INTSOY Country Reports

International Soybean Program

INTSOY

College of Agriculture
University of Illinois at Urbana-Champaign

College of Agricultural Sciences
University of Puerto Rico, Mayagüez Campus

OILSEED PRODUCTION IN EGYPT

ICR-80-1

R. J. Henning, R. A. Hinton, I. J. Jansen,
T. A. McCowen, W. W. Roath, M. E. Sarhan,
and J. A. Jackobs

International Soybean Program
University of Illinois
Urbana, Illinois

April 1980

A Technical Report

Prepared for
U.S. Agency for International Development
Department of State
Washington, D.C.

OILSEED PRODUCTION PROJECT FOR EGYPT

Report of an INTSOY Team assigned under

Contract, AID/NE-C-1677

R.J. Henning	Extension Agronomist University of Georgia
R.A. Hinton	Professor of Farm Management University of Illinois
I.J. Jansen	Assistant Professor of Soils University of Illinois
T.A. McCowen	Assistant Director of INTSOY University of Illinois
W.W. Roath	Research Geneticist USDA-SEA North Dakota State University
M.E. Sarhan	Assistant Professor of Agricultural Economics University of Illinois
J.A. Jackobs	INTSOY Agronomist and Team Leader University of Illinois

ACKNOWLEDGMENTS

In the preparation of this report the Oilseeds team has been assisted by many people and organizations during our stay in Egypt. In addition we have relied heavily on two reports: Current and Potential Production and Utilization of Oilseed Crops in Egypt, and Major Cereals Improvement in Egypt. The first is a report of a feasibility study conducted in 1978 by an INTSOY team. Many portions of this report are revisions of parts of that report. The second is a technical report prepared by the CID team. Many of the aspects concerning staffing in the Major Cereals Improvement Project are incorporated in this report.

Dr. Moustafa Serry Hassan Serry, Undersecretary of the Ministry of Agriculture has been invaluable in our liaison with the many individuals and groups with whom we have consulted. He has also provided basic information and has been a gracious host. A partial list of persons we interviewed follows:

Mr. Mohamed Said Dessouki, Undersecretary for External Agricultural Affairs

Dr. Ali Abdel-Aziz, Deputy Director, Field Crop Research Institute

Dr. Ali Serry Hassan Serry, Director, Soils and Water Research Institute

Dr. Mokhtar M. Satour, Plant Pathology Research Institute

Dr. Badr A. Elahmar, Oil Seeds Research Section, Field Crops Institute

Dr. Mohammed El-Shirbini, Legume Crops Section, Field Crops Institute

Eng. Raafat Fawzi Eskander, Director General of Agricultural Industries, Ministry of Land Reclamation

Dr. Abdel Mawla Bishir, Deputy Director of Agricultural Statistics and Economics

Dr. Yousef Hamdi, Chief Researcher, Agricultural Microbiology Section

Dr. Ahmed Momtaz, Fiber Crops Section, Field Crops Institute

Dr. Mohamed Aly Fouda, Head of Agricultural Microbiology Section, Soils and Water Institute

Dr. Elwy Atalla, Deputy Director, Plant Protection Institute

Dr. M. F. Tayel, Undersecretary for Agricultural Extension

Mr. Ahmed Awad Salama, Director General of Extension

Dr. Ibrahim S. Khafagi, Chairman, Higher Council for Food Industries, Ministry of Industries

Dr. Abdallah Nasif, Director, Legume Crops Research Section

Dr. Ezzat Abdel Naeim, Head, Sandy and Calcareous Section, Soils and Water Research Institute

Mr. Ali Kamel, Foreign Relations Department, Ministry of Agriculture

Dr. Baligh Shindi, Deputy Director, Soils and Water Research Institute.

Mr. Mohamed Abdel Wahed, Chief Researcher, Soil Survey Research Section, Soils and Water Research Institute

Staff members at the Agricultural Research Stations at Sakha, Nubaria, Sids and Ismailia explained their programs during our visits to the stations.

Among USAID staff members, we are especially grateful to Dr. R. J. Edwards and Mr. John G. Rogers for the logistic support which they provided.

Members of the Oilseeds team feel that our working conditions were almost ideal. The shortcomings of this report are ours.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviations, Terms and Conversion Factors

Abbreviations

DACB	The Development and Agricultural Credit Bank
GOE	Government of Egypt
MOA	Ministry of Agriculture
LE	Pounds Egyptian
USDA	U.S. Department of Agriculture
USAID	U.S. Agency for International Development
USG	U.S. Government
INTSOY	International Soybean Program
CSU	Colorado State University
MLR	Ministry of Land Reclamation
MOI	Ministry of Interior
ORU	Oilseeds Research Unit
CRWG	Central Research Working Group
RAG	Regional Action Group (at Regional Research Stations)
ARC	Agricultural Research Center
MHE	Ministry of Higher Education
NRC	National Research Center
TDY	Temporary Duty Assignment
AID/W	Agency for International Development/ Washington

Terms

Old Lands refers to the Nile Valley and the Delta

New Lands refers to virgin land reclaimed from the desert

Old New Lands refers to those lands which have been reclaimed since 1953 and which have been farmed for some time

Conversion Factors

U.S. $1.00 = 0.79 Egyptian Pounds (LE)

LE 1.00 = 100 piastres (pt)

One feddan = 1.04 acres = 0.42 hectares

I. INTRODUCTION

Egypt faces two serious problems: a severe shortage of cultivable land and a rapidly increasing population. The current population is approximately 41 million, with less than 6 million feddans (1 feddan = 1.04 acres or 0.42 hectare) of cultivated land or 6.8 persons per feddan. Cropping intensity is high on this area, with approximately 11 million feddans of crops grown annually, or nearly two crops per year. Yields are high for many crops. Egyptian agriculture is labor intensive and complex in many respects, with both primitive and modern elements.

There is a shortage of edible oils of plant origin in Egypt. Cottonseed is the major domestic source of oil, but it currently supplies only one fourth of the edible oils consumed. Most of their remaining edible oil requirement is imported. Peanuts are grown, but they are consumed whole in Egypt or exported. Small amounts of sunflower, safflower, sesame, flax, and castor are also grown. Soybeans were introduced into Egypt during the early 1970's and their production is increasing rapidly to supply both oil and high protein meal.

Primary emphasis should be placed on expanding the production of soybeans, peanuts, and sunflowers. Although production expansion would include all three major land types, the newly reclaimed lands along the Eastern and Western border areas should be given emphasis. These lands offer considerable potential for oilseed crop production. A "Coordinated and Expanded Oilseeds Research and Production Program" is suggested to increase the production of these oilseeds in both old and new reclaimed land. This program would emphasize interdisciplinary work which would be focused on increasing the production of selected oilseed crops. The suggested program would involve on-the-job training of Egyptians, both in the country and abroad. It would also include a few overseas specialists who would work beside Egyptians in implementing the Coordinated Oilseeds Program. Funding for equipment, materials and supplies is proposed to vigorously promote this Coordinated and Expanded Oilseeds Research and Production Program.

Study of the oilseed processing industry revealed that the management and efficiency of the processing plants are substandard, even though relatively new solvent-process equipment is being used. Also, the headquarters of the Council for Food Industries does not exercise the most effective overall management of the oilseed processing industry.

II. SUMMARY

Egypt currently produces only about one-fourth of its requirement for edible oil of plant origin. Therefore, the Government is interested in increasing the production of edible oils and evaluating soybeans, peanuts and sunflower for this purpose. AID/W has been requested by the GOE to provide financial support for an oilseed production project which was recommended earlier by an INTSOY team which studied the overall oilseed situation in Egypt during October/December 1978.

Nineteen constraints, 11 biological and 8 institutional, to oilseed production have been identified. Several steps are suggested for the alleviation of each constraint. It is estimated that if the remedies recommended are adopted there will be a 45% increase in yield level.

Particular attention was given to the economic and financial aspects of an expansion in oilseed crop production. The aggregate effects of the improvements suggested and an expanded area in oilseed production will result in a 100% increase in production by 1985 and nearly a 200% increase by 1990. The aggregate benefits in the first ten years of the project will total nearly $ 160,000,000 which will give a 5.7 to 1.0 gross benefit ratio during the first ten years. During the following ten years the project will generate an additional $ 247,800,000.

At farm gate prices and costs paid by cultivators in 1978, soybeans and peanuts were more profitable than cotton and maize. However, when calculated on the basis of international prices cotton was the most profitable crop and maize was less than peanuts but more than soybeans. In the future maize will remain the chief competitor with soybeans and peanuts for land. Assuming equal costs of production on old lands for soybeans and maize, soybeans can be competitive with maize if its yield is 1.0 MT/feddan and the price ratio is 2:1. Similarly, on new lands, soybeans will be more profitable than maize if the yields are over .75 MT/feddan. The removal of some of the constraints addressed in the project will result in yields much higher than these.

The returns, at farm gate prices, from crop sequences on old lands with and without soybeans were compared. Berseem and early- or mid-season planted soybeans were more profitable than wheat-maize but less profitable than berseem-maize. At international prices the returns from the berseem-soybean sequence was about equal to the wheat-maize but still considerably less than the berseem-maize. With improved technology soybeans planted in early- and mid-season after berseem will be considerably more profitable than berseem-maize. However, wheat-late-planted soybeans will be less profitable.

The area in soybeans is expected to increase from 100,321 feddans in 1979 to 200,000 acres in 1984. About one-half of the increase will be on old lands, about 43,000 feddans on the old new lands and only 7,000 feddans on the new new lands. Most of the new new land is too sandy for soybeans, but is well suited for peanut production. The GOE plans to have 200,000 feddans of peanuts in 1988 with most of the increase coming on new new land. The location of sunflower production remains to be determined. Production increases will probably come on the heavier textured soils of the old new lands. Forty-six thousand feddans are expected to be planted in 1988.

A research and extension program for the GOE to be supported by USAID is recommended. An interdisciplinary Oilseeds Research Unit (ORU) is to be established within the ARC at an organizational level of the ARC institutes. It is to be supported by sufficient physical facilities and operating funds to carry out a well-balanced research and extension program to promote oilseed production. The estimated cost of the project for the first five years is $ 27,933,070. The GOE contribution, $ 6,112,655 will be 74.5% in salaries and 24.5% for supporting facilities and services. The USAID contribution, $ 21,820,415, will be 25.2% for salaries, 6.2% for training, 23.9% for buildings and installations, 24.4% for commodities, and 20.3% for other direct costs and contingencies.

The project is to be carried out at the ARC headquarters in Giza and at five regional research stations: Sakha, Sids, Shandaweel, Nubaria and Ismailia.

III. CONSTRAINTS LIMITING OILSEED CROP PRODUCTION IN EGYPT

Following are constraints to achieving efficient levels of peanut, soybean, and sunflower production on both old and new lands in Egypt and a listing of activities to which this project will provide leadership to alleviate or reduce each constraint and result in the projected oilseed yield per feddan increase of 45 percent for each of the three crops.

A. Biological and Technical Constraints

Constraint 1. Sandy soils of the new lands are inherently low in fertility and have pH values above 7.0 which further limit soil nutrient availability, especially minor elements.

a. Conduct, through the Village Agents, a soil test survey of representative lands within their village area to determine levels of pH, as well as all macro-, secondary, and micro-elements.

b. Conduct research trials (on-station and on-farm) to determine the optimum levels and proper balance of soil nutrients for peanuts, soybean, and sunflower.

c. Educate oilseed crop growers, through the District Agronomists and Village Oilseeds Agents, the value of soil testing and application of fertilizer according to soil tests results.

d. Conduct on-farm demonstrations and oilseed crop production clinics to show yield and/or quality increases resulting from proper fertilization.

e. Publish and distribute, through the extension service, fertilizer recommendations for peanuts, soybean, and sunflower based on research results.

Possible gain in production: Peanuts 2%; Soybean 2%; Sunflower 6%.

Constraint 2. New lands being developed for peanuts and soybeans are lacking in adequate nitrogen fixing *Rhizobia* bacteria resulting in the need for high levels of applied nitrogen to achieve maximum production levels.

a. Provide modern technology and equipment so that adequate supplies of viable inoculum are available when needed.

b. Provide one time planting service which would include proper inoculation application and planting to areas where soybeans and peanuts have not been grown.

c. Conduct on-farm demonstrations and production clinics to show the value and correct application of *Rhizobia* inoculation to decrease nitrogen requirements and increase peanut and soybean yields.

d. Publish and distribute, through the extension service, peanut and soybean inoculation recommendations.

Possible gain in production: Peanuts 4%; Soybean 5%.

Constraint 3. Reduced oilseed crop yields due to improper land preparation.

a. Conduct research (station and on-farm) to test various methods of land preparation (i.e., land turning vs. methods currently being used by peanuts growers).

b. Teach proper land preparation techniques through on-farm demonstrations and oilseed crop production clinics.

c. Publish and distribute, through the extension service, land preparation recommendations based on research findings.

Possible gain in production: Peanuts 5%; Soybeans 2%; Sunflower 1%.

Constraint 4. Yield loss due to improper weed control techniques (i.e., moving soil onto the lower branches of the peanut plants interferes with normal flowering and fruiting and increases disease potential).

a. Conduct weed survey, through the extension service, to determine problem weed species in farmer fields.

b. Conduct research (on-farm and station) to determine the effective use rates and application techniques of available herbicides to control weeds.

c. Teach growers, through demonstrations and weed control clinics, the value of chemical weed control for oilseed crops, especially peanuts, compared to mechanical methods as measured by increased yields and reduced labor costs.

d. Teach growers the correct and safe use of herbicides by demonstrations of handling, mixing, and storage of herbicides, as well as sprayer calibration.

e. Publish and distribute, through the extension service, a weed control bulletin based on research findings.

f. Publish and distribute, through the extension service, sprayer calibration procedures.

Possible increase in production: Peanuts 4%; Soybean 4%; Sunflower 4%.

Constraint 5. Yield loss due to inadequate disease control (both foliar and soil borne diseases).

a. Conduct, through the extension service, a survey to identify diseases encountered in grower fields.

b. Design and conduct research programs to test the effectiveness of various cultural practices on disease incidence including:

- land preparation techniques
- crop rotation sequence
- weed control practices
- fertilizer rates and methods of application (i.e., fertilizer turned down pre-plant vs. soil surface applied at, or post planting).

c. Establish, through research, the "best" fungicide or fungicide combinations, particularly for leafspot control on peanuts, as well as the time to begin treatment, and the application interval for highest economic return.

d. Breed disease resistant oilseed crop varieties.

e. Extend research findings to growers through extension demonstrations and disease control clinics.

f. Publish and distribute, through extension, a complete set of recommendations on peanut, soybean, and sunflower disease control.

Possible increase in production: Peanuts 5%; Soybean 4%; Sunflower 6%.

Constraint 6. Inadequate plant population to achieve maximum oilseed crop yields.

a. Develop, through extension, optimum in-row plant populations with row spacing designed to fit modern, mechanical cultivation and harvesting machinery and chemical weed control practices.

b. Conduct on-farm demonstrations on proper plant spacing through the use of mechanical planters.

c. Publish and distribute, through extension, recommendations, based on research findings. regarding row spacing, as well as in-row seed spacing.

Possible increase in production: Peanuts 2%; Soybean 4%; Sunflower 2%.

Constraint 7. Lack of modern seed cleaning and processing equipment and production of high quality seed.

a. Provide equipment and facilities for four modern, 20 ton/day capacity seed processing plants, one plant for peanuts, and three capable of processing both soybeans and sunflower. These plants will process breeders, foundation, and registered seed classes. They will also be used for processing other crop seeds, particularly winter crops.

b. Implement seed production and management practices, including storage for oilseed crop seeds so as to provide adequate supplies of high quality registered seeds to seed growers.

c. Teach growers the value of planting seed of known germination, vigor, and purity.

Possible increase in production: Peanut 2%; Soybean 2%; Sunflower 2%.

Constraint 8. Excessive harvest losses.

a. Develop, through research, the approximate number of days from planting to optimum maturity for highest economic yields using the "shell out" maturity determination method for peanuts.

b. Conduct in-field harvest clinics to: teach growers the use of the "shell out" method to determine "when to dig peanuts"; teach growers proper methods of digging peanuts to minimize pod losses.

c. Teach growers the value of correct row spacing as it relates to present design of harvest machinery (if crops are mechanically harvested).

d. Breed shatter resistant varieties, particularly, soybean and sunflower.

e. Establish, through research, the best harvest techniques, including the use of defoliants on sunflower.

f. Teach growers, through extension, proper harvest techniques.

Possible gain in production: Peanuts 5%; Soybeans 3%; Sunflower 3%.

Constraint 9. Lack of irrigation and water management technology.

a. Cooperate with CSU project regarding water use management.

b. Design and conduct research to determine the daily and total water requirements for peanuts, soybeans, and sunflower.

c. Study "sprinkler" vs. "flood" irrigation on the different soil types and its effect on peanut pod-rot and other soil borne diseases of sunflower and soybeans.

d. Teach growers, through demonstrations and irrigation clinics, "when" and "how much" water to apply.

e. Breed saline resistant oilseed varieties.

f. Publish and distribute, through extension, peanut, soybean, and sunflower irrigation recommendations, based on research results.

Possible gain in production: Peanuts 4%; Soybean 4%; Sunflower 4%.

Constraint 10. Improper insect control techniques.

a. Conduct a survey, through extension, to identify and determine infestation severity of oilseed crop insect pests.

b. Through research, develop "economic threshold" levels of infestation.

c. Breed insect resistant varieties, particularly, soybean resistance to cotton leaf worm.

d. Teach growers the value of identifying and determining the insect infestation levels and delaying treatment until economic threshold levels are reached.

e. Publish and distribute, through extension, a complete insect control recommendation bulletin including insect identification, how to determine field infestation, economic threshold levels, and control measures for peanuts, soybeans, and sunflower.

Projected gain in production: Peanuts 2%; Soybeans 5%; Sunflower 3%.

Constraint 11. Lack of high yielding, high oil, adapted oilseed crop varieties.

a. Provide an aggressive breeding program to develop source populations for increased yield, oil content, and disease and insect resistance, including screening and incorporation of diverse germplasm.

b. Establish a selection-testing program to insure rapid, orderly identification of superior genotypes, resulting in a continuing release of adapted varieties to producers.

c. Provide expatriate plant breeding staff to assist Egyptian plant breeders in implementation of the above.

d. Provide for a training program for Egyptian plant breeding specialists, both in Egypt and overseas, to insure that they have the latest technology available.

Possible increase in production: Peanuts 4%; Soybean 3%; Sunflower 6%.

B. Institutional Constraints

Constraint 1. Lack of a strong, well organized, highly motivated, education oriented extension program.

a. Provide leadership to design and implement a simple, practical extension education organization for oilseed crops in Egypt with lines of authority and information flow.

b. Provide expatriate leadership assistance to give direction to the program with emphasis on extension education philosophy.

c. Provide in-service and out of country training opportunities for extension program leaders.

Possible increase in production: 6%.

Constraint 2. Lack of communication between research and extension counterparts.

a. Promote continuous and rapid information exchange between research and extension through staffing of research/extension personnel and officing of District Agronomist at each research station.

b. Utilize research/extension Subject Matter Specialists in bulletin publication, Village Oilseed Agent training, on-farm demonstrations, and village oilseed production clinics.

Possible increase in production: 6%.

<u>Constraint 3</u>. Inadequate training for Village Agents.

a. Provide leadership to plan and conduct in-service training for Village Oilseed Agents at at least two levels:

   (1) Program planning, development of visuals and teaching aids, effective use of radio and television, effective use of printed communications; and

   (2) Subject matter training.

b. Provide training requirements for Village Oilseed Agents when attending in-service training meetings at the Research Stations and/or Central Headquarters.

Possible increase in production: 6%.

<u>Constraint 4</u>. Inadequate transportation for District and Village Staff.

a. Provide vehicles for all extension staff (Central, District, and Village) according to need and as prescribed in this report.

Possible increase in production: 8%.

<u>Constraint 5</u>. Lack of extension Subject Matter Specialists.

a. Provide for personnel who will serve as research/extension Subject Matter Specialists. These staff will serve to both <u>generate</u> and <u>extend</u> through the District Agronomists to the Village Oilseed Agents, pertinent information regarding various aspects of each oilseed crop.

Possible increase in production: 8%.

<u>Constraint 6</u>. Village Agents have other duties such as regulatory crop allotment assignments, fertilizer and pesticide allocation, which serve to detract from the professional image of the agent.

a. This project will provide the framework in which the Village Agents' reponsibilities will be strictly educational in nature.

b. Every effort will be made at the Central and Research Stations to elevate the Village Oilseed Agent to the level of the "most informed authority" on oilseed crop production in the eyes of the village oilseed farmer.

Possible increase in production: 3%.

<u>Constraint 7</u>. Poor management of oilseed processing plants resulting in inefficient oilseed mill operation.

a. Provide consultants to go into existing plants to make recommendations on organization and operation.

b. Develop training programs to provide plant management and key plant production personnel with both in-country and overseas training.

Possible gain in production: 1%.

<u>Constraint 8</u>. Lack of efficient marketing functions, consistent markets and processing capacity.

a. Continue to encourage GOE efforts in developing, upgrading, and expanding peanut, soybean, and sunflower oilseed crushing mills.

b. Develop a training program for oilseed crushing mill administrators and key processing personnel so that they have the latest management and technical skills to effectively and efficiently operate their mills.

c. Encourage oilseed processors to provide contracts to growers.

d. Encourage growers and processors to develop a grading system for oilseed crops that will improve the marketing functions and quality control for processing and/or exporting the products. This project will have no direct input in that regard.

e. This project will have no direct involvement on implementing oil processing and utilization of plants for peanuts, and other oilseeds, but there is some apparent interest in development through the private sector.

Possible increase in production: 1%.

The product of each of the estimated percent increases due to solving each biological, technical constraint and each institutional constraint results in the estimated total production increase of 45 percent for each crop. It is assumed that the solution of the biological, technical constraints and the institutional constraints operates independently, but failure to solve any one constraint will reduce the estimated total production increase, e.g., for soybeans, total production increase of 1.45 equals the 1.02 increase from olving the fertility constraint, times the 1.04 increase from solving the inoculation constraint, etc. until finally, times the 1.03 increased from improved varieties. However, the institutional constraints must also be solved to obtain 45 percent increases.

IV. NATURAL CONDITIONS AND FARMING SYSTEMS

A. Climate

Egypt has an arid climate (see data in Appendix A), but it may be divided into three subtypes. Limited rain occurs primarily during the four winter months, November through February, along the Mediterranean Coast and a few kilometers inland. The average annual rainfall in this area ranges from 65 to 190 mm (2.5 to 7.5 inches). In this area some rainfed barley, castor, and tree crops, such as olives, are grown. All other crops throughout Egypt are grown with irrigation water. The Nile Delta and adjacent areas, which receive 25 to 65 mm (1.0 to 2.5 inches) of rainfall annually, have mild winters and warm, nearly rainless summers. Areas south of Cairo, in Middle and Upper Egypt, have mild, almost rainless winters and hot, rainless summers; the average annual rainfall is less than 25 mm (1.0 inch).

In the three climatic regions, the maximum and minimum temperatures (C^{o}) average as follows during January and July:

Region	January Max.	January Min.	July Max.	July Min.
Mediterranean Coast	18	9	30	23
Nile Delta and adjacent areas	20	6	34	20
Middle and Upper Egypt	21	4	37	20

Wind speeds are greatest from March to June, and dust storms are common during this period. Relative humidity is lowest from April to June and in Middle and Upper Egypt, where it often goes as low as 30 to 50 percent during the spring months.

B. Soils 1/

Our attention has been focused primarily on the Nile Delta, newly reclaimed land near the Delta, and cultivated

---

1/ See Appendix B: Soils Technical Report by Ivan Jansen.

land in the Nile Valley in Middle and Upper Egypt. All soils which we examined were calcareous, with contents of $CaCO_3$ ranging from one percent to as high as 90 percent.

The predominant soils in the Nile Delta are moderately dark colored clays with weakly developed profiles (Eutric Torrifluvents[1/]), but some soils have enough slickensides and deep cracking to be designated Torrerts[1/]. $CaCO_3$ content is often one to five percent. Alluvial soils of coarser texture also occur in the Delta, especially near present and former stream channels and near the Delta margins which have received wind-blown sand from the adjacent desert. Salinity is a growing problem in soils with high water tables in the lowest part of the Delta, and a few alkali soils also occur in this area.

In the Nile Valley above Cairo, the proportion of clay soils gradually decreases and salinity problems are more localized. Most of the soils in the Nile Valley are highly productive. These alluvial soils are predominantly moderately dark colored and weakly developed (Torrifluvents and Torrerts) and have some free $CaCO_3$, usually not more than three percent.

Between the north edge of the Nile Delta and the Mediterranean coast there are sandy soils (Torripsamments[1/]) on ridges associated with finer textured saline or saline-alkali soils in depressions. Soils derived from calcareous marine sediments also occur in this area.

East of the Nile Delta toward the Suez Canal, large areas of sandy soils have been recently reclaimed from the desert. The loam and sandy loam soils in these areas should be productive for a wide variety of crops. However, the sands and loamy sands are low in moisture-holding capacity, not well adapted for producing many crops, and are relatively low in productivity. For example, the predominant soils on the large Mullak Farm have loamy sand surface horizons and light sandy loam to loam subsoils. They have low moisture-holding capacity and must be irrigated with sprinklers or drip equipment. The soil pH ranges from 7.3 to 7.8, and the $CaCO_3$ content varies from one to seven percent. Most of these soils are nonsaline.

1/ Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys. Soil Survey Staff U.S. Department of Agriculture Handbook No. 436. U.S. Gov't Printing Office, Washington, D.C. 1975

Large areas of new lands have also been reclaimed from the desert west of the Delta and south of Alexandria. Many of the soils in this area are highly calcareous, with $CaCO_3$ contents which are typically 25 to 35 percent, but they range from 10 to 40 percent or more. High $CaCO_3$ contents in soils are often associated with P imbalance and deficiencies of micronutrients such as Zn and Mn. There is a wide range of soil textures in this area, with the most common being sandy loam, loam, and clay loam. A soil survey of the Nubaria area delineated the following proportions of various land classes:

Land Class	Feddans	Percent of area
II, Medium textured	700	0.6
III, Fine textured	1,300	1.2
V, but potentially II after reclaimed	46,000	41.8
V, but potentially III after reclaimed	42,000	38.2
Coarse textured, rocky, or	13,000	11.8
Shallow water	7,000	6.4
Total	110,000	100.0

Some of the soils are saline and a few are alkali. The saline soils can be improved by providing adequate drainage and leaching the salts out. Carefully timed treatment with gypsum while leaching will be necessary in most placed to prevent formation of alkali soils. Alkali soils are difficult to treat. Although the high carbonate content of many soils in the Nubaria area creates some special crop nutrient problems which require research and guidance to farmers, the soils in this area offer more promise for general crop production than some of the very sandy, newly reclaimed soils.

C. Cultivated Land and Major Agronomic Zones

The cultivated area in the Nile Valley and Delta is slightly less than six million feddans, which is approximately three percent of the area of Egypt. However, the annual crop area is about 11 million feddans (Table 1) so that the average cropping ratio is 1.9. The number of crops per calendar year varies among regions depending on duration of crop species, access to market, and soil productivity. In regions where sugarcane and tree fruits are grown, the cropping ratio can be as low as 1.7, cotton, wheat, maize, rice, sorghum, and clover combine in various sequences to achieve an intensity around 2.0. The highest ratio of 2.5 occurs when shorter-season vegetables are inserted into the cropping system at various times during the year.

Table 1. Cultivated area and crop area in the Nile Valley and Delta (excludes newly reclaimed lands)

Year	Cultivated area	Crop area	Cultivated to crop area ratio
	1,000 feddans		
1970	5,665	10,746	1.90
1974	5,884	11,026	1.87
1977	5,864	11,090	1.89
1978	5,900	11,100	1.89
1979	5,835	11,243	1.93
1980 - 1984[a]	5,900	11,450	1.93

a/ Average, projected by GOE, Ministry of Agriculture

Since 1952 there has been an aggressive program to develop new lands to increase the food supply in Egypt (Table 2). In spite of limited production to date, the reclamation of desert soils remains an ambitious government objective. Plans for reclamation of another 823,000 feddans by 1984 are being implemented (Table 3).

Table 2. Area of new lands reclaimed by various organizations, 1952 - 1975

Organization	Area 1,000 fed
General Authority for Land Development (GALD)	683
General Authority for Desert Development (GADD)	152
General Authority of Agrarian Reform (GAAR)	77
Total	912

Source: Contemporary Egyptian Agriculture. H.A. El-Tobgy. 1976.

Table 3. Present and Projected Agricultural Land Use in Egypt

Type of Use	1979 Land Use: Old Lands a/	1979 Land Use: Reclaimed 1952-77 Lands b/	1984 Projected Land Use: Old Lands	1984 Projected Land Use: Reclaimed 1952-77 b/	1984 Projected Land Use: Reclaimed 1978-84 c/
	000 fd	000 fd	000 fd	000 fd	000 fd
Winter Crops					
cereals	1,498		1,515	196	
legumes	362		396	56	
forages	2,789		2,864	198	
vegetables	283		276	81	
other	150		5,175	15	
Total winter	5,082	NA	5,175	546	NA
Summer Crops					
cotton	1,195		1,200	79	
cereals	3,338		3,475	211	
oilseed					
peanuts	31		45	88	105
soybeans	100		100	12	6
sunflower	18		20	17	13
sesame	37		4	40	4
vegetables and others	853		770	135	
Total summer	5,572	NA	5,650	546	NA
Permanent Crops					
forages	-		-	34	
orchards	340		335	33	
sugar cane	249		290	21	
other	1		-	2	
Total summer	590	NA	625	90	NA
Total Crop	11,244	NA	11,450	1,182	NA
Total Cultivated	5,835	592	5,900	636	NA
Uncultivated	1,260	111	1,160	67	NA
Unsuitable for agriculture	42	70	40	70	NA
Public utilities	663	139	700	139	NA
Total Agriculture	7,800	912	7,800	912	823

a/ Excluding new lands. Provided by Under-Secretary of Economics and Statistics, Ministry of Agriculture

b/ Provided by first Under-Secretary of the Ministry of Land Reclamation

c/ The Five-Year Plan, Ministry of Land Reclamation

On the basis of natural conditions, seven major agronomic zones were delineated (see Table 4 and Figure 1) for our study of oilseeds in the Nile Valley and adjacent areas in Egypt.

Table 4. Major Agronomic Zones, Governorates and Agricultural Research Stations in the Nile Valley in Egypt

	Zone	Governorate[a]	Agricultural Research Station
1.	Northern Delta	Kafr El-Sheikh Dakahlia Damietta	Sakha
2.	Southern Delta	Gharbia Menufia	Gemmeiza
3.	Cairo	Qalubia Giza	Bahteem Barrage Giza
4.	Western Border	Beheira Alexandria	Nubaria Mariut Alexandria
5.	Eastern Border	Ismailia	Ismailia (being developed)
6.	Middle Egypt	Fayum Beni Suef Minia	Fayum Sids Mallawi
7.	Upper Egypt	Assuit Sohag Qena Aswan	Shandaweel Mataana

[a] Does not include three city governorates and four frontier governorates in Egypt.

D. Irrigation Water, Drainage, and Water Requirements of Selected Crops

Although most of Egypt is nearly rainless, the Nile River furnishes water which is essential for human habitation, agriculture, and other uses. The overall amount of water is adequate for current needs, but its distribution is not satisfactory everywhere. Nile River water is of high quality, with low salinity and alkalinity hazards for irrigation purposes (Table 5).

Figure 1. Governorates and Agricultural Research Stations in the Nile Valley in Egypt

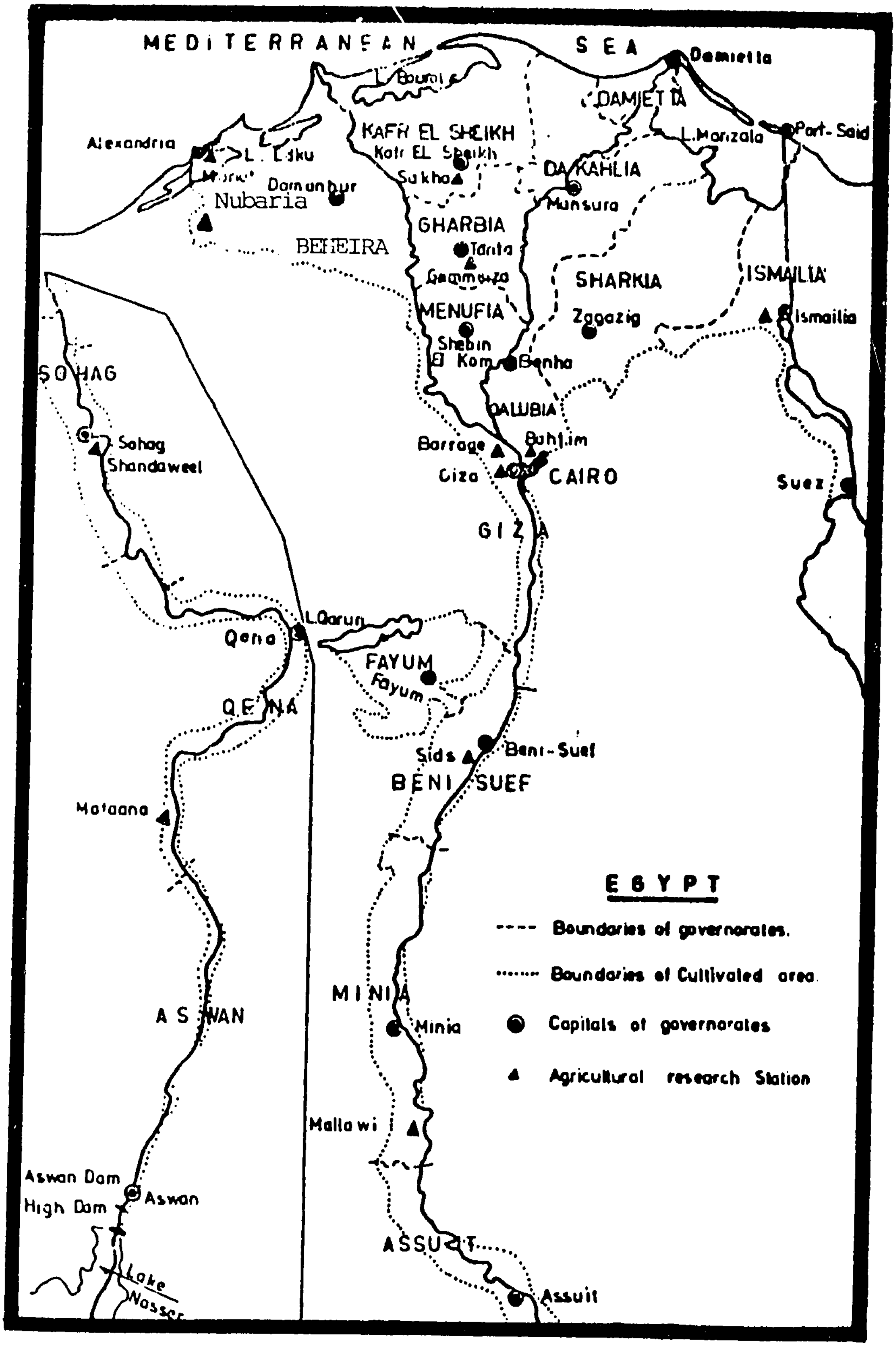


Table 5. Chemical quality of Nile River water at Cairo

Item	Annual Average 1972	1975	July 7, 1976
pH			8.02
Elec. cond. K x 10^6 at 25^o			250
Total dissolved solids, ppm	199	170	206
Cations, me/l			
Ca			1.20
Mg			0.63
Na			1.09
K			0.75
Anions, me/l			
CO_3			2.56
HCO_3			
SO_4	0.38		
Cl	0.60	0.45	0.51
Sodium-adsorp. ratio (SAR)			1.14

Source: Research Institute for Studies of Effects of the Aswan High Dam.

