices reflecting needs of the Empire.

2. Seeding rates among peasant farmers are assumed to be 150 kg/ha, which will continue until 1978. We assume, starting in 1978, seeding rates will be reduced each 3 years by 10 kg/ha to a minimum level of 130 kg/ha. This reduction will be due to improved cultural practices and improved varieties.

3. Seeding rates for improved seed will be limited to 125 kg/ha when germination is at least 85 percent. We assume that farmers will purchase new seed only once each 4 years, except in the case of severe disease or introduction of an unusually better variety.

4. We assume that by 1979 durum wheat will have achieved an export status. This will result in a small increase in hectarage and an increase in demand for improved seed. Projected improved seed needs are shown in Table 2.

F. Teff

1. We assume that some increase in production of teff will be required to meet market demand. Increased yields are expected to meet this requirement.

2. We do not believe that hectarage of teff will increase in the next 10 years--it may decline.

3. Due to difficulty in selection and breeding of teff, we consider the probability of improved strains or varieties of teff to be very low. For this reason, no estimate of improved seed needs is made.

APPENDIX C

ESTIMATED FUNDING

APPENDIX C

Tables C-1 and C-2 summarize the time-phased funding for the three seed production and processing facilities that will start up after the Awasa pilot units. The funding for each facility is assumed to be the same but will start in different years.

Table C-3 shows the estimated power, machinery and labor costs for an "optimum machinery investment" farming operation. These figures would be somewhat comparable to costs in the United States if it were possible to produce corn and beans in the same growing season on the same land in that country.

Table C-4 shows the estimated costs of producing maize, beans and wheat under the seed farm situation funded for Awasa in Table 8. This information was developed as a guide for negotiating with potential contract seed growers. The administrative and land use costs are not normally considered as costs by farmers. They are, however, real, but not "out-of-pocket" cash costs.

Table C-5 shows the estimated costs of processing improved seed of maize, beans and wheat with the seed processing facilities funded in Table 9 and detailed in Tables A-8 and A-9. This information was developed for guidance of private investors in seed processing facilities. We believe these costs are reasonable and include most costs that would normally be incurred in preparing improved seed for sale.

Table C-6 shows the marketing costs that would likely be incurred by a company selling improved maize seed with a volume of 4,000 quintals per year. We see no reason why other packaged seed would have different selling costs. These figures have been compared with costs of companies selling seed in Ethiopia and they are considered a reasonable estimate. Government bodies and cooperatives might choose to subsidize this cost in one or more ways, but the costs still exist. This information was generated for guidance of private and public organizations that may be interested in selling improved seed.

Table C-7 shows the summary of costs from the previous three tables. The marketing and distribution costs may vary from these figures, but they are guideline estimates of the cost farmers will be required to pay for improved seed produced, processed and sold in Ethiopia.

TABLE C-1. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF - 3 SEED FARMS - TIME PHASED

Year	Salaries & Allowances	Maintenance	Total	Salaries & Allowances	Maintenance	Total	Salaries & Allowances	Maintenance	Total
	Nazaret			Alemaya-Dire Dawa			Alamata		
				(Eth. $)					
1976	20,400	200	20,600[a]						
1977	40,600	200	40,800[a]	20,400	200	20,600[a]			
1978	42,700	200	42,900	40,600	200	40,800[a]	20,400	200	20,600[a]
1979	44,800	200	45,000	42,700	200	42,900	40,600	200	40,800[a]
1980	47,000	200	47,200	44,800	200	45,000	42,700	200	42,900
1981	49,400	200	49,600	47,000	200	47,200	44,800	200	45,000
1982	51,800	200	52,000	49,400	200	49,600	47,000	200	47,200
1983	54,400	200	54,600	51,800	200	52,000	49,400	200	49,600
1984	57,200	200	57,400	54,400	200	54,600	51,800	200	52,000
1985	60,000	200	60,200	57,200	200	57,400	54,400	200	54,600
1986				60,000	200	60,200	57,200	200	57,400
1987							60,000	200	60,200
Totals	468,300	2,000	470,300	468,300	2,000	470,300	468,300	2,000	470,300

a/ Only the funding for the initial two years of operation is considered a "cost" to the seed improvement project. After the first two years the seed farms are to be self-supporting.

