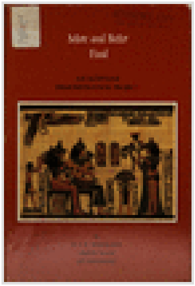

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More and Better Food

AN EGYPTIAN DEMONSTRATION PROJECT

by

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NOTICE: The More and Better Food Demonstration Project in Egypt, which is the subject of this report, is the product of multidisciplinary and multi-institutional collaboration among many Egyptian workers and institutions, with the National Research Centre (Dokki, Cairo) taking the leadership role. The project was a major component of the Applied Science and Technology Research Program, a collaborative activity in science and technology for development supported by the Government of Egypt and the United States Agency for International Development during the years 1977-1986.

The report is a case study of agricultural, nutrition, and health interventions in three Egyptian villages; it was written to inform an interested audience of development specialists, administrators, and others concerned with the role of science and technology in socioeconomic development. The report is a product of the authors and does not necessarily represent the opinions of the sponsors or of the collaborating institutions.

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PREFACE

The More and Better Food Project began in 1977 as a collaborative effort between Egypt, represented by the National Research Centre (NRC), and the United States, represented by the U.S. Agency for International Development (USAID). The ultimate goal of the project was to demonstrate the impact of science and technology on food, agriculture, and nutrition.

This report documents the integrated effort of more than 400 scientists from the NRC and other institutes concerned with problems of food and nutrition. It is a case study of a research institute (NRC) that has adapted its system and mobilized its manpower to address a major development problem. The report does not concentrate on technical details (such information is included in separate documents); instead, it focuses on aspects of planning, priority selection, management, and program impacts, as well as lessons learned. Background information on the status of food, agriculture, and nutrition in Egypt and the research and development resources in these sectors is also presented.

The authors wish to thank all the scientists who helped the MBF Project achieve its objectives. Special thanks are due to Dr. M. Kamel, the president of the ASRT; Dr. M.B.E. Fayez, the director of the NRC; and Dr. M. Abdel-Akher, the chairman of the steering committee. It is also appropriate to thank the members of the steering committee for their efforts in managing the project for more than eight years.

The authors are grateful to the organizations that made this study possible. The USAID provided financial support, and the U.S. National Research Council assisted in technical aspects including training, consultancy, documentation, and information, as well as staff support. Special appreciation is extended to the many American scientists who served as advisors or consultants. It is impossible to note here the number of U.S. universities, research institutes, and other scientific laboratories that collaborated with the Egyptian team at the NRC, but their assistance is most gratefully acknowledged. The editorial assistance of Miss Nina Graybill, Mrs. Mary-alice Risdon, Ms. Patti Lowery, and Miss Irene Martinez, and the major contribution of Miss F. R. Ruskin, who coordinated and prepared the manuscript for publication, is acknowledged with thanks.

CONTENTS

ABBREVIATIONS AND TERMS

ARC	Agricultural Research Centre (MOA)
Ardab	A measure of capacity, equal to roughly 5.62 bushels (also spelled ardeb)
ASRT	Academy of Scientific Research and Technology (Egypt)
FED or F	Feddan = 1.038 acres
FY	Fiscal Year
GNP	Gross National Product
KT	Kirat = 1/24 feddan
L	Liter
LE	Egyptian Pound (1LE = 0.83 $US, official exchange rate)
MBF	More and Better Food
MOA	Ministry of Agriculture (Egypt)
MOH	Ministry of Health (Egypt)
NIDOC	National Information and Documentation Centre (ASRT)
NIS	National Institute of Standards (ASRT)
NRC	National Research Centre (Egypt)
ORDEV	Organization for Reconstruction and Development of the Egyptian Village
PT	Piaster = 1/100 LE
SIC	Scientific Instrumentation Centre (ASRT)
STRD	Science and Technology in Rural Development Program
T	Ton
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
$	U.S. Dollar

EXECUTIVE SUMMARY

Egypt's demand for food has been steadily increasing. Not only is more food needed for a growing population, but a higher quality of food products is sought as more Egyptians are able to afford and appreciate the significance of improved nutrition. These dual demands led to the design and implementation of a cooperative Egypt-U.S. program in science and technology to address problems of food, agriculture, and nutrition. The More and Better Food (MBF) demonstration project is a major activity of this program. Responsibility for managing the project was assigned to the National Research Centre (NRC), the largest affiliated research institute of the Egyptian Academy of Scientific Research and Technology (ASRT).

The MBF Project had two major objectives:

1. To mobilize the NRC's scientific manpower in a multidisciplinary program to increase crop production in selected demonstration villages, and to study the impact of increased productivity on the nutritional and socioeconomic status of the village community.

2. To develop the NRC's capability to manage multidisciplinary and multi-institutional programs.

This report describes how science and technology can be applied to solve the staggering problem of food shortage in Egypt. As a result of the MBF Project, the NRC has developed an effective system for mobilizing its scientific manpower to deal with problems at the village level and to influence national food policies.

The document includes four sections:

1. The Status of Food, Agriculture, and Nutrition in Egypt.
2. Research and Development Resources.

3. The National Research Centre and the More and Better Food Project.
4. The More and Better Food Intervention Projects.

Egypt, which until 1960 had been self-sufficient in all crops but wheat, now faces a steadily widening gap between production and consumption; this creates an enormous burden on the national economy. The value of food imports grew from $150 million (mostly wheat) in 1960 to $184 million in 1970, then soared to $1.9 billion in 1980. The striking increase in the demand for food during the 1970s was largely due to the increase in population, the increase in per capita consumption, and the expansion of the government's food subsidy policy.

Egypt's scientific manpower in agriculture, food, and nutrition totals more than 3,300 researchers (Ph.D.) and more than 4,400 research assistants (M.Sc.) working in the areas of crop production, horticulture, soil sciences, botany, agricultural pests and plant protection, agricultural economics and rural development, animal production, farm mechanization and engineering, food and dairy sciences, and human nutrition.

Most of these researchers (55.5 percent) are in university faculties of agriculture. The Agricultural Research Centre (ARC) of the Ministry of Agriculture (MOA) employs 21.5 percent of the nation's overall science and technology manpower in its 13 institutes. The NRC has 3 divisions (9 laboratories) that specialize in agriculture, food, and nutrition, and that employ more than 400 researchers and research assistants.

The authority for agricultural research and extension in Egypt rests with the ARC. In addition, the ASRT, the NRC, the universities, and the Ministry of Irrigation conduct research of direct or indirect interest to agriculture.

The NRC is by far the largest multidisciplinary research institute in Egypt. It includes 14 divisions and 41 laboratories, and employs 160 professors, 225 associate professors, 318 researchers (Ph.D.), 321 research assistants (M.Sc.), 369 research fellows (B.Sc.), and 981 special and technical assistants. More than 30 percent of NRC manpower is engaged in food, agriculture, and nutrition research.

The history of NRC research in those areas reveals that from 1957 to 1968 the major effort was to build scientific and technical manpower in various disciplines; most of the research was academic in nature, resulting in publication of theses for advanced degrees. Collaboration among laboratories was informal.

In 1968, the NRC entered a new era when it began coordinating its activities with the Scientific Council for Food Industries and with the El-Fayum Governorate. Two joint councils were established, and the NRC began letting contracts designed to address problems of food and agriculture (22 contracts, value LE 97,500). In 1975, the NRC management adopted a new policy that called for expansion in user-oriented research, and began to explore every possible source of funding for applied research and development.

The MBF, started in 1977, therefore came at a time and in an environment that provided--and continues to provide--major prerequisites for success: availability of scientific manpower with all specialties needed to start a multidisciplinary program, an administration seeking improvement of its research and development management system, and a new policy that placed a high premium on user-oriented research.

Management of the MBF Project was handled by a steering committee, chaired by a former minister of agriculture, with representation from government sectors and the heads of NRC divisions dealing with food, agriculture, and nutrition. Several factors facilitated the work of the steering committee:

- Full support by the NRC director
- Independent management authority and responsibility
- Resources to implement projects
- Careful determination and application of selection criteria for projects to receive R&D funding
- Full participation of end users (farmers and villagers) in program design and management.

The steering committee recognized that many factors, both technical and managerial, would be essential for the success of the project. The most important of these were as follows:

- The ordinary farmer, as the intended client of the project, should be a partner in the processes of decision making, execution, and choice of technology as well as a consumer of the scientific information generated.
- The technology used should be simple, appropriate, affordable, and acceptable to the farmer. Preference should be given to technologies adapted specifically for Egyptian socioeconomic conditions.
- The project should be carefully selected to ensure that farmers would quickly learn that new methods would produce substantial results.

- The plan should consider expansion and popularization of the activity.
- The ultimate goal should be the incorporation of the activities in national programs for rural development.

According to the steering committee's plan, the MBF Project proceeded in three major stages:

1. Selection of village(s) typical of rural living patterns.
2. Collection of baseline data on selected villages.
3. Design of projects that met criteria adopted by the steering committee, which included:

   -- addressing problems of agricultural productivity as identified by the farmers
   -- guaranteeing that farmers would not suffer losses for their participation in any demonstration activity
   -- attempting to make all activities suitable to local conditions.

The process of village selection sought to identify (1) a village typical of a traditional rural area (Kafr Al-Khadra, Menufia), (2) another representing newly reclaimed land (Omar Makram, Beheira), and (3) one influenced by nearby urbanization (Beni-Magdoul, Giza). The selection process utilized baseline data on agriculture, health, utilities, social services, and public services. Final stages required field visits that gave special attention to farmers' requests for assistance.

Intervention projects carried out through the MBF included:

- Plant-production-related projects on peanuts, corn, wheat, onions, cucumbers, tomatoes, potatoes, grapes, mangoes, weed control, insect control, soil fertility, and silkworm raising and honeybeekeeping
- Animal-production-related projects on poultry farming, animal health and productivity, raising rabbits, and dairy production
- Health and nutrition projects on child health and nutrition, child growth patterns, anemia, nutrition education, and the impact of agricultural projects on health, nutrition, and socioeconomic status.

The following represent the general achievements of the MBF:

- The MBF was by far the largest assignment ever carried out by the NRC. The program involved the collaboration of more than 300 scientists in 13 specialties from the NRC who worked directly with about 100 scientists from the ministries and the universities.
- The MBF was the vehicle through which the NRC staff gained experience in the management of large multidisciplinary, multi-institutional projects.
- The MBF provided the first chance for the NRC staff to communicate and deal with the real problems of the village, and to establish a long lasting researcher-farmer relationship.
- The MBF created an awareness among its scientific staff of the importance of socioeconomic aspects in both project design and implementation.
- The MBF led to more expanded efforts at the regional level (Al-Tahady and Al-Salheia), governorate level (Giza Governorate), ministerial level (NRC staff was represented on all ARC committees), and the national level (corn project).

Some specific achievements of the MBF are described below.

The tomato project introduced two new practices: growing tomatoes on wire and starting seedlings under plastic tunnels. Average productivity increased from 4.0 tons/feddan* (t/f) to 27.8 t/f in Omar Makram and from 5.7 t/f to 32.4 t/f in Kafr Al-Khadra. Based on this increase and other findings of the MBF, the Giza Governorate financed a project entitled "Science and Technology in Rural Development" (STRD). In 1981, 1,000 feddans owned by 572 farmers from 14 villages reported average production of 22.8 t/f (compared with 6.74 t/f on acreage outside the project) and extra income of LE 1,614/f. In 1982, the Supreme National Committee for Policies and Economics (chaired by the prime minister) approved the expansion of the STRD to three governorates--Giza, Beni-Suef, and El-Fayum. Tomato planting covered 7,831 feddans owned by 6,109 farmers in 56 villages, with an average production of 29.99 t/f.

The corn project introduced an improved agronomic package for two high-yielding maize varieties: imported Pioneer 514 (hybrid) and local Giza. The package also included the cultivation of a summer forage crop (Sordan 77 or Millex-24) on 2 kirats** per feddan. The project was implemented in Omar Makram and Kafr Al-Khadra, and

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*One feddan = 1.038 acres.
**One kirat = 1/24 feddan.

later extended its activity to the Giza Governorate. The ASRT and the MOA launched a national campaign for growing maize (Giza 2) in more than 150,000 feddans in 23 governorates. Average production ranged from 3.32 to 4.05 t/f compared with 1.65 t/f before the project was begun.

The peanut project demonstrated an integrated approach to the effective implementation of science and technology in the field, beginning with the complete problem diagnosis, allocation of resources, and careful timing of the proposed intervention. The achievements of this project in the Al-Tahady sector were widely recognized and reported in Egypt. Between 1979 and 1982, Al-Tahady had shown successive decreases in the average yield of the 6,000 feddans from 9 ardab*/f to 2.8 ardab/f. The MBF intervention began in 1982 with a complete diagnosis of the causes and initial implementation of treatment. By 1984, the MBF applied the new principles of the peanut project to 1,250 feddans in Al-Tahady and 750 feddans in Omar Makram; average productivity reached 17 ardab/f and 26 ardab/f, respectively. In 1985, the MBF spread its methodology to all 6,000 feddans of peanut cultivation and was supported by LE 100,000 from the Ministry of Agriculture (MOA).

A small-scale poultry production unit (family size) was introduced in the demonstration villages to provide farmers with a good source of protein and with added income. In 1984, 58 families from Omar Makram participated in the project with 100 chicks/family/rotation (5 rotations/year). Families in the neighboring villages of Omar Shaheen later implemented the project on their own. Statistics reveal that a typical unit with 100 chicks/rotation and a total of 5 annual rotations produced a net profit of about LE 400.

The following table shows the crop production figures of farmers in the MBF project compared with figures reported for nonparticipating farmers.

Research teams currently are operating through contracts with privately owned mango and orange farms in Beni Magdoul and Kafr Al-Gabal (Giza Governorate), Samalout (El-Minia Governorate), and El-Santa (El-Gharbia Governorate). This reflects a significant sign of institutionalization and new mode of services by the NRC.

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*Ardab (ardeb): volume measure = 5.62 bushels.

CHAPTER I

STATUS OF FOOD, AGRICULTURE, AND NUTRITION IN EGYPT

Ever since man discovered the fertile soil along the banks of the River Nile more than 5,000 years ago, Egypt's land has been under cultivation. Today, agriculture continues to play a major role in the Egyptian economy. The land being farmed is about 6 million feddans; through intensive crop rotation, the cultivated area covers more than 11 million feddans.

Agricultural products constitute 21 percent of Egypt's gross national product (GNP) and 70 percent of Egypt's total exports. Fifty-seven percent of the population live in farming areas, and 51 percent of Egypt's manpower work in agriculture. Food and textile products comprise about 42 percent of Egypt's total industrial production.

Despite these statistics, Egypt faces a critical situation: its consumption of major food commodities significantly exceeds domestic supply, sharply decreasing self-sufficiency levels and necessitating importation of large quantitities of food and feed products. The simultaneous effects of population growth and a decline in production quality exacerbate the problem.

The expansion of the Egyptian agricultural sector through modern technology offers the potential for reducing the rapidly widening gap between domestic production and utilization. This report explores the dimensions of the food crisis in Egypt and analyzes the More and Better Food Demonstration Project, which shows promise for helping the country rectify its current production/consumption imbalance.

GEOGRAPHY AND DEMOGRAPHY

The Arab Republic of Egypt, located at the extreme northeast corner of Africa, has a total area of 1,000,000 square kilometers (306,000 square miles), almost 96 percent of which is desert. The remaining 4 percent is the long, narrow, fertile Nile Valley and its delta in the north. The area under cultivation equals 6 million feddans (6.228 million acres), though intensive rotation creates a cropping area of about 11.4 million feddans. Ninety-six percent of Egypt's population live in the cultivated region.

Egypt is divided into 25 political regions called "governorates," of which 4 are city governorates (Cairo, Alexandria, Port Said, and Suez), 9 are governorates of Lower Egypt, 8 are governorates of Upper Egypt, and 4 are frontier governorates. (See Figure 1.)

The population increased from 16 million in 1937 to 41 million in 1979 (Figure 2). During the mid-1960s, the population growth rate reached 2.5 percent. By 1978, the rate had climbed to 2.8 percent, and the population to 40 million; in 1979, the rate had risen to 2.9 percent. The 1985 population is estimated to be 47.8 million. By 1990, the projected population will be 54 million; by 1995, 61 million; and by the year 2000, Egypt's population is expected to reach 66 million.

Egypt is the most populous of the Middle East Arab states. The estimated population density in 1985 was 124 persons per square mile. However, the country's capital, Cairo, with a total population of 12 million, has a population density of about 90,000 persons per square mile. Fifty-seven percent of the population live in rural areas.

An age breakdown of the Egyptian population as of 1976 shows a high percentage of young children. Children in the 0-14 years age bracket account for more than 40 percent of the total population. This means high food consumption by a large segment not participating in economic production. The 15-19 age bracket accounts for 10.4 percent of the population; ages 20-24, 8.9 percent; ages 25-59, 34.1 percent; and the over 60 bracket, 5.4 percent.

TABLE 1 Population Distribution by Age and Sex (1976)
(in millions)

Age	Male	Female	Total
1-14	7.46	7.08	14.54
15-19	2.14	1.85	3.99
20-59	7.83	7.95	15.78
60 and above	1.12	1.17	2.29
	18.55	18.05	36.60

SOURCE: O. Galal. "State of Food and Nutrition in Egypt," UNICEF/MOH, Cairo, Egypt, October 1984.

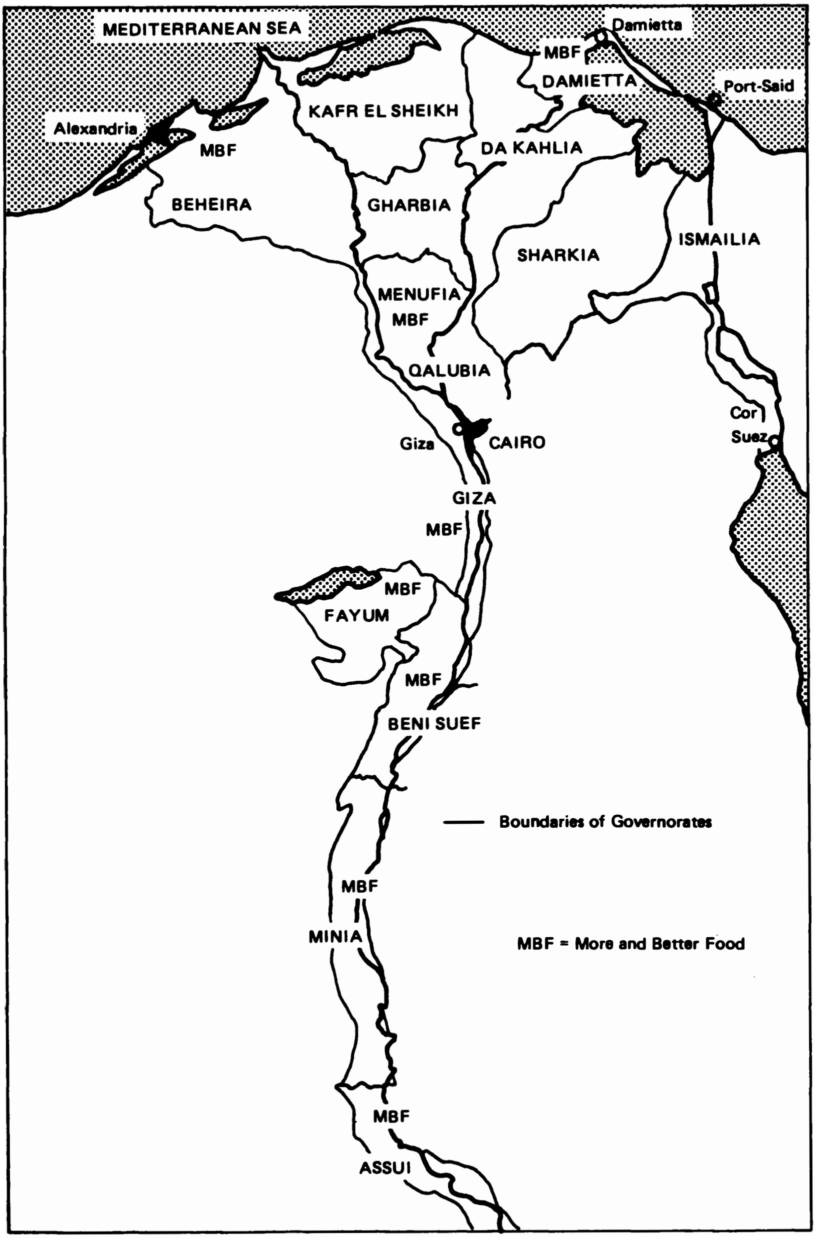

FIGURE 1 Partial map of Egypt showing governorates where MBF projects occurred. (H.A. El-Tobgy. "Contemporary Egyptian Agriculture," Second Edition, The Ford Foundation, Cairo, Egypt, 1976.)