Since the Egyptian government provides water free to farmers, excessive irrigation water is used, particularly on old lands, and the water table is rising too close to the soil surface for optimum crop production. This also concentrates in the soils excess soluble salts which are harmful to crops and costly to leach out. Much of this secondary soil salinity problem could be avoided with proper irrigation and drainage. Currently, there is an active UNDP drainage program (open ditches and underground tile) and soil amelioration program (leaching, gypsum application where needed, and some deep tillage) to correct the drainage, salinity, and alkalinity problems by 1985. This program is in the initial stages, and much more needs to be done to safeguard Egypt's good, but scarce soils.

Water requirements of oilseed crops, except sunflower, in Lower, Middle, and Upper Egypt and the typical growing seasons of these crops are listed in Table 6 1/. Less water is used by these oilseed crops than many other crops, such as sugarcane, and rice.

1/ Sunflower consumption water use reference: R.G. Robinson, 1978. Sunflower Production and Culture In: J.F. Carter Ed. Sunflower Science and Technology, pg. 123. No. 19 Agronomy Series. American Society of Agronomy, Madison, Wisc. USA.

Table 6. Consumptive use of water by some oilseed crops and their typical growing season in Egypt

Crop	Growing Season	Consumptive use of water Lower Egypt	 Middle Egypt	 Upper Egypt
		centimeters (depth)		
Soybeans	May - August	40.1	42.1	43.8
Peanuts	April - October	71.0	75.1	79.2
Safflower	November - May	52.4	53.6	57.5
Sesame	May - August	43.0	45.1	47.0
Flax	November - March	33.5	33.5	36.0

E. Farm Size and Organization

A series of agrarian reform acts, starting in 1952, have altered the pattern of land ownership. Among other features, the reform laws placed upper limits on the number of feddans which can be owned. The 1969 act places a ceiling of 50 feddans per owner and 100 feddans per family (husband, wife, and minor children). Approximately 92 percent of the land holders have tracts of five feddans or smaller in size (Table 7). The average size of holdings for the total area, excluding state lands, desert, and land under distribution is about two feddans.

Table 7. Number and size of farms in Egypt

Size class in feddans	Number of holder In 1,000	 % of total	Area Feddans in 1,000	 % of total
1.0 and smaller	1,124	39.4	739	12.3
1.1 - 3.0	1,160	40.7	2,023	33.8
3.1 - 5.0	355	12.4	1,186	19.8
5.1 - 10.0	149	5.2	944	15.8
10.0 - 50.0	65	2.3	986	16.5
More than 50.0	--	--	106	1.8
Total	2,853	100.0	5,984	100.0

Source: Some statistical Indicators in the Egyptian Agriculture. Ministry of Agriculture, Institute of Agricultural Economics Research. November 1978.

Approximately 46 percent of the cultivated land is leased, mostly on cash leases with rents not to exceed seven times the land tax. It has been estimated by Radwan[1] that in 1972 there were 3.7 million families engaged in agriculture. Of these, approximately 50 percent owned no land. Table 7 indicates that there were 2.9 million land holders in 1978.

The fellahin (farmers) live in approximately 4,500 villages from which they travel to farm their usually scattered plots. The agrarian reform acts, together with the tradition of distribution of property among heirs, has led to substantial fragmentation. To reduce the inefficiencies caused by fragmentation, land use projects have been established on some of the old lands. Under these projects, a farmer with the most common rotation (see Figure 2) has three approximately equal-sized fields in different large sections comprised of a number of fields belonging to different farmers. In one section all farmers would follow the field 1 sequence (Figure 2); in another section all farmers would follow the field 2 sequence, etc. Such grouping permits gains from operations such as plowing and pest control.

On the newly reclaimed lands, the government is encouraging the utilization and productivity of lands. Thus, land has been distributed to graduates in 20 feddan tracts and to settlers in five feddan tracts. Also, the government is promoting somewhat more extensive joint ventures with foreign partners in order to introduce new desert farming techniques.

F. Cropping Systems

Livestock feed requirements play an important role in the determination of cropping systems. Animals are the primary source of power for field operations, such as tilling the soil, pumping water, and transport. Marketed animals and animal products comprise about 30 percent of agricultural output. The forage requirements for these animals must be met from land that could otherwise be used for grain, fiber, or oilseed crops. Berseem clover successfully competes with these crops because of high livestock prices and the need for maintenance of the power source.

The proportionate areas devoted to various crops during the year are shown in Figure 3.

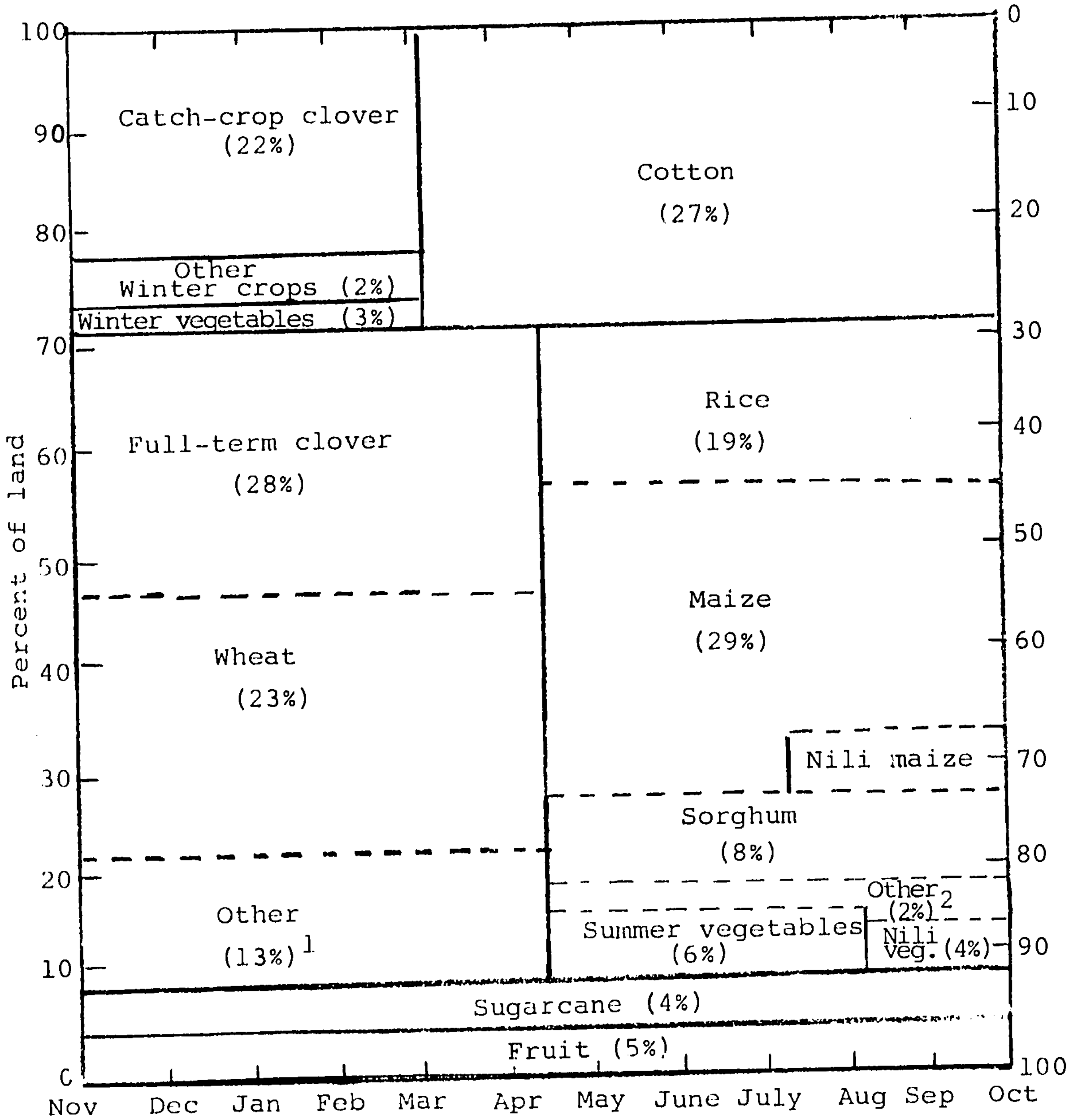
---

[1] Samir Radwan. The Impact of Agrarian Reform on Rural Egypt, 1925 - 1975. World Employment Program Research, ILO WEP 10-6 WP-13, Geneva. 1977.

Figure 2 Three-year rotation on old lands

	Field 1	Field 2	Field 3
Year 1			
Winter	Catch-crop clover	Wheat	Full-term clover
Summer	Cotton	Rice and/or maize	Rice and/or maize
Year 2			
Winter	Full-term clover	Catch-crop clover	Wheat
Summer	Rice and/or maize	Cotton	Rice and/or maize
Year 3			
Winter	Wheat	Full-term clover	Catch-crop clover
Summer	Rice and/or maize	Rice and/or maize	Cotton

Figure 3. Proportionate area devoted to specified crops during the year, 1972-74 average



1 Chiefly field beans, lentils, and onions.

2 Chiefly sesame and groundnuts.

Source: Egypt: Major Constraints to Increasing Agricultural Productivity. U.S. Dept. of Agriculture, USAID, and Egyptian Ministry of Agriculture. U.S. Foreign Agricultural Economics Report No. 120. 1976.

Cotton occupies the land about seven months, which is longer than any other annual crop. Rice, maize, and sorghum are the major grain crops. Berseem clover is fitted into the system as a full season (six months) fodder crop, but it may be terminated after two to three cuttings so that cotton can be planted at the optimum time. Various vegetable crops may be included in the cropping sequence or as separate small plots.

Virtually no intercropping is practiced. In one region, onions are planted as a relay crop in cotton. Safflower is frequently planted on the border ridges around wheat fields.

An additional complicating factor occurs when the government encourages farmers to plant adjacent fields in the same crop, usually cotton or rice, in order to have a solid block for convenience in treatment for pests and to meet production targets. This system disrupts the cropping sequence planned by farmers.

Cottonseed is processed to provide almost all of the domestically grown edible oil. A small quantity of sesame is pressed for oil, but most of it is consumed as a protein or confectionary food. Peanuts are widely grown. Some are consumed directly and part are exported in the shell. Sunflower is also produced and used for confectionary purposes.

A number of oilseed crops show promise. Considerable research and extension efforts have been devoted to introducing two summer oilseed crops, soybeans and sunflower. Sunflower production has met with only moderate success, while soybeans, although modest in area, have increased geometrically in feddans for several years. Another summer annual, peanuts, has received little research attention, but offers considerable promise, especially on new lands. Castor is grown most frequently as a perennial under rainfed conditions, although some annual plantings are made to utilize residual moisture in the soil.

Among the winter oilseed crops, flax has received considerable research attention and is cultivated in several regions for fiber and seed. Although potentially important because of relatively low water requirements, neither safflower nor rape has generated much interest, probably because of low yield of local varieties and a limited market.

G. Inputs for Crop Production

Most inputs for agricultural production are supplied at subsidized rates to the farmer through government agencies such as cooperatives. Irrigation water is provided free, i.e., fully subsidized. Both research and extension organizations are involved in production and distribution of some inputs.

The seed supply system for row crops, as described by the Ministry of Agriculture, includes maintenance of breeder seed, increasing of foundation seed, and additional bulking of certified seed in the final stage before distribution to farmers. Research staff numbers are usually involved in growing all three types of seed, although occasionally large farmers are selected for certified seed production. Distribution to farmers is made through depots operated by the Agricultural Development Bank (ADB). Seed is sold to farmers at commercial or near-commercial market grain prices.

Phosphate fertilizer is manufactured from domestic rock phosphate and analyzes about 16 percent P_2O_5. Granulation is not uniform. In 1976, 382,000 tons were distributed for 10.2 million feddans of crop area, which gives an average application of 6.1 kg of P_2O_5 per feddan of crop area. Nitrogen is imported as urea (46 percent N) or ammonium nitrate (33 percent N), while the domestic production is calcium nitrate (15.5 percent N). Approximately 2,646,000 tons of 15.5 percent equivalent material materials were distributed in 1976. This suggests that the average rate applied was 40 kg of elemental N per feddan cropped. Recommended rates vary from 15 kg for peanuts to 120 kg for sugarcane. Distribution of most of the fertilizer is made through the ADB at subsidized prices, and the remainder is sold at full cost. These inorganic sources are supplemented significantly by application of organic material composed of livestock and poultry manure combined with some plant residues.

Most tillage operations on the small farms (up to 10 feddans) are done with oxen power. Limited numbers of tractors and plows are available through cooperatives or from neighboring farmers. Local sources indicated that the cost of tractor and equipment was LE 5.00 per feddan, while a pair of oxen and equipment rented for LE 2.00 per feddan. Larger farmers sometimes own tractors and equipment. Company farms are usually mechanized, although hand labor is used extensively. All farm operators complained about the shortage and cost of farm labor, which ranged from LE 0.25 to more than LE 1.00 per day.

On small farms, primary soil tillage is done with the traditional ox-drawn plow or tractor-drawn chisel plow. A heavy plank is used to break clods in the soil surface. Seed is broadcast or sown in rows by hand. Seed is covered by hand hoe or by use of the plank. Weeding is done by hand hoe, although some duck-foot tractor cultivators are coming into use. Perhaps 80 percent of the crop is threshed by hand or on compacted soil or concrete floors through the abrasive action of sleds dragged by oxen or tractors. The number of stationary threshers is increasing, and a few combines are in operation on company farms, which grow small grains, maize, peanuts, and soybeans.

Irrigation water is provided to farmers without direct charge which often results in excess application. The supply of water along gravity canals is more than adequate. However, on new lands, where the supply canals are recharged by lift pumps, the water supply is reported to be frequently inadequate or intermittent. The cause for this deficiency is attributed to inconsistency between the objectives of the Ministry of Agriculture staff and farmers who operate the farms and the Ministry of Irrigation staff who operate the pumps. Drainage canals have been dug through most irrigated areas. Underground drain tiles have been installed on about one-third of the lands which need them, and they are urgently needed in additional areas.

V. GOVERNMENT POLICIES

For several years government policy in Egypt has been focused on economic growth. Since about 1960, the Egyptian economy has experienced a high growth rate. The 6.5% growth in 1975 appears to be typical of this period. Industrialization objectives have frequently drawn attention and investment to nonagricultural programs. On the other hand, several development activities in agriculture have received major support. Irrigation, drainage, and new land development are examples.

The Egyptian farmer is an independent businessman. Land holdings are small, but most farmers cultivate their own land. Yet, down through the centuries, government has had a close working relationship with the farmer. Agriculture on the Nile floodplain and delta has always required the input of public initiative for canals, levies, dams and, recently, drainage systems. As well as receiving the benefit of public initiative, farmers have always had to devote some of their activities to enhance the public good. In this setting, government policy has three primary aspects: capital projects, administered prices and crop allocations.

A. Capital Projects

A major activity of the Egyptian government is the maintenance and operation of the irrigation systems. Through this system, water is made available to farmers at no cost. The farmer must distribute water from government-operated canals to irrigate his land. A major new program to improve drainage is also in operation.

Government initiative is also focused on development of new lands. This involves earth-moving to level the surface and make canals. Some new land is sold to farmers, and a significant amount is operated by public authorities.

Government agencies also operate a farm input supply organization. Through this system, farmers receive loans, fertilizer, seed, and other supplies - some at subsidized prices. The government also operates some parts of the processing industry which buys and handles farm output. Cotton gins and cottonseed processing are examples of such government-operated agri-businesses.

In addition to the government programs, the Ministry of Land Reclamation's 1980 - 1984 Plan calls for joint venture and private development on the new land. The government would still provide social and physical infrastructure on most projects.

B. Administered Agricultural Prices

Direct taxation of Egyptian farmers is a complex political process, as is typical of small-holder agriculture. For this reason, "... the tax burden as a proportion of real income per feddan has declined over the years, from about 6 percent of income in 1952 to about 2 percent now."[1/] In most years, agricultural tax revenues do not pay for the public initiatives in irrigation alone. Other forms of taxation from agriculture were needed to finance subsidies for input supplies and other significant programs in agriculture and nonagricultural programs.

The alternative programs to provide public funds from agriculture have been called "price differentiation" arrangements. In these arrangements, the government becomes the sole buyer of the crop and determines farmer prices and consumer prices in such a way as to gain a flow of profits from the crop. Cotton, rice, wheat, and sugarcane are the main crops involved, with cotton being by far the most important. In 1971, (the latest year for which data are available) the taxes collected from cotton were about twice as large as the total taxes on agriculture.

Egyptian cotton lends itself very well to this pattern. It is a specialty crop which claims prices about twice as high as world prices for other cotton. It is important that quality be controlled because large increases in sales would likely cause large price declines. By setting low prices to farmers, excess production is prevented and the premium prices which give a good profit to the government have been maintained.

C. Crop Allocation Activities

Consequences of this pricing policy include a pattern of crop allocations requiring farmers to produce their "quota" of cotton. This premium cotton is an expensive crop to produce. Growing it requires about seven summer months on some of the world's most fertile soil, plus significant inputs of labor, fertilizer, and pest control. The behavior of farmers indicates that the low farm price for cotton may be a bit overdone.

1/ Waterbury, John. Administered Pricing and State Intervention in Egyptian Agriculture. 23 p. memo p.11. 1978.

There are indications that the farmers' disincentive in producing cotton leads to unfortunate practices. Some farmers harvest an additional cutting of berseem and plant cotton later than required for maximum yield and quality. Also, some of the fertilizer and pest protection intended for cotton may be diverted to other more profitable crops.

The context of these price policies can best be described by quoting directly from the current Five-Year Plan. The Egyptian Five-Year Plan, 1978 - 1982, sets forth the following targets for the agricultural sector (Vol. 4, August 1977):

> "Provision of food security for the people. Positive contribution to the balance-of-payments problem. Absorption of urban population growth into new villages."

These targets are to be achieved by implementation of the following policies (Five-Year Plan, Vol. 4, P. 2):

> "Crop formation on the basis of place and climatic spheres, created for specialization in exports against free currencies and to reduce the volume of imports. This is to be done by developing agricultural production practices in the old lands (5.6 million feddans), implementing a price policy to ensure optimal crop formation, increasing the yields of lands previously reclaimed (912,000 feddans), and reclaiming more new lands."

Soybeans have not come into the picture as an "allocated" crop along with cotton, rice, wheat, and sugarcane, but farmers have been allowed to use soybeans to satisfy their cotton allocation. The farm price offered for soybeans is 200 LE per ton and has remained static for the past 5 years. This price compares roughly with the value of soybeans in the world markets of 1978 (laid down in Alexandria). The farmer is required to sell soybeans to the government and they are to be processed in government-owned mills or in private mills in the Free Trade Zone on a fee basis.

At present, no other oilseed crop has been singled out for expanded domestic production and processing. Several other oilseeds are the object of extensive research. With the stimulus given to soybeans, some other crops (sunflower or peanuts) are projected to increase in yield and area. At present, the greater value of soybean meal in the growing poultry industry and the higher yields obtained seem to justify the special stimulus given to soybeans.

VI. RESEARCH AND EXTENSION

A. Research

Agricultural research in Egypt is conducted by four major categories of institutions. These institutions include the Agricultural Research Center (ARC) in the Ministry of Agriculture, the Ministry of Irrigation, the faculties of agriculture in the universities under the Ministry of Higher Education, and the National Research Center (NRC) in the Academy of Science. The ARC has responsibility for research on problems relating directly to the farmer, whereas the NRC conducts basic research on more abstract long-range agricultural problems. The professors and graduate students in the faculties of agriculture are most frequently engaged in basic rather than applied problems, although there are exceptions. The Ministry of Irrigation is concerned primarily with water conveyance and distribution systems, but also conducts some crop water-requirement studies. The Soil Salinity Laboratory attached to the Ministry of Agriculture, located near Alexandria, carries out both preventive and reclamation studies on saline and alkali soils. The Academy of Science has a department which conducts crop and soil evaluation and development research for the new lands.

Virtually all research in all institutions is conducted within one discipline. Communication between scientists in different disciplines and between institutions on a day-to-day basis is very limited and is dependent on individual scientist's initiative. Journals are prepared by all institutions, but the lag time between completion of experiments and receipt of the printed publication can be as much as three years. The ARC prepares journals on an institute basis - that is, each month one of the institutes prepares and publishes articles from its staff and discipline only. Extension publications are prepared by the Extension Department from research results sent by the Director of the ARC to the Director of Extension.

The primary constraint to a relevant and aggressive research program is institutional in nature. Scientists are locked into rigid disciplines and institutional frameworks where they do not have official sanction and encouragement to pursue multi-disciplinary projects or to communicate directly with extension staff and with farmers. Some senior scientists are, on their own initiative, conducting extension type on-farm demonstrations sometimes completely out of their particular field. Thus, communications and interaction between members of different organizations and the farmer have become excessively complex and rigid. The specification of a production problem or the solution to a problem must travel all the way up through one organization to its Director, then to the Director of the other organization and to his staff, and finally back through channels in the opposite direction. There are a large number of scientists employed who have good academic qualifications, and many of these scientists would prefer to carry out meaningful research. However, funds that are budgeted for research are inadequate and cannot all be spent. Equipment and transportation are also inadequate. Salaries are inadequate, which causes staff to be concerned about promotions, alternate positions, or even second jobs, rather than total dedication to the task at hand. Individual scientists, particularly plant breeders, have responsibility across several crops, further diluting their efforts.

The Agricultural Research Center (ARC) has its headquarters and central experiment station on 40 feddans in Giza, which is a suburb of Cairo. There are substations which are located in each of the major Agronomic Zones (Table 3). These substations have some office and laboratory buildings, but with some exceptions (such as Sakha, Shandaweel, and Mallawi) there is only minimal housing for staff and guest houses for visitors. The net result is that senior staff rarely live at and visit these substations. Field equipment and routine field and laboratory supplies (except for fertilizer and seed) are usually old, worn out, or not available. Rather than permanently assigning the best land, machinery, and labor to research functions, the first choice of this critical support is most frequently given to the seed and crop production department which owns the land on which the research station is built.

Research staff must rely upon trains, buses, and sometimes private vehicles for travel from headquarters to substations, which make frequent visits to stations and to farmers' fields highly unlikely. It is reported that no transportation is provided to Extension staff.

Research on the different phases of oilseed crop production is carried out in six different Institutes in the ARC: Field Crops, Cotton, Soil and Water, Plant Diseases, Plant Protection, and Agricultural Economics. Within the Field Crops Institute, the Oilseed Section has responsibility for peanuts, sunflower, safflower, sesame, castor, rapeseed, and mustard; the Legume Section for soybeans; and the Fiber Section for flax. The number of senior research staff (including those at substations) working on oilseeds in the Field Crops Institute are listed in Table 8. Most of these research workers are crop breeders or agronomists. Only minor attention is given to castor, rapeseed, and mustard. In the Cotton Institute, approximately 40 senior research staff members with Ph.D. or M.S. degrees work on cotton, with primary attention to fiber production.

Table 8. Number of senior staff conducting research on oilseed crops in the Field Crops Institute, ARC

Section	Oilseed crop	Number of senior staff	Highest academic degree
Oilseeds	Peanuts	3	Ph.D.
	Sunflower	3*	M.S.
	Safflower	11*	B.S.
	Sesame		
	Rapeseed, mustard, and castor		
Legume	Soybeans	3	Ph.D.
		5	M.S.
Fiber	Flax	2	Ph.D.
		6	M.S.
		6	M.S.

* In addition to these numbers of senior research staff, 3 persons with M.S. degrees and 6 with B.S. degrees are away on leave for graduate study, etc.

B. Extension

The stated goal of the Egyptian Agricultural Extension Service is to carry the results of research to farmers in the form of recommendations for better cultural practices, which result in greater crop yields and a higher standard of living. A country-wide network of extension units is being developed to accomplish this goal. Egyptian farmers cultivate land near approximately 4,500 villages grouped into some 123 districts. Extension education programs are dependent upon two to three extension workers per district, supervised by a chief extension officer and two or three deputies at the governorate level. Ideally, a village extension worker is the connecting link between the district workers and the farmers.

Indicative of a failure of agricultural extension to accomplish the stated goal of higher crop yields and higher farm income, is the leveling off or, in some cases, an actual decline in crop yields in recent years. Good examples are yields of peanuts and sunflower. Peanut yields have remained virtually unchanged since 1970, while yields of sunflower actually declined during that period. Soybeans illustrate the opposite extreme. Egyptian farmers have written a success story unparalleled any place in the world with this crop. Not only has acreage increased in an exponential fashion since 1974, but yields have more than tripled during the same period. What constitutes the difference? It can only be concluded that the farmers are ready to adopt new and better crop varieties, and/or cultural practices if presented to them in such a manner as to encourage their adoption.

Crop technology is currently available to increase farm yields by at least 15 to 20% if such technology is applied at the farm level. Evidence to support this statement lies in the reported peanut research yields up to twice as high as country-wide farm yield averages.

If technology is available for increased farm yields and farmers are ready to adopt such information if presented to them, it can only be concluded that the farmers do not have access to the information. What then are the major factors limiting an effective extension education program?

Several conditions have been suggested in answer to this question including: (1) inadequate communication between extension staff and their research counterparts; (2) extension programs originate at headquarters and may or may not be relevant to solving local problems; (3) contact of extension agents with farmers is limited; (4) inadequate supply of properly trained professional extension staff; (5) inadequate support including financial, teaching equipment, and transportation; and, (6) village agents have duties other than farmer education which tend to detract from the agents' professional image, i.e. regulatory and/or technical duties.

Although all these factors may limit extension education programs to some extent, inadequate supply of and support for properly trained, highly motivated professional staff is probably the strongest barrier. This very important barrier will greatly influence all the other conditions mentioned.

A major emphasis on insuring adequate support, both financially and otherwise, is mandatory and prerequisite to success. Emphasis on selection and training extension workers will also be necessary.

VII. COTTON

Cotton is primarily a fiber crop but it also produces cottonseed which is processed for meal and edible oil. This source comprises most of the domestically produced oil in Egypt and accounts for one fourth of the national requirements. Any significant increase in feddans planted to summer oilseed crops will likely have some effect on the cotton area which is established by government policy.

A. Cotton Production

Cotton is the single most important crop in Egypt. It occupied about 1,196,000 feddans or 19.9% of the arable lands during 1979 (Table 9). Cotton fiber is the leading export crop and contributes much of the raw fiber required for domestic cloth weaving. Cottonseed supplies 95% of the domestically produced edible oil. However, this source comprises only about 90,000 to 100,000 tons or 27 - 29% of the present oil requirements of 340,000 tons.

Cotton is normally planted in March and harvested in October, although both late planting and poor husbandry may delay harvest on some fields into late November. Because of its long growing period, the only other crops suitable for planting in sequence with cotton include short-season clover and winter vegetables.

During 1972 - 1974, three agronomic zones planted 78% of the available area in cotton, and this supplied 81% of the cottonseed (USDA/USAID FAE Report No.20[1/]). These zones included I, Northern Delta = 34%; II, Southern Delta = 22%; and, VI, Mid-Egypt = 22%. Three additional zones contributed 17% of the cotton area and 15% of the cottonseed. These included III, Cairo = 5%; VII, Fayum = 5%; and, VIII, Upper Egypt = 7%. The remaining 5% of the production area and 4% of the cottonseed was distributed almost equally among zones IV, Western Border = 2%; V, Eastern Border = 2%; and, IX, El Husseiniya = 1%.

1/ These zones are not identical with those decribed in Table 4 and used elsewhere in our report.

Table 9. Cotton: Area, yield, and cottonseed production* by agronomic zones - 1970-72, 1972-75, 1976-78 and 1979 averages

Year/Period	1	2	3	4	5	6	7	Total
				Agronomic Zone				
				Average Area Cultivated (Feddans)				
1970-1972	376,626	199,778	49,873	183,532	183,532	326,878	214,605	1,568,158
1973-1975	363,906	220,494	39,351	177,609	158.670	305,304	200,941	1,466,266
1976-1978	339,301	194,228	24,118	167,533	145,970	256,864	158,781	1,286,526
1979	NA	NA	NA	NA	NA	NA	NA	1,196,000
				Cottonseed Yield per Feddan (M.T.)				
1970-1972	.52	.79	.75	.54	.63	.58	.59	.59
1973-1975	.51	.60	.69	.50	.59	.48	.63	.55
1976-1978	.55	.67	.79	.59	.62	.42	.61	.57
1979	NA	NA	NA	NA	NA	NA	NA	
				Total Production of Cottonseed (M.T.)				
1970-1972	196,260	158,243	37,282	99,935	115,455	188,316	125,868	921,361
1973-1975	184,364	133,212	27,263	88,443	92.862	145,692	127,467	799,305
1976-1978	185,533	130,885	19,118	98,897	91,075	109,128	96,714	731,352
1979	NA	NA	NA	NA	NA	NA	NA	

* Based on cottonseed being 64% of raw cotton weight and lint 36% of raw cotton weight. One M. kantar of lint converts to 0.09 M.T. of seed.

B. The Place of Cotton in the Cropping System

The Five-Year Plan, 1978 - 1982, Vol. IV, designated three alternative crop formation plans. The first emphasizes agricultural exports and the foreign exchange contribution, and thus requires an increase in cotton area, even though the impact of cotton exports on balance of payments is dampened by the fact that commitments are mostly to countries under agreement arrangements and not free-currency countries.

The second alternative emphasizes food security and raw material for industry. Under this alternative, cotton area is kept at about one million feddans.

The third alternative places greater reliance on an increased percentage of high-yielding crops and the consequent increase in value of production as compared to the second alternative, which most closely coincides with the objectives of the Ministry of Agriculture (p. 130, Vol. IV, Five-Year Plan, 1978 - 1982).

Of special importance to evaluation of oilseed production is the fact that the third alternative calls for a pattern of crop area changes which, among other things, involves substantial increases in cotton area (p. 127, Vol. IV, Five-Year Plan, 1978 - 1982), as shown below (also compare with Table 10).

Table 10. Cotton crop formation plan - third alternative

Crop	1970	Third Alternative projected for 1985
	1000 Feddans	
Cotton	1,622	1,900
Cereals	4,650	4,099
Legumes and Green Forages	3,679	3,945
Fruits and Vegetables	1,218	1,767
Other Crops	374	724
Total	11,543	12,435

Despite the trade advantages of a large cotton allocation, the government policy points toward a stabilized cotton area of 1.2 million feddans (Five-Year Plan, Vol. IV, P. 130). Consistent with this intent, the shifts from 1977 actual to 1979 projections are as follows:

	1977	1979 Planned	Change
	1000 Feddans		
Cotton	1,423	1,200	- 223
Maize	1,765	1,760	- 5
Soybeans	32	150	+ 118

Although it is natural to think of crop competition and substitution on the old lands with established systems, it is equally relevant to compare oilseeds with other potential crops on new lands. In the third alternative of the Five-Year Plan, the new lands would comprise 17 percent of total crop acreage in 1985. Emphasis in planning for the new lands has been on the cultivation of fruits and vegetables for export and production of green forage for cattle feed. However, the role of the new lands in expanded oilseed production is expected to be an important one under the third alternative plan. The newly reclaimed lands are expected to contribute 46 percent of the oilseed production in 1985 (p. 128, Vol. IV, Five-Year Plan). This is expected to come from crops other than cotton.

Preliminary data for 1978 show continued decrease in cotton feddans, but an increase in yield. On the basis of present information, policy, and, projection, we expect oil production from cotton to remain about constant at 100,000 MT during the 1978-88 period. This will come from declining areas in cotton and improvements in the crop yield per feddan and the oil yield per ton of cottonseed (Table 11).

Table 11. Production of cottonseed, oil, and meal, 1974 - 1978, and projections for 1979, 1983, and 1988[a]

Year	Cotton, Feddans	Cottonseed Yield/ Feddan	Cottonseed Produced	Cottonseed Processed	Products Crude Oil	Products Meal (cake)[b]
	1000	MT	MT	MT	MT	MT
1974	1,453	0.55	793,175	674,199	107,872	512,391
1975	1,346	0.54	723,642	615,096	98,415	467,473
1976	1,248	0.57	713,293	606,299	97,008	460,787
1977	1,423	0.50	717,637	609,991	97,599	463,593
1978	1,189	0.60	707,754	601,591	96,255	457,209
1979[c]	1,337	0.55	735,290	625,000	100,000	475,000
1983[c]	1,259	0.55	692,640	606,061	100,000	460,606
1988[c]	1,188	0.55	653,595	588,235	100,000	447,059

[a] Actual data for feddans, yields, and production, 1974 through 1978. MT processed is estimated as 85 percent of production for 1974 - 1979. 87.5 percent in 1983, and 90 percent in 1988. Oil production is 16 percent of processed cottonseed through 1979, 16.5 percent for 1983, and 17 percent in 1988. Meal is 76 percent of cottonseed processed throughout. Feddans for 1979, 1983, and 1988 are chosen consistent with the above percentages, yield levels (.55) at the 1974 - 1978 average, and oil processed at 100,000 MT per year.

[b] Includes hulls and lint.

[c] Estimated.

VIII. SOYBEANS

A. Soybean Production

1. Location

a. Old Lands: In 1979, soybeans were grown on old lands in 17 of the 21 governorates. The largest area in soybeans, 37,737 feddans, was in Minia in Middle Egypt. Three governorates in the Delta had slightly over 8,000 feddans each. The average yield in 1979 was 1,056 kg per feddan. Yields ranged from 723 kg per feddan in Assuit to 1,432 kg per feddan in Menufia. Total production in 1979 was 106,033 metric tons (Table 12).

The area in soybeans increased 25 fold from 1974 when 4078 feddans were planted, to more than 100,000 feddans in 1979. Yields have also increased steadily during the period from 329 kg per feddan in 1974 to 1,056 kg per feddan in 1979. It appears that an average yield of 1.35 MT per feddan can be expected in the future on old lands.

b. New Lands: Soybean production on the new lands will be more important on the lands developed in the 1954-79 period than those still to be reclaimed. Many of the developed soils in this area are heavier textured than those of the area to be developed in 1980-84, which tend to be too sandy for soybeans. In the old new lands (developed 1954 to 1979) there are 228,000 feddans in annual crops. With a vigorous soybean promotion program it is reasonable to expect that over 40,000 feddans will be planted to soybeans by 1984. The production on the new new lands should be about 7,000 feddans. Total area of soybeans on the new lands in 1984 should be about 50,000. It appears that an average yield of 1.0 MT can be expected in the future on new lands.

Table 12. Soybeans: Area, yield, and production by agronomic zones - 1974-1979

Year	Agronomic Zone 1	2	3	4	5	6	7	Total
				Area Cultivated (Feddans)				
1974	494	101	30	41	132	3,201	79	4,078
1975	742	1,021	208	138	778	4,827	633	8,347
1976	1,779	2,494	471	647	532	9.112	1,417	16,452
1977	3,760	6,329	621	4,256	805	14,397	1,838	32,006
1978	14,795	13,223	1,975	9,413	2,233	31,455	8,812	81,906
1979	8,401	16,251	2,876	15,570	1,246	46,047	10,030	100,421
				Yield per Feddan (M.T.)				
1974	0.351	0.508	0.258	0.269	0.274	0.316	0.471	0.329
1975	0.465	0.410	0.372	0.358	0.305	0.517	0.363	0.464
1976	0.674	0.857	0.636	0.821	0.545	0.631	0.506	0.660
1977	0.835	0.859	0.883	0.858	0.662	0.664	0.686	0.741
1978	0.824	1.285	0.958	1.243	0.022	0.796	1.011	0.965
1979	0.960	1.417	0.868	1.202	0.931	0.966	0.806	1.056
				Total Production (M.T.)				
1974	175	51	8	11	36	1,012	37	1,330
1975	345	419	77	49	237	2,496	232	3,855
1976	1,199	2.137	299	531	290	5,751	629	10,836
1977	3,140	5,435	548	3,652	533	9,562	1,198	24,068
1978	12,192	16,994	1,891	11,700	2,283	25,040	8,909	79,039
1979	8,069	23,030	2,495	118,708	1,160	44,485	8,086	106,033

2. Time Grown

Soybeans, in Egypt, are grown as a summer crop. Yields tend to decrease as planting is delayed after April 15. In later plantings, more applications of insecticide are required to control the cotton leaf worm. Other insects also increase in numbers during late summer. Group III and IV varieties are used in order to minimize insect damage and insecticide costs. These varieties mature early enough so that only one or two applications of insecticide are required. Group V and later-maturing varieties have higher yield potential and are better suited for later plantings, but require several applications of insecticide.

