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REPORT NO. II

THE FEASIBILITY OF PRODUCING CEREAL GRAIN CROPS FOR EXPORT MARKETS

PART A The Feasibility of Producing Durum Wheat for Domestic and Export Markets

PART B Domestic and Potential Export Marketing of Malting Barley

PART C Reconnaissance Survey of Maize, Barley, and Sorghum Production in Ethiopia and Potential Export Markets

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:

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

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

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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.

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* Part C was originally issued in December, 1971, as "Production and Marketing of Pulse Crops in Ethiopia", Experience, Incorporated.

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I. SUMMARY AND RECOMMENDATIONS

For several years, Ethiopia has not produced enough wheat to meet its domestic needs. As a result, we expect "bread" wheat prices to be import-oriented until domestic production meets demand.

The only research done on durum wheat in Africa and the Near East has been screening for disease resistance. There are no superior day-length, insensitive, disease-resistant varieties available to Ethiopia.

Exporting durum nations, including Argentina, Canada and the United States, are supplying the European market at a price without a significant premium above the hard winter and spring wheat.

Based on these points and others discussed in this report, Experience, Incorporated recommends that:

1. Screening research for adaptation and yield be initiated at Kalumsa, Alamata and Eritrian stations. Domestic varieties and strains and likely candidates from the world collection of durum wheat should be included in the study.

2. Ethiopia explore, with Italy, trade opportunities in durum wheat to determine whether Ethiopian durum, if produced, could compete with other nations at world prices.

3. Ethiopia explore, with Italy, the possibility of establishing manufacturing facilities for macaroni products, made from domestic durum wheat, in Ethiopia.

4. Ethiopia not consider producing durum wheat until research has shown opportunities for the crop.

II. INTRODUCTION

Durum wheat is believed to have originated in the Near or Middle East as a result of an accumulation of mutations from the wild emmer-type wheat. The emmer-type wheat was taken into cultivation about 8,000 BC, but durum, as we know it, did not appear in Egypt until after 300 BC. Additional research may show it was actually grown much earlier.

The specific qualities of durum wheat currently considered as important were of little concern until fairly recently. Drought tolerance and relatively favorable production under adverse environmental conditions were its early attributes. These attributes still persist, but utilization and yields of durum are the limiting factors on world production today.

Durum wheat is used primarily for pasta products including macaroni, spaghetti and noodles. The durum flour does not make a satisfactory bread product. Bread wheat flour can be used to make pasta products though such products are considered inferior. This limited use of durum wheat is a factor that must be considered before Ethiopia embarks on a production program.

Durum wheat of variable quality is now grown on a limited basis in the northern parts of Ethiopia, but this wheat does not get into commercial channels, nor is the quality or quantity suited for export purposes.

III. USES OF DURUM WHEAT

A. Products

Semolina and flour milled from amber durum wheat are uniquely adapted to the manufacture of macaroni, spaghetti and noodles. These products are similar and are often referred to under the generic name of macaroni or as pasta products or alimentary pastes. They differ mainly in shape and size and may be distinguished as follows:

Macaroni - hollow tubes of different diameters and lengths, made by extrusion. Various shapes such as "elbow macaroni" may be made. Some forms are stamped from a sheet of dough.

Spaghetti - solid rods of smaller diameter than macaroni.

Noodles - flat strips often made with the addition of egg solids.

Macaroni and spaghetti are made from semolina, a coarse granular product. Noodles are made from the flour. Durum wheat has a hard, vitreous endosperm and, therefore, gives the miller a higher yield of semolina than bread or soft wheat. Durum flour is a by-product of milling semolina and is preferred for noodles.

In North America and Western Europe the manufacturing of macaroni products is highly automated. Because the consumers and processors demand a specific quality of product, the specifications for semolina are exacting. All products are dried before marketing, and drying processes used are critical and expensive. In parts of Asia, the Near East and Africa, the processing of noodles and other pasta products is more simple and on a smaller-batch scale. Often the product is used "wet" or dried in the sun. Usually, whatever meal or flour available is used.

Italy, with 65 pounds, has by far the highest per capita consumption of macaroni products--roughly eight times more than the United States. Among potential importers, Libya, Switzerland, Tunisia, Portugal, Greece, Spain, and France all consume more than 12 pounds per capita yearly. The per capita consumption of pasta products is increasing both in Europe and in North America. No reliable figures are available for the Near East. Japan's use of noodles has increased during the past 5 years.

B. Substitution of Durum by Other Wheats

It has already been mentioned that amber durum wheat is preferred for use in all types of pasta products, especially macaroni and spaghetti. However, when durum is in short supply, premiums may be high, and spring or winter bread wheats are often substituted for or blended with durum semolina. Semihard or soft wheats are less desirable substitutes.

A greater range of flours can be used for noodles of all types, since egg solids and other ingredients may be added. Japan, for instance, uses some soft wheat. In the United States many of the soup manufacturers and others making canned and frozen products containing noodles use bread rather than durum because of the lower cost. The inclusion of a small amount of monoglyceride can minimize some of the disadvantages of hard or even soft wheat flours.

There are certain countries, such as Italy, where durum wheat must be used for pasta products. France also requires that macaroni products be made from durum wheat.

C. Firmness of Demand

If there is a scarcity of durum wheat domestically and imports are not available except at considerable premium, the next best quality and cheapest wheat will be used by the miller and processor. The premium that can be obtained for durum varies considerably with the standards of the miller, the processor and the consumer in different countries. On an average, a premium of 5¢ to 10¢ per bushel for the equivalent of US #3 Hard Amber Durum will be obtainable in Western Europe, based on consistent world supplies. This premium would be as high as 25¢ to 30¢ per bushel for No. 1 Hard Amber Durum. In the United States some processors of macaroni and spaghetti may pay 30¢ to 40¢ per bushel premium for durum before they blend or substitute other wheat. A number of factors such as supply, relative quality, and price affect the premium.

IV. THE WORLD DURUM WHEAT MARKET

A. Historical Production Patterns

Durum wheat production has increased about 25 percent in the past 5 years. The United States and Canada produce about 30 percent of the world's total; the Middle East about 25 percent; Europe 20 percent; and Algeria, Morocco, and Tunisia about 15 percent. Yields vary widely from 27 quintals per hectare in France and 21.5 in the United States, down to less than 8 quintals per hectare in North African countries.

Detailed production by principal areas is shown in Table 1.

TABLE 1. WORLD PRODUCTION DURUM WHEAT-1964/65 to 1969/70

Region & Country	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70 Provisio
			(in thousands of metric tons)			
Europe	2,200	2,700	2,600	3,500	3,100	3,500
France	62	92	127	221	303	339
Italy	1,462	1,948	1,675	2,573	2,130	2,650
Portugal	77	86	37	66	75	55
North America	2,770	2,365	2,480	2,360	3,945	5,155
Canada	915	460	773	550	1,236	2,259
USA	1,855	1,905	1,705	1,808	2,708	2,894
South America	703	419	516	532	475	695
Argentina	703	419	516	532	475	695
Near East Asia[a]	4,800	4,900	3,600	5,100	4,000	4,700
Syria	1,277	1,040	559	1,049	600	1,000
North Africa	2,300	2,450	1,900	2,030	3,110	2,350
Algeria	918	1,001	900	899	1,000	855
Morocco	889	1,009	615	850	1,775	1,192
Tunisia	350	420	300	240	310	220
Others	600	600	600	600	600	600
World (excluding centrally planned countries)	13,373	13,434	11,696	14,122	15,230	17,000

[a] Revised

SOURCE: International Wheat Council, London, England.

B. Historical Import-Export Patterns

Durum wheat and flour exports in 1960-64 crop years totaled 1,359,000 metric tons, or about 10 percent of world production. In 1967 trade increased to over 2,500,000 metric tons, which was over 20 percent of the world's production. Trade totaled about 13 percent of production in 1968 and 14 percent in 1969.

Principal exporters of durum and durum products are the United States, Canada, and Argentina. In recent years the United States accounted for about 50 percent of world exports; Canada about 25 percent; and Argentina about 20 percent.

Principal importers have been the Western European countries. European imports have generally totaled 70 to 80 percent of all world imports. France, West Germany and Italy are large importers of durum wheat, although at the same time they have been major producers. Italy in particular has had durum production from 2 million to 2.5 million tons, yet has been an importer of about one-half million to almost 1 million tons additionally.

Across the Mediterranean, South Algeria, Morocco, and Tunisia have been important producers with combined production reaching as high as 3 million tons, yet they have continued to import about 10 percent to satisfy domestic demands.

Details of exports and imports of durum and durum products for 1960-64, 1967, 1968, and 1969 are shown in Table 2.

C. Historical Durum Wheat Price Patterns

Durum wheat, which totals only about 5 percent of the world wheat production, is a specialty wheat used for the production of high quality pasta products such as spaghetti, macaroni, and noodles. It generally sells at premiums substantially higher than ordinary bread wheats, but more recently it has sold at about the same price.

The prices for 1962 to 1970 in the three principal exporting countries' ports of exit are shown in Tables 3 and 4. Prices are quoted in US dollars per bushel and Eth. dollars per metric ton.

Weekly offering prices, delivered Rotterdam, are shown in Table 5. Latest available quotation (April 12, 1972) on US #3 Hard Amber Durum delivered Rotterdam was $1.82 per bushel. It is important to note that #2 Hard Winter 13.5 percent protein was quoted at $1.80 per bushel and #2 Dark Northern Spring 14 percent protein was quoted at $1.89 while 15 percent protein was $1.97 per bushel.

TABLE 2. DURUM WHEAT AND FLOUR EXPORTS[a] SOURCE AND PRIMARY DESTINATION

Destination	Argentina	Canada	EEC	US	Others	Total
	August/July 1966/67 (1,000 mt)					
Europe	377	544	18	762	90	1,791
EEC	332	336	4	447	90	1,209
France	54	13	-	219	88	374
Germany	5	247	-	117	-	369
Italy	219	56	4	73	2	354
Others	76	226	12	347	-	661
USSR	5	122	-	-	-	127
N&C America	-	3	-	7	-	10
South America	-	1	-	22	-	23
Asia	-	59	1	75	8	143
Africa	21	1	15	327	67	431
WORLD	403	730	34	1,193	165	2,525
	August/July 1967/68					
Europe	389	293	38	466	109	1,275
EEC	364	172	20	387	109	1,032
France	31	3	-	221	83	338
Germany	-	90	7	57	-	154
Italy	319	28	10	88	26	471
Others	37	171	19	96	-	322
USSR	-	28	-	-	-	28
N&C America	-	2	-	15	-	17
South America	-	2	-	33	-	35
Asia	-	10	9	15	4	38
Africa	17	13	2	309	70	411
WORLD	406	348	30	838	183	1,805
	August/July 1968/69					
Europe	318	473	10	867	74	1,742
EEC	316	349	-	808	56	1,530
France	-	54	-	206	-	351
Germany	-	116	-	105	-	221
Italy	309	163	-	352	-	824
Others	9	139	9	113	18	288
USSR	-	15	-	-	-	15
N&C America	-	2	-	43	-	45
South America	-	-	-	38	-	38
Asia	-	19	5	11	-	35
Africa	12	19	-	270	-	302
WORLD	330	528	15	1,230	73	2,177

a/ Based on the records kept by the International Wheat Council.
SOURCE: International Wheat Council, London, England.

TABLE 3. DURUM WHEAT EXPORT PRICES:[a] ARGENTINA, CANADA, AND USA - Yearly 1962/63 to 1968/69

Crop Year	Argentina Candeal Taganrog fob Up River		Canada No 1 CW Amber In Store Ft William/ Pt Arthur		Canada No 1 CW Amber In Store Van-Couver		United States No 3 Hard Amber fob Lakes		United States No 3 Hard Amber fob Gulf	
	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt
1962/63 (Aug/July)	1.84	169	2.40	220	--	--	2.41[b]	221[b]	2.39[b]	219[b]
1963/64 (Aug/July)	1.84	169	2.40	220	--	--	1.81[b]	166[b]	1.93[b]	177[b]
1964/65 (Aug/July)	1.54	141	1.84	169	1.83	168	1.70[b]	156[b]	1.83	168
1965/66 (Aug/July)	1.56	143	1.85	169	1.92	176	1.62	148	1.68	154
1966/67 (Aug/July)	1.76	161	2.09	191	2.14	195	1.91	175	2.09	191
1967/68 (Aug/June)	1.74	159	2.00	183	2.04	187	1.89	173	1.96	180
1968/69 (July/June)	1.93	177[c]	2.04	187[d]	2.03	186[d]	1.80	165	1.97	180

a/ Based on reports by member exporting countries.
b/ No. 2 grade.
c/ From July 1968 prices for European destinations
d/ From July 1968 prices on fob basis.

SOURCE: International Wheat Council, London, England.

TABLE 4. DURUM WHEAT EXPORT PRICES:[a] ARGENTINA, CANADA, AND USA - Monthly, July 1968 to February 1970

Crop Year & Month	Argentina Candeal Taganrog fob Up River		Canada No 1 CW Amber In Store Ft William/ Pt Arthur		Canada No 1 CW Amber In Store Vancouver		United States No 3 Hard Amber fob Lakes		United States No 3 Hard Amber fob Gulf	
	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt	US$ per bu	Eth. $ per mt
1968/69 July	1.92[b]	176[b]	1.96[c]	180[c]	1.98[c]	181[c]	1.82	167	2.03	186
August	1.91	175	1.97	180	1.98	181	1.78	163	2.06	189
September	1.88	172	1.97	180	1.98	181	1.79	164	1.96	180
October	2.01	184	2.00	183	2.01	184	1.82	167	--	--
November	1.79	164	2.04	187	2.05	188	--	--	--	--
December	1.85	169	2.04	187	2.05	188	--	--	1.96	180
January	1.88	172	2.04	187	2.05	188	--	--	1.94	178
February	1.91	175	2.04	187	2.05	188	--	--	1.94	178
March	1.98	181	2.07	190	2.05	188	1.83	167	1.89	173
April	2.05	188	2.10	192	2.05	188	1.79	164	1.94	177
May	2.05	188	2.10	192	2.05	188	1.79	164	2.00	183
June	--	--	2.10	192	2.05	188	1.79	164	--	--
1969/70 July	--	--	2.07	190	2.03	186	1.83	168	--	--
August	--	--	1.99	182	1.95	179	1.80	165	--	--
September	--	--	1.96	180	1.94	178	1.77	162	--	--
October	1.86	170	1.93	177	1.92	176	--	--	1.78	163
November	1.80	165	1.89	173	1.89	173	--	--	1.74	160
December	1.77	162	1.88	172	1.87	171	--	--	1.73	158
January	1.70	156	1.86	170	1.86	170	--	--	1.71	156
February	1.68	154	1.85	169	1.84	169	--	--	1.68	154

a/ Based on reports by member exporting countries.
b/ From July 1968 prices for European destinations.
c/ From July 1968 prices on fob basis.
SOURCE: International Wheat Council, London, England.

TABLE 5. WEEKLY OFFERING PRICES DELIVERED ROTTERDAM
US #3 HARD AMBER DURUM

(US$ per bushel)

	1970					1971				
July	1.82	1.82	1.84	1.83		1.80	1.82	1.80	1.79	
August	1.79	1.81	1.88	1.88		1.80	1.78	1.82	1.81	
September	1.88	1.92	2.01	2.01		1.81	1.81	1.78	1.75	
October	2.02	2.04	2.05	2.05		1.73	1.74	1.80	1.80	
November	1.90	2.01	1.97	2.01		1.79	1.83	1.80	1.80	
December	2.03	2.03	2.03	2.01	2.01	1.81	1.81	1.81	1.83	1.85

	1971					1972				
January	2.01	2.03	2.03	2.03		1.81	1.82	1.82	1.82	
February	2.03	2.01	2.01	2.01		1.82	1.82	1.82	1.81	
March	2.01	2.01	2.01	2.00	1.91	1.81	1.78	1.83	1.86	1.86
April	Not Available									
May	Not Available									
June	Not Available									

Canadian No. 1 CWRS 14 was quoted at $1.98 and USSR SKS 14 was $1.86 per bushel--all delivered Rotterdam basis. In addition to the basic wheat price, the EEC adds levies on bread wheat of $1.68 per bushel. The import levy on durum, however, was $1.76 per bushel, or $64.80 per metric ton. The durum levy is separate from the bread wheat levy. The levy for Italy is the same as the levy for other EEC countries.

At times, the EEC duty is determined by the price of US durum wheat, with durums from Canada and Argentina priced above or below the basic price. At other times, the EEC duty is determined by durum prices from other exporting countries and US durum price may be above or below this basic price.

In addition to the levy, carrying charges are assessed from time to time for deferred delivery positions. On April 12, 1972, the monthly import levy carrying charge was $1.15 per metric ton--equal to 3.1 cents per bushel monthly.

V. TECHNICAL ASPECTS OF DURUM WHEAT

A. Genetic Characteristics

Durum wheat (Triticum durum) is a preferred raw material for the manufacture of macaroni products. The desirable characteristics of this wheat include the hard vitreous grain, an amber, golden-yellow color, and a cooked product firmness. Almost any hard wheat flour can be used in the manufacture of macaroni products, but durum is much preferred because it yields more of the granular semolina,which makes the desired firmness.

The vitreous character of durum is genetically controlled, but can be altered by environment.

The yellow cartenoid pigments so desirable in durum wheat are also genetically controlled, but the color intensity can be altered by environment. This yellow color is generally accepted in the export market as the single most important quality property of durum wheat.

Durum wheat tends to have a higher protein content than most bread wheats and is definitely higher than soft wheats. Protein levels are genetically controlled, but can be sharply altered by environmental condition. Protein is not an important quality factor by itself, but higher protein is related to gluten quality, which is important.

Lipoxidase, an enzyme contained in wheat, is genetically controlled. High lipoxidase in durum is undesirable because it causes destruction of the desired yellow color.

Until recently, durum wheat was among the most rust-resistant species. As new races of rust appeared, durum was severely attacked. Rust resistance or tolerance is a genetically controlled factor, but environment determines whether conditions are favorable for infection.

A generally accepted statement by plant breeders is that it is not so much the genetic character itself but the manner of reaction under a given set of environmental conditions that is inherited. Objectives of wheat breeding programs are: to develop varities that will reduce production hazards, to increase yields, and to produce qualities satisfactory for market demands. In the United States breeding emphasis is placed on yield and disease and insect resistance while maintaining acceptable quality. The Rockefeller Centro Internacional de Majoramiento de Maiz Y Trigo (CIMMYT) program in Mexico emphasized widespread adaptability and yield,with less attention to quality factors.

An effective wheat breeding program must be a cooperative venture between the breeders and the genetists, pathologists, entomologists, climatologists, chemists, statisticians, and others.

In Ethiopia a durum wheat improvement program must place high priority on quality, especially color and rust resistance. Ethiopia is interested in a specific export market even at the expense of highest yields. With limited personnel it seems advisable for the Ethiopian program to emphasize a variety screening program of the world collection rather than embark on a plant breeding program at this time. Identification of variety-environment interactions is the first essential step in determining if durum wheat can be grown competitively in Ethiopia.

B. Physical and Chemical Characteristics of Amber Durum Wheat

The quality factors that make durum wheat products so well suited for macaroni products are related to the demands of the miller, the processor of pasta products, and the consumer. Briefly, durum wheat is more desirable than bread wheat because of better semolia yields, better color, extensible gluten characteristics, and superior eating quality.

1. Gluten Characteristics and Cooking Quality

The main reason durum semolina is preferred for pasta products is because of the amount and physical properties of its gluten. When durum samples are tested, a small amount is milled on an experimental mill and the product tested visually for color and by washing out the gluten. The gluten must be extensible. When bread wheats are used to make macaroni or spaghetti, the product is often too "mushy" and there is more loss of starch in the cooking water. Macaroni and spaghetti should have a good "bite". This occurs only when the protein content is sufficiently high (over 13 percent) and the gluten is extensible.

Specifications established by the miller are based on his knowledge of the processors' requirements and are outlined in greater detail below.

2. Milling Specifications

The miller wants a durum wheat that satisfies his particular requirements as well as those of his customers, the macaroni and spaghetti processors.

Here are the main criteria of the durum buyer for the miller:

1. High test weight (weight per bushel) or grams per 1,000 kernels
2. Large and uniform kernel size
3. High percent of vitreous kernels

4. Low moisture
5. Low damage
6. Bright yellow color
7. Satisfactory gluten cooking qualities

a. Test weight, weight per 1,000 kernels, kernel size, and vitreousness. A high test weight, preferably over 59 lb per bu, (78.4 kg/hectoliter) or a high weight per 1,000 kernels indicates the yield of semolina, as does a large and uniform kernel size. In order to operate profitably the durum miller must obtain the maximum yield of the granular coarse product, called semolina. This is stock that goes through a #30 Tyler wire (about .02 inch sieve openings). A satisfactory durum grist will give 50-60 percent semolina, about 10-20 percent flour, and the balance feed. The milling of durum is more critical for granulation than the processing of bread wheat where all the endosperm is ground to flour passing at least a 100 mesh US standard sieve (about .006 inch openings). If some kernels are too small, they escape the break rolls. The greater the uniformity in size, the easier it is to obtain a good yield. Semolina is required for processing macaroni and spaghetti. Flour is used for noodles.

b. Moisture. As is true with all grains, storage is better with low moisture. This is especially true for durum because color decreases in storage if the moisture is high. A lower moisture also gives the miller a better yield.

c. Damage. Damage affects both milling and macaroni processing, most often because of poor color or poor gluten quality.

d. Bright yellow color. The most important single grading factor is color of semolina and the macaroni or pasta products made from it. The plant breeder, therefore, must provide durum varieties with the maximum yellow color. A dull, gray color may result from various forms of damage. Speckiness is likewise due to some forms of damage or to poor milling. The demand for a bright yellow color originated because the durum wheats that made the best macaroni happened to be more yellow than bread wheats. The color is a genetic factor of wheat and depends on the amount of yellow pigments (mainly xanthophylls) and the level of lipoxidase, an enzyme that can destroy the yellow color by oxidizing it. In screening selections of durum, the testing of pigment and lipoxidase content is essential.

C. Environmental Considerations

Wheat is among the most drought-resistant of cultivated crops. The wheat seedling is especially drought tolerant. This characteristic has important implications for the area north of Dese in Ethiopia where durum wheat production may be increased.

Wheat, as a plant, is considered to be a "weak" feeder on soil nutrients, but total demand is also lower than for more demanding crops such as maize. Wheat will grow well on soils ranging from quite acid to severely alkaline. It seldom responds to direct application of lime on acid soils. This tolerance to pH levels is an advantage in Ethiopia where pH levels in soils are so variable.

Wheat responds to levels of nitrogen as long as phosphorus levels are not limiting, and yields are increased with increased nitrogen levels up to +40 kg/ha. Organic matter content of soils and potential yield level de[illegible] ne necessary nitrogen additions.

eat is very sensitive to phosphorus deficiencies and it is not obtain high yields on phosphorus-deficient acid soils. Wheat phorus most in the early growth stages. Up to 75 percent horus uptake by wheat has been accumulated by the time ned 25 percent of its dry weight.

tive soil must be fertile, but must also possess a satisfactory [illegible]al co[illegible]n which affects air, water, and temperature relationships. If a satisfactory seed bed can be prepared, surface moisture in amounts to permit germination and early growth is essential. The success of the crop yield is frequently determined by subsoil moisture. Wheat grows well on high clay content soils as long as they are not waterlogged.

The weather in the area north from Dese is generally favorable for wheat production. Durum should grow especially well with yields usually limited by cultural practices rather than by soils and weather conditions.