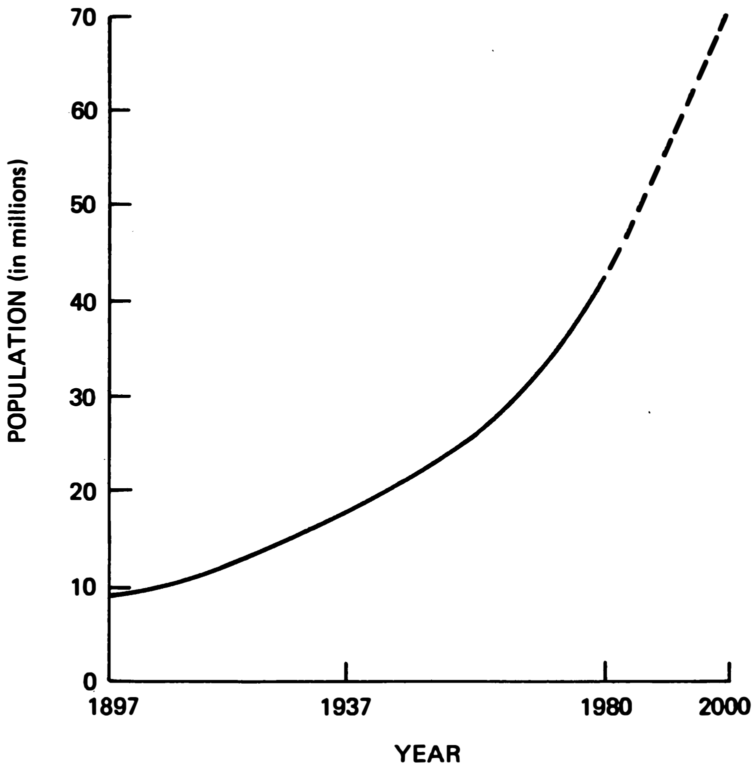

FIGURE 2 Population growth in Egypt, 1897-1980, with projections to the year 2000. ("Strategies for Accelerating Agricultural Development," a report of the Presidential Mission on Agricultural Development in Egypt. MOA, Egypt, and USAID, July 1982.)

The following table shows educational attainment in the male and female populations above 10 years of age. The high illiteracy rate among women is considered to be a major factor affecting the poor nutritional and health status of children and mothers.

TABLE 2 Educational Attainment by Sex (1976)

Education	Male %	Female %	Total %
Illiterate	43.2	71.0	56.7
Read or Write	33.2	16.2	25.1
Secondary School or Higher	23.6	12.8	18.4
			100.0

SOURCE: O. Galal. "State of Food and Nutrition in Egypt," UNICEF/MOH, Cairo, Egypt, October 1984.

Population records of Egyptian rural and urban areas reveal that the rural population doubled during a 50-year period, while the urban population more than quadrupled. The rural population dropped from 73 percent in 1927 to 56 percent in 1976, and the urban population grew from 27 percent to 44 percent (Table 3).

TABLE 3 Population Distribution in Rural and Urban Settings (1927 and 1976)

Year	Population in Millions		Population (%)	
	Rural	Urban	Rural	Urban
1927	10.37	3.81	73.12	26.88
1976	20.56	16.10	56.09	43.91

SOURCE: O. Galal. "State of Food and Nutrition in Egypt," UNICEF/MOH, Cairo, Egypt, October 1984.

The growing urbanization through rural to urban migration has affected the demand for food. Urbanization also means cuts in food-producing manpower. Moreover, urbanization often leads to slums populated by low-income individuals with low levels of education, poor nutrition, and poor health and hygiene standards.

The Egyptian birth rate is very high. The death rate decreased from 17 per 1,000 to 10.3 per 1,000 from 1960 to 1982. The death rate among children followed a similar pattern. (See Table 4.)

TABLE 4 Change in Birth and Death Rates per 1,000 Persons

Year	Birth Rate	Death Rate	Population Increase
1960	43.1	16.9	26.2
1970	35.1	15.1	19.4
1980	40.8	10.4	30.4
1981	38.0	10.2	26.8
1982	36.9	10.3	26.6

SOURCE: O. Galal. "State of Food and Nutrition in Egypt," UNICEF/MOH, Cairo, Egypt, October 1984.

Active manpower (ages 20-60), totaling 43 percent of the population, is distributed among the economic sectors as follows: agriculture, 52 percent; industry, 26 percent; and services, 23 percent.

The 1980 GNP was estimated at LE 15.808 billion; the per capita GNP was LE 374. Agriculture contributes 20.6 percent to the country's GNP, and industry, 26.7 percent.

EGYPT'S AGRICULTURAL PRODUCTION

This section provides a statistical overview of agricultural production in Egypt.

Changes in Crop Pattern

Table 5 gives estimated averages of areas cultivated with various crops during the periods 1969-1971, 1979-1981, and 1983-1984.

TABLE 5 Crop Patterns in Egypt

Crop	1969-1971		1979-1981		1983-1984	
	Area[a]	Percent[b]	Area[a]	Percent[b]	Area[a]	Percent[b]
GRAINS	4,535	42.2	4,774	42.9	4,682	41.1
Wheat	1,300	12.0	1,372	12.3	1,475	12.9
Barley	86	0.8	98	0.9		
Corn	1,503	14.0	1,905	17.1	1,800	15.8
Sorghum	489	4.6	410	3.7	400	3.5
Rice	1,157	10.8	989	8.9	1,007	8.8
LEGUMES	436	4.1	349	3.1	373	3.3
OILSEED	105	1.0	165	1.5	233	2.1
Peanuts	43	0.4	29	0.3	28	0.3
Sesame	59	0.5	39	0.4	35	0.3
Soybean	3	0.1	97	0.8	170	1.5
SUGARCANE	183	1.7	251	2.3	278	2.4
FIBER	1,618	15.0	1,269	11.4	1,061	9.3
Cotton	1,591	14.8	1,206	10.8	1,023	9.0
Flax	27	0.2	63	0.6	38	0.3
CLOVER	2,748	25.6	2,729	24.5	2,782	24.4
VEGETABLES	576	5.4	1,030	9.2	885	7.8
FRUITS	241	2.2	361	3.2	448	3.9
OTHERS	299	2.8	213	1.9	647	5.7
TOTAL	10,741	100.0	11,141	100.0	11,390	100.0
% Crop Intensity	179.4		186.1		190.2	

(a) Area: feddans x 1,000.
(b) Percentage of total cultivated area.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

In the early 1960s, the Egyptian government established fixed areas for major crops--in particular, cotton, rice, wheat, and corn. The government also took over the marketing of cotton and sugarcane and required farmers to give a certain amount of their rice and peanut crops to the cooperative.

However, as Table 5 shows, farmers did not follow these regulations: areas cultivated in cotton, rice, legumes, peanuts, and sesame decreased, and the production of fodder crops, wheat, corn, soybeans, and sugarcane rose.

Cotton, traditionally Egypt's major crop, showed the greatest decrease in cultivated area. During the past 15 years, cotton farmland was reduced by 36 percent. Clover production occupies one-fourth of the cultivatable area, reflecting the extent to which farm animals share the land with man. Soybeans are increasing significantly in the crop pattern, from 3,000 acres in 1969 to 170,000 acres in 1984.

The cultivation of vegetables and fruits was another way in which farmers avoided the crop rotation rules. The total cultivatable area given to those agricultural products increased from 241,000 feddans to 448,000 feddans over the past 15 years. Vegetables now represent 7.8 percent of the total area, compared with 5.4 percent in 1969.

Changes in Crop Production

Egypt's agricultural production does not keep pace with the nation's ever-growing demand for food, a demand intensified both by population increases and by increased per capita consumption rate (that results from the rise in per capita income--Egyptians have more money to spend on food).

Table 6 shows the size of local production of agricultural crops during the period 1969-1981. The data reveals that changes in production amounts have varied with different crops. Some crops--such as wheat, corn, soybean, linseed, sugarcane, vegetables, fruits, and animal products--increased in production. Other crops--such as rice, legumes, peanuts, and sesame--showed a reduction.

The data also reveals that wheat, which constituted 22.9 percent of all grain production during the 1979-1981 period, increased from about 1.5 million tons in 1969-1971 to 1.9 million tons in 1979-1981 (for a 2 percent increase in annual production). Corn, at 38.7 percent of the total grain crop (1979-1981), increased from 2.4 million tons in 1969-1971 to 3.2 million tons in 1979-1981 (about 2.9 percent increase in annual production).

TABLE 6 Agricultural Production in Egypt

Crop	1969-1971 Average[(a)]	1969-1971 Percent[(b)]	1979-1981 Average[(a)]	1979-1981 Percent[(b)]	Percent Increase/Decrease 1969 - 1981
GRAINS	7,372	100.0	8,154	100.0	+20.9
Wheat	1,505	20.4	1,864	22.9	+23.9
Barley	88	1.2	111	1.4	+26.1
Corn	2,367	32.1	3,159	38.7	+33.5
Sorghum	847	11.5	643	7.9	-24.1
Rice	2,565	34.8	2,377	29.1	-7.3
LEGUMES	349		276		-20.9
OILSEED	971	100.0	979	100.0	+0.8
Peanuts	38	3.9	26	2.7	-31.6
Sesame	19	2.0	15	1.5	-21.0
Soybean	1	0.1	109	11.1	+108.0
Cottonseed	901	92.8	797	81.1	-11.5
Linseed	12	1.2	32	3.3	+166.0
SUGARCANE	7,107		8,732		+22.9
COTTON FIBER	8,914		8,629		-3.2
LINEN FIBER	66		168		+154.0
VEGETABLES	4,635		6,731		+45.2
FRUITS	1,420		6,731		+45.2
MEAT	378	100.0	469	100.0	+24.1
Animal Meat	282	74.7	337	71.9	+19.5
Poultry	96	25.4	132	28.1	+37.5

(a) Tons x 1,000 except for cotton fiber, which is in thousand metric tons.
(b) Percentage of total production for that category of agricultural product.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

Vegetable and fruit production increased markedly. Vegetable production grew from 4.6 million tons in 1969-1971 to 6.7 million tons in 1979-1981 (a 3.8 percent increase in annual production). Fruit production increased from 1.4 to 6.7 million tons.

In contrast, production rates decreased for rice (7 percent), sorghum (24 percent), and peanuts (31 percent) during the same period. This decrease in production was caused primarily by the farmers' reluctance to grow those crops because of the government's pricing policy and the marketing regulations that require a specified yield to be turned over to government collection centers.

Soybeans, which were first produced experimentally in the 1970s, increased from 1,000 tons (1969-1971) to 109,000 tons by 1981, and currently constitute about 11 percent of total oilseeds. Sugarcane showed an average annual increase in production of about 1.9 percent. Cotton production remained relatively stable (8.9 million metric tons in 1969-1971 and 8.6 million metric tons in 1979-1981).

The animal and poultry production rate was somewhat higher than that of plant products; overall meat production showed an annual increase of 2.2 percent between the two periods.

Generally speaking, changes in the overall production of different crops are due to changes in the cultivated area and productivity of the land.

Standard Measures of Agricultural Production

Values given in Table 7 represent real standard measures of agricultural production for the period 1970-1981. Using the 1970 overall production as a base value of 100, the 1981 production of plant products was 122 percent; animal products, 125 percent; and overall agricultural products, 123 percent. The data also reveals an average annual increase in production of about 2 percent for agricultural products during the 1970s, and shows that animal production exceeded plant production.

Changes in Production per Feddan

There was little consistency in annual production changes for major crops per feddan during the period 1970-1981 (Table 8). Cotton, corn, linseed, and soybeans showed increased production per feddan; many other crops tended to decrease.

TABLE 7 Standard Measures for Agricultural Production (1970-1981)[a]

Year	Plant Products	Animal Products	Overall Agricultural Products
1970	100.0	100.0	100.0
1971	103.4	101.9	102.9
1972	105.0	104.4	104.8
1973	105.8	106.1	105.8
1974	104.6	108.6	105.8
1975	106.8	110.5	107.8
1976	109.2	112.4	110.1
1977	105.1	115.1	108.1
1978	113.8	116.4	114.5
1979	118.3	119.0	118.5
1980	123.0	123.2	123.0
1981	122.4	125.0	123.1

(a) Reference Standard Value for 1970 = 100.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

The annual increase in cotton fibers per feddan amounted to 0.14 metric tons during the period 1970-1981. This accounted for Egypt's constant production level of cotton even though the cultivated area decreased.

Yield per feddan for wheat, rice, peanuts, potatoes, onions, and oranges did not show consistent increases or decreases, despite efforts by the Ministry of Agriculture (MOA) to regulate production of those crops.

Beans, sugarcane, lentils, sesame, and sorghum showed real decreases in yield per feddan. For example, the annual reduction in sugarcane amounted to 0.45 tons per feddan.

Value of Agricultural Products

Table 9 gives estimates of the value of agricultural products during the periods 1969-1971 and 1979-1981. Data reveals an increase from LE 1,048 million to LE 2,984 million during those periods, an annual rate of approximately 9.7 percent. The value of plant products increased from LE 782 million to LE 1,940 million by 1981. Field crops constitute the largest proportion of the value both of plant products (80 percent for

TABLE 8 Changes in Production per Feddan for Major Crops (1970-1981)[(a)]

Crop	Annual Standard Deviation	Averages		
		1970	1981	1970-1981
Wheat	--	1.16	1.39	1.36
Corn	+0.01	1.59	1.72	1.59
Rice	--	2.28	2.34	2.27
Sorghum	-0.02	1.75	1.58	1.64
Beans	+0.01	0.92	0.87	0.95
Lentils	-0.04	0.70	0.43	0.61
Cotton	+0.14	5.48	7.14	5.90
Flax	+0.03	2.43	2.79	2.58
Peanuts	--	0.897	0.899	0.872
Sesame	-0.02	0.49	0.41	0.47
Soybean	+0.08	0.31	1.19	0.70
Linseed	+0.01	0.45	0.51	0.49
Sugarcane	-0.45	37.29	34.14	35.72
Onion	--	6.84	8.33	7.95
Potatoes	--	7.11	7.26	7.04
Tomatoes	+0.10	7.11	7.26	6.74
Oranges	--	--	6.78	7.29

(a) All in tons except cotton, which is in metric tons.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

1969-1971 and 65 percent for 1979-1981) and of agricultural products as a whole (60 percent and 42 percent, respectively). Of the field crops, cotton had the highest value--LE 371 million (29.5 percent of the value of field crops for the period 1979-1981). Corn ranked second with a value of LE 282 million (22.5 percent), followed by rice, LE 168 million (13.4 percent); and wheat, LE 133 million (10.6 percent).

Vegetables and fruits followed field crops, with an average annual production value of LE 439 million for vegetables and LE 277 million for fruits; these constitute 22.6 percent and 11.7 percent, respectively, of overall field crop value for 1979-1981.

The LE 266 million value of animal, poultry, and fish products was 25.4 percent of the 1969-1971 total cost of agricultural products. In 1979-1981, that product value increased greatly to LE 1,044 million, representing

TABLE 9 Value of Agricultural Production[a]

Product	1969-1971 Average	1969-1971 Percent	1979-1981 Average	1979-1981 Percent
PLANT	782	74.6	1,940	74.6
Field crops	624	59.5	1,256	42.1
Vegetables	110	10.5	439	14.7
Fruits	46	4.4	227	7.6
Medicinal	2	0.2	18	0.6
ANIMAL AND POULTRY	266	25.4	1,044	35.0
Animal meat	126	12.1	404	13.5
Poultry meat	35	3.3	131	4.4
Other[b]	105	10.0	509	17.1
TOTAL AGRICULTURAL	1,048	100.0	2,984	100.0

(a) In millions of Egyptian pounds.
(b) Includes milk, egg, fish, honey, wool.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

35 percent of the total value of agricultural products for that period.

EGYPT'S FOOD INDUSTRIES

Until the early 1950s, Egypt had no stable policy for the food industry. The few factories that existed were owned by foreigners, and most of the products were consumed domestically; there were no plans for export. Many factories went out of business because they were unable to compete with imported products. During the Second World War, 12 food canning factories had been established to can products for the Allies and the local market. After the war, imported canned food flooded the Egyptian market, and 11 of the 12 factories were closed. Only the Kaha Factory survived, and today it is one of the biggest food canning factories in the country.

In 1956, with the establishment of the first ministry of industry, the government adopted a national industrialization policy. In 1957, the first five-year plan for industrialization was released; that plan called for the establishment of food industries. The government also established the General Organization for the Five-Year Plan.

Under that plan, priority was given to industries that had available local resources, that produced domestically needed products, and that had a potential for export, especially to Arab regions. Preference was also given to labor-intensive industries.

The first five-year plan included 130 projects. Among the major food-related industries developed were:

- The Edfina Company for Food Preservation
- A canning and preservation factory in Tahrir Province
- A sardine and shrimp factory in Damietta
- The Al-Nasr Dairy Company, with factories in Tanta, Mansoura, and Ismailia
- A sugar factory in Edfu
- The Al-Nasr Drying Factory in Sohag.

The second five-year plan was developed in 1965 with 50 more projects. Two major problems faced the ambitious first and second plans: poor coordination among sectors and productivity/quality control relationships.

- Poor coordination among sectors:

  - Poor coordination between agricultural and industrial sectors greatly limited production.
  - Prices fixed by government discouraged farmers from growing crops in amounts needed by industry; the sugarcane industry was especially hard hit.
  - Some economic sectors, especially the construction industry, failed to fulfill their obligations; the delay resulted in termination of set plans. Shortages of local funds and increases in prices of building materials contributed to the problem.

- Poor Productivity/Quality Control Relationships:

  - Shortage of skilled labor affected development of quality products.
  - The dependence of the economy on labor-intensive industries affected final product costs.

At present, Egypt's food industry includes six major groups: sugar, bakery products, drink and beverage products, oilseed processing, milk and dairy products, and food preservation and canning.

The Food Industry's Position among Other Industries

The food industry in Egypt leads all other industries in terms of the value of products. The total value of industrial production in 1976 was about LE 3,363.7 million. The different sectors and their contributions are as follows:

TABLE 10 Comparison of Value of Major Industries

	Million LE	Percent
Food	811.0	24.1
Textiles and weaving	754.2	22.4
Chemical	505.1	15.0
Machine and metallic	501.5	14.9
Building (construction)	189.5	5.6
Petrol	444.1	13.3
Electricity	135.0	4.0
Mining	23.3	0.7
	3363.7	100.0

SOURCE: A.S. El-Nockrashy. "Food Processing in Egypt: Status, Prospects and Recommendations," report submitted to ASRT, Cairo, Egypt, June 1980.

Changes in Size and Value

Table 11 gives the size of production of major industrial food products during the period 1965-1980. Table 12 shows the change in the value of industrial food products during the same period.

The data reveals that the standard annual increase in the value of industrial food products, at the running cost, was about 10.8 percent. Note that agriculture provides the raw materials for industries (food and textile) that contribute 46.5 percent to the total value of all local industries.