3. Production Practices

Since soybeans are often grown after berseem, it is necessary for the land to be plowed to prepare a suitable seedbed. The seed is planted on ridges to facilitate irrigation. Frequently, adequate nodulation is not achieved even though the seed is inoculated with the proper strain of Rhizobium, so some nitrogen fertilizer is used as a side-dressing. Ten to thirty kg per feddan of N and 20 to 30 kg per feddan of P_2O_5 are recommended fertilizer applications. In 1980, 60 kg of N is the recommended rate.1/ Crops do not respond to potash fertilizer on most Egyptian soils. Cotton leaf worm is the most serious pest of soybeans in Egypt and causes considerable damage. It requires constant control measures in June and July.

Soybeans generally are harvested by hand and are threshed with flails or by trampling with animals, but in some cases stationary gasoline motor-powered threshers are used. Even on large farms in the new lands, soybeans are cut by hand and carried to stationary combines or threshers.

4. Associated and Competing Crops

Soybeans will usually be grown after a winter crop of berseem or other winter crops such as broadbeans or onions. It is not likely to follow wheat, since wheat is not harvested until May. By the time a seedbed can be prepared after wheat is harvested,

---

1/ Egypt Arab Republic, Ministry of Agriculture. Order No. 99 - Fertilizer Allotments for Summer and Nili Crops for 1980.

it will be too late to plant soybeans. Soybeans will compete for area with other summer crops, principally cotton and maize.

Short season soybeans are planted early to avoid the heavy insect infestations and usually are grown following an early harvested winter crop. These crops would include berseem with only two to three cuttings, or vegetable crops such as broad-beans. Present varieties of soybeans cannot follow a winter cereal because winter cereals are not harvested until mid May.

This early planting date makes the winter berseem and soybeans compete with berseem and cotton or the combination of full season berseem and maize or wheat and maize. The development of insect tolerant, later planted, longer season varieties which would follow winter cereals would make soybeans more competitive.

5. Cost of Producing Cotton, Soybeans, and Maize

The cost of production for soybeans is LE 124.8 per feddan. This is 21 percent (LE 21.83) higher than those costs reported for maize. Comparisons of cost of production data from the U.S. suggest that soybean production costs should be 10 to 20 percent less than those for maize. There are several reasons for a higher soybean cost, arising mainly from the fact that soybeans are a new crop for Egyptian farmers. First, fertilizer applications and costs are the same for corn and soybeans. Usually with adequate nodulation, no nitrogen fertilizer should be necessary for soybeans. Second, the least cost method of planting and harvesting soybeans is not being used. The hand pod harvesting methods used by many cultivators may explain at least part of the 25 percent greater labor costs on soybeans over maize (Table 13).

6. Competitive Position of Soybeans vs Cotton with Prices Variable (Yields and Costs Given)

In the old lands area the farmgate price ratios of soybeans and cotton will play an important role in expanding soybean production. A break-even price analysis will provide a rough measure of the range of price ratios at which these crops may be expected to be close competitors. Both the cotton and soybean prices to farmers are presently fixed by the central government, thus permitting a degree of control of the acreages of these crops. Furthermore, it has been the current policy to allow feddans planted in soybeans to substitute for the required area to be planted in cotton.

Table 13. Average costs of production per feddan, 1978[a/]

	Cotton		Soybeans		Maize	
	L.E.	%	L.E.	%	L.E.	%
Rent	32.98	21.9	25.26	20.3	21.63	21.0
Wages	68.20	45.4	45.86	36.8	36.52	35.5
Draft power	4.53	3.0	4.55	3.6	5.43	5.3
Machinery	13.78	9.2	16.16	13.0	13.58	13.2
Seed	1.57	1.0	7.65	6.1	2.17	2.1
Manure	8.13	5.4	3.88	3.0	10.51	10.2
Fertilizer	10.76	7.2	10.99	8.8	10.53	10.2
Pesticides	7.69	5.1	7.67	6.1	-	-
Other	2.75	1.8	2.82	2.3	2.60	2.5

[a/]Department of Statistics, Ministry of Agriculture.

Recent cost-of-production data on a national basis available from the Ministry of Agriculture is presented in Table 13. The total cost of production for cotton is LE 150,39 per feddan. The subsidized input items (seed and fertilizer) make up a relatively small fraction of the total cost of production. Rent, wages, draft power, and machinery comprise 79 percent of the total cost for cotton and 71 percent of the total cost for soybeans. Seed, chemical fertilizer, and pesticides are only 13 percent of the total cost of cotton production, but make up 21 percent of the total cost of soybean production. Because cotton occupies the land for a longer period than soybeans, the rent per feddan is higher than it is for soybeans (LE 32.98 for cotton and LE 25.26 for soybeans). Clearly the rents are an inadequate substitute for a more comprehensive analysis; for example, through the use of a linear programming model with land constraints by time periods.

At what farmgate prices for cotton and soybeans are the two crops equally profitable? The raw cotton yields for 1976, 1977, and 1978 average 5.52 kantar (0.88 MT) per feddan. Soybean yields for the three years, 1977, 1978, and 1979 have averaged 0.940 MT per feddan.

Using the above costs and yields, and ignoring the value of by products, the net returns for the two crops would be equal when the price per MT of unginned cotton is equal to:

$$\frac{0.94 \times \text{price per MT of soybeans} + \text{LE } 25.59}{0.88}$$

The relationship is presented in Figure 4. Price combinations lying above the line result in cotton being more profitable; those below the line result in soybeans more profitable. Note that soybeans are a more profitable crop with the 1977 and 1978 prices of unginned cotton (LE 128 and 225 per metric ton) and the guaranteed price for soybeans of LE 200 per metric ton. On the other hand, the LE 289 price paid for cotton in 1979 made cotton the more profitable crop.

In a later section of the report, comments are made on the implications of international prices. Placing such prices on this chart guages the comparative advantage of the two crops in the world market.

7. Competitive Position of Soybeans vs. Maize with Prices Variable (Yields and Costs Given)

A procedure similar to that described for the soybean-cotton comparison was followed. The 1978 cost of production for maize reported by the Ministry of Agriculture was LE 102.97 per feddan. The cost of production for soybeans is LE 124.80 per feddan. This cost is LE 21.83 higher than those costs for maize.

With these yields and with the costs of production per feddan of LE 102.97 for maize and LE 124.80 for soybeans, and ignoring the value of by products, the price per metric ton of maize which makes the two crops equally profitable is:

$$\frac{0.94 \times \text{price per MT of soybeans} - \text{LE } 21.83}{1.7}$$

The line in Figure 5 divides the maize-soybean price combination into those causing maize to be more profitable and those causing soybeans to be more profitable. Both the 1978 and 1979 maize and soybean price combination of LE 200.00 per MT for soybeans and LE 71.42 and 74.00 per MT farmgate prices for maize results in soybean production being more profitable.

8. Competitive Position of Soybeans vs. Cotton with Yields Variable (Costs and Prices Given)

The previous break-even analysis was in terms of varying the farmgate prices of these two crops. We now shift to a break-even analysis of yields and ask the question: at what yield combinations of soybeans and cotton will the returns from the two crops be identical? In this analysis we consider only the soybean seed and raw cotton. We also assume that the cost remains constant, at the level specified in the special report prepared by the Ministry of Agriculture for the Team in March, 1980. Again, we assume that the higher rent for cotton reflects, but not completely, its greater length of time on the land. The total cost per feddan for cotton is LE 150.39, and the estimated soybean cost is LE 124.80 per feddan. Using the 1979 farmgate price for unginned cotton (LE 288.80 per MT) and the 1979 guaranteed farmgate price for soybeans (LE 200.00 per MT) and ignoring the value of by products, the net returns for thw two crops will be equal when the yield of unginned cotton is equal to:

$$\frac{200.00 \times \text{yield per feddan of soybeans} + 24.29}{288.29}$$

The break-even yield combinations are presented in Figure 6. By plotting the 1974-79 yields, we note the effect of the relatively greater yield improvement in soybeans. However, at the increased cotton prices offered farmers in 1979, all of the cotton-soybean yield combinations show cotton to be more profitable.

Year	Yield in MT per feddan	
	Cotton (unginned)	Soybeans
1974	0.843	0.329
1975	0.789	0.464
1976	0.882	0.660
1977	0.778	0.741
1978	1.003	0.960
1979	1.050	1.056

If the 1979 soybean yield of 1.056 is used in the formula, the cotton yield would need to be 0.82 MT per feddan in order to obtain the same profit as soybeans.

9. Competitive Position of Soybeans vs. Maize with Yields Variable (Costs and Prices Given)

In the following analysis we use the same procedure as that used with the cotton-soybean comparison. The maize price used is the 1979 price of LE 7.400 per MT with a cost of production of LE 102.97 per feddan. The net returns per feddan for soybeans and maize will be equal when the yield of maize is equal to:

$$\frac{200.00 \text{ x yield per feddan of soybeans - LE } 21.83}{74.00}$$

The results are presented in Figure 7. The 1974-79 yield combinations are also plotted. The rates of increase in soybean yields have exceeded those of maize, and the 1977, 1978, and 1979 yield combinations favor soybeans.

Four break-even charts (Figure 4 through 7) were prepared for assessing the economic incentives for farmers to adopt soybeans. The principal limitation of such an analysis is that it views the farm decision as an isolated choice between two crops that may occupy the land for different lengths of time. Furthermore, the two crops may play other roles in the year-long or multiple-year cropping system than simply producing the harvested crop.

In spite of these limitations, the analysis does suggest that with the present price and cost structure, and with recent crop yields, soybeans are a viable competitor with the summer crop of maize. The yield increases expected are of a nature that warrants a strong supporting effort in research and extension to insure that soybean yields do not reach a premature plateau.

Figure 4. Break-even farm gate prices for cotton and soybeans

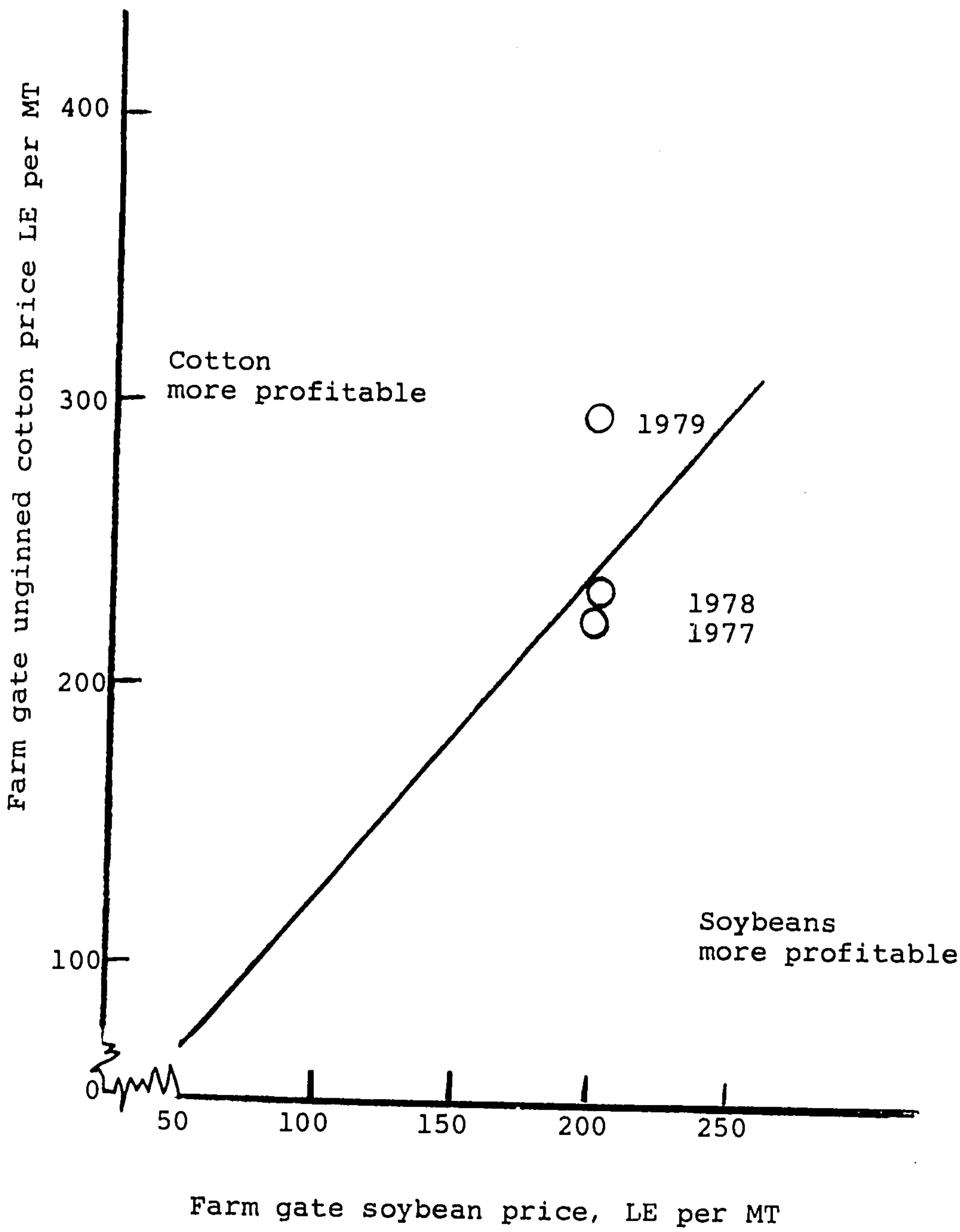


Figure 5. Break-even farm gate prices for maize and soybeans

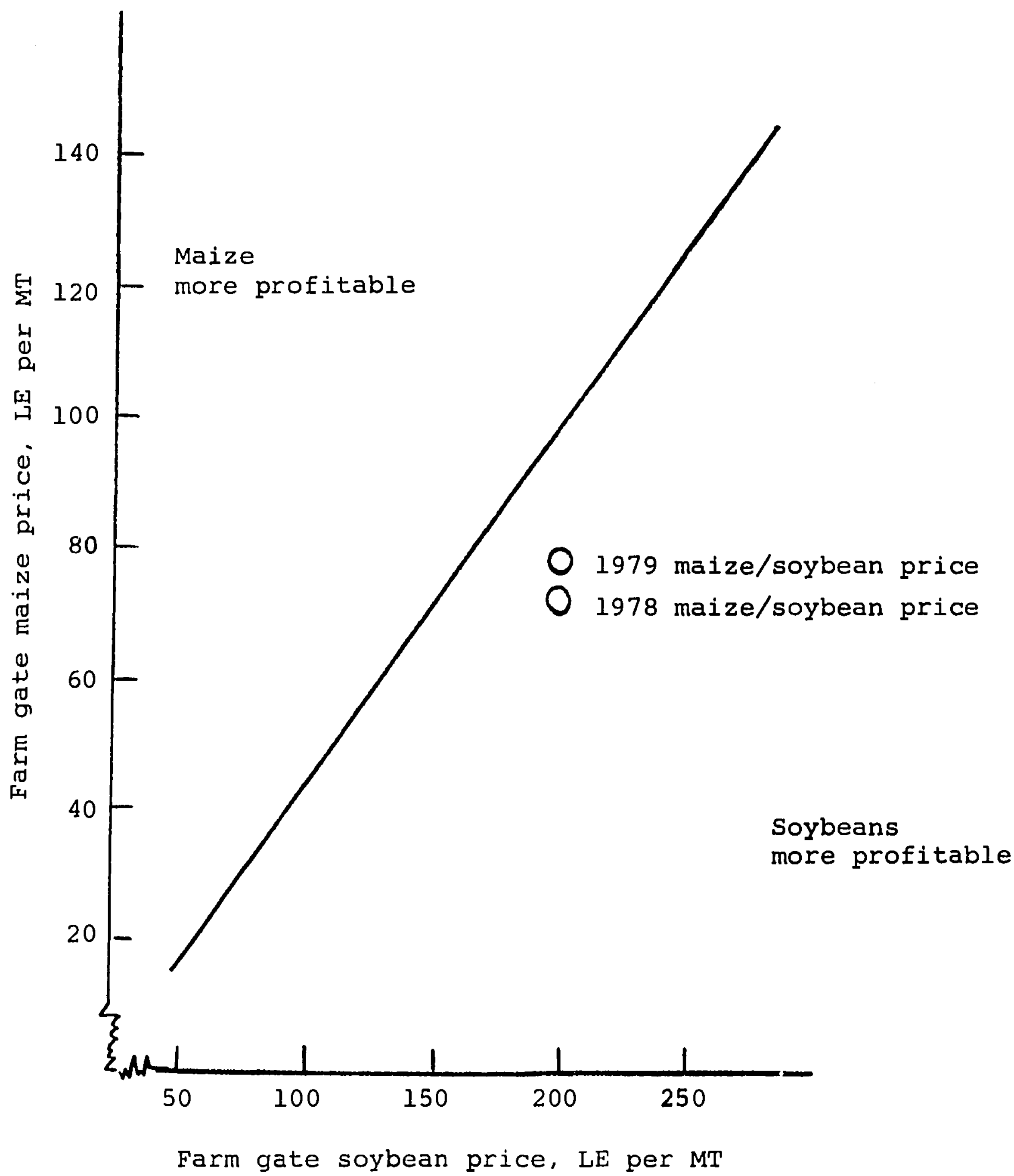


Figure 6. Break-even crop yields for cotton and soybeans

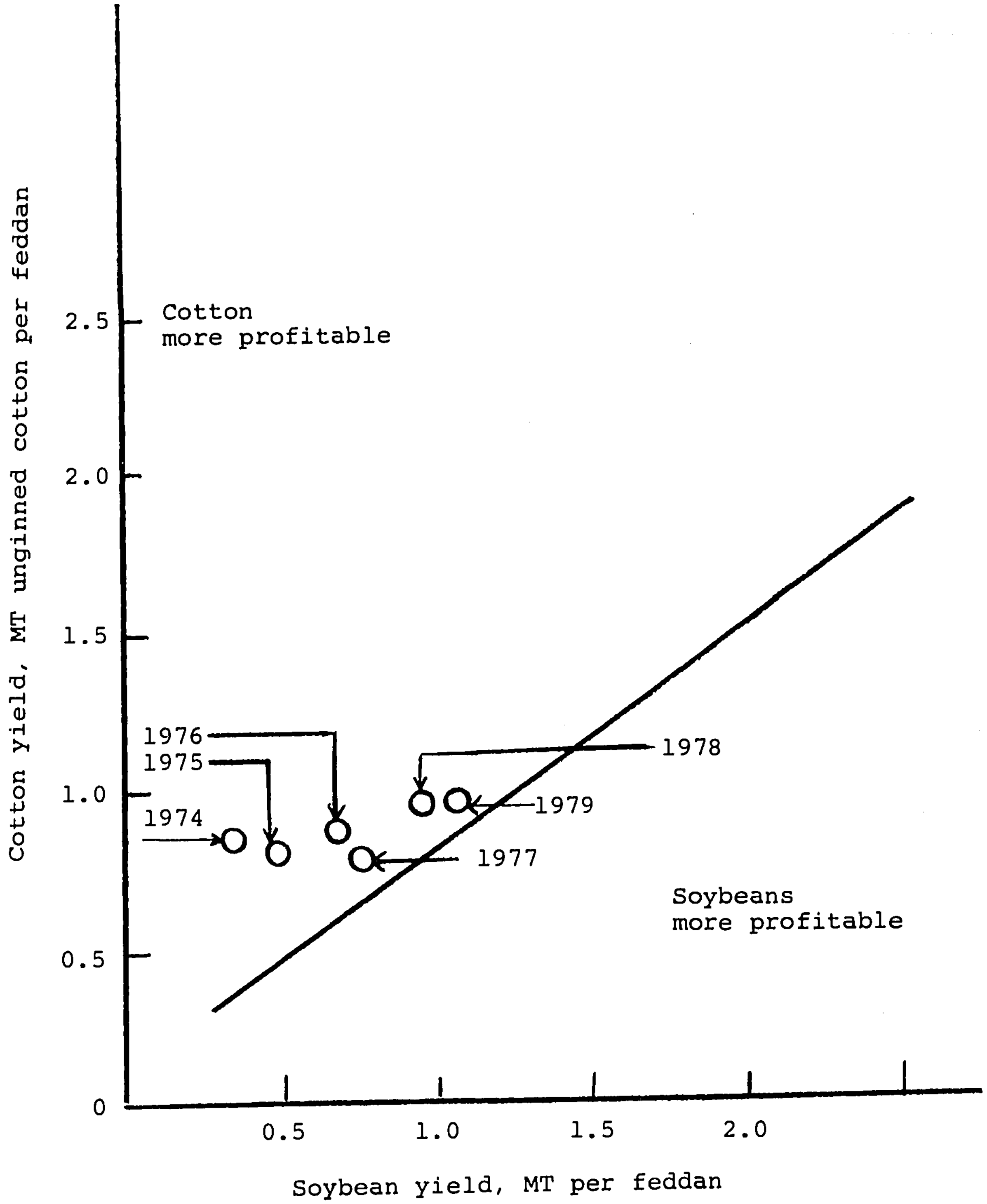
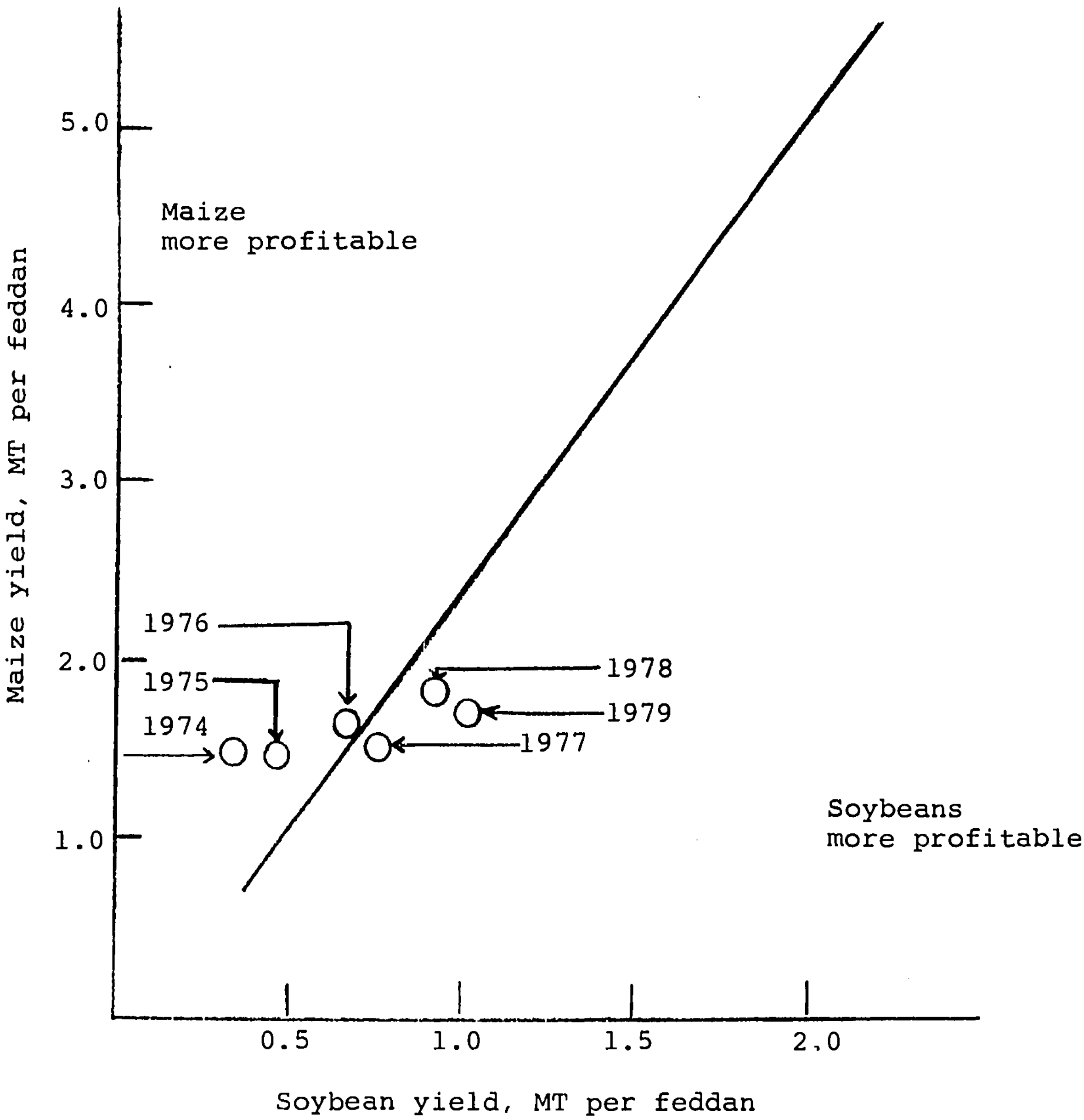


Figure 7. Break-even crop yields for maize and soybeans



B. Marketing the Soybean Crop

About 100,421 feddans of soybeans were harvested in the 1979 growing season (Table 12). They were produced and harvested by well over 100,000 farmers, with the average area planted being probably less than one feddan per farm. Most of this crop was picked by hand and threshed in the traditional method, involving flailing by hand and winnowing. The threshed soybeans are delivered by the farmer to a Farmer Credit store or warehouse (shouna) in burlap bags. The average quantity produced and delivered will be between 200 and 300 kilograms per farm.

1. Grading and Handling

The soybeans are weighed and the farmer receives a receipt. He may protest the weight and get a reweigh -- at his expense. He gets receipted credit for the higher of the two weights. He can get a preliminary payment immediately at the Farm Credit Bank (ADE), where borrowed production expenses are deducted. The farmer obtains a final settlement after the soybeans are graded. The grade is on foreign material only. The price is LE 200 per metric ton for 96 percent purity. The settlement may be more or less, depending on the grade (100 less percent foreign material). There is no regularized appeal procedure for grade determination.

Soybeans received at village Farm Credit stores and/or warehouses (shouna) are stored at the shouna until needed by the processing mill. This period of storage may be as much as two to four months. Shouna operators indicate no problem in storage and handling of soybeans. The examples of stored soybeans appeared to be of high quality and showed no effects of rodent or insect attack. They were in bags with the bottom row kept off the ground by a grid of timbers. The pile of bags was protected by a canvas covering. The operators indicated that rat bait was used occasionally when symptoms appeared and that fumigation was performed rarely, but as necessary to prevent insect damage.

2. Evaluation

The "handling in bags" mode was considered carefully by our group. Bags require much hand labor. The bag itself is expensive and short-lived. Bags stored for further use are often contaminated with insects. Material in bag storage is vulnerable to rodent and insect losses. Bags contribute to waste during handling and storage because they are fragile and easily torn.

Conversely, bulk handling has important positive attributes. The product is more protected from quality deterioration and waste. Handling methods are more efficient. Adoption of other automated techniques is stimulated. Bulk handling also has some disadvantages. Equipment and facilities are expensive. The risk of heat buildup and resultant quality loss is increased (the very low moisture level in soybeans grown in Egypt may minimize this risk).

On balance, bulk handling seems not to fit this setting despite its attractive features. The many procedures and small quantities here make quite a contrast to the large holdings and automated harvesting in other countries. Bags fit the scale of harvesting better than any alternative handling sequence. Once in bags, it is more efficient to keep the soybeans there until unloaded at the processing mill than mixing two handling systems. Funds oriented to better handling and marketing would probably find higher priority at other stages in the system, such as bulk handling between processing mill and feed mill, consumer packaging of oil at the refinery, and bulk distribution of feed to poultry houses.

The practical technology for minimizing waste and preventing rodent or insect damage to raw product in bags seems well understood and used. The responses to questions concerning inventory shrink before soybeans reached the processing plant indicated a low rate of loss. It was not apparent that the handling system contained strong incentives for waste prevention, but it is difficult to observe incentive levels perceived by workers and supervisors.

C. Major Constraints to Soybean Production

Damage from the cotton leaf worm is probably the most serious limiting factor. Difficulty in achieving adequate nodulation with proper strains of Rhizobium increases the cost of production. Difficulty lies in supply of quality inoculant and proper application. Proper management is lacking, particularly management of irrigation. Adapted soybeans have not been developed in Egypt. Insect tolerant, longer season varieties would enhance the competitive position of later planted soybeans. Competition for land with other summer crops will restrict the area that can be grown, especially on old lands.

D. Potential for Increased Production of Soybeans

A successful soybean production program is underway. It is likely that the area planted to soybeans may expand to 200,000 feddans by 1988. Certain introduced varieties are reasonably well adapted and, while the cultural requirements have not been worked out in detail, a satisfactory "package of practices" has been developed for the extension workers to use in promoting production.

Production should be on both "old" and "new" lands. The area on the old lands should be limited to 150,000 feddans, because of the competition for land with other summer crops. Some production on old lands will be desirable in order to give a minimum assured supply for the processing plants. Major production, however, should come from the old new lands. These areas have heavier soils and fewer pests and therefore, can support high yielding soybeans. In addition, there will be less competition from other summer crops, such as cotton and maize. Only limited production of soybeans (7,000 feddans) are planned for the 1978-84 newly reclaimed lands. These areas have coarse textured soils less adapted for soybean production.

New varieties and improved cultural practices should be developed to increase yields and reduce the cost of production. The present varieties were developed in other parts of the world where day-length and other environmental factors are quite different than in Egypt. It is reasonable to expect that varieties can be developed in Egypt that are more productive than present varieties. An attempt should be made to develop varieties that are resistant to feeding by the cotton leaf worm and would permit cropping sequences that are not now practical. More effective methods of inoculating soybeans are needed. More cultural experiments are needed to develop better "package of practices". More data are needed, especially on effect of planting date, plant population, and row spacing on yield.

IX. PEANUTS

A. Current Production and Practices

Although peanuts were grown on approximately 34 thousand feddans of old lands during 1972 - 1978 (Table 14), the crop represented only 0.57 percent of the total cultivated land of Egypt and an on-farm cash value of only 0.4 percent of the total from all crops. Therefore, peanuts as a cash crop currently has significance in only limited areas of the country. At present, peanuts are produced for fresh consumption and export and none are crushed for oil. Approximately 60 percent of the total production is consumed domestically and the remaining 40 percent is exported as edible peanuts. Peanuts are an economically important crop to the country, since they are both a food crop and a source of foreign exchange on the export market.

1. Location

During 1972 - 1979, 53 percent of the total peanut crop area of Egypt was confined primarily to the Eastern Border (Agronomic Zone 5) governorates of Sharkia and Ismailia (Table 4). The second and third zones of importance were Cairo (Zone 3) and Upper Egypt (Zone 7), which contained 15.4 percent and 13.2 percent respectively, of the total area. The remaining 18.4 percent of area was mainly along the Western Border (Zone 4) and in Middle Egypt (Zone 6).

In the area planted to peanuts, the most noteworthy trend occurred in Middle Egypt (Zone 6). The area planted in this zone has declined from 20.2 percent of the total in 1970 - 1972 to 5.5 percent in 1979.

Peanuts are currently being produced on a limited area of lands reclaimed prior to 1974. The exact acreage and yield levels are not available. Estimates of 14,000 feddans with 0.400 MT/feddan have been suggested.

Table 14. Peanuts: Area, yield, and production, by agronomic zones; averages for 1970-72, 1973-75, 1974-78 and 1979

Year/ Period	Agronomic Zone 1	2	3	4	5	6	7	Total
				Area Cultivated (feddans)				
1970-72	25	332	4547	2186	17123	7748	6089	38052
1973-75	6	224	4772	2065	17869	1613	3536	30086
1976-78	2	170	5737	2386	19420	1344	4075	33135
1979	2	146	5090	2492	17223	1695	4357	31005
				Yield per feddan (M.T.)				
1970-72	.47	.46	1.05	.31	.88	1.00	.87	.88
1973-75	.90	.61	1.08	.19	.92	.77	.78	.87
1976-78	.42	.68	.99	.24	.94	.71	.80	.86
1979	.79	.73	.98	.36	.94	.72	.80	.87
				Total Production (M.T.)				
1970-72	11.67	154	4762	683	14993	7701	5288	33594
1973-75	5.67	136	5153	396	16506	1238	2777	26214
1976-78	.85	116	5668	577	18208	960	3226	28626
1979	1.58	107	4988	907	16210	1216	3490	26922

2. Yields and Total Production

Since 1970, the average peanut yields for the country have held fairly steady at approximately 0.87 MT per feddan. Likewise, total production has remained fairly stable since 1970, ranging from 26,214 to 33,594 MT.

Yield varies only slightly among the major production zones. In general, the zones with the largest areas planted also have the highest average yields, probably because these areas are most suited to peanuts and farmers are more skilled in production. The Cairo zone (Agronomic Zone 3, Table 4) has the highest yield per feddan, which probably reflects the influence of the Research Station at Giza and competitive pressure from vegetable production.

Although available data are limited, yields of 1.8 to 2.0 MT per feddan have been reported by researchers. This represents at least a two-fold yield difference between the governorate average from farms and yields obtained from research plots. There appears to be a potential for significant increases in farm yields and thus farm income using technology already available. A tremendous challenge confronts research personnel to publish available information and extension workers to present and encourage its adoption by farmers.

3. Time Grown and Crop Competition During the Growing Season

Peanuts are a summer crop planted between March and May. Current data indicate that peanuts should be planted by April 15, if possible, since lower yields are reported for later plantings. This planting date allows peanuts to follow winter crops such as clover, field beans, lentils, onions, barley, and possible wheat if it could be harvested by early April. Peanuts compete for land with cotton, soybeans, maize, sesame, and summer vegetables. Peanuts are uniquely suited to sandy soils which may not produce high yields of other summer crops.

One disadvantage of peanuts is the long growing season of 140 to 150 days required for the crop to reach optimum maturity. Therefore, seeding of the following crop would be delayed until around October 1.

4. Current Production Practices

a. Seedbed Preparation and Planting The seedbed is prepared by plowing to a depth of 10 to 15 cm with a chisel or duck-foot type plow. Ridges are first formed by special plows and then finished by hand. Fields are irrigated prior to planting. Peanuts are usually planted by hand, with seeds spaced at 20 cm intervals on one side of ridges, which are spaced at 60 cm intervals.

b. Varieties Planted Since 1962, four improved peanut varieties have been released to farmers for planting. Giza 1 and Giza 2 were released in 1962 for local consumption and according to reports, Giza 2 is still being planted in Upper Egypt. Giza 3, a two-seeded, semi-runner type, was released in 1964 and has been accepted very well in the export market. A fourth variety, Giza 4, a large-seeded, semi-runner type with two seeds per pod, was distributed in 1974. Giza 4 is reported to yield more than Giza 3 by approximately 15 percent, and because of the larger pod and seed size, it is well suited to the demands of the export edible market. It is noteworthy that the 15 percent increased yield potential of Giza 4, which was identified by research, has not been reflected in increased farm yields.

c. Fertilization of Peanuts Approximately 30-40 kg per feddan of phosphorous fertilizer (as P_2O_5) is spread broadcast by hand prior to seedbed preparation. About 15 kg of actual nitrogen is sidedressed by hand approximately 20 days after peanut plants emerge.

d. Pest Management Farm use of pesticides to control weeds, diseases, and insects is limited. Weeds, primarily annual grasses, are a major problem. At present, control is accomplished by hand weeding and cultivation. During the cultivation process, a portion of the ridge on which the peanut is planted is transferred to the opposite side of the peanut plant, leaving the plant in the center of the newly formed ridge. The goal of this cultivation operation is to control existing weeds and also provide an adequate soil area to accommodate fruiting.

Pathologists have reported root- and pod-rots to be major peanut disease problems. Yield losses from leafspot diseases have also been reported. Currently, only limited applications of leafspot control fungicide are used. No pesticides are applied to control root- and pod-rots.

Insects are not reported as important economic yield-limiting factors. However, it is likely that they do cause some damage.

e. Harvesting Peanuts are lifted from the soil by hand or dug with a plow at harvest. Pods are removed from the vines by hand and spread to dry in the sun for approximately ten days. Vines are utilized as livestock feed.