D. Yields and Yield Deterrents

Wheat yields in Ethiopia tend to be quite low compared with other wheat producing and exporting nations. Farm yields of durum wheat range from as low as 12 quintals per hectare in Canada and the United States in unfavorable seasons to well over 25 quintals per hectare in favorable seasons. Farm yields in Ethiopia would range from 5 to 15 quintals per hectare. Experimental yields in all wheat producing nations have been well over 30 quintals per hectare,which shows that the potential is available for higher yields but one or more environmental factors limits yields. Durum is normally grown on less productive soils under less favorable environmental conditions.

There are numerous yield deterrents wherever durum is grown. Ethiopia has more than its share. Among the most serious are the following:

1. With the probable location for durum wheat production in the north central highlands, there may be a day-length problem (7-9° latitude) and a possible elevation problem (2,000-2,700 meters). Day-length, insensitive varieties are essential and only recently has serious breeding work been started on this factor.

2. Rust-resistance breeding on durum wheat has been considerably successful in many of the producing regions. Recent varieties developed in the United States and Canada have proven resistant to rust where tested, except in certain South American and most African countries. It is possible that the north central highlands of Ethiopia may not encounter serious rust problems.

3. Seed bed preparation and seeding methods for cereals are among the most primitive in the world. Continued lack of recognition of these essential elementary practices will continue to limit yields and probably quality of durum wheat.

4. Seed costs and seeding rates for large-seeded wheats are relatively high. This is a deterrent from using improved wheat varieties.

5. Average weather conditions, including rainfall in the north central highlands of Ethiopia, would be favorable for durum wheat production. Deviation below the average can result in short rainfall with resulting undesirable, small-size grain and low test weight. A careful analysis of weather conditions, with appropriate probability statements, should precede any durum wheat promotion program.

6. The problem of producing, and especially marketing, a uniformly high-quality durum wheat would be difficult in Ethiopia. Durum wheats of variable quality are already grown in this area. An exporter would have problems without a recognized grading system in the maintenance of quality identity and the establishment of a realistic premium.

Most of these problems could be overcome with an intensive educational effort and the payment of premiums for a high-quality product.

I. SUMMARY AND RECOMMENDATIONS

This study is directed toward a proposed new industry. The conclusions drawn and recommendations made are based on a choice of alternatives believed appropriate to Ethiopian conditions.

A. Handling and Marketing of Malting Barley Within Ethiopia

Experience, Incorporated recommends that:

1. A contract be entered into between grower and malting company, prior to planting, contract to specify the number of hectares to be planted, and tonnage and quality of barley to be produced, and price to be paid.

2. Improved seed of high quality and of a variety chosen by the malting company be supplied to growers each year; the seed to be provided at a reduced price to encourage its use and to assure good malting results.

3. Credit be extended to the growers at favorable rates as an additional inducement to produce malting barley, credit to be protected by a first claim against proceeds from sale of the crop.

4. The malting company facilitate or assure the availability of supplies and services needed by the controlled or contract producers.

5. The malting company provide a qualified field staff to assist growers with their farm management practices,including field training programs to be conducted to assist new growers and to disseminate timely new practices.

6. Grade specifications and accepted tolerances be used as a basis of consummating the sale of the malting barley.

7. There be an agreement on the place and time of delivery and type of container in which delivery will be made; if bags are required, enough clean and sanitary bags should be supplied by the malting company before harvest, at a reasonable rental charge.

8. Cleaning, drying and storage be the responsibility of the contractor; this service may be supplied by an approved organization or by the malting company, at a reasonable cost to the grower.

9. Purchase price be determined at time of contract signing, either as a stipulated price for the product delivered or at a specified premium above the prevailing barley market at a predetermined rate.

10. To alleviate the problems of marketing and quality control, initial production of malting barley in Ethiopia be restricted to one or two varieties and concentrated on larger farm units.

B. Feasibility of Exporting Malting Barley

The following points summarize the outlook for exporting malting barley from Ethiopia:

1. World trade in malt and malting barley is large. Export/import trade in malt exceeds 1 million tons annually and malting barley is estimated at 1 3/4 million tons.

2. There are 51 barley exporting countries and 78 importing countries. Europe and Japan are the largest importers.

3. Ethiopia should meet its domestic needs by substituting local malting barley for imports of malt and barley before it attempts to export. In order to export, it must also meet the price competition of very efficient producing countries.

4. To meet world competition, costs of production and marketing must be reduced drastically. Increased yields and sales to nearby countries offer most promise.

5. Prospective farmgate returns from malting barley exports, based on current prices in Europe and export marketing costs, are considerably below prevailing local prices of ordinary barley in Ethiopia.

6. The prospects are somewhat more favorable for malt exports to nearby markets in the Middle East and Africa. By exporting malt, Ethiopia may be able to improve the operating base of a local malt industry.

II. INTRODUCTION

This report is one of three segments in an overall study of the feasibility of developing a malting industry in Ethiopia. The principal motivating interest behind this study is the prospect of an import substitution opportunity that would improve the balance of payments situation of the Imperial Ethiopian Government (IEG).

The three segments of the overall report, which is expected to be released by the Technical Agency of the IEG, include:

1. Work by the Institute of Agricultural Research (IAR) to isolate and test strains and varieties of barley that can meet the requirements of maltsters.

2. This study by Experience, Incorporated to consider the domestic aspects of marketing malting barley and the prospects for export of the grain.

3. A study by the Technical Agency to determine (1) the design and size of malt house necessary to supply the needs of domestic breweries and (2) the feasibility of malt exports.

This particular study is identified in the series of four final reports prepared by Experience, Incorporated, of Minneapolis, Minnesota, as Part B of Report No. II "The Feasibility of Producing Cereal Grain Crops for Export Markets".

A. Objectives

There are two primary purposes of this study:

1. To determine the most suitable marketing methods to meet the needs of a possible malting barley industry in Ethiopia. (the recommendations will be limited to marketing and handling of malting barley between the grower and the malt house).

2. To examine the feasibility of exporting malting barley and malt from Ethiopia.

B. Background

Methods of marketing cereal grains are influenced by the nature of the product, size and location of producers and purchasers, volume of trade, and price and cost considerations.

Farmers in Ethiopia have no experience in producing or handling malting barley and are not familiar with the needs of the malting industry. In countries such as Denmark, Canada and the United States, farmers have been producing malting barley for many years. They are familiar with crop requirements that must be taught to Ethiopian farmers. To stimulate local production, it may be both necessary and desirable for the final purchaser of malting barley to provide educational and other assistance to farmers.

Malt used for brewing beer is simply germinated barley, and any good quality barley can be malted. However, very few varieties are well suited for controlled malt production. A collection of 1,500 barley varieties has been identified in Ethiopia and only six are considered to have suitable malting characteristics. Most barley produced in Ethiopia is used in making "talla", a home brew, or for food.

The quality of malting barley depends not only on variety but also on weather, soil types, and grade and amount of fertilizer used. These factors influence color, shape, plumpness, physical and chemical composition, and germination potential.

Quality varies so much in Denmark, for example, that producers who grow only one variety segregate their production into a number of separate quality categories for storage. Even where there are official grade designations, maltsters may insist on representative samples, name of the variety, name and location of producers, and time of harvest. They will even subject the barley to a number of tests to determine its malting capabilities.

Quality of barley influences malt quality, which in turn influences the quality and taste of the beer. The brewmaster determines the type and quality of malt he buys. Malt production may be integrated with the operation of the brewery when the volume of beer produced is large enough.

III. QUALITY AND TECHNICAL CONSIDERATIONS

A. Feed Barley

When barley is used for feed there are few quality problems. Protein content is most important and this may vary from 8 to 20 percent. As with most grains, the protein content varies each year, depending mainly on weather conditions, soil, and variety. A typical analysis (dry basis) of North American barley is:

Fat	2.0%
Fiber	6.0
Ash	3.0
Protein	13.0
Carbohydrates (mainly starch)	76.0

The feed manufacturer who uses a computer to evaluate ingredients often specifies the protein content of the barley he buys. For the other constituents he generally uses average figures.

B. Malting Barley

The barley used by the malting industries, particularly the brewer, commands a higher market price and has much more stringent quality standards. Before barley can be used by the brewer, it must be germinated to make malt.

Barley is particularly well adapted to germination because it is one of the few grains where the outer hull is tightly fastened to the kernel. This hull will not rub off during harvesting, as often happens with wheat and rye. When the barley starts to germinate, the young sprout does not emerge immediately. It stays inside the tough protective coat and continues to grow. This is one of the reasons why barley is more suitable for germination than other grains. Another reason is its enzyme systems.

Malting is a complex biological process whereby germination of the grain is started and stopped within definite limits. Essentially, the properly selected barley is soaked in a steep tank until the barley has absorbed about 45 percent water. It is then moved to a germinating compartment where temperature is controlled and high humidity air is drawn through the layer of grain. The barley will require 4 to 6 days to complete the germination, at which time the process is stopped by drying with warm air. The drying must occur before the rootlet and shoot emerge too far, otherwise too much of the starch is consumed. On the other hand, the proper level of enzymes, particularly starch-splitting enzymes called alpha and beta

amylase, must be developed. When the proper balance occurs between the solubilization of the starch and the enzyme development, the barley is kiln dried and is said to be "well modified."

The malting process has been described to indicate why the requirements for barley bought for this purpose are more demanding than for other uses.

There are two main genetic types of barley-- 2-row and 6-row. 6-row barley is the type largely used by the brewing industry in North America and 2-row by the industry in Western Europe. 6-row kernels are longer and narrower than 2-row and have a decided twist. The main difference in the two types is that 6-row germinates more rapidly. There are several hundred varieties of barley and each has its particular characteristics. As with other grains, suitability for malting depends on weather conditions during growth as well as on type and variety.

The following are the general specifications for malting barley:

1. The maltster prefers one type of barley, whichever is suited for the area and one variety. This makes for more uniform and profitable malting, other conditions being equal.

2. The barley must be "alive", i.e., capable of germination. If barley is damaged by excessive heat, disease, insects or long storage, its germination suffers. If a maltster obtains only 90 percent germination, then 10 percent of the grain is lost for malt. A sound barley suitable for malting should germinate at least 96 -97 percent.

3. The barley should be plump, with as high a test-weight as possible, and of as uniform a size as can be obtained. Plump, high test-weight barley has more starch and gives a higher extract figure. The amount of extract in malt may vary from 72 to 83 percent. Plump and thin barleys germinate at different rates and if there is too much thin barley, malting efficiency is affected.

4. Enzyme activity affects malting quality and barleys show wide variation in enzyme levels. Enzymes are organic catalysts (protein in nature) and small amounts have the property of converting large amounts of substrate. Barley contains enzymes that can convert starch to sugars, proteins to peptides and amino acids, and fats to fatty acids. Under the influence of sufficient moisture, as occurs in germination, enzymes break down starch, protein and fat, making them more soluble and available as food for the new seed.

The maltster needs to know especially the potential amylase (formerly called diastase) level. There must be enough to "modify" the barley kernel during malting, in addition to the amount required to convert any starch added in the form of adjuncts during the brewing or distilling process.

No one can determine the suitability of barley for malting purposes by a simple visual inspection. The principal tests used for this purpose are:

1. Physical tests

a. Type (2-row or 6-row) and variety. A maltster should decide on one type and one variety if possible.

b. Test weight, the higher the better.

c. Plumpness and uniformity, this is related to test weight but should also be measured by screening; for example, a measure of "overs" on a 6/64 screen.

d. Color, a bright barley is essential and is indicative of good germination and lack of damage. Color differences are easier to evaluate when the husk is wet and can be expressed on a scale from 1 to 10, ranging from light to dark. The Agtron color meter is often used.

e. Damage, barley should be free from damage by heat, insects or disease. The outer hull can be removed and the kernels examined to see if the germ is discolored.

f. The above tests will all be indicative of germination ability but actual germination tests on a representative sample of barley are advisable. There are two tests in use:

(1) Wet blotter germination. A definite number of barley kernels (200 for example) are germinated on a wet blotter at a uniform temperature. This normally requires 4 to 6 days. The test can be accelerated by soaking the barley overnight in a weak solution of hydrogen peroxide. The latter stimulates germination and shortens the time required by a few days. It is useful when new crop or dormant barley is tested.

(2) Dye test. The dye, tetrazolium, colors a living germ red. It can give an approximation of germination within 5 hours, but is not as reliable as the conventional germination test method.

2. Chemical tests

a. Protein content. Generally,low protein barley is preferred for malting and higher protein is preferred in distilling. There is an inverse relationship between protein content and starch or the amount of extract. Higher protein barley is usually lighter weight and has a higher amylase content (sometimes termed diastatic power).

b. Potential extract

c. Alpha amylase

d. Wort nitrogen

Procedures for b, c, and d are available [1/] and will not be outlined here since the other tests are sufficient for initial screening. Some large maltsters are set up to run small scale malting and brewing tests on purchased barley. Finally, it is important to remember that no single test can adequately predict the malting behavior.

C. Summary

The maltster should buy one genetic type, either 6 - row or 2 - row, and one variety. This will give him a more uniform and profitable operation.

The barley should be low protein and plump. This means the highest possible test weight or weight in grams per 1,000 kernels.

The barley should be free from disease, insect, or heat damage. All forms of damage affect germination.

A bright color is indicative of a healthy barley.

The barley should have the highest possible germination, preferably over 97 percent. Barley can be stored for nearly a year without adverse effects on germination if the moisture is low (under 13%) and temperatures not too high (over 80F).

Ethiopia could save part or all of the import costs of malting barley and malt by developing and producing a high-yielding, 2-row or 6-row barley suitable for malting.

1/ American Society of Brewing Chemists, Methods of Analysis. The Society: Madison, Wisc. (1958).

IV. MARKETING WITHIN ETHIOPIA

A. Relation Between Production and Marketing

Factors of production that affect the quality of a product have an important influence on marketing. Overtime farmers generally tend to produce a product of the quality that prospective buyers will purchase. The situation with malting barley is somewhat different. In this case the buyer requires a very specific product; maltsters must have a barley to meet their particular specifications and tastes. The maltster, along with his specialists in techniques of producing barley, may be better qualified to determine necessary production practices than the farmer. This is particularly true in Ethiopia where farmers have no experience in growing malting barley. The basic interests of the grower and the maltster are the same, however; both are seeking an acceptable product for a special purpose.

B. Seed Distribution

Production of malting barley is new in Ethiopia, so growers are unfamiliar with acceptable varieties. Appreciable varietal testing has been done by the IAR. As a result, certain malting barley varieties have been recommended for the Chilalo and Holetta Highlands.

Since variety has an important bearing on malting quality, the contractor or maltster should assume the responsibility of supplying the grower with the necessary variety and amount of seed. This appears essential to assure production of the desired quality of malting barley. A carefully controlled seed production and certification program may be essential for malting barley production in Ethiopia.

Certified or even "quality seed" normally sells at higher prices than barley for malting, and to assure its use, the contractor may find it necessary to subsidize the seed. The maltster could minimize this cost by purchasing in large quantities and distributing the seed as part of a general field service program.

C. Credit Extension

Financing is usually necessary in the production of any commercial crop. For a new crop involving inexperienced growers and where only one prospective buyer exists, credit may be an essential part of the production program.

The amount and terms of the credit to be extended, the use to which it is to be put, and the extent of supervision must be determined in advance. As the industry matures, growers and/or lending agencies may relieve the contractor or buyer of this responsibility.

D. Supplies and Production Services

A contract grower may already have available most of the equipment needed for the production of this crop, but he may require specialized equipment and inputs such as combines and suitable fertilizer. Usually, it would be better to have the producer provide his own inputs, but initially, the contractor may find it essential to supply these inputs or be sure they are available. Farmers with surplus machine capacity may be able and willing to do certain types of custom work such as combining.

E. Field Service

It is common for firms that contract with growers for specific quantities and quality of product to employ a field service staff to work with their growers. This is done in many countries of the world by contract buyers of canning vegetables, seed corn, and other seed crops, as well as livestock and livestock products. This is especially important when growers are unfamiliar with production practices or with solutions to problems specific to the crop. Emergencies may be frequent in the beginning and growers may have urgent need for specialized assistance.

A small but skilled field staff would be required. Training programs, particularly for new growers, and personal contacts prior to planting, fertilizing, and harvesting may be essential. To be effective, these services must be considered important and helpful by the growers. Good and rapid communication is essential to meet emergencies.

Field service may be delegated where organizations, such as CADU in the Chilalo Highlands area, are conducting a strong educational program. Where sufficiently close supervision is available, the smaller farm units may be incorporated in the production program without sacrificing the high degree of uniformity of product that is required.

F. Grading

In 1971, Ethiopia had no grade standards for grains and no national seed grading or testing laboratory. The Ethiopian Standards Institution has been working to develop a suitable set of standards for most agricultural commodities. The Institution believes these standards will be available in 1972. Until a grading and testing laboratory and a trained enforcement staff are available, standards will have little use or meaning even if they are established.

It appears that the malting barley contractor must supply maximum assistance to growers and purchase the resulting product on an "as is" or company-grade basis until an official grading and specification system can be instituted.

An example of standards for malting barley used in the United States is shown below in summary form:

BARLEY (MALTING BARLEY AND BLUE MALTING BARLEY)

Grade	Min. Limits of		Maximum Limits of					
	Weight per bu.	Sound Barley	Damaged Kernels	Foreign Material	Skinned and Broken Kernels	Thin Barley	Black Barley	Other Grains
	(Pounds)	(----------Percent----------)						
US No. 1	47	97	2.0	1.0	4.0	7.0	0.5	2.0
US No. 2	45	94	3.0	2.0	6.0	10.0	1.0	3.0
US No. 3	43	90	4.0	3.0	8.0	15.0	2.0	5.0

These tolerances may not be suitable in Ethiopia, but they do include specific factors that can be measured objectively. In the official grades there are many qualifications which may be added to the above summary. Among the terms that could be added are bright, choice malting, two-rowed, western barley, tough, smutty, and numerous others. A mutual understanding of any terms used is essential. To foster this understanding, a detailed description must be incorporated in the grade specification. As an example, "thin barley" may be explained in terms of the exact type of sieve to be used, dimensions of the perforations, number of perforations per given area, and basis of determination if by mechanical sieving method or hand sieving method.

In a country where most farmers do not read, this degree of sophistication may not be realistic and visual inspection of a representative sample may be made to determine whether the product appears to have merit for malting and has a reasonable proportion of satisfactory kernels. A simple test-weight determination can be established. This can be used as a standard and a premium may be given for exceeding the standard or a discount taken if the reverse is true.

Where facilities are available, field-run grain can be cleaned and graded, with the grower receiving credit for the volume of acceptable grade delivered. The barley that is unsuited for malting would be returned to the grower or sold for his account to outlets such as feeder or distilling.

G. Transportation

The method of transportation used will be influenced by the tonnage of barley involved, the distance transported, the type of road, if any, and the means of transport available.

If the distance is short from the field to the place where the grain is loaded or stored, a combine with attached hopper may be used advantageously. This hopper may have a capacity of up to two tons. It can be emptied into a four-wheeled bulk trailer of up to six-ton capacity to be moved by tractor or truck to the cleaning or storage facilities.

When threshing is done at a central location, the grain will usually be sacked. For most efficient use of sacks and to insure that sanitary sacks are used, they must be supplied by the contracting buyer. He can insure proper fumigation before reuse. To avoid sack abuse and to assure their use for the purpose intended, a reasonable charge per bag should be made.

Transportation of malting barley to the malt house should be done in bulk, if at all possible to eliminate an extra emptying of bags. A hydraulic dump truck, or, with a suitable incline, a bulk truck with an opening tail gate can be used for bulk handling. Bulk transportation can be more efficiently done by a group, a cooperative, the contractor, or by specialized transporters on a contract basis. Loading and unloading bags from a truck is costly and reduces truck efficiency. Bulk movement in Ethiopia does not appear feasible, however, until a grading system is established, understood, and accepted.

H. Cleaning and Drying

In the cleaning and drying of seed grain by the grower, there would be advantages to doing this as close to his farm as possible. A saving in transportation cost is possible, since 5 to 10 percent or more of the original volume may be removed in the cleaning process. The small, immature or broken kernels as well as other foreign material can be retained by the producer for livestock feed or human food. A producer who owned cleaning and drying facilities could increase his income by providing this service to other producers.

Cooperatives can also provide cleaning, drying, storage and other services for their members. Suitable feasibility studies would usually be required to determine whether the prospective volume of business would justify a cooperative venture.

I. Storage

Determining the location and type of storage for malting barley is difficult in Ethiopia; it is more difficult for malting barley than for other cereal crops or pulses. Factors that must be considered in answering this question include:

1. Varieties must be kept separate in storage.

2. Quality must be maintained by controlling temperature and humidity in storage, and providing insect and disease control measures.

3. Type, size, location and alternative uses of storage facilities.

4. Pattern and volume of use of malting barley by the malt plant.

Normally, it might be expected that a combination of farm, intermediate and terminal storage would be used. As malting barley is a "new" crop in Ethiopia and quality requirements are more stringent than for other cereals produced up to this time, we believe that terminal storage at the malt plant must be provided for this crop. This is the only practical method of assuring quality maintenance, and a continuous supply of barley as needed for efficient plant operation.

J. Prices and Pricing Policies

Contract production of cereal crops is new in Ethiopia and not common in most other countries of the world. Contract production of vegetable, seed maize, popcorn and other speciality crops is found in certain countries and is mutually satisfactory to both the producer and the contractor. Malting barley would be classified as a speciality crop in Ethiopia because of quality specifications and requirements and probable controls on production.

Prices for cereal grains normally vary widely over the year, being abnormally low immediately following the harvest season and gradually increasing through the planting and growing season. In determining contract prices for malting barley, this seasonal price fluctuation must be considered. It is not equitable for the contractor to expect the grower to accept the low price usually prevailing at harvest time even though delivery may be made at that time. It is equally unreasonable for the grower to expect the highest price of the year even though he may not be paid in full for his crop until late in the season.

The grower has some idea of his costs of production, though he has no positive control over his yield level. The contractor or maltster knows what he can obtain for his malt. Both parties know that malting barley is somewhat more costly to produce than feed barley, that yields tend to be lower, and that malting barley can be sold in the market place for seed, food, or feed at no disadvantage.

A contract price must be negotiated, and it should be fair to both parties. It should be subject to adjustment according to services supplied by the contractor and quality of product delivered by the producer. We recommend that production of malting barley in Ethiopia be done on a contract basis with the basic price agreed on before planting.

Appendix Table B-13 shows the yields of barley reported in certain European countries. Appendix Table B-1 shows the price variation by months and years for feed grade barley.

V. FEASIBILITY OF EXPORTING MALTING BARLEY

Specific data on the movement of malting barley are not generally available, thus the feasibility of exporting malting barley must be considered indirectly and based on assumptions. However, reasonable inferences can be made through this approach.

A. Potential World Market

Barley is one of the important world cereal crops. Its main use outlet is for animal feed. A small amount of barley is processed for food, but an estimated 25 percent is used by the malting industry. The brewing industry is the largest user of malt. Smaller amounts of malt are bought by the distilling industry for alcohol and syrup production. A small quantity is made into food as pearled or pot barley. The world output of barley has been rising in recent years. This is indicated by the following estimates of production:

	1,000 mt
1960-64 (Average)	84,600
1968	113,200
1969	113,800
1970	117,500
1971	132,600 2/

If the malting industry is using 25 percent of the crop, then as production of barley has increased, it appears that more than 20 million tons of malt was produced in 1969 and almost 23 million tons in 1971 (using a conversion ratio of 48 tons of barley to 34 tons of malt).