TABLE C-2. ESTIMATED FUNDING REQUIRED FOR THE ETHIOPIAN STAFF - 3 PROCESSING PLANTS - TIME PHASED

Year	Salaries & Allowances	Maintenance	Total	Salaries & Allowances	Maintenance	Total	Salaries & Allowances	Maintenance	Total
	Nazaret			Alemaya-Dire Dawa			Alamata		
				(Eth. $)					
1976	24,000	7,900	31,900[a]						
1977	31,200	400	31,600[a]	24,000	7,900	31,900[a]			
1978	32,800	400	33,200	31,200	400	31,600[a]	24,000	7,900	31,900[a]
1979	34,400	400	34,800	32,800	400	33,200	31,200	400	31,600[a]
1980	36,100	7,900	44,000	34,400	400	34,800	32,800	400	33,200
1981	38,000	400	38,400	36,100	7,900	44,000	34,400	400	34,800
1982	39,800	400	40,200	38,000	400	38,400	36,100	7,900	44,000
1983	41,800	400	42,200	39,800	400	40,200	38,000	400	38,400
1984	43,900	7,900	51,800	41,800	400	42,200	39,800	400	40,200
1985	46,100	400	46,500	43,900	7,900	51,800	41,800	400	42,200
1986				46,100	400	46,500	43,900	7,900	51,800
1987							46,100	400	46,500
Totals	368,100	26,500	394,600	368,100	26,500	394,600	368,100	26,500	394,600

[a] Only the funding for the initial two years of operation is considered to be a "cost" to the seed improvement project. After the first two years, the processing plants are considered to be self-supporting.

TABLE C-3. ESTIMATED POWER, MACHINERY AND LABOR COSTS FOR PRODUCING MAIZE AND BEANS. (400 HECTARE FARM) - (OPTIMUM MACHINERY)

Cost Item	Annual Costs	Maize	Beans
	(Eth. $)	(Eth. $/quintal)	
Tractor Costs:			
Fixed or Overhead	15,140		
Fuel, Oil, Grease	22,500		
Total Tractor Costs	37,640	0.78	2.35
Combine Costs:			
Fixed or Overhead	15,840		
Fuel, Oil, Grease	1,710		
Total Combine Costs	17,550	0.38	1.96
Other Machinery Total	13,250	0.27	0.83
Labor Total	20,000	0.42	1.26
TOTAL	88,440	1.85	6.40

The costs shown here would fit a 40 ha situation with irrigation or one with highly favorable "small" rains. Yields are assumed as 60 q/ha for maize and 20 q/ha for haricot beans, with costs divided equally between the two crops. The total costs to farmgate with a optimum machinery assumption would be somewhat less for beans than for maize. These production costs would result in "export" prices.

TABLE C-4. ESTIMATED COST OF PRODUCING IMPROVED SEED[a] OF MAIZE, BEANS AND WHEAT.[b]

Cost Item	Maize	Beans	Wheat
		(Eth. $/quintal)	
Foundation Seed[c]	1.25	(60kg/ha) 2.40	(125kg/ha) 2.50
Fertilizer	(1qDAP+1q Urea/ha) 1.70	(75 kg/haDAP) 1.43	(1q/haDAP) 1.90
Field Tractors	.78	1.56	1.00
Combine	1.38	1.38	1.38
Other Machinery	.27	.54	.40
Labor (field workers)	.50	1.00	1.00
Transport (field to processing plant)	.42	.42	.42
Administrative Cost	2.60	5.20	5.20
Depreciation (all buildings)	.42	.84	.84
Land Use	1.90	3.80	3.80
Miscellaneous (repair, insurance and other operating cost)	.50	1.00	1.00
Total Cost	11.72	19.57	19.44
Profit for Producer - 20%	2.34	3.91	3.88
Costs of improved seed delivered to seed plant	14.06	23.48	23.32

[a] The per quintal cost estimates for maize, beans and wheat are based on 8,000 quintals of maize, 2,000 quintals of beans, and 2,000 quintals of total yields.