TABLE 11 Size of Production of Food Industries (1966-1980)

Product	Unit of Measurement	1965	1970	1975	1980
Sugarcane	1,000 ton	354	286	697	1,016
Glucose	1,000 ton	33	39	36	40
Blackstrap molasses	1,000 ton	32	48	60	74
Chocolate candy	ton	2,732	1,885	1,218	5,130
Bakery products	1,000 ton	58	56	74	102
Dried vegetables	ton	3,189	4,036	4,907	6,619
Fruit preserves	ton	170	-	14	5
Tomato sauce	ton	994	1,239	2,872	5,240
Canned legumes	ton	5,537	3,279	5,606	6,348
Yeast	ton	3,251	7,017	9,167	698
Starch	1,000 ton	12	15	18	16
Malt	1,000 ton	4	2	2	-
Vinegar	million L*	6	4	8	11
Cottonseed oil	1,000 ton	148	116	157	196
Shortening	1,000 ton	41	64	122	159
White cheese	1,000 ton	116	165	121	162
Processed cheese	ton	4,108	7,679	9,165	1,535
Pasteurized milk	1,000 ton	20	29	41	52
Canned fish	ton	7,106	1,271	1,769	5,077

*L = liters

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

PRODUCTION-CONSUMPTION GAP

The shortage of food is by far the most serious impediment to development in Egypt. Egypt's ever-increasing dependence on imports absorbs a large portion of the nation's foreign exchange income.

Food Gap

Food consumption and food production data show a continuous and widening gap in both quantity and value. In 1960, the gap between food consumption and food production was 1 million tons; in 1970, it was 1.7 million tons, and by 1980, the gap had increased to 7.4 million tons. In contrast, only 20 years earlier (in 1960) Egypt was self-sufficient in all crops but wheat.

TABLE 12 Change in the Value of Industrial Food Products (1965-1980)[a]

Year	Value
1965	385.4
1966	308.7
1967	341.5
1968	368.3
1969	435.2
1970	482.8
1971	485.6
1972	302.6
1973	563.6
1974	614.8
1975	708.0
1976	778.0
1977	871.0
1978	989.0
1979	1,158.0
1980	1,442.0

(a) In millions of Egyptian pounds at the running cost.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

Table 13 shows the tremendous burden on the national economy of the value (cost) of the food gap. The value

TABLE 13 Change in Value of Food Gap in Egypt, (1960-1980)[a]

ELEMENT	1960	1970	1972	1974	1980
Production	$4,201	$5,737	$6,035	$6,358	$7,428
Consumption	4,351	5,921	6,381	7,078	9,298
Imports	319	683	734	948	2,104
Exports	169	499	388	228	234
Gap	150	184	346	720	1,870

(a) Values in millions of dollars.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

was $150 million in 1960, $184 million in 1970, and then reached the shocking figure of $1.9 billion in 1980 (a ten-fold increase in 10 years).

Wheat makes the major contribution to this gap. Wheat imports increased from $274 million in 1960 to $554 million in 1970, then skyrocketed to $1,180 million in 1980, representing two-thirds of the food gap.

The increase in the food gap is due to many factors, some related to production and some to consumption. During the 1970s, food production increased at an annual rate of 2.6 percent, more or less equal to the population growth rate. However, during the same period, the average increase in consumption rates reached about 5 percent, nearly double the production rate, thus necessitating increased imports.

Moreover, the 1970s witnessed a lowering of the standards of production. The aftereffects of the high dam, especially the increase in subsoil water level and the degradation of soil quality, as well as the lack of serious action for technological development, are among the factors responsible for this decline.

The increase in the demand for food during the 1970s resulted from the increase in the population, the increase in per capita consumption (512 kg in 1970 to 636 kg in 1980), and the expansion of the food subsidy policy, especially for wheat, flour, vegetable oil, sugar, and meat. The consumption pattern was also affected by population shifts from rural to urban areas and even within rural areas. Finally, as noted earlier, increases in per capita income (due to the work in Arab countries and higher Egyptian salaries) also affected the consumption patterns of some segments of society.

The per capita share of imported food grew from $12 in 1960 to $21 in 1970 to $50 in 1980. The extent to which Egypt has become increasingly dependent upon imports of major agricultural commodities, especially since 1974, is shown in Figures 3 and 4.

Changes in the Consumption of Food Commodities

Wheat and Wheat Flour

Consumption increased from 4.48 million tons in 1972, to 7.42 million tons in 1980, to 7.87 million tons in 1981/1982 (an annual increase of 6.5 percent during the period 1972-1980).

This increase was caused both by the rise in population and the expansion in the government's food subsidy policy. Per capita consumption was 117 kg in 1972, 171 kg in 1980, and 179 kg in 1981/1982 (there was an

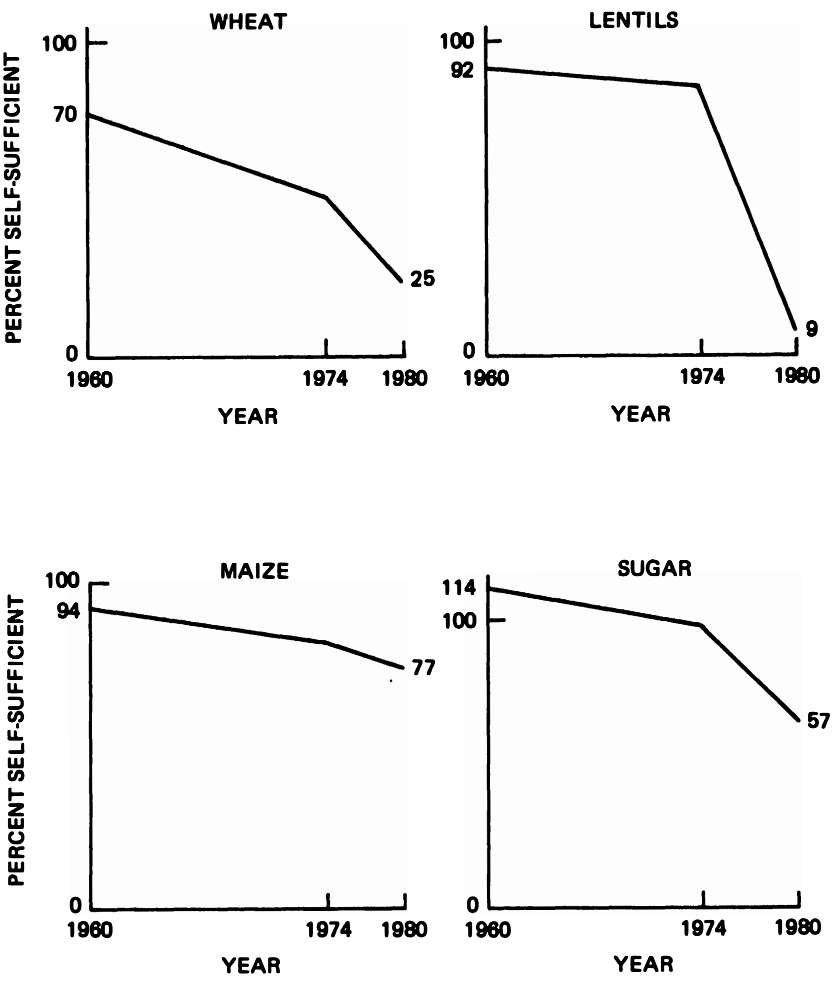

FIGURE 3 Percent self-sufficiency, 1960-1980. (Youssef Wally. "Strategies for Accelerating Agricultural Development," MOA, Egypt, July, 1982.)

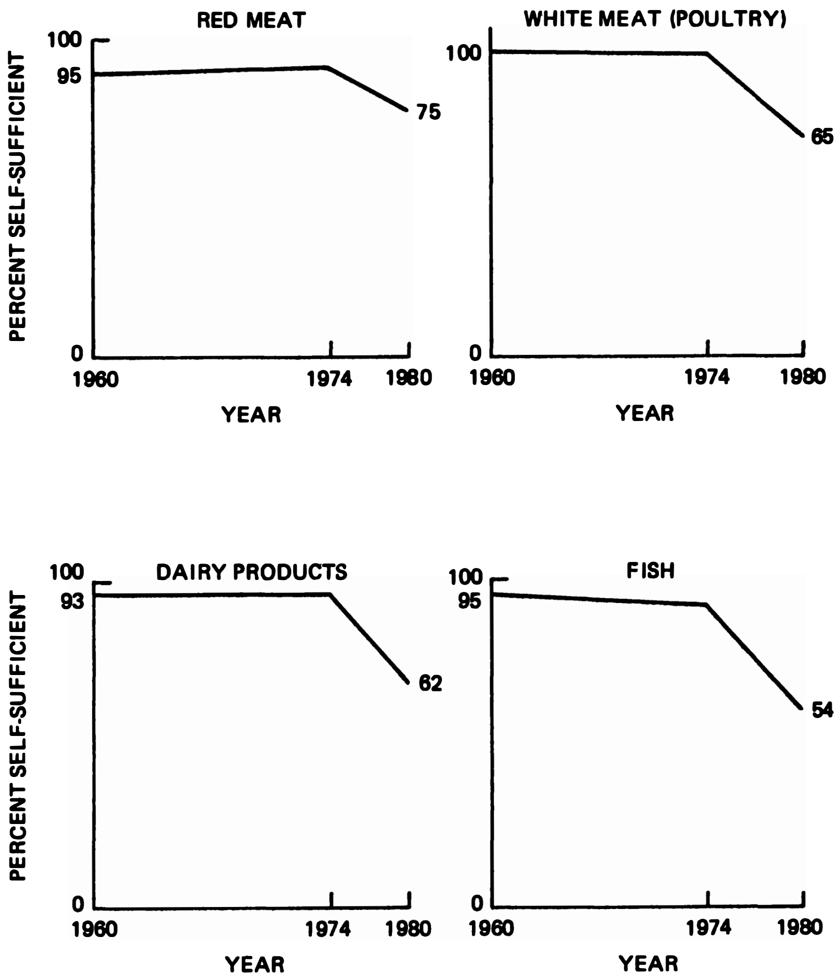

FIGURE 4 Percent self-sufficiency, 1960-1980. (Youssef Wally. "Strategies for Accelerating Agricultural Development," MOA, Egypt, July, 1982.)

average annual per capita increase in consumption of 3.4 percent during the overall period, while the population increased by 2.55 percent). Local production of wheat, which was 1.6 million tons in 1972, increased to 1.8 million tons in 1980 (an annual rate of increase of 1.5 percent); at the same time, wheat self-sufficiency changed from 56 percent in 1972, to 25 percent in 1980, to 26 percent in 1981/1982 (1981-82 percentages throughout this section are derived from Egyptian Ministry of Agriculture report, "Human and Material Resources in Agricultural Scientific Research," November, 1983).

Corn (Maize)

Local needs increased from 3.2 million tons in 1972, to 4.5 million tons in 1980, to 5.2 million tons in 1981/1982 (an annual increase of 4.4 percent during the period 1972-1980 and of 5 percent during the period 1972-1981/1982). As a result, Egypt, which was self-sufficient in corn in the early 1970s, experienced drops to 77 percent self-sufficiency in 1980 and 76 percent self-sufficiency in 1981/1982.

Rice

The increased consumption--from 1.2 million tons in 1972 to 1.6 million tons in 1981/1982, with more or less constant production during those years--devastated exports, which dropped from 426,000 tons in 1972 to a marginal level of 25,000 tons in 1981/1982.

Beans

In 1972, Egypt was 150 percent self-sufficient in fava beans. The estimated 361,000 tons produced in 1972 decreased to 234,000 tons in 1975, then to 213,000 in 1980. Successful development programs in 1981/1982 brought the production up to 354,000 tons.

Sugar

Egypt was self-sufficient in sugar until the early 1970s, when the country greatly increased its importation of sugar. In 1973, 36,000 tons were imported; imports by 1981/1982 had increased to 603,000 tons. Local consumption increased from 577,000 tons in 1972 to 1.03 million tons in 1980, to 1.23 million tons in 1981/1982 (an annual increase of 7.5 percent). Because production levels of this strategic commodity did not increase, Egypt was only 57 percent self-sufficient in 1980 and 51 percent in 1981/1982. The per capita share of sugar in 1981/1982 reached 28 kg, one of the highest rates in developing countries.

Vegetable Oil

Cottonseed was and still is the major source of vegetable oil in Egypt. Oil production is tied to government policy on cotton cultivation. Because cotton cultivation has remained relatively unchanged during the past 20 years, only about 100,000-120,000 tons of cottonseed oil have been produced annually, even though oil mills have been modernized to minimize losses.

Egypt, which was self-sufficient in this commodity in the early 1960s, is now producing only 25 percent of its local needs. Egypt's oil consumption in 1980 amounted to 430,000 tons and is expected to reach 947,000 tons in the year 2000. Soybean oil increasingly is being used to meet the demand for cooking oil.

Vegetables and Fruits

Egypt is self-sufficient in fresh vegetable and fruit production and is expected to stay that way until the end of the century.

Animal Protein

Livestock and poultry meat, as well as fish, eggs, and dairy products, make up this category. Consumption of these commodities has risen to the point that the demand cannot be met even when local production is combined with imports. The increased consumption of animal protein is due to the per capita income increase and urbanization and population growth.

Local demand for red meat was 335,000 tons in 1972, 464,000 tons in 1980, and 526,000 tons in 1981/1982 (4.6 percent annual increase throughout the overall period). Local production was 296,000 tons in 1972, which increased to 354,000 tons in 1980 (a 2.36 percent annual increase). Self-sufficiency decreased from over 95 percent in 1972 to 69 percent in 1981/1982.

The 1981/1982 per capita share of red meat averaged 12 kg; of poultry meat, 3.5 kg; of fish, 4.7 kg; and of milk, 56 kg.

Figure 5 represents the change in per capita production and utilization of wheat, maize, sugar, and rice. Figure 6 illustrates the change for animal products.

Figure 7 illustrates the percentage of increase in the per capita use of wheat, sugar, maize, poultry, dairy products, and fish during the years 1974-1980.

Food Subsidy

Government policies have contributed to increased consumption. The Egyptian Ministry of Supply maintains a food subsidy and ration system that provides food at a low cost to consumers. This system, which was directed mainly to urban consumers with limited incomes, has been expanded to rural areas. It comprises three basic programs: unlimited provision of subsidized wheat, rationing of other subsidized food, and food price controls.

Wheat in the form of bread is sold to consumers in unlimited quantities at highly subsidized prices. Seven loaves weighing 1 kg each are sold for the price of 7 piastres (PT). Flour is available in unlimited quantities at 13.5 PT per kg.

Four commodities--sugar, tea, cooking oil, and rice--are included in the government rations and can be purchased in their rationed quantities at subsidized prices. Additional amounts can be purchased from public and private stores at higher prices. Subsidized meat also can be purchased in rationed amounts.

The food subsidy system of Egypt is expensive, and amounted to LE 1.1 billion in fiscal year 1980 (Table 14). As the population grows, subsidy costs will also grow, even if present per capita consumption rates do not.

EGYPT'S NUTRITIONAL STATUS

As we have observed in previous sections, food production in Egypt is falling behind population growth, despite all national efforts to reverse the trend. The provision of enough food (calories) simply to meet minimum human energy needs is not sufficient. Food of adequate quality that supplies enough protein is also required for normal body maintenance and function; it must also support growth, maturation, pregnancy and lactation needs, and assist in the recovery from sickness. Not only do episodes of malnutrition permanently scar the physical and mental capabilities of children, they also affect the health, stamina, and productivity of the adult

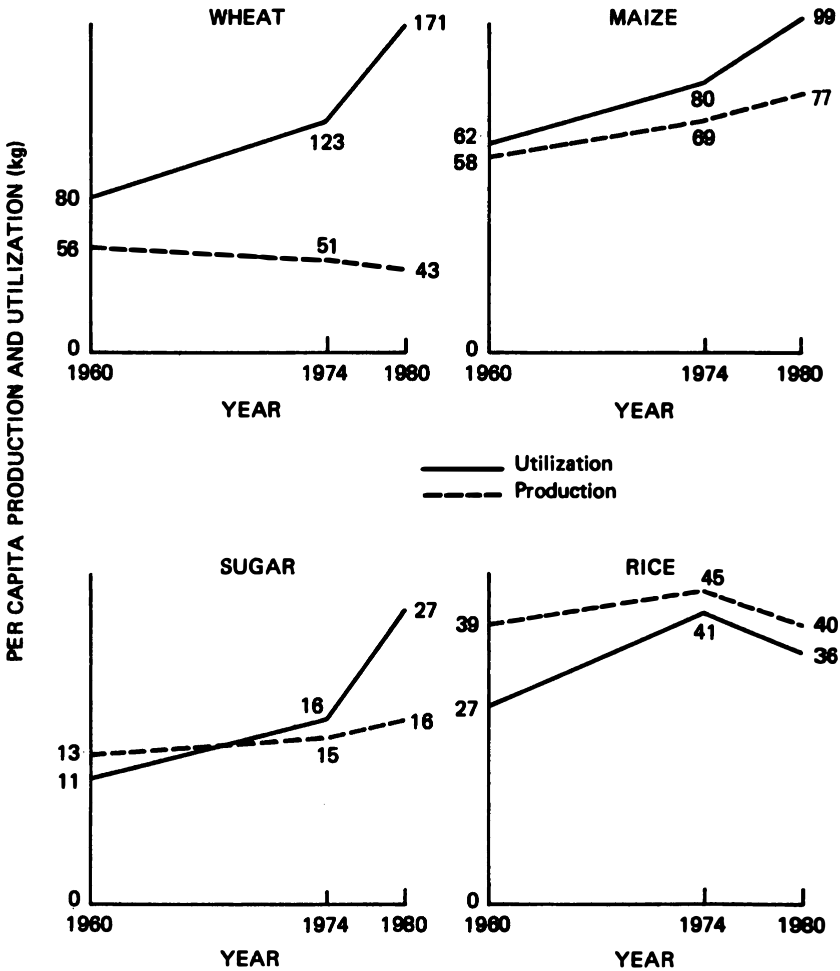

FIGURE 5 Per capita production and utilization of wheat, maize, sugar, and rice (kilograms annually) 1960-1980. (Youssef Wally. "Strategies for Accelerating Agricultural Development," MOA, Egypt, July, 1982.)

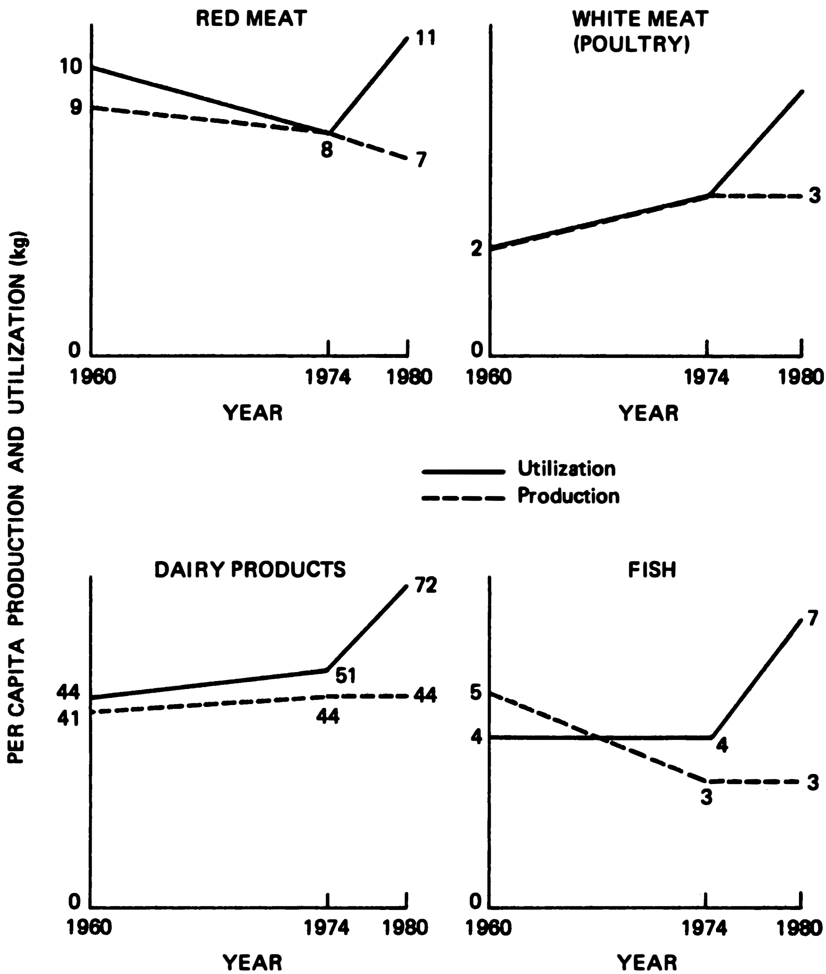

FIGURE 6 Per capita production and utilization of meat and animal products (kilograms annually) 1960-1980. (Youssef Wally. "Strategies for Accelerating Agricultural Development," MOA, Egypt, July, 1982.)