As has been noted, malting barley is suited not only for the production of malt, but also for animal feed and human food. Separate production and trade statistics for each use are generally not available. The most recent estimates on utilization of barley in the United States are for the 1968 crop year; of the 372 million bushel (48 pounds) disappearance reported, 108 million bushels, or 29 percent of the total, were used for alcohol and alcoholic beverages. Of the estimated 20 million tons of malt produced in 1969, over 1 million tons went into the export market (Appendix B- Table 2). Europe is by far the largest exporter of malt, but the region also imports considerable quantities. Japan was the world's largest importer of malt in 1969 (Appendix B- Table 3).

The world trade in malt gives some indication of a potential for malt export from Ethiopia and may indicate possible markets for malting barley. However, the foreign trade in barley probably gives a better clue. No estimate of the proportion of exported barley used for malt pro-

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2/ World Agricultural Production and Trade, USDA, FAS, March 1972, Washington, D.C.

duction is available other than the generalized estimate of approximately 25 percent. If this same percentage is applied to the world export of barley in 1969 (Appendix B- Table 4), the export of malting barley would amount to about 1.8 million tons. In the absence of other estimates this can be used as an approximation. This figure suggests a market that justifies further detailed investigation.

B. Competitors in the World Markets

The world exports of all barley for the years 1964-1969 averaged over 7.5 million tons, including a calculated 1.8 million tons of malting barley. The estimates fluctuate from year to year, but show no pronounced trend. Europe is the dominant supplier, providing more than one-half of the total world exports. Canada and Australia are also large exporters. Syria and Morocco are in the same general region as Ethiopia and are fairly important exporters of barley. In 1969, they exported 273,100 and 133,300 tons, respectively. There are 51 exporting countries and 78 importing countries for barley but there is no way of knowing just which of these countries import malting barley per se, or in what amounts. Nor is it known whether Ethiopia can compete effectively for this market. A specific market survey could supply information that would be useful in answering this question.

Europe received nearly 5.5 million tons of the world barley imports that totaled slightly less than 7 million tons in 1969. In Europe, East and West Germany imported nearly 2.5 million tons with Belgium-Luxembourg taking about 600,000 tons and the United Kingdom 650,000 tons. Japan's importance as a market is indicated by imports of barley totaling almost 700,000 tons in 1969. In 1969, Japan also imported more malt than any other country in the world, nearly 14 percent of the total. This suggests that the Japanese market is worthy of investigation as a possible outlet for Ethiopian malting barley.

C. Relative Advantage of Ethiopia

Ethiopia cannot realistically expect to export malting barley in the next 5 to 10 years. There is no production at the present time, nor is there experience with the quality standards necessary for producing this crop for export. We anticipate that a new malt plant would find it necessary to import malting barley temporarily while farmers learn to produce and deliver a malting barley of suitable quality.

Malt imports into Ethiopia increased from 2,082 tons in 1967 to 4,213 tons in 1970. The annual increases during this period were 26.9, 23.5 and 29.0 percent, respectively (see Appendix Table B-5). The total

value increased from 0.75 million to 1.5 million Ethiopian dollars to add to the growing unfavorable balance of trade. Malt extract imported in 1967 is shown in Appendix B- Table 6.

Barley imports from 1967 to 1970 varied from 800 tons in 1968 to 1,505 tons in 1970 (Appendix B-Table 7). France, Italy and Denmark were the suppliers in 1967; but in 1970, 1,000 tons were supplied by Australia, 500 tons by France and 5 tons by Kenya. The barley equivalent of malt imports rose from 2,935 tons in 1967 to 5,940 tons in 1970 (Appendix B- Table 8). This, together with the barley imports, would require 3,720 hectares (Appendix B- Table 9) of malting barley at a yield of 20 quintals per hectare, to replace the imports in 1970. If imports continue to increase at the same rate as in 1967-70, it will be a real challenge to produce enough malting barley in Ethiopia to meet local requirements. The estimated average yield of 20 quintals may be somewhat optimistic for the immediate future but should be attained eventually.

The relative advantage of Ethiopian malting barley growers is considered in the more comprehensive study concerning the feasibility of a malting industry in Ethiopia. The unit value of imports of malting barley and malt is shown in Appendix B- Table 10 and Appendix B-Table 11.

Ethiopian beer has more than held its own in competition with imported beer. There has been a steady increase in malt imports, but beer imports declined each year between 1967 and 1969; however, they increased in 1970, but not to a level above the 1967 figure (Appendix B- Table 12). The principal sources of imported beer are Holland, West Germany and Denmark. The sources of these imports of barley, malt, and beer give some indication of the competition faced by Ethiopian malting barley and also provide other clues to markets that may be available in the future.

An important consideration in comparing the relative advantage between competing countries is cost of production. Malting barley has been produced in Ethiopia only on an experimental basis. The limited production cost data which are available on barley show a wide variation in yield and, therefore, in cost per quintal. The calculated costs vary from Eth. $12 to Eth. $26 per quintal. Barley yields for the Empire are shown as 8.5 q/ha, but with good production practices, a yield of 20 quintals is considered possible. Average yields in the principal producing and exporting countries are much higher than the hoped-for 20 quintals per hectare in Ethiopia. In six of the important European, barley-producing countries (Appendix B-Table 13), the average yield during the five-years of 1960-64 was 35.5 quintals per hectare. Since then, yields have increased to 38.2 quintals in 1969. World barley production in 1971 reached a record 127 million metric tons. This is formidable competition for Ethiopia.

1. Price Competition

It is not possible to make a comparison of farm level prices for barley between countries. The average price of barley in the United States for the years 1964 to 1968 is shown in Appendix B- Table 14. These prices varied from a high of Eth. $12.06 in 1966 to a low of Eth. $10.43 per quintal in 1968. These prices include all types of barley. In the United States, malting barley generally receives a premium of US$0.25 to US$0.50 per bushel of 48 pounds; during 1964-68 the price was 25 to 50 percent over feed barley prices. Even with these premiums, the market price of malting barley in Minneapolis, Minnesota, was below the price of barley of the non-malting varieties in Addis Ababa. In four of the five years for which comparable data are available, the price of United States and Canadian barley in Rotterdam was below the 1969 wholesale price in Addis Ababa; e.g., the Canadian barley price was Eth. $3.56 per quintal lower. While prices remained relatively constant in Addis Ababa, there was a distinct downward trend in Rotterdam. The landed value of imported barley at the port in Ethiopia decreased from Eth. $25.32 in 1967 to Eth. $22.29 per quintal in 1970 (see Appendix B- Table 17). These prices are believed to be for malting barley.

Largely as a reaction to the expanding production in Europe and the consequent reduction in prices, exports of barley to Europe from the United States decreased from an annual average of over one million tons in 1960-64, to 95 thousand tons in 1968 (Appendix B- Table 15). Malt exports also decreased during these same years. Most of the malt exported went to Latin America and Japan, as shown in Appendix B- Table 16.

In a recent export feasibility study it was concluded that, due to high domestic prices, Ethiopian maize was at a distinct disadvantage in world markets. In recent years, barley prices in world markets have been below prices for maize; whereas in Addis Ababa prices of barley are usually above maize prices. From 1965 to 1969 barley averaged Eth. $1.25 per quintal higher than maize (Appendix B- Table 18). In late March 1972, the wholesale price of maize was Eth. $12 per quintal and the price of barley was Eth. $15 per quintal.

2. Marketing and Handling Costs

Costs of transportation by both truck and rail are on the basis of weight and are the same for all grains. Costs of handling the various grains are also similar.

Marketing, transportation, and handling charges between Addis Ababa and either Assab or Djibouti, shown in Appendix B- Table 19, can be expected to range from Eth. $7 to Eth. $10 per quintal.

3. Estimated Farmgate Prices

Calculated farmgate prices must be based on certain arbitrarily assumed conditions. Every effort has been made to be realistic, in

most instances using current prices and costs, except for truck transport costs, which are expected to be reduced with the opening of the new highway to Assab.

The calculated farmgate value (Appendix Table B-20) depends on the nature of competition for truck service. The railroad has given a special low rate for moving products into the export market and has also lowered these rates further to meet the competition of truck rates. Under the most favorable conditions anticipated, the calculated farmgate price for barley of malting quality in Addis Ababa is Eth. $70.25 per ton and under normal conditions is Eth. $56.25 per ton. The two recommended initial producing areas, Chilalo and Holetta Highlands, are some distance from Addis Ababa and this results in an additional transport charge.

I. SUMMARY AND RECOMMENDATIONS

A. Summary

Official IEG statistics indicate that production of all cereal grains increased from 4.5 million tons in 1961 to 5.6 million tons in 1970, an average increase of about 2 percent annually. Barley production doubled in this same period, maize increased about a third and sorghum production declined slightly. Total hectarage planted in all cereals changed very little except for barley, which almost doubled in a decade. Except for maize, average yields gained less than one quintal per hectare, or only about one percent per year.

Grains are consumed almost entirely as food in Ethiopia; this is true of barley, maize and sorghum as well as wheat and teff. Barley, maize and sorghum are classified as feed grains in many countries. Exports of grain in recent years have been about 3,000 tons annually as compared with imports that have averaged some 15,000 tons, but have reached levels above 60,000 tons. Shortly after World War II, Ethiopia attained an export level of almost 150,000 tons for cereals but this showing of strength was short lived.

Accurate and complete costs of production per hectare of grains are generally not available and yields and costs per quintal cover a wide range. Based on such data as are available, there seems to be no significant difference in production costs per quintal between grains and some pulse crops (e.g. haricot beans).

For several years prior to 1971, wholesale prices of grains apparently did not vary significantly from those prevailing on pulse crops. In 1971 wholesale pulse prices in Addis Ababa averaged about one dollar per quintal over the level of all grains.

In late 1971, grain prices in Ethiopia averaged about double the comparable prices reported in certain of the major producing countries of the world. Ethiopian prices thus encourage imports and are far above the level that would prevail if the nation were on an export basis.

A comparison of delivered costs of maize to principal importing countries (Europe, Mideast and Asia) indicates that major exporting countries have been selling their grain at less than half of the cif value of Ethiopian maize in those same countries, based on recent prices in Ethiopia. For barley and sorghum the comparison would be even more unfavorable due to the fact that these grains sell below maize prices in major exporting countries. In Ethiopia, barley and sorghum sell above maize prices.

Economies of scale, both in production and marketing, within the major exporting countries and economies in ocean shipping account for most

of the competitive disadvantage of Ethiopia in selling grains abroad.

Forecasts for the decade ahead indicate that domestic cereal grain demand may increase by as much as two million tons, or more than double the actual production increases of the past decade. To meet this demand alone, without resorting to imports, will require substantial increases in both hectarage and yields.

Certain forecasts for the decade ahead, principally by the FAO, indicate that world demand for grains, particularly feed grains, will not increase as rapidly as world production. The FAO predicts that unless major exporters change their agricultural policies, a surplus as large as 41 million tons of feed grains will overhang the market by 1980 and world prices will be depressed.

If in-country requirements alone indicate an increase in cereal production to as much as 8 million tons by 1980, and with domestic prices now more than double the prices necessary to compete effectively in export markets, it seems that Ethiopia should logically give first priority to increased production of all grains needed to meet domestic requirements.

More and better storage at points of production in the decade ahead is expected to improve returns to growers. Improved farm-to-market roads will improve efficiency of marketing.

The present organization of the Ministry of Agriculture with its several semi-autonomous departments may result in coordination difficulties. It also makes communications and flow of technology difficult.

The staff of the Extension and Project Implementation Department (EPID) appear well suited to their present assignments; but more technical training, assistance and supervision will be required to maintain and improve field staff competence. The extension field staff has been well trained at the College of Agriculture and Institutes of Agriculture. Course work and instruction are impressive. General in-service training for field staff members of EPID appears well done and adequate, but technical training is not sufficient for anticipated needs of Ethiopia's agriculture in the near future.

Neither technical nor field staff of EPID are adequate or qualified to work effectively with commercial farmers. Additional technical staff, trained at a higher level, must be supplied to assist this group of farmers, which is especially important to realization of the nation's production potential.

B. Recommendations

1. The Ministry of Agriculture should encourage increased production of all grains, primarily to meet the domestic requirements of the future. In general, local output should be sufficient to make it unnecessary to import grains or grain products. Import substitution deserves thorough study to determine economic feasibility of such a program.

2. The IEG (through appropriate agencies) should encourage the provision of production credit on an organized basis, and assist both cooperatives and the private entrepreneurs to improve efficiency of both production and marketing.

3. Moderate increases in sales of grains to neighboring areas at prices more favorable than those in the world market are a distinct possibility and these outlets should be exploited. Although a combination of high domestic prices and high production and marketing costs currently precludes any near-term entrance of Ethiopia into the intensely competitive world market for feed grains, it is possible that future developments, both in-country and in the overseas competitive situation, may alter present relationships and better Ethiopia's export opportunity in these commodities. A continuing effort to reduce costs and improve efficiency is essential if Ethiopia is to meet its domestic needs and to exploit any opportunity that may develop for feed grain exports.

4. The Ministry of Agriculture should encourage development of seed stocks of improved varieties of grain and assist in establishment of a seed multiplication and distribution program to ensure that farmers produce the types that yield more and are of better quality.

5. The Imperial Highway Authority or another appropriate agency should provide more farm-to-market roads in major producing areas by utilizing lower cost designs and construction.

6. The Ministry of Agriculture and other organizations should establish wider and more rapid dissemination of grain prices and general market information on outlets for cereals.

7. A suitable and efficient household-compound grain storage unit of one-ton minimum capacity must be developed for use by many of the small, subsistence-type farmers in Ethiopia.

8. A combination of sacked and bulk cereals with a low-cost but adequate grain handling system needs to be developed for the commercial farms and cooperative centers. Bulk storage and handling equipment to be installed in present warehouses should be introduced gradually where marketing does not involve more than one sacking cycle.

9. Establishment of grain standards that adequately describe quality would facilitate the commercial movement of grains. In order to achieve better and continuing research and education, direct lines of administration should be established in lieu of dependence on a liaison system.

10. A new dimension should be added to the Extension and Project Implementation Department (EPID) so that the commercial farming sector can be served more effectively. Additional well-trained, technical staff should be added to EPID so that the present field staff can be better trained and supervised, and the commercial farmers can be assisted in meeting their specific needs.

II. 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 is in pastures. Crop land totals some 10 million hectares but probably as much as half of the 66 million hectares of pasture land could be cultivated. About 8 million hectares are used for cereal grains and pulses production. The potential for increased crop production is generally believed to be great.

A. 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. Large commercial farms are still few, and the contribution to 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.

B. Agricultural Production

Based on IEG 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 C-1 through C-3 of the Appendix C. 1/

With fewer than 250 extension agents 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.

1/ 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.

C. Farm Income and Tenure

Agriculture is credited with some 55 percent of Ethiopia's GDP, which reached Eth. $3,860 million in 1969.[2/] 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 first by a drought in 1965-66, increased to levels considerably above world prices; in effect, domestic prices of these important food products have been 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.

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.

D. Organization for Agricultural Development

At the present time, the principal mechanism being employed to develop the agricultural plant is the so-called "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 procedures and methods. In the Pulse Development Program, most production for increased exports

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

will come from commercial-scale farms.[3/]

E. External Trade in Agricultural Products

At one time (1945-1955), Ethiopia exported a considerable quantity of cereals (153,000 tons in 1947), but this trade has fallen off to less than 5,000 tons in recent years (Appendix Table C-6). In the immediate post-World War II period, exports were stimulated by favorable prices guaranteed by a British-backed firm that was catering to a market characterized by short supplies. Actually, the nation has been importing more grains than were exported all through the past decade. Both oilseeds and pulses have been trending upward as earners of foreign exchange, but neither of these crops has reached the point of providing much more than 10 percent of the income from all exports. Pulse exports declined in 1970 but appear to be increasing again.

3/ For purposes of this project proposal, 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 1 gasha (40 hectares) of cultivated land, and operated without tenants.

III. FEED GRAIN PRODUCTION

A. Maize

1. Production Areas

Maize is produced in essentially all areas of Ethiopia where the elevation is from 1,500 to 2,200 meters. At these elevations the natural rainfall is usually adequate for satisfactory plant growth. In recent years, however, there has been some maize production below the 1,500-meter elevation where supplemental irrigation is used.

The 1970 IEG statistics indicate the total maize production in 1969 at 909,000 hectares, with an average yield of about 10 quintals per hectare. Yields are usually lower on the subsistence-size, peasant farms, due largely to poor varieties, poor cultural practices, inadequate weed control and essentially no use of fertilizer. On commercial-size farms the yields are usually higher, with 30-40 quintals per hectare not uncommon.

Most of the present maize production is in eight provinces, which are listed here in order of estimated importance. For each province the principal awrajas for maize production are listed in order of magnitude of production.

a. Shewa Province

(1) Haykoch and Butajira Awraja. This includes most of the southern Rift Valley area and probably includes a major portion of the commercial-size operations.

(2) Yerer and Kereyu Awraja. There has been some development of irrigated maize in this Awraja in recent years.

(3) Jibat and Mecha Awraja. This Awraja has mainly small to medium-size, subsistence farms.

b. Welega Province. Maize is grown on small to medium-size subsistence farms in most of Welega Province. It has not been possible to get a reliable estimate of total production.

c. Kefa Province

(1) Limu Awraja; and

(2) Jimma Awraja are probably of about equal importance. Most of the maize is on subsistence farms, but there are a few commercial-size operations.

(3) Northern part of Gimira Awraja.

(4) Northern part of Kefa Awraja.

d. Harerge Province

(1) All of Webera Awraja

(2) Northern part of Chercher Awraja

(3) Northern part of Gara Muleta Awraja

(4) Southern part of Adal and Isa Awraja

e. Sidamo Province

(1) Welamo

(2) Deresa

(3) Northern Sidamo

(4) Jemjem

f. Gemu Gofa Province

(1) Northern Gofa Awraja

(2) Northern Gemu Awraja

(3) A portion of Gardula Awraja

g. Illubabor Province. Maize production is not centralized but subsistence-scale production of maize is in most of the northern part of the province.

h. Arusi Province. A few commercial operations have been developed in Chilalo Awraja. Subsistence production occurs in Arba Gugu Awraja and western Ticho Awraja.

2. Cost of Production

It is not possible to obtain accurate costs of production from peasant farms. Exact hectarage is seldom known because fields are frequently irregular in shape and many are on steep hillsides. Time allocation of the family labor is not recorded, production is primarily for family use, and farmers are suspicious of enumerators. Consequently, data reported from peasant farmers must be considered unreliable. They are shown here for purposes of comparison with more reliable but fewer figures from commercial-scale operations.

Reports from two studies of yields and costs on subsistence-size farms are shown in the following tables:

Eth. $ per hectare	Yields q/ha	Eth. $ per quintal
67.00 4/	10.68	6.27
155.05 5/	6.95	22.31
301.19 5/	20.00	15.06

It is difficult to improve production among tenant farmers because of existing share rental arrangements. It is not customary for landlords to share the added cost of improved practices, even though they may be highly profitable.

On owner-operated, commercial-scale farms, the adoption rate for improved practices is more rapid. Improved practices are reflected not only in higher production costs per hectare but also in higher yields and lower costs per quintal. Some cost and yield information on the commercial-size operations is presented.

Non-Irrigated Maize 6/

Eth. $ per hectare	Yields q/ha	Eth. $ per quintal
194	28	6.93
220	27	8.15
230	40	5.75
204	18	11.33
200	15	13.33

Irrigated Maize

Eth. $ per hectare	Yields q/ha	Eth. $ per quintal
408 7/	40	10.20

Experimental plots at Melka Werer have produced yields of up to 76 quintals per hectare. A reasonable expectation under commercial conditions may be 35-50 quintals.

4/ Production and Utilization of Grains and Pulses, SRI Report # 10.

5/ Production Cost Budgets for a Farm in Bishoftu Area, John Asfaw, IEG, Technical Agency, SRI.

6/ Commercial farmers in Debre Zeit, Jimma and Dese areas.

7/ On the Abadir Farm near Metehara, 40 hectares were in a salt area, which reduced average yields on the entire area of 240 hectares to 27.8 quintals.

3. Potential for Increased Production

Any increase in maize production in Ethiopia in the near future is expected to come from three general sources:

1. Yield improvement on land now producing maize but mainly from commercial-scale operations.

2. Increased hectarage in land not now cultivated, which is mainly in low income-producing pasture.

3. Increase of both hectarage and yield in irrigated areas. This can be from two different approaches:

a. Production as a single crop, using a long season variety such as SR52, which has a maturity time of around 200 days and a yield potential of 50-70 quintals per hectare.

b. Double cropping with cotton, which will require a short-season variety such as the Israeli variety No. 160 or a local selection, with a maturity time of around 100-110 days and a yield potential of 30-45 quintals per hectare.

It seems realistic to predict that the yield of maize on the present production area could be doubled within 5 years to 20 quintals per hectare and further increased to 30 quintals per hectare average in 10 years. This would involve an expanded extension program, increased use of fertilizer, improved seed, greatly improved weed control and generally better cultural practices.

Research yields of maize from small plots at 10 locations have ranged from 54 to 148 quintals per hectare. With present farm production practices, a commercial farmer might get one-third such yields. As they become more knowledgeable, producers can expect to do better. In the US the most successful farmers commonly get yields which exceed those of research plots.

Nonirrigated lands, not now being cultivated and which are suitable for maize, exist in large tracts in the Rift Valley from Zuai Lake South to Awasa and Sodo. Only scattered fields in this whole area are now in maize or any cultivated crop. The total area involved may be as much as 100 kilometers by 50 kilometers, of which up to three-fourths could be cultivated, giving an estimated 250,000 hectares of additional maize land, all within 25-30 kilometers of an all-weather road.

With improved seed, effective weed control, use of fertilizer and other known effective cultural practices, a yield of 30-40 quintals per hectare could be expected.

Other places farther from roads include various large valleys, some of which require drainage or irrigation.

Irrigated lands that will become available within the near future will be mainly in the Awash Valley. In the middle Awash, when the Kesem dam and the diversion canal are completed, an estimated total of 48,000 hectares of land can be irrigated. This could provide, within 3 years, a conservatively estimated 4,000 additional hectares of maize, with an estimated yield of 40 to 50 quintals per hectare. If the practice of double-cropping of cotton and maize in the same year became feasible, it could provide 10,000 additional hectares, with a yield of 30 to 40 quintals per hectare.

A similar situation exists in the lower Awash irrigated area, where with the completion of the Tendaho dam, 50,000 hectares additional land can be irrigated, which might provide 10,000 hectares of maize over a 10-year period.

To produce maize as an alternating crop with cotton in the same year will require considerable research work. This research must assess the economic feasibility and mechanical equipment needed to prepare land rapidly for the succeeding crop. There is usually not more than 3 or 4 weeks between crops for these operations. It is unlikely that over 20 percent of the crop land could be handled in this manner.

Other countries in Africa produce maize and certain ones export large quantities. Kenya, for example, has had an irregular export pattern, with declining exports since 1968. Experimental varieties of new hybrids perform similarly in Kenya and Ethiopia, with comparable growing conditions and cultural practices. The 1970 yields of 8 hybrids at 28 locations in Kenya ranged from 40 to 66 quintals per hectare.

B. Barley

1. Production Areas

Most of the barley production of Ethiopia is in a higher elevation of the central highlands, at a 2,000 to 2,800-meter elevation. Much of the area is not accessible by roads, and production estimates are difficult to make. The 1970 Statistical Abstract shows the barley plantings of Ethiopia as 1,734,800 hectares, with an average yield of 8.5 quintals per hectare.

Most of the barley now produced is used by the local farmers for home use, either for beer (talla) or for direct consumption as food.