B. Peanut Marketing and Use

Prices for peanuts for direct consumption are higher than for oil and meal from processed peanuts. This is true partly because local production is small and rarely burdens this direct consumption market. There is, in addition, a successful export trade in peanuts to Europe at prices higher than the value of the processed products. For this reason, peanuts have not become an important commercial oilseed crop.

If peanuts prove to be well suited to the sandy soils in some of the new land areas, large-volume production may burden the more narrow and variable market for direct consumption at home and for export. This will cause low and variable prices and returns and will encourage the establishment of processing outlets for the crop. In order for peanuts to compete effectively with other crops, yields must increase.

The transition from a "fresh" to a processing industry is often a difficult maneuver. It is hard to justify investment in facilities until production volume is up -- and it is hard to get production up until there is a market. In other economies, cooperatives often offer some stability through the transition. Here, the government has oilseed processing capacity which is adaptable to peanuts at minor expense. Facilities planning and production research should be coordinated so that the yet unknown potential of this crop is fully realized. The key is yield per feddan. If the yield per feddan can be significantly increased, the potential for a successful processing industry is worth considering.

C. Potential for Increased Production of Peanuts

Expansion of peanut acreage in Egypt, especially on the newly reclaimed lands, offers great potential for increased income to farmers, as well as contributing substantially to the economy of the country. Expanded utilization in the food industry could contribute greatly to improved protein diets. Peanut seeds contain approxmately 25 percent protein and 50 percent oil. Most of the protein is highly digestible. The energy value in one pound of peanuts is about equal to that of 14 oz of cooked round steak, 15 oz of natural cheddar cheese, three quarts of milk, or eight eggs.

Utilization of peanuts as peanut butter in the diet also offers potential to improve human nutrition. Presently, more than half the edible peanuts in the U.S. are consumed as peanut butter. One pound of peanut butter has as much total food energy as one pound of cheese, two pounds of steak, four quarts of milk, or 32 eggs.

Blending peanut butter with other foods also offers a potential for increased utilization. Research has shown that almost any flavor can be blended with peanut butter. Blends with items such as jelly, marshmallow, and banana are common. In addition, peanut butter is used in several variations of sandwiches, ice cream, and milk shakes.

Peanut oil is valuable as a cooking oil. It has a high smoking point and does not absorb odors easily. Crushing 100 pounds of shelled peanuts yields 50 pounds of oil and 50 pounds of peanut meal (cake). Peanut meal contains about 50 percent protein and is an important protein supplement in feeds for ruminant animals. It can also replace about 25 percent of the soybean meal in poultry rations.

Peanut hulls, a by-product of the peanut shelling operation, constitute 25-27 percent of the total weight. They may be used for fuel, poultry litter, or in livestock feeds.

Thus, peanuts offer potential for increasing farm income in certain areas of the country as well as improving human nutrition. Establishing oil mills to crush peanuts for oil and meal also offers potential for edible oil production, as well as for livestock feed.

1. Increase Yields on Current Areas

Farm yields of peanuts in Egypt have not increased since 1970 - 1972, despite the 1974 introduction of the higher-yielding Giza 4 variety. Research yields are currently 1.5 to 2.0 times higher than average farm yields.

Based on observation of a limited number of peanut fields and a review of the cultural practices for peanuts in Egypt, farm yield losses are likely the result of improper crop rotation, unsuitable seedbed preparation, poor quality seed, improper planting, poor weed control, inadequate disease control, and improper harvesting procedures. Research in the U.S. has shown that peanuts are extremely sensitive to these cultural practices, and therefore, substantial yield responses could be realized by farmers if more attention were given to them.

a. Crop Rotation Peanuts should not be planted on the same land more often than one year out of three in order to minimize losses from soil-borne and foliar diseases. Also, if possible, peanuts should follow a grain crop such as wheat or barley in the rotation.

b. Seedbed Preparation Surface litter and weed seed should be buried completely below four inches of soil. Research in Georgia (U.S.) has shown that this can best be accomplished by the use of a properly adjusted bottom plow equipped with trash-covering devices. This also provides an ideal physical environment for peanut root development. Fertilizer, if needed, should be applied broadcast prior to seedbed preparation. The next step in seedbed preparation is the uniform application and incorporation of preplant incorporated herbicides to a depth of three inches in the soil as flat raised row beds are formed.

c. High Quality Seed is essential if adequate stands and high yields are to result. Seed should be well matured. Immature seeds have low vigor and germinate poorly. Peanut seeds are also very sensitive to other harvesting and shelling practices. Seeds which become too hot from direct, prolonged exposure to the sun or have been overheated in piles at harvest time will likely have low germination. Also, seeds which have undergone rough handling during the shelling, cleaning, treating, and storage process will often be damaged and will germinate poorly. Peanut seeds should not be stored for long periods of time after shelling unless they are kept under refrigeration and at a low relative humidity. Seed should be protected from direct heat from the sun during storage, since quality and germination will deteriorate rapidly. Seed treatment with approved fungicides is a very important practice in maintaining high germination and adequate stands. Fungicides will protect seeds from seed-rotting fungi while the seeds are in the soil prior to germination and will provide some protection during germination and emergence.

d. Planting Peanut seeds should be planted 4 to 6 cm deep, spaced 5 to 8 cm apart in the row, in rows 75 to 90 cm apart. Care should be exercised that previously buried weed and crop residues are not pulled back to the soil surface and that the row profile remains level and smooth. This will allow the peanut plants to flower and develop normally and reduce the incidence of soil-borne seedling diseases.

e. Weed Control Herbicides are available which, if applied properly, will control grasses and weeds. Chemical weed control will minimize the need for plowing and thus minimize damage to the fruiting mechanism of the developing plant. If plowing is necessary it should be accomplished with flat, non-dirting sweeps properly adjusted to run just below the soil surface. Movement of soil onto the lower branches of the peanut plant must be avoided if maximum yields are to result.

f. Disease Control Suppression of soil-borne diseases may be obtained by proper crop rotation and seedbed preparation. Many fungi which attack peanut plants begin by feeding on dead organic matter at the soil surface and then invade the live peanut plant tissue. Therefore, disposal of previous crop and weed residue is essential. Good soil drainage is also important. A high water table can result in a higher incidence of root- and pod-rot. *Cercospora* leafspot and peanut rusts are serious foliar diseases of peanuts and can result in significant yield losses if they are not controlled by properly scheduled fungicide applications.

g. Harvesting too early or too late can result in major yield and quality losses. Research has shown that peanut yields increase at the rate of 50-75 kg per week per feddan during the last three to four weeks of the pod-filling period. However, pod losses can be very high if peanuts are not dug at the "optimum" time. The time required to reach optimum maturity varies with peanut variety and type. The best method currently available to determine maturity is to remove all the pods from several representative plants, shell them out, and determine from the color of the interior of the hull and seed coat the stage of maturity. Hull interior will darken and seed coat will turn a dark pink as peanuts reach maturity. Generally harvesting should be delayed until 70 to 80 percent of the runner type peanuts have turned dark inside of the hull or 65 percent of the kernels of the large seeded Virginia type have become dark pink in color.

Research and Extension should immediately develop locally-adapted methods of accomplishing the proven principles discussed above and encourage their adoption by peanut producers in Egypt. If this is accomplished, peanut yields should increase by 40-50 percent within the next five to ten years on lands presently planted to peanuts.

2. Peanut Production on New Lands

Peanuts are best suited to sandy, well drained soils of medium to high fertility and having a pH ranging from 6.0 to 6.5. Most soils in Egypt have a pH higher than 7.0. Expansion of peanut acreage into new lands should be confined to areas with sandy loam soils, minimal drainage problems, and potential for sprinkler irrigation. Initially, major emphasis on peanut expansion should be confined to the Eastern Border Agronomic Zone (see Table 4). These lands appear to be well adapted to peanut production, and considerable farmer expertise is already available since a sizable portion of Egypt's peanuts are already being produced in the area. Also, potential for expansion of peanuts exists in the sandy soils along the Western Desert between Cairo and Alexandria and also in the area west of Alexandria, provided sprinkler irrigation can be made available.

a. Land Preparation Land forming should be accomplished to insure adequate drainage and smooth, level fields. All plant residues and foreign material should be turned under prior to planting. Provision for adequate, properly managed irrigation (preferably sprinkler type) should also be made.

b. Fertilization Ideally, peanuts should be planted following some other highly fertilized crop since peanuts generally do not respond as well to directly-applied fertilizers as do certain other crops. However, if peanuts are planted as one of the first crops on new lands, a complete fertilizer (N-P-K) should be applied according to needs as established by soil tests. Since the pH of these soils may be 7.0 or higher, it is also possible that yield responses may be obtained from the addition of certain micronutrients such as Mg, Mn, Fe, B, and/or Zn. All complete fertilizers should be applied broadcast prior to land preparation, since peanut seeds are extremely sensitive to fertilizer salt injury. Micronutrients such as Mn, Fe, B, and Zn may need to be foliar applied for best results.

c. Inoculation Since peanuts are legumes, they have the ability to fix nitrogen from the atmosphere through a symbiotic relationship with nitrogen-fixing Rhizobia bacteria in the soil. These bacteria are not likely to be present in newly reclaimed soils. Therefore, inoculation of these soils with peanut Rhizobia will be necessary at least the first time peanuts are planted in a new field. Peanut inoculum is commercially available. Best results have been achieved by applying the inoculum in the row along with the seed. Inoculum should not be applied as a planter box treatment or scattered on top of the soil. Care should be exercised to insure that the inoculum applied is peanut inoculum, since strains available for soybeans and other legumes are not effective on peanuts. If inoculum cannot be obtained, an application of 20 to 25 kg per feddan of N should be applied as a side-dressing 15 to 20 days after peanut emergence.

d. Irrigation Sprinkler irrigation should be more effective than flood irrigation for peanuts on sandy soils. Research is needed to obtain more precise information concerning this problem. Better control of soil moisture, especially in the pod development zone, may be more readily achieved with sprinklers than with flood irrigation. This may be a critical consideration in root- and pod-rot suppression.

e. Weed Control Effective weed control is essential if maximum peanut yields are to be achieved. It should be accomplished on new lands in the same manner as described for old lands. If chemical control is not possible, cultivation should be done with care as previously described and soil movement onto the peanut plant must be avoided.

f. Disease Control Pressure from soil-borne and foliar diseases is not likely to be as great on newly developed lands as on lands where peanuts have previously been grown. Care should be exercised, however, to insure good seedbed preparation as a preventative measure against soil-borne diseases. Growers should be prepared to begin application of leafspot fungicides at regular intervals when the first leafspots are noted on the lower leaves of the plants.

g. Harvesting Harvesting procedures on newly developed lands should be similar to those used on old lands. Peanuts should reach optimum maturity as determined by the shell out method before they are harvested. Initially, peanut yields from new lands may not be as high as those obtained from old lands. Lower soil fertility and lack of nitrogen-fixing bacteria in the soil may reduce yields during the first few years that peanuts are grown. However, if precision cultural practices are followed, economic yields should be obtained.

During the next decade, peanut yields per feddan should rise and the area planted to peanuts should also increase, especially on newly developed, sandy lands near Ismailia and along the Western Desert. Estimates for peanut production on old lands in 1984 are listed below with actual production during 1979. Also, increased acreage and production from the new lands as projected by the Ministry of Land Reclamation are shown in Table 15.

Table 15. Area, yield/feddan and total peanut production from old and new lands 1979 - 1984

Old Lands			
Year	Area (Fed)	Yield (MT/Fed)	Total Production (MT)
1979	36,404	0.94	31,005
1984	51,600	1.24	64,000
New Lands*			
Year[a]	Area (Fed)[a]	Yield (MT/Fed)[b]	Total[c] Production (MT)
1981	7,200	0.40	2,880
1982	28,000	0.45	12,600
1983	58,000	0.50	29,400
1984	104,700	0.55	57,585

* Projected peanut acreage

a Eskandar, R.F., 1980. The Five Year Plan - Ministry of Land Reclamation

b Estimated

c Calculated

D. Major Constraints to Peanut Production

One of the major factors which limits farm yields of peanuts may be land preparation. The method currently used by farmers is most likely reducing yields by inhibiting normal flower and pod formation, and in addition, may be increasing the incidence of pod- and root-rot disease. The effect of method of seedbed preparation on disease and yield should be thoroughly studied. The long growing season required for peanuts (140-150 days) is also a barrier. The return per feddan per unit time is lower than for several other crops. Underdeveloped markets restrict the consumption of peanuts and peanut products. Per capita consumption is currently reported to be about 0.6 kg per year.

E. Peanut Research and Extension Programs Needed

Some programs concerning peanut production which are needed for increasing production:

1. Extensive testing of yield performance of peanut cultivars from other parts of the world should begin as soon as possible.

2. The effect of method of seedbed preparation on incidence of stem- and pod-rots and yield should be tested.

3. The effect of crop rotation on stem- and pod-rots and yield should be evaluated.

4. The effect of flat vs. ridged culture on stem- and pod-rots and yield should be tested.

5. The effect of various methods of pre-plant herbicide soil incorporation on weed control should be investigated.

6. A study on the effect of additions of selected micronutrients (Mg, Mn, Fe, B, and Zn) on yield and quality of peanuts (foliar and soil) should be tested.

7. A comparison of sprinkler vs. flood irrigation on salt movement, incidence of root- and pod-rots and yields should be made.

8. A comparison of rate and application interval of selected fungicides on leafspot and rust control should be studied.

9. The effects of peanut <u>Rhizobia</u> bacteria from various sources and with different application methods on peanut yields and quality, in comparison with side-dressings of nitrogen must be evaluated.

X. SUNFLOWER

A. Current Production and Practices

During the period 1970-77, an average of 21.9 thousand feddans of sunflower were planted annually (Table 16). The highest total area of 44,000 feddans was harvested in 1971. Since then, acreage has declined steadily to a low of 17.4 thousand feddans in 1977. Reasons given for the decline were: (a) diseases, including charcoal stem-rot, rust, leafspots, and root-rots; (b) inadequate bee populations for proper pollination; (c) low prices for seed to be crushed for oil; (d) cost of transporting seed to crushers; and (e) lack of sustained markets.

1. Location

During 1970-77, sunflower acreage was concentrated in agronomic zones 6 and 7 (Middle and Upper Egypt, respectively) and in zone 1 in the Northern Delta (see Table 4). Seventy-five percent was in Middle and Upper Egypt and about 16% was in the Northern Delta area. Agronomic zones through the middle of the country contained less than 10% of the total sunflower grown. There were no important shifts in production areas during this period.

2. Yields and Total Production

Yield per feddan averaged 0.665 MT during the eight-year period, 1970-77 (see Table 16). Production per feddan has declined slightly since 1971. The decline in both area planted and production per feddan has resulted in a 65% decline in total production of sunflower seed in the country.

Research yields of sunflower are extremely varied and are not consistently much greater than farm yields. Low yields in research plots reflect the problems of lack of adapted advanced varietal lines, poor germination, and predator damage, and all await solutions.

Table 16. Sunflower: Area, yield, and production, by agronomic zones, 1970-79

Year	Agronomic Zone 1	2	3	4	5	6	7	Total
				Area cultivated (feddans)				
1970	86	92	50	639	54	6,436	5,953	13,310
1971	1,143	364	1,198	689	487	19,331	20,804	44,016
1972	5,037	216	660	144	363	10,368	9,877	26,665
1973	3,024	136	831	323	119	5,037	3,902	13,372
1974	5,605	832	1,296	378	252	7,659	3,446	19,468
1975	7,245	75	804	308	---	9,081	3,424	20,937
1976	3,743	75	991	308	---	11,247	3,761	20,125
1977	2,161	56	639	64	---	11,812	2,649	17,381
1978	---	---	---	---	---	---	---	9,434
1979	---	---	---	---	---	---	---	17,720
				Yield per feddan (M.T.)				
1970	0.701	0.680	0.973	0.335	0.640	0.730	0.810	0.747
1971	0.468	0.708	0.917	0.669	0.690	0.729	0.789	0.754
1972	0.431	0.889	0.799	0.710	0.720	0.720	0.739	0.679
1973	0.441	0.815	0.877	0.381	0.780	0.628	0.721	0.563
1974	0.445	0.810	0.908	0.484	0.700	0.599	0.861	0.629
1975	---	---	---	---	---	---	---	0.631
1976	---	---	---	---	---	---	---	0.669
1977	---	---	---	---	---	---	---	0.675
1978	---	---	---	---	---	---	---	0.756
1979	---	---	---	---	---	---	---	0.768
				Total Production (M.T.)				
1970	60	63	49	214	35	4,700	4,822	9,943
1971	535	258	1,100	461	336	14,097	16,415	33,202
1972	2,170	192	527	102	261	7,468	7,308	18,128
1973	1,334	111	729	123	93	3,164	2,815	7,531
1974	2,492	674	1,176	183	176	4,590	2,967	12,258
1975	---	---	---	---	---	---	---	12,239 a/
1976	---	---	---	---	---	---	---	13,475 a/
1977	---	---	---	---	---	---	---	11,727 a/
1978	---	---	---	---	---	---	---	7,132 a/
1979	---	---	---	---	---	---	---	13,609 a/

--- Not available

a/ Based on country data

3. Time Grown and Crop Competition During the Growing Season

Sunflowers are grown as a summer crop, but may be successfully grown over a wide range of planting dates. Few data are available to indicate the optimum planting date for Egypt which will result in highest yields. Time to maturity varies among varieties and ranges from 85 to 150 days. Generally, later-maturing varieties yield more than the earlier-maturing varieties. Therefore, variety selection will depend on competition with other crops for land, labor, and equipment. It might be desirable to plant early-season sunflower varieties following berseem clover or winter vegetables if they can be terminated in time for an April 1 planting of sunflowers If a short-season sunflower could be planted by April 1 and harvested by July 10 (100 days) and followed either by a second crop of sunflowers or a short-season maize, three crops per year could be produced. Adapted short-season sunflower could also fit well into rotations following small grain crops.

4. Production Practices

a. Seedbed Preparation and Planting Seedbed is prepared in the conventional manner by plowing to depths of 10 to 15 cm with a chisel or duck-foot type plow. Ridges 65 to 75 cm apart are generally formed mechanically and finished by hand. Sunflower seeds are hand-planted at various intervals on one side of ridges. Fields are generally furrow irrigated prior to planting.

b. Varieties Planted Giza 1, a white-seeded variety released in the 1950's, is the most widely grown sunflower in Egypt. It is reported to yield up to 1.0 MT per feddan on the best soils. Giza 1 has fair tolerance to leafspot and soil-borne diseases, but was observed to be damaged by neck- and head-rots. A major problem with the Giza 1 variety is its low oil content (30%). Giza 1 is an open-pollinated variety with considerable variability which could impose management difficulties, particularly insect control and mechanical harvest.

c. Fertilization Fertilizer application recommendations are to broadcast 15 kg per feddan of P_2O_5 on old land or 30 kg per feddan

P_2O_5 on new lands just before planting. Plants are side-dressed with a recommended 30 kg nitrogen per feddan on old lands or 45 kg per feddan nitrogen on new lands a few weeks after emergence.

<u>d. Pest Management</u> Apparently the use of pesticides to control weeds, insects, diseases, and other pests is limited. Since sunflower growth is fairly rapid, it competes vigorously with weeds; hence, they are not considered major problems. Existing weeds are removed by hand, and no herbicides are used by farmers.

No serious insect problems were reported. Sunflower head moth is the most common insect pest in heavy-production areas of the U.S. and Eastern Europe. This insect could become a problem in Egypt as the sunflower industry develops in intensity. The adult moth lays eggs on the sunflower head between the individual flower tubes. The larvae begin to feed on the developing seed, after the third instar.

Sunflowers are severely infected by diseases, and this is the principal factor given for the decline in production. Major diseases include charcoal stem-rot, rust, leaf-spots, and root-rot. Fungicidal protection against diseases in sunflower is not generally economical. Therefore, growing resistant varieties, if available, and using proper cultural practices offer the best opportunity to minimize losses.

Birds and rodents can be serious pests for sunflower growers. Varieties with drooped heads may offer some protection from bird damage, but do little in preventing losses from rodents.

<u>e. Harvesting</u> Most of the sunflowers are currently harvested by cutting the stalks at the ground level, removing the head, and separating the seeds by hand. The stalk and head residue is used for fuel or livestock feed.

B. Potential for Increased Production of Sunflower

Sunflower can become an important crop, particularly considering the need for additional edible oils in Egypt. Improved sunflower varieties contain 48% to 50% oil. Sunflower oil is suited to a number of edible uses, including cooking oil, salad oil, margarines, and shortening.

Sunflower meal may also be utilized as a high-protein ingredient in mixed feeds. Feeding trials with sunflower meal indicate that in ruminant rations it is equal to other oilseeds as a nitrogen source. In broiler rations, indications are that it can replace up to 50% of the protein supplied by soybean meal if the meal is from decorticated seed. Sunflower seed hulls can be used as a roughage ingredient in rations for ruminant livestock or burned as an energy source for processing.

1. Increase Yields on Current Areas

The major constraints to sunflower production in Egypt at the present time are low-yielding varieties and losses from diseases. Major research efforts should be employed to screen a vast array of germ plasm from all over the world to be used as germ plasm sources for the development of varieties with high yield potential (oil and seed) in Egypt. Selections for disease-, insect-, and bird-resistant varieties need to be made. An aggressive breeding program should be initiated to rapidly develop high yielding, high oil content, adapted varieties.

Although yield potential of presently-grown cultivars is apparently low, certain cultural and management practices can be suggested to help reduce the yield loss from diseases.

a. Rust Normally, late-planted fields are more severely damaged by rust than early plantings. Therefore, early planted sunflower may be less susceptible; but the only way to avoid yield loss from rust is to plant rust-resistant varieties. Volunteer sunflower plants should be destroyed as early in the spring as possible. Since the fungus persists on plant debris, complete removal and burning of all such material will reduce the availability of spores.

b. Sclerotinia stalk and head rots This fungus has the potential to appear in all areas of sunflower production. It reportedly has an extremely wide host range, and attacks many vegetable and field crops, but does not appear to attack grain crops. Resistant varieties are virtually unknown at present and effective fungicides are not yet available. Consequently, yield losses must be minimized by management practices including the following: (a) plant seed free of sclerotia; (b) use at least a four-year rotation, including a grass-type crop such as wheat, just prior to planting sunflowers; and (c) avoid growing highly susceptible host crops such as dry beans, rapeseed, and mustard in the rotation.

c. Charcoal stem rot This disease, caused by the fungus Macrophomia phaseoli (Sclerotium batatiocola), is the most destructive stalk rot of sunflowers under high temperatures and dry conditions such as those in Egypt. Charcoal rot has a wide host range, attacking many other crops. At present, crop rotation and sanitation are the only methods of control, although genotypes with at least moderate resistance are available as sources for breeding resistant types.

d. Leaf-spots Several leaf- and stem-spot diseases infect sunflowers, but resultant yield losses are usually minimal. Under the low-humidity growing conditions of Egypt, these diseases should not be major problems.

Research, mostly in the U.S., has shown that certain other cultural and management practices also influence sunflower yields. These practices are discussed below.

e. Planting dates Although sunflowers may be planted over a wide range of dates, higher yields will normally be obtained from earlier planting dates. Seeds should not be placed deeper than 6cm or 7cm in the soil, however, with adequate moisture emergence will not be affected at planting depths up to 11 cm. Uniform stands are necessary for most efficient utilization of water, nutrients, and light.

f. Plant population Sunflowers compensate for differences in plant population by producing large heads and large seeds at low populations. Oilseed varieties should be planted at higher population than non-oilseed varieties. Generally, plant populations for oilseed varieties should range between 15,000 and 25,000 plants per feddan, with adjustments made for soil type and production potential of the soil. Populations of 20,000 to 22,000 plants per feddan should be used for maximum production. Varieties grown for human food (non-oil) should be planted at populations of 12,000 to 18,000 plants per feddan.

g. Fertilization Sunflower seeds are extremely sensitive to injury from fertilizer salts. Therefore, fertilizers should either be applied broadcast prior to seedbed preparation or banded at least 5 cm to the side and 5 cm below the seed. Complete fertilizer (N-P-K) should be applied at rates determined by crop needs as established by soil tests.

h. Pollinating insects Open pollinated sunflower varieties will benefit from the addition of bees. Generally one hive per one to two feddans will be adequate to insure pollination.

2. Expanded Sunflower Production on New Lands

Significant potential exists for expanded production of sunflower. It is adapted to a wide variety of soils and climatic conditions. However, medium to moderately fine textured soils with good internal drainage are better-suited to sunflower production than coarse or extremely fine textured soils. Therefore, extremely coarse or fine textured soils should be avoided as sunflowers are introduced into newly-developed land. Poorly drained soils should also be avoided. Excessive soil water results in slow growth and provides more favorable conditions for disease. Poor drainage also results in increased soil salinity. Limited testing at the Soil Salinity Laboratory near Alexandria showed a significant reduction in plant height on silt loam soils with 2,000 ppm salt concentration. Injury to sunflowers from salt was much more severe on soils with high $CaCO_3$ levels.

Production practices to obtain maximum sunflower yields on new lands will not differ greatly from those discussed previously for old lands. Disease and weed pressure may not be as great, however, on new lands as on the old lands.

During the next three years, 1980 - 1983 yield of sunflowers is not likely to increase much. Research is needed to solve some of the current production problems. However, if these production problems are solved, yield of sunflowers should increase significantly by 1988, as is estimated below. Projections are for an 18,000 feddans increase in sunflower production on newly reclaimed lands by 1985 (Table 17).

Table 17. Projected sunflower production to 1988

Years	Area Feddans	Yield per feddan MT	Total Production MT
1970 - 1977 avg.	21,900	0.67	14,700
1983	27,200	0.75	20,400
1985	39,900	0.75	29,925
1988	46,000	0.95	43,700

C. Sunflower Research

1. Constraints

a. Lack of coordination between institutes of oil seeds, plant protection, and plant pathology conducting sunflower research. What coordination that exists is dependent on individual scientist's initiative.

b. Breeders seem reluctant to make crosses, particularly with exotic material. They seem to want to depend on finding introduced material which would be adapted to Egyptian conditions.

c. Breeders have responsibility for several crops.

d. Agronomic-cultural studies are being conducted by breeders and by pathologists.

e. Confusion exists as to the availability of adequate pollinators for hybrid seed production or for commercial production of open-pollinated sunflower varieties.

2. Needs

a. An aggressive breeding program is needed to develop source populations for increased yield, oil content, disease and insect resistance. Included would be a selection-testing program to insure rapid, orderly identification of superior genotypes, resulting in adapted varieties being made available to producers.

b. Initially, improved open pollinated varieties will probably be most adapted to available management. However, with increased mechanization, the advantages of the uniformity of hybrids will become apparent. Therefore, breeding efforts are needed to initiate selection of superior inbreds which will eventually result in adapted hybrids.

c. Production-oriented research is necessary to identify those management practices most needed for maximum economic production of sunflowers. This research should include emphasis on management on developing reclaimed lands and should include research on land preparation, plant population requirements, fertilizer requirements, irrigation requirements (timing, water amounts, and saline tolerance), seed production, pollinator requirements, weed control, bird control, harvesting, and seed storage.

d. Major emphasis needs to be placed on identifying genotypes resistant to the major disease and insect threats to sunflower production. However, research is also needed to develop integrated pest management programs which include cultural practices, chemical control and biological control of pests.

XI. ECONOMIC ANALYSIS OF THE COMPETITIVE POSITION OF OILSEEDS WITH OTHER CROPS

In order to be included in the cropping system of cultivators, oilseed crops must meet two tests. The first is that the financial returns are greater than the financial variable costs. The second is that the net returns to the fixed resources must be greater than the net returns from alternative uses.

Limited evidence related to the financial viability of traditional alternative crops can be shown by examining the production farm gate prices, and costs of production summarized by Ministry of Agriculture. Since both the returns and costs have been distorted from international market price levels we also can examine the crop competition after correcting for these factors.

A. Comparison Between Individual Summer Crops on Old Lands

The summary of costs and returns for the major summer crops for 1978 as reported by the Economics and Statistics Department of the Ministry of Agriculture is presented in Table 18. At the farm gate prices and costs offered cultivators, these national average figures suggest that soybeans and peanuts have been more profitable than the major summer crops of maize and cotton. In 1979 and 1980, the farm gate price for cotton is 289 LE per ton. At this level, cotton becomes more profitable than any of the other summer crops.

This comparison of the net contributions of crops as a measure of optimum resource allocation is distorted by a number of forces. The government has set prices of cotton, food grains, and some other commodities below the international prices, as a part of a de facto taxation system. These low prices have been offset in part by subsidization of seeds, fertilizer, pesticides, pest control, and machinery inputs. To provide a more rational basis for evaluating land use and development, some analysts have adjusted both farm level prices received and purchased input costs for seed, fertilizers, pest control and machinery to reflect international alternative market prices. We have made adjustments in input costs to reflect that international alternative market prices are used. The revised comparison of net returns shows that cotton is by far the most profitable crop. The adjusted net return for maize is less than peanuts, but greater than soybeans.

Table 18. Costs and returns per feddan for selected summer crops, 1978 [a/]

	Cotton	Maize	Soybeans	Peanuts
Farm Gate Prices				
Yield, M.T.	.86	1.68	.812	.825
Price, L.E.	215	77	200	250
Gross returns	186	129	170	206
By-product value	8	10	-	-
Total returns	195	139	170	206
Production costs	150	103	125	108
Net returns L.E.	44	36	50	98
International Prices and Costs				
Price, L.E.	719	100	188	200
Gross returns	618	169	152	165
Production costs	209	132	125	125
Net returns L.E.	409	37	27	40

a/ Adapted from data presented in Policy Study on Pricing and Taxation of Major Alternative Agricultural Crops, Ministry of Agriculture, December 1979.

In the future, maize will remain the major competition with soybeans for land. Cotton acreage will remain subject to quota. Therefore, break-even price yield comparisons for cotton and soybeans are less necessary. We now feel that the major crop to compete with soybeans and other oilseeds is maize. Therefore, data on prices, costs, and yields have been set up in a break-even matrix to illustrate the threshold combinations for profitability for the alternatives of soybeans versus maize. The formula is as follows:

$$\text{Break even soybean yield} = \frac{(\text{price of maize} \times \text{yield of maize}) + (\text{maize cost} - \text{soybean cost})}{\text{price of soybeans}}$$

The break-even yield combinations with varying prices and costs are presented in Table 19. The break-even corn and soybean yield combinations with varying prices and cost differences are presented in Table 19. The recent farmgate price relationships have been 2.5 to 1 and the national 1976-79 maize yield has averaged 1.75 M.T. per feddan. Under these historical relationships, the break-even soybean yields for equal profits to cultivators would range from .575 M.T. per feddan of costs are 25 L.E. less for soybeans than corn to .875 M.T. per feddan if costs are 25 L.E. less for soybeans than corn to .875 M.T. Even with an increase in farmgate prices of maize to 100 L.E. per M.T. (a 2 to 1 soybean to maize price ratio), the break-even level of soybean yields would range from .75 to 1.0 M.T. per feddan. National soybean yields have been .74, .965 and 1.056 M.T. per feddan for 1977, 1978 and 1979. This matrix of relationships show that an expected increase in soybean yields and reduction of soybean production costs would improve the competitiveness of soybeans for maize.

B. Comparison of Selected Rotation Alternatives on Old Lands

The competitiveness of any crop depends upon its contribution to the net returns for all crops grown in the rotation. The complementary and supplementary relationships often confound direct comparison of the contributions of single crops and the additive relationships of sequential crops. These relationships are particularly difficult to evaluate when there is a year-round cropping of the land. In this section, we attempt to compare net returns of selected oilseed crop rotations by simply summing the net returns from the winter and summer crops.

Tabel 19. Break-even yields of soybeans with varying price ratios and cost difference

Yield of Maize, MT/fed	2.5 to 1 Price Ratio[a/] 25 LE less	2.5 to 1 Price Ratio[a/] No Cost Difference	2.5 to 1 Price Ratio[a/] 25 LE more	2 to 1 Price Ratio[b/] 25 LE less	2 to 1 Price Ratio[b/] No Cost Difference	2 to 1 Price Ratio[b/] 25 LE more	1.67 to 1 Price Ratio[c/] 25 LE less	1.67 to 1 Price Ratio[c/] No Cost Difference	1.67 to 1 Price Ratio[c/] 25 LE more
				Metric Tons per feddan					
1.00	.275	.4	.525	.375	.500	.625	.475	.60	.725
1.25	.375	.5	.625	.500	.625	.750	.675	.75	.875
1.50	.475	.6	.725	.625	.750	.875	.775	.90	1.025
1.75	.575	.7	.825	.750	.875	1.000	.925	1.05	1.175
2.00	.675	.8	.925	.875	1.000	1.125	1.075	1.20	1.325
2.25	.775	.9	1.025	1.000	1.125	1.250	1.225	1.35	1.475
2.50	.875	1.0	1.225	1.125	1.250	1.375	1.375	1.50	1.625

a/ Maize LE 80 per MT, Soybeans LE 200 per MT
b/ Maize LE 100 per MT, Soybeans LE 200 per MT
c/ Maize LE 120 per MT, Soybeans LE 200 per MT

Again we use both the 1978 farm gate internationally adjusted cost and return data as the basis for illustrating the factors affecting the competitiveness of oilseeds on old lands. Data for five rotations are presented in Table 20.

We have included two soybean rotations that assume later planting dates than are currently being recommended. We have made arbitrary estimates of yields and costs related to these changes based upon the judgments of Egyptian researchers that yields would be considerably lower, with much higher pest losses. In addition, the pest control costs will be higher.

The data for the present average yields, prices and costs suggest that the berseem-maize rotation with 200 L.E. per feddan would net the greatest return over the major production cost items (Table 20). Berseem-soybean rotations (165 and 175 L.E.) would be more profitable than wheat-maize (62 L.E.) or wheat-soybean (49 L.E.). Even with adjustments for international prices and costs, the berseem-maize rotation is best. The position of the wheat and maize is improved to equal the late berseem mid-soybean rotation.

In the last section of Table 20 the effect of improved culture of soybeans on the expected rotation net return is presented. If improved yields and reduced costs of nitrogen fertilizer and pest control are attained, then the soybean rotations including both the winter crops of berseem and wheat would be more profitable than those rotations with maize.

C. Competition of Oilseed Crops in the New Lands

Production of crops in the new lands faces additional hurdles. The costs of lifting and distributing water is an added cost of production that the producers on old lands do not face. Researchers in "New Lands Productivity in Egypt"[1/] calculated that with expected increases in power costs, the full costs of lifting and distributing water by sprinkler irrigation only might range from 116 to 137 L.E. per feddan per year. It is estimated that at present cost levels, approximately 52 L.E. are associated only with the minimum lifting and distribution of irrigation waters with sprinkler irrigation on the settler farms. The combination of winter and summer crops would have to absorb at least the distributing costs from the farm water access.

1/ New Lands Productivity in Egypt - Technical and Economic Feasibility, Pacific Consultants. Jan. 1980 and supporting working papers.

Table 20. Estimated net returns per feddan of alternate rotations on old lands.

Winter - Summer -	Berseem early Soybeans	Berseem mid Soybeans	Wheat late Soybeans	Wheat Maize	Berseem Maize
		PRESENT TECHNOLOGY			
Estimated Yields, M.T.					
Winter crop	18.0	24.0	1.4	1.4	24.0
Summer crop	1.0	.8	.5	1.7	1.7
Farm gate prices, L.E.					
Winter	10	10	54	54	10
Summer	200	200	200	76	76
Gross Return including by-product L.E.	380	400	284	254	380
1978 cost L.E. of production	215	225	245	192	186
Net rotation return at farm gate prices L.E.	165	175	49	62	200
International prices, L.E.					
Winter	10	10	132	132	10
Summer	200	200	200	100	100
Gross Returns including by-product L.E.	380	400	324	393	410
1978 adjusted production cost	225	235	254	226	206
Net rotation return at international prices L.E.	155	165	70	167	204
		IMPROVED OILSEED TECHNOLOGY			
Estimated yields of Soybeans	1.30	1.20	1.10	-	-
Production costs	209	214	230	226	206
Net Returns at International prices L.E.	231	266	175	167	204

In Table 21 some calculations were made to give a perspective on the level of yield necessary to cover the full economically costed variable costs to be borne by both the government and the producer. This approach assumes that the level of production costs, other than land and water, will be those calculated in Pacific Consultants' study[1]. Full future costs of irrigation are also included. Then, assuming product prices at economic international price levels, the return and the threshold yields necessary to cover these costs are calculated in Table 21.