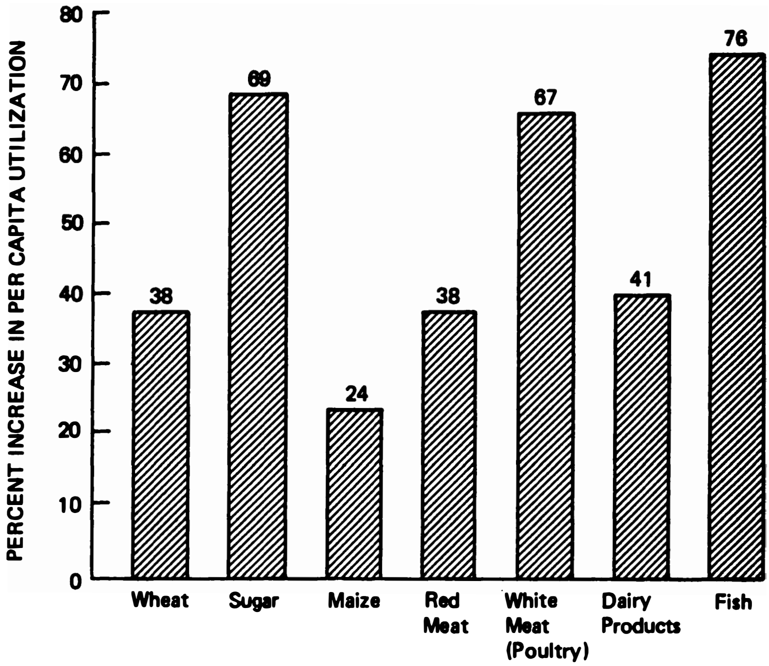

FIGURE 7 Percent increase in per capita utilization, 1974-1980. (Youssef Wally. "Strategies for Accelerating Agricultural Development," MOA, Egypt, July, 1982.)

TABLE 14 Egyptian Government Budget for Food Subsidies CY 1979, FY 1980-81, and FY 1981-82[(a)]

Commodity	Expenditure (in millions of Egyptian pounds)		
	1979 Budget	1980-81 Budget	1981-82 Budget
Wheat and flour	588.2	776.0	845.5
Maize	50.4	104.0	152.7
Fava beans	12.7	19.8	33.0
Lentils	14.1	18.5	31.8
Edible oils/tallow	200.1	231.4	231.0
Meat, poultry, fish	41.5	92.2	148.2
Sugar	44.4	224.0	131.4
Tea	54.6	26.5	34.7
Rice	--	41.0	52.5
Sesame, helava, margarine	24.8	26.3	31.5
Administrative Costs	--	61.1	11.4
Subtotal	1,030.8	1,620.8	1,703.7
Profits	-44.5	-12.0	-14.2
Rationalization Measures	89.7	0	0
Subtotal	-134.2	-12.0	-14.2
Total	896.6	1,608.8	1,689.5

(a) In 1980 the government moved from a calendar year (CY) to a fiscal year (FY) budget.

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

population. Yet Egypt's crop-growing area of only 4 percent of its total land mass is expected to feed and clothe a population that reached 45 million in 1982.

There is no single or simple solution to the problem. Coordinated and intensified government efforts and, most importantly, awareness by all sectors of society of the dimensions and consequences of the problem are vital to the development of realistic solutions.

Consumption Patterns

The daily food supplies available for human consumption in Egypt are given in Table 15. Animal sources, including meat, milk, eggs, and fish, supply 15 percent of the total protein. Cereal grains supply more than 70 percent of the consumed protein. Legumes supply about 5 percent of the total protein.

Any program aimed at providing adequate high-quality protein must consider three key factors. First, with respect to supply, intensified efforts must be made to improve production of conventional protein sources and

TABLE 15 Daily Food Supplies Available for Human Consumption in Egypt (Grams/Person/Day)

Food Commodity	1970	1980
Cereals	588	668
Starchy food	34	53
Sugar and sweets	56	74
Legumes	23	21
Vegetables	238	316
Fruits	112	157
Meat	25	34
Fish	8	12
Milk	136	202
Eggs	4	5
Fats and oil	20	23
Total calories	2,878	3,390
Total fat	47.3	56.2
Total protein	81.1	95.6
Animal protein	10.3	14.5

SOURCE: O. Galal, Harrison, G.G. and Abdou A. "MBF: Impact on Socioeconomic and Health Status," University of Arizona, Tucson, Arizona, July 1985.

to prevent unnecessary losses in the production process. New and unconventional protein sources that appeal to Egyptian tastes should be explored. Second, with respect to consumption, efforts must be made to improve distribution and extension services. Nutrition education programs and increased public awareness of the need to minimize waste are also vital. Finally, appropriate training and research facilities and management systems must be established to strengthen the institutional framework and to provide the technical education and training needed to deal with Egypt's nutrition problems.

Food consumption patterns are distinctly different in urban and rural areas. Bread is a staple of the Egyptian diet. Eighty three percent of all families consume wheat bread (urban, 93 percent; rural, 67 percent); 20 percent of all families consume bread made of wheat and maize flour, with more rural families than urban dwellers eating this type of bread. Only about 0.5 percent of families, mostly from the rural areas, eat corn bread occasionally supplemented by okra or fenugreek seeds.

All Egyptian families consume sugar. In rural areas, sugar is used primarily in tea. Honey, jam, and molasses are much less frequently consumed. Fresh milk is consumed more frequently in urban areas, and fermented milk is used more frequently by rural populations. Skimmed cheese is more popular in rural areas. Fava beans are the major legume in the Egyptian diet and are eaten by about 64 percent of all families. The average daily consumption of vegetables and fruits is about 425 grams.

Table 16 compares the per capita food supply in Egypt to typical figures for developed and developing countries.

Nutritional Problems

For the past 30 years, the Egyptian Ministry of Health (MOH) has helped fund nutritional surveys, most of which were conducted on scattered groups or communities. These surveys have pointed up the country's nutritional problems.

Malnutrition

A nutritional status survey conducted in Cairo in 1956-1957 found that the birth weight of Cairo children was higher than western averages, but that the growth curve (height or weight) began to show signs of retardation as early as the third month of life. By the end of

TABLE 16 Per Capita Food Supplies in Egypt Compared with Typical Values in Developed and Developing Countries (Grams/Person/Day)

Food Commodity	Developed Countries (1974)	Developing Countries (1974)	Egypt (1974)	Egypt (1980)
Cereals	326	386	633	668
Starchy food	312	195	35	53
Sugars and sweets	88	30	63	74
Pulses/legumes	16	49	26	21
Vegetables/fruits	364	184	386	473
Meat	151	30	26	34
Fish	190	11	8.8	12
Milk	570	79	138	163
Eggs	30	2.7	3.6	5
Oil	49	11	23	23
Total Calories	3,050	2,150	3,122	3,390
Total Protein	90	58	86.8	96
Animal Protein	40	9	10.7	15

SOURCE: O. Galal, Harrison, G.G. and Abdou A. "MBF: Impact on Socioeconomic and Health Status," University of Arizona, Tucson, Arizona, July 1985.

the second year, the average Cairo child weighed 7 pounds less and measured 12 centimeters less than the Iowa growth standards. The retardation begun in infancy is not overcome, but continues into school age and adulthood.

Three nutritional surveys have been conducted at the national level during the past 5 years. A Massachusetts Institute of Technology-Cairo University project in 1979 collected anthropometric data for children up to 5 years of age from 17 governorates. The study used the Gomez nutritional system. Applying this system, the findings were: in Lower Egypt 34.8 percent, 21 percent, and 27 percent of the children were considered to be 1° (mild), 2° (moderate), and 3° (severe) malnourished compared to 38.2 percent, 14.8 percent and 3.3 percent, respectively, in Upper Egypt.

Some striking difference in malnutrition levels were observed in various governorates. The lowest level was found in Kafr El-Sheikh Governorate, where 70.3 percent of the children were considered normal, and only 8 percent were 2° and 3° malnourished. In contrast, in the

Sharkia Governorate, only 3.9 percent of the children were found to be of normal weight for their age, and 76.0 percent were 2° and 3° malnourished.

Other surveys of preschool malnutrition clearly revealed that malnutrition statistics are relatively independent of urban-rural influences. Malnutrition was lowest in small cities (except for a special group of 6- to 72-month-old upper income children in a private nursery school in Cairo); it was highest in rural areas in Upper Egypt. However, these differences were quite small and the incidences of 1°, 2°, and 3° malnutrition in the total representative sample were 38.5 percent, 8 percent, and 0.8 percent, respectively. Corresponding values for the nursery school were 14 percent, 0.5 percent and 0.0 percent. Malnutrition data based on Waterlow Class measurements (weight-to-height, ignoring age) show general population incidences of stunting (weight is normal for height but height is below average for age), wasting (weight is markedly below expected for height and age), and stunting-wasting combined to be 20.8 percent, 0.3 percent, and 0.3 percent, respectively, compared to 1.1 percent, 0.1 percent, and 0.0 percent for the nursery school children.

Anemia

Anemia is a major public health problem in Egypt. It is common among children and pregnant and lactating mothers in both rural and urban areas. Anemia in Egypt is thought to be due to the interaction of malnutrition and infection.

One Cairo study found anemia and rickets to be the major nutritional deficiency diseases. Anemia (i.e., hemoglobin [Hb] less than 10 g/100 ml) was found in 90 percent of pregnant women, 70 percent of lactating women, and 80 percent of children under 2 years of age (hemoglobin norm in 11 g/100 ml). Ninety-six percent of the anemia in both mothers and children was of the hypochronic microcytic (iron deficiency) type, and 5 percent was of the megaloblastic (folic acid deficiency) type.

Hemoglobin concentrations of less than 11 g/100 ml were observed in 90 percent of the 4- to 6- month old infants studied. The incidence of low Hb levels was higher for boys than for girls, for artificially fed than for totally breastfed infants, and for infants of anemic mothers than for infants of nonanemic mothers.

A 1978 national nutritional survey on preschool children 6- to 72-months old found the prevalence of anemia highest in rural areas. Among the low socioeconomic subsample groups surveyed in Cairo, Giza, and

Alexandria, anemia was more prevalent than in other urban areas. Anemia is most prevalent in the rural areas of the Beheira, Giza, El-Fayum, Beni-Suef, and El-Menia Governorates. Children of high socioeconomic level families showed a prevalence of less than 17 percent. Small cities also showed low prevalences of anemia.

Anemia is highest in the 12 to 23 months age group, then decreases with increasing age.

Mothers in rural areas have a high incidence of anemia, the highest being in large villages, followed by rural Upper Egypt and rural Lower Egypt. Urban populations generally have the lowest incidence of anemia. Women from the lower socioeconomic population of Alexandria have the highest incidence of anemia.

Anemia among school children has been quantified only at the governorate and city levels. The reported incidence of anemia in both urban and rural areas ranged from 58 to 73 percent among ages 6 to 12, and 20 to 43 percent among teenagers, 12 to 18. Another study found the prevalence of anemia among primary school children (6-12 years) to be 27.7 percent; among preparatory school students (12-15 years), the prevalence dropped to 18.7 percent and dropped again to 13.8 percent among secondary school students (15-18 years).

Rickets (Vitamin D Deficiency)

A 1965 survey of preschool children found that the prevalence of rickets varied from 11 to 14 percent.

In a 1978 national nutrition survey, interviewers elicited the presence or absence of six readily observable clinical signs commonly associated with vitamin D deficiency, which, in general, affects the development especially of the long bones, but also may produce enlargement of the liver and spleen. These signs were craniotabes, frontal bossing, rachitic rosary or deformed chest, enlarged wrist or double malleoi, leg deformity (bowing) in children 12 months or older, and open anterior fontennel in children 24 months or older. The finding of only one of these signs in a child is insufficient to diagnose vitamin D deficiency; two or more signs confirm deficiency.

CHAPTER II

RESEARCH AND DEVELOPMENT RESOURCES IN FOOD, AGRICULTURE, AND NUTRITION

Egypt's agricultural problem-solving capabilities rest with the Agricultural Research Centre (ARC) in the Ministry of Agriculture (MOA), the universities with faculties of agriculture, the Academy of Scientific Research and Technology (ASRT), the National Research Centre (NRC), the Water Research Centre, the Ministry of Irrigation, and the Desert Research Institute. Human nutrition research is conducted by the Nutrition Institute of the Ministry of Health (MOH) and the NRC.

Support for agricultural research and technology for 1983/1984 came from the Government of Egypt for the Agricultural and Water Research Centres (LE 40,470,000); external agency funds for the NRC (LE 6,211,000); United States PL-480 funds ($2,985,000 for the life of 15 projects); and other donors ($483,075 for the life of 26 projects). Support for nutrition research came as a part of funds allocated by multiple resources for health development in Egypt. The Government of Egypt, the United States, other bilateral and multilateral donors, and private voluntary organizations have supported recent ongoing projects that broadly address health-related issues.

National goals for agriculture are determined by the ministries of Planning, Agriculture, and Irrigation, and by the ASRT. Health and nutrition goals are determined by the ministries of Health and Planning, and by the ASRT.

Science and technology priorities include strengthening planning capabilities, improving technology delivery services, improving the management of resources (groundwater, farm mechanization, land use, and energy) and increasing commodity production (food grains, winter vegetables, specialty fruits, and livestock). Priorities are also given to the coordination and integration of health research with the environmental, food, agricultural, nutrition, and socioeconomic sciences.

RESEARCH AND DEVELOPMENT INSTITUTES

The predominant responsibility for agricultural research and extension in Egypt rests with the Agricultural Research Center (ARC) in the MOA. In addition, research of direct or indirect interest to agriculture is conducted within the Ministry of Irrigation, the ASRT, and the universities.

The Agricultural Research Centre

The ARC conducts its work through 13 research institutes located in Cairo. They are:

- Agricultural Economics
- Agricultural Mechanization
- Animal Health
- Animal Production
- Animal Reproduction
- Horticulture
- Plant Pathology
- Plant Protection
- Serums and Vaccines
- Soils and Water
- Cotton
- Field Crops
- Sugar

The staffs of these institutes include nearly 400 Ph.D.s, more than 1,100 M.Sc.s, and nearly 1,300 B.Sc. graduates in 1983.

Thirty-one commodity-oriented research stations located in various ecological and agricultural zones provide research facilities. The regional areas, each with three to seven stations, are Alexandria and the North Coast, the New Lands, the North Delta, the Middle Delta, the South and East Deltas, Middle Egypt, and Upper Egypt.

Total staffing of these stations includes 125 Ph.D.s, 361 M.Sc.s, and 238 B.Sc.s. Staff at these stations are members of the various research institutes in Cairo, and Cairo-based staff conduct most of their field research at these stations. One of the stations in each of the seven regions is designated as the regional station center and has a regional director and administrative staff. A strong connection has been maintained between the research stations and the institutes. The stations are usually associated with a production farm, which provides land for research.

The agricultural production activity has been transferred from the General Authority for Agricultural Production to the Division of Experiment Stations and Production in the ARC. There are about 27,000 feddans in farms for use in the production of various types of seeds, nursery fruit trees, and some livestock. The seed operations are geared to handle breeders' seed, foundation seed, and some certified seed. Most of the certified seed is produced on growers' farms. That seed is owned by the farmer and an incentive price is paid for its production.

Agricultural extension, which, for purposes of the current study, can be considered a component of research and technology, is administered by a deputy director of the ARC, thus strengthening the association between research and extension. That association has been further fortified by a directive that requires research staff of the ARC to devote part of their time to extension activities. Field personnel are administratively under local government and perform regulatory and service functions as well as extension education.

University Research in Food and Agriculture

Thirteen universities in Egypt have faculties of agriculture: Ain Shams, Alexandria, Assuit, Al Azhar, Beni-Suef, Cairo, El-Fayum, Kafr El-Sheikh (Tanta), Mansoura, Minia, Menufia (Shebin El-Kom), Suez Canal, and Zagazig.

These universities conduct agricultural research, primarily through their graduate students. Some staff members who are teaching assistants have joint appointments with the ARC and may be pursuing graduate studies using ARC facilities. The ARC does not support research by faculty, although some professors are able to obtain funding through foreign donor agencies--USAID and the PL-480 program in the United States, among others.

Through USAID support, research projects are funded in Egyptian universities, some involving linkages with U.S. universities. The funded projects include a wide variety of objectives, such as control of plant diseases, production of specific crops (onions, garlic, bananas, forages, figs), milk and meat production, mechanization, and irrigation. Some of the work may be published, adding to the development and dissemination of scientific knowledge; however, there is no organized system for the delivery of university-developed information to users.

Academy of Scientific Research and Technology

The ASRT, in addition to other activities, supports research directed toward agricultural problems through its Council on Food and Agriculture. The Council also has developed a five-year plan for agriculture. The agriculture program is a major priority of the ASRT. However, the Council has no research staff and thus achieves its objectives through financial support of other organizations. Of the eight somewhat autonomous research organizations under the ASRT, the NRC and the Institute of Oceanography and Fisheries conduct research on food, agriculture, and nutrition.

The National Research Centre

The NRC conducts basic and applied research in natural sciences. It is organized into five programs, one of which is food and agriculture. These programs are funded by several sources. Ten laboratories are currently engaged in food, agriculture, and nutrition research. More than 600 employees, 240 of whom have Ph.D.s, work in these laboratories. Figure 8 is an illustration of these NRC laboratories, their research interest, and their manpower.

Institute of Oceanography and Fisheries

The Institute of Oceanography and Fisheries has four main branches: the Mediterranean Sea Branch at Alexandria, with three stations; the Red Sea Branch at Al-Ghardaga, with three stations; the Inland-Water Fisheries and Fish Culture Branch in Cairo, with four stations; and the Shore Protection Research Branch at Alexandria, with two stations. The institute's 16 departments cover all basic and applied research. The institute employs 490 persons, of which 188 are research staff.

Ministry of Irrigation

The Water Research Centre, the research agency of the Ministry of Irrigation, is organized into 11 research institutes; it also has a project for the Water Master Plan and departments for technical training and for research services. The Water Master Plan studies models for upper Nile flow routing, Nasser Lake reservoir operation, drainage, downstream water distribution, and changes in the Equatorial Lakes basin down to the Lake Albert outlet.