About 1,500 strains of barley have been identified in Ethiopia, mostly feed types. Less than 3 percent can be classified as suitable malting types. The major producing areas, mainly of feed barley, are

in Shire Awraja of Tigre Province; Simen Awraja of Begemdir Province; Tegulet-Bulga and Menagesha Awrajas of Shewa Province; Bahar Dar, Damot, Mota, Bichena, and Debre Marcos Awrajas of Gojam Province; and Chilalo Awraja of Arusi Province. However, barley is grown by peasant farmers in all of the central highlands.

2. Cost of production

As with other cereals, accurate cost of production of barley is essentially impossible to obtain. Much of the production is on small peasant farms, for which no oost records are available. The following data 8/ have been reported and are given here but may be subject to question.

Eth. $ per hectare	Yields	Eth. $ per quintal
200.38	7.6	26.36
309.80	15.0	20.65

The Holetta Agricultural Research Station recently estimated the cost of producing malting barley at Eth. $260 and feed barley at Eth. $252 per hectare, with a 20-quintal yield and a cost of Eth. $12-$13 per quintal.

3. Potential for Increased Production

Small plot tests of malting-type barley made at Holetta and Sheno in Shewa Province, at Sagure in Arusi Province, Asmara in Eritrea Province and at other places, gave yields ranging from 15 to 54 quintals per hectare. These plots demonstrated that a satisfactory quality of malting barley can be produced in several areas of Ethiopia, especially in the Holetta, Sagure and Sheno areas. Tests for malting quality showed that in some locations, the product was satisfactory for malt production.

In view of the yields on small plots, it is realistic to forecast that with selected seed, use of good fertilizer and better cultural practices, a yield of 20 quintals per hectare of malting barley could be obtained.

The three breweries in Ethiopia imported about 4,200 tons of malt in 1970 at a cost of Eth. $1.6 million. This represents about 6,000 tons of screened barley and an equivalent cost of Eth. $25 to Eth. $30 per quintal of barley. By 1982 the estimated requirement is about 10,000 tons (equivalent).

The present import of the equivalent of 6,000 tons of malting barley could be eliminated by 3,000 hectares yielding 20 quintals per hectare. Malting barley needed to supply the local breweries 5 years hence would likely be double the above figure. A yield of 20 quintals per hectare at a

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8/ Production cost budgets for an arable farm in Bishoftu Area by John Asfaw, IEG, Technical Agency, SRI.

price of Eth. $20 per quintal would give the grower about Eth. $140 per hectare profit. The 6,000 hectares necessary for malting barley production would be less than one percent of the total hectarage and could be readily developed in the better areas, accessible to roads, with a little extra effort in extension work.

Converting the Ethiopian breweries to using locally produced barley would require:

1. The construction of a malt house, probably in the Addis Ababa area. A malt house of sufficient capacity for the foreseeable future has been estimated by one interested company to cost about Eth. $4.3 million. This would presumably have to be financed through a share company, with the breweries as the principal shareholders.

2. The conversion would have to be gradual while malting barley production was being established, with breweries importing malting barley rather than malt at first.

3. Marketing cooperatives might have to be organized and extension service expanded to demonstrate to farmers the advantages of producing malting barley.

4. Suitable seed would likely have to be supplied by the breweries. Farmers would probably also require credit for seed and fertilizer.

5. It is probable that the breweries would have to pay growers a small premium over the regular market price for reed-type barley.

It would be expected to take 3 to 5 years to complete the transition from imported barley to locally produced barley. During this time, the breweries would realize a saving by importing barley rather than malt.

After complete conversion to locally produced barley, the breweries would be purchasing their malt for less than the equivalent of Eth. $25 per quintal, as compared to the present Eth. $25 - Eth. $30 price.

This difference in price will provide a savings in addition to the import substitution advantage to the empire.

A substantial import duty on imported malt could provide a further stimulus to moving the industry in the desired direction.

C. Sorghum

1. Production Areas

Sorghum is widely grown in Ethiopia. The principal production is at the lower elevations where the rainfall averages 500 to 800 millimeters per year. The main areas are the northwest lowlands in Begemdir and Eritrea Provinces, along the eastern escarpment of the highlands in Welo Province and in the Dire Dawa and Chercher Plateau areas of Harerge

Province. There are, however, many peasant farmers in all provinces who grow sorghum for home consumption.

There are a few large commercial farms in the Setit-Humera area, from which sorghum is moved to Asmara, where it is channeled to various parts of the country, such as Tigre Province, a food deficit area. There is also a relatively new development of commercial farms in the eastern part of Harerge Province, from which some sorghum is exported to Afars and Issas. The 1970 statistics give the total area in sorghum as 1,174,000 hectares, with an average yield of 8.4 quintals per hectare. Most of the crop is consumed at or near the place of production.

2. Cost of Production

Cost and yield figures for sorghum vary widely. Many subsistence farmers grow small areas of sorghum for home use and they keep no cost records. Few know their exact hectarage or their yield. They keep no record of labor time. It is probable that these subsistence farmers would not divulge their costs even if they were known. Data obtained from commercial farmers are somewhat more reliable. The following estimates serve as examples:

Eth. $ per hectare	Yield q/ha	Eth. $ per quintal
245.00 9/	20.0	12.50
269.00 10/	35.0	7.68

Other generalized estimates vary from Eth. $10 to Eth. $20 per quintal, with yields of around 16 quintals per hectare. 11/ The Eth. $20-per-quintal cost was based on an assumed loss of crop every third year.

3. Potential for Increased Production

Increased production will come from a combination of increased yields and expanded hectarage. The most important factors necessary for better yields of sorghum on both present and future areas are:

(a) effective weed control

(b) adapted varieties, with selections made for each main area, and probably some earlier dwarf or semi-dwarf varieties for late planting in marginal rainfall areas

(c) improved cultural practices

(d) use of fertilizer when needed

(e) increase in extension efforts to improve understanding

9/ Farmer in Dese Area

10/ Alemaya Experiment Station

11/ Commercial farmers in Humera and Jijiga areas

Area	Humera	Dese	Alemaya	Harrar	Bako	Jijiga	Adi-Ugri
Top yield q/ha in small plots	33	40	59	72	59		48
Top yields in commercial fields q/ha	16					16	

In these data, the top yields at Alemaya, Harrar and Bako involve the best known varieties, combined with good cultural practices and fertilizer.

There is a large potential increase in production from new areas. In the Setit-Humera area, there are several thousand hectares of brushland, which would be suitable for sorghum if cleared. Estimates of clearing costs are about Eth. $20 per hectare. This area is well suited to large-scale commercial farming. In the Jijiga area, there are possibly 200,000 hectares of land now in pasture, much of which could be converted to large-scale, sorghum production.

Looking into the decade ahead, there are several other promising potential areas for sorghum production. Among these are the southwest and western lowlands of the Omo and Baro river valleys and a large area in Western Gojam Province, essentially undeveloped because of inaccessibility, malaria, and tsetse fly problems. The lower Wabi Shebelle River Valley also has a considerable area of undeveloped land. In the Raya and Kobo Awraja of Welo Province, up to 30,000 hectares of new land for sorghum could be developed.

It is not unreasonable to estimate that the total production of sorghum in Ethiopia could be trebled within 5 years, given an adequate economic incentive.

Excellent screening research work on sorghum has been done at the Alemaya Station, and yield tests have been conducted at other locations. There has been essentially no adequate breeding program to develop varieties of sorghum suitable for the wide range of soils and climate where the bulk of the sorghum is grown. Before substantially increased yields and decreased unit cost of production can be obtained in the present large-scale production areas of Setit-Humera, Dese and Jijiga, it will be necessary to find or develop more suitable varieties, study fertilizer needs, develop more effective weed control measures and institute other improved cultural practices.

IV. MARKETING OF PULSES AND FEED GRAINS

In Ethiopia, all cereals, including maize, barley and sorghum, as well as most pulse crops, are actually used for human food. Little or none is fed to livestock and poultry. The bulk of these crops is consumed on or near the farm where produced. The small amount that is marketed off the farm is moved from areas of surplus production to areas of deficit production within the country, or into the export trade.

A. Domestic Requirements - A Preliminary Evaluation

A comprehensive survey has never been conducted to determine the food consumption pattern of Ethiopian households. Estimates of per capita utilization and/or demand have been made by US/AID and FAO; also, there have been estimates of required production growth rates in the Five-Year Development Plans.[12/] Per capita consumption of cereals and pulses has been estimated as follows:

1. US/AID (per W.G. Eichberger)

	1966	1973
	(Kg. per Annum)	
Teff	35.17	39.86
Wheat	9.89	12.04
Barley	17.45	22.35
Maize	25.67	35.50
Sorghum	32.29	40.94
Pulses	24.70	25.76

2. FAO (per 1970-80 Projections)

	1965	1970	1975	1980
	(Kg. per Annum)			
All Cereals	160.8	163.4	167.4-171.7	170.1-175.0
Wheat	23.6	23.7	24.8-26.5	25.8-28.9
Maize	25.0	25.1	25.6-26.1	25.9-26.3
Sorghum	29.1	29.2	29.9-30.4	30.2-30.6
Other grains	82.9	85.1	86.9-88.5	88.0-89.1
Pulses nuts	19.6	19.7	20.3-21.2	20.8-22.4

12/ Eichberger, W.G., "Food Production and Utilization", US/AID, Addis Ababa, 1966.

FAO, "Agricultural Commodity Projections, 1970-1980", Rome, 1971.

IEG First, Second and Third Five-Year Development Plans, Addis Ababa.

Under the US/AID projection, the total caloric intake per capita would advance from 1,920 per day in 1966 to 2,250 in 1973; in the FAO series, the average daily intake increases from 2,152 calories in 1965 to about 2,300 in 1975.[13]

Converting these indicated requirements to total demand in terms of gross quantity produced,[14] the indicated domestic needs would be:

	Cereals (Metric tons)	Pulses (Metric tons)
Report production 1969-70	5,593,000	628,000
Indicated requirements, 1973, US/AID[15]	6,535,000	732,000
Projected requirements, 1980[16]	8,036,000	899,000
Indicated increase, 1970-80	2,443,000	271,000

It is of significance to note the considerable differences between 1969/70 production (Appendix Table C-1) and the projections of requirements; however, it must be realized that the production and consumption data on which the estimates are based are of doubtful validity, and the projections cannot be considered precise. The more important indicator in this case is the required rate of growth in domestic requirements.

13/ In its projections of demand, the FAO assumes that population and income are the major shifters of demand. As a starting point, the annual per capita consumption of all items in the diet, by country, during 1964-66 was used in making the projections to 1980.

14/ Gross quantity produced is synonomous with disappearance, which includes harvest and storage losses, amounts used for seed, non-food purposes and home processing, marketing shrink, etc.

15/ Based on population of 26.4 million and a daily intake of 2,250 calories.

16/ Assumes a 3-percent annual growth rate (population and income effects combined).

B. Production Outlook - IEG Projections

In the Third Plan, the projected rates of growth for cereals range from 1.5 percent for teff to 4.0 percent for wheat.[17] The average for all grains would be about 3.0 percent per annum, which, even if achieved, would fall short of meeting the growth in domestic requirements. In these circumstances cereals would be expected to continue on a net import basis, and only in special situations would grains be available for export. Present indications are that on an overall basis, agricultural growth during the first 3 years of the TFYP did not exceed the targets; for grains alone, the performance is not favorable.

Pulses, in contrast to cereals, have been and are now produced in quantities that exceed domestic consumption by a considerable margin. This margin is wide for haricot beans but narrow on peas; thus, the export trade in haricots is relatively more important than in peas. The TFYP adopted targets, calling for an annual growth of production, averaging about 3.6 percent; the range was from 2.3 for field peas to 5.2 for horse beans. If domestic needs are increasing at the rate of 3.0 percent, the Plan goals would not provide for any important increase in exports of either grains or pulses. As in the case of cereals, it now appears that the progress toward producing the quantities targeted for 1972-73 is not ahead of schedule.

It is recognized in the Third Plan that the great bulk of the market-oriented production must come from commercial and semicommercial farms. Although completely dominant in terms of number and area cropped, the subsistence sector is expected to show a growth rate of less than 2 percent. At this rate, the sector would only care for its population increases, leaving the commercial producers the task of covering the requirements of the balance, which includes the growing urban sector. It was estimated in the TFYP that monetary agriculture should show almost a 9-percent growth rate if it is to provide the desired output. There has been a substantial development of large-scale production in cotton and sugar cane on commercial farms and plantations, but this development has not yet made any important impact on the output of cereals and pulses.

C. Supply - Demand Implications

Despite the poor crops of 1966, there has apparently been no substantial increase in the domestic price of cereals until 1970. However, prices of these commodities in Ethiopia have now reached a level considerably above the prevailing averages in North European markets. This

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[17] IEG, "Third Five-Year Development Plan, 1968-1973", Addis Ababa.

is perhaps best illustrated by the fact that in 1970, the average wholesale prices of barley, maize and corn in Addis Ababa were at least 50 percent above the quotations in Rotterdam. This tends to prove only that Ethiopia's price structure on grains is now import-oriented. During recent years, very limited exports of cereals, virtually all to neighboring areas, have been made at prices closely in line with those prevailing domestically. It cannot be overlooked, however, that the relatively high cereal prices have served to improve the terms of trade for agriculture in relation to the urban population, which constitutes the bulk of the buying public.

The price situation on pulses is contrary to that prevailing on cereals; in this case, the local prices are export-oriented and closely related to the fob value of the products shipped abroad. For example, the 1970 average price of horse beans in Addis Ababa was Eth. $22.6 per quintal, whereas, the fob return from exports was Eth. $22.5 (Appendix Tables C-5 and C-14).[18/] There were greater differences in certain other cases but not enough to invalidate the observation on price relationships. This situation is not likely to change as long as pulses are exported in any quantity.

As long as the disparity in pricing bases for grains and pulses persists, it will not only be extremely difficult to export grains competitively, but grains will also be abnormally competitive with other crops such as pulses, which are priced on an export basis. Appendix Table C-13 was compiled to point out this competitive situation, and the analysis would tend to support the contention that grains are currently a competitor of pulses where production returns are concerned. A firm price in pulses compared to any decline in grains would thus work to the advantage of pulses.

It should be noted that, if and when Ethiopia reaches the point of self-sufficiency in cereals, there could be a very severe downward adjustment of grain prices. It is possible that the price of one or more of the cereals could decline without necessarily causing the prices of other grains to collapse. Much depends on the extent to which consumers will substitute one product for another, and little factual information is available on this point. It seems likely, however, that a sustained drop in the price of maize, for example, would also tend to bring other cereal prices down. For some reason, seasonal price spreads on both cereals and pulses seem to have been widening in recent years. A more efficient marketing system should minimize some of these price swings.

18/ It is recognized that these prices are not exactly comparable. They represent different quality and different manner of pricing. These discrepancies, however, do not invalidate the comparison intended only to show that domestic prices of pulses are export-oriented.

D. Institutional Setting

The business "climate" of a country often determines whether export trade will be encouraged to expand or be hampered in its growth. Regulations and procedures governing the conduct of foreign trade are sometimes unduly burdensome to traders. Export promotion, if properly conducted, can be a strong element in selling commodities abroad. Services such as credit and market news also play an important role in facilitating trade. Taxes, duties and licenses can influence exports and even lead to increased smuggling in some circumstances. Another important element in the setting for external trade is the attitude of traders themselves and their ability to organize for aggressive action. In general, it appears that these various facets of the institutional setting, as they affect the export of grains and pulses from Ethiopia, are not a serious obstacle to increased trade; but neither are they a particular stimulus to such activity.

1. Ethiopian Grain Board (EGB)

After several years of being completely dormant, the EGB was revived in 1970 and is now playing a major role in the export of grains, pulses and oilseeds. The general objectives of the Board are to improve quality, to protect the nation's foreign exchange position, and to maximize export; it also has the power to regulate prices, counsel on production programs, and license grain cleaners and graders. Although organized as an autonomous IEG agency, the Grain Board is chaired by the Minister of Commerce and Industry. Several of the activities of the EGB are related directly to the export trade in grain and pulses; the more important are:

a. Issuance of export permits or certificates in which quality, origin and authorization to sell are listed. A permit will not be issued unless the Board believes the price is satisfactory; at times and for certain commodities, this permit provides the mechanism for efforts to maintain a minimum price on exports of commodities controlled by the EGB. In the institutional setting, this price control effort appears to be a source of some concern to certain exporters. The EGB certificate must be obtained as one of the steps in the process that includes certain other formalities involved in making an export sale, such as currency control and customs clearance.

b. Grain cleaners are licensed and their charges are controlled by the EGB; the maximum charge for cleaning services is currently Eth. $1 per quintal.

c. The current EGB regulations require that new bags of any type approved by the Board are to be used in exporting grains and pulses. Previously, some shipments were made in used bags that detracted from appearance and often led to loss through breakage. It should be noted that the cost of bags is increased by the tariff and tax on bags or raw materials imported. Some markets abroad are reported to prefer pulses packed in 50-kg bags; Ethiopian exporters generally use 100-kg bags.

At present, quality control consists mostly of certifying the volume of impurities in a shipment. In cooperation with the newly formed Ethiopian Standards Institution, the Grain Board is hoping to establish definitive grades that will provide a more rational basis for controlling quality in exports.

2. National Bank of Ethiopia (NBE)

Currency control regulations affecting external trade are administered by the NBE. A trader proposing to export grains or pulses must file an export declaration, covering the full value of the products to be shipped. Approval of the transaction is usually based upon a sales contract and the Bank must be satisfied that the price is in line with the going market. In some cases, forward and consignment sales are authorized. Payment for all exports must be made in convertible currency through the Bank or its authorized agents. It is reported that the NBE has recently liberalized its approval of properly documented applications for exchange to cover claims arising from differences between buyers and sellers. This has removed what was formerly a source of serious concern to foreign buyers.

3. IEG Customs Department

An export declaration supported by a series of documents, including the clearances by the EGB and NBE, must be filed at point of shipment by the exporter or his agent. It has been reported that paperwork is especially heavy on shipments through Djibouti and not much better at Assab.

A transaction tax of 2 percent ad valorem is collected on all domestic and export transactions, including those on grains and pulses. The tax on exports is payable at the time of customs clearance, and it is based on the value set by customs.

4. Ministry of Commerce and Industry (MOCI)

Aside from its role in the program of the Grain Board, the MOCI, at present, plays only a relatively minor part in the exporting of grains and cereals. However, this Ministry is primarily responsible for surveillance of all marketing in Ethiopia, and it has the potential of being a more important factor in the development of export trade. Dealers involved in the export trade are licensed by the MOCI.

The MOCI is now proposing to establish an Investment and Export Promotion Center that would be a Ministry agency but would be attached to the Ethiopian Chamber of Commerce. Although authorized by the IEG, the Center has not yet been funded. In the opinion of some observers, export promotion might be conducted more effectively as an integral part of the COC program; in this way, the business community could be more directly involved and operations could be more flexible.

5. Ethiopian Chamber of Commerce

The COC is a general, semi-public organization composed mostly of individuals and firms engaged in all lines of business in Ethiopia. Aside from providing a clearing house for information of concern to businessmen, the Chamber functions as a spokesman or mediator in representing and presenting the position of the business community to the IEG and the general public. It also sponsors trade delegations, which go abroad, seeking to develop exports. At present, Ethiopia does not have permanent commercial representation in the form of trade representatives or commercial attachés stationed in foreign markets.

Associations of exporters that are organized along commodity lines are a very useful mechanism for unified action in the common interest, such as negotiating with IEG agencies, and for providing an element of self-policing within the trade. In Ethiopia, it may be possible for the Chamber to set-up such subgroups within the structure of the general organization.

6. Ethiopian Grain Corporation (EGC)

Organized as an autonomous government agency, the Corporation is closely related to the Ministry of Agriculture, with the Minister of Agriculture serving as chairman of the EGC board. Although it is authorized to purchase and export grains, pulses and oilseeds, the EGC has not operated extensively in this trade, and there is little probability that it will soon enter the export field for its own account in any volume. Present activities of the Corporation are concerned mostly with domestic purchases; partly for price stabilization purposes but more for evening out supplies among regions. It also distributes the sizable quantity of cereals imported by Ethiopia.

Despite its primary attention to the domestic side, the EGC does, at times, supply pulses to exporters who may need additional quantities to meet sales commitments. The Corporation has also made loans to certain growers who are producing pulses for export, particularly haricot beans. A well-executed purchase program for pulses, in which price leadership aimed at giving the growers a better return is provided by the EGC, may be entirely practicable and it might be conducted at a relatively modest cost. Actually, the Corporation is currently engaged in such a program for haricot beans.

7. Commercial Bank of Ethiopia (CBE)

Financing of exporters is a major element in the credit program of the CBE. Loans for procurement of commodities are made against security in the form of facilities or inventory. The preferred type of credit, however, is based on the pledge of documents covering sales abroad. In the latter case, up to 100 percent of the proceeds may be advanced but 70 to 80 percent is more customary. Interest on short-term loans to exporters is usually 7.5 to 8.5 percent per annum. There is little or no indication that bank credit

would be readily available to enable an exporter to extend credit or supply inputs to growers; unless, of course, acceptable conventional security were provided by the borrowers. In fact, organized credit to enable farmers to engage in production for export is virtually nonexistent in most of Ethiopia.

The observations above are not intended to imply that the CBE is the only commercial bank involved in financing exporters; others also engage in it to a greater or lesser degree and on substantially the same basis.

8. Ministry of Agriculture (MOA)

Except for issuing certificates of health on foods, including cereals and pulses that are required for shipments to some markets, the MOA is not directly involved in export sales of cereals and pulses at the present time. However, the MOA, through its close working relationship with the Grain Corporation, does have some indirect influence on the export of cereals and pulses.

9. Ethiopian Standards Institution (ESI)

The Ethiopian Standards Institution was established in 1970 and is in the process of establishing standards on units and measures for the local and export trade and also for grades and quality control on coffee, hides and skins, as well as cereals and pulses, in this order of importance. The grade standards for these products are expected to be published by July, 1972. The publications by the International Organization for Standardization serve as the base for elaborating Ethiopian standards. The Experience, Incorporated project team has been of assistance to the ESI by informing them of the grade standards already established for cereals and pulses in international trade, the specifications regarding quality, and the procedures employed in inspecting the quality and issuing grade certificates.

V. EXPORT OF FEED GRAINS

About half the world's production of all grains is consumed for food and half for feed. What is feed grain in one country is sometimes food grain in another, the latter being the case in Ethiopia. Production of feed grains, sometimes called coarse grains, has increased about 50 percent in the past 15 years and in 1970 totaled about 580 million metric tons.

World exports of feed grains in the same 15 years have expanded even faster, from 4 percent of production to 8 percent of production. The exports now total 40 million metric tons. There was a five-fold increase in exports of maize and a four-fold increase in sorghum; these grains together accounted for 80 percent of the total. The United States and Argentina, alone, provided about 90 percent of the exports of maize and sorghum, while Europe and Japan received 90 percent of the imports.

The demand for feed grains in areas near Ethiopia is substantial. Imports by Israel, for example, have averaged over 600,000 metric tons in the 1966-69 period. Other countries bordering the Red Sea have averaged over 200,000 tons during the same period. This total is sufficient to provide any market that Ethiopia is likely to be able to supply in the decade ahead; without including India or Japan who also are large importers of such grains.