Only the winter crops of wheat and barley are considered in combination with the summer crops of soybeans, peanuts, sunflower, and maize. At international prices and the yields reported in recent years by farms in the newly reclaimed desert area, none of these crop rotations would generate return great enough to cover direct variable costs of production and irrigation.

Neither forage crops nor vegetable crops have been included in the comparisons made in Table 21. On limited acreages, high value vegetable crops and fruit probably would meet the full costs of production. However, this alternative is not considered because the production and distribution infrastructure is not in place, and some analysts have questioned the ability of Egyptian products to penetrate the European fresh produce market in competition with present international producers. Similarly, winter berseem is omitted from consideration because the short season forage crop is likely to be less valuable than it now is in the densely populated and smaller farms of the old lands area. There is less demand for animal power off-farm, and there is a great demand for high quality forage for year-round livestock product production. This demand can be met better with alfalfa and other perennial grasses.

The yield thresholds necessary to make oilseeds financially viable are presented in the last section of Table 21. If we assume that winter crops of barley and wheat remain at present yield levels, soybeans could cover assumed direct variable costs at 0.8 to 0.9 MT per feddan yields. Peanuts as marketed as meal and oil require 1.1 MT yield. Maize would need 1.9 and 1.7 metric ton yield. In the judgment of technical consultants of this team, these minimum level feasibility yields of oilseeds are attainable.

The decision to continue the development of desert lands has been made at least partly on political grounds. This continued development is to serve as a hedge against increased future food needs and possible shifts in terms of trade for food items.

1/ New Land Productivity in Egypt. Pacific Consultants, January 1980.

Table 21. Comparison of alternative rotation net returns per feddan, at economic price levels, necessary break-even yields, and potential yields on new lands.

	Rotation					
	Barley Peanuts	Barley Soybeans	Barley Sunflower	Barley Maize	Wheat Maize	Wheat Soybeans
Production costs, excluding land and water a/						
Winter crop	90	90	90	90	97	97
Summer crop	153	92	107	112	112	92
Irrigation b/	116	116	116	116	116	116
Total variable costs L.E.	359	298	313	318	325	315
Estimated present yields, a/ c/						
Winter, M.T.	.58	.58	.58	.58	.73	.73
Summer, M.T.	.52	.30	.15	.80	.80	.30
Estimated gross value d/ L.E.	273	147	153	190	212	182
Net returns to land and water L.E.	- 85	-151	-160	-127	-112	-133
Break-even summer crop yields if no change in winter crop yield, M.T.	.74 (food) 1.10 (meal)	.90	.90	1.86	1.65	.83
Estimated potential yields with improved technology MT	1.0	1.0	1.0	1.6	1.6	1.0

a/ "New Lands Productivity in Egypt" January 1980.
b/ This cost would be 52 LE per feddan at current .015 per KwH electric rate.
c/ Some consideration was given to yield data summarized in the Suez Canal Region Integrated Agricultural Development Study, Huntington Technical Services Limited, April 1979.
d/ Economic prices per M.T. were barley, 125 L.E.; wheat, 147 L.E.; maize 132 L.E.; peanut food 387, peanuts (oil and meal), 265 L.E.; soybeans 250 L.E.; and sunflower, 270 L.E.

Clearly in order to justify the full economic viability of the development of the new lands, some improvement in yields and values of winter crops as well as the development of adapted, improved yielding oilseed crops and other summer crops will be required. A monoculture of one crop is not a feasible solution to development of the desert lands. The major research concern is one of searching for improved production possibilities that would reduce the costs of developing this reserve of new lands. The combination of adaptive research, development of crop management techniques, and improved water management should make oilseeds a reasonable alternative to pursue.

XII. OILSEEDS PROCESSING AND REFINING[1/]

The government of Egypt recognizes its need for a practical means of increasing the domestic production of edible oils and of high-quality meal to supply protein feed for the expanding poultry and cattle industries. This section of the report indicates how the GOE might best increase its capabilities for processing cottonseed, soybeans, peanuts, and sunflower. Oil-bearing seeds are produced by both the private and public sectors. At the present time, marketing and processing of the products are primarily by the public sector. However, discussions with government officials and agribusiness groups indicated that these activities will be carried out by private and joint venture operators, particularly from oilseeds produced on new lands.

A. Cottonseed Processing

1. Capacity

Cottonseed is purchased from the gin by the General Authority for Supply Commodities (GASC) and transported in bags to processors. Allocations of cottonseed to processors are made by the GASC on the basis of physical capacity and past performance. GASC owns the inventory and pays a charge for processing (with final settlement made according to profit or loss). Typically, the mill that crushes the seed also refines the oil and prepares it for distribution to consumers.

Depending upon government programs over the next ten years, the cottonseed industry may not have much growth. A projected annual planting of about 1.2 million feddans will produce approximately 600,000 MT of cottonseed for processing (see Table 11) The processing capacity of the mills (see Table 22) as of April 1979 was:

1/ Adapted from S.E. Cramer, 1978. Contributions to Current and Potential Production and Utilization of Oilseed Crops in Egypt. Report by INTSOY Team. Task Order #8, AID/TA/BOA-1109.

3 solvent mills in Cairo and southward	132,000 MT
7 solvent mills north of Cairo	468,000
Capacity for processing cottonseed	600,000 MT
Capacity reserved at Damanhur for processing soybeans or cottonssed	60,000 MT
Total solvent capacity (330 days operation)	660,000 MT
In 1978-79 GOE processed cottonseed on hydraulic presses	30,000 MT
Total	690,000 MT

See Figure 1 for the location of processing units listed in Table 22. The government's planning program to consolidate the processing mills and modernize by replacing hydraulic units with solvent units has become a reality. However, their program has reduced the industry capacity from approximately 800,000 MT cottonseed to 600,000 MT cottonseed plus 60,000 MT soybeans (or cottonseed), which totals 660,000 MT the way management is presently operating the mills. There are many opportunities for improvement.

The solvent capacity is tight, but adequate, provided the annual throughput is increased by:

a. Increasing daily throughput

b. Having the mills mechanically ready to process when seed is first received from the gin and processing 330 to 340 days annually instead of 300 days.

c. Achieving continuous operation with sound preventative maintenance programs to reduce breakdowns.

2. Pricing System

The GASC is involved in oil processing. The Ministry of Supply fixes prices for cottonseed delivered to the mill. Oil mills are controlled by the Ministry of Industry, which sets the charge for processing cottonseed in each plant.

Table 22. Capacity of cottonseed and soybean processing mills (MT); all solvent units - April 1979

Company	Location	Type of mill	Rated daily capacity: Cotton-seed	Rated daily capacity: Soybeans or cot-tonseed	Remarks	Est. tons operating: 300 days	Est. tons operating: 330 days
			MT	MT		MT	MT
1. Egyptian Salt & Soda	Alexandria	French[a/]	100			30,000	33,000
2. Alexandria Oil & Soda	Alexandria	French	100			30,000	33,000
3. Extracted Oils	Damanhur	DeSmet	100	200	300 da sb	30,000	33,000[b/]
					30 da cs	--	6,000
4. Misr Oil & Soap--	Tanta	French	0		Needs repair		
5. Tanta Oil & Soap	Tanta	French	0		Needs repair		
6. Egyptian Salt & Soda-	Kafr El Zayat	Prepress	400			120,000	132,000
7. Alexandria Oils & Soap-	Kafr El Zayat	DeSmet	200			60,000	66,000
8. Tanta Oil & Soap	Benha	DeSmet	200			60,000	66,000
9. Misr Oil & Soap	Zagazig	DeSmet	200			60,000	66,000
0. Cairo Oil & Soap	Badrashin	French	100			30,000	33,000
1. Cairo Oil & Soap	Ayate	French	0		Dismantling		
2. Nile Ginning	Minia	DeSmet	200			60,000	66,000
3. Nile Oil & Soap	Sohag	DeSmet	200			60,000	66,000
Total:	Cottonseed		1800			540,000	600,000
	Soybeans			200			60,000
					Grand Total	540,000	660,000

a/ French equipment manufactured by Speichim

b/ Based on processing at 200 MT/day

Oil is sold by the plants at prices fixed by the Ministry of Supply. If the oil price set by the Ministry of Supply is less than the processing cost, the GASC pays the difference to the Ministry of Industry. If the price set by the Ministry of Supply is greater than the cost of processing the oil plus a reasonable profit to the processing plant, the surplus is returned from the Ministry of Industry to the GASC.

Transportation costs are paid by the GASC. The Ministry of Industry assigns oil quotas to each processing company.

3. Actual Tonnage Processed Versus Capacity

Table 23 lists the actual tonnage processed by various mills during the past three years and the estimated tonnage processed during 1978-79.

In 1973-74 and 1977-78, the government installed 12 solvent extraction units (one prepress DeSmet unit had been installed earlier), replacing hydraulic presses (Table 23). The six newer DeSmet units from Spain will each process 200 MT per day. The six French units still have throughput bottlenecks which restrict the processing volume to 100 MT per day at three of the plants. Two other French units need repairs and are not operable. The plant at Ayate is being dismantled for parts. These new solvent processing plants produce 17 to 18 percent crude oil per ton of cottonseed, whereas a hydraulic mill produces only 13 percent. The solvent plants provide a nucleus upon which to build an efficient processing program.

The smaller, 100 T per day plants continue to show, at best, a high risk potential because of the high per-ton cost and the lack of potential returns on capital investment needed to modernize, upgrade efficiency, and capably manage.

4. Extraction of Oil

For 1977-78, all 17 mills reported an average oil yield of 16.1 percent, while leaving 1.6 percent of oil in the meal (cake) produced. Processing some cottonseed with hydraulic presses last year, which produced as low as 13 percent oil, was a major factor in pulling the total amount of crude oil down to 16.1 percent. See Figure 1 which shows that each one percent reduction in oil content in the meal (cake)

Table 23. Cottonseed actually processed by various mills during three recent years and estimated for 1978-79

Company	Type[a] of mill	Location	Cottonseed processed (000 MT) 1975-6	1976-7	1977-8	Est. 1978-9
Alexandria Oil & Soap	(H)	Karmoz (Alex.)	50	--	--	--
	(H)	Ragib (Alex.)	23	18	14	--
	(S)	Alexandria	7	15	25	30
	(H)	Kafr El Zayat	54	48	54	--
	(S)	Kafr El Zayat	--	--	--	60
Tanta Oil & Soap	(S)	Tanta	35	34	40	--
	(H)	El Mehala	15	16	13	--
	(H)	Benha	20	22	25	--
	(S)	Benha	--	--	--	60
Extracted Oils	(S)	Damanhur	25	45	55	60[b]
	(S)	Damanhur	--	--	--	30
	(H)	Abo Sanab	18	--	--	--
Nile Oil & Soap	(H)	Beni Kora	31	30	32	--
	(H)	Sohag	30	28	27	--
	(S)	Sohag	--	--	--	60
Cairo Oil & Soap	(S)	Badrashin	15	18	19	20
	(H)	Ayate	25	22	24	25
	(S)	Ayate (Dismantling)				
	(S)	Zagazig	--	--	56	60
	(H)	Mit Gamr	10	9	--	--
	(H)	Mansura	20	21	--	--
	(H)	Zagazig	20	10	--	--
Egyptian Salt & Soda	(S) + (PP)	Kafr El Zayat	90	88	80	75
	(S)	Moharem Bey (Alex.)	30	31	33	30
	(H)	Alexandria	40	30	32	--
Nile Ginning	(H)	Minia	50	52	--	--
	(S)	Alexandria	--	--	56	56
Private Sector			6	6	6	6
		Total	614	552	581	573

a/ (H) Hydraulic
(S) Solvent
(PP) Prepress

b/ Cottonseed or soybeans

provides 6,200 more MT of oil, based on processing 620,000 MT of cottonseed. The best operations leave 1.2 percent oil in meal (cake) -- some leave as much as two percent oil -- compared with their objective of 0.8 percent. This is a very serious oil loss.

It should be pointed out that while an increase of one percent in extraction rate, from all cottonseed processed, results in 6,200 MT greater oil output annually, worth about LE 1,674,000 (LE 2,480,000 for additional oil less LE 806,000 for lost meal), the actual gain would depend on the proportion of extraction capacity that can be improved. Increasing the extraction rate in new solvent processing plants is difficult since it was already as high as 17 to 18 percent in recent years. The major contribution to crude oil production in the near future would likely come from replacing the hydraulic processing equipment by solvent operations. Thus, since the hydraulic processing represented approximately five percent of total capacity (30,000 from 690,000 MT capacity) the net gain from replacing the hydraulic by solvent equipment is a little over LE 40,000 annually.

The cost of the new facilities as well as the cost involved in training managers and workers must be considered in evaluating the net value of improved and/or new facilities. The Egyptian government should continue with its vigorous program for strategically located oilseed mills which are well-adapted to modernization and have enough annual volume to make the mills efficient if they are managed properly.

5. Findings

Based on mill visits, observations, and discussions, the following conclusions were made with regard to improving the efficiency of the cottonseed processing plants:

a. Grading of cottonseed at the time of receiving is not adequate to have information on the acid content of seed. If acid content is high, the cottonseed should be processed promptly instead of being stored.

b. Oil mills do not delint or dehull cottonseed. Some gins are leaving up to four to six percent lint on cottonseed; for good oil extraction there should be no more than 2.5 percent.

c. Law prohibits oil mills from storing seed in bulk. This currently precludes effective use of bulk bins at receiving points and the use of a seed house.

d. Preventative maintenance and continuous operation are essential. Only one of the five mills visited was operative.

e. Conditions of some flaking rolls were very poor. Flakes should not be more than 0.25 mm thick, nor less than 0.125 mm thick.

f. Quality control is not evident. Proper quality control would increase yields and uniformity of products. The analytical laboratory service appears to be too slow with data on product specifications to guide operating conditions and control quality. Products may have been shipped, or hours of operation may have passed before adjustments are made.

g. Hexane used per ton of cottonseed processed is excessive. It should not exceed 6 kg per ton of cottonseed.

h. Sanitation is often poor. The bottom row of sacked cottonseed was on inadequate "flooring". Damage to cottonseed quality results.

i. Waste on heavy jute bags (47 to 50 piasters each) on damp floors, wrapping chutes, etc. is very costly.

j. Housekeeping in mills, with two exceptions, was far below standard. Many areas were deplorable -- very wasteful.

k. Driveways, which are heavily used by receiving and shipping trucks, were in very poor condition with excessive wet spots. Employees were unable to keep them clean.

l. Bulk bins and conveying equipment are urgently needed to transport:

  (1) Meal (cake) to feed mill -- to eliminate sacking; and

  (2) Crude oil to refinery by pipe or tank truck -- to eliminate drumming.

m. An adequate safety program should be activated, with guards installed over conveyors, wheels, and belts. A completely safe program for operating the solvent unit should be enforced.

B. Processing Soybeans

The growth of the world production of soybeans continues at a rapid rate. High quality oil and meal are in great demand. Soybean oil accounts for about one-fifth of the world total high-protein meal. Egypt needs both products.

Soybean processing world-wide has grown rapidly through the building of more large processing units and expanding and modernizing the old units. The world soybean processing industry has become highly sophisticated. Many oil operations in Egypt have fallen behind because of a lack of know-how and their survival depends upon the adoption of new processing techniques and capable management. Most modern soybean processing mills built in the world this past year have a capacity of 1,000 to 2,000 tons per day, with capability of expanding. This characterizes the world-wide competition. There are no secrets in the business. Success depends upon well-trained management.

1. Production of Soybeans, Meal and Oil

Egyptian farmers, with assistance from their Ministry of Agriculture, have rapidly learned how to grow soybeans. Table 24 shows the dramatic increase in Egyptian production of soybeans. The oil and meal are important for the Egyptian food industry.

2. Soybean Processing

The processing of cottonseed, soybeans, and other oilseeds involves similar technological problems. Where different kinds of oilseeds are readily available, it is a natural path of expansion for a firm to combine processing of two or more kinds of oilseeds. Especially with the recent technological development in solvent equipment capable of processing different oilseeds, the combined processing of cottonseed and soybeans or other oilseeds offers economic advantages to processing companies located in areas where more than one kind of oilseed is produced.

The Egyptian government has considered alternatives for processing the soybeans produced and very wisely made these decisions:

Table 24. Soybeans produced and processed, with projections to 1988

Year	Soybeans			Products	
	Grown	Produced	Processed	Crude Oil[c]	Meal[d]
			MT	MT	MT
1974	4,078	1,330			
1975	8,347	3,855			
1976	16,452	10,836			
1977	32,006	24,068	20,000	3,600[e]	15,800
1978	81,906	79,039	60,000	10,800[e]	47,400
1979	Not available				
1983	225,000[a]	270,000[a]	256,500[b]	46,170	202,635
1988	300,920[a]	361,100[a]	343,045[b]	61,748	271,005

a/ See Table 22, page 84. Current and potential production and utilization of oilseed crops in Egypt. INTSOY report Task Order No. 8, AID/TA/BOA-1109.

b/ 95% of quantity produced

c/ 18% of quantity processed

d/ 79% of quantity processed

e/ For real quantity produced see Table 26.

a. Egyptian soybeans would be concentrated and shipped to the mill at Damanhour for processing. (This was a cottonseed mill used to process soybeans from the 1977 crop without dehulling.)

b. The cracking rolls and necessary auxiliary equipment were installed in 1979 for dehulling up to 60,000 MT soybeans annually to produce a meal with 45 percent protein (preferable 48 percent) for the poultry industry.

c. They plan to review annually the projected production of soybeans and decide how much additional capacity should be added at Damanhour.

The economics of plant location favor Damanhur for processing soybeans because it is located close to the center of soybean production in Egypt and also near the market for oil and meal -- thus minimizing total transportation charges for raw material and finished products. The location may, at a later date, offer an opportunity to augment the domestic soybeans processed by buying imported beans. This possibility will be of greater significance when soybeans can be transported in bulk from the Alexandria port to Damanhour. Damanhour is 60 km from Alexandria and 160 km from Cairo.

Damanhur has a seed warehouse which holds 60,000 mt of cottonseed or soybeans. The most sophisticated and expensive part of the processing equipment is the 200 MT per day DeSmet solvent extractor, which does not require modification. However, equipment for cleaning the beans, dehulling, flaking, and cooking must be installed to produce a high-protein, low-fiber meal for the poultry industry.

3. Soybean Processing Observations

Domestically produced soybeans have a high oil content (about 20 percent) partly because they are very dry. They usually contain six to eight percent moisture. However, they are very dirty and dusty. They often contain a few stones, some immature beans, and occasionally some green beans.

The mill should adopt and follow a program of sampling and grading. In addition, they should run chemical analyses for determination of quality and quantity of the product being produced. The yield of products from a metric ton of domestic soybeans, low in moisture, producing 48 percent protein meal is shown in Table 25 under "efficient performance". Actual production at Damanhur will, in a few months, demonstrate their capabilities.

Egypt has had some experience in processing soybeans for the Ministry of Supply for the public Poultry Company on a per-ton fixed price toll arrangement. The Poultry Company owns the soybeans and the finished products. Damanhur processed 20,000 MT of soybeans in 1977-89. They did not dehull the soybeans; therefore, oil extraction was poor and the protein in the meal (cake) was only 36 to 38 percent -- with high fiber content. Such a product is not desirable for poultry feed. It is an economic waste to make poor products from good quality beans.

Table 25. Performance standards for soybean processing

	Performance with inefficient personnel and equipment		Efficient performance	
	%	Kg	%	Kg
Crude oil	18	180	18.5	185
Meal (cake)	73	730	74.5	745
Hulls	6	60	6.0	60
Milling Loss	3	30	1.0	10

Damanhur is scheduled to process about 60,000 MT of soybeans in 1979-80. The machinery for cleaning, dehulling, preparation, and cooking was installed in June 1979. This equipment, with good management, should produce a meal with low fiber content (three to four percent) and a high protein content (45-58 percent). Specifications for high quality meal from dehulled soybeans are as follows:

Protein	min. 48% (may approve 45%)
Fat	min. 0.5%
Moisture	max. 12.0%
Fiber	max. 3.5½
Color	light tan to light brown
Texture	free-flowing, without coarse particles or excessive fines

In 1978, the Poultry Company made arrangements with the Al Arz Industries (private sector) soybean processing (solvent) plant at Alexandria Free Port Zone to process 750 tons of Egyptian-grown soybeans on a toll basis. Al Arz Industries reported that this soybean meal (cake) met specifications (48% protein, 3.5% fiber) and had a bright color, indicating that it was not over-cooked. Such soybean meal should be satisfactory for poultry feed. Al Arz Industries import soybeans, which must be transferred from ship to barge, and then unloaded at their plant for processing.

4. Problems in Soybean Processing

The problems encountered in processing soybeans for making crude oil and 48 percent protein meal are many and varied. Some of the most important problems and their solutions for the plant at Damanhur or elsewhere, wherever future processing is at a rate of 200 MT per day or 1,000 MT per day, are outlined below. Management must shift from an art to a science based on objectives, better management information, and performance.

a. Preparation of Soybeans Proper preparation is the key to efficient, economical processing. Adequate cleaning with the removal of foreign material, stones, and all metal is a must in order to prevent damage and excessive wear to the cracking and flaking rolls, which must operate with precision. Shakers must be cleaned frequently for efficient flow of beans.

b. Tempering Soybeans for Flaking A stack cooker-type vessel is usually used to temper the soybeans. Heating the soybean makes it easier to properly flake as it goes through the rolls. Use only sparge steam, as needed, in tempering the soybeans. Do not add raw water -- it forms protein balls and clogs the rolls.

c. Extracting and Refining the Oil Soybean oil contains approximately two percent gum, which may be partially removed as lecithin. The remaining phosphatides must be removed by caustic refining. Detailed procedures are furnished by DeSmet and other equipment manufacturers, and they should be followed.

d. Desolventizer-Toaster A desolventizer-toaster should have enough capacity to handle 10 to 20 percent above the designed tonnage of a plant in order to avoid difficulty with surges and overloads. The meal dryer should dry meal, which contains 18 to 20 percent moisture as it comes from the desolventizer-toaster, down to 12 to 14 percent moisture.

e. Meal Handling Proper meal handling equipment is required to cool the meal from the desolventizer-toaster, grind it to finished quality, and screen and store the finished meal in bulk bins. In the future, it would be desirable to load the meal out in bulk trucks to transport it to feed manufacturing plants. There is a large potential saving and a real need to develop a program with feed mills for transporting bulk meal and storing it in bins.

f. Importance of Producing High-Quality Soybean Meal The quality of soybean meal can vary considerably due to variations in heat used during processing. Excess or insufficient heat can be detrimental to protein meals. Proper heat treatment and moisture conditions are required during processing to make meal which retains optimum lysine efficiency and amino acid growth factors. There are difficulties other than depressed growth of the poultry and reduced feed efficiency from under- or over-cooking soybean meals, such as the incidence of rickets in poultry and the appearance of blood spots in eggs from hens fed undercooked soybean meal. It is necessary to precision-cook soybean meal to attain optimum protein efficiency, especially for young chicks. It is the responsibility of the superintendent or works manager to see that his production of meal is properly processed. Also, all products must be kept within the system, and excess spills must be stopped. Plant housekeeping and sanitation must be greatly improved above current levels.

C. Peanut Processing

As indicated in the marketing section, peanuts have not become an important commercial oilseed crop for economic and technical reasons. However, with the anticipated large quantities produced on new lands, as shown in the Ministry of Land Reclamation 1980 - 1984 Plan, it is expected that processing of peanuts would be a viable alternative. At the present time, the existing facilities are not equipped to process peanuts.

D. Sunflower Use and Processing

Sunflower seeds are now being used regularly as a confectionary food in Egypt.

When sunflower seed production is increased, it will not be difficult to prepare one of the cottonseed mills to process it efficiently. The seed should be graded as it is received at the mill, cleaned, stored in silos after cleaning, decorticated, (removal of the hulls), and then put through beaters. Sunflower seed may be processed with the hull intact or after decortication, but meal quality is low if decortication is not done. Processing plants usually decorticate the seed just before extraction. Since sunflower seed contains more than 25 percent oil, processors usually prepress the seed to an oil-meal mixture with 14 to 17 percent oil content before extracting. Solvent-extracted sunflower meal usually contains less than one percent residual oil. The product yields from processed sunflower seed are as follows:

Oil	38.5%	Very high quality
Meal (28% protein non decorticated - 45% decorticated)	56.0%	High fiber content used for ruminant animal feed (not decorticated)
Shrink	5.5%	
	100.0%	

No special precautions have been found necessary for processing sunflower meals, except that it is necessary to reenforce the cyclones and pipe bends because of the abrasiveness of sunflower husks. After cooking, the meats are flaked to 0.25 mm thickness before feeding the prepress expeller, and then the solvent extraction of the oil cake is done under normal conditions.

E. Refining Vegetable Oils

A review of the refineries was not included in the scope of this study. However, visits by the 1978 Oilseeds Review Team[1] with representatives of the Ministry of Food and company managers responsible for cottonseed processing and refinery operation included some discussions of refining vegetable oils.

1. Capacity of Refineries

The vegetable oil demand will increase with both an increased population and a high standard of living through the end of this century. (Table 26)

Table 26. Demand for edible oil versus refining capacity[a] (MT)

Year	Production of Crude Oil: Cotton-seed	Production of Crude Oil: Soy-bean	Import Require-ment	Total Require-ment[b]	Refinery Capacity	
1977	124,709	919	198,492	324,120	221,750	Refined
					92,000	Hydro-genated
					313,750	
1978	124,217	8,092	204,820	338,129		
1979[c]	128,188	8,314	209,948	346,450		
1983	127,400	10,247	282,223	419,870		
1988	129,127	12,679	392,485	534,291		

[a] Black and Veatch International, Sept. 1978

[b] Excludes tallow ranging from 28,915 to 47,000 MT

[c] Estimated by the Project Design Team

---

[1] Current and Potential Production and Utilization of Oilseeds Crops in Egypt.

F. Looking Ahead

Management must promptly establish a program to operate the oilseed mills efficiently and remove the processing throughput bottlenecks. A management system should be initiated so that the mill organization will learn how to:

1. Identify cost accurately.

2. Establish useful cost improvement goals and budgets. Coordinate, in practice, a systematic cost improvement program, using monthly cooperative mill expenses tailored to the needs of the business.

3. Increase working capital efficiency. For example, the cottonseed mills are charged for the cottonseed when it is received at the mill (fixed price x tons). This debit charged is credited when the products (oil and meal) are shipped. The company mills are charged interest for the use of this money. The current rate is 10 to 11 percent. In private industry this would give a major incentive for effective scheduling systems, accurate inventory and money management programs to reduce interest costs, and increase working capital turnover. It is not clear to us how this affects incentives in Egypt.

4. Apply a variety of modern techniques, including average chemical analyses and product yields per ton of oilseed crops processed.

5. It would be prudent to operate at least 330 days annually and if the production of oilseed increases faster than anticipated, increase the capacity to 400 or 600 MT per day before putting in a large amount of fixed capital for expansion of existing plants.

6. Design a training program for plant managers, engineers, supervisor, and other key personnel with job descriptions for each person within the organization.

7. Maintain quality control of products.

8. Improve housekeeping.

9. Provide safer working conditions.

The oilseeds processing industry extends world-wide. It has become a sophisticated, well-run industry. It is of major importance that the Egyptian government continue to modernize the mills and apply effective management to this multimillion LE industry. The tools are available and need not be extensively researched nor invented.

XIII. SUGGESTIONS FOR INCREASING THE PRODUCTION OF SOYBEANS, PEANUTS, AND SUNFLOWER FOR OIL

A. Coordinated Oilseed Crops Research and Production Program

1. Proposed Research System

The Agricultural Research Center (ARC) has conducted research on some of the problems affecting oilseed crop production. While the quality of the research personnel is impressive, the type and level of support they have received has been inadequate. Field and laboratory equipment and vehicles are lacking in quality and quantity for progress. Poor communication between researchers, extension personnel, and farmers has delayed the application of solutions to farmers' problems.

To address this problem, we recommend an expanded oilseed research and production project to be organized and conducted by an interdisciplinary Oilseeds Research Unit (ORU) within the ARC. The ORU should be established at an administrative and organizational level no lower than the present ARC Institute level. The research and production project should feature a coordinated interdisciplinary applied research program, including strengthened linkages with the agricultural extension staff. It should be adequately supported by sufficient equipment, including vehicles, and operating funds. The system as proposed would utilize the existing ARC Institute system and would require minor realignments within and between the existing research and extension organizations. Because of improved linkages to be developed between research and its farmer-clients greater budgetary support for research and extension personnel, it is expected that rapid introduction and adoption of research results by farmers will occur.

The ORU should be headed by a Project Director appointed by the Ministry of Agriculture. The Director will have the support of a full time Deputy Director, who will have responsibility for day to day operations.

He will interface between the Director and the multi-disciplinary teams of Principal Investigators, and Senior Investigators. Senior Investigators will assist the Principal Investigators in day to day operations. Action teams will be assigned at five Regional Research Stations under the supervision of an Oilseed Crop Team Leader at each station. The objectives of the project would be to identify major problems limiting oilseed crop production; to plan and conduct a coordinated multi-disciplinary research program; to annually evaluate results, prepare written interpretations, and production recommendations; and, to introduce and gain adoption of improved varieties and better crop husbandry practices by farmers. An important aspect of the project is that it will consider economic returns to farmers, as well as increased production of oilseed crops.

The organization at the central level is designed to facilitate the planning, administration, and coordination of the work which will take place at the five Regional Research Stations.

2. Project Administration

The project will be under the administrative control of the Minister of Agriculture, who shall appoint the Chairman of the Executive Committee and the Project Director.

a. Executive Committee

The Executive Committee shall perform general direction and advisory functions within the framework of the project design. Matters on which established policies are not in existence will be taken up by the Committee to develop such policies as may be deemed necessary. The Executive Committee shall consist of the highest ranking official or his designated representative, from each of the following:

(1) Agricultural Research Center

(2) Agricultural Extension Department

(3) Undersecretary for Agricultural Production

(4) Development and Agricultural Credit Bank

(5) Ministry of Irrigation

(6) Ministry of Land Reclamation

(7) Under-Secretary of Animal Husbandry (Ministry of Agriculture)

(8) Food Industry Council.

Other members may be appointed as needed.

Members ex-officio will be:

(9) Director ORU

(10) Technical Assistance Contract Team Leader

(11) Office of Agricultural Development, U.S. Agency for International Development Mission to Egypt.

Other members may be appointed as needed.

The Chairman of the Executive Committee shall be appointed by the Minister of Agriculture from among the members listed above.

b. Office of Director, ORU

The Office of the Director, ORU shall consist of the Director, Deputy Director, the Technical Assistance Contract Team Leader, and necessary support staff. The responsibilities of this office are those dealing with the operation and implementation of the project within the policies established by the project design and the Executive Committee. All functions relating to staffing, budget, logistics, and attainment of objectives of the project are the responsibilities of this office.

c. Central Research Working Group (CRWG)

A multi-disciplinary working group shall be established utilizing appropriate specialists from several ARC Research Institutes, the Department of Agricultural Extension, and other Departments as appropriate.

A Principal Investigator and at least one Senior Investigator will be appointed in the following areas:

(1) Soybeans

(2) Sunflower

(3) Peanuts

(4) Soil and Water Management, including Soil Microbiology

(5) Plant Protection

(6) Seed Production and Processing

(7) Seed Technology

(8) Extension

(9) Agricultural Economics

(10) Agricultural Mechanization.

This working group will handle the functions of planning, organizing, supervising, and evaluating the research conducted at the Regional Research Stations.

d. Regional Action Groups (RAG)

Multi-disciplinary action groups will be formed at Regional Research Stations at Sakha, Sids, Shandaweel, Nubaria and Ismailia. The groups will be led by a Team Leader and a Co-Team Leader. These Regional Action Groups will translate the research plans formulated by the Central Research Working Group and approved by the Directorate into applied research and extension activities. They will promptly report the results of their activities to the Central Research Working Group, together with recommendations for continuation or modification of reseaarch and extension activities.

The composition of the Regional Action Groups will vary from station to station. The core group would consist of a Research Officer and Extension Subject Matter Specialist for each crop grown at the station (soybeans, sunflower, and/or peanuts), a Soil/Water Management Specialist, and a Plant Protection Specialist. On certain stations, e.g., Ismailia, Nubaria, Sakha, and Sids, where seed production and processing operations will be carried out, there will be specialists in Seed Technology and Processing.

e. Operational Guidelines

The Headquarters staff, Directorate and Central Research Working Group (CRWG) would be officed at Giza and would coordinate the National Oilseeds Research and Extension Program and be responsible for the allocations and disbursement of funds for project activities. They would plan, coordinate, evaluate, and publish all oilseeds research. They would be responsible for conducting research in variety development, agronomic practices, plant protection, water management, and agricultural mechanization. They should regularly visit Regional Research Stations to supervise and evaluate research underway there and have responsibility for in-service training of junior research and extension staff of the Regional Action Groups.

The Regional Action Groups (RAG), located at five sub-stations would be designated to conduct parts of the national research and extension plan. The staff officed on these stations would be responsible for research both on the sub-station and on farmers' fields. They would participate in the annual planning, evaluation, and interpretation of the national research and extension plan. At least once each year they would observe and evaluate the oilseeds research and extension activities conducted at one of the other five sub-stations.

In order to provide flexibility for a complete and responsive research program, the Directorate would be authorized to contract for specific research to be conducted at other ARC research stations, university faculties of agriculture, Academy of Science, international institutes or other similar organizations.

In those cases where research expertise outside the Ministry of Agriculture is required, and the expertise is available from other Ministries of institutions, e.g., universities within Egypt, the Director may invite qualified organizations to submit specific proposals to address the research needs. Contractual research proposals will be reviewed by an appointed committee of the CRWG, who shall recommend to the Director. All recommended proposals for contractual research must be approved by the Executive Committee. The research shall be supported from a special discretionary fund administered by the Director and will be an identified line item in the Other Direct Costs line of the project budget. This research would be carried out under the supervision of specialized senior oilseeds scientists.

In summary, the salient operational goals of the oilseed crops research and production project are as follows:

(1) Establish a core team of scientists from different disciplines under the Directorate for Oilseed Crops Research(ORU)

(2) Establish responsibility under the Directorate for coordinating research and disbursing funds for research

(3) Augment Regional Research Stations at Sakha, Sids, Shandaweel, Nubaria, and Ismailia with junior scientist staff members and associated resources.

(4) Improve support for staff in the form of field research equipment and vehicles. Refurbishment or construction of facilities may be required.

(5) Initiate annual conferences to formulate goals for the national oilseeds research and production program.

(6) Provide support for on-farm trials, supplies for demonstrations by extension officers and subject matter training for extension workers as part of the national coordinated research and production program.

(7) Develop special research goals for evaluating reclaimed lands and develop cropping systems for new lands.

(8) Develop closer liaison with other national research programs and research organizations in Egypt and other countries to obtain research information.

(9) Where there are gaps in research capability, develop contacts with other ARC units and stations, university faculties of agriculture, national institutions, and international organizations.

(10) Review results of research and publish the results promptly.

(11) Establish a central lending library for technical journals and books for utilization by all the sub-stations.

(12) Locate extension officers in the same offices as research staff at Headquarters and sub-stations to promote communication between research and extension staff, facilitate on-farm demonstrations, and improve in-service subject matter training of extension officers.

B. Coordinated Oilseed Crops Extension Program

The goal of an effective extension education program is to assimilate and interpret useful information generated through on-going research programs and to disseminate this information to farmers in such a way as to encourage its adoption.