The Drainage Research Institute of the Water Research Centre studies drainage design for agricultural lands, including re-use of drainage water, water management, and

**NATIONAL RESEARCH CENTRE
AGRICULTURE, FOOD, AND NUTRITION
LABORATORIES (1985)**

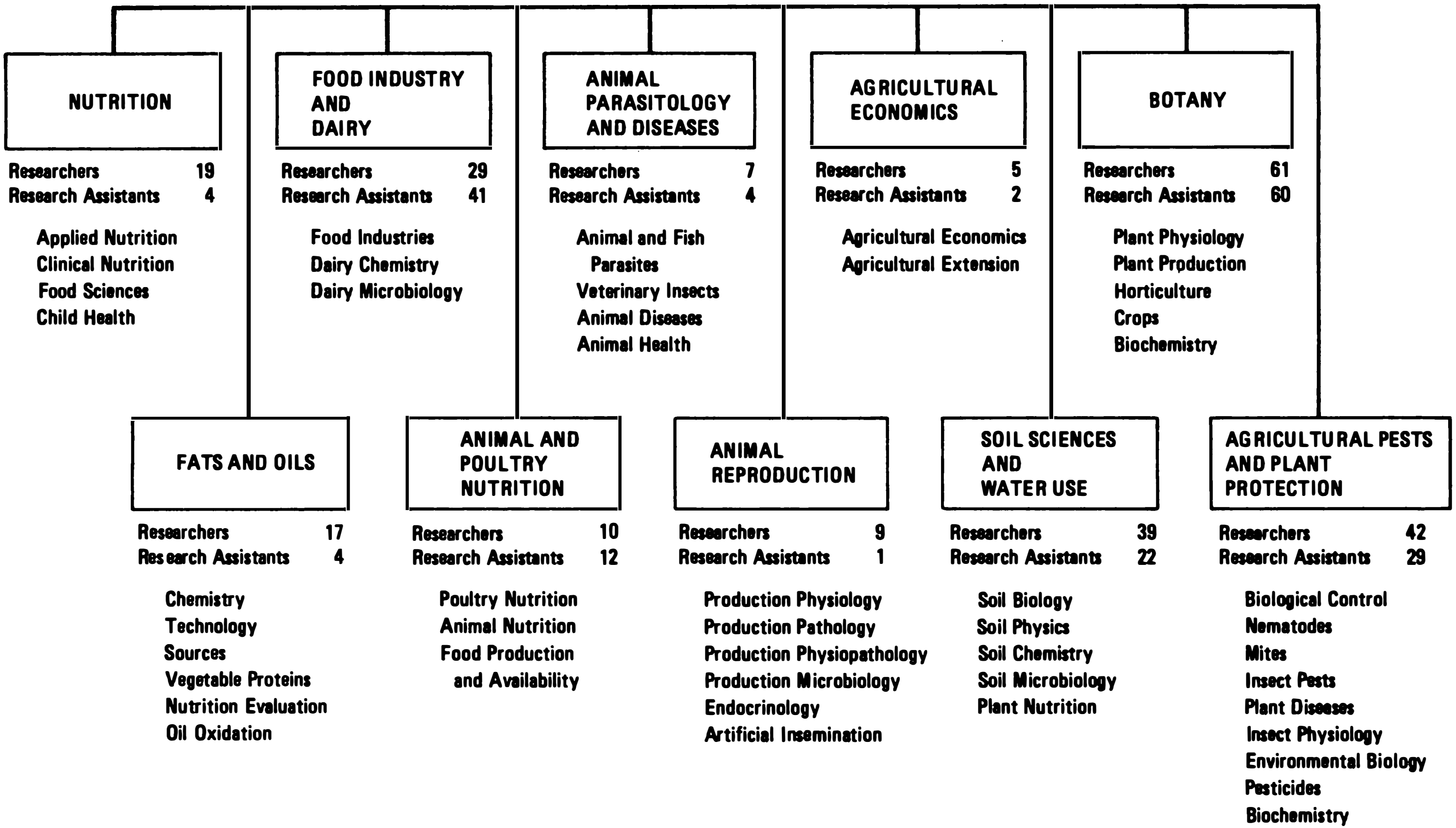

FIGURE 8 NRC laboratories, research interests, and research manpower.

water logging and salinity control. The Groundwater Research Institute gathers hydrologic data and studies the development and management of groundwater, the use and application of groundwater, and the protection of groundwater from contamination. The Water Research Centre is geared toward resolving problems in the storage and delivery of water for agricultural, industrial, and domestic use.

The Desert Research Institute

The Desert Research Institute, affiliated with the Ministry of Land Reclamation, studies desert and lands development. The institute is organized into divisions of water resources, soil resources, plant production, and animal production. It manages a 110-feddan experimental station at Marriut in the Mediterranean littoral zone; there, sheep production, range management, horticulture, reclamation of saline soils, irrigation techniques, and the use of saline water for crop production are studied. Another field station is under development in the Sinai. The institute has a staff of approximately 100 researchers and assistants, half of whom have Ph.D.s.

RESEARCH AND DEVELOPMENT MANPOWER

This section provides an analytical documentation of the manpower that conducts research in agriculture, food, and nutrition. It considers three major elements: field of specialization, institutional affiliation, and time devoted to research. Two levels of personnel are considered: research staff, which includes all Ph.D.s; and assistant researchers, which include M.Sc. and B.Sc. degree holders who assist in research activities.

Personnel in agriculture, food, and nutrition work in 10 areas of specialization:

- **Society and Economics**, which includes agricultural economics, agriculture extension, and rural society.
- **Botany**, which includes plant physiology, plant genetics, plant diseases, and plant ecology.
- **Soil Sciences**, which includes soil biology, physics, chemistry, microbiology, and plant nutrition.
- **Crops**, which includes plant production and cotton technology.
- **Horticulture**, which includes fruits and vegetables, and medicinal plants.

- **Agricultural Pest and Plant Protection**, which includes economic insects, pesticides, and biochemistry.
- **Farm Mechanization and Engineering.**
- **Animal Production**, which includes poultry production and animal diseases and protection.
- **Food Industries and Dairy Production.**
- **Human Nutrition**, which includes child health.

Table 17 shows manpower distribution among the 10 specialties. In 1981, total Egyptian manpower involved in research in the areas of agriculture, food, and nutrition was 6,815. Supporting technical staff totaled 7,501. Agriculture, food, and nutrition researchers constitute about 30 percent of all the scientific manpower in Egypt. Ratio of researcher: research assistant: technical assistants is 1:1.36:2.26.

TABLE 17 Manpower Distribution According to Specialty (1981)

Specialty	Researchers		Research Assistants	
	NO.	%	NO.	%
Animal production	752	22.7	738	16.4
Pests and plant protection	432	13.0	663	14.7
Soil	427	12.9	721	16.0
Botany	385	11.6	472	10.5
Crops	380	11.5	564	12.5
Fiber crops	354	10.7	516	11.5
Food industry	306	9.2	311	6.9
Society and economics	198	6.0	385	8.5
Farm mechanization	33	1.0	43	0.9
Human nutrition	45	1.4	100	2.2
TOTAL	3,312		4,503	

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

Table 18 shows manpower distribution according to sector. More than 50 percent of the researchers are found in the faculties of agriculture. The ARC occupies second place, with 21.5 percent of all researchers. Faculties of veterinary medicine have 11.4 percent, and the ASRT has 7.5 percent, most of whom are in the NRC.

Table 19 provides estimates of time allocated for research by researchers at the faculties of agriculture, the ARC, and the NRC. In Egypt, scientists distribute their time among three major functions: research, teaching, and administration. Time devoted to research ranges from 40 percent for university staff, where teaching occupies a good deal of their time, to 80 percent for the staff of the ARC, who also have administrative responsibility, and to more than 87 percent for the NRC staff.

TABLE 18 Manpower Distribution According to Sector (1981)

Sector	Researcher		Research Assistant	
	NO.	%	NO.	%
Faculties of Agriculture	1,838	55.5	1,731	38.4
Faculties of Veterinary	377	11.4	312	6.9
Agric. Research Centre	712	21.5	1,962	43.6
Egyptian Academy (ASRT)	250	7.5	260	5.8
Others	135	4.1	238	5.3
TOTAL	3,312		4,503	

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

TABLE 19 Percentage of Time Devoted to Research (1981)

	Faculties of Agriculture	Agricultural Research Centre	Academy of Scientific Research and Technology
Society and environment	41.6	80.8	90.0
Botany	43.3	96.7	88.1
Crops	39.6	82.0	90.0
Pests and plant protection	44.7	79.0	84.0
Horticulture	47.1	84.3	90.0
Food industries	43.0	70.7	84.9
Animal production	40.2	66.5	83.2

SOURCE: "Human and Material Resources in Agricultural Scientific Research," MOA, Cairo, Egypt, November 1983.

CHAPTER III

THE NATIONAL RESEARCH CENTRE AND THE MORE AND BETTER FOOD PROGRAM

The continuing development of a society depends largely on the abilities of its scientific and technological community. Resource availability, people's awareness of the problems, the society's commitment to growth and development, and the nature and extent of external influences are also important. But without the scientific and technical capability to transform physical, biological, and organizational phenomena and resources into activities that affect the overall population, the potential for change generally remains unrealized.

Egypt is committed to development. Over the past 30 years, the country has developed a sizable and well-trained scientific community of more than 24,000 M.Sc.s and Ph.D.s in pure and applied sciences who work in more than 200 research institutes. While excellence in institutional and individual research has been achieved in many branches of science, the lack of organized and systematic application of knowledge to development problems has kept the scientific community on the periphery of the development process.

Historically, the agricultural sector has been a major contributor to the Egyptian economy and has constituted one of the most significant sources of government revenue and foreign exchange. In the early 1960s, Egypt was self-sufficient in all crops except wheat. By the early 1970s, however, the relative contribution of agriculture to government revenue and foreign exchange earnings had begun to decline. At that time, Egypt imported food worth about LE 700 million. Since then, Egypt's economic situation has changed dramatically. Petroleum, remittances from workers abroad, and tourism have become major sources of foreign exchange.

The dimensions of the problem can be illustrated by these 1980 facts: Egypt's total food import reached LE 2.1 billion, self-sufficiency in strategic food products dropped drastically (see Table 20), and agricultural growth was 2 percent, compared to 8 percent for services and 30 percent for petroleum. It is apparent that, unless dramatically new but realistic strategies are followed, the current gap between production and consumption will double in less than 15 years. Moreover, there must be an increase of approximately 60 percent over the current production level to stop the expansion. A 1982 report on "Strategies for Accelerating Agricultural Development in Egypt" shows that increases of this magnitude have been attained elsewhere in even shorter periods. Nonetheless, massive efforts and strong national commitment are essential to achieving such growth.

SCIENCE AND TECHNOLOGY TO IMPROVE AGRICULTURE

The Egyptian scientific community has begun to assume a leadership role in resolving the problems of food and agriculture. Measures have been taken to bridge the gap between academic research on the one hand, and the practical needs of agriculture and the other sectors of the economy on the other.

Research and development programs closely linked to national goals can be successful only when they provide results useful to the targeted community. To realize such results, the different specialties must mesh in well-coordinated multidisciplinary programs, under the guidance of an effective research and development management system.

In 1977, a cooperative program known as the "Applied Science and Technology Research Program" was begun by the Academy for Scientific Research and Technology (ASRT) and

TABLE 20 Percent of Self-Sufficiency in Major Food Products

	Wheat	Maize	Lentils	Sugar	Red Meat	Poultry	Dairy	Fish
1960	70	94	92	114	95	100	93	95
1980	25	77	9	57	75	65	62	54

SOURCE: "Strategies for Accelerating Agricultural Development in Egypt," A Concluding Field Report, ARCE Newsletter No. 119, Fall 1982.

the U.S. Agency for International Development (USAID). It had the following objectives:

- o To demonstrate how scientific and technical manpower resources and research institutions can solve pressing problems relating to economic and social development in Egypt
- o To reorient Egyptian research and development management systems to address problems requiring a multidisciplinary and multi-institutional approach
- o To strengthen the ASRT, the National Research Centre (NRC), and other Egyptian research and development sectors by providing technical assistance, instrumentation, and access to scientific and technical information resources.

The program seeks to achieve these objectives largely through a set of research, development, and demonstration projects, each of which is a learning vehicle with specific goals and objectives. Overlying these projects is a management structure that views both the broad program purpose and the components that comprise the program.

More and Better Food (MBF), one of the demonstration projects, was set up to explore ways to increase food production to meet the ever-growing demand. It was designed as a multidisciplinary, multi-institutional project covering food, agriculture, and nutrition. It operates under the auspices of the NRC, which also plays a major role in implementing the project.

The ultimate goal of the MBF is to demonstrate the role that science and technology should play in food, agriculture, and nutrition. The project has four major objectives:

1. To increase the productivity of farm crops by using appropriate practices and simple technologies
2. To develop an effective interaction mechanism between Egyptian scientists and farmers that will provide a better understanding of the problems of the rural areas of Egypt
3. To develop NRC's managerial ability to direct resources in a multidisciplinary and multi-institutional activity
4. To assess the impact of increased productivity on the nutritional and socioeconomic status of the target population.

The first two chapters of this report described the extent of the problem and the manpower and institutional resources available to cope with it. This chapter documents how a research institute (the NRC) mobilized its scientific and technical manpower and utilized its system to develop, implement, and institutionalize a multidisciplinary R&D program that serves the national development priorities in food, agriculture, and nutrition. (The chapter does not include technical details of the implemented projects; that information is available in individual reports on those projects.)

THE NATIONAL RESEARCH CENTRE

The NRC is the largest diversified R&D institute in Egypt. It is located on a large campus in Dokki, across the Nile and two kilometers west of downtown Cairo. The main building contains a central management complex that includes the library and the National Information and Documentation Centre (NIDOC), which are affiliated with the ASRT, conference and meeting rooms, and four laboratories. In addition to the main building, the NRC campus also includes the Biology Building, the Chemistry Building, the Pilot Plant, and workshops; all are NRC affiliated. The Scientific Instrumentation Centre (SIC) and the National Institute of Standards (NIS), both affiliated with the ASRT, have separate buildings on the NRC main campus. The physics department of NRC is located in the NIS building.

There are two off-campus sections: one includes administrative offices (finance and personnel), and the other conducts demonstration research in such areas as solar energy, biogas, and protein from algae; there are also textile and food technology buildings.

History and Development of the NRC

The NRC as it exists today is the result of five evolutionary stages begun in 1939 when certain far-sighted Egyptian leaders, exposed to international scientific development, adopted the idea of having a National Research Council affiliated with the Cabinet. In 1940, the first group of researchers was sent to developed countries to study various research areas.

The second stage began in 1953 when the Permanent Council for Development of National Production was integrated into the National Research Council and became the National Research Institute. Its main function was the preparation of studies on such pressing problems as schistosomiasis, combat against animal diseases, development of agricultural machinery, and exploration of underground water in the western desert.

The third stage came in 1956, when a presidential decree gave the Institute independence and immunity from government regulation. The Institute's name was then changed to the National Research Centre, which became affiliated with the President's Office. In 1956, some campus buildings were completed and the first group of scientists trained abroad joined the NRC, thus inaugurating Egypt's first attempt to develop a generation of scientists and specialists in all scientific areas. The effort included the participation of university professors and an expanded program to send students abroad for graduate education and training. While initial emphasis was on the basic sciences, the increasing need to transform scientific work into practical activities dictated that the NRC direct part of its efforts toward problems of production and services. Successful individual efforts were reported, but they lacked sufficient institutional support to have an ongoing impact.

The fourth stage began in 1968, when the NRC was reorganized to direct its efforts toward problems of national economic development. The NRC was divided into seven research departments: Applied Organic Chemistry, Applied Inorganic Chemistry, Agriculture and Biology, Engineering, Petroleum and Metallurgy, Physics, and Medicine and Pharmacology. Each department had several laboratories specializing in specific aspects of the subject. To encourage staff to address the problems of production and services, the NRC developed a Project Contracting System and Technical Training Programs. In 1973, the NRC administration established consultative councils with the basic objective of fostering interaction among scientists and the production and services sectors. Membership for the councils was drawn from among NRC researchers, university professors, and technologists in the sectors. The councils covered such aspects as plant production, food industry, textiles, and chemical industries.

The fifth stage, which started in 1975 and continues today, is marked by a basic redirection of NRC activities from "self-oriented" research to "customer-oriented" or "user-oriented" research. The goal is to address national needs more effectively through scientific and technical research. In 1976, the NRC organized its development-related activities into seven major multidisciplinary programs: Food and Agriculture, Technology Transfer, Health and Environment, Energy, Natural Resources, Rural Development, and Basic Research. R&D management offices (including a Programming Office, an Office of Internal Contracts, an Office of External Contracts, and a Marketing Office) were established to support and facilitate activities. In August 1985, the NRC management system was again reorganized to delegate authority to NRC staff who received specialized training in R&D management. Figure 9 illustrates the current organization of the NRC.

At present, the NRC consists of 12 departments and 41 laboratories. The research staff includes 160 professors, 225 associate professors, 318 researchers, 321 research assistants, and 369 research fellows. There are 634 special assistants, and 347 technical assistants. A total of 2,374 persons are involved in research activities; the administrative staff totals 1,396.

Research in Food, Agriculture, and Nutrition

In 1954, the first group of seven scientists returned to the NRC after receiving degrees and specialized training in England, Germany, and the United States. The first fellowships for B.Sc. holders were granted in 1955. In June 1956, a law was passed specifying that the function of the NRC was to undertake basic and applied research in agriculture, industry, and general health.

In 1957, the NRC was organized into four divisions: Agriculture, Physical Sciences, Chemistry, and Medicine. The Agriculture Department was composed of three laboratories: Plant Protection, Soil and Fertilizers, and Agricultural Technology. Other laboratories--Nutrition, Fats and Oils, Dairy, and Biochemistry--were established to deal with food problems. The following list of graduate study requirements for Egyptian universities shows the areas of research interest in food, agriculture, and nutrition in 1957.

1. Plant Production and Protection
   - Studies on broomrape parasite of fava beans*
   - Nitrogenous requirements of banana*
   - Wheat resistance to stem rust*

2. Animal Production and Protection
   - Development of vaccines for chicken*

3. Soil and Fertilizers Laboratory
   - Use of gypsum to treat alkaline soil
   - Micronutrient depletion from soil
   - Physical and chemical properties of the soil in Egyptian oases

4. Soil Microbiology
   - Nematode classes in Egyptian soil

*These projects were supported by the NRC but conducted elsewhere.

ORGANIZATION CHART: NATIONAL RESEARCH CENTRE

TECHNICAL/ECONOMIC
FEASIBILITY

FIGURE 9 Organization of the National Research Centre.

5. Nutrition Laboratory
   - -- Screening of the nutritive value of common food in Egyptian diet
   - -- Protein-rich foods
   - -- Requirement from animal protein
   - -- Calcium sources in Egyptian diets and their constitution of phosphorus and iron

6. Fats and Oil
   - -- Microbiological production of fats and oils
   - -- New sources of fats and oils
   - -- Rice bran oil extraction and refining

7. Dairy
   - -- Carotene and Vitamin A content of buffalo and cow's milk
   - -- Microbiological determination of Vitamin B in milk and dairy products
   - -- Fatty acid and constitution of cow and buffalo milk

8. Food Technology
   - -- Nutritional constituents in artichoke*
   - -- Salting of local fish*

In 1957, the NRC began to establish permanent and ad hoc committees composed of consultative groups of scientists and technologists. There was a permanent committee on biological and agricultural sciences, as well as ad hoc committees for vegetable oils, organic fertilizers, and glucose preparation. Services extended to outside sectors included assessment of vegetable oil quality, analysis of well water, and examination of nozzles of pesticide sprayers.

In April 1957, researchers assigned to food, agriculture, and nutrition included: 1 foreign consultant, 15 supervisors from universities, 7 NRC staff members with Ph.D.s, and 30 research fellows holding B.S. degrees.

The year 1968 witnessed the beginning of expanded NRC efforts in food, agriculture, and nutrition research, and the successful resolution of certain problems regarding production and services for some types of contracts. Between 1968 and 1972, the NRC deepened its commitment to use its resources to serve national development priorities. During the period, activities in food, agriculture, and nutrition proceeded in three directions:

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*These projects were supported by the NRC but conducted elsewhere.

1. Research carried out in the NRC, basically for graduate work
2. Research contracts
3. Establishment of the Scientific Council for Food Industries, and the Specialized Committee for Research and Development of the El-Fayum Governorate.