[b] Cost per hectare for maize, beans and wheat can be estimated by multiplying Eth. $/q by yield of 40, 20 and 20 per quintal respectively.

[c] Cost estimated at Eth. $200, Eth. $80 and Eth. $40 per quintal for maize, beans and wheat respectively.

TABLE C-5. ESTIMATED COST OF PROCESSING IMPROVED SEED[a] OF MAIZE, BEANS AND WHEAT.

Cost Item	Maize	Beans	Wheat
		(Eth. $/quintal)	
Unloading and loading at plant	.10	.10	.10
Cleaning costs (to include removal of inert matter and foreign material and unsalable seed)	.20	.20	.20
Packaging			
50 kg double bags	5.00	2.50	2.50
Treatment, Thread, Tags	.50	.10	.10
Common Labor	.10	.10	.10
Storage (pre and post-processing including insect control)	.15	.15	.15
Transport - handling to other warehouses	.25	.25	.25
Administration, Foreman and Subordinate Staff	1.80	1.80	1.80
Depreciation (buildings and equipment)	.90	.90	.90
Miscellaneous (repair, insurance and other)	.50	.50	.50
Total Cost	9.50	6.60	6.60
Profit to owner and operator of plant - 20%	1.90	1.32	1.32
Total Processing Cost	11.40	7.92	7.92

[a] Cost estimates are based on 8,000 quintals of improved maize, 2,000 quintals of improved beans, and 2,000 quintals of improved wheat seed.

TABLE C-6. ESTIMATED COSTS OF MARKETING MAIZE[a/]

Cost item		Eth. $/quintal
Seed Division:		
Manager (1/4 share)	$16,000	1.00
Sales Department:		
Manager	$14,000	
Two Assistants @ $8,000 each	16,000	
Materials	6,000	
Total Dept. Expense (1/3 share)	$36,000	3.00
Technical Service Department:		
Manager	$12,000	
Three Assistants @ $8,000 each	24,000	
Demonstration Plot costs (printing, education, meetings, etc.)	12,000	
Total Dept. Expense (1/3 share)	$48,000	4.00
Travel Expense for Sales and Technical Service Group (car, lodging, meals, etc.)		
Total Dept. Expense (1/3 share)	$24,000	2.00
Office Expense (estimated share)		2.00
Transportation (seed to dealer points and branches)		2.00
Dealer Allowance or Branch Office Sales Cost		6.00
Total Cost		20.00
Profit (calculated at 20%)		4.00
TOTAL MARKETING COST		24.00

a/ Based on 4,000 q sales. Costs of marketing other improved seed would be similar but somewhat lower for large quantity purchases.

TABLE C-7. ESTIMATED RETAIL PRICE PER QUINTAL OF IMPROVED SEED

Cost Item	Maize	Beans	Wheat
	----------	Eth. $/quintal	---------
Field Production Cost	14.06	23.48	23.32
Processing Cost	11.40	7.92	7.92
Marketing and Distribution Cost	24.00	24.00	24.00
Retail Price Per Quintal	49.46	55.40[a]	55.24[a]

[a] Based upon marketing cost for maize.

Because of the quintal seed volume used per hectare for beans and wheat, the seller will sell more seed to each customer compared to maize; therefore, the selling price should be less.

APPENDIX D

NOTES FROM PREVIOUS SEED PROGRAM STUDIES

APPENDIX D

Use of improved crop varieties, better seed quality, and adoption of proven agronomic practices are accepted "working tools" for agriculture in developing nations. It is reasonable that there should be high interest in these considerations for increasing agricultural production. Developed nations obtain crop yields ranging up to more than 10 times those obtained in less developed countries.

At least three previous attempts have been made to provide guidance to the IEG, relating to methods for improving crop varieties and seed quality in the Empire. The first study was conducted in the early 1960's. The results were never made available to the IEG, and no information is available regarding the conclusions.