The following proposal is a "Pilot Extension Education Program" to aid in establishing such a program for oilseed crop production in Egypt. The program could be modified and adapted where needed to serve other crop disciplines as well. According to this proposal, oilseed crops would be given special emphasis and the coordinated research and extension program handled separately from other crops.

1. Organization and Scope

A list of proposed Egyptian Extension personnel is shown in Table 27. Administrative leadership for the total extension program would be provided by a Principal Extension Leader and a Deputy Extension Leader located at the Giza Headquarters. These specialists would be administratively responsible to the Director and Deputy Director, ORU.

In addition, the Principal Extension Leader would be responsible for planning and coordinating, through the Extension Team Leader at each Research Station, the training needed for all district and village staff within the project. Training should be directed toward the effective use of visuals, radio, television, news articles, and demonstrations to insure the dissemination and timely adoption of pertinent information generated through research.

The Deputy Extension Leader should be an agronomist by training and in addition to working cooperatively with the Principal Extension Leader in Program Development, he would be responsible to coordinate the research information exchange between the researchers at Central Headquarters as well as researchers and Extension Subject Matter Specialists at the five Regional Research Stations. In addition, this leader would publish and distribute bulletins, circulars, and newsletters relative to oilseed crop production.

An Extension Team Leader will be located at each of the five Regional Research Stations. These leaders will be administratively responsible to the Regional Research Station Team Leader (Table 27). In addition, in cooperation with the Principal Extension Leader they would be responsible for and provide leadership for all administrative program planning and educational methods training for the Extension Subject Matter Specialists and village staff.

Extension Subject Matter Specialists will also be located at each of the five Regional Research Stations. It is projected that there would be three Subject Matter Specialists (one each for peanuts, soybeans, and sunflower), at Ismailia and Nubaria and two (one each for soybeans and sunflower), at Sakha, Sids, and Shandaweel. This would make a total of 12 Extension Subject Matter Specialists. They should be agronomists by training and be administratively responsible to the Extension Team Leaders at the Regional Research Stations. The major responsibility of these "very key positions" is the assimilation of pertinent information generated through the researchers at Giza and outlying regional research locations. They will be responsible, working through the Area Oilseeds Agents, to conduct on-farm demonstrations, to assist in on-farm visits to solve field problems and encourage adoption of recommended practices. In addition, these specialists will provide leadership to conduct village or area production clinics with the assistance of the Research Subject Matter Specialists at the various research centers.

The Area Oilseeds Agents (30) will be administratively responsible to the Extension Team Leader for direction in program planning and educational methods development. Additionally, these agents will be responsive to the direction of the Extension Subject Matter Specialists to initiate on-farm demonstrations and conduct village or area oilseed crop production clinics in approximately six villages per agent. The number of villages served by each Area Oilseed Agent will be dependent upon the feddans of oilseed crops planted in the area. The primary objective of these agents will be to become keenly aware of on-farm production problems and to utilize the Research and Extension Subject Matter Specialists at the research station to the fullest extent possible to solve these problems, thus promoting maximum efficiency in oilseed crop production.

Proposed in this plan are six Area Oilseed Crop Agents working in an area surrounding each of the five research stations. Each agent would be responsible for the oilseed crop education program in each of approximately six villages. Such a program would carry the full impact of a complete integrated oilseed crop production research program directly to oilseed crop producers in approximately 180 selected villages. These farmers would then serve as "demonstration models" thus extending the improved oilseed production practices far beyond the scope of this project.

Table 27. Egyptian extension personnel

		Number	Location
1.	Principal Extension Leader	1	Central Station-Giza
2.	Deputy Extension Leader	1	Central Station-Giza
3.	Extension Team Leader	5	Research Stations
4.	Extension Subject Matter Specialists	12	Research Stations 3 Ismailia 3 Nubaria 2 Sakha 2 Sids 2 Shandaweel
5.	Area Extension Oilseeds Agents	30	
	Total	49	

C. Proposed Seed Increase Processing Facilities

Existing seed processing plants in Egypt are owned or leased by the GOE, Seed Department. Capacity of these very old plants (approximately 50 years old) is extremely limited. Essentially, they are in place to process wheat, rice, and some soybeans. Soybean capacity is about 4,000 MT per year. There are no peanut seed processing plants in the country and very little capacity for sunflower (maybe 15 MT per year).

Seed processing plants are under the direct control of the Seed Department, GOE, and are located at four research stations. Six others are leased by the Seed Department and are under its supervision.

The variety development program involves release of breeder seed by the plant research breeder. Breeder seed and foundation seed increases are accomplished on the regional research stations. Registered seed increase are then contracted out to large farmers, GOE farms, and certain agricultural companies for seed increase. Roguing and field inspections are the responsibility of the Seed Department. The resulting increase is sold as certified seed to the farmer.

Quality standards have been established for purity, disease, and germination. According to the Seed Department, all certified seed must be at least 95 percent pure as to variety. Soybeans must germinate at least 75 percent, peanuts and sunflower a minimum of 85 percent, and be completely free of disease. It is doubtful if there is sufficient quality control to insure that these standards are met.

Seeds are bagged in 50 kilo bags and sold through the cooperatives to the farmer. Fungicide (Vitavax 200; Vitavax 200 + Captan) is provided without cost to the growers to treat the seed. All seed treatment is accomplished manually by the grower. In the case of peanuts, the farmer must also shell his own seed. This is usually accomplished by hand in the field. Seeds may be treated by hand prior to planting.

In general, seed processing is virtually nonexistent for the oilseed crops. The limited capacity which may be available is extremely old and unreliable. No plans are currently underway by the GOE Seed Department to improve or increase seed processing facilities.

Therefore, the design team recommends that four small seed increase processing plants (20 ton per day - maximum capacity) be established to insure the availability of quality breeders, foundation and registered seed to accommodate the project needs. Plans are to locate one plant at Ismailia, primarily for peanuts and one each at Sakha, Nubaria, and Sids, which would process both soybeans and sunflower seed. In addition, it is projected that these plants would also be available to process other crop seeds as capacity permits.

XIV. REVIEW OF FUTURE POLICY ALTERNATIVES FOR INCREASING OIL PRODUCTION

This section considers some options available to policy makers in the next ten years. The basic inputs into this policy process are expected vegetable oil requirements and available alternatives for meeting these needs. A special effort is made to be sensitive to constraints represented by the scarcity of land and the need for foreign exchange currencies.

In view of the present state of technology as reflected in crop yields, the major thrust in vegetable oil planning must involve soybeans and cotton. The primary source of vegetable oil will come from cotton for the foreseeable future. It is possible that a significant contribution may be made by soybeans, peanuts, and sunflower during the next ten years. In addition, there are several other possibilities in developmental stages, particularly as new lands continue to receive emphasis.

Peanuts offer a promising source of vegetable oil. The adaptability of peanuts to sandy soils would seem to make them an attractive prospect for some of the new lands. Low yields make them uneconomic at present for oil and meal production. Also, the high value of peanuts for direct consumption will direct the crop away from processing until production volume reaches a much higher level.

Sunflower production holds promise of special interest. It is very high in oil. It may be adaptable to new lands. For these reasons, research continues on its development. At present, the low yields and poor meal quality make it uneconomic.

Since both sunflower and peanuts (and perhaps some other crops) are uneconomic for oil and meal production until better yields are obtained on old lands and their production possibilities improved on new lands, this policy analysis is focused on cotton and soybeans. If one or more alternative crops are introduced at a significant scale, their oil output may reduce required imports more than the following analysis indicates.

A. Edible Oil Requirements

Egypt's 1976 population of 37.2 millior is expected to grow at a rate between 2.2 percent and 2.5 percent per year. At the lower rate, the 1988 population will be approximately 46.2 million and, at the higher rate, 47.6 million. In 1972/73, the per capita consumption of vegetable fats and oils was estimated to be 7.5 kg per year (El-Tobgy, p. 10). This does not include the oil consumed directly in the form of oilseeds and nuts. In terms of calories, vegetable fats and oils furnished about seven percent of the total energy consumed.

The 1979 consumption of edible vegetable oils (cooking oil plus the vegetable oil content of shortening) was estimated at 370,000 MT, or about 9.2 kg per capita (U.S. Agr.Attache Report EG-0002 Jan. 1980). Although no explicit statement of nutritional goals is available, we assume that per capita consumption rates are likely to increase moderately with increasing incomes. Italy illustrates rapid growth in fats and oils consumption with economic growth. Italy's 1956 consumption of salad oils, cooking oils, and shortening was 9.7 kg per capita, going up to 15.9 kg per capita in 1962 (Vandeborre, 1970). An approximation of 1988 edible vegetable oil requirements for Egypt can be obtained by assuming a ten kg per capita consumption rate for that date. This gives a requirement of approximately 470,000 MT. Alternatively, if we extrapolate the current annual increase of 25,000 MT, the 1988 consumption would be 595,000 MT (370,000 plus 225,000). A projected levelof 500,000 MT is chosen to provide the perspective needed to roughly gauge the potential contribution of increased domestic oilseed production.

Of course, the actual consumption levels in 1988 will depend, among other things, on per capita income and price relationships, which in turn, arc influenced substantially by public policy. For example, in 1980, edible oils are rationed at the rate of 450 grams per person per month, and purchases are made at subsidized prices of ten pt. per kilogram. About 70 percent of the cooking oil is rationed. Additional quantities in excess of the ration may be purchased at prices of 34 pt. per kilogram, which are three times the official price for rationed oil -- evidence of a latent demand.

B. Possible Policy Alternatives

Given this estimate of 1988 edible vegetable oil requirements, four different policy alternatives are considered in order to indicate the critical role of government policy in assessing the potential for oilseed expansion in Egypt. Two of the goals of the Five-Year Plan are relevant: (a) provision of food security and (b) contribution of agriculture to the balance-of-payments problem. The first policy alternative is to meet the growth in needs through increased imports. Of course, this reduces food security.

The portion of the total vegetable oils consumption that have been imported in recent years is shown in Table 28). Over the last three years, domestic production has averaged 28.8 percent of total utilization.

Table 28. Estimated supply and utilization of vegetable oils in Egypt

	Production		Imports		Total Utilization[a/]	
	Quantity	%	Quantity	%	Quantity	%
1977	100,600	(29.8)	236,400	(70.2)	337,000	(100.0)
1978	104,400	(29.3)	251,600	(70.7)	356,000	(100.0)
1979	110,700	(27.5)	291,300	(72.5)	402,000	(100.0)
1977-79 Average	105,200	(28.8)	259,800	(71.2)	365,000	(100.0)

[a/] Includes inventory change, losses, as well as consumption
Adapted from Preliminary Attache Report
April 3, 1980.

Policy Alternative II (Table 29) will seek to continue the current ratio of domestic production and imports of vegetable oil. If these domestic production and imported shares of expected consumption remain constant until 1988, domestic production will need to be 140,000 MT (29 percent of 500,000 MT), requiring imports of 360,000 MT (see Table 29).

Policy Alternative III seeks a moderate increase in emphasis on food security in terms of edible vegetable oil Table 29). Rather than domestic production of 29 percent of the requirements, Policy Alternative III would increase domestic production to one-third of the requirements with the balance to be imported. This would require domestic production of 165,000 MT in 1988.

Policy Alternative IV further increases the emphasis on food security, projecting domestic production to supply half of needs. Production requirements for 1988 under this alternative are 250,000 MT (Table 29).

Table 29. Alternative combinations of sources to meet 1988 edible vegetable oil requirement of 500,000 MT

Policy alternative	Imports 1000 MT	Production Cottonseed 1000 MT	Production Other 1000 MT	Food Security Index[a]	Total 1000 MT
I - Increased requirements met from imports	390	100	10	22.0	500
II - Hold even; domestic production is constant share of needs	367	100	33	26.5	500
III - Improved Food Security	335	100	65	33.3	500
IV - Increased requirements met from production	250	100	150	50.0	500

[a]Proportions of need supplied from domestic production.

1. Level of Cotton Production Unchanged

Cottonseed oil currently comprises about 90 percent of the domestic production of vegetable oils, with the balance coming primarily from soybean oil. The projected supply of cottonseed oil is likely to be largely determined by factors other than its contribution to edible vegetable oil production. With the exception of 1977, the cotton area from 1976 to 1980 has remained at 1,200,000 feddans. The long-term outlook appears to be one of no increase in cotton area and perhaps a moderate decrease. There is a prospect for higher yields, particularly if marginal producers change to other crops. The balance of these influences leads us to expect approximately stable total production.

For the purpose of appraising the relative contribution of expanded domestic production of oilseed crops, we assume the annual domestic cottonseed oil production to remain at about 100,000 MT through 1988. Under the assumption of Policy Alternative II maintaining the same ratio between domestic production and imports, the domestic production of other oilseed crops would thus need to be 40,000 MT in 1988 (140,000 MT minus 100,000 MT) (Table 29).

To assist in determining if the goal of Policy Alternative II is feasible, let us assume that this production is to be met solely by soybean production and calculate the land area requirements. Assuming the oil content of soybeans to be 18 percent, the 40,000 MT of oil converts to 222,200 MT of soybeans. With an average yield of 1.0 MT per feddan, 222,200 feddans would be required; at a yield of 0.75 MT per feddan, 296,000 feddans would be required. Using the 1.2 MT per feddan yield of the 1984 plan, 185,200 feddans are required.

The feddans required for soybeans with each of the policy alternatives are as follows:

Policy Alternative	Soybean yields (MT/fed) 0.75	1.00	1.20
I	74,061	54,990	45,825
II	296,300	222,220	185,180
III	481,470	361,100	300,920
IV	1,111,000	833,000	695,010

Policy Alternative IV increases the emphasis on food security, with half of the requirements coming from each source. Again, using soybeans as the example for the oilseed, the area required would be 833,000 feddans with yields averaging 1.0 MT per feddan. Clearly, a goal of producing one-half of the edible vegetable oil requirements would require drastic reductions in the competing crops and severe adjustments in the total economy.

Policy Alternative I shifts to increased reliance on imports. The desirability of such a policy must rest heavily on balance-of-payments considerations. The requirement of 10,000 MT could easily be met with domestic production of oilseed crops. Alternative I seems too modest, while Alternative IV is so ambitious that major disruptions would affect the entire economy.

For these reasons, we will focus on Alternative II, the "Hold Even" goal, and Alternative III, the "Improved Food Security" goal (Table 29). The "Improved Food Security" goal seems consistent with general policy objectives and obtainable with a high degree of probability. An indication of the expansion rate necessary to attain the "Improved Security" goal is given by the projections of crop area, yields, and production from 1978 to 1988 in Table 30. This projection will be used to consider processing methods.

Table 30. Projections of area, yield, and total production of soybeans, 1978 - 1988 to meet improved security goal

Year	Area[a/] fed	Yield[b/] per fed MT	Total Production MT
1978	81,906	0.965	79,039
1979	110,687	1.010	111,794
1980	139,468	1.060	147,836
1981	168,249	1.110	186,756
1982	197,030	1.150	226,585
1983	225,000	1.200	270,000
1984	240,184	1.200	288,221
1985	255,368	1.200	306,442
1986	270,552	1.200	324,662
1987	285,736	1.200	242,883
1988	300,920	1.200	361,100

[a/] Area increases by 28,781 feddans annually between 1978 and 1983 and by 15,184 between 1983 and 1988. It is assumed that the introduction during the first five years will be primarily on old lands and will go faster.

[b/] Yield increases 47 kilograms per feddan during the first five years and remains constant during the second five years. It is expected that yield increase will level when cultivation of new lands becomes more important.

2. Cotton Area Variable

The preceding section assumed a stable production of 100,000 MT of cottonseed oil. The effect of substitution of soybeans (or other oilseed crops) for cotton on the production of both oil and meal needs to be considered. There are quality differences between soybean meal and cottonseed meal, and these will be considered in other sections of the report. In this section, only the production relationships are considered.

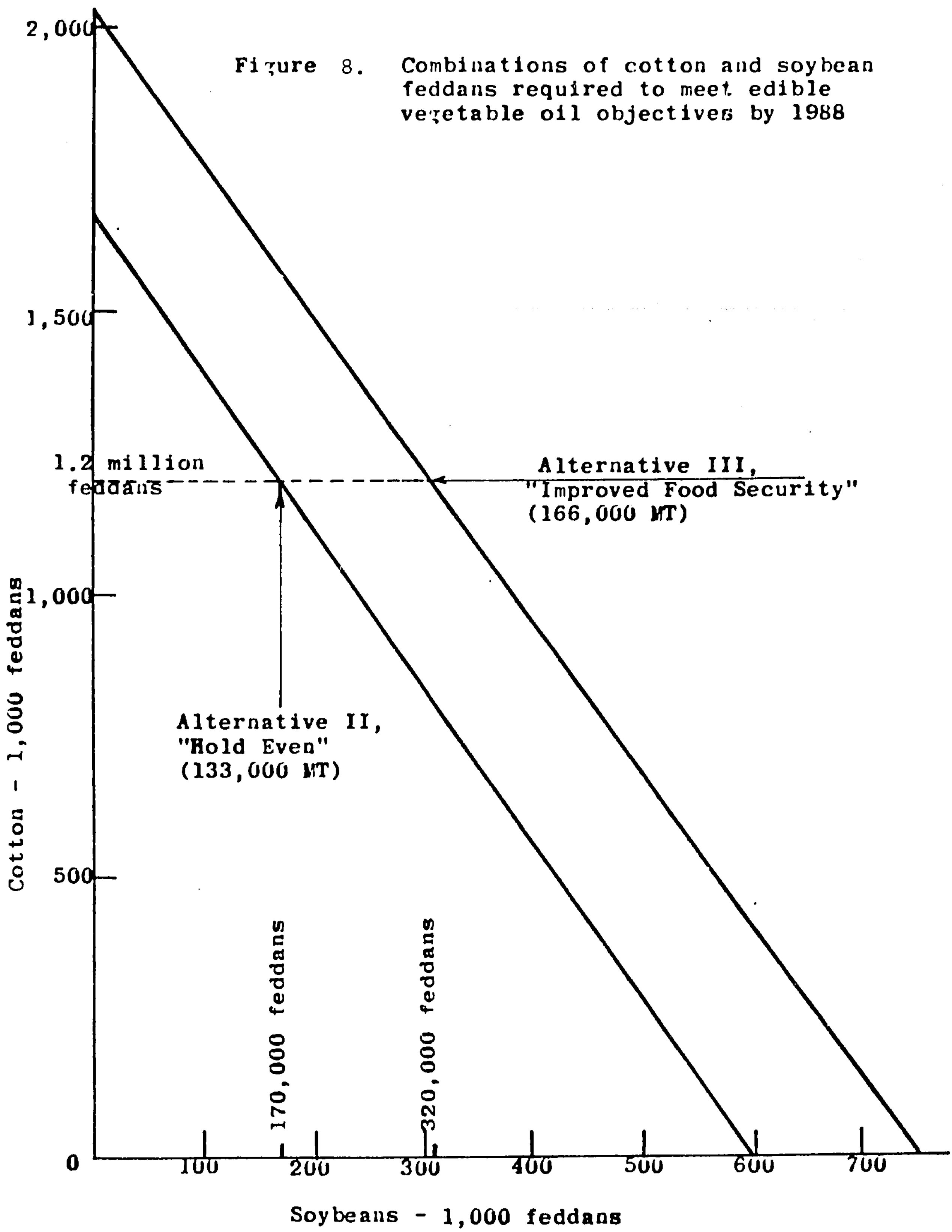
Regardless of the cropping patterns planned or adopted, cotton and soybeans are substitutes in the sense that they represent alternative ways of meeting a fixed edible vegetable oil requirement. Accordingly, it is useful to determine the substitution rate in terms of feddans required to meet such a requirement. Admittedly, this is a rather narrow view. It neglects the importance of cotton lint, cottonseed meal, and soybean meal which must be included in any comprehensive analysis.

For this substitution analysis, we assume a cottonseed yield per feddan of 0.50 MT and soybean yield per feddan of 1.20 MT. These are the yields in the 1979 projected cropping system (Table V of "Some Statistical Indicators"). Oil content is assumed to be 16 percent for cottonseed and 18 percent for soybeans. Thus, the oil yield per feddan is 0.09 MT for cotton and 0.22 MT for soybeans. It takes approximately 2.75 cotton feddans to furnish the same amount of oil as 1.0 feddan of soybeans. This, of course, neglects quality differences.

Consider Policy Alternative II in Table 29. Domestic production of 140,000 MT of oil is required to "Hold Even" with demand growth. Rather than fixing the level of cotton production, consider cotton and soybean to be substitutes. Combinations of cotton and soybean feddans required to meet the "Hold Even" goal are shown on the diagonal line nearest the origin (see Figure 8). Note that if cotton feddans drop from 1.2 million to 1.0 million, soybean feddans must increase from 168,000 to 240,000.

The "Improved Food Security" goal requires combinations of feddans shown by the diagonal line further from the origin (Figure 8). This level of production would require about 320,000 feddans of soybeans with 1.2 million feddans of cotton, and about 390,000 feddans if cotton dropped to 1 million. It is clear that meeting either of these goals would require a considerable reallocation of scarce land.

Figure 8. Combinations of cotton and soybean feddans required to meet edible vegetable oil objectives by 1988



The allocation of land is affected by several other factors. Sacrificing of other crops will be less painful if soybeans can be extensively developed on new lands. If yields increase more than projected, fewer feddans will be required. If the allocation of feddans goes to late planted, short-season soybeans, more winter crop grains and less catch crop berseem and maize may be grown in the rotation. The values of cotton lint and soybean meal must also be considered.

C. Implications for Balance of Payments

Egyptian long staple cotton is a very high quality, speciality product. It commands a price over twice the prevailing price for cotton in world markets. Although the percentage contribution of cotton to the foreign exchange has been declining over the past few years, it remains an important export crop and it may have a relatively significant effect on the country's future balance of payments.

Even with the very high prices for export cotton, a smaller proportion of the crop is being exported as lint. In 1973, 58 percent of production went into export, while only 32 percent of the production was exported in 1977. On the other hand, the return seems to be increasing as a larger share of export sales are for exchange currencies at announced prices and a smaller proportion is bartered ("agreement" and "clearing account" countries).

The most important analysis involving balance of payments is the comparison of cotton and soybeans. This comparison is complex because it involves cotton lint, cottonseed meal, cottonseed oil, soybean oil, and soybean meal. All of these products (with the possible exception of cottonseed meal) are involved in balance of payments -- the oil because of the national deficit, the cotton lint as discussed above, and the soybean meal because of its special usefulness in poultry rations.

Another factor important in comparing the export contribution is the resources expended. It is a natural tendency to compare output, yield, or contribution to balance of payments on a per feddan basis. In this case, however, this analysis is incomplete. Cotton yields very high export credits per feddan, but it also occupies growing space for almost eight months. Soybeans occupy the land for only about half that amount of time. Both crops are summer crops, but cotton requires the entire summer. The shorter season of soybeans may enable better use of the marginal months in spring and fall. The full effect upon the crop rotation of shifting a feddan from cotton to soybeans is not completely identified at this time and should be investigated. At the very least, however, the different length of time on the land must be taken into account. Table 31 is designed to assist in this analysis. While some of these data are tentative, these ratios provide a good first approximation of the relative effects on balance of payments resulting from allocating a feddan to cotton, soybeans, sunflower, peanuts, and safflower.

Because of yields of both crops and the high value of cotton lint, both cotton and soybeans make the largest contributions to export earnings (or import savings) per feddan per week. The reason for the strong showing of soybeans is the increase in actual and projected yields in contrast to cotton's more modest showing.

It is interesting to take a long-range and less formal look at the competition between these two crops. The cotton lint is a premium specialty crop. If higher yields or increased feddans resulted in rapid growth of supplies, this special price might collapse. Long staple cotton is a narrow market. The world price for cotton (a close substitute) is usually less than half of Egypt's price. Competition also includes a growing number of quality synthetics. Therefore, growth opportunities in this market are very limited. Often, in these markets for specialty products, a small crop can bring more than a large crop. The decline in exports may be the reason the price has held up.

In contrast, soybeans is a growth market. The oil needs in Egypt are large. The meal is valuable because of the protein quality (balance of amino acids) and low fiber content. It is well-suited to poultry production and is a potential source of human food. With current technology, poultry is destined to grow in importance in Egypt and many other countries. If research and other support can exploit natural advantages which soybeans appear to have in Egypt, the effects on national diet and balance of payments seem positive now and also in the longer term future.

D. Implications for Food Security

The relationship of soybean production and the national needs for vegetable oil is discussed in earlier paragraphs of this section. The consequences of this production on the availability of poultry feed, however, deserve attention. The following discussion assumes that the entire soybean meal production goes into poultry feed. This may be valid at first, but the quality and versatility of soybean meal will make it an attractive input in many human food and animal feed products in the future.

Table 31 shows the effects of alternative goals of soybean production on projected poultry feed needs. By 1988, the "Hold Even" strategy identified for vegetable oil would satisfy almost half of the needs for soybean meal. On the other hand, the "improved food security" goal would satisfy almost 90 percent of the needs of the poultry industry by 1988.

The objectives of food security are probably not completely attainable, particularly for oil. On the other hand, considerable progress can be made. The more ambitious alternative moves to accommodate one-third of oil needs and over 90 percent of meal needs. Together with the development of processing capability to handle the domestic production, this pattern makes the Egyptian food system considerably less dependent on external sources. In case of national emergency, the proposed system could provide a much better diet for the population than the present arrangement.

Table 31. Soybean meal needs for projected broiler and egg production, 1982 and 1988.

	1976[a/]		1982[a/]		1988[d/]	
	No. (mil)*	MT (000)	No. (mil)*	MT (000)	No. (mil)*	MT (000)
Broilers	35	53	110	165	275	413
Feed needs[b/]		174		543		1299
Soybean meal[c/]		35				260
Eggs	65		300		900	
Feed needs[b/]		20		92		272
Soybean meal[c/]		4		18		54
Total soybean meal		39		127		314
Percent of meal needs met from domestic production (cotton 1.2 million fed)						
Hold Even (oil)		--		--		45
Improved food security (oil)		--		--		86

* Millions of broilers and eggs.
a/ Five-Year Plan 1978-82, Vol. 4, page 106.
b/ Average of U.S. rates 1973-77 (Feed Situation November 78, Table 16) plus 15% in 1976 and 1982 and plus 10% for 1988.
c/ Assumed to be 20% of ration.
d/ Assumes a 2½ times increase in broilers and a 3-fold increase in eggs over 1982. With a 1988 population of 47 million, this would provide 8.8 kilos of broiler meat per person and 19 eggs.

XV. IMPLEMENTATION PLAN

Major inputs of the contractor to this project will be in the form of personnel, training, and commodities. This section will feature a brief description of the major items included in each of these areas.

A. Expatriate Personnel

1. Long-term Staff

Estimated requirements for the expatriate staff are shown in Table 32. The team will be stationed at Directorate Headquarters at Giza to be readily available for consultation with the Egyptian staff at Giza and all five regional research stations, as well as to other entities of the Government of Egypt. Brief descriptions for each of these specialists follow:

a. Research Administrator and Team Leader - 60 work months

1) Administrative: This person will administer all expatriate personnel and the local support group.

2) Qualifications: This position requires an agricultural scientist. Management skills and experience are desirable.

3) Responsibility: This administrator will perform at least the following several functions. He/she will serve as the principal U.S. technical representative for all activities of the project and act as project co-director. Technical and administrative assistance to GOE authority responsible for planning and implementing programs of work under the project shall also be provided by this leader. He/she will also assure that project activities are scheduled and implemented according to the project design and operational work plan. Establishing and maintaining coordination with GOE and USAID personnel for timely and efficient implementation of project activities will be a primary function. This leader will provide

Table 32. Requirements for expatriate staff

Speciality	Yr.1	Yr.2	Yr.3	Yr.4	Yr.5	Total
Long Term						
1. Research Administration and Team Leader	12	12	12	12	12	60
2. Plant Breeder	12	12	12	12	12	60
3. Soil Micro-biologist	-	12	12	6	-	30
4. Plant Pathologist	-	12	12	-	-	24
5. Oilseeds Extension	12	12	6	-	-	30
6. Extension Agronomist	12	12	12	12	12	60
7. Seed Production and Processing	-	12	12	12	12	48
Subtotal work months	48	84	78	54	48	312
Subtotal work years	4.0	7.0	6.5	4.5	4.0	26.0
TDY						
1. Soil Microbiology	3	-	-	-	-	3
2. Entomology	2	2	2	2	2	10
3. Plant Pathology	2	-	-	2	2	6
4. Weed Science	6	3	3	3	3	18
5. Extension	3	3	3	9	9	27
6. Seed Production and Processing	3	-	-	-	-	3
7. Soils Specialist	3	3	3	3	3	15
8. Water Management Specialist	3	3	3	3	3	15
9. Oilseed Processing	2	2	2	2	2	10
10. Agricultural Economics	3	3	3	3	3	15
11. Unspecified in Special Problem Areas	12	12	12	12	12	60
Subtotal work months	42	31	31	39	39	182
Subtotal work years	3.5	2.58	2.58	3.25	3.25	15.17
Total work months	90	115	109	93	87	494
Total work years	7.5	9.58	9.08	7.75	7.25	41.17

evaluation reports to GOE and USAID, as well as recommend needed changes or amendments to the project. He/she will also approve and facilitate requests for staff to be recruited, training assignments, and commodity procurement authorized by the project.

b. Plant Breeder - 60 work months

1) Administrative: This person will be administratively responsible to the Research Administrator and Team Leader.

2) Qualifications: This position requires broad experience in oilseed crop breeding. This person will have a technical background in one of the project emphasis crops, soybean, sunflower or peanuts. He/she will be supported as appropriate by plant breeders with experience in the other two crops on a TDY basis.

3) Responsibility: He/she will provide advice, in coordination with GOE counterpart breeders on the emphasis crops, in planning, conducting, evaluating and reporting of plant breeding research. He/she will cooperate with extension personnel in transferring basic research information to Subject Matter Specialists Village Agents, and farmers.

c. Soil Microbiologist - 30 work months

1) Administrative: This scientist would be administratively responsible to the Team Leader.

2) Qualifications: This position requires considerable experience in legume production and the use of legume inoculum to promote nodulation. Experience in soybean and/or peanut production is desirable.

3) Responsibility: This person will provide advice on the production of legume inoculants and recommend inoculation techniques best suited to project environmental conditions.

d. <u>Plant Pathologist</u> - 24 work months

1) Administrative: This person will be responsible to the Team Leader.

2) Qualifications: This position requires experience in oilseed crop diseases with special emphasis on arid lands crop production under irrigated conditions.

3) Responsibility: The application of various techniques to integrated crop protection should be a focus of this work, in co-operation with the entomology and weed science components, to minimize environmental effects of chemical pest control methods. He/she will work closely with Egyptian counterparts in identification of disease problems associated with project crops and in finding the best control methods of these problems.

e. <u>Oilseeds Extension Specialists</u> - 30 work months

1) Administrative: This specialist will be administratively responsible to the Team Leader.

2) Qualifications: This position requires broad experience in extension programs and extension education.

3) Responsibility: The person will have an advisory role to the total extension program of the project. He/she will assist with training activities involving extension administration, extension methods, program planning and evaluation, human behavior in the education process and other areas as appropriate.

f. <u>Extension Agronomist</u> - 60 work months

1) Administrative: This person will be responsible to the Team Leader.

2) Qualifications: This position requires experience in extension program operation. The person should be experienced in oilseed crop production with special emphasis on on-farm demonstrations.

3) Responsibility: The person will work with the Deputy Extension Leader to develop improved agronomic practices and recommendations for all three of the project crops - soybean, sunflower, and peanuts.

g. Seed Production and Processing Specialist - 48 work months

1) Administrative: This specialist will be administratively responsible to the Team Leader.

2) Qualifications: This position requires experience in seed increase programs, including production, processing and distribution. Experience in hybrid seed production is desirable.

3) Responsibility: The person should focus on in-service training for workers in the four seed processing plants at Sakha, Sids, Nubaria, and Ismailia, and will liaise with the Major Cereals and Rice Projects in seed processing requirements.

2. Short Term Staff

Approximately 182 work months of short term specialists (TDY) will be used over the life of the project to support the efforts of the resident long term staff (Table 32). Crop consultants will address specific problems identified by ORU staff. Egyptian staff in extension, soil and water management, plant protection, seed processing and agricultural economics will be provided special TDY assistance. Processing requirements may be met largely through TDY specialists in staff training and personnel policy, operations, accounting and fiscal control, laboratory and quality control, and other special problems.

TDY personnel will be selected based on the specific problems encountered, as determined by the expatriate Team Leader and Director, ORU. These individuals will be highly qualified personnel with background and experience necessary to meet these specific problems.

3. On-Campus Backstopping

a. Technical: An average of three work months of technical backstopping per work year of expatriate staff will be provided by the project. Persons in these backstopping roles will be located on-campus and will provide such support as developing and supervising nondegree training programs for Egyptian personnel in the U.S., providing technical information to U.S. expatriate staff in Egypt, and other appropriate services. Once each year, they will visit project operations in Egypt to review support needs and plan for their implementation.

b. Administration: A Campus Coordinator, appointed on not less than a half time basis and with appropriate secretarial support for administrative and technical backstopping operations, will oversee staff recruitment and support, arrange for placement of trainees and arrange for purchase of commodities. Approximately two full time secretaries will be required to support the administrative and technical backstopping functions. The Campus Coordinator will visit project operations in Egypt as necessary to discharge his responsibilities. An average of two trips per year is estimated as necessary for good project coordination between field and campus.

[XV. IMPLEMENTATION PLAN - PERSONNEL (Cont')]

B. GOE Personnel

The central office for this project, the Oilseed Research Unit - ORU will be located at Giza. Administrative support for center and field components will be located in the Directorate office. The Directorate Staff will function as both an administrative and a technical team working toward the goal of establishing a multi-disciplinary research and production system along crop-oriented lines with the capability of responding effectively to reduce and remove existing constraints to production. Project staffing requirements for GOE inputs are shown in Table 33 - 34.

The systems should be administered by capable and committed staff which will have accepted the responsibilities inherent in the project, been given the necessary authority commensurate with the responsibilities, and be assured the necessary policy and operational support.

The Director ORU will be appointed by the Minister of Agriculture. He should be an agriculturist with successful experience in research and/or extension administration. He should be extremely knowledgeable of Egyptian agriculture and the research, education and extension infrastructure that supports it. Experience with or knowledge of, international agricultural development organizations would be helpful.

The Deputy Director should possess essentially the same qualifications as the Director, although the Deputy Director will not likely be as experienced as the Director. He will be in administrative charge of the project in the absence of the Director and will assume specific duties assigned by the Director.

Capsule summaries for technical supervisory and operational personnel follow:

Table 33. Egyptian staffing requirements Giza

Position		Directorate Giza	CRWG Giza	RAG Giza
Professional Staff				
1. Director		1		
2. Deputy Director		1		
3. Prin. Investigator	Soybeans		1	
4. " "	Sunflowers		1	
5. " "	Peanuts		1	
6. " "	Soil & Water		1	
7. " "	Plant Protection		1	
8. " "	& Processing			
	Extension		1	
9. " "	Agricultural		1	
10. " "	Economics			
11. " "	Agricultural Mechanization		1	
12. Sr. Investigator	Soybeans		2	
13. " "	Sunflower		1	
14. " "	Peanuts		1	
15. " "	Soil & Water		4	
16. " "	Plant Protection		3	
17. " "	Seed Production & Processing		1	
18. " "	Seed Technology		1	
19. " "	Extension		1	
20. " "	Agricultural Economics		1	
21. " "	Agricultural Mechanization		1	
22. RAG Specialist	Agricultural Economics			2
	Totals	2	25	2
Support Staff				
1. Expediter		1		
2. Secretary		2		
3. Clerks		1	5	
4. Drivers		2	12	
5. Others		2		
	Totals	8	17	

1. Personnel - Egyptian Giza Staff - Principal Investigators

a. Plant Breeder - Agronomist

1) Administrative: Under the supervision of the Deputy Director, ORU. He/she is responsible for the Senior Investigators for Plant Breeding and Agronomy.

2) Qualifications: Ph.D. in Agronomy or Plant Breeding with at least 10 years experience, preferably in soybean, peanut and/or sunflower production and/or breeding.