Agriculture, food, and nutrition research activities conducted during the 1968-1972 period included both pure and applied research. Most of the work was carried out to fulfill M.Sc. and Ph.D. thesis requirements. Five sectors in the NRC, each totally independent of the others, oversaw research in five major areas. The period marked the beginning of research contracts between the NRC and the five production sectors. Table 21 illustrates the research activities of those sectors.

TABLE 21 Research Activities in Agriculture, Food, and Nutrition (1968 - 1970)

Sector	Research Completed	Research Ongoing	Contracts	Patents
Plant production and protection	55	39	10	2
Soil and water use	10	61	2	--
Animal production	10	7	1	--
Food industries				
Fats & oils	9	10	4	--
Food products	14	9	3	--
Dairy products	9	17	--	1
Nutrition	7	15	2	--
TOTAL	114	158	22	3

SOURCE: "National Research Centre," Annual Report, Al-Amiria Publishing, Cairo, 1972.

Twenty-two research contracts for services were signed and performed by the five sectors. Five of the contracts were with the Ministry of Agriculture (MOA) and the rest with companies belonging to the public sector. The value of contracts ranged from LE 800 to LE 30,500; the average was LE 4,432, and the total, LE 97,500.

Two councils were established within the NRC to deal with these contracts and other aspects of food, agriculture, and nutrition. The Scientific Council for Food Industries was headed by the President of the Supreme Council for Administration of Food Industries; it was composed of directors of production in 12 major industries, the El-Fayum governor, a former university professor, 5 NRC staff members, and 1 university representative. The Specialized Committee for Research and Development of the El-Fayum Governorate dealt with food problems as well as other areas of development. The committee was headed by the El-Fayum governor and had 5 members from ministries, 7 from the production and services sectors, and 15 from NRC, 5 of whom dealt with food, agriculture, and nutrition.

The period beginning in 1975 is characterized by the institutionalization of user-oriented research in all sectors. NRC policy has been to encourage activities undertaken through research contracts. In 1977, four types of contracts were in use:

1. Contracts with NRC administration, financed from its budget
2. Contracts with the ASRT
3. Contracts with the production and services sectors
4. Contracts with foreign agencies.

Table 22 shows the number of NRC contracts from 1977 to 1980.

TABLE 22 Research Contracts with the NRC in Food, Agriculture, and Nutrition (1977-1980)

	1977	1978	1979	1980
Total Contracts	96	93	102	103
Food, Agriculture and Nutrition Contracts	23 (24%)	28 (30%)	34 (33%)	33 (32%)

SOURCE: "National Research Centre, 25th Anniversary," Al-Ahram Publishing, Cairo, 1983.

Contracts with the ASRT totaled 32, of which 8 were in food, agriculture, and nutrition (25 percent). Contracts with production and services totaled 62, of which only 3 were in food industries, 2 in agriculture, and 1 in animal nutrition. Increased contracting with industry was evident, with private sector contracts totaling 16, or 26 percent; that figure reflects the willingness of the private sector to request research and development services.

The 1977-1980 period was also characterized by the initiation and development of research contracts with foreign agencies. Thirty-eight contracts were signed with the NRC administration. In the area of food, agriculture, and nutrition, contracts with the United States totaled 7 (the Food and Drug Administration, the United States Department of Agriculture, the Environmental Protection Agency, and the USAID); with West Germany, 2; United Kingdom, 1; and Saudi Arabia, 1.

The Applied Science and Technology Program, begun in cooperation with the USAID, and more specifically, the program's More and Better Food Demonstration Project were by far the largest assignments the NRC had ever attempted. The overall program involved the collaboration of more than 700--or 30 percent--of the NRC research staff. The following breakdown illustrates the scope of the More and Better Food Project.

o Number of qualified staff at any given time in MBF:		160-221
	Average	183
o Total qualified staff involved in MBF:		400
o Percentage by sector:	NRC	78%
	Ministries	16%
	Industry	4%
	Universities	2%
o Training:		17 person/months
o Consultancy:		50 person/days
o Equipment purchased abroad:		$600,000
Local materials:		LE78,000
o Number of projects:	Agriculture	17
	Animal Production	6
	Food Technology	4
	Nutrition	4
	TOTAL	31

THE MORE AND BETTER FOOD PROJECT

Increasing agricultural productivity in Egypt is vital, as has been shown by earlier discussions. To summarize, however, it bears repeating that both the per capita consumption rates and the demand for higher quality food are on the rise, as is the absolute number of people who must be fed from a small, and relatively unchangeable, amount of arable land. Although some additional improvements in food production are possible, clearly there are limits to the amount of food the Nile Valley can produce. Currently, food deficits are running 30 to 40 percent of annual consumption. Moreover, food subsidies have become a large item in the Egyptian national budget.

Every effort must be made in all sectors of the economy to use science, technology, and optimal management practices to alleviate Egypt's food production, distribution, and industrialization problems.

Project Definition

The MBF project is an attempt to apply the talents, resources, and experience from modern science and technology to a well-defined area of food-related problems both in Egyptian villages and the Egyptian food industry. The project is a major effort by the NRC to implement a practical program of multidisciplinary and multi-institutional research and development for the benefit of end-users and for the country as a whole.

Because the project has been included in the Applied Science and Technology Research Program, it benefits from technical cooperation and inputs of material resources provided by USAID. The project is a cooperative effort between the ASRT and the NRC in Egypt, and federal agencies, private institutions, and universities in the United States. In addition, within Egypt, other groups participating in the MBF come from the ministries, the governorates, the universities, and the food industry.

Goals, Objectives, and Basic Assumptions

The MBF project is designed to demonstrate that the application of science and technology increases the land productivity of food (plants and animals) and hence improves the socioeconomic status of a target population. The nutritional status of that population is also expected to improve because of the increased productivity. As a result of improvements in both socioeconomic and nutritional status, the physical characteristics of life in general could be expected to change, thus creating still further increases in productivity, which in turn equal development.

To achieve these goals, the project developed the following objectives:

- To apply NRC food, agriculture, and nutrition resources in selected villages in order to teach farmers, through simple practices and appropriate technologies, ways to improve land productivity and thus increase income and welfare of the overall community
- To study the impact of increases in productivity and quality on the socioeconomic and nutritional status of the village community
- To help institutionalize rural development research in the NRC
- To develop NRC managerial capacity to respond to multi-disciplinary and multi-institutional programs
- To provide opportunities for NRC staff to participate in applied research and to receive recognition for their achievements.

The following basic assumptions underlie the design and implementation of the project.

- The ordinary farmer is the intended client of the project. He is also a partner in the execution of the project, in decision making, and in the planning and choice of technology, and will be the consumer of the scientific information generated.
- The technology used should be simple, appropriate, inexpensive, and acceptable to the farmer. Preference should be given to technologies tested in Egypt or similar environments.
- Projects to be implemented must be carefully selected. Any failures will widen the confidence gap between the researcher and the farmer. The farmer should be guaranteed success.
- The project must work toward continuity and expansion of activities and increase public awareness and appreciation of the undertaking.
- Activities that show repeated success will be expanded to become a national program for development.

Justification

The justification for the project can be summed up by the following statements:

- The project deals with a national development problem.
- The project, which requires a multidisciplinary approach, will demonstrate the ability of the NRC to manage and execute relatively large and complex programs in collaboration with other research institutes.
- The NRC's technical capability will be developed by demonstrating the utility of applied research.
- The field studies will initiate a feedback mechanism that will orient the NRC laboratories to the real problems of development.

Project Initiation

In November 1975, the late Andre Colpitz, a USAID representative, was sent to Cairo to talk with the scientific and technical community about possible future cooperation between the two countries. Among the many institutes Mr. Colpitz visited was the NRC, where he held discussions with leading scientists. On his return to the United States, Mr. Colpitz recommended that USAID work with the NRC in the area of food. He even named the project "More and Better Food."

Because of this visit, the NRC scientific staff began thinking about a coordinated effort among the laboratories that work on food problems. Scientists involved in food problems met to frame proposed activities that would both meet project parameters and enhance the potential for a coordinated effort on food production problems. Discussions took place among individuals, between laboratories, and at department levels. Several documents were drawn up for discussion purposes. Three departments, Agriculture, Food Industry and Dairy, and Nutrition, were involved in the discussions.

The first document, 17 pages long, gave policy directions for increased production and better utilization of available food resources. The document was oriented toward the production of protein-rich food from conventional and unconventional sources. It did not give criteria for priority selection.

A second document of 61 pages pinpointed the utilization of available protein-rich sources in bread enrichment, baby food formulation, school lunch programs, and nutritious beverages.

The 80-page third document described three major stages of action in the preparation phase: selection of village(s) typical to rural living patterns; collection of baseline data on selected village(s); and design of experiments to increase food production. It called for three major project components: animal production, plant production, and protein enrichment of bread.

In December 1977, the president of the ASRT established a distinguished ad hoc Advisory Committee to review the documents and to guide the NRC staff as the project got under way. Members of the committee included Dr. Abdel Razak Sidky, former Minister of Agriculture; Dr. M. Bakr Ahmed, former Minister of Land Reclamation; Dr. Hady Al Magraby, former Minister of Supplies; Dr. Mahmoud Abdel-Akher, former Minister of Agriculture; Dr. Yousef Wally, present Deputy Prime Minister and Minister of Agriculture; Dr. Khalid Al-Shazly, Professor of Animal Husbandry; and Dr. Rashid Barakat, Professor of Nutrition. The Advisory Committee defined the two elements that would make up the activity in the village: (1) agriculture, including plant production and animal production, and (2) food and nutrition.

Since the food industry is by far the major industrial sector in Egypt, the committee recommended the selection of two or more projects that deal with major problems in the food industry sector. The NRC director established a committee drawn from the food industry to advise on the projects to be selected.

Based on the ad hoc Advisory Committee's recommendations, the NRC staff developed plans and requested the U.S. National Academy of Sciences (NAS) to select a U.S. panel to review the NRC plans and to discuss the implementation process with the NRC staff.

That panel included Dr. Donald Plucknett, head of the Agronomy Department of Hawaii University; Dr. Harold Calbert, head of the Food Technology Department, University of Wisconsin; and Dr. Kristin McNutt, nutrition consultant to the U.S. Congress. At the meeting, the panel recommended that three elements constitute the overall activity of the MBF: (1) agriculture and animal resources, (2) nutrition studies, and (3) food technology.

It also recommended that the project have these major goals:

- Improve productivity both quantitatively and qualitatively
- Improve the diet of a selected group of villagers, and hence increase their nutritional status
- Select two priority problems of food industries.

Finally, the panel recommended that the demonstration project be conducted in two villages, one typical of the traditional rural villages of the Nile Valley, and one selected from the newer villages that have grown up on reclaimed land.

The Steering Committee

Once the elements constituting the MBF demonstration project were established, the NRC Director set up a steering committee of the MBF. Committee members include Dr. Bakr Ahmed (former Minister of Land Reclamation), Chairman; Dr. M. Abdel Akher, former Minister of Agriculture; Dr. M. Abdel Kader, Professor of Nutrition; and from NRC, Dr. H. S. Salama, head of the Agriculture Department; Dr. Ibrahim Rifaat, head of the Food Technology and Dairy Department; Dr. M. Nawito, head of Animal Husbandry; Dr. A. Gad, head of the Fats and Oils Laboratory; Dr. Osman Galal, Professor of Nutrition (MBF Coordinator); and Dr. A.S. El Nockrashy, Professor of Biochemistry (Director of Applied Science and Technology Program). Representatives from the governorates to which the villages belong and the Director of the Organization for Reconstruction and Development of the Egyptian Village (ORDEV) are also members of the steering committee, whose functions include:

- Policy direction
- Establishment of criteria for project selection, approval of team members, approval of budgets, decisions on extension or discontinuation of projects
- Follow-up on project execution through evaluation, discussion, site visits, and meetings with the village community
- Approval of reports, incentives, and honoraria
- Enhanced utilization of project results for the establishment of national campaigns.

A number of factors contributed to the success of the steering committee and, hence, the MBF project:

- The steering committee had the full support of the NRC Director and complete delegation of authority.
- The NRC departments are not involved in project selection, but respond to the MBF steering committee. Proposals on areas identified by the steering committee are submitted by research teams directly to NRC representatives on the committee.

- The projects that were implemented in the villages were carefully selected.
- The group meetings held with the village community and participating farmers ensured that everyone involved had a clear understanding of the project's mechanisms and the outcomes it sought.

Project Management

In its early days, the steering committee laid down these criteria for the selection of projects to be implemented in the villages:

- The project must be suitable to village conditions; that is, it must be simple, effective, and inexpensive.
- The project must solve a problem that is well recognized by the village community, and the community must agree to support and participate in the activity.
- The project must ensure increased productivity and better income to the farmers, and must provide an opportunity for the researchers to demonstrate their ability to solve national development problems.
- The project must add to the overall effort to institutionalize research in rural development in the NRC.

The steering committee also set out sequential operational steps for the MBF project:

- **Village selection:** The establishment of criteria that would lead to a selection of a typical rural village in Egypt was assigned to a group of specialists from the ORDEV.
- **Baseline data collection:** Because the MBF seeks an overall program of development in the village community, it was necessary to collect baseline data on demographic, social, economic, political, environmental, and technical characteristics of the village. Analysis of the baseline data was expected to lead to the selection of projects that would contribute to an integrated rural development program.

Because the MBF activity was a new experience for the NRC, the steering committee moved carefully. An initial meeting to introduce the program was held; it was attended by Egyptian government representatives and governorate and markaz (county) representatives; by representatives from the agriculture, health, and social affairs sectors; and by the omda (mayor) of the village, leading village officials, the imam (Moslem prayer leader), as well as farmers in the village and from neighboring villages. The problems as seen by the village community and the role of the NRC and the supporting American agencies were discussed. The process of collecting baseline data was a long and tedious procedure. Almost daily visits by specialists in socioeconomics, agriculture, nutrition and general health, and food production were made to the villages. In addition, intensive laboratory work was conducted on such technical aspects as soil, pests, and food composition.

As the collection process stretched out to more than six months, some villages began to doubt the seriousness of the program. The steering committee therefore decided to go ahead immediately with some carefully selected projects. These activities were designed to renew the villagers' confidence in MBF and to demonstrate that the program would in fact increase productivity of farm crops. At the same time, the steering committee kept its long-term plan to use the collected baseline data in an integrated manner.

Management Mechanisms

Figure 10 is a diagram representing the mechanism through which the MBF operates.

Inputs for projects selected for implementation include available baseline data, demands from village councils, requests from groups of farmers, and new effective practices introduced by specialists in other villages or under similar environments.

The projects are assigned by the steering committee, through the program coordinator, to a team of specialists who submit a proposal; the team itself may propose a project that would meet the criteria set by the steering committee and request approval. Proposals are evaluated by a special panel on the steering committee. The ASRT coordinator allocates a budget for an approved proposal and reports on achievements to the ASRT, the Ministry of Investment and Internal Cooperation, and the U.S. counterparts. The NRC coordinator reports to the director and coordinates the MBF with other related activities in the NRC.

Steering committee members visit the project sites. The full committee holds periodic meetings in the villages to review the overall activity.

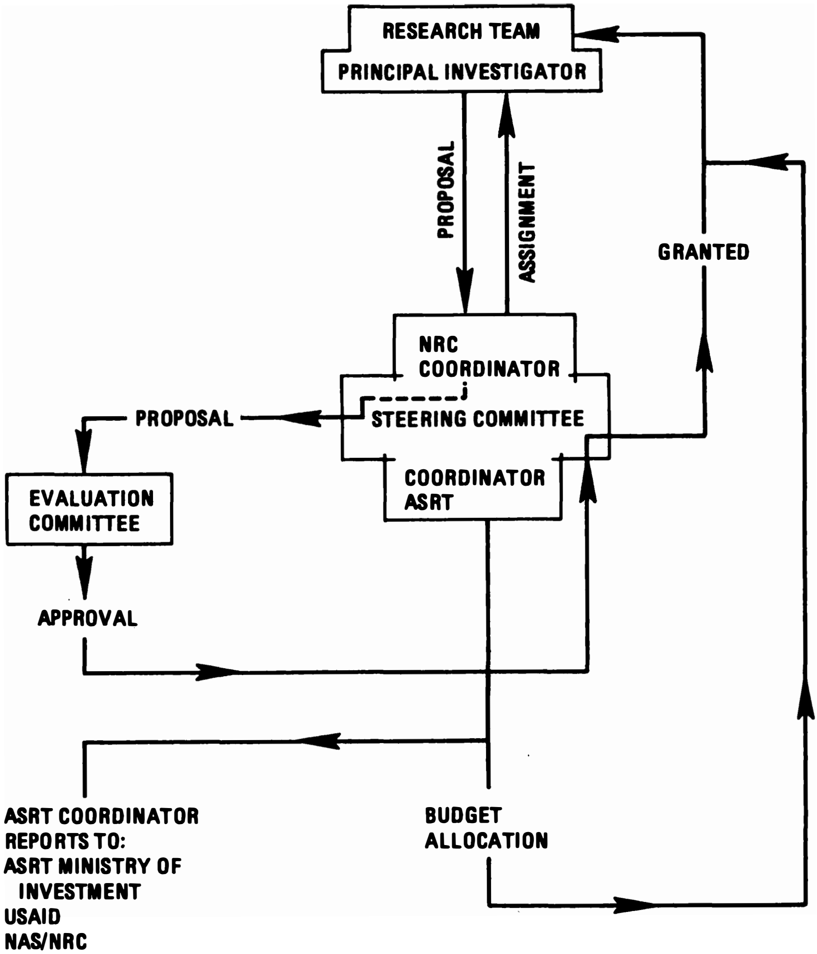


FIGURE 10: Management mechanisms of the MBF. (A.S. El-Nockrashy. From a presentation to the March 1984 meeting of a Phase II Planning Committee of the MBF.)

Continuity and expansion of a given activity are granted based on the importance of the project to MBF goals and objectives, its reception by the village community, its possibilities for expansion outside the village, and its suitability for nationwide application.

Village Selection

It was determined that two villages would be selected--one would be a typical Nile Valley village, of the sort that has existed throughout Egypt's history. The second would be a new settlement located on reclaimed land.

Nile Valley Village

Egypt has more than 4,100 villages that share many characteristics, yet differ in many others. As of 1978, 50 percent of Egypt's 40 million citizens lived in the country's 4,142 rural villages. Thus, selection of an Egyptian village to represent a typical example of the country's rural area was a delicate process and had to be based on well-defined and acceptable criteria and guidelines. Paramount was the need to establish guidelines and standards that could be replicated in similar projects.

The first set of criteria for a typical village included these requirements:

- o The selected village should have about 5,000 people.
- o The geographical location of the village should represent the Egyptian rural environment; thus, villages near cities or towns, which could become suburbs one day, were to be excluded.
- o There should be ready access to communication and transportation channels to allow the transport of personnel, products, and equipment.
- o The selected village should contain at least minimal agricultural, educational, health, and social services, as well as public utilities; water and electricity were necessities.
- o Agricultural production should be conventional and nonspecialized; work experience should be of high quality, nonspecialized, broad in application, and typical of much of the countryside.
- o The villagers must be aware of the experiment, accept it, and actively participate in its implementation.

- o The physical and nutritional levels of the selected village should reflect the general levels in the rest of the rural area; there should be no exceptional cases of malnutrition or disease.

Other considerations also governed the selection process. For example, it was thought that a broad base of agricultural knowledge would also facilitate the transfer and utilization of technology.

Because arable land is so limited in Egypt, the size of the farms and the number of landowners in the selected village would affect the success of the experiment. Statistics show that 94.5 percent of landowners in Egypt possess 57.1 percent of the total arable area in the form of small farms of five feddans and less; hence, when selecting a site, the balance between the number of owners and the area held must be considered.