As has been noted, Ethiopia's exports of cereals have been negligible in recent years (less than 5,000 tons) after reaching almost 150,000 tons in the 1940's. Of late, the few shipments made have been mostly sorghum sold to neighboring countries. Conversely, imports of cereals and cereal products have reached significant levels (over 60,000 tons). Prices realized on sales to nearby areas such as Saudi Arabia, Afars and Issas, etc., have generally been closely in line with the level reported for local sales in Ethiopia. As a matter of general policy, the IEG has not subsidized exports of grains in the manner of certain other countries, particularly those using marketing boards or similar mechanisms.

A. Competitive Conditions in Feed Grain Exports

The major exporters of feed grains have economies of scale in their favor plus the advantage of low costs to ports of exit. United States merchants handle millions of tons of feed grains in bulk and consequently can work on a smaller unit margin. The United States, Argentina and Canada have the advantage of unusually low water transportation costs to and from their principal ports. The quantities handled for export attract ships with tonnage of 20,000 to 50,000 tons and higher and consequently have shipping costs that are only about one-third of what ocean ship owners charge Ethiopian exporters who handle smaller lots. A comparison is shown below:

COMPARISON OF OCEAN FREIGHT RATES

TO	FROM		
	US Gulf 20,000 Tons	Assab 20,000 Tons	Assab Under 5,000 Tons
Yokohama, Japan	US. $4.50	US$ 6.25	US$18.50
Bombay, India	7.75	3.00	16.10
Rotterdam, Holland	3.00	10.30	17.30
Mediterranean Ports	6.25	12.80	24.60

NOTE: For 40,000 to 45,000-ton shipments the rate is $1.00 less than for 20,000 tons.

In Appendix Table C-4 a comparison of Ethiopian and United States marketing costs shows that at present (Dec. 1971), United States costs for maize delivered to Israel, Rotterdam and Bombay are less than half the costs of maize exported from Ethiopia.

The competitive situation on barley and sorghum is even less favorable to Ethiopia. In the world markets barley sells at about 10 percent under maize and sorghum at 8 percent less than maize. In Ethiopia, however, market prices of these two grains are above the price of maize.

B. Export Potential for Feed Grains

Projections of production of feed grains for 1980 by FAO indicate that about 95 million tons will be available for export but that import requirements will be only about 54 million tons, thus leaving a surplus of 41 million tons of feed grains.[19] It will be the present exporting countries that are expected to expand their production the most rapidly.

In their recently published projections to 1980, the FAO stated "the thrust of the (export) projections is unmistakable; world agricultural trade is likely, in the absence of policy changes, to be faced with a widespread tendency toward an overhang of surplus supplies in international markets. The most severe problems of surpluses--and hence the most pressing need for countries to concert policies, if the harsh discipline of heavy price falls is to be minimized... are expected to arise for... coarse grains".[20] Not all observers are as pessimistic as the FAO in their forecasts,but there is little or no expectation that relative prices of feed grains will strengthen measurably during the 1970's.

C. Export Prospects for Ethiopia

It has already been stated that Ethiopian grain prices are on an import basis and that prices would have to decline over 50 percent to be

19/ FAO "Agricultural Commodity Projections, 1970-1980", Rome 1971.

20/ Ibid. 19.

competitive in major export markets at the present time. If world surpluses in feed grains develop in the decade ahead, as the FAO forecasts, major exporting countries can be expected to resort to subsidies and other incentives to maintain or increase their exports. This is already being done by theUnited States under the PL 480 export programs. Under these circumstances, it would be very costly for Ethiopia to enter feed grain export markets on a significantly expanded basis at the present time or in the near term.

In an analysis of Ethiopia's prospects for exporting maize (see Appendix Tables C-7 to C-10) under certain assumptions, it is indicated that farmgate returns in the range of Eth. $27 to $117 per ton might be realized from shipments to Europe, Japan and Israel. Within this extreme range, the estimates,based on 10,000-ton loads in bags and the 20,000-ton loads in bulk,would appear to be the maximum practicable targets. In these cases, the farmgate value would range from Eth. $63 to Eth. $85 per ton,which would certainly indicate that a maximum effort to reduce production costs would be required in order to make export sales profitable to Ethiopian farmers. More will be said on this subject in Chapter X, where overall feasibility of producing grains for export is discussed.

VI. STORAGE AND HANDLING FACILITIES

A. Present Methods

Many different methods are used to store grains in Ethiopia. The subsistence farmer may store in baskets or gourds within the home and occasionally in underground pits (gudguads) where soil conditions are suitable. Small-scale commercial farmers often use small, round, aboveground structures made of local plant materials, sealed with Chika and roofed with thatch. Larger commercial farmers frequently have larger but poorly ventilated permanent buildings where maize is stored before shelling.

Grains from peasant and small commercial farms come to market in goatskins, small bags, and sacks tied to the backs of donkeys, mules, horses, and camels. In a few of the mechanized areas, tractor trailers are used extensively. Once the grains enter the market stream they are usually handled and stored in sacks.

Storage at the market centers is usually in the common warehouses. In general, the smaller warehouses are crudely built, but the large warehouses are well-built structures, utilizing field stone and cement-sand mortar for the foundation, floor, and walls. The walls are frequently massive, averaging 1/2 meter in thickness and about 6 meters in height (3 to 8 meters). Steel reinforcing is used in only the largest, best-type structures. Roofs are usually corrugated metal, fastened and supported by a wood pole or steel framework, which forms the purlins and roof trusses.

B. Present Storage Capacity

A recent survey of the amount and condition of marketing center storage facilities available in Ethiopia, conducted by US/AID in cooperation with the Ministry of Agriculture, revealed a large concentration of warehouses in Addis Ababa, Asmara, and Nazaret. A summary of this rather detailed survey presented in the table below shows the total warehouse capacity in these three principal marketing centers to be about 300,000 tons.

Adding an estimated 20 percent for the several smaller marketing centers not yet surveyed, increases this amount to 339,700 tons. When the total capacity of the metal silos owned and operated by the Ethiopian Grain Corporation is added on, the grand total of 371,200 tons of terminal storage capacity is found to be available. What percent of this overall capacity is actually utilized at any one time for food grains is not known. Very few of the warehouses were reported full at the time of the survey. Also, this figure does not include any storage facilities available at the ports, in the small villages, or on the farms.

Grain Storage Facilities in Ethiopia

1. Warehouses in Marketing Centers:

	Tons	
(1) Addis Ababa	104,600	
(1) Nazaret	80,500	
(1) Asmara	98,000	
	283,100	
Plus 20% of above for other marketing centers	56,600	
Subtotal		339,700
2. Silos:		
(2) Addis Ababa	20,000	
(2) Other Centers	11,500	
Subtotal		31,500
(3) Grand Total		371,200

NOTES: (1) From warehouse survey data by Dr. Kenneth W. Eubanks, US/AID.
(2) From EGC data.
(3) Does not include port and on-farm or village storage.

C. Harvest, Handling and Storage Losses

1. Handling and Storage Losses

Grain losses after harvest may be caused by either molds and/or insects. All harvested grains are contaminated with mold spores, and in continuously warm regions, most grains are field-infested with grain storage insects before harvesting.

Mold spores will remain dormant if the grain is "dry" (below 12% to 14% moisture content,depending upon the kind of grain). or if damp when harvested, is dried immediately and then kept dry. Grain losses due to mold development in stored grains in Ethiopia are small,due to highly favorable dry-weather conditions during and after normal harvest seasons.

Storage insects in grains do not remain dormant in normally dried grains, but several months (three or more) are required for serious damage to occur. In Ethiopia, there is little loss of grains due to insects during the first three to four months after harvest, but grains that are to be stored for longer periods will usually need to be disinfested by fumigation or other means to prevent serious insect damage. Control of insects in good bulk storage is easier and more efficient than when the grain is stored in sacks.

Pit-stored grains have been found to be frequently and severely damaged by both molds and insects.

2. Harvest Losses

Ethiopian farmers are favored in the harvesting of most crops by the dry weather and low humidity that prevails during and following the harvesting season. All of the cereal crops, most of the oilseeds and most pulses are now harvested during the dry (bega) season. Conditions at that time are also favorable for drying, threshing, and short-term storage. Most crops, except sesame and occasionally sorghum, have low harvest losses. This is because of hand-harvesting and gleaning. Machine harvest would be expected to increase field losses in some cases. Shattering is a very serious problem with sesame. Bird damage to sorghum before harvest can be very serious. Earlier and careful machine harvest could help to reduce losses in these two crops.

D. Some Economic Aspects of Storage

1. Value of Storage

The economic benefits of good storage, often taken for granted, may be summarized as follows:

1. Reduces harvest losses of some crops
2. Minimizes physical losses after harvest
3. Maintains quality and market value
4. Provides all-season supply for local consumption and sale
5. Limits undue seasonal price fluctuations, and this usually benefits both producer and consumer
6. Improves marketing efficiency

2. Cost of Storage

Since more profit is often the incentive to more production, and storage is, in reality, a charge against production, the economic objective becomes that of providing adequate storage at minimum or competitive cost. Too often the storage problem is viewed simply as making a judicious decision between sack storage and bulk storage. But more is involved, in that the overall systems of handling, moving, and marketing are inseparable parts of the storage system. The most economical storage system for Ethiopia must, of necessity, include these types of storage:

1. Subsistence farm family storage
2. Small commercial farm storage
3. Commercial farm storage
4. Cooperative farm storage
5. Market center storage
6. Terminal storage
7. Port storage

All of these types of storage are subject to improvement in Ethiopia. On the assumption of annual per capita consumption of up to 175 kilograms of cereals, a 10-month storage period, and seven people per household-compound, a one-ton, minimum-capacity household grain storage unit is needed on some 4 million Ethiopian farms.[21] None of the several types of household storage now generally employed in Ethiopia are adequate for more than a 3-month storage period. The pit-type storage has much potential if it can be made moistureproof and airtight, which would cause asphyxiation of any insect life and prevent any mold development. This "if" clause must be resolved through a low-cost solution before pit storage can be widely recommended.

A specially adapted medium-size, combination bulk and sack-type storage is needed for the larger commercial farms and the farmer-cooperative centers now being established.

Most of the terminal storage space now consists of large warehouses suitable only for sacks, and many of these could not store sacks safely through a wet season. It appears that simple bulk storage could be introduced advantageously into several of these large warehouses. Several small metal silos, as developed by Hobbs at Alemaya but without roof or floor and with simple, bulk-handling equipment, could be progressively installed into these large warehouses. Such metal bins are easily aerated to control moisture, and fumigated when necessary to control insects by use of a gas-proof tarpaulin cover. In 1965, a grain storage program was proposed for Ethiopia, based on the construction of a range of sizes of steel, storage-silo units (from 5 to 100,000 quintals in capacity) with estimated costs per quintal varying from 4 to 8 dollars. The metal wall for the 20-ton size alone costs only Eth. $0.75 per quintal capacity--less than half the cost of new sacks. Designs were also developed for rectangular warehouses suitable for either bulk or sack storage, with estimated costs around Eth. $4.00 per quintal.[22]

One of the recently completed large, well-built warehouses inspected in the market area of Addis Ababa (7 x 27 x 32 meters) was reportedly built

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21/ FAO "Agricultural Commodity Projections, 1970-1980", Rome, 1971.
22/ Hobbs, W. & Berhe, B., A Construction Guide for Grain Storage Structures. IEC of Agr. & Mech. Arts Exp. Station Bulletin No. 24 (no date).

at a unit capacity cost of Eth. $4.80 per quintal. These figures are for storage space only. No handling equipment of any kind is included. Total annual storage cost estimates require the inclusion of several other overhead and operational cost items.

E. Conversion to Bulk Facilities for Cereals

When an entire country is equipped and geared to the sack system, many changes must occur simultaneously to convert to bulk handling and storage. Such changes will of necessity be slow, but if done in an orderly manner, much of the arduous labor of sack handling and the cost of sacks can be greatly reduced. Any change should begin at the terminal storage centers and then proceed backwards to the grain flow channels extending to the country markets, villages and farms. Any gaps in this bulk handling chain will require an emptying-filling cycle and another supply of sacks. In general, it will be poor economy to introduce any changes from sack to bulk as long as more than one cycle of filling-emptying is still required. Ideally, once grain is emptied from a sack at the first collection station, it should never have to reenter another sack, unless that sack is the marketing package. A good criterion for deciding to convert to bulk is the possibility of reducing the sack emptying-filling cycle to one.

On the assumption of 150-160 kilograms per capita per year consumption of cereals and pulses at present, and two million persons living in the urban areas, the total annual movement into the city terminals for domestic consumption would be 300,000 tons.[23/] Effective demand for warehouse space would be nearer 250,000 tons and compares with total available warehouse space of about 371,200 tons.

Converting 250,000 tons of the warehouse space now available to bulk handling and storage by installation of banks of small metal silos could provide a cost reduction of about 80 percent as calculated in the following table:

CONVERSION COSTS TO BULK

BULK

Capital Cost

250,000 tons of silos @ Eth. $10/ton	Eth. $2,500,000
Bulk handling equipment @ Eth. $ 5/ton	1,250,000
Total Capital Cost	Eth. $3,750,000

23/ Eichberger, W. G. "Food Production and Utilization", US/AID, Addis Ababa, 1966.

Annual Cost

Depreciation @	10%	
Average interest on balance @	5%	
Operation and repair of equipment @	3%	
	18%	
	Total Annual Costs	Eth. $675,000

SACKS

Total sack handling labor	Eth. $10/ton	
Sack use cost @ Eth. $1.60 per sack (used 4 times)	4/ton	
Total	14/ton	
Total Sack Costs, 250,000 x Eth. $14		Eth. $3,400,000
Total Bulk Costs		Eth. $ 675,000
Possible Savings per quintal		Eth. $1.13

The above example further assumes that any costs for conversion of transportation will be offset by possible savings in transportation costs.

If, however, completely new bulk storage silos and equipment (modern elevators) were considered at the present estimated cost of Eth. $80 per ton to build, there would be no benefit to be derived from such a conversion.

Sack storage will continue to be required for handling the pulse crops, as handling beans and peas through bulk storage often causes a high percentage of breakage and abrasion. Dried beans are handled and shipped in sacks throughout the world.

VII. TRANSPORTATION FACILITIES

A. Background

Ethiopia's ability to increase its exports of pulses and feed grains depends considerably upon the progress that it can make in improving its transportation system. Especially important is the development of low-cost penetration and farm-to-market roads, which will permit the substitution of wheel transport for pack animal transport in moving surpluses of crops from the farm to local or regional markets.

Although about 90 percent of Ethiopia's 24 million population is dependent upon agriculture for a livelihood, approximately 80 percent of this total population lives in areas that are inaccessible by modern transport. Many of these areas have a good production potential for various types of agricultural crops, including pulses and grains.

B. Means of Transport

The lack of both penetration and farm-to-market roads in Ethiopia, the most critical in Africa, results in the widespread use of slow and expensive pack animal transport--donkeys, mules, horses, and camels travel over distances ranging from 15 to over 100 kilometers. Some estimates indicate that the costs of pack animal transport are about three times that of trucks traveling on dry-weather roads and six times the truck rates on all-weather roads.

Ethiopia has an adequate and competitive motor vehicle fleet, consisting of large 10-ton trucks and 22-ton truck/trailer combinations. This equipment is readily available for hauling pulses, grains, and other commodities directly from the farms whenever access is provided.

The motor truck fleet is supplemented by rail transport, particularly on export and import traffic to the ports of Djibouti and Massawa. Assab, the third port serving Ethiopia, is an all-truck port.

C. Quantities Transported

Total volume of cereals and pulses marketed off-the-farm is estimated to range from 600,000 to 850,000 tons. After allowing for local consumption near the source of production, there would be about 425,000 to 600,000 tons[24] that could be transported by truck and rail.

24/ These estimates reflect allowance for post-harvest shrink; they represent net quantities consumed or exported.

About 35 to 45 percent of the pulses transported off-the-farm move to the ports for export; whereas, for cereals, tonnages exported were insignificant. Pulse exports now average about 70,000 tons annually, of which three-fourths move through the port of Assab and the remainder through Djibouti and Massawa.

The export movement for pulses is seasonal, being rather heavily concentrated in the five months of November through March. During this same period, other important crops such as coffee, oilseeds, fruits and vegetables are moving to export and competing for trucks and rail cars. The result is a very substantial increase in rail and truck transport rates during this heavy shipping season. These rates on export commodities are not presently regulated.

D. Possibilities for Increasing the Effectiveness of the Road System

1. Low-Cost Farm-to-Market and Penetration Roads

The substitution of truck transport for pack animal transport from the farmgate to the market is an important consideration in the marketing of grains and pulses, as well as for most of the country's agricultural development. This can be achieved through the construction of low-cost penetration and farm-to-market roads at standards very substantially below those presently being applied by the Imperial Highway Authority to their feeder road program. Nonsurfaced, well-drained roads such as those being constructed at the WADU project are adequate for the low traffic volumes expected over most of the country's farm-to-market roads during the next ten years. Since these roads are being constructed at a cost as little as one-tenth the cost per kilometer of the IHA's feeder roads, the same amount of money put into this type of construction could provide several times as many kilometers of road. This is a matter of extreme importance if Ethiopia is to increase its pulse and cereal exports.

2. Need for Connecting Centers of Production

Providing connecting links between the major production centers is another means of increasing the effectiveness of the transportation system in moving pulses, cereals and other agricultural crops. The present highway network is centered around the two large cities of Addis Ababa and Asmara, with few or no connecting links in the rural areas. Links between the production centers would increase the exchange of commodities between the surplus and deficit areas, reduce transportation costs and tend to reduce price fluctuations.

3. Lower Empty Return Ratios

Better utilization of the truck fleet is necessary to improve transport effectiveness. On a number of major routes, trucks have rather high, empty return ratios. One reason is lack of knowledge and communication between truckers and shippers in terms of the supply of and demand for the equipment. Another is the seasonality of the export movement, which may be due to lack of storage facilities and/or lack of credit.

A means of improving communications between shippers and truckers is through the expansion and increased use of truck brokers. There are some truck brokers operating in the Addis Ababa and Dese areas who bring truckers and shippers together for a nominal fee. Further expansion of these brokerage services into other major production centers as the road system improves should assist in reducing the large, empty return ratios. Measures recommended elsewhere in this report concerning increased storage facilities and the expansion of cooperatives should assist the exporters in reducing the seasonal export peaks and thus reduce the present seasonal peak transport rates by both truck and rail.

4. Removal of Restrictions on Truckers in Eritrea Province

Eliminating the restrictions imposed by the Northern Ethiopian Railway on the operations of trucks to the port of Massawa as well as throughout the Province of Eritrea will also improve the utilization of the truck fleet with reduced costs to shippers. Through a licensing system for trucks, the Railway is exercising a monopoly that has serious economic and social consequences on the development of the Province.

5. Opening of the Awash-Tendaho Highway

The opening of the Awash-Tendaho Highway, scheduled for September 1973, opens up a rich agricultural area. Of even greater importance, however, is the fact that it will provide a paved-surface route to the port of Assab with much easier grades and curves than the present Addis Ababa-Assab highway, which has many gravel sections in difficult mountainous terrain. Calculations indicate that truck-trailer cost savings (using the new route from such major centers as Addis Ababa, Nazaret, Shashemene, and Asella to Assab) would permit a reduction, even in the low, off-season export rate, of about 30 percent. This assumes that the present high rates on inland movement of imports, set by the government, remain the same.

VIII. PRODUCTION AND MARKETING COOPERATIVES

Two principal difficulties facing developing nations are:

1. Inadequate, slowly available, and high-cost inputs, i.e., fertilizer, improved seed, equipment, credit, etc.

2. Lack of an available, orderly market that will provide a fair price for products produced, especially by the small and medium-size farm sector.

Most years, Ethiopia is generally self sufficient in staple food crops, though poor distribution frequently leads to near famine conditions in some areas and surpluses in others.

Agricultural production input (supply) and output (marketing) cooperatives appear to have an important potential for providing fair prices for needed inputs and for products marketed.

A. Present Situation

A cooperative law was passed in 1966, and a training center for cooperative organizers and personnel is presently operating at Awassa. Professional expatriate cooperative personnel are active in Ethiopia, particularly in the CADU project area.

An August, 1971, report lists 77 cooperatives registered or in the process of being registered in Ethiopia, with 10,113 members. [25] Of this number, 51 are listed as multi-purpose, with 6,351 members. Few of these 51 are cooperatives in the modern sense. Several of those recently formed are concerned primarily with coffee marketing. None of these has as many as 1,000 members and all had less than Eth. $70,000 in paid-up share capital in 1969. The National Coffee Board announced in December, 1971, that it is assisting in the formation of 12 new coffee cooperatives to be in operation in 1972.

Probably the largest marketing cooperative is at Setit Humera, with over 500 members, Eth. $230,000 in paid-up share capital, and an annual volume of over Eth. $3,000,000. The volume of business of this cooperative will vary from year to year, depending on production and price of sesame, sorghum, and cotton.

Present emphasis by the Community Development, Cooperative Development, and Extension Service Departments is on input (supply) cooperatives using fertilizer as the principal "vehicle". The best example of

[25] Report by Mulugetta Kassa, IEG, Ministry of Agriculture, August 1971.

the formation of such a cooperative is the Dankaka cooperative in the Debre Zeit area. In the third year of organization effort, the cooperative was formed with a membership of 70 farmers who contributed Eth. $4,591. It appears to be on sound footing, is growing, and has expanded into product marketing, selling improved seed, and credit.

B. Apparent Difficulties in Organization

A recent report based on a sample survey of cooperatives in Ethiopia described the problems facing organization of new cooperatives or expanding existing ones.[26]

1. Inability of peasant farmers to read and write
2. Lack of cooperative education and educational facilities
3. Lack of knowledgeable cooperative workers
4. Inadequate feasibility studies before attempting establishment of cooperatives
5. Inadequate financing, especially in early stages of development
6. Problems of land tenure and small holdings
7. Suspicion toward any project requiring cash contributions before rendering service, basically a fear of loss of the contribution due to misappropriation or poor management

These problems are not listed in order of importance and there may be others. One other problem involves the lack of coordination or cooperatio among government agencies and their personnel in the field. This may not be serious but was found to exist.

C. Prospects for Establishing New Cooperatives

There are apparently no political deterrents to establishing either input, output or multi-purpose cooperatives in Ethiopia, nor are there such deterrents to increasing the size of existing cooperatives. There are, however, problems of educating farmers to take such action and perhaps even greater problems of guiding and staffing the cooperatives in the beginning years.

Three groups of farmers might expect to encounter these and other problems in varying degrees.

1. The peasant farmer using the EPID Minimum Package as a base is receiving greatest attention from the government. This group is also expected to have the greatest problems of member education and funding.

26/ "Assistance in the Field of Promotion of Cooperatives", IEG, Ministry of Agriculture, October, 1970.

Peasant farmers are expected to move into the input or supply cooperative first, using fertilizer as the primary incentive. Based on recent experience in establishing cooperatives within this segment, it would appear possible to establish 7 to 12 cooperatives by 1977.

2. Certain commercial farmers are interested in output (marketing) or possibly multi-purpose cooperatives. There is no problem of education, but there remains the problem of funding and staffing a larger and more sophisticated cooperative. It is believed that a cooperative made up of commercial farmers would have relatively few members. One to three cooperatives involving this segment of farmers may appear by 1977.

3. The medium-scale farmer is more difficult to analyze. They are frequently educated people but are neither large enough to own large machinery nor small enough to be efficient with primitive methods. Until more specific information is available on this segment of farmers, one would suspect they might join the supply cooperative of the primary peasant farmer and the marketing cooperative of the commercial farmer. This group would be expected to benefit most from a machinery input cooperative if such were established.