3) Responsibility: This individual will be responsible to plan, implement and co-ordinate the oilseed research activities pertaining to plant breeding and agronomic problems. He/she will work closely with the other Principal Investigators and the U.S. expatriate staff to insure timely aggressive research yielding improved adapted varieties and the agronomic practices, including weed control, to maximize economic production of soybeans, peanuts and sunflowers.

b. Soil and Water Management

1) Administrative: Under the supervision of the Deputy Director, ORU. He/she will be responsible for the Senior Investigators for Soil and for Irrigation.

2) Qualifications: Ph.D. in Soil Science or Irrigation Practices with 10 years experience. This individual should have had experience in problems associated with soils and irrigation of reclaimed desert lands.

3) Responsibility: This individual will be responsible for planning, implementing and coordinating research pertaining to soil and irrigation problems associated with oilseed crop production. He/she will work closely with other Principal Investigators and with the U.S. expatriate staff to insure a timely, coordinated and aggressive research program leading to maximum economic production of soybeans, peanuts and sunflowers.

Particular attention will be directed toward problems associated with developing new lands and with drainage and saline soil problems.

c. Plant Protection

1) Administrative: Under the supervision of the Deputy Director, ORU. He/she will be responsible for the Senior Investigators Plant Pathology and Entomology.

2) Qualifications: Ph.D. in Entomology or Plant Pathology, with 10 years experience, preferably with pests or diseases associated with soybean, peanut and/or sunflower production.

3) Responsibility: This individual would be responsible for planning, implementing and coordinating research pertaining to Pathological and Entomological problems associated with soybean, peanut and sunflower production. He/she will work closely with other Principal Investigators and with U.S. expatriate staff to design and implement integrated pest management systems for oilseed production.

d. Seed Production and Processing

1) Administrative: Under the supervision of the Deputy Director, ORU. He/she will be the Senior Investigator - Seed Production, Processing and Seed Technology.

2) Qualifications: Ph.D. in Agronomy or Seed Technology and 10 years experience in Seed Production and Processing. Experience in soybean, peanut and/or sunflower production and in hybrid seed production is desirable.

3) Responsibility: This individual will be responsible for production and processing of soybean, peanut and sunflower seeds so that adequate amounts of high quality registered seed of these crops is available to certified seed growers, on a timely basis, including any new varieties released by plant breeders. He/she will be responsible for the management of seed processing plants, and storage facilities at the

individual research centers, to insure that they are in good working order. This individual will be responsible for planning, implementing and coordinating any research activities pertaining specifically to those problems associated with Seed Production and Processing, including hybrid seed production.

e. Agricultural Economist

1) Administrative: This economist would be administratively responsible to the Deputy Director, ORU.

2) Qualifications: A Masters degree in agricultural Economics would be required. Experience in computer programming and cost analysis evaluation of crop enterprises is desired.

3) Responsibility: The major responsibilities of this position would be to continuously collect, tabulate, analyze all input-output costs of research, and cultural practices for soybeans, sunflower and peanuts. He/she would furnish counsel to Research/Extension as recommendations are formulated to insure highest economic farm yields. He/she would also assist extension subject matter specialists in teaching farmers to keep and use cost analysis records.

2. Personnel - Egyptian Giza Staff - Senior Investigators

a. Plant Breeders (3)

1) Administrative: Under the direction of the Principal Investigator - Plant Breeding, Agronomy.

2) Qualifications: M.S. in Plant Breeding plus 10 years experience.

3) Responsibility: Each individual will be responsible for the development of improved, adapted cultivars for the assigned crops (soybeans, peanuts, or sunflower) and only that one crop. He/she will work closely with agronomist, pathologist and

entomologist, as well as other oilseed research and extension personnel at Giza, and the regional research stations to insure timely release of improved cultivars with adequate pest resistance. These duties will be accomplished with the assistance of Crop Specialist-Plant Breeder at the regional research stations.

b. Agronomist (1)

1) Administrative: Individual will be responsible to the Principal Investigator, Agronomy-Plant Breeding.

2) Qualifications: M.S. in Agronomy with 10 years experience.

3) Responsibility: Will work closely with other oilseed research and extension staff at Giza and at the regional research stations to develop crop management systems to maximize economic oilseed crop production. Major emphasis will be placed on cropping sequences and management systems particularly adapted to developing new lands. These duties will be accomplished with the assistance of the Crop Specialist-Agronomist at the regional research stations.

c. Soil Specialist (1)

1) Administrative: Individual will be responsible to the Principal Investigator-Soil and Water Management.

2) Qualifications: M.S. in Soil Science with 10 years experience.

3) Responsibility: Will work closely with the agronomist, irrigation specialist, and extension personnel at Giza and the regional research stations to develop soil fertility systems for maximum economic oilseed production. Major emphasis will be directed to identifying and solving soil productivity problems associated with oilseed production on new lands. These duties will be accomplished with the assistance of the Soil Specialists at the regional research stations.

d. Irrigation Specialist (1)

1) Administrative: Individual will be responsible to the Principal Investigator-Soil and Water Management.

2) Qualifications: M.S. with 10 years experience in water management practices.

3) Responsibility: Will work closely with agronomist, soil specialist and extension personnel at Giza and at each of the regional research stations to develop efficient, timely water management systems for maximum economic oilseed crop production. Major emphasis will be placed on identifying and solving water management problems associated with oilseed crop production on developing new lands. These duties will be accomplished with the assistance of the Soil Specialists at the regional research stations.

e. Plant Pathologist (1)

1) Administrative: This individual will be responsible to the Principal Investigator-Plant Protection.

2) Qualifications: M.S. in Plant Pathology plus 10 years experience.

3) Responsibility: Will work closely with the other Senior Investigators at Giza, and team leaders at the regional research stations. They will identify disease problems associated with oilseed crops and develop integrated disease management systems for these crops. These activities will be accomplished with the assistance of the Crop Specialists (particularly of plant breeding and plant protection) at the regional research stations.

f. Entomologist (1)

1) Administrative: This individual will be responsible to the Principal Investigator-Plant Protection.

2) Qualifications: M.S. in Entomology with at least 10 years experience, preferably in economic entomology.

3) Responsibility: Will work closely with other Senior Investigators at Giza and team leaders at the regional research stations. They will identify insect problems of oilseed crops and develop integrated insect management systems in these crops. This individual will be required to develop insect management systems in sunflower compatible with pollinator requirements. These activities will be accomplished with the assistance of the Crop Specialists-Plant Protection (particularly of plant breeding and plant protection) at the regional research stations.

g. <u>Seed Production-Processing</u> (1)

1) Administrative: This individual will be responsible to the Principal Investigator-Seed Production and Processing and will work closely with the other Senior Investigators at Giza and the team leaders at the regional research stations.

2) Qualifications: M.S. in Agronomy or Seed Technology with 10 years experience in seed production and processing.

3) Responsibility: With the assistance of the Crop Specialist-Seed Production and Processing he/she will supervise the increase and processing of oilseed crop breeders, foundation and registered seed so as to provide adequate supplies of high quality registered seed to certified seed producers.

h. <u>Seed Technology</u> (1)

1) Administrative: This individual will be responsible to the Principal Investigator-Seed Production, Processing.

2) Qualifications: M.S. degree in Seed Technology preferred, or in Agronomy with 10 years experience.

3) Responsibility: This individual will monitor, by appropriate tests, the quality of breeders', foundation and registered seed to insure that seed produced meets

the standards established for those classes for germination, purity and variety integrity for oilseed crops. He/she will aid the Principal Investigator-Seed Production, Processing and the Seed Department in determining appropriate changes in quality standards for the oilseed seed classes.

i. Agricultural Economist

1) Administrative: This individual will be responsible to the Principal Investigator - Agricultural Economist

2) Qualifications: M.S. degree in Agricultural Economics with 10 years experience.

3) Responsibility: Participate in the continuous collection, tabulation and analysis of input-output cost of production for soybeans, sunflower and peanuts. Formulate recommendations for Research/Extension personnel for combinations of input to obtain highest economic yields. Assist extension subject matter specialists in a program to teach farmers to keep and use cost analysis records.

j. Agricultural Mechanization

1) Administrative: This individual will be responsible to the Principal Investigator-Plant Breeding, Agronomist.

2) Qualifications: M.S. degree in Agricultural Engineering or associated field with 10 years experience, preferably in farm mechanization and repair.

3) Responsibility: He/she will be responsible for the machinery and equipment assigned to the ORU at each of the regional research stations at Giza. He/she will with the assistance of the regional research station farm machinist, be responsible for the repair, replacement and maintenance of this equipment and will insure that it is kept in good working order. This individual will be responsible for planning for and providing for farm machinery necessary to carry out oilseed research and extension duties pertaining to

the oilseeds project. He/she will assist the extension staff in determining farm mechanization requirements for efficient economical oilseed production.

3. Egyptian Staff - Crop Specialists (RAG) at Regional Research Stations

In addition to their specialist duties, one of the specialists will serve as Team Leader and one other as Co-team Leader. These individuals will be administratively responsible to the Deputy Director, ORU. Those not designated as Team Leader or Co-team Leader will have administration responsibilities as outlined below (Table 34).

a. Crop Specialist-Plant Breeding, Agronomy

1) Administrative: These individuals will be responsible to the regional research station Oilseed Team Leader, and under the subject matter supervision of the Senior Investigator-Plant Breeding and/or Agronomist.

2) Qualifications: B.S. in Agronomy or related field. One full time specialist for each of the three crops, soybeans, peanuts, and sunflower.

3) Responsibility: Will plant, manage, and harvest breeding populations, variety yield trials and agronomic study trials as supplied by the Senior Investigators for Plant Breeding and Agronomy. He will assist the Senior Investigators for Plant Breeding, Plant Pathology and Entomology in making selections yielding varieties with desirable agronomic characteristics and resistance to diseases and insects. He/she will further assist the responsible Senior Investigators in keeping necessary notes and records to assure accurate, timely plant breeding and agronomic research.

b. Soils Specialist

1) Administrative: These individuals will be responsible to the Oilseed Team Leader and, under the supervision of the Senior Investigator-Soil and Water Management.

2) Qualifications: B.S. degree in Soil Science. One full time specialist at each regional research station.

3) Responsibility: Conduct those trials planned to develop soil fertility and water management systems for maximum economic production of oilseed crops.

Table 34. Egyptian staffing requirements
RAG

Position	Giza	Sakha	Sids	Sandaweel	Nubaria	Ismailia
Crop Specialist						
1. Soybean		2	2	1	2	1
2. Sunflower		2	1	1	1	1
3. Peanuts		1	1	1	1	2
4. Soil and water		4	4	4	4	4
5. Plant Protection		3	3	3	3	3
6. Seed Production and Processing		1	1	1	1	1
7. Extension		3	3	3	4	4
8. Agricultural Economics	2	-	-	-	-	-
9. Agricultural Mechanization	1	1	1	1	1	1
Totals	2	17	16	15	17	17
Support Staff						
1. Farm Manager[1/]					1	1
2. Clerks		3	3	3	3	3
3. Drivers		6	6	5	5	5
Totals		9	9	8	9	9

[1/] Responsible for for management of land assigned to the oilseeds project. The Station Superintendant may serve as the Farm Manager.

c. Plant Protection Specialist

1) Administrative: These individuals will be responsible to the Oilseed Team Leader and under the supervision of the Senior Investigators-Plant Pathology and Entomology.

2) Qualifications: B.S. degree in Plant Pathology or Entomology. One full time specialist at each regional research station.

3) Responsibility: Will conduct those experiments necessary to develop integrated pest management systems. They will work closely with Crop Specialist-Plant Breeding.

d. Seed Production and Processing

1) Administrative: This individual will be responsible to the Team Leader and, under the supervision of the Seed Production-Processing Specialist.

2) Qualifications: B.S. degree in Agronomy. One full time specialist at each Sakha, Sids, and Ismailia Regional Research Station.

3) Responsibility: Will increase and process seed provided by that specialist so as to produce adequate supplies of registered seed of the highest quality to certified seed producers.

e. Agricultural Economist

1) Administrative: Responsible to the Senior Investigator, Agricultural Economics.

2) Qualifications: B.S. degree in Agricultural Economics. Two full time positions stationed at Giza headquarters but with direct operational responsibilities of RAG teams at the five research stations.

3) Responsibility: Continuously collect and tabulate data on input-output costs of production for soybeans, sunflower and peanuts. Assist in program to teach farmers to keep and use cost analysis records.

f. Agricultural Mechanization-Farm Machinist

1) Administrative: Responsible to the regional research station Team Leader.

2) Qualifications: B.S. degree in farm mechanization or related field. This individual must have those mechanical skills necessary to keep farm machinery in good working order. Experience with machinery associated with agricultural research is preferred.

3) Responsibility: Under the supervision of the Senior Investigator-Agricultural Mechanization, this individual is responsible for the oilseeds project field equipment and machinery assigned to the regional research station where he/she is located. He/she is responsible to insure that this equipment is kept in good working order. Also, that parts inventories are kept so that needed repairs can be performed without undue delays. This individual will also assist the individual researchers or extension specialists in designing and manufacturing specialized machines or equipment needed to meet special research or extension requirements.

4. Egyptian Staff - Extension

a. Principal Extension Leader

1) Administrative: This staff member would be directly responsible to Deputy Director, ORU. He would have direct administrative responsibility over the Extension Team Leaders in each of the five research stations involved in the project and indirectly over the Area Oilseed Extension Agents.

2) Qualifications: This leader should have a minimum of a Masters degree, preferably in Extension Education and/or Administration. He should also have a minimum of ten years experience and have documentable evidence to support his ability to effectively administrate and develop an extension education program.

3) Responsibility: The Principal Extension Leader will administer the total Extension Oilseed Program in concert with the goals and objectives determined cooperatively with the Director/Deputy Director, Oilseeds Team Leader and the Expatriate Extension Leader. He will be expected to provide leadership, to develop a dynamic, enthusiastic, well-trained extension oilseed program. This should be accomplished through the implementation of training programs for

Extension Team Leaders, Extension Subject Matter Specialists, and Area Extension Oilseed Agents to insure their efficiency in planning, conducting and evaluating extension education programs. This person should also provide leadership to develop methods of personnel job evaluations to be used in providing incentive rewards to those doing a good job, suggest additional training where needed and/or a basis for reassignment of personnel not able to accomplish the overall objectives.

b. Deputy Extension Leader

1) Administrative: This individual would be administratively responsible to the Principal Extension Leader. He would be administratively responsible for the Extension Subject Matter Specialists.

2) Qualifications: This person should have a minimum of 10 years experience in Agronomic Crop Production. Preferably, he/she will have knowledge of peanut, soybean and/or sunflower culture.

3) Responsibility: This extension leader would be expected to work closely with the Research Subject Matter Specialists at all research locations to coordinate a rapid, efficient information exchange between the research-extension staffs located at the research stations. He would be responsible to arrange update training meetings between research and extension subject matter specialists for the purpose of exchanging research needs and results. He would also be responsible for recruiting the expertise to publish and disseminate a complete "package of production practices" resulting from research on "Growing Peanuts, Soybeans, and Sunflower in Egypt."

c. Extension Team Leader

1) Administrative: These extension professionals would be located at each of the five research stations and administratively responsible to the Principle Extension Leader. He would have administrative control over the area oilseed extension agents.

2) Qualifications: The extension worker should have a minimum of a B.S. degree and perferably a M.S. He should have administrative experience

and proven ability to conduct an effective extension education program. He should have first hand knowledge of the Village Agents job responsibilities and associated problems. He should be in complete agreement with the overall established objectives and goals of the extension oilseed program.

3) Responsibility: This staff member will be expected to conduct Area and Village Agent training meetings as deemed necessary to accomplish the goals fo the Extension Oilseed Program. Under the leadership of the Principal Extension Leader, he/she will implement on-the-job training and assist with personnel evaluations.

d) Extension Subject Matter Specialists

1) Administrative: This worker is administratively responsible to the Deputy Extension Leader. He will also work cooperatively with the Extension Team Leader at his respective location to assist where needed in the implementation of training for area oilseed Extension Agents.

2) Qualifications: This specialist must have a minimum of a B.S. degree in Agronomy and an M.S. is preferred. He should have experience in planning and initiating on-farm demonstrations and in conducting effective crop production clinics.

3) Responsibility: The Subject Matter Specialist will be responsible to furnish expertise to six area oilseed extension agents on production problems relating to soybeans, peanuts and sunflower. He will also be responsible to conduct on-farm demonstrations to promote the implementation of research findings. He will be expected to coordinate the assistance of research subject matter specialists to conduct Village and Area Oilseed Crop Production Clinics. These clinics should also be coordinated through the Village Agents within each area.

e. Area Oilseed Extension Agent

1) Administrative: This agent is administratively responsible to the Extension Team Leader at the research station where he is working. He should work cooperatively with the Subject Matter Specialist and the Village Agent to insure a smooth, efficient transition of oilseed crop research information to the farmer.

2) Qualifications: This staff member should have a B.S. degree and four to five years of Village Agent experience. There should be documentable evidence to support his ability to conduct an effective extension education program.

3) Responsibility: He/she will be expected to work closely with the Subject Matter Specialists to initiate and conduct on-farm demonstrations to promote the "Package Approach" to oilseed crop production. This agent's activities should be limited in scope to include only oilseed extension education efforts.

C. Training

Training activities for this project will be conducted within Egypt and abroad. Degree and non-degree training will be supported in each category.

1. Degree Training Within Egypt

Postgraduate education in agriculture is well established in Egypt. At present all 12 Egyptian public universities offer graduate work leading to the M.S. and Ph.D. degrees in one of the specialized fields of agriculture. The project intends to take advantage of this rich resource to provide selected Egyptian junior scientists with appropriate level degree training opportunity. Such persons may be directly associated with the project during the thesis research phase of this program by being assigned to project research activities. Although the exact level of degree training has not been determined it is anticipated that up to 15 postgraduate students may be supported for 350 months of degree training.

2. In-service Training Within Egypt

Short term and intensive in-service training will be provided for an array of GOE agricultural staff. Focus of the training will be on extension personnel although junior research staff will have opportunity for workshop, seminar and institute experience. Training will be provided at sites appropriate to the training needed. The Oilseeds and Agronomy Extension Specialists and ORU counterparts will have primary responsibility for designing and conducting this training. Training during the first two years will focus on extension subject matter specialists and area oilseed extension agents. Training in subsequent years will be based on a needs analysis and assessment of the effectiveness of training provided during the first two years. This training will be offered in English and in Arabic to accommodate those who are not operational in the English language. Approximately 150 trainees will receive 750 study months of in-service training.

3. Non-degree Training Outside Egypt

Project related Egyptian personnel whose needs cannot be adequately met by in-country training may be sent abroad, primarily to the U.S., for non-degree training. Current estimates of the number and type of participants to be trained and the duration of the training follows:

a. Approximately 70 junior research and extension staff members will receive up to four months training during the middle three years of the project. Some of these may be enrolled in the excellent annual short courses offered by U.S. universities in co-operation with USDA's International Training Office. Others will benefit from programs specially designed to their needs.

b. Approximately 25 persons in other fields may be sent abroad for training periods averaging three months each. Most of these will be senior research and administrative staff who require broad exposure to research administration and program planning and management.

4. Advanced Degree Training in the U.S.

Although Egypt has a number of well-trained individuals with advanced degrees, there remain subject matter areas where this type of training is needed and appropriate. Training requirements will be carefully studied before degree training in the U.S. is recommended. Staff in all subject matter areas will be considered for degree training, however, major emphasis will be placed on plant breeding, plant protection and farm management. Approximately five individuals will receive 180 study months of participant training in the U.S.

D. Commodity Procurement

Equipment, materials and supplies, to be provided under this project are organized in six major categories and are shown in detail in the following tables.

Table	Category
35	Machinery and Equipment for Regional Research Stations
36	Laboratory Equipment for Central Office and Regional Research Stations
37	Vehicles for Expatriate Team, Central Office and Regional Research Stations
38	Building Requirements for Oilseeds Research Units
39	Office Equipment and Supplies
40	Household Equipment/Furnishings for Long Term Expatriate Staff

Table 35. Machinery and equipment for regional research stations (Sakha, Nubaria, Ismailia, Sids, Shandaweel)

Item		Unit Costs $	Subtotal $	Spare Parts $	Total Cost $	Location
90 d.b.h.p. Tractor	(1)	25,000	25,000	4,000	29,000	Sa or Si
60 d.b.h.p. Tractors	(4)	18,000	72,000	14,000	86,400	Sa or Si, Nu, Is, Sh
35 d.b.h.p. Tractors	(5)	14,000	70,000	14,000	84,000	Sa, Si, Nu, Is, Sh
Land plane (40')	(1)	3,000	3,000	600	3,600	Sa or Si
Moldboard Plows	(5)	4,500	22,500	500	23,000	Sa, Si, Nu, Is, Sh
Disk (Tandem)	(5)	3,000	15,000	500	15,500	Sa, Si, Nu, Is, Sh
Field Cultivators	(5)	2,450	12,250	500	12,750	Sa, Si, Nu, Is, Sh
Ripper-Hipper (Bed Shaper)	(5)	3,000	15,000	300	12,300	Sa, Si, Nu, Sh
Planter (4 Row) with granulator applicator	(5)	6,000	30,000	500	30,500	Sa, Si, Nu, Is, Sh
Cone Planter (att)	(5)	500	2,500	100	2,600	Sa, Si, Nu, Is, Sh
Cultivator (4 Row)	(5)	2,200	11,000	500	11,500	Sa, Si, Nu, Is, Sh
Fertilizer Spreader (Broadcast 10')	(5)	1,400	7,000	100	7,100	Sa, Si, Nu, Is, Sh
Sprayer (21' boom)	(5)	1,000	5,000	200	5,200	Sa, Si, Nu, Is, Sh
Digger Shaker	(2)	2,000	4,000	200	4,200	Is, Nu
Peanut Thresher	(2)	2,000	4,000	200	4,200	Is, Nu
Plot Thresher	(5)	4,500	22,500	200	22,700	Is, Nu, Sa, Si, Sh
Wagons - 4 Wheel	(5)	3,000	15,000	200	15,200	Is, Nu, Sa, Si, Sh
Lilliston Cultivator (4 Row)	(2)	3,800	7,600	200	7,800	Is, Nu
Irrigation Pipe with Risers & Sprinkler Heads (3000', 4")		5.00/ft	15,000	-	15,000	Is
Shop Equipment	(2)	46,500	93,000	-	93,000	Complete Is, Nu, Sh Partial Sa, Si
Trailer (1-5th Wheel)		8,000	8,000	-	8,000	Si or Sa
Seed Processing	(4)	250,000	1,000,000	200,000	1,200,000	Si, Sa, Is, Nu
Total			$ 1,456,350	$ 235,200	$ 1,691,550	

Table 36. Laboratory equipment for central office and regional research stations

Item	Number	Unit Cost	Total Cost	Location
Plant Protection labs	5	$ 33,000	$165,050	Sa, Si, Sh, Nu, Is
Soils Labs	3	25,000	75,000	Sa, Nu, Is
Plant Breeders Labs	5	33,800	169,000	Sa, Si, Sh, Nu, Is
Soil Microbiology Lab	1	223,400	223,400	Sa
Subtotal			$632,450	
Central Laboratories				
Plant Breeder	1	33,800	$ 33,800	G
Plant Pathology	1	132,000	132,000	G
Entomology	1	15,010	15,010	G
Soil Microbiology	1	223,400	223,400	G
Soil and Water	1	76,700	76,700	G
Seeds	1	75,000	75,000	G
Subtotal			$555,910	
Total			$1,188,360	

Locations: G = Giza, Sa = Sakha, Si = Sids, Sh = Shandaweel, Nu = Nubaria, Is = Ismailia

Table 37. Vehicles for expatriate team, central office and regional research stations

Location and Project	Sedans	Double cabin ½ ton Pick-up	3/4 ton pick-up w/ 5th wheel hitch	12 Passenger van	Motor cycles
Cairo					
Expatriate Team	7	2			
Egyptian Team					
Administration	2			2	
Research	4	3			
Extension	2			1	
Regional Research Stations					
Sakha					
Administration	1				
Research		3			
Extension		1	1		6
Ismailia					
Administration	1				
Research		3			
Extension		1			6
Nubaria					
Administration	1				
Research		3			
Extension		1			6
Sids					
Administration	1				
Research		3			
Extension		1	1		6
Shandaweel					
Administration	1				
Research		3			
Extension		1			6
Totals	20	25	2	3	30

Table 38. Building requirements for oilseeds at research units

Location	Number Required	Avg. unit Size	Est. sq.ft. Required	Est. cost sq.ft.	Est. cost
Giza-Directorate and CRWG					
Staff offices	28	150	4,200	$ 40	$ 168,000
Secretarial offices	11	100	1,100	"	44,000
Laboratories	3	600	1,800	"	72,000
Storerooms	6	200	1,200	"	48,000
Growth rooms	1	240	240	"	9,600
Conference rooms	2	500	1,000	"	40,000
Reading/Library	1	1,000	1,000	"	40,000
Lounge	1	500	500	"	20,000
Greenhouse	1	2,700	2,700	10	27,000
Sub Total					$ 468,600
Sakh,Sids,Ismailia,Nubaria					
Staff offices	62	150	9,300	$ 40	$ 372,000
Secretarial offices	12	100	1,200	"	48,000
Laboratories	12	600	7,200	"	288,000
Reading/Library	4	500	2,000	"	80,000
Conference rooms	4	500	2,000	"	80,000
Storerooms	24	200	4,800	"	192,000
Feed storage	4	1,000	4,000	"	160,000
Equipment storage	4	12,000	48,000	20	960,000
Shops	4	1,000	4,000	20	80,000
Greenhouses	4	1,800	7,200	10	72,000
Seed plants	4	30,000	120,000	10	1,200,000
Apartments for staff	30 @ $ 17,500				525,000
Sub total					$ 4,057,066
Shandaweel					
Staff offices	15	150	2,250	$ 40	$ 90,000
Secretarial offices	3	100	300	"	12,000
Laboratories	3	600	1,800	"	72,000
Reading/Library	1	500	500	"	20,000
Conference room	1	500	500	"	20,000
Storerooms	6	200	1,200	"	48,000
Seed Storage	1	1,000	1,000	"	40,000
Equipment storage	1	12,000	12,000	20	240,000
Shops	1	1,000	1,000	20	20,000
Greenhouse	1	1,800	1,800	10	18,000
Apartments for staff	5 @ $ 17,500				87,500
Sub total					$ 667,500
Total					$ 5,193,100

Table 39. Office equipment and supplies

Item	Number	Unit Price	Total Cost
Hand calculators	50	40	$ 2,000
Desk calculators	10	400	4,000
Ditto/mimeo machines	2	400	800
Typewriters			
Arabic	20	1,200	24,000
English	5	1,000	5,000
Photocopy machines - table top Xerox	2	7,500	15,000
Office furniture 150 sets	150 sets	1,000	150,000
Supplies @ $ 10,000/ location	6	60,000	360,000
Training aids @ $ 5,000/location	6	30,000	180,000
Air conditioners	150	750	112,500
Legume inoculant for 1st three years			30,000

FOB-USA	10%	$ 883,300
Freight	50%	441,650
Breakage and Loss	10%	88,300

Total Est. Cost $ 1,413,250

Table 40. Household equipment/furnishings for long term expatriate staff

Item	Number	Unit Price	Total Cost
Air conditioners/ heaters	35	700	$ 24,500
Refrigerators	7	650	4,550
Freezers	7	550	3,850
Washers/Dryers	7	750	5,250
Gas Ranges	7	275	1,925
Water Heaters	35	250	8,750
Three bedroom furniture units	7	15,000	105,000
			$ 153,825

FOB-USA	153,825
Freight 50%	76,900
Breakage 10% and loss	15,380
Total Est. Cost	$ 246,105

XVI. PROJECT COMMENCEMENT ACTIVITIES

A. Responsibilities of the Director, ORU

The Director should be appointed shortly after the Program Agreement for the project is signed by representatives of USAID and GOE and before such time as a technical assistance contract is negotiated. His participation in the negotiation process is important to the successful implementation of project activities. Once a contractor has been selected, and an agreement signed, the Director should initiate the following actions: (1) acquire land for the project at the sub-stations; (2) arrange for office space for the Egyptian and expatriate professional and support staffs and for the Directorate staff; and, (3) assist the contractor in making arrangements in preparation for the arrival of the expatriate team.

B. Responsibilities of the Technical Assistance Contractor

Soon after the technical assistance contract is signed and shortly before the first expatriate staff depart, the Campus Coordinator should arrive in Egypt to make certain necessary arrangements among which would include the following: (1) arrange the temporary housing for the first group of expatriate staff; (2) arrange for Administrative Assistant/Expediter and other support staff for the team; (3) arrange transportation and drivers for the team; (4) arrange procedures for receipt, transfer, and/or temporary storage of project commodities and team effects; (5) initiate preparation of commodity lists; (6) initiate the planning process for buildings and facilities; and, (7) assist in the orientation of the first group of expatriate team as they arrive in Egypt.

XVII. ACTIONS REQUIRED OF GOE TO ASSURE PROJECT SUCCESS

There are existing and potential constraints which require response and commitment by GOE to assure success of the Oilseeds Research and Production Project. Among these activities are to:

1. Significantly increase Egyptian staff salaries using the pay scale employed on other USAID financial projects such as the Major Cereals Project, as a guide. The success of this project is dependent upon the involvement and commitment of highly qualified and dedicated Egyptian scientists. Research and extension personnel in the Ministry of Agriculture view their salaries as inadequate. Many acquire a second job in order to receive what they perceive to be an adequate income to sustain them and their families. The design team seriously questions whether adequate number of staff with requisite qualifications and sufficient time to devote to this project can be obtained if they do not receive considerably higher compensation.

2. Extend the working hours to a more realistic 40-44 hours per week. Given the design of the project, its expected goals and the major investments to be made by GOE and U.S. in personnel and material, it becomes essential that the staff have adequate time and resources for operational effectiveness. The normal work day of the Ministry of Agriculture, 8:00 AM to 2:00 PM does not afford the work hours to conduct the work of the project. The design team therefore recommends the following minimum work schedule for Egyptian and expatriate staff and support personnel for this project.

   8:00 AM to 5:00 PM Saturday - Wednesday

   8:00 AM to 12:00 Noon Thursday

3. Adequate land should be allocated for, and placed under exclusive control of this project. Estimated land requirements at the five Regional Research Stations and Giza Headquarters is 753 feddans distributed in the following manner:

Location	Feddans Required
Sakha	150
Sids	150
Shandaweel	150
Nubaria	150
Ismailia	150
Giza	3

4. GOE will have the following responsibilities regarding items imported from the U.S. and other countries for this project:

   (a) exempt all commodities from import duties or, alternatively, be responsible for their payment.

   (b) insure and license all project vehicles

   (c) provide phytosanitary certificates for the unrestricted movement of seeds in Egypt

   (d) provide to expatriate staff all privileges and immunities normally extended to international organizations

   (e) assure that all commodities and vehicles purchased for this project will remain under the control of the Director, ORU and the Contract Team Leader, and will be used exclusively for activities directly pertaining to the project

   (f) assure that professional staff of the project may make decisions regarding the use of information for extension purposes prior to the formal publication of research results.

XVIII. FINANCIAL ANALYSIS AND PLAN

Table provides a summary of the financial support needed for the implementation of the Oilseed Research and Production Program. Supporting tables for the major line item categories provide detailed information on the calculation of estimated costs.

All costs are expressed in U.S. dollars. Egyptian professional and support staff salaries have been converted from LE to dollars at an exchange rate of L.E. .79 = $1.00, as supplied by USAID/Agriculture. Costs are expressed at current rates over the five year span of the project. The Project Paper financial analysis section should apply an appropriate compound inflation factor to all categories of the budget. The inflation factor should be applied over the life of the project for Personnel, Training, and Other Direct Costs. For Buildings and Installations and Commodities, where activity will be concentrated in the first three years, the inflation factor could be less.