A second study was conducted in 1968 by Dr. W.P. Feistritzer and Mr. F. Pinto under the auspices of the FAO. Only a draft report was prepared, and apparently it was never presented to the IEG. This report, entitled "Cereal Seed Statistics - Ethiopia, 1968" dealt with cereal seeds and seed testing laboratory statistics existing at that time. Recommendations in that draft report are as appropriate in 1972 as when the study was made. Implementation plans were lacking, however. The following are recommendations from the report:

1. Encourage existing or establish new activities in plant breeding research, especially with regard to development of superior new varieties.

2. Encourage existing or establish new activities on agronomic research (development of new methods of cultivation, fertilization, irrigation, harvesting, etc.).

3. Select areas suitable for seed multiplication.

4. Arrange with progressive growers for the production of quality seed of improved varieties.

5. Develop or strengthen services for the control of weeds, diseases and insect pests in seed crops.

6. Develop or strengthen services for seed certification including field inspection, seed testing, sampling, and labeling of seed containers.

7. Develop minimum seed certification standards.

8. Develop or improve facilities for processing, treatment and storage of seed.

9. Encourage and strengthen agencies for the distribution of seed.

10. Prepare new laws and regulations pertaining to seed production and seed trade.

11. Collect and publish seed statistics, such as seed needs, seed consumption, quantities produced, certified, imported, exported, etc.

12. Assist the agricultural extension service, associated farmer, farm women, and youth clubs to organize a campaign to educate farmers to use quality seed of improved varieties and to adopt improved cultivation methods.

The study reported that the country's estimated seed needs during 1967-68 were 128,600 metric tons of wheat; 41,400 metric tons of maize; and 67,600 metric tons of sorghum.

The report also showed that wheat grain imported averaged Eth. $19.27 per quintal and wheat flour averaged Eth. $27.51 per quintal. At that time, these prices were lower than the average price of locally produced products, indicating insufficient domestic production.

No seed laws or regulations existed at that time. Cereal breeding was being conducted at the following locations:

1. IAR - Holetta (barley, wheat, teff).

2. Debre Zeit Agricultural Experiment Station (wheat, teff, sorghum).

3. Ethio-German Agricultural Experiment Station, Bako (maize, sorghum, teff, wheat and barley).

4. Paradise Experiment Station, Asmara (wheat, barley, sorghum, millet and teff).

5. College of Agriculture, HSIU, Alemaya (sorghum, millet, wheat, barley and teff).

6. CADU- Kalumsa(various cereals, oilseed crops and pulses).

7. Awasa Agro-Industrial Development Center, Awasa (maize, pepper, wheat, oilseed crops and pulses).

Seed testing, probably only germination tests, was being carried out on a limited basis at the experiment stations at Debre Zeit, Holetta, Bako, Alemaya and Awasa. Equipment available appeared neither adequate nor much used except at Kalumsa. Holetta and Bako facilities were established after 1968.

It would appear unfortunate that this report was never widely circulated. The conclusions and recommendations were obviously made by someone with an understanding of the problems and need for a seed improvement program in Ethiopia.

A third study was conducted in 1970 by A. Forbes and R. Roberts for the FAO. The report, in draft form, was prepared under the number DDC 3/70 ETH., dated October 7, 1970. This report dealt with a proposal for a "Certified Seed Scheme", but apparently a final report was not prepared, or at least not presented to the Ministry of Agriculture.

This report estimated that wheat seed requirements by 1975 would be 2,164 metric tons; teff, 354 metric tons; and maize, 296 metric tons. These estimates have proven to be conservative.

The proposed project was to be organized through three main agencies:

1. The Institute of Agricultural Research would be responsible for producing the improved varieties of different crops.

2. A Seed Inspection and Certification Service would be estimated in the Plant Production and Protection Division of the Ministry of Agriculture, which would implement the new "Seed Ordinance".

3. A company (CERES) which could deal with the commercial multiplication and distribution of the basic seed supplied by IAR and certified by the Seed Certification Service of the Plant Production and Protection Division.

The project costs were estimated at US $1,400,500 for a 5-year period, foreign exchange cost at about US $0.67 million and the project's annual sales after 5 years were estimated at Eth. $1.0 million. Internal rate of return to the economy was estimated at 24 percent.

It is not known why this proposal was not formalized, but it is known that FAO remains interested in participating in the implementation of this or a similar scheme.