Due to the time required to establish, staff, and adequately fund peasant farmer cooperatives, the logical conclusion is that multi-purpose or marketing cooperatives of this group will have little impact on prices received during the coming 5 years. Prospects are more promising over the longer term, and in fact, this may be the only effective route toward bringing the peasant farmer into the monetary sector of the economy.

D. Agricultural Development Programs Related to Export Production

On January 1, 1972, there will be five area development projects functioning or approved for operation.

1. Chilalo Agricultural Development Unit (CADU) was established in September, 1967, by agreement between the Swedish International Development Authority (SIDA) and the Imperial Ethiopian Government (IEG). Main crops are wheat, barley, teff, maize, pulses, and vegetables.

2. Wolamo Agricultural Development Unit (WADU) was established in 1969 and is being funded with the assistance of the International Development Association (IDA) of the World Bank. The major crops in the area are maize, coffee, and cotton.

3. The Ada District Development project will be activated in 1972. The main crops of the area are wheat and teff. US/AID will assist in funding and implementing this project.

These three projects will be directed primarily toward the peasant farmers and the development of institutions for their benefit.

4. The Humera Agricultural Development project is located in the northwest lowlands. This project was established in 1970 with funds extended by IDA of the World Bank. The major crops are sorghum, sesame, and cotton.

5. The Awash Valley Authority is concerned with a different type of development and is not a formal project. The Authority was developed in 1954 as a chartered agency charged with the task of developing the natural resources of the valley. This includes conducting surveys, administration of water rights, control of water flow, and coordinating activities of ministries and public authorities in the valley area.

Both the northwest lowlands area and developments resulting from the Awash Valley Authority activities are immediately more nearly associated with commercial-scale farming than with the subsistence farming sector.

E. Short-Term Contribution to Exports

It is unlikely that the CADU, WADU, or Ada projects will contribute significantly to agricultural exports in the next 3 to 5 years. It is possible that CADU can significantly contribute to minimizing imports of wheat and malting barley in the 5 to 10-year term.

The CADU project area is doing an excellent job in wheat production, and experimental work with barley is progressing. Land is available for increasing output of pulses and, more particularly, haricot beans. If price incentives are suitable, this project area could be expected to:

1. Contribute modestly to export of pulses
2. Assist in reducing imports of wheat
3. Provide a beginning for reducing imports of malting barley

The objective of WADU is to make that project area self-sufficient in food and feed. Pulses can be grown but are not expected to reach export proportions due to local need for subsistence food.

Since the Ada project area is only beginning active operation in 1972, it is doubtful if this area will significantly change its pattern of production in the next 5 years.

The northwest lowlands project area at Setit Humera is expected to export oil crops (sesame), provide cotton for domestic use and provide sorghum for perennially deficit portions of Eritrea and Tigre provinces. Thus, there is little, if any, opportunity for exports of cereals or pulses from this project area.

The Awash Valley Authority is creating conditions favorable for future exports of certain pulses. In the foreseeable future (next 5 years), the profitability of cotton is expected to limit introduction of other crops

not now grown in quantity. Beyond this time, significant changes may occur.

One must conclude that the existing development project areas are not likely to contribute significantly and directly to export of cereals and pulses in the near term. Indirectly, through advice to commercial farmers, some contributions may be made.

IX. AGRICULTURAL EXTENSION, EDUCATION, AND RESEARCH

A. Introduction

An Extension Service was established for Ethiopia in 1952. The pattern that evolved was influenced by Oklahoma State University and followed the triumvirate system (resident teaching, research, and extension), which has been a part of the Land Grant University system in the United States for more than 100 years. As the Oklahoma State University phased out in Ethiopia, financial problems, among other things, dictated that the "Land Grant System" be abandoned. After a second Ministry of Agriculture reorganization in 1969-70, the Extension Service became the Extension and Project Implementation Department (EPID) of the Ministry of Agriculture.

The 1970-71 Master Plan for the EPID indicates that two main thrusts will be made on behalf of the farmers of Ethiopia.

1. Encouragement of commercial farming to improve the foreign exchange position and availability of raw materials, and,

2. Development of peasant agriculture to raise the standard of living for the majority of Ethiopia's population.

In January, 1972, little had been done to implement the first point, but appreciable activity was underway in support of the second.

B. Organization and Personnel of the Extension Department

In order to understand extension's potential and limitations, it is necessary to understand the structure of the present EPID in relation to the Ministry of Agriculture. A flow chart is shown in Figure C-1 of the Appendix.

Organization of the Ministry of Agriculture is now patterned, in part, after the recommendations of the 1970 Rockefeller Foundation team. Certain significant changes from the initial recommendations of the team have altered the administrative flow of authority. It appears quite possible that the several essentially autonomous "departments" and projects attached to the MOA will result in coordination problems in the future.

Communications with field locations are difficult and frequently slow. The field staff frequently lacks mobility due, in part, to type of transportation available, difficulty of keeping some types of transportation functioning, and to budget limitations.

The headquarters technical staff is not presently adequate to handle field staff training and supervision, and also to supply needed technical support. More personnel with greater specialization cipated in the near future.

Extension field supervisors, both in and out of the 9 Minimum Package areas, are college graduates. They range in field experience from a few months to several years of service. Those contacted appear unusually competent.

The extension field staff appear quite capable of handling their present assignments, when their lack of technical supervision is considered. Additional technical in-service training and specialization would allow these men to handle anticipated needs of the peasant farmers.

Extension agents are usually "diploma" men from either the Jimma or Ambo Institute of Agriculture. Assistant extension agents have a formal education of tenth to twelfth grade. They normally have at least 6 months of practical training at Bako or in the CADU project area. These men are usually assigned to their home area.

Trade Center foremen in the Minimum Package Areas normally have no more than an eighth to tenth-grade education plus 4 to 6 weeks of intensive in-service training. The men may become assistant agents as a promotion. The Trade Center organizers may have up to a twelfth-grade education plus in-service training with established extension agents.

1. Capability and In-Service Training

The technical staff responsible for much of the in-service training consists of two sections:

1. Agronomy. One senior agronomist recently recruited from the position as nominal head of the Debre Zeit research station. There are 4 agronomists (all Ethiopian): a cereal crop specialist, a legume and oilseed specialist, a soils man, and a crop protection specialist. There are also two expatriate (FAO) fertilizer specialists and one agronomist attached to the SIDA group.

2. Marketing and Credit. This section consists of one senior economist and two economists, all Ethiopian.

These men may have suitable expertise for their present assignments, but it is too much to expect them to be fully qualified in their wide range of responsibilities.

Overall, the extension field staff must be considered quite capable. Alemaya graduates appear knowledgeable, resourceful, and confident. Observations on their administrative ability were too limited to justify

conclusions. Jimma and Ambo "diploma" men function as extension agents and may be promoted to assistant supervisors. The men are carefully screened before being admitted to the schools and are given an excellent course of instruction and training by a dedicated staff. They are required to have both knowledge of and experience with all peasant farming operations. They receive more extension education training than most extension field workers in the United States. Their technical and interpretive knowledge may be limited, but their applied knowledge appears quite good. Most are capable and confident.

Special in-service training is provided at Bako for selected staff members. Two former extension agents conduct most of the training but receive valuable assistance from the research station staff at Bako. Other in-service training covering the same general course work is given at CADU. This group also gives extensive credit and cooperative background training. The staff of CADU project does much of the teaching.

General in-service training for field staff is varied and apparently well done. The number of days varies from year to year, but no less than two weeks of total training in any year is provided. Technical agronomic training appears inadequate in light of the very heavy agronomic orientation of the present extension program. Headquarters staff specialists handle much of the regular in-service teaching.

2. Relations with the Commercial Farming Sector

The Master Plan of EPID for 1970-71 recognized the need for action directed to the commercial farmer to enhance agriculture's contribution to Ethiopia's balance of trade. Apparently, no educational activities have been initiated in this group's behalf, nor does there appear to be any probability that action will be taken in the near future. Commercial farmers can, on their own initiative, gain information from observation areas, demonstrations, Minimum Package programs, and directly from the research stations.

One must make the judgment that the divisions and departments of the Ministry of Agriculture and the essentially autonomous units are not staffed, funded, or directed to work with the commercial farmer. From the point of view of this study, EPID is contributing relatively little to this potentially important export segment of the farming sector.

3. Staff Adjustments Needed

Since agronomic efforts are underway to help the peasant farmer and cooperative organization efforts are also planned, these comments will be directed toward the commercial farmer but not exclusively to him.

The Extension Division must have additional, highly qualified specialists on the staff, who would have direct and continuing contacts with the Institute of

Agricultural Research. At this time, a minimum addition to the staff should consist of:

1 Soil Survey Specialist
1 Soil Chemist and Fertilizer Specialist
1 Agronomist for sorghum and maize
1 Agronomist for pulses, especially beans
1 Entomologist for economic crop plants
1 Plant Pathologist for economic crop plants
1 Agricultural Climatology Specialist
1 Farm Organization Economist (crops oriented)

These men must be trained to the M. S. level, be fully supplied with "tools of their trade", be completely mobile and be required to work as a team, using a complete problem-solving approach. These positions are essentially over and above the existing staff structure.

These specialists would have the responsibility of technically training the field extension staff, advising with commercial farmers on their problems, bringing research needs to the attention of IAR, and assisting in or originating applied interpretations of research.

There is no reason why this staff, in cooperation with the Institute for Agricultural Research, should not conduct simple but needed agronomic research at locations away from the experiment stations. They should also be given the responsibility, in cooperation with the field extension agents, of interpreting experiment station research for the commercial farmers.

Ethiopia has a good basic extension staff, but questions must be raised as to whether the "demonstration" programs are the most logical base on which to build a long-range educational effort for the farm sector. Other questions must be raised about the effect of the essentially autonomous special project areas on the long-range extension educational efforts. A final question for the longer term is that of extension not being involved with family living, nutrition, and youth activities.

C. Status of Applied Agronomic Research

The following is a summary of the situation in January, 1972, relating to the status of research on various cultural practices for selected crops under consideration by the Experience, Incorporated study team.

CROPS

	Maize	Sorghum	Barley	Haricot Beans	Chick Peas	Horse Beans	Lentils	Other Pulses
Improved Varieties [4]	1	2	2	2	3	3	3	3
Fertilizer Use	2	2	2	2	3	2	3	3
Plant Spacing	1	2	-	2	3	2	3	3
Plant Density	2	2	1	1	2	2	2	2
Seeding Methods	2	2	2	2	3	2	3	3
Climatic Limitations	2	2	1	2	2	3	3	3
Weed Control	1	2	2	2	3	2	2	3
Disease Control	3	3	2	3	3	3	3	3
Insect Control	3	3	3	3	3	3	3	3
Time of Planting	1	2	2	2	2	2	2	3

1. Ready for extension dissemination with judgment.
2. Ready for demonstrations to check local adaptation.
3. Research inadequate, not ready for dissemination.
4. Several of the indicated "practices" including improved maize varieties are given the specific ratings for each crop with the understanding that associated known desirable practices will be imposed simultaneously with the specific practice under consideration. A rating of (1) does not suggest that additional research work is not needed.

1. Research and Research Needs

It is essential that well-coordinated research programs be developed for all cereal crops, including varietal improvement, agronomic practices, and disease and insect control. Trials should be carried out in major production areas of the crops concerned. The Institute of Agricultural Research (IAR) has made a very impressive start on such programs. These activities should be broadened and intensified; priorities also need to be established.

Certain inputs are needed to remove existing obstacles to increased production. These obstacles can be largely eliminated through research, education, and limited production incentives. Removing these obstacles will require attention to the following inputs:

1. Improved, adapted varieties made available to and used by producers;

2. Improved cultural practices for more satisfactory seed beds and more suitable stands;

3. Attainment of acceptable levels of weed control to minimize competition and allow most efficient use of moisture and plant nutrients;

4. Use of at least minimum levels of fertilizer as needed to supplement soil supplied nutrients;

5. Reduction of disease and insect problems through use of tolerant varieties, appropriate cropping patterns, improved cultural practices, and supplemental chemicals when necessary;

6. Assistance with harvesting, storage, and marketing techniques made available so that losses of grain produced are held to a minimum and the producer receives a fair price for his crop.

2. Suggested Research Priorities

1. A thorough screening program for maize, sorghum, barley and pulses should be instituted immediately and the materials planted for observation at all locations where there is an economic production potential. Three years should provide a suitable primary screening period. The surviving material should provide an effective germplasm and variety pool for future rapid gains.

2. Simple, effective machinery must be developed for seed bed preparation, planting, and handling of products.

3. Interplanting of crops must be studied at all locations where weather is suitable.

4. A soil testing laboratory, with provision for appropriate field research, must be established, funded, and staffed to minimize errors in fertilizer use.

5. Weed control measures, cultural and chemical, must be studied and evaluated for different types of farming operations and for different crops.

6. Information must be gathered to determine, for Ethiopia, the most effective method of procuring and maintaining improved seed supplies for all principal commercial crops. Production and marketing facilities should be established and placed in operation as soon as desirable materials become available. It is believed that different seed production facilities and marketing methods may be required to meet the needs of various groups of farmers.

X. OVERALL FEASIBILITY OF EXPANDING EXPORTS OF FEED GRAINS

Based on official IEG data, production of all cereals in Ethiopia increased from 4.5 million metric tons in 1961 to 5.5 million in 1970. This represents an average annual increase of approximately 2 percent, slightly less than the estimated 2.2 percent population increase.

The 1964-65 estimates have been revised considerably for all cereals except maize, but there is no evidence that proportional hectarage among most crops actually changed. Except for 1964-65, hectarage shows a remarkably regular upward trend as to yields. It is not reasonable that such consistency would persist over a 10-year period; therefore, the IEG data must be considered suspect. One must conclude that there is no suitable or conclusive evidence on which to base trends in yields, crop area or production.

A. Market Outlook

Since 1958, there has been no significant trend in exports of cereals from Ethiopia. The yearly average has been about 3,000 metric tons, with a wide range from 100 to 5,200 tons in annual shipments. Similarly, there was no significant trend in imports of cereal grains until 1970. It is not known if the large increase in wheat and flour imports in 1970 represents the beginning of a new trend. If the increased receipts of imported wheat continue and the domestic price of all cereals remains high, it will be a positive indication that local production is lagging behind the market needs. Domestic demand in 1970-71 has been strong enough to raise prices to an import-level basis.

At the present and anticipated world prices for maize, and even in most favorable circumstances, the farmgate value of exported maize in Ethiopia could not be much above Eth. $9 per quintal. Barley and sorghum usually sell for 8 to 10 percent under maize in the world market; thus, farmgate prices for these grains would have to decline even more than maize prices in Ethiopia in order to compete in the export market (without subsidy).

Malt imports, for the production of beer, have been increasing steadily since 1967 and are expected to continue to grow at least until 1975. Production of malting barley is possible in Ethiopia. The Imperial Ethiopian Government could easily "stimulate interest" in producing malting barley to meet domestic needs; e.g., by discouraging imports and by emphasizing this crop in the research and extension programs.

B. Production Outlook

Increased production of cereal grains in Ethiopia should be considered in two time periods: the near-term (3 to 5 years), and the longer-term (more

than 10 years). In the near term period, only adoption and use of presently known technology should be given attention because it is unlikely that new technology and facilities can be generated in so short a time. In the longer term, new technology may be generated, additional irrigation opportunities may appear, new roads may be built, and changed institutional settings may emerge.

Data from maize experimental work, using improved varieties and improved cultural practices, indicate that yields can be increased in the near term. The principal problem is to get the practices adopted. Doubling yields on commercial farms in the near term is possible. In the longer term, commercial farm yields would be expected to increase still further and yields on subsistence farms could be doubled. Prospects for exceeding the domestic maize requirements in the longer term are quite favorable.

Expanded production of sorghum will likely come from increased hectarage in the near term. There are few, if any, known superior varieties not now being used, and very limited research on cultural practices is underway at present. Also, present areas of other than subsistence production are found primarily in locations with less dependable weather.

In the longer term, improved varieties of sorghum can be expected to more than double yields on commercial farms, stabilize yields under unfavorable weather conditions, and provide opportunities for complete mechanization. Research on crop nutrient needs and cultural practices will make possible additional increases. It appears unlikely that production beyond subsistence demand will take place on peasant farms.

Increased production of wheat and barley above domestic demands does not appear likely in the near term. Most of this production comes from the peasant farming sector, and prospective profit opportunities on wheat and barley will probably not attract the commercial farming sector away from other alternate crops in most areas. Pressure for malting barley production, with production incentives, can make Ethiopia self-sufficient in that commodity in the near term. This, however, would require no more than one percent of the present barley hectarage.

C. Export and Import Substitution Outlook

The Third Five-Year Plan (TYFP) projected the rate of growth for all cereals at 2.6 percent. Growth rates projected for individual crops show maize at 3.3, wheat at 4.0, teff at 1.5, barley at 2.3 and sorghum at 2.8 percent. Since the validity of the IEG agricultural data has been questioned, there is no way of knowing with certainty the progress being made toward the projected goals. Considering the firm price of these cereals in the 1970-71 market year, there is at least an indication that production is not keeping up with domestic demand.

If world prices of cereal grains were to increase, the principal exporting nations at the present time could and probably would expand their production quickly. This would in turn depress world prices again. With only a partial removal of constraints in the United States in 1971, the 1971 maize crop was 35 percent, or 49 million metric tons, greater than in 1970. This experience is cited only to demonstrate the great world production potential for maize, in spite of low profit levels, provided there is favorable weather and removal of production constraints.

There seem to be no apparent constraints to producing enough malting barley, even in the short term, to meet the needs of the brewing industry in Ethiopia. Price incentive and availability of satisfactory seed should readily bring about the desired results in this case. Substitution of local wheat for imports poses certain problems but they are not believed insurmountable.

As an example of export prospects, for Ethiopian maize to enter and compete in the world export market, the following conditions appear necessary:

1. Increased annual production of 500,000 to 1 million tons.
2. Reduction of production costs to less than Eth. $10 per quintal.
3. Establishment of suitable storage and carry-over stocks equivalent to about 5 percent of the annual production (about 500,000 tons of maize).

Substantially increased output is necessary to make feasible a change-over to bulk handling and storage. This change-over appears necessary, if marketing costs are to be reduced, so that a residual farmgate return of about Eth. $10 per quintal might eventually be achieved.

Production costs must be considerably less than Eth. $10 per quintal, and at the same time, total production must be increased by 10 percent or more, if Ethiopia is to seriously consider an effort to export maize in quantity.

A preliminary analysis of farmgate returns theoretically available on maize exported from Ethiopia to selected markets has been made as a part of the study on which this report is based. Various assumptions have been made on size of shipment, bag or bulk handling, and points of production. In this analysis, it is indicated that the farmgate return on maize exported in bags might range from Eth. $27 to Eth. $73 per metric ton, depending upon point of production, marketing methods employed and quantities handled. On shipments handled in bulk, the farmgate value is indicated to be Eth. $73 to Eth. $117 per ton, depending mostly on volume exported and size of shipments. In all cases, these particular estimates are based on "most favorable" situations; in other assumptions, the farm-

gate value could range downward to even a negative return. In the short term, it is considered highly improbable that the "most favorable" situations can be achieved in Ethiopia. Over a longer time, however, the outlook is somewhat more hopeful,provided some or all of the conditions outlined above can be met.

APPENDIX B
(PART B)

TABLE B-1. MONTHLY WHOLESALE PRICES OF BARLEY IN NAZARET AND ADDIS ABABA 1967-1971

Month	1967	1968	1969	1970	1971
		(Eth. $/quintal)			
		NAZARET			
January	12.00	12.45	12.43	16.16	19.66
February	11.83	12.93	11.43	15.50	17.41
March	12.50	12.31	11.80	-	19.87
April	12.91	12.40	12.50	18.75	20.50
May	14.00	12.06	12.12	21.66	25.00
June	16.50	12.25	14.50	21.00	-
July	16.66	12.10	-	-	-
August	16.16	13.25	-	28.00	-
September	15.87	13.30	-	28.00	25.00
October	15.85	13.12	-	30.00	13.21
November	15.66	11.37	-	19.83	12.37
December	13.06	11.55	17.00	19.25	14.00
		ADDIS ABABA			
January	15.00	15.29	14.20	16.73	22.07
February	14.31	14.50	14.20	15.57	21.20
March	14.09	14.50	13.58	16.78	19.77
April	14.41	14.50	13.48	20.92	22.50
May	15.21	14.50	13.50	22.79	23.70
June	15.49	14.37	13.94	22.75	23.25
July	15.54	14.40	15.45	24.77	24.20
August	16.96	14.05	15.00	26.64	25.20
September	17.14	14.24	16.17	28.20	24.44
October	16.63	14.50	16.85	26.93	23.70
November	13.34	14.00	17.86	23.49	18.26
December	15.60	13.98	17.68	24.70	15.73

SOURCE: Ethiopian Grain Corporation

TABLE B-2. WORLD TRADE IN MALT [a] 1964-1969

Country	1964	1965	1966	1967	1968	1969
	(000 metric tons)					
	EXPORTS					
Europe	537.2	554.2	597.0	646.3	717.0	856.3
North & Central America	126.2	102.1	111.2	117.6	112.5	111.4
South America	25.1	22.5	30.3	27.4	32.0	-
Asia	-	-	1.8	2.9	2.4	.5
Africa	.7	1.4	4.4	2.0	2.7	5.6
TOTAL	763.2	753.9	829.6	891.1	951.3	1,081.1
	IMPORTS					
Europe	330.2	354.2	369.2	389.3	398.2	454.2
USSR	6.5	27.8	33.8	54.8	51.7	90.4
North & Central America	53.1	46.8	50.2	52.6	52.0	53.5
South America	108.0	98.3	123.1	124.8	116.8	139.5
Asia	133.6	104.0	125.1	134.0	184.7	193.4
Africa	66.4	79.4	102.9	81.1	93.8	115.5
Oceania	2.0	2.2	2.6	3.0	4.1	4.5
TOTAL	699.8	712.7	806.9	839.6	901.2	1,051.0