The following governorates were excluded for consideration either because agriculture is not the prevailing activity or because the area is more urban than rural:

- o Urban governorates: Cairo, Alexandria, Suez, and Port Said
- o Coastal desert governorates: Sinai, Red Sea, and Marsa Matrouh
- o Governorates with predominantly urban characteristics: Giza, because of its proximity to Cairo; Damietta, because of its closeness to the Mediterranean; and the three governorates that overlook the canal.

The selection, therefore, was limited to the remaining 13 governorates. The three-stage selection process evolved: Stage I--selection based on population; Stage II--selection based on availability of services; Stage III--selection based on field visits to update information.

Because the human element is the chief concern of the project, population was the major factor in selecting villages that would reflect typical village populations.

Preliminary information provided by the ORDEV showed that the population of four governorates was homogenous with the standard population of Egyptian villages. Thus, the primary studies were limited to the villages of the governorates of Qalubia, Menufia, Sharkia, and El-Fayum.

To determine the prevailing village population, the quartile range method was adopted because it gave a more homogenous society from which sample selections could be made. The first step in Stage I was to tabulate the villages of each governorate in ascending order of population. A frequency table for the villages of each governorate was made based on population category, and the ascending cumulative frequency distribution was calculated. Next, the upper and lower quartiles of each governorate were arranged and their values were calculated. For the villages falling within the quartile range, homogenous in population size, a number was randomly selected. These steps were repeated for the four previously selected governorates as a group.

Under this process, the MBF team found that the upper and lower quartiles of all governorates fell within the quartile range of the selected four governorates. Moreover, the number of villages falling within the quartile range of each governorate was very close to its counterpart within the general quartile range for all governorates (Table 23); the latter range was used to select 25 percent of the sample, or 139 villages (Table 24).

Studies found that the village population of all governorates ranges between 2,061 and 7,455, and the village population of the four governorates combined ranges between 2,255 and 6,309.

For Stage II, information about services and their availability in the 139 sample villages was provided by the ORDEV. The services included agriculture (agricultural cooperative society, veterinary unit); health (family planning office, health office, rural health unit health complex, child care); utilities (water, electricity, communications); social services (youth center, social unit, nursing home/kindergarten, social development unit); and public services (post and telegraph offices).

TABLE 23 Upper and Lower Quartiles of Number of Villages within Quartile Range

Governorate	Quartile	Quartile	Governorate	Total
Sharkia	2,061	5,994	232	224
Qalubia	2,493	7,104	87	90
Menufia	2,250	5,808	146	160
El-Fayum	2,571	7,455	79	80
Total	2,255	6,309	544	554

SOURCE: MBF-Village Demographic Survey. Applied Science and Technology Project, the Agricultural Economics Research Group Report, NRC, NIDOC, Cairo, 1980.

TABLE 24 Villages within Quartile Range and Villages per Sample

Governorate	Number of Villages in Sample	Total Number in Quartile Range
Sharkia	52	224
Qalubia	23	90
Menufia	35	160
El-Fayum	29	80
Total	139	554

SOURCE: MBF-Village Socio-Economic Baseline Data, Volumes I-III. Agricultural Economics Research Group Report, NRC, NIDOC, Cairo, 1980.

The sample villages of each governorate were then arranged in descending order according to the availability of services. Twenty-five percent of the villages of each governorate were selected to include, to the extent possible, the administrative districts. The sample was limited to 35 villages.

Additional information was needed for the 35 sample villages. In the area of agriculture, information was needed on type of soil, irrigation and drainage, predominant crops, and animal resources. The information was provided by the MOA. In the area of education, the number and type of schools as well as the number of classes in each school needed to be determined.

After that information was studied, 10 sample villages (about 25 percent) were selected representing the four governorates on the same bases of availability of services, irrigation, drainage, conventional agriculture, and highest number of livestock.

The village committee, a branch from the steering committee, updated the information and ensured its validity.

Before final selection of a village in which the More and Better Food Project was to be implemented, more detailed information about the 10 sample villages was gathered based on the following questionnaire:

-- Is there a guest house? If not, what is the most suitable place to use?
-- Is there a road to the site?

-- Number of land holdings; locality area in feddans; number of livestock registered at cooperative society; quantity of feed (cattle-cake) used per year; soil (type and area); irrigation and drainage; pests (agricultural); animal resources; mechanization; irrigation pumps and tractors; labor conditions; method of storage; other agricultural activities (animal husbandry, poultry breeding, pigeon coops)?
-- Beehives; milk products; rural industries (mills, bakeries, slaughterhouses, grocery stores, butchers, barbers)?
-- Are cold meals served in nurseries or schools?
-- The activities of social institutions and the participation of residents.
-- Research work ongoing or already carried out in the village.

At Stage III, field visits were made by the village committee to the 10 villages to update statistical data so that the villages could be ranked before final selection.

During the site visits, meetings were held with the governors, governorate secretary general, village council, and executive and administrative leaders to discuss village activities related to MBF goals and objectives.

The questionnaire used to select the final villages was designed to give the following weights for the set of questions under the corresponding element:

ELEMENT	PERCENT
Agriculture	55%
Services	12%
Road	20%
Guest house	2%
Participation of residents in social institutions' activities	10%
School meals	1%

The villages that showed the three highest scores were: Kafr Al-Khadra, 80.1 percent; Mobasher, 73.3 percent; and Demleeg, 60.1 percent.

The steering committee and the village committee paid several visits to the three villages. This time the meetings were conducted directly with the farmers and the leaders in each village, as well as with those responsible for agriculture extension services, health, veterinary care, and social affairs.

The two committees selected the village of Kafr Al-Khadra (Bagour, Menufia Governorate) as the representative village of the old land.

Village from New Settlements

Land reclamation is vital to meeting the ever-increasing demand for food by Egypt's fast-growing population.

El-Tahrir Province is by far the largest new settlement in Egypt. There are about 400 villages in the new societies that are 15 to 20 years old; one village, South Tahrir, is more than 25 years old.

Information from the Ministry of Land Reclamation provided basic data on the villages. The same criteria for village selection used for the old settlements were used here, taking into consideration the proximity of the areas to Cairo.

The following settlements were found to conform with the selection bases: Al Nahda sector, with 11 villages; South Tahrir, with 8; North Tahrir, with 4; and Mariout, with 7.

Again, the statistical bases for selection were the same used for the village selection from old settlements, as were Stages I, II, and III.

After application of the above principles, the villages of Om Saber, Omar Makram, Omar Shaheen, Saladin, Baghdad, Al-Nagah, and Al-Maaraka were selected as a sample.

The population ranged between 2,500 and 7,485. With the random selection of 25 percent of the sample (according to the previous method) the villages of Omar Makram and Saladin were chosen for the study, and field visits were made to update and ensure accuracy of data before final selection.

The village of Omar Makram was selected because the majority of its inhabitants are landowners; this is not the case in Saladin village.

Baseline Data

The baseline data are important inputs for planning comprehensive development programs. They also form the base against which program outcomes can be measured.

Baseline data include data collected on the prevailing cropping systems, as well as data collected on the different technologies and practices used by various farmers in the villages. In addition, the data include analyses and assessment of the productivity of the different cropping systems in relation to technologies used, and the preliminary testing of new technologies or improved practices through small-scale trials that serve as background information for implementation during the second phase of the project. A determination of the

SUMMARY OF VILLAGE CHARACTERISTICS

KAFR AL-KHADRA

- Location: 55 km north of Cairo
- Inhabitants: 5,421
- Land Area: 1,159 (F) Cultivated: 895 (F)
- Total Holdings: 833

No. of Holders	Area of Holding (feddan)
471	less than 1
336	1 - 3
22	3 - 5
3	5 - 10
1	more than 10

- Cropping System

Area (feddan)	Crop
724	corn
504	clover
287	wheat
10	vegetables
5	soybean
31	potato
0	cotton
68	fruit trees

- Animal Wealth

1,285	buffalo and cattle
62	sheep
1	poultry farm

(60 families work in fishing)

- Education: Two preparatory schools (14 classes)
  Kindergarten for 30 children
  Literacy: 36.2%
- Annual Per Capita Income: LE 208
- Infant Mortality: 112.6/thousand; health unit exists.

SUMMARY OF VILLAGE CHARACTERISTICS

OMAR MAKRAM

- Location: 120 km north of Cairo
- Inhabitants: 4,860 Households: 749
- Land Area: 1,421 F (cultivated)
- Land Tenures: 319
- Average Land Holding Size: 3-5 F
- Crops:
  Summer: peanuts, maize, watermelon, and vegetables
  Winter: clover, wheat, barley, fava beans, and vegetables
  A limited area cultivated with fruit trees.
- Animal Wealth: 1,077 plus a veterinary unit
- Education: Three schools; literacy rate: 36.5%.
- Annual Per Capita Income: LE 149
- Infant Mortality: 94/thousand; health unit exists

major pest problems in the area and an assessment of the losses caused by those pests are also included in the baseline data. Finally, soil properties in the selected areas are explored to identify any defects that might affect plant production.

A typical work plan, including detailed investigations and analyses, was similar to the following:

A. Collection of General Data: Total cultivated area, area of each crop, agricultural practices, agricultural wastes, yield losses, transportation and marketing, storage conditions, problems of agricultural labor, and economic evaluation of cropping system.

B. Analysis of Soil Samples: Chemical and physical analysis.

C. Collection of Data on Particular Practices and Technologies:

- Crops, Cultivars and Cropping Systems: Prevailing cropping system, assessment of crops and cultivars, assessment of crop arrangement and practices, small-scale experiments to test possibilities of new crops and cultivars.
- Terrestial and Aquatic Weeds (survey and control): Periodic qualitative and quantitative identification in canals and drains, assessment of weed control measures.
- Irrigation and Drainage Systems: Assessment of irrigation management of different crops including equipment and methods, small-scale trials for identification of better water regimes of major crops, periodic determination of water quality and analysis of drainage water, soil permeability.
- Plant Nutrition and Fertilization: Kinds and quantity of fertilizers and manure used for different crops; deficiency symptoms of nutrients N_2, P, K, Fe, Zn, Mn, and B in soil and availability; condition and role of bacteria nodules of leguminous plants; periodic leaf analysis for macro- and micronutrients; testing for possible modifications of prevailing systems of fertilization.

D. Pests and Plant Protection: Survey of agricultural pests, changes in their population and rotation to surrounding environment; pests that cause significant losses to field crops and economics of losses; pests of stored products; pesticides used; pesticide residues; honeybee breeding conditions; possibility of breeding promising strains of silkworms on a large scale.

E. Farm Animals: Livestock as to species, type, sex, breed, products, market; specialized farms; insurance; housing; forage crops and waste; productivity parameters; calf rearing; reproductive efficiency parameters; causes of fertility impairment; milk production and use; animal parasites and diseases; poultry as to type, source, feed, market; medical care.

F. Food and Dairy Industry: Fruits and vegetables as to area cultivated, production and consumption, market, preservation, collecting centers or station; bread composition; baking techiques; energy sources; food processed locally or imported; by-products; milk sources, and use.

G. Nutritional: Conditions relevant to nutritional status, for example, social conditions, housing, economics, expenditure pattern, cultural background, services, health care unit attendance, facilities in unit, vaccination; prevalence of deficiency diseases; groups at risk; infant mortality rate.

Intervention Projects

MBF consisted of three primary activities: improving agricultural productivity in the two villages of Omar Makram and Kafr Al-Khadra; monitoring the nutrition and health status of younger children (ages 0-12) in those villages and at the same time making appropriate short-term interventions to improve health and nutrition; and working with industrial clients in the area of food technology to solve specific problems in the market preparation of local food items. The primary goal was to further food self-sufficiency and at the same time enhance the nutritional status of the community.

MBF interventions were broadly focused. NRC agricultural, nutritional, medical, and social scientists worked with the selected population on problems deemed important by the villagers themselves. A listing of those subprojects illustrates both the range of topics and the extent of cooperation between NRC and the village:

A. Agricultural Projects: Plant Production

1. Improvement of peanut production
2. Improvement of corn production
3. Wheat production
4. Vegetable crop improvement
   - -- Onions
   - -- Cucumbers
5. Fruit crop improvement
6. Soil fertility studies and interventions
7. Insect control studies
8. Weed control studies
9. Other
   - -- Silkworm raising
   - -- Honeybeekeeping

B. Agricultural Projects: Animal Production

1. Improvement of poultry production
2. Dairy production
   - -- Yogurt making
   - -- Cheese making
3. Animal health and reproductivity
   - -- Water buffalo
4. Raising of rabbits

C. Health and Nutrition Projects

1. Baseline study of nutrition/health status of young children (ages 1-12)
2. Determination of child growth patterns
3. Intervention to reduce child anemia
4. Intervention to improve nutritional status of preschool and school age children via a fortified, balanced food supplement
5. Health and nutrition education activities among village mothers

D. Food Technology Projects

1. Village-level cheese/yogurt making
2. Introduction of an industrial process for soft cheese (Damietta) produced from powdered milk
3. Improvement of storage life and consumer acceptance of a locally produced weaning food
4. Demonstration of a method to improve refining process of locally produced cottonseed oil
5. Formulation of new, highly nutritious prototype beverages produced from local products.

In 1983, a third village (Beni Magdoul, Giza Governorate) was selected as a new demonstration site for MBF activities. The activities listed above, as well as new projects in the areas of vegetables, fruits, poultry, and food technology, are currently being implemented.

In March 1983, MBF activities were reviewed to identify the inputs needed so the NRC could conduct a more systematic analysis of the data available. This analysis would be the basis for a program on integrated rural development that could be established and institutionalized. Under that program, the NRC would provide technical problem-solving and educational resources and would coordinate its efforts with other Egyptian agencies. The review identified three activities the NRC could undertake as an initial step:

1. Data analyses to determine the impact of the implemented projects on the socioeconomic development and nutritional status of the village community
2. Possible use of the three villages and their activities as demonstration sites
3. Establishment of organized efforts on nutrition education, support of women's role in development, and health and sanitation.

CHAPTER IV

THE MORE AND BETTER FOOD INTERVENTION PROJECTS

The More and Better Food Demonstration Project (MBF) began in May 1978 as a multidisciplinary, multi-institutional activity aimed at increasing land productivity (both quantitatively and qualitatively) and improving nutritional and health status, thus enhancing the socio-economic pattern of life in typical Egyptian villages.

The project was designed to cover three areas, each of which would include intervention projects: farm-system-related projects, nutrition-related projects, and food-technology-related projects. The initiation stage of the MBF project included four major sequential steps: (1) the establishment of a steering committee, with full delegated authority; (2) selection of three villages according to well-defined sets of criteria: one village represents the old land of the Nile Valley (Kafr Al-Khadra, Menufia); the second, newly reclaimed land (Omar Makram, Tahrir, Beheira); and the third, a village close to Cairo to determine the impact of location near the central government on the migration of manpower (Beni Magdoul, Giza); (3) collection of baseline data including demographic, social, economic, environmental, and technical aspects (the data would be used in the selection of intervention projects and as a reference throughout the life of the program); and (4) careful selection of priority projects to be implemented in each demonstration village.

This section reports on some of the projects that were executed under the three major areas. (It is beyond the scope of this section to discuss technical details of the project.) The goal is to give the reader a clear idea of the interaction between the team and the farmers, the accomplishments of the project (including techno-economic evaluation), the lessons learned, and above all the impact of the project on the NRC and the village community.

PLANT-PRODUCTION-RELATED PROJECTS

Selection of intervention projects that would have a substantial impact on village plant production relied on baseline data covering the cultivated areas, the cropping systems, crop productivity, irrigation and drainage systems, fertilization and deficiency symptoms of nutrients, soil properties, agricultural pests and their effects, pesticides used, and policy for plant protection.

Plant production projects implemented in the three villages included improved production of four major farm crops (maize, wheat, peanuts, and fava beans); improved production of four vegetable crops (tomatoes, onions, potatoes, and cucumbers); improved production of three fruit crops (grapes, citrus, and mangoes); soil fertility studies and intervention; insect control; and weed control. The plan also included two projects directed at increasing family income: a honeybeekeeping project and a silkworm raising project.

Three of these projects--tomatoes, maize, and peanuts--are examined more fully below. Other projects will be discussed in less detail but will also emphasize the major aim of each project--increased productivity and socioeconomic impact.

Project on Improvement of Tomato Productivity

Background

Tomatoes are by far the largest vegetable crop in Egypt. On average, 350 thousand feddans, representing 40 percent of the area cultivated with vegetable crops, are used to grow tomatoes each year. The average productivity is a low 6 tons/per feddan, yet the overall production of tomatoes is still higher than the production for any other vegetable crop.

In Omar Makram (Tahrir), tomatoes, the major vegetable crop, are grown on an area that ranges between 300 and 450 feddans every year. Kafr Al-Khadra, although it is in the Menufia Governorate where vegetable production has increased, has only a very limited area (10 feddans) that grows tomatoes, potatoes, and eggplants. Kafr Al-Khadra is a wheat and maize growing village. Beni Magdoul, which is close to Cairo where the market potential for vegetables and fruits is high, considers tomatoes a main crop. The average production rate of tomatoes in Tahrir is 5.6 tons per feddan; in Menufia and Giza, 4 tons each.

Modern technology and agricultural practices have made it possible to increase the productivity of land growing tomatoes by five or more times. The world record is as high as 120 tons of tomatoes/acre, and the ratio is likely to increase.

Thus, a project to increase tomato productivity through new techniques seemed to be an ideal initial undertaking for MBF, one that would gain the confidence of the farmers and increase their real income.

Objectives

The objectives of the project were:

- To increase the productivity of each unit area of tomatoes by more than three times through the application of new practices
- To increase the income of the farmer and encourage others to shift from traditional farming to modern techniques
- To increase possibilities for industrialization of the crop and for export
- To train some of the participating farmers in ways to produce healthy tomato seedlings for sale to neighboring villages, thereby creating a new business in the demonstration village
- To use the tomato farms as demonstration sites, and to give participating farmers responsibility for promoting the feasibility of the project among other farmers
- To create a healthy atmosphere of cooperation between the farmer and the Ministry of Agriculture's (MOA) advisor, and among those two segments and National Research Centre (NRC) staff.

Problems and Solutions

At the time the MBF project started, the experience of the NRC staff with tomato cultivation was limited to thesis-oriented research on plant physiology, nutrition, growth and development, pests, and pest control. Actual experience on new practices or modern methods was virtually nonexistent. Fortunately, the chairman of the steering committee had served as Dean of Agriculture, Cairo University, then as Governor of El-Fayum and Minister of Agriculture. While in El-Fayum, he supported new practices and technologies to improve production of farm crops. Tomato plantation on wires was introduced there and has been progressing since. The steering committee hired the top specialist from El-Fayum to set up the experiments in Omar Makram and Kafr Al-Khadra; NRC staff worked under him so they could take over the project. At present, the NRC has the top specialists in the country on several technologies of tomato farming.

A second difficulty was how to convince the farmer himself to participate in the project. Would a farmer who owns one feddan or less to feed himself and his family give his piece of land to a project or an outsider? What guarantees would he get? Where would he get the money to start a new practice that would cost more? Would he be attracted to a collective farm approach? These and other questions were discussed during the steering committee meeting and while campaigning in the villages to seek the farmers' support for the project. The solution involved a contractual agreement between MBF and the farmer on the following terms:

- The farmer conducted all the work on his farm according to the directions given by the project team.
- The project supplied all the facilities and products not used in traditional tomato farming.
- MBF guaranteed a net income equivalent to that received from the same crop under traditional farming.
- At the end of the season, the farmer reimbursed the money spent on materials and supplies according to agreed-upon settlements.
- All other income and reusable materials went to the farmer.

Technical difficulties included selection of tomato varieties that give a large, high-quality crop, that resist diseases, and that fit in the growing season; protection against diseases and pests to which new varieties were susceptible, as well as seedling bed protection against virus infection before transfer; proper preparation of land before cultivation to suit the new practices; determination of the optimum number of plants per unit area; timing types, quantities, and application procedures for fertilizers; and irrigation techniques to prevent overirrigation as well as drought. Accordingly, the program designed and implemented by the NRC staff included selection of high-yielding varieties, proper care of seedling beds in cultivation under tunnels, intensive farming, proper utilization of soil and leaf fertilizers, control of irrigation practices, and application of a highly efficient system for disease and pest control.