Table 41. Summary of project cost estimates

Category	$	LE (in $)
A. Personnel		
U.S.		
Expatriate Staff	$ 4,243,400	
Campus Backstopping	1,259,230	
Egyptian		
Professional Staff-GOE		2,779,745
Support Staff - GOE		1,832,910
Support Staff-TA contract	152,400	
B. Training	1,352,500	
C. Buildings & Installations	5,223,100	
D. Commodities		
Machinery & Equipment	2,706,380	
Laboratories	1,901,375	
Vehicles	724,000	
E. Other Direct Costs		
In Egypt	2,126,355	1,500,000
In U.S.	148,000	
Sub Total	$ 19,836,740	$ 6,112,655
U.S. Contribution		
Sub Total	19,836,740	
Contingencies-10%	1,983,675	
Total	21,820,415	
Egyptian Contribution	6,112,655	
Total		
Total for Project	$ 27,933,070	

Table 42. Cost estimates for technical assistance resident staff and campus support group

In Egypt				
1. Expatriate resident staff 26.0 years		@105,350/year		$ 2,739,100
2. TDY staff	60 one month TDY's	@ 8,900		534,000
	13 two month TDY's	@ 16,300		211,900
	32 three month TDY's	@ 23,700		758,400
		Subtotal		$ 4,243,400
In U.S.				
1. Campus technical support				$ 878,630
a) Year 1	7.5 units	@ $21,430	$160,725	
b) Year 2	9.5 "	@ $21,430	203,585	
c) Year 3	9.0 "	@ $21,430	192,870	
d) Year 4	7.75 "	@ $21,430	166,085	
e) Year 5	7.25 "	@ $21,430	155,365	
2. Country administrative support	5 years	@ $76,120		380,600
		Subtotal		$ 1,259,230
		Total		$ 5,502,630

Table 43. Illustrative costs for resident U.S. staff[1/]

Category		Amount
1.	Base Salary	$ 40,000
2.	Fringe Benefits @ 23%	9,200
3.	Indirect Costs @ 30%	12,000
4.	Post Differential @ 10%	4,000
5.	Shipment of Effects	6,500
6.	Shipment of Auto	2,500
7.	Housing Allowance and Settling In	18,500
8.	Education Allowance 2 @ 3,750	7,500
9.	Storage	600
10.	International Travel for 4 Persons	3,000
11.	Marine Insurance	1,500
		$ 105,350

1/ Assuming 2 year tour of duty and family with 2 school-aged children

Table 44. Illustrative costs for TDY staff (Assignments of one, two, and three months duration)

Category	Amount 1 month	2 month	3 month
Salary @ $3,300/mo	$ 3,300	6,600	9,900
Fringe benefits @ 23%	760	1,520	2,280
Indirect costs @ 30%	990	1,980	2,970
International Travel	1,500	1,500	1,500
Per diem @ $70/day	2,100	4,200	6,300
Miscellaneous expenses	250	500	750
	$ 8,900	16,300	23,700

Table 45. Illustrative cost for U.S.-based technical support staff[1/]

Category	
Base Salary 25% of $36,000	9,000
Fringe Benefits @ 17%	1,530
Indirect Costs @ 70%	6,300
Materials and Supplies	1,000
International Travel	1,500
Per diem - 30 days @ $70/day	2,100
	21,430

1/ Assumed 25% staff appointment for each year of expatriate service

Table 46. Illustrative cost for U.S. based administrative support staff[1/]

Category			Amount
1.	Base Salaries		$ 36,000
	a. Coordinator 50% of $36,000	$ 18,000	
	b. Secretaries 2 @ $9,000	$ 18,000	
2.	Fringe Benefits @ 17%		6,120
3.	Indirect Costs @ 70%		25,200
4.	International Travel 2 trips / year		3,000
5.	Per diem in Egypt 60 days @ &70/day		4,200
6.	U.S. Travel		1,000
7.	Per diem in U.S. 10 days @ $60/day		600
			$ 76,120

1/ Assume 50% staff appointment for Campus Coordinator and two full time secretaries

Table 47. Estimated costs for GOE professional staff

Number Required	Title	Annual Salary LE	5 year Total
Directorate Office-Giza			
1	Director	6,000	30,000
1	Deputy Director	5,400	27,000
CRWG - Giza			
	Principal Investigator		
1	Soybeans	5,400	27,000
1	" " Sunflowers	5,400	27,000
1	" " Peanuts	5,400	27,000
1	" " Soil & Water	5,400	27,000
1	" " Plant Protection	5,400	27,000
1	" " Seed Prod.& Proc.	5,400	27,000
1	" " Seed Technology	5,400	27,000
1	" " Extension	5,400	27 000
1	" " Agricultural Economics	5,400	2[illegible]00
1	" " Agricultural Mechanization	5,400	27,000
	Senior Investigator		
2	Soybeans	9,600	48,000
1	" " Sunflower	4,800	24,000
1	" " Peanuts	4,800	24,000
4	" " Soil & Water	19,200	96,000
3	" " Plant Protection	14,400	72,000
1	" " Seed Prod.& Proc.	4,800	24,000
1	" " Seed Technology	4,800	24,000
1	" " Extension	4,800	24,000
1	" " Agricultural Economics	4,800	24,000
1	" " Agricultural Mechanization	4,800	24,000
RAG at 5 Regional Research Stations			
	Crop Specialist		
8	Soybeans	18,000	144,000
6	" " Sunflower	18,000	108,000
6	" " Peanuts	18,000	108,000
20	" " Soil & Water Mgt.	72,000	360,000
15	" " Plant Protection	54,000	270,000
5	" " Seed Prod.& Proc.	18,000	90,000
17	" " Extension	61,200	306,000
2	" " Agricultural	7,200	36,000
	Economics (Giza)		90,000
5	" " Agricultural Mechanization	1,800	90,000
	Total LE		LE 2,196,000
	$ Equivalent @ 0.79		$ 2,779,745

Table 48. Estimated costs for GOE support staff

Number Required	Position	Annual Salary LE	5 year Total
Directorate Office-Giza			
1	Expediter	3,000	15,000
2	Secretaries	4,800	24,000
1	Clerk	2,000	10,000
2	Messengers	1,200	6,000
2	Drivers	3,600	18,000
CWRG - Giza			
5	Clerks	24,000	50,000
10	Laborers	12,000	30,000
12	Drivers	21,600	108,000
RAG at 5 Regional Research Stations			
10	Mechanics	24,000	120,000
10	Mechanics Helpers	12,000	60,000
6	Tractor Drivers	10,800	54,000
50	Technicians	60,000	300,000
10	Seed Processing Tech.	12,000	60,000
50	Laborers	30,000	150,000
27	Drivers	48,600	243,000
15	Clerks	30,000	150,000
5	Cooks	9,000	45,000
1	Farm Manager	5,000	25,000
	Total LE		1,448,000
	$ Equivalent		$ 1,832,910

Table 49. Estimated costs for expatriate team support staff

Position	
Expediter 5 yrs @ LE 3,000	15,000
Administrative Assistant 5 yrs @ LE 3,600	18,000
Secretaries - bilingual (2) 5 yrs each @ LE 2,400	24,000
Drivers (7) 5 yrs each @ LE 1,800	63,000
Total LE	120,000
$ Equivalent	$ 152,400

Table 50. Estimated costs of laboratory equipment

Laboratory Type and Location[1/]		Cost
Plant Breeders Lab	G	$ 33,800
Plant Pathology Lab	G	132,000
Entomology Lab	G	15,010
Soil Microbiology Lab	G	223,400
Soils Lab	G	76,700
Seeds Lab (including oil determinations)	G	75,000
Sub total for central labs		555,910
Plant Protection Labs	Sa,Si,Sh,Nu,IS	165,050
Soils Labs	Sa,Nu,Is	75,000
Plant Breeders Labs	Sa,Si,Sh,Nu,Is	169,000
Soil Microbiology Lab	Sa	223,400
Sub total for regional labs		632,450
FOB-US		1,188,360
Freight 15%		594,180
Breakage and Loss 10%		118,835
	Total	$ 1,901,375

1/ Locations: G=Giza; Sa=Sakha; Si=Sids; Sh=Shandawell; N=Nubaria; Is= Ismailia

Table 51. Estimated costs for participant training

	Number Training	Study Mos. of training	Cost/ month	Total Cost
In Country Training	165	1,100	650	$ 715,000
Overseas Training				
Degree in U.S. - Ph.D.	5	180	1,250	225,000
Non Degree				
Senior Staff	25	50	1,250	62,000
Junior Staff	70	280	1,250	250,000
		Sub Total		637,500
		Total		$ 1,352,500

Table 52. Estimated costs of buildings and installations

Location	Estimated Cost
Giza	$ 468,600
Sakha	1,014,250
Sids	1,014,250
Shandaweel	667,500
Nubaria	1,014,250
Ismailia	1,014,250
Total	$ 5,193,100

Table 53. Estimated costs of machinery and equipment for Regional Research Stations

Purchases	
Equipment and Machinery	$ 1,456,350
Spare Parts	235,200
Sub Total	1,691,550
Shipping Costs	
Freight (50%)	$ 845,675
Damage and Loss (10%)	169,155
Total	$ 2,705,380

Table 54. Estimated costs of vehicles

Type of Vehicles	Number Required	Unit Cost	Total
Sedan	20	6,000	$ 120,000
Vans - 12 Passenger	3	11,000	33,000
Half ton Pick-up Double cabin	25	9,000	225,000
3/4 ton Pick-up w/ 5th wheel hitch	2	11,000	22,000
Motorcycles	30	1,000	30,000
Total Vehicle Cost FOB-USA			430,000
Freight	50%		215,000
Spare parts	20%		86,000
Damages	10%		43,000
Total			$ 724,000

Table 55. Estimate of other project costs

Category	Per yr	5 yr Cost
In Egypt		
Office equipment and supplies		$ 1,413,250
House furnishings for expatriate staff		246,105
Per diem for expatriate professional staff and support group		357,000
Special contractual research		50,000
Petrol for project vehicles - $ 5,000/mo		60,000
Per diem for Egyptian professional staff[1/]		750,000
Experimental stations land (in kind 750 feddans)		750,000
		$ 3,625,355
In United States		
Telecommunications	$ 10,000	50,000
Office supplies	6,000	30,000
Office equipment	3,000	18,000
Reports, publications, etc.	5,000	25,000
Miscellaneous	5,000	25,000
		$ 148,000

[1/] Part of GOE contribution

XIX. PROJECT ANALYSIS

Increases in productivity of selected oilseed crops - soybeans, sunflower and peanuts - described in Section will have beneficial effects on the economy of Egypt by improving its balance of trade through a lessened dependence on oilseeds production of other countries. Increased oilseed crop production will create increased indigenous economic activity creating more employment, increasing payments to wage earners, and creating increased demand for other goods and services.

Since it is assumed that increases in oilseed crop productivity can be achieved without proportionate increases in the cost of production, i.e., improved yield and seed quality characteristics, adoption of improved yield and seed quality characteristics, adoption of improved management practices, the net income of farmers will be increased resulting in additional economic activity in the rural area of Egypt. The rural communities of Egypt are in serious need of increased economic activity to provide the financial base to upgrade community services and individual living conditions.

A. Economic Analysis

The success of the project also will depend to a great extent on activities outside the scope of the project itself. Some constraints have been noted earlier which will not be actively pursued, e.g., soil salinity and waterlogging which are definite constraints to increased production of oilseed crops. Some of these problem areas are being addressed by other development projects and are not included here to avoid undesirable duplication of efforts.

The purposes of this project include the expansion of research to develop the production possibilities of selected oilseed crops, the encouragement of the adoption of more profitable practices and cropping patterns, and the improvement of processing and extraction of oilseeds. This implies a substantial investment in research equipment and in human capital through education and training. This analysis examines the cost/benefit ratio of the project.

Increased research development of expanded production possibilities in oilseed production is important to food security policies of the Egyptian government and to the economic development of Egyptian agriculture. The key to increased production lies with the development and dissemination of information that will enable individual farmers to make and execute production decisions that increase incomes and food production. This requires development of new technology in the form of new seed varieties and new cultural production practices. In addition, it requires training agricultural advisors, and in turn, farmers and laborers about the technology. These benefits in latter areas go beyond the oilseed crops alone. Thus, the cost/benefit analysis of this project should consider some of the benefits beyond the direct effect on costs for and production of oilseed agricultural products.

An approach to estimating the balance between costs and likely returns can take two forms. One is a cost/benefit ratio. Another is to project the outflow of costs and inflow of benefits and calculate an internal rate of return. In Table 56 below, a summary of the flow of costs and benefits are shown. The direct benefits of oilseed production research and extension will arise from five sources. First, production and utilization of appropriate strains of Rhizobium inoculation will reduce the amount of N fertilizer used on soybeans and peanuts and allow 15 percent of currently used fertilizers to be diverted for use on nonlegume crops. Specifically, reduce recommended 60 kg of N per feddan to 0 - 6 kg on soybeans and recommended 15 kg on peanuts to 0 - 6 kg. (The lower rate for heavy soils, the higher for sandy soil.) The value of N is priced at 20 pt. per kg. Second, improved varieties and cultural practices for old lands crop area will increase the production on existing lands devoted to oilseeds (soybeans and peanuts) 45 percent. Third, the development of improved late season varieties and cultural practices particularly for soybeans will permit the economic increase of 50,000 feddans of soybeans in the place of summer crop maize in the rotation. It is estimated that this substitution will increase income 25 L.E. per feddan. In addition these developments will result in a 25,000 feddan increase in winter crop wheat and a reduction of 25,000 in berseem. This substitution of crops is estimated to add another 25 L.E. per feddan to grower returns. Fourth, the development and adoption of varieties of oilseeds and production practices will allow the economic production of oilseeds and production of oilseeds on 50,000 feddans of old new lands and on 118,000 feddans of newly reclaimed desert lands. In early years the net

Table 56 Flow of costs and benefits for oilseed project

	Year 1	Year 2	Year 3	Year 4	Year 5	Total 1 - 5	Total 6 - 10	Total 11 - 20
				(000)				
Annual Costs of Project (GOE & USAID)	$ 3000	$ 7500	$ 7,500	$ 6,000	$ 4,000	$28,000	-	-
Benefits of Project								
1. Reduced fertilizer cost with improved nodulation								
soybeans	-		630	945	1,260	3,150	7,875	15,750
peanuts	-	17	34	51	68	170	425	950
2. Increasing yields on existing acreages								
soybeans	1230	2570	5,140	7,710	10,280	26,930	64,300	128,600
peanuts	290	630	1,260	1,890	2,520	6,590	15,750	31,500
3. Improved late season varieties & cultural practices								
soybean for corn	-	-	900	1,350	1,800	4,050	9,000	21,000
wheat for berseem	-	-	-	150	300	450	4,000	10,000
4. Improved technology on new lands	-	100	250	400	600	1,350	5,000	40,000
5. Improvement in oil extraction	2200	2200	2,200	2,200	2,200	11,000	-	-
Total Benefits	$ 3520	$ 5832	$ 10,414	$14,696	$19,028	$53,690	$105,925	$247,800

additions to farm production income from oilseeds will be marginal. We have allowed a 10 L.E. in early years and increasing to 25 L.E. in later years. Lastly, the improvement of management practices in extraction and processing plants will increase the amount of oil produced from existing supplies and facilities. This improvement will accrue only through the early years until improved new plant facilities are in place. The aggregate effects of these improvements and adjustments will result in more than a 100 percent increase in the annual oilseed production by 1985 and nearly 200 percent by 1990. The aggregate of the benefits for the first 10 years will total $ 159,615,000. If the cost of the project is 28 million then this gives a 5.7 to 1 gross benefit ratio during the first 10 years. It is expected that impacts of the project would generate an additional $ 247,800,000 in the following 10 years.

B. Social Analysis

The social impact of the project can be considered as a direct result of the economic impact. An improved trade balance will result in improved social conditions as financial resources are freed from purchases of oilseed products to be used for improved living conditions.

Social impacts will also be significant at the village level as farmers' incomes increase. The marginal propensity to consume is extremely high in rural Egypt and very high proportions of additional income are used to purchase consumer goods and services. In conjunction with the multiplier effect this high rate of consumption of additional increases in incomes will have significant and beneficial effects on the economic life in rural communities.

C. Technical Feasibility

Egypt has a large number of well-trained and educated crop scientists. They also have the capability to educate crop scientists. The presence of this cadre of excellent plant breeders, pathologists, entomologists and other crop specialists insures the feasibility of this project. The constraints of insufficient operating funds, equipment and organization have been dealt with in this proposal. Also, the lack of coordination between disciplines and between research and extension will be met with the implementation of this commodity-oriented project. A supporting structure of U.S. crop and extension scientists will further strengthen the project and insure its feasibility.

The Government of Egypt has pledged itself to increasing its production of edible oils and to reclaiming additional feddans to provide the area for such production. The project's approach will be well-suited to meet those goals.

XX. SUGGESTED OILSEED CROP EMPHASIS AND PRODUCTION AREAS

The Oilseeds Team has found that there are several major kinds of farming systems in Egypt which affect the extent and location of oilseed crop production. These systems include the proportion of old and new lands available for oilseed crops; the adjustments possible in the area planted to cotton, rice, maize, sorghum, wheat, clover, and vegetables; the degree of mechanization and labor intensity on farms; and whether the oilseed crop can be grown during the winter or summer season. Each set of effects impinges in a different way on realistic alternatives.

The Oilseeds Team makes the following general recommendations concerning expanded production of oilseeds in Egypt. Primary emphasis should be placed on expanded production of soybeans, peanuts, and sunflower as summer oilseed crops. Secondary emphasis should be given to safflower, sesame, rape or mustard, flax, and castor.

A. Soybeans

The area of soybeans on both old and new lands should continue to be increased. Projected increases are for an additional 50,000 feddans each for old and old-new lands by 1985. Soybeans, as a summer crop, will displace some cotton, but will primarily compete with maize and sorghum. With the development of short seasoned, cotton leaf worm resistant varieties, soybean will become even more competitive with summer cereal production. Production on old lands will probably continue to be labor-intensive; however a shift toward mechanization will probably occur on new lands.

B. Peanuts

Development of new lands with sandy soils are particularly suited for peanut production. Thus a relatively large increase of nearly 200,000 feddans of peanut production is projected by 1985. The majority of this expansion will probably occur in the Eastern Border region, but considerable expansion is also projected in the Western

Border region. Peanuts will not generally compete with other oilseed production in these areas because of its adaptation to sandy soils, but may compete with cereal production, primarily corn. Peanut production lends itself well to mechanization, particularly for such operations as bed preparation, weed control, and harvest; however production will probably remain labor-intensive on small farms.

C. Sunflower

Sunflower, as well as soybean and peanuts, is a summer crop, with present production concentrated in Upper and Lower Egypt. Extensive expansion will be limited until development of improved adapted varieties has occurred; however a projected increase of 18,000 feddans on new lands is planned. Sunflower is probably best adapted to the calcareous soils of new reclaimed lands, but research is needed to determine the most favorable areas of adaptation. Development of adapted, short season varieties may allow three crops to be grown, and this will contribute to a significant increase in total per feddan production.

XXI. EVALUATION PROCEDURES

One of the primary objectives of this project is to improve social and economic conditions of the Egyptian small farmer. In order to reach this main objective, the project has designed a multi-disciplinary research, extension, and training program. This program will focus on removing and/or alleviating constraints to oilseed production in Egypt. As constraints are removed or reduced, yields, production, and income should increase in proportion to production inputs, resulting in a greater net income to the farmer.

Other outputs of this project are to establish a cadre of qualified oilseeds research and extension specialists which will conduct on-farm trials and demonstrations in five major oilseed growing regions.

To insure progress toward these objectives, program reviews will be made by the office of the Director, ORU, from reports prepared by program leaders every six months. It is also recommended that a disinterested team of at least three expatriates should conduct a project review during the third and fifth year of this project.

Perhaps the best evaluation would be the measurement of crop yields in the extension pilot program areas. Yields in these areas should be carefully and systematically monitored each year and compared with previous years' yields. Similar procedures should be used to evaluate other districts and governorates to determine the effectiveness of the regional programs.

Importation of crude vegetable oil and oilseeds for crushing should be monitored. If yields and production are increased, imports of oil and oilseeds should be reduced. Less imports should have a positive effect on the balance of payments in the Egyptian economy.

On-farm and research tests and extension demonstrations results should be a guide to the yield potential of new cultivators and cultural practices. If the yield spread between farmers' yields and research results is small, it would indicate that information transfer, improved cultivars and cultural practices are being readily accepted. (It is also an indication that more research effort is needed.)

The number of improved cultivars released and the rapidity with which they are accepted would also be a measure of the effectiveness of this program.

Quality of commercial seed should be monitored each year and compared to registered seed produced by the research station. Seed purchased by farmers should be sampled and checked for purity, germination, and yield potential.

The quantity of training of personnel could be measured by the number of study-months of training received per period. The quality measurement of training is more difficult to evaluate. However, an assessment of job performance should be made before and after an individual receives training to determine the effectiveness and appropriateness of his training program.

A sociological survey or study of farmers in the extension pilot program areas should be made. This study should be designed to determine if there are any changes in the farmers' attitudes toward the service they receive from the government, in the area of extension, research, and seeds.

APPENDIX

Appendix A: Maximum, minimum, and daily mean temperatures (C°) relative humidity (%), rainfall (mm), Piche evaporation (mm), wind speed (knots), and solar radiation (g cal/cm/day mean total) at selected locations in the Nile Valley in Egypt.

Item	January average	July average	Annual Average
Zone 4, Mediterranean Coast, Alexandria, Lat. 31°12"N, Long. 29°57"E			
Max. temp.	18.3	29.6	24.9
Min. temp.	9.3	22.7	15.9
Mean daily temp.	13.5	26.1	20.2
Rel. humidity	71	73	71.3
Rainfall	48.3	Trace	192.1
Piche evap.	4.4	5.7	5.2
Wind speed	8.6	8.5	7.8
Solar radation	491	961	740
Zone 1, Northern Delta, Sakha, Lat. 31°07"N, Long. 30°57"E			
Max. temp.	19.4	34.0	27.5
Min. temp.	6.1	19.0	12.8
Mean daily temp.	12.8	26.5	20.2
Rel. humidity	74	67	68.0
Rainfall	14.2	0.0	66.0
Piche evap.	2.2	5.7	4.2
Wind speed	2.8	2.8	2.9
Solar radiation	491	961	740
Zone 2, Southern Delta, Tanta, Lat. 30°47"N, Long. 31"00"E			
Max. temp.	19.7	34.5	28.0
Min. temp.	6.0	19.1	13.0
Mean daily temp.	12.8	26.8	20.5
Rel. humidity	71	60	63.8
Rainfall	9.0	Trace	45.5
Piche evap.	2.1	6.6	4.5
Wind speed	3.5	3.5	3.3
Solar radiation	491	961	740
Zone 5, Eastern Border, Ismailia, Lat. 30°36"N, Long. 32°14"E			
Max. temp.	20.4	36.4	28.8
Min. temp.	8.1	22.2	15.5
Mean daily temp.	14.2	29.3	22.2
Rel. humidity	59	51	54.6
Rainfall	4.4	0.0	29.4
Piche evap.	4.7	9.3	7.0
Wind speed	3.5	3.8	3.5

Appendix A: Continued

Item	January average	July average	Annual average
Zone 3, Cairo, Cairo, Lat. 30°N, Long. 31°E			
Max. temp.	19.4	35.4	28.1
Min. temp.	8.6	21.5	15.4
Rel. humidity	59	52	55
Rainfall	--	--	2[illegible].8
Zone 6, Middle Egypt, Minia, Lat. 28°05"N, Long. 30°44"E			
Max. temp.	20.6	36.9	29.8
Min. temp.	4.0	20.2	13.2
Mean daily temp.	11.8	28.6	21.2
Rel. humidity	56	44	51.3
Rainfall	0.5	0.0	5.3
Piche evap.	4.5	14.1	9.4
Wind speed	4.1	7.1	6.2
Solar radiation	534	955	754
Zone 7, Upper Egypt, Shandaweel, Lat. 26°36"N, Long. 31°38"E			
Max. temp.	22.5	37.5	31.4
Min. temp.	4.7	20.5	14.5
Mean daily temp.	13.6	29.0	23.0
Rel. humidity	67	47	52.3
Rainfall	Trace	0.0	1.0
Piche evap.	2.6	8.4	6.2
Wind speed	4.4	3.8	4.2
Solar radiation	554	952	771

Appendix B: Soils Technical Report by Ivan Jansen

The soils that are most productive, or potentially so, are the alluvial soils of the delta and of the Nile Valley of Middle and Upper Egypt. These areas are now under intense cultivation; oilseed crop production can be increased there only by displacing other crops. New lands are either sandy and moderately calcareous (less than ten percent $CaCO_3$), or highly calcareous (30 to 90 percent $CaCO_3$). The new lands are less productive and require lifting of the irrigation water at considerable energy cost. But the new lands must be considered if there is to be a major expansion in oilseed production.

Alluvial Soils: These are soils of the Nile Valley and the Delta. The predominant soils are moderately dark colored and weakly developed (Torrifluvents and some Torrents). They are moderately dark colored and do have some free $CaCO_3$, though commonly not more than three percent. They are medium to fine texture (30 to 50 percent clay), have high water storage capacity and high cation exchange capacity. The lighter textured soils are on natural levies along the Nile and on the upper delta. The heavier soils are in low areas back from the Nile in the valley and between or back from active distributary channels on the lower delta.

Substantial areas of the alluvial soils are inhibited by salinity or alkalinity. These problems in turn result from inadequate drainage and/or incorrect irrigation management. These problems are increasing in severity and extent, particularly following the completion of the Aswan High Dam and the consequent shift from basin irrigation to perennial irrigation. The most seriously affected areas are in the lower delta and in the heavier soils of the slack water deposits back from the Nile channel in Middle and Upper Egypt. Intrusion of salt water from the sea following the elimination of annual flooding is also a factor on the lower delta. Development of salinity is a problem; however, anywhere that drainage is inadequate or irrigation is not properly managed.

Though the salinity and alkalinity problems are serious, they can be corrected. Most of these soils have excellent potential for being made highly productive. Provision for adequate drainage is the first step. Then excess salts can be flushed out with water, treating with gypsum at the critical time where alkalinity persists to prevent dispersion.

A drainage program to correct drainage problems within the next 15 years is under way. The drainage technology is generally well developed and additional drainage research is underway within the Ministry of Agriculture. There does seem to be a problem getting good installation of tile drains, resulting in blockage and subsequent failure. The current plans to use continuous plastic tubing in the future rather than concrete tile should help, but it will still be necessary to establish a continuous gradient.

The alluvial soils, after correction of any salinity or alkalinity problems would be first choice for all of the oilseed crops except peanuts.

Calcareous Soils: The calcareous soils are predominant on the new lands west of the Delta and south of Alexandria (North Tahrir and Nubaria). Calcium carbonate contents range from 20 to 90 percent, but are typically between 25 and 40 percent. Soil texture ranges widely, with the most common being sandy loam, loam, and clay loam. A soil survey of the Nubaria area delineated the positions of various land classes (see chapter IV, B. Soils, p. 17). These soils have an adequate water storage capacity for irrigation agriculture and a cation exchange capacity of two to five meq/100 g. Crust formation is a potentially serious problem, but frequent irrigation can be used to keep the surface soft and prevent crop damage. Fertility management is more critical on these soils than on the alluvial soils. Phosphorous must be applied and is subject to fixation as calcium phosphate. Deficiencies of micronutrients such as Zn and Mn should be expected and applied as needed. Drainage must be provided so that the soluble salts can be flushed out periodically. Open drains are being used predominantly now. Subsurface drainage systems should also work well if properly designed and managed.

Although the high carbonate content of these soils creates special management problems which require research and guidance to farmers, they offer much promise for general crop production. Sunflower should do well in these soils. Soybean adaptation is somewhat less certain, but certainly there should be some work with soybeans here as well as elsewhere. Peanuts probably would not do well on the calcareous soils because of the crusting problem and difficulties in harvesting.

Calcareous soil areas for oilseed production should be carefully selected to avoid those with cemented layers or excessively high carbonates. Soils with less than 30 percent $CaCO_3$ would be a good objective.

<u>Sandy Soils</u>: The sandy soils are extensive on either side of the Delta. Substantial areas of sandy soils have been reclaimed over the last 20 years east of the Delta toward Ismailia and west of the Delta in South Tahrir. Much of the remaining desert land that is available for new development consists of sandy soils.

Sands and loamy sands predominate in these areas, though some areas having sandy loam and loam surfaces were observed. These soils are calcareous, though there is commonly less than ten percent $CaCO_3$. Cation exchange capacity and water storage capacity are very low on the sands; the sandy loams and loams will be substantially better where they can be found. Fertility is very low. Both macro- and micro-nutrients must be supplied. Yet, these soils can be productive when managed according to their needs.

Surface irrigation is being practiced on some of the developed sandy soils. This might be reasonable for the more loamy ones, but it is not appropriate for those which are most sandy. High infiltration rates result in inefficient use of water and aggravate the drainage problems. Soluble fertilizers are flushed out with the excess water before the growing crops can use them. Sprinkler or drip irrigation should be considered.

Scientists from the Egyptian Ministry of Agriculture emphasized that the sandy soils improved over time under agriculture. Accumulation of organic matter from plant residue and manure increased cation exchange capacity, the water holding capacity, and the nutrient status. Certainly that is a significant trend that can significantly improve these soils. It is slow and will not progress far enough to eliminate all of the problems associated with the more sandy soils.

The sandy soils do have the potential for being productive and should be included under the project. The more loamy areas should be selected for development where possible, because rather small differences in the amount of fines can be quite significant in these soils. Peanuts is the most promising crop for the sandy soils. Soybeans should definitely be tried and should have reasonable good potential. Sunflower should be evaluated on these soils, though it will likely do better on the calcareous soils.

The oilseed project should include all three of the major land types. The first step should be careful site selection by detailed soil mapping on potential sites. The work should be done cooperatively by American and Egyptian soil scientists. The most favorable, or most representative sites could then be selected for the initial work.

Drainage of soils on the old lands is the most urgent need and should take precedence over developing more new lands. The Egyptian Ministry of Agriculture certainly has the technical competence; it is a matter of allocating the capital and getting the job done.

Energy costs for lifting water become limiting for further development of new lands. There appears to be some potential for shifting citrus production to the sandy soils at the higher elevations. This would permit drip irrigation in these high lift areas, which should provide for more efficient water use and lower energy costs. A bonus would be realized in the form of minimizing saline seep and irrigation canal water degradation problems.

Soybean Nodulation Problem: I suggest that Egypt first solve the nodulation (inoculation) problem, and then worry about expanding soybean production, rather than vice versa. I suggest that the first steps should be to stop applying nitrogen fertilizers to soybeans. Then there would certainly be no need to worry about interference, but more importantly, the benefits of good inoculation management would be apparent to all. Just don't grow soybeans until the inoculation problem is resolved.

Sunflower : Emphasis on the calcareous soils. Should do well there. Probably would do better on the alluvial soils, but other crops are more competitive there. Some evaluations should be made on the sandy soils as well.

Peanuts: Emphasis on the sandy soils.

Soybeans: Will do best on the alluvial soils. Should try both the sandy and the calcareous soils as well. It is not clear which will perform best, assuming that management will be suited to the soil in both instances.

Appendix C: Distribution of Lands to be Reclaimed during 1980 - 1984 by Governorate

Governorate	Total 1980-84	Distribution over plan period 1980	1981	1982	1983	1984
	fed	-----------	-----------	fed	-----------	-----------
N. Sinai	5,500	1,500	1,000	1,000	1,000	1,000
S. Sinai	7,000	1,000	1,500	1,000	1,000	1,000
Port Said	70,000	—	—	15,000	25,000	30,000
Ismailia	54,750	7,000	12,750	17,000	18,000	—
Sharkia	91,700	15,000	18,500	5,000	28,200	25,000
Dakahlia	44,000	5,000	7,000	8,000	8,000	16,000
Damietta	20,000	4,000	4,000	6,000	6,000	—
Kafr El Sheikh	36,900	11,000	6,000	4,400	7,500	8,000
Alexandria	60,000	—	10,000	35,000	15,000	—
Beheira	86,500	24,500	21,000	18,000	14,000	9,000
Marsa Matrouh	112,500	12,500	11,000	15,000	31,000	38,700
Giza	45,000	2,000	7,000	9,000	11,000	16,000
Beni Suef	5,000	—	—	2,500	2,500	—
Minia	20,000	4,000	4,000	4,000	4,000	4,000
Fayoum	25,000	—	5,000	5,000	5,000	10,000
Assuit	5,000	—	2,000	2,000	1,000	—
Sohag	18,300	—	3,000	4,300	5,000	6,000
Qena	32,700	7,000	10,000	9,600	6,000	—
Aswan	23,000	2,000	3,500	6,000	6,000	5,000
New Valley	60,300	12,000	11,300	12,500	13,500	11,000
Total	823,150	109,000	138,650	181,800	208,700	185,000

Appendix D: Distribution of Lands to Be Reclaimed during 1980 - 1984 Period by Reclamation Source

		Responsible Agency		
Governorate	Total Areas	Ministry of Land Recl.	Individuals & Coops	Joint Ventures
	------------------------	fed	------------------------	
N. Sinai	5,500	5,000	—	—
S. Sinai	7,000	7,000	—	—
Port Said	70,000	70,000	—	—
Ismailia	54,750	27,750	18,000	9,000
Sharkia	91,000	4,500	79,000	8,200
Dakahlia	44,000	—	44,000	—
Damietta	20,000	—	20,000	—
Kafr El Sheikh	36,900	—	36,900	—
Alexandria	60,000	50,000	10,000	—
Beheira	86,000	32,000	54,500	—
Marsa Matrouh	112,000	107,000	5,000	—
Giza	45,000	10,000	35,000	—
Beni Suef	5,000	—	5,000	—
Fayoum	25,000	—	25,000	—
Minia	20,000	—	20,000	—
Assuit	5,000	—	5,000	—
Sohag	18,300	—	18,300	—
Qena	32,700	3,500	29,200	—
Aswan	23,000	5,000	18,000	—
New Valley	60,000	60,300	—	—
Total	823,150	383,050	422,900	17,200

Appendix E: Conversion Factors

Since 1961, Egypt has officially adapted the metric system for general use. The one big exception is the 'feddan' which has been retained as the land unit area. For conversion, however, one hectare equals 2.5 feddans, and a feddan and an acre are very similar in area, with a difference of only 4 percent.

Area		Acre		Feddan		Hectare
1 acre	=	1	=	0.963	=	0.405
1 feddan (fed)	=	1.038	=	1	=	0.420
1 hectare (ha)	=	2.471	=	2.380	=	1
1 sq. kilometer	=	247.105	=	238.048	=	100
1 sq. mile	=	640	=	616.4	=	259

Also in the agricultural sector, local units of weight and capacity are still used in reporting production and yield of field crops. Thus, a 'metric kantar' is used for cotton, a 'kantar' is used for sugarcane, onion and flax straw, and a capacity unit called an 'ardeb,' equivalent to 198 liters, is used for all grain and seed crops. Production figures are given in metric tons, but crops yields may be reported either as Egyptian units per feddan or as metric units (kg. or metric tons). The Egyptian units per feddan or as metric units (kg. or metric tons). The Egyptian units of field crops and conversions are as follows:

Commodity	Egyptian unit	Weight in kg	To convert Egyptian units/fed to tons/ha, multiply by
Cotton (unginned)	Metric kantar	158	0.375
Cotton (lint or ginned)	" "	50	0.119
Sugar, onion, flax straw	Kantar	45	0.107
Rice (rough or unmilled)	Dariba	945	2.250
Lentils	Ardeb	160	0.381
Broadbeans, fenugreek	"	155	0.369
Wheat, chickpeas, lupine	"	150	0.357
Maize, sorghum	"	140	0.333
Linseed	"	122	0.290
Barley, cottonseed sesame	"	120	0.286
Groundnuts (in shells)	"	75	0.178

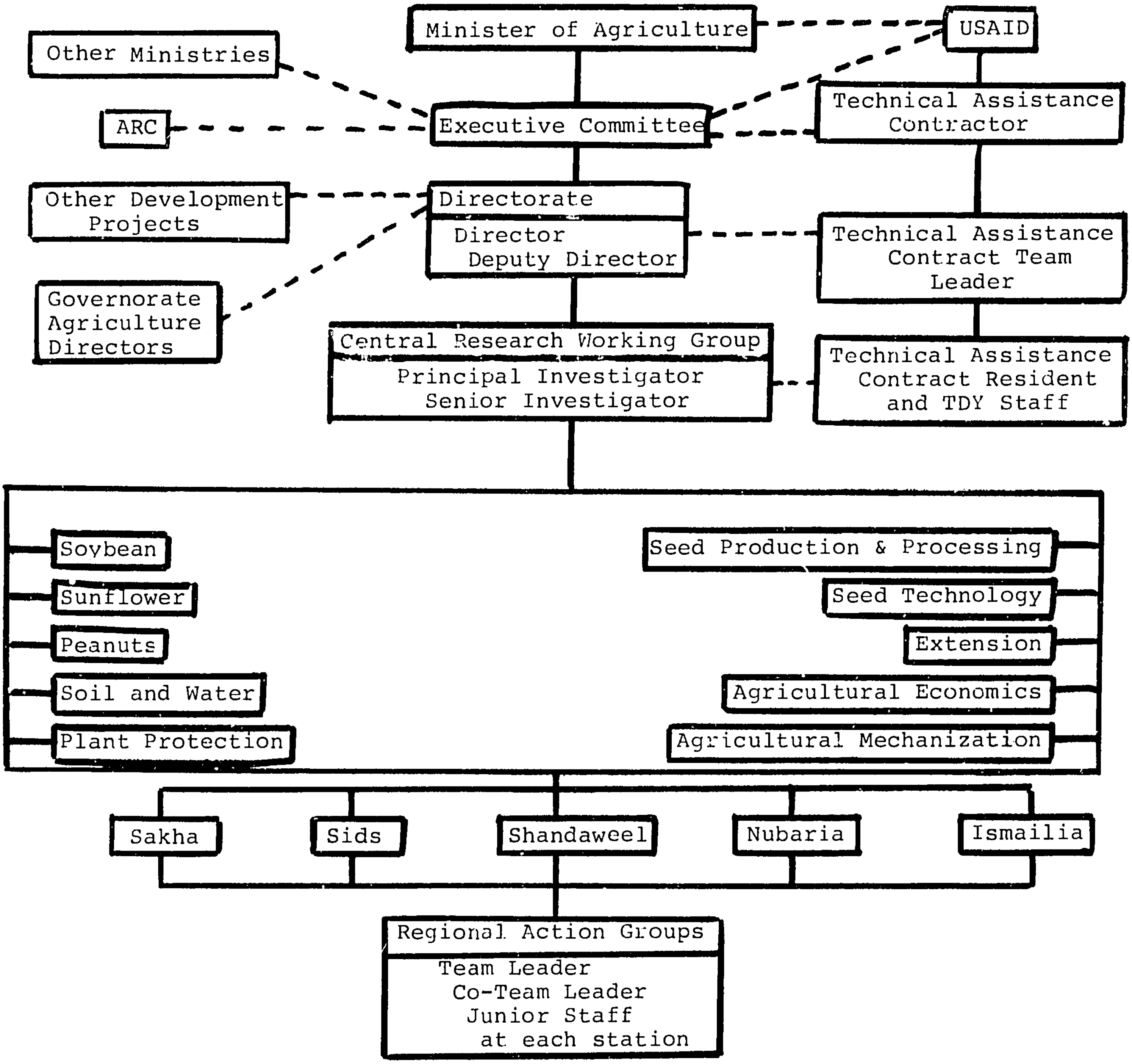
Other conversions

1 ardeb	=	198 liters = 5.62 bushels (US)
1 ardeb/feddan	=	5.41 bushels/acre
1 kg/feddan	=	2.12 lb/acre

U.S.A. currency equivalent of the Egyptian Pound (LE)

LE 1 = U.S. $ 1.43 U.S. $1 = LE 0.70

Appendix F. Oilseed Research and Production Program Organizational Schedule



____________ Lines of authority

------------ Lines of Cooperation

Appendix G: Administrative and Information Flow Chart
Extension