[a] Including malt flour

SOURCE: Trade Year Book Vol. 24, 1970. FAO, Rome

TABLE B-3. MALT [a] FOREIGN TRADE OF SPECIFIED COUNTRIES 1964-1969

Country	1964	1965	1966	1967	1968	1969
		(000 metric tons)				
		EXPORTS [b]				
Belgium - Luxembourg	96.9	104.3	107.6	116.2	132.5	173.3
Czechoslovakia	156.8	177.8	192.2	204.8	207.5	- [c]
Denmark	28.1	31.0	28.1	21.7	25.8	32.0
France	110.5	115.3	115.7	138.0	166.5	222.0
West Germany	38.0	33.6	44.8	51.1	41.4	79.2
Ireland	9.5	7.2	8.1	7.4	11.5	10.7
Netherlands	4.5	3.2	4.3	6.4	4.7	10.6
United Kingdom	47.8	39.6	40.9	49.0	76.6	69.1
Canada	85.4	69.8	70.4	89.1	82.6	84.3
United States	40.8	32.3	40.9	28.5	29.9	27.1
Australia	74.0	73.6	84.9	95.0	84.7	72.1
TOTAL	692.3	687.7	737.9	807.2	863.7	780.2
		IMPORTS [d]				
Belgium-Luxembourg	12.4	8.5	7.7	10.4	12.6	32.6
West Germany	125.6	125.1	123.6	115.0	106.5	100.7
Italy	35.6	39.7	44.9	48.6	49.1	42.9
Netherlands	16.4	22.9	23.2	30.0	35.3	43.3
Spain	19.2	15.8	14.9	25.0	27.4	32.0
Sweden	8.3	10.0	11.4	14.7	16.6	26.1
Switzerland	79.1	78.2	78.0	91.4	81.8	89.9
United Kingdom	6.3	14.4	21.4	11.2	10.2	21.5
Yugoslavia	17.8	25.1	28.6	27.4	42.4	40.8
Brazil	49.3	45.4	63.1	59.9	47.6	71.4
Venezuela	42.0	44.7	45.3	49.9	57.9	57.9
Japan	67.3	36.3	51.3	55.0	99.2	107.4
Philippine	28.5	30.7	27.6	35.9	42.8	38.5
Vietnam Republic	10.9	12.6	14.0	8.0	10.8	13.8
Congo Dr.	17.4	24.5	27.3	15.1	22.5	23.1
Nigeria	9.5	10.4	12.0	8.0	11.0	20.0
South Africa	7.4	5.6	14.9	9.0	7.9	15.0
TOTAL	546.7	549.9	609.2	614.5	681.6	776.9

a/ Including malt flour

b/ There are 25 exporting countries

c/ Not available

d/ There are 100 importing countries

SOURCE: Trade Yearbook, 1970, FAO, Rome

TABLE B-4. WORLD TRADE IN BARLEY BY CONTINENTS AND SPECIFIED COUNTRIES, 1964-1969

Country	1964	1965	1966	1967	1968	1969
			(000 metric tons)			
			EXPORTS			
EUROPE						
Denmark	149.6	314.1	192.2	212.3	155.9	-
France	2,583.7	1,724.5	1,838.0	2,374.9	3,062.8	3,153.4
West Germany	39.9	30.9	45.4	20.5	7.8	134.1
Netherlands	161.9	163.4	121.9	135.8	129.4	149.4
Spain	-	-	-	-	-	-
Sweden	95.5	120.1	47.0	153.7	122.3	202.9
United Kingdom	89.4	199.1	996.0	929.4	600.4	10.0
Other	140.3	153.5	238.2	346.4	187.0	139.4
	3,260.3	2,705.6	3,478.7	4,173.0	4,265.6	4,396.9
USSR	665.8	2,067.9	290.4	452.4	614.4	748.4
NO. & CEN. AMERICA						
Canada	912.3	725.9	714.3	1,184.6	688.2	657.1
United States	1,562.8	1,388.8	1,327.3	832.2	346.0	142.5
	2,475.1	2,114.8	2,041.7	2,016.8	1,034.2	799.6
SOUTH AMERICA						
Argentina	535.8	299.8	114.5	65.1	181.6	208.5
Other	3.0	2.7	3.3	-	.7	2.9
	538.8	302.5	117.8	65.1	182.3	211.4
ASIA						
Iraq	24.8	127.5	149.9	11.0	39.0	81.9
Syria	208.0	244.8	17.1	34.1	104.5	273.1
Other	59.6	95.1	21.8	21.7	7.0	11.5
	292.4	467.4	188.8	66.8	150.5	366.5
AFRICA						
Algeria	251.6	8.8	47.7	5.1	-	-
Morocco	74.1	6.6	-	-	10.1	133.3
Other	25.2	7.8	22.5	1.2	.5	.4
	350.9	23.2	70.2	6.3	10.6	133.7
AUSTRALIA	402.7	369.2	226.7	424.5	129.3	450.7
TOTAL	7,986.0	8,050.5	6,414.2	7,204.8	6,386.8	7,107.2
			IMPORTS			
EUROPE						
Austria	233.3	311.2	245.8	165.9	131.1	119.6
Belguim-Luxembourg	224.4	364.2	413.4	522.9	512.9	602.8
Czechoslovakia	395.8	641.3	134.9	181.9	125.0	174.7
Denmark	478.3	344.0	377.0	375.2	248.8	15.7
East Germany	219.0	289.0	126.0	203.0	170.0	219.0
West Germany	1,203.9	1,380.0	1,581.7	1,615.3	1,269.9	1,324.0
Italy	587.0	862.6	1,004.0	832.6	1,094.3	1,055.0
Netherlands	223.2	291.2	207.8	200.7	174.3	196.4
Holland	287.4	485.5	139.3	418.3	545.4	375.2
Switzerland	249.7	271.4	352.6	422.9	394.1	423.9
United Kingdom	344.0	285.3	127.5	221.6	72.0	650.9
Other	1,232.5	1,248.5	753.4	608.0	330.2	295.5
	5,678.5	6,774.2	5,463.4	5,768.3	5,068.0	5,442.7
NO. & CEN. AMERICA						
United States	265.2	125.7	125.3	155.9	162.0	214.6
Other	87.8	116.9	74.0	40.8	56.7	40.0
	353.0	242.6	199.3	196.7	218.7	254.6
SOUTH AMERICA	55.4	55.6	86.9	50.5	74.1	85.3
ASIA						
China, Mainland	567.5	23.6	-	-	.3	-
Japan	471.0	635.5	447.3	602.7	634.4	676.5
Korea Republic	194.4	105.8	7.2	3.0	154.6	107.1
Other	148.3	220.2	306.2	291.9	253.7	308.9
	1,381.2	985.1	760.7	897.6	1,043.0	1,092.5
AFRICA	40.0	53.7	115.6	165.0	68.2	76.0
OCEANIA	-	-	.1	-	3.3	30.4
TOTAL	7,508.1	8,111.3	6,626.0	7,078.1	6,475.3	6,991.5

NOTE: Countries exporting 51, importing 78.
SOURCE: Trade Yearbook, 1970, FAO of United Nations, Rome

TABLE B-5. MALT IMPORTS BY COUNTRY OF ORIGIN 1967/1970

Country of Origin	1967	1968	1969	1970	1967	1968	1969	1970
	(Tons)				(Eth. $)			
Belgium	350.0	1,035.0	1,965.0	400.0	113,751	413,385	694,243	145,945
West Germany	5.0	10.0	503.5	654.6	4,754	9,356	306,033	255,458
United Kingdom	7.5	4.5	10.8	30.0	4,190	3,762	5,308	15,634
Denmark	456.8	200.0	375.0	400.1	171,361	84,237	122,558	149,371
Austria	12.8	-	-	-	7,123	-	-	-
Poland	100.0	-	-	-	36,370	-	-	-
Czechoslovakia	950.0	1,350.0	399.9	1,200.0	369,669	529,001	158,803	448,500
Bulgaria	200.0	-	-	-	78,500	-	-	-
Holland	-	4.6	6.0	8.2	-	3,456	4,505	6,400
Australia	-	50.0	-	-	-	16,230	-	-
Switzerland	-	-	5.0	-	-	-	3,750	-
France	-	-	-	1,520.0	-	-	-	573,566
TOTAL	2,082.1	2,644.1	3,265.7	4,212.9	785,718	1,059,427	1,295,200	1,594,874

SOURCE: External Trade Statistics, IEG, Ministry of Finance, Issued jointly by Customs Head Office and Central Statistical Office Addis Ababa, Annual Issues 1967-1970.

TABLE B-6. IMPORT OF MALT EXTRACT, 1967[a]

Country of Origin	Tons	Value (Eth. $)	Eth. $/quintal [b]
Belguim	650.0	249,470.00	38.38
West Germany	5.0	4,845.00	96.90
Italy	3.0	3,705.00	123.50
United Kingdom	11.3	11,944.00	105.70
Denmark	128.0	53,230.00	41.59
TOTAL	797.3	323,194.00	

a/ None imported in 1968, 1969 or 1970.

b/ Calculated.

SOURCE: External Trade Statistics, IEG Ministry of Finance, Issued jointly by Customs Head Office and Central Statistical Office, Addid Ababa, Annual Issues 1967-1970.

TABLE B-7. BARLEY IMPORTS BY COUNTRIES OF ORIGIN - 1967 - 1970

Country of Origin	1967	1968	1969	1970	1967	1968	1969	1970
	(Tons)				(Eth. $)			
France	600	800	-	500	155,295	204,020	-	113,625
Italy	500	-	-	-	110,045	-	-	-
Denmark	200	-	-	-	63,787	-	-	-
Australia	-	-	1,000	1,000	-	-	205,281	220,807
Kenya	-	-	-	5	-	-	-	1,155
TOTAL	1,300	800	1,000	1,505	329,127	204,020	205,281	335,587

SOURCE: External Trade Statistics, IEG Ministry of Finance, Issued Jointly by Customs Head Office and Central Statistical Office, Addis Ababa, Annual Issues 1967-1970.

TABLE B-8. BARLEY EQUIVALENTS OF MALT IMPORTS, 1967/1970[a]

Year	Malt[b]	Barley Equivalent[c]
	(metric tons)	
1967	2,082.1	2,935.8
1968	2,644.1	3,728.2
1969	3,265.7	4,604.6
1970	4,212.9	5,940.2

a/ 1 ton of malt equals 1.41 tons of barley

b/ Column 1, Table No. B-5.

c/ Column 2, Calculated

TABLE B-9. PRODUCTION AND HECTARAGE OF BARLEY REQUIRED TO REPLACE IMPORTS, 1967-1970

Imports	1967	1968	1969	1970
Barley	1,300.0	800.0	1,000.0	1,505.0
Malt, in barley equivalent[a]	2,935.8	3,728.2	4,604.6	5,940.2
TOTAL	4,235.8	4,528.2	5,604.6	7,445.2
Hectarage needed to replace:[b]				
Barley Imports	650.0	400.0	500.0	752.5
Malt Imports	1,467.0	1,864.1	2,302.3	2,970.1
TOTAL	2,117.0	2,264.1	2,802.3	3,722.6

a/ One ton of malt equals 1.41 tons of barley (conversion from 1970 Agricultural Statistics, page VIII). See Tables B-5 and B-7 for malt and barley imports.

b/ At yields of 20 quintals per hectare.

TABLE B-10. VALUE OF IMPORTED MALT BY COUNTRIES OF ORIGIN 1967/1970

(Eth. $ per quintal)

Country of Origin	1967	1968	1969	1970	1967	1968	1969	1970
	(Malt)				(Barley Equivalent a/)			
Belgium	32.50	40.33	35.33	36.49	23.05	28.60	25.06	25.88
West Germany	95.08	93.56	60.78	39.02	67.43	66.35	43.11	27.67
United Kingdom	55.87	83.60	49.15	52.11	39.62	59.29	34.86	36.96
Denmark	37.51	42.12	32.68	37.33	26.60	29.87	23.18	26.47
Austria	55.65	-	-	-	39.47	-	-	-
Poland	36.37	-	-	-	25.79	-	-	-
Czechoslovakia	38.91	39.18	39.71	37.37	27.59	27.79	28.16	26.50
Bulgaria	39.25	-	-	-	27.84	-	-	-
Holland	-	75.13	75.08	78.05	-	53.28	53.25	55.35
Australia	-	32.46	-	-	-	23.02	-	-
Switzerland	-	-	75.00	-	-	-	53.19	-
France	-	-	-	37.73	-	-	-	26.76
TOTAL	37.73	40.06	39.72	37.85	26.76	28.41	28.17	26.84

a/ Based on Ratio 1.41 to 1 or .7083 malt = 1 barley

SOURCE: Based on Table B-5.

TABLE B-11. VALUE OF IMPORTED BARLEY AND MALT [a] 1967-1970

Year	Barley	Malt	Barley[b] Equivalent	Local Barley Addis Ababa
		(Eth. $/quintal)		
1967	25.32	37.73	26.76	15.56
1968	25.50	40.06	28.41	14.40
1969	20.53	39.72	28.17	15.17
1970	22.29	37.85	26.84	22.52

a/ Columns 1, 2 and 3 calculated.

b/ Based on Ratio 1.41 to 1, or .7083 malt = 1 barley

SOURCE: External Trade Statistics, IEG, Ministry of Finance, Issued jointly by Customs Head Office and Central Statistical Office, Addis Ababa, Annual Issues, 1967-1970, Addis Ababa wholesale prices from Ethiopian Grain Corporation.

TABLE B-12. BEER IMPORTS BY COUNTRY OF ORIGIN 1967/1970

Country	1967	1968	1969	1970	1967	1968	1969	1970
	(000 liters)				(Eth. $)			
Holland	86.0	86.6	151.9	171.9	74,612	61,988	121,189	148,494
West Germany	115.0	66.9	53.4	81.0	97,956	65,501	49,813	72,968
France	1.1	-	-	-	445	-	-	-
Italy	4.4	4.9	-	.1	2,268	10,455	-	530
United Kingdom	3.0	2.3	3.2	2.8	3,626	2,043	3,877	2,254
Denmark	50.2	49.1	68.1	63.4	31,753	41,558	60,531	48,704
Czechoslovakia	.7	-	-	-	3,910	-	-	-
Poland	-	6.1	-	-	-	4,728	-	-
Bulgaria	-	-	4.8	-	-	-	3,565	-
Unspecified	.04	-	.01	.1	100	-	210	240
TOTAL	266.5	215.9	181.4	319.3	214,670	186,273	239,185	273,190

SOURCE: External Trade Statistics, IEG Ministry of Finance, issued jointly by Customs Head Office and Central Statistical Office, Addis Ababa, Annual Issues 1967-1970

TABLE B-13. BARLEY YIELDS IN SPECIFIED COUNTRIES

Country	Average 1960 - 64	1968	1969	Average 1960 - 64	1968	1969
		(bu/acre)[a]			(quintals/ha)	
Belgium	69.0	69.2	66.8	37.1	37.2	35.9
Denmark	70.5	74.8	74.9	37.9	40.2	40.3
West Germany	57.7	69.5	68.8	31.0	37.4	37.0
Ireland	58.2	69.9	75.6	31.3	37.6	40.7
Netherlands	75.7	67.7	72.9	40.7	36.4	39.2
United Kingdom	64.6	64.0	67.7	34.7	34.4	36.4
Average	66.0	69.2	71.1	35.5	37.2	38.2

a/ bushel = 48 pounds

45.9296 bu = 1 metric ton

SOURCE: Agricultural Statistics, 1970, USDA Washington, DC.

TABLE B-14. BARLEY PRODUCTION, UTILIZATION AND AVERAGE FARM PRICES IN UNITED STATES AND WHOLESALE PRICES IN MINNEAPOLIS, ROTTERDAM AND ADDIS ABABA, 1964-68 & 1965-69

Year	Production	Malt Alcoholic	Use for Beverages	Farm		No. 2 of Malting Barley Minneapolis		Wholesale Addis Ababa	CIF US#3	Rotterdam[a] Canadian
	mil bu	mil bu	%	US$/bu	Eth. $/q	US$/bu	Eth. $/q	Eth. $/q	Eth. $/q	Eth. $/q
1964	386	95	24.61	.947	10.87	1.268	14.56	15.50	-	-
1965	392	97	24.74	1.020	11.71	1.321	15.17	19.13	16.61	16.59
1966	393	103	26.21	1.050	12.06	1.348	15.48	15.80	16.14	15.86
1967	373	105	27.88	1.000	11.48	1.236	14.19	15.56	15.02	13.85
1968	423	108	25.53	.908	10.43	1.153	13.24	14.40	12.13	12.48
1969	-	-	-	-	-	-	-	-	11.90	12.61
Average Prices	393.4	101.4	25.77	.985	11.31[b]	1.265	14.52	16.08	14.36	14.08

a/ 1965-69 average.

b/ 1964-69 average price of corn was $13.04 /quintal. See Table B-18 for relationship in Ethiopia.

1 bushel = 48 pounds
1 US$ = $2.50 Eth.
1 ton = 45.9296 bushels

NOTE: No. 2 Malting barley and U.S. #3 are usual in trading. Average farm prices include malting barley, which usually receives a premium of 25 to 50¢ per bushel.

SOURCE: USDA Agricultural Statistics, 1970; Ethiopian Grain Corporation; US Feed Grains Council.

TABLE B-15. BARLEY EXPORTS FROM UNITED STATES TO EUROPE, AVERAGE 1960-64 AND ANNUAL 1967 and 1968 [a]

Country of Destination	Average 1960 - 1964	1967	1968	Average 1960 - 1964	1967	1968
	(000 bushels)[b]			(metric tons)[c]		
Belgium and Luxembourg	1,827	222	47	39,861.8	4,843.6	1,025.5
Denmark	3,853	1,028	1,121	84,065.5	22,429.1	24,458.2
West Germany	14,912	1,283	-	325,352.7	27,992.7	-
Italy	5,977	9,264	2,512	130,407.3	202,123.6	54,807.3
Netherlands (Holland)	7,955	344	-	173,563.0	7,505.5	-
Poland	6,006	1,279	-	131,040.0	27,905.5	-
Spain	2,177	-	-	47,498.2	-	-
United Kingdom	611	-	-	13,330.9	-	-
Other Europe	8,105	566	676	176,836.4	12,349.1	14,749.1
TOTAL	51,423	13,986	4,356	1,121,955.8	305,149.1	95,040.1

a/ Year beginning July 1

b/ Bushel = 48 pounds

c/ Calculated

SOURCE: Agricultural Statistics, 1970, USDA p. 46, Barley and Malt Exports

TABLE B-16. MALT EXPORTS FROM THE UNITED STATES BY COUNTRY OF DESTINATION AVERAGE 1960-64, ANNUAL 1967 and 1968 a/

Country of Destination	Average 1960 - 64	1967	1968	Average 1960-64	1967	1968
	(000 bushels) b/			(metric tons) c/		
Canada	79	33	28	1,220.9	510.0	432.7
Mexico	148	61	136	1,287.3	942.7	2,101.8
Costa Rica	48	27	20	741.8	417.3	309.1
Honduras	120	164	226	1,854.5	2,534.5	3,492.7
Panama	80	8	8	1,236.4	123.6	123.6
Dominica Republic	92	111	99	1,421.8	1,715.5	1,530.0
Jamaica	29	68	93	448.2	1,050.9	1,437.3
Colombia	77	-	-	1,190.0	-	-
Ecuador	14	5	1	216.4	77.3	15.5
Guyana	14	43	30	216.4	664.5	463.6
Peru	62	54	32	958.2	834.5	494.5
Venezuela	1,348	1,044	1,186	20,832.7	16,134.5	18,329.1
Other Americas	158	39	29	2,441.8	602.7	448.2
Congo (Kinshasa)	304	62	63	4,698.2	958.2	973.6
Japan	21	43	68	324.5	664.5	1,050.9
Other Countries	28	13	7	432.7	200.9	108.2
WORLD TOTAL	2,622	1,775	2,026	40,521.8	27,431.6	31,310.8

a/ Year beginning July 1

b/ Bushel = 34 pounds

c/ Calculated

SOURCE: Agricultural Statistics 1970 USDA page 46.

TABLE B-17. VALUE OF IMPORTED BARLEY BY COUNTRIES OF ORIGIN, 1967-1970

Country of Origin	1967	1968	1969	1970
	(Eth. $/quintal)[a]			
France	25.88	25.50	-	22.72
Italy	22.01	-	-	-
Denmark	31.89	-	-	-
Australia	-	-	20.53	22.08
Kenya	-	-	-	23.10
Average	25.32	25.50	20.53	22.29

a/ Calculated on basis of data in Table B-7.

TABLE B-18. COMPARISON OF AVERAGE ANNUAL WHOLESALE PRICES OF BARLEY AND MAIZE I
ADDIS ABABA AND CIF PRICES OF BARLEY AND MAIZE IN ROTTERDAM, 1965 - 19

	ADDIS ABABA		ROTTERDAM	
	Barley	Maize	Barley	Maize
	(Eth. $ per quintal)		(Eth. $ per quintal)	
1965	19.13	15.75	16.61	15.30
1966	15.80	18.55	16.14	15.87
1967	15.56	13.54	15.02	14.01
1968	14.40	12.42	12.13	13.23
1969	15.17	13.56	11.90	14.80
Average	16.01	14.76	14.36	14.64

Note: Addis Ababa prices are for calendar year. Rotterdam prices are for US#3 barley and maize crop year at Eth. $2.50 - US$1.00

SOURCE: Ethiopian Grain Corporation
US Feed Grains Council

TABLE B-19. ESTIMATED MARKETING COST FOR MALTING BARLEY FARMGATE ADDIS ABABA TO FOB PORT ETHIOPIA

Item	Min	Typical	Max
		(Eth. $/mt)	
Local Buyer Margin (inc. sacking and loading)	2.50	5.00	10.00
Machine Cleaning	5.00	5.00	6.00
Sacks (80 kilos)	18.75	20.00	21.25
Truck Broker	0.00	0.50	1.00
Loading Truck	1.00	1.00	1.50
Storage (4 to 8 months @ 10¢ q/mo)	4.00	6.00	8.00
Exporter Margin (profit or loss)	--	--	--
	31.25	37.50	47.75
Via Truck to Assab [a]	15.00	25.00	50.00
Via Rail to Djibouti:			
Truck to Railway (truck $25, with trailer $50)	2.27	2.27	2.50
Load Railway Car	1.00	1.00	1.00
Transport to Djibouti	16.00	20.00	25.00
	19.27	23.27	28.50
Fumigation at Port	2.00	2.00	2.00
Transaction Tax 2% ($200 value)	4.00	4.00	4.00
Ethiopian Grain Board	3.00	3.00	3.00
	9.00	9.00	9.00
Assab Forwarding Agent (total charge) (includes unloading truck, $1; storage and loading, $1; transport to dock, $1; unloading, $1; loading ship, $2.40; miscellaneous and profit)	11.00	11.00	11.50
Djibouti Forwarding Agent (total charge) 800-1,300 FD, (87.34 FD = Eth. $1) (includes unloading car, 115FD; storage and transport to dock, 180FD; loading ship, 210FD; total Eth. $5.78; also miscellaneous and profit)	9.16	12.00	14.88
Total Cost Via Assab	66.25	82.50	118.25
Total Cost Via Djibouti	69.68	81.77	100.13

[a] Estimated cost over new highway.

NOTE: Many of these costs are only estimates, since malting barley has not been produced nor has other barley been exported. Most marketing costs should be similar to other cereals or pulses.

These costs apply from Addis Ababa only. Transportation costs from points south or west would have an added charge of 10¢-15¢/ton kilometer.

SOURCE: Transport Administration Department
Private Truckers
NATRACO
Franco-Ethiopian Railway

TABLE B-20. ESTIMATED FARMGATE RETURNS FROM EXPORTS OF MALTING BARLEY FROM ETHIOPIA UNDER ASSUMED CONDITIONS

	Eth. $ per mt			
Assumed cif value (Rotterdam)[a]		187.50		
Less:				
Ocean Freight[b]	43.25			
Insurance and Commission[c]	6.00			
		49.25		
Net fob Assab/Djibouti		138.25		
Net fob Assab/Djibouti			138.25	138.25
Less:				
In-country costs from Addis Ababa				
Lowest			68.00	
Typical				82.00
Farmgate Value[d]			70.25	56.25

a/ Based on a January 1972, average price of U. S. $75.00 per mt for malting barley in Rotterdam. The average of US and Canadian barley in Rotterdam in 1965-69 was Eth. $142.20 (Table B-14).

b/ Rates prevailing via Suez (Rotterdam only) on lots up to 5,000 mt during 1971. Via the Cape, the ocean freight to Rotterdam is Eth. $62 per ton. Ocean freight to Yokohama is $46.25 per ton.

c/ Insurance and commission are estimated at 3% of the cif value.

d/ For malting-quality barley, an average of 15% of the field run barley consists of thins, brokens, immatures, etc., that must be removed. The price for field run barley would therefore be about $60.00 and $48.00, respectively. The rejects would have a market value to add to this amount.

APPENDIX C

(PART C)

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

	1953 1960/1	1954 1961/2	1955 1961/3	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 C-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 C-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	8.5
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 C-4. ETHIOPIAN AND UNITED STATES MARKETING COSTS-MAIZE (1971)

	Ethiopian Produced Maize	US Produced Maize	
	Eth. $/q.	US $/bu.	US $/mt.
Price paid to producer	20.00	1.00	39.30
Transportation to first market (Cleaning and bagging) (Cost of bags)	1.50	.03	1.18
First market costs (merchants margin) (2% turnover tax)	4.00	.04	1.57
Trucking cost to port (Assab)	2.50		
Port charges	1.50	.20	7.96
Grain Board Fee	.30		
Exporters cost f.o.b. ship	29.80	1.27	50.01
Ocean freight to Israel	1.69	.16	6.25
Insurance and broker's commission 3%	1.00	.04	1.57
Cost delivered Israel	32.49	1.47	57.83
Cost delivered, Eth. $/metric ton	324.90		
Cost -- US$/metric ton	129.96		57.83

SUMMARY	Ethiopia	United States	% of Ethiopia
	---- US$------		
Farmgate price	80.00	39.30	49
Total marketing cost	49.96	18.53	37
Delivered Israel Cost	129.96	57.83	44
Delivered Rotterdam	130.12	54.58	42
Delivered Bombay	129.64	59.33	46

NOTE: The purpose of this table is to illustrate the approximate competitive position of maize produced in Ethiopia vis-a-vis maize exported from the USA under conditions prevailing late in 1971. In this illustration, the estimated costs of marketing are abbreviated and somewhat understated.

TABLE C-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, I. E. G., Addis Ababa.

TABLE C-6. EXPORTS OF GRAINS AND PULSES FROM ETHIOPIA, 1942/70

Year	Whole Grains[a]	Flour	Pulses[b]	Total
	(Metric Tons)			
1942	NA	NA	NA	13,000
1943	NA	NA	NA	33,000
1944	NA	NA	NA	45,000
1945	67,000	14,500	100	81,600
1946	120,000	14,700	600	135,300
1947	147.000	6,200	600	153,800
1948	53,400	4,400	37,000	94,800
1949	32,300	4,400	22,600	59,300
1950	19,700	1,000	33,200	53,900
1951	50,500	650	34,400	85,550
1952	30,800	2,200	64,000	97,000
1953	30,400	2,200	68,700	101,300
1954	18,900	100	60,500	79,500
1955	14,300	100	55,400	69,800
1956	6,300	100	43,100	49,500
1957	5,200	600	54,800	60,600
1958	2,300	-	33,300	35,600
1959	500	-	46,400	46,900
1960	1,500	-	66,600	68,100
1961	2,500	c/	80,200	82,700
1962	3,600	100	69,000	72,700
1963	5,800	400	69,800	76,000
1964	2,300	500	68,000	70,800
1965	4,300	900	55,100	60,300
1966	100	c/	69,200	69,300
1967	3,800	c/	69,200	73,000
1968	1,400	c/	74,700	76,100
1969	3,900	c/	78,600	82,500
1970	3,000	600	51,100	54,700

a/ Average composition 1948-61: 40% sorghum, 25% maize, 25% wheat, 10% other. After 1961 sorghum became increasingly dominant.

b/ Average composition 1948-61: 36% horse beans, 33% lentils, 13% haricot beans, 13% chick peas, 5% other. After 1961, haricot beans gained rapidly in relative position.

c/ Less than 50 mt.

SOURCE: Central Statistical Office, IEG, and Annual External Trade Statistics, IEG, Ministry of Finance, Addis Ababa.

TABLE C-7. ESTIMATED RETURNS ON MAIZE EXPORTS FROM ETHIOPIA

	Rotterdam		Yokohama		Israel	
	(Eth. $ per mt)					
Assumed cif value[a]		150.00		155.00		160.00
Less:						
Ocean Freight[b]	43.25		46.25		42.25	
Insurance & Commission[c]	4.50	47.75	4.65	50.90	4.80	47.05
A) Net fob Assab/Djibouti		102.25[d]		104.10		112.95[e]
Savings on 20,000 mt shipment		28.25		30.60		31.00[e]
B) Net fob Assab/Djibouti[f]		130.50[d]		134.70		143.95
Further savings on 40,000 mt shipment		2.50		2.50		2.50[e]
C) Net fob Assab/Djibouti[f]		133.00[d]		137.20		146.45

a/ Based mostly on average value of maize (No. 3 grade) shipped from the USA to the indicated markets from 1966 to 1970 in 20,000 ton lots. Value of maize imports reported by FAO was also considered in establishing the assumption for the three markets.

b/ Rates prevailing via Suez (Rotterdam only) on lots up to 5,000 mt during 1971. From Djibouti, there is an additional surcharge of Eth. $4.75 to some destinations. Via the Cape, the ocean freight to Rotterdam is Eth. $62.00 per ton. Discounts of 10% to 35% from the indicated charges can sometimes be negotiated on lots of 5,000 to 15,000 tons.

c/ Insurance and commission are estimated at 3% of the cif value.

d/ Via the Cape the net fob on Rotterdam shipments would be 1) Eth. $83.50, 2) Eth. $119.75 and 3) Eth. $122.25.

e/ Shipments to Israel (Eilat) from Ethiopia are made only by Zim Line and rates are sometimes obscured by being included in purchase price. It is not likely that vessels capable of carrying lots of 20,000 tons and more, would be readily available for the Red Sea run to Israel.

f/ In the short term future the ports of Assab and Djibouti are not expected to be prepared to handle vessels loading more than 20,000 tons of grain.

TABLE C-8. ESTIMATED MARKETING COST FOR MAIZE EXPORTED IN BAGS, FARMGATE TO FOB PORT, ETHIOPIA[a/]

	Min.	Typical	Max.
		(Eth. $ per mt)	
Village buyer - total margin (includes 1.50 sacking and loading)	2.50	5.00	10.00
Sacks	15.00	16.00	17.00
Local transport to wholesaler	1.50	1.50	1.50
Truck broker	0.00	0.50	1.00
Loading truck	1.00	1.00	1.50
Transport to Addis Ababa	20.00	25.00	30.00
Unloading and weighing	1.00	1.50	1.50
Storage, 4 to 8 mos. @ 10¢ q/mo.	4.00	6.00	8.00
Wholesaler or exporter margin (profit or loss)			
	45.00	56.50	70.50
Via Truck to Assab:			
Truck broker	0.00	0.50	1.00
Loading	1.00	1.00	1.00
Transport to Assab	10.00	20.00	35.00
	11.00	21.50	37.00
By Rail to Djibouti:			
Load truck to railway	1.00	1.00	1.00
Truck to railway (truck $25, with trailer $50)	2.27	2.27	2.50
Load railway car	1.00	1.00	1.00
Transport to Djibouti	11.00	20.00	25.00
	15.27	24.27	29.50
Fumigation at port	2.00	2.00	2.00
Transaction tax 2% ($100 value)	2.00	2.00	2.00
Ethiopian Grain Board	3.00	3.00	3.00
	7.00	7.00	7.00
Assab forwarding agent (total charge) (Includes unloading truck $1, storage, loading $1, transport to dock $1, unloading $1, loading ship $2.40, miscellaneous and profit)	11.00	11.00	11.50
Djibouti forwarding agent (total charge) 800-1300 FD. (87.34 FD = Eth$1) (Includes unloading car 115 FD, storage, transport to dock 180 FD, loading ship 210 FD, total Eth$5.78 also misc. and profit of agent)	9.16	12.00	14.88
Total cost via Assab	74.00	96.00	126.00[b/]
Total cost via Djibouti	76.43	99.77	121.88[b/]

NOTES: The above farmgate prices are at Shashemene. For distances from this point, truck rates are about 20¢ per ton kilometer with an additional charge where pack animals are used. The computed unit cost of using pack animals may be five times that of trucks but farmers owning their animals may not consider this cost.

Charges calculated above are based on existing rates except for transport from Addis Ababa to ports of Assab or Djibouti. The assured motor truck rates from Addis Ababa are predicated on an expected saving of about 30% in truck operating expenses over the new highway from Awash to Assab. It is assumed also that the railway rates, at the lowest level, would be reduced to meet truck competition as has been done heretofore.

a/ Based on Shashemene to Assab and Djibouti.

b/ Comparable costs computed for Awash are:

	Min.	Typical	Max.
		(Eth. $ per mt)	
Total cost via Assab	48.50	61.50	80.00
Total cost via Djibouti	47.66	62.00	82.88

SOURCES:
1. Transport Administration Department
2. Private Truckers
3. NATRACO
4. Franco-Ethiopian Railway
5. Northern Ethiopian Railway

TABLE C-9. ESTIMATED MARKETING COSTS FOR MAIZE EXPORTED IN BULK, FARMGATE TO FOB SHIP, ETHIOPIA

Place	Item of Operation	Case I[a]	Case II[b]
		(Eth. $ per mt)	
	Transport to market	5.00	5.00
Farm Market Center	Buyer margin	2.00	1.00
	Storage (including receiving cleaning, loading, etc.)	6.72[c]	5.95[d]
	Transport to port (truck)[e]	15.00	10.00[f]
Port	Port storage - including receiving & loading ship	1.30[g]	0.97[h]
	Fumigation	1.00	1.00
	Forwarding agent	1.00	0.50
	Grain Board	2.00	1.00
	Tax	2.00	2.00
	Total farmgate to ship	$36.02	$27.42

[a] Assumes 500,000 mt exports annually.

[b] Assumes 1,000,000 mt exports annually.

[c] $\frac{18,650,000 \times 18\%}{500,000}$ = Eth.$6.72

[d] $\frac{33,050,000 \times 18\%}{1,000,000}$ = Eth.$5.95

[e] Add 4.50 for transport by rail, unless there is a rail siding to storage.

[f] Assumes continuing improvement in maximum truck use and good roads, and 800 km average haul.

[g] $\frac{30,000 \text{ tons} \times \$120/\text{ton} \times 18\%}{500,000 \text{ tons/year}}$ = Eth.$1.30/ton

[h] $\frac{60,000 \times 90 \times 0.18}{1,000,000}$ = Eth.$0.97/ton

Annual cost in percentage of initial cost:

Depreciation (20 yr. life)	- 5%
Interest (Av. = 10%/2)	- 5%
Repairs and maintenance	- 4%
Operation	- 4%
Total	18%/year

Overall average cost per ton/year:

Case I - $\frac{20,750,000 \times 18\%}{500,000}$ = Eth.$7.50

Case II - $\frac{38,450,000 \times 18\%}{1,000,000}$ = Eth.$6.90

SUB-TABLE C-9 (1) ASSUMED SOURCE AND AMOUNT OF MAIZE INCREASE FOR EXPORT[a]

	Source	Metric Tons
CASE I -	One half million tons/year for export (5-year goal)	
	1. Increased yield of 6 q/ha on 50,000 farms with 5 ha maize	150,000
	2. Increased yield of 8 q/ha on 10,000 farms with 12.5 ha maize	100,000
	3. Increased hectarage (10%) on commercial farms (new land, double-cropping, etc.) 830,000 x 10% x 30 q/ha	250,000
	Total	500,000
CASE II -	One million tons/year for export (10-year goal)	
	1. Increased yield of 6 q/ha on 100,000 farms with 5 ha maize	300,000
	2. Increased yield of 8 q/ha on 20,000 farms with 12.5 ha maize	200,000
	3. Increased hectarage (15%) and yield (33% over Case I) on commercial farms	500,000
	Total	1,000,000

[a] The figures in this table were assumed only for estimating the numbers and sizes of storage units required. They are not intended to reflect probable increased area or yield possibilities.

SUB-TABLE C-9 (2) ESTIMATED CAPACITY AND CONSTRUCTION COST OF BULK STORAGE AND HANDLING EQUIPMENT, ETHIOPIA

	Storage Cost (Eth. $ per mt)	Totals Case I Tons (1000)	Totals Case I Cost (Eth. $ 1000)	Totals Case II Tons (1000)	Totals Case II Cost (Eth. $ 1000)
1. Medium-size farm storage					
Case I - 50,000 farms x 4 ton-storage (1 ton for household)	20	200	4,000	-	-
10,000 farms x 10 ton storage	14	100	1,400	-	-
Case II - 100,000 farms x 4 ton-storage	20	-	-	400	8,000
20,000 farms x 10 ton-storage	14	-	-	200	2,800
2. Commercial farms					
Cases I and II - 100 farms with 250 ton-storage	35	250	8,750	250	8,750
Case II - 250 farms with 1000 ton-storage	30	-	-	250	7,500
3. Rural market center storage					
Case I - Warehouse conversion - 100,000 tons	15	100	1,500	-	-
Case II - Warehouse conversion - 200,000 tons	15	-	-	200	3,000
Case I - New installations 50,000 tons	30	50	1,500	-	-
Case II - New installations - 100,000 tons	30	-	-	100	3,000
4. Port storage					
Case I					
Assab - 10,000 tons	120	10	1,200	-	-
Massawa - 10,000 tons	120	10	1,200	-	-
Djibouti - 10,000 tons	120	10	1,200	-	-
Case II					
Assab - 20,000 tons	90	-	-	20	1,800
Massawa - 20,000 tons	90	-	-	20	1,800
Djibouti - 20,000 tons	90	-	-	20	1,800
TOTAL		730	20,750	1,460	38,450

ASSUMPTIONS AND EXPLANATIONS FOR ESTIMATES IN TABLE C-9

A projection of a pattern or system of country-wide, bulk storage and handling units is required in order to estimate the costs of conversion from sacks to bulk handling. Sub-Table C-9 (1) indicates the numbers and sizes of storage units that might be required for marketing 500,000 tons of maize per year for export (Case I) and for a 1-million ton level (Case II). Sub-Table C-9 (2) gives (1) the estimated costs per ton for the various types and sizes of bulk storages with handling equipment where necessary, considered practical and feasible for the assumed conditions, and (2) the total country-wide capacities and costs for all types. Obviously, much of the up-country storage proposed would serve domestic use and marketing as well as export marketing. The farm storage proposed could perhaps more logically be charged as a cost of production before the farmgate. As will be noted, however, the unit storage costs in the Table are charged entirely against the grain that is to be exported.

The total annual costs, including both overhead and operating costs, are estimated to be 18% of the first or construction cost. An overall average annual cost figure, per gross ton of storage capacity provided in this proposal, can be readily calculated; indicated at the bottom of the Table it is Eth.$7.50 per ton/year for Case I and Eth.$6.90 per ton/year for Case II.

TABLE C-10. ESTIMATED FARMGATE RETURNS FROM EXPORTS OF MAIZE FROM ETHIOPIA UNDER CERTAIN ARBITRARILY ASSUMED CONDITIONS

	Rotterdam				Yokohama				Israel			
	(Eth. $ per mt)											
F O B RETURNS:[a]												
5,000 mt load[b]	102				104				113			
10,000 mt load		111	111			113	113			121	121	
20,000 mt load				130				135				14
IN-COUNTRY COSTS:[a]												
Low-Bags (Shashemene)	75				75				75			
Low-Bags (Awash)		48				48				48		
500,000 mt - bulk			36				36				36	
1,000,000 mt - bulk				27				27				2
FARMGATE VALUE	27	63	75	103	29	65	77	108	38	73	85	11

a/ See Appendix Tables C-7, C-8, and C-9 for details of costs and returns.

b/ Based on an estimated 20% reduction from the published 5,000 mt rate.

NOTE: This tabulation is intended only to indicate certain selected farmgate returns representing "most favorable" situations for shipments at specified levels. Many other combinations of costs and returns are possible, of course, and this particular listing is only illustrative. In general, the existing situation with a reduced cost structure is represented by the 5,000 and 10,000 mt figures; the 20,000 mt estimates together with bulk handling are definitely long term possibilities. It is not considered likely that 40,000 mt loads will be handled in the foreseeable future; thus, costs are not computed on that basis.

TABLE C-11. ANNUAL WHOLESALE PRICES OF GRAIN IN SELECTED MARKETS, 1965/70

Country	1965	1966	1967	1968	1969	1970
			(Eth. $ per Quintal)			
			CORN			
Addis Ababa	15.75	18.55	13.54	12.42	13.56	21.17
Debre Marcos	-	18.04	15.02	14.92	15.40	20.72
Bahar Dar	-	17.69	15.48	15.14	32.98	22.22
Gondar	-	-	17.98	15.65	17.58	18.99
Asmara	-	-	18.94	14.04	18.62	30.62
Dese	-	16.65	14.50	10.52	14.57	22.22
Dire Dawa	-	-	14.71	12.29	14.68	27.53
Nazaret	-	19.19	12.46	11.64	12.07	20.67
			SORGHUM			
Addis Ababa	21.89	24.94	19.96	15.26	20.45	28.67
Debre Marcos	-	-	-	-	-	18.50
Bahar Dar	-	-	19.94	14.08	-	-
Gondar	-	-	19.94	14.08	18.19	21.50
Asmara	-	-	21.42	12.41	18.93	26.34
Dese	-	20.84	17.03	10.88	17.80	25.56
Dire Dawa	-	-	19.07	14.24	18.16	30.62
Nazaret	-	24.71	12.46	11.64	15.66	24.45
			BARLEY			
Addis Ababa	19.13	15.80	15.56	14.40	15.17	22.52
Debre Marcos	-	13.00	12.06	14.75	-	13.50
Bahar Dar	-	19.94	-	-	-	-
Gondar	-	-	15.07	14.50	18.48	20.06
Asmara	-	-	16.77	14.48	18.81	23.29
Dese	-	16.12	14.30	11.46	15.98	24.41
Dire Dawa	-	-	18.86	16.95	18.64	28.00
Nazaret	-	14.75	14.01	12.43	13.11	21.82

SOURCE: Ethiopian Grain Corporation.

TABLE C-12. MONTHLY FARM PRICES OF GRAINS AND PULSES IN THE DEBRE ZEIT AREA OF ETHIOPIA

October, 1969 - September, 1970

	Maize	Barley	Sorghum	Chick Peas	Horse Beans	Lentils	Field Peas
			(Eth. $ per Quintal)				
October	16.25	16.75	-	16.75	11.50	27.50	16.25
November	14.33	16.00	15.00	16.00	14.25	30.33	15.50
December	15.00	19.00	-	17.00	14.50	24.50	19.00
January	15.50	20.00	-	22.00	15.16	24.50	21.33
February	16.00	18.33	17.00	18.00	16.00	27.00	24.00
March	19.37	19.00	25.00	20.50	18.50	31.00	25.50
April	20.50	20.00	-	20.00	18.00	30.50	24.50
May	22.00	23.66	-	22.00	21.00	31.00	25.66
June	22.00	23.66	24.50	26.00	23.00	32.00	27.50
July	27.66	26.00	29.00	28.00	27.00	31.66	31.50
August	28.00	27.00	31.50	34.00	30.00	28.00	38.00
September	29.20	29.70	34.20	33.50	33.00	39.00	39.00

NOTE: Prices not available on white haricot beans.

SOURCE: Institute of Agricultural Research, Debre Zeit.

TABLE C-13. ESTIMATED COSTS AND RETURNS FOR CERTAIN CROPS IN ETHIOPIA[a]

Commodity	Assumed Yield per Ha. Quintals	Costs per Ha.	Gross Return per Ha.[b]	Net Return per Ha.
		(Eth. $)		
Teff	9.1	184	319	135
Wheat	9.3	156	287	131
Maize	16.8	157	356	199
Barley	9.0	118	202	84
Sorghum	8.6	126	246	120
Chick Peas	8.0	122	227	105
Broad Beans	9.6	119	217	98
Lentils	6.4	118	189	71
Haricot Beans	10.0	260	363	123

a/ Computation based mostly on estimates of yield and costs in reports on Ada and Shashemene Projects and on surveys of Ethiopian farms by Stanford Research Institute.

b/ Prices used were 1970 average for Addis Ababa reported by the Ethiopian Grain Corporation.

NOTE: This analysis is intended only to show the relative returns from cereals and pulses in certain conditions; it does not represent on-farm returns, nor are the yields and costs other than indicative for comparative purposes.
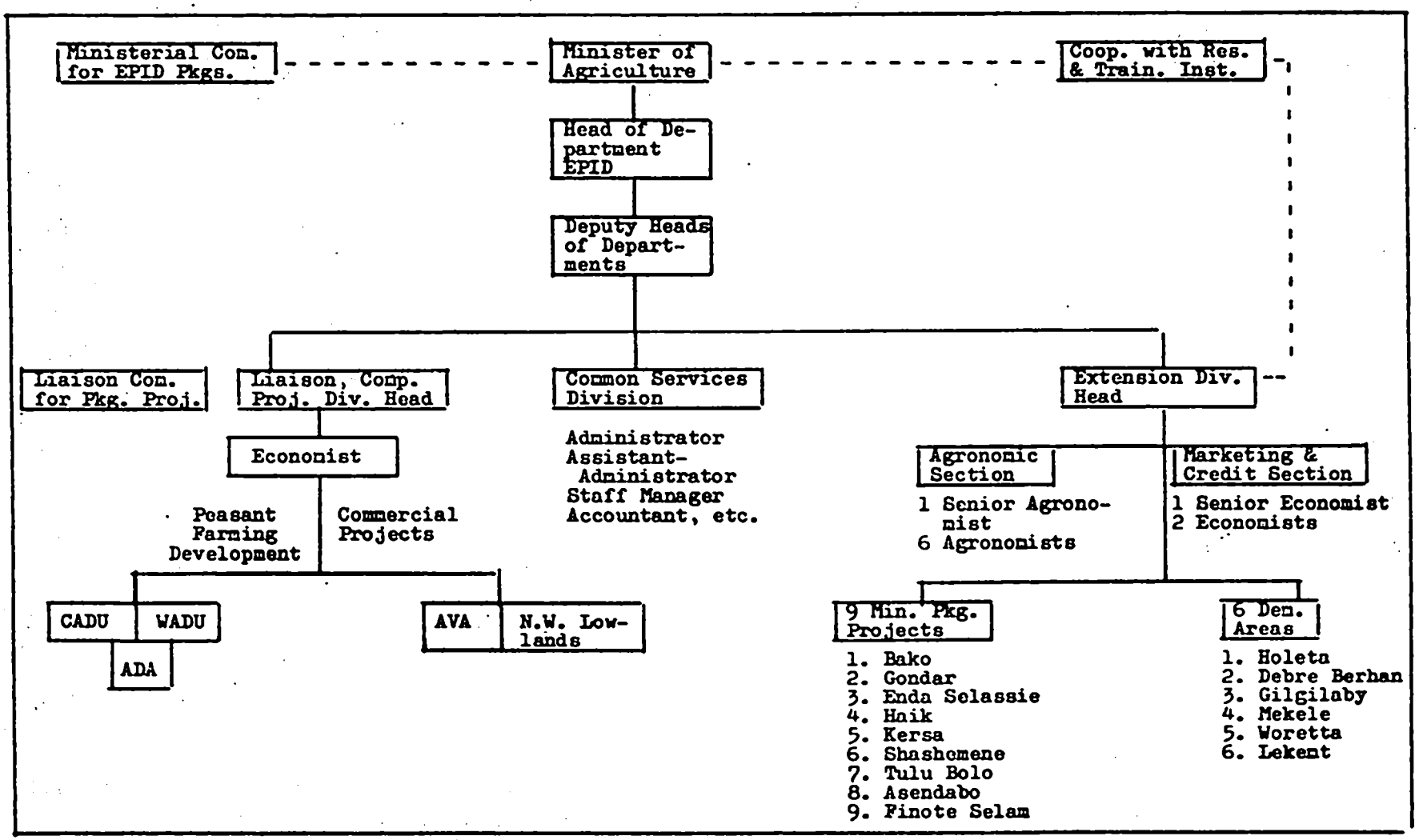
FIGURE C-1. ORGANIZATION OF EXTENSION AND PROJECT IMPLEMENTATION DEPARTMENT (1971)