The following steps were also found to be necessary to achieve the objectives: periodic meetings had to be held between the NRC team and individuals involved in the project (agriculture extension specialists, governorate personnel, village councils, and farmers) to explain details and ensure continued commitment; the Organization for Reconstruction and Development of Egyptian Villages (ORDEV) had to make all materials available to the project (seed, fertilizers, pesticides); a multidisciplinary team had to be organized to cover all aspects; the Ministry of Agriculture had to assign one member of its extension staff to supervise the planting of each of the 50 feddans; and the NRC, in collaboration with ORDEV, had to prepare a card index for each farmer to record requirements.

Accomplishments

The project implementation passed through three major stages that reflected the development of new practices to increase tomato productivity and an expansion in cultivation; the continuity of the activity given the high rate of acceptance by the farmer; the support of the highest executive national committee; and the development of an experienced team within the NRC in several technologies of tomato cultivation (Figures 11 and 12).

In 1979/1980, the NRC implemented a program of increased productivity of tomatoes by wire cultivation. The project was conducted in Omar Makram and Kafr Al-Khadra. The extent of increased productivity is shown below:

TABLE 25 Increased Production of Tomatoes (1979/1980)

Village	Production (Ton/Feddan)		Extra Income
	Average in Governorate	Average MBF	LE/Feddan[a]
Omar Makram	4.0	27.8	2380
Kafr Al-Khadra	5.7	32.4	2670

[a] 100 Egyptian Pounds/Ton

SOURCE: "Program on Development of Tomato Crop in Giza, El-Fayum and Beni-Suef Governorates," NRC, ORDEV, and Agricultural Research Centre (ARC), General Organization for Agriculture (GOA), Al-Hadara Al-Arabia Publishing, Cairo, 1983.

FIGURE 11 Traditional tomato farming in Omar Makram.

FIGURE 12 MBF tomato cultivation on wires Omar Makram.

In 1981, based on the achievements of several projects of the MBF, the Governorate of Giza and the Academy of Scientific Research and Technology (ASRT) mutually financed a program entitled "Science and Technology in Rural Development" (STRD) to serve as an expanded application of the MBF's achievements. In that year, tomato farming in the Governorate of Giza covered 1,000 feddans owned by 572 farmers from 14 villages. The average production increased from 6.74 tons/feddan to 22.88 tons/feddan (LE 1,614 extra income/feddan).

In 1982, the National Supreme Committee for Policies and Economics, chaired by the Prime Minister, approved the STRD Program, which included the expansion of the tomato program in Middle Egypt Governorates to 7,831 feddans in the Governorates of Giza, Beni-Suef, and El-Fayum. There, 6,109 farmers in 56 villages from 5 counties participated in the program. Seedling beds were established on 145 feddans that supplied both the participants and an additional 1,000 feddans belonging to nonparticipating farmers in other parts of the country.

Table 26 shows cultivation, production, and income rates in the three governorates.

In 1984, the MBF project introduced the technique of growing tomato seedlings under plastic tunnels in Beni Magdoul (Giza Governorate). The seedling beds initially covered one feddan and then four. Crop yield increased from 7 tons to 25 tons (variety BC 97).

Economic Evaluation

Total production from the three governorates was 233,988 tons from a total area of 7,831 feddans (an average of 29.99 tons/feddan). The expected total production from the same area if the project had not been implemented was 60,062 tons; the increased productivity of areas covered by the program was 173,926 tons. The average increased productivity per feddan in the three governorates was 22.21 tons. The percentage of increase in overall productivity was 289.5. Increased profit as a result of the project in the three governorates was LE 17.39 million (one ton of tomatoes sold for = LE 100).

Project on Improvement of Maize Productivity

Background

Maize (corn) ranks high among farm crops in Egypt, both in terms of the cultivated area it occupies and the total revenue it generates. About 1.8 million feddans

TABLE 26 Tomato Projects in the Governorates of Giza, Beni-Suef, and El-Fayum

Gover-norate	County	Cultivated Area Feddan	Kirat	Number of Farmers	Average Productivity in MBF Participants	Average[a] Productivity in Non-Participants	Extra Profit (LE/feddan)
Giza	Aiat	1,556	13	1,204	25.17 / 39,175	6.81 / 10,600	1,836
Beni-Suef	Alwasta	1,000	—	821	26.35 / 26,350	7.21 / 7,210	1,914
El-Fayum	Tamia El-Fayum Sanoras	5,275	—	4,084	31.94 / 168,478	8.01 / 42,252	2,393

[a] Top values represent average productivity in tons per feddan for MBF participants and nonparticipants, respectively. Bottom values represent overall production (in tons) of the area participating in MBF, and an equivalent nonparticipating area, respectively.

SOURCE: "Program on Development of Tomato Crop in Giza, El-Fayum and Beni-Suef Governorates," NRC, ORDEV, and ARC, GOA, Al-Hadara Al-Arabia Publishing, Cairo, 1983.

(33 percent of all arable land) produced about 3 million tons of maize in 1983. Recent records show that the current domestic consumption of maize is about 5 million tons and is estimated to reach more than 6 million tons by 1990, necessitating an increase in total production of more than 50 percent. Therefore, assuming the area planted in maize remains constant, production per unit area must be doubled. This can be achieved only by application of new practices and modern techniques.

In Kafr Al-Khadra, maize occupied 724 feddans in 1983, or about 81 percent of all cultivated land there. Average annual production of maize did not exceed 11-12 ardab (1 ardab = 140 kg maize), a low figure given Kafr Al-Khadra's fertile soil, abundance of water, and the suitability of its weather.

FIGURE 13 Production of early tomatoes by application of plastic tunnel techniques for seedlings.

In Omar Makram, maize is considered a basic commodity for breadmaking and for animal and poultry feeding. It occupies 577 feddans, or 36 percent of all arable land in the village; in addition, 300 feddans of maize are double-cropped with peanuts. Average production of maize in the village (single crop) ranged between 6.7 and 8.6 ardabs, an extremely low productivity rate.

Current technologies applicable to small holdings potentially could triple the productivity of maize per unit area in the two villages. If such a goal were to be achieved, Egypt would not only become self-sufficient in maize for the foreseeable future, but could also turn over part of that land to other crops.

Objectives

The maize project set several objectives:

- To more than double productivity per unit area through the use of new varieties and suitable practices, thus increasing the income of the small farmers
- To encourage maize growers to adopt a package of improved agronomic practices through the use of demonstration fields
- To work toward application of the improved practices on a national level to reach self-sufficiency in this strategic crop
- To introduce a summer forage crop for feeding livestock and to avoid defoliation and detasseling of the plants.

Program Elements

The program applied practices developed by NRC scientists in the extension field at Kafr Al-Khadra. The program comprises four major elements: use of high-yielding maize varieties, application of simple agronomic practices, increase in plant density, and introduction of multicutting summer forage crops to prevent defoliation and detasseling of maize plants and to produce green fodder for feeding livestock during the summer season.

Problems and Solutions

Maize growers are accustomed to growing Baladi (an impure variety), which is characterized by low productivity and susceptibility to fungal diseases. Nonetheless, Kafr Al-Khadra, even with a low productivity rate, was self-sufficient in this crop. As maize was not a commodity for sale in the village, it was used as a dual-purpose crop for supplying grain and green fodder. Farmers were reluctant to shift to new varieties.

Under the traditional approach, primitive seeding practices led to uneven distribution of seeds, a decrease in germination percentages, and delays in plant emergence. Moreover, defoliation and detasseling of maize plants affected the grain yields. Plant density was too low (10,000-12,000/feddan) and too uneven to produce high yields. The low level of nitrogen fertilizer and an unfairly distributed irrigation system were other major constraints.

The solution was in the form of a package of improved agronomic practices that would guarantee increased productivity and income to the farmer in a contractual agreement similar to that used in the tomato project.

The Improved Agronomic Package

Six major elements constituted the newly developed agronomic practice. All farmers were required to follow regulations put forward and supervised by the team. The following elements were included:

- o The use of high-yielding maize varieties: imported Pioneer-514 (hybrid) and local Giza 2
- o Early sowing during late May early June
- o Furrow/ridge irrigation to provide better control of irrigation and to facilitate weed control
- o Increased use of nitrogen fertilizer from 60 to 90 kg/feddan and use of foliage fertilizer
- o Maintenance of maize density to more than 20,000 plants/feddan until harvest time
- o Use of a summer forage crop (Millex-24) grown on 2 kirats (kt) for every feddan owned by the farmer; thus, there was no defoliation or detasseling.

A detailed program on the agricultural practices was written in simple language and distributed among participating farmers. The program covers both maize and the summer forage crop. A condensed training program was given to extension service agricultural engineers.

Accomplishments

The maize project started in 1980 and continued until 1983 under the MBF project. In 1981, the maize project was extended to the Giza Governorate as part of the mutually financed ASRT-Giza Governorate Program on "Science and Technology in Rural Development." The MOA, in collaboration with ASRT, started a national campaign for improved maize production. The goal is to reach self-sufficiency in this strategic crop.

Table 27 provides statistical comparisons of the maize projects in Kafr Al-Khadra and Omar Makram. Figure 14 illustrates the crop.

Pioneer-514 maize (an American hybrid) has a shorter and thicker stem than the traditionally grown Baladi variety, as well as a greater number of green leaves, a larger leaf area, and a larger leaf area index. These characteristics decrease the amount of lodging and breakage. Pioneer-514 was chosen for cultivation in Omar Makram. The plant was cultivated at a density of more than 20,000 plants/feddan, almost double the number of Baladi plants per feddan in farms outside the project. However, farmers were dissatisfied with the technological properties of the grain when it was mixed with wheat flour in bread baking. Thus, the variety was changed to Giza-2 (an Egyptian variety), with grain properties similar to the Baladi variety but with a yield equivalent to the Pioneer-514. The 1982 decrease in the area planted in maize was due to the unsatisfactory experience with Pioneer-514. However, the six feddans planted in Giza-2 attracted more farmers in 1983. In 1983, farmers were able to plant their fields with only a little guidance from the MBF team, a reflection of the extent to which they had acquired the necessary technology.

TABLE 27 Maize Projects in Kafr Al-Khadra and Omar Makram

Village	Year	Maize Variety	Area (Feddans)	Number of Owners	Average Yield Ardab/Feddans[(a)]
Kafr Al-Khadra	1980	Giza-2	4	4	22.9
	1980	Baladi[(b)]			11.8
	1982	Giza-2	46	72	25.5
	1982	Baladi			11.8
Omar Makram	1980	Pioneer-514	64	70	22.2
	1980	Baladi			7.5
	1982	Giza-2	6	11	23.7
	1982	Baladi			8.6
	1983	Giza-2	54	54	18.6

[(a)]1 ardab = 140 kg of maize.
[(b)]Baladi is an impure variety traditionally grown in Egyptian villages.

SOURCE: N.I. Ashour. "MBF: Program on Development of Maize Crop and Introducing a Summer Green Fodder," National Information and Documentation Centre, Cairo, March 1983.

The MOA's national campaign for growing Giza-2 maize got underway in 1980. Table 28 shows the results of the program for the years 1980 through 1983. Today, Giza-2 is grown on more than 300,000 feddans in 12 governorates.
Economic Evaluation

TABLE 28 National Campaign for Giza-2 Maize (1980-1983)

Year	Governorates	Total Area (Feddans)	Average Productivity (Ardab/Feddan)
1980	Dakahlia	3,058	23.7
1981	Dakahlia, Gharbia, Menufia	7,380	26.4
1982	Dakahlia, Gharbia, Menufia, Sharkia	9,427	28.9

Ardab = 140 kg

SOURCE: N.I. Ashour. "MBF: Program on Development of Maize Crop and Introducing a Summer Green Fodder," National Information and Documentation Centre, Cairo, March 1983.

The economic impact of the maize project is illustrated by the following results of 1982 season in Kafr Al-Khadra:

- Area cultivated with Giza-2: 46 feddans, 5 kirats
- Total crop: 1,179 ardabs
- Expected yield from same area with Baladi variety: 545 ardabs
- Increased production with Giza-2: 634 ardabs (116.3 percent)
- Increased income with Giza-2:
  - LE 8,879 (LE 14/ardab) government price
  - LE 11,416 free market price
- Production of green fodder Millex-24 on area of project (4 feddans, 15 kirats): 325 tons
- Price of fodder crop: LE 3,250 (LE 10/ton)
- Total area cultivated by both crops: feddans 50, 20 kirats

- Total income: LE 12,129
- Total cost of application, including materials, supplies, and salaries: LE 1,709
- Net increase in income from entire area: LE 10,420
- Net extra income per feddan = LE 205
- Cost/benefit ratio 1 to 7.1.

Lessons Learned

Several conclusions were drawn during the course of project initiation:

- In demonstration projects it is advisable, at least in initial stages, to have the experimental area cover as many plots as possible so all farmers in the village have a chance to see the impact.
- The maize variety Pioneer-514, although it produces a large crop, is not acceptable to the Egyptians because of its poor flour characteristics; the locally produced Giza-2 is the most suitable for national programs.
- The cultivation of an animal fodder, such as Millex-24 or Sordan 77, on an area of 1-2 kilotons/feddan lessens defoliation of maize leaves and increases net income.
- Successful expansion of maize production requires that enough Giza-2 seed and pesticides be available at fixed stages in the planting cycle. To achieve this, there must be better development of management systems and more support for the agricultural cooperatives.

Project on Improvement of Peanut Productivity

Background

In 1980-1982, the total area cultivated in peanuts in Egypt averaged 28.6 thousand feddans/year, producing about 332 thousand ardabs/year (1 ardab = 75 kg peanuts), or 11.6 ardabs/feddan. Egypt's exports of peanuts in 1982 amounted to 55,373 ardabs (4,153 tons) of hulled peanuts and 6,521 ardabs (489 tons) of kernels, for a value of LE 2.7 million. Peanuts are exported to more than 12 Arab and European countries.

Tahrir province is a major peanut producer. One of its sectors, Al-Tahady, plants more than 6,000 feddans in peanuts every year. (This sector is made of reclaimed land that the government distributed to graduates of faculties of agriculture at a rate of 10 feddans/person.)

The peanut project was implemented in Omar Makram, which is located in a peanut-growing area. (Kafr Al-Khadra and the rest of the Menufia Governorate do not grow peanuts.) The five-year-old project is an excellent example of the use of science and technology to increase production. The project not only succeeded in identifying the causes of deterioration of the peanut crop in the Al-Tahady sector (from an average of 9 ardabs/feddan in 1979 to an average of 2.8 ardabs/feddan in 1982), but it also launched an integrated treatment that, in 1983, resulted in an average production of 18.6 ardabs/feddan in a demonstration area of 150 feddans. This year (1985), the program will cover the entire 6,000 feddans in the sector. This effort will be financed by the Egyptian MOA and supervised by NRC staff. The MOA has also established a national committee to develop Egypt's peanut crop; the NRC will play a leading role in that effort.

Objectives

The program had the following objectives:

- To demonstrate, through an integrated program, how scientific and technical expertise can diagnose the problems facing peanut producers, allocate needed resources, and implement a timely production plan
- To demonstrate how the program increases peanut production, to make farmers aware of the benefits they gain by joining the project, and to lead to a nationwide program for developing the peanut crop
- To increase the country's export of the commodity, thus bringing in more foreign currency.

Problems and Solutions

The project began in Omar Makram in 1981. The healthy appearance of the peanut crop there as well as the high crop yield (an average of 31.2 ardabs/feddan [2.3 tons/feddan] compared with a reported average of 10 ardabs/feddan [0.75 ton/feddan] in former years) prompted the Al-Kherigeen (Graduates) Union (landowners in Al-Tahady) to ask the MBF steering committee to help them overcome the disaster that affected their peanut crop.

Thus the project was expanded to cover both Omar Makram and Al-Tahady (both in Tahrir Province, Beheira Governorate). Each had a set of problems that required an individualized action plan.

In Omar Makram, the problems were as follows:

- The reuse of old cultivars for more than 10 years resulted in a continuous decrease in the peanut yield in Omar Makram; farmers were using self-produced seeds from previous seasons.
- Farmers used an unbalanced fertilization system that lacked both major and minor nutrients.
- Farmers did not know how to combat disease and insects; thus, they were unable to identify early stages of infection, where control measures are most effective.

The MBF offered Omar Makram farmers a package of production practices. The package included: the use of the high-producing variety, Giza-4; instructions regarding ground preparation by double-ploughing and the addition of super phosphate; pretreatment of seedlings with Vitafax pesticide and with nitrogen-fixing rhizobium (prepared by NRC scientists); addition of Endrin pesticide after sowing; irrigation techniques consisting of watering every 4 to 6 days, then discontinuing the water near ripening to avoid wrinkling; fertilization techniques whereby nitrogen and potassium were applied to the soil and micronutrients were applied as foliar spray; no intercropping of peanuts with other plants; and start of harvesting 120 days after sowing.

The Al-Tahady sector's 18,000 feddans are divided among six cooperative unions. The sector is cultivated by the 520 families of the Al-Kherigeen (Graduates) Union. Peanut crops cover more than 6,000 feddans. In 1979, peanut fields in four cooperatives--Al-Kefah, Al-Semoud, Al-Eibour, and Al-Marakah--began to be affected by a disease that sharply decreased crop yields year after year. The problem started at the 70th day of growth, when new leaves turned yellow. The yellowing affected the entire crop between the 90th and 100th day of plant growth. The plants then began to wilt, and the yellow color turned dark brown. Damage was so extensive that many farmers did not even try to salvage what peanuts they could. Records kept by the Al-Kefah Cooperative showed the average peanut yield in Al-Tahady in 1979 to be 9.0 ardabs/feddan; in 1980, 5.0; in 1981, 3.2; and in 1982, 2.8 ardabs/feddan.

Between 1979 and 1982, the economy lost LE 1.116 million, based on 6,000 feddans under cultivation and LE 30 per ardab of peanuts.

Four attempts were made to understand the problem and resolve it:

- In July, 1980, the Plant Nutrition Institute of MOA identified the problem as a lack of iron.
- In September, 1981, MOA identified the cause as infection with nematodes and recommended treatment, but did not assist farmers in implementing the treatment.
- In September, 1981, the agriculture faculty of Menufia University confirmed the MOA identification and offered to assist in resolving the problems.
- In December, 1981, the farmers' union contacted the MBF steering committee.

In 1982, a team of NRC specialists in the areas of nematode, fungi, and pest control; soil sciences; and fertilization techniques started to work on 10 feddans. Its primary goal was to determine conclusively the cause of the disease. At the end of the growing season, a complete picture of the course of the disease was reported to the MBF steering committee, along with specific recommendations for an integrated program of disease control and fertilization.

The team found that nematodes of the root-nodulizing type injured the roots of the plant; this was followed by fungal infections (*Fusarium* and *Aspergillus flavus*) that spread to block the xylem vessels and caused the plant to wilt.

After diagnosing the causes, the team developed a treatment package based primarily on protection of the crop against fungi and nematodes beginning with planting and continuing until complete maturity. Vitafax serum was used for seed and soil, and Diathen 45 was used for plants. Fertilizers and micronutrients were also applied. Figure 15 illustrates peanut project at Al-Kherigeen.

Achievements

The peanut project began in 1981 and has been expanding since then into a program for the improvement of peanut productivity for the entire country. The program has gone through several stages, which are briefly described in the following paragraphs.

In 1981, the program began in Omar Makram (Tahrir Province) on an area of 64 feddans owned by 54 farmers. As a result of successful design and execution of the project plan, average productivity of the project's peanut crop was 31.2 ardabs/feddan, compared to a village average of 10 ardabs/feddan for nonparticipants. This was an increase of 21.2 ardabs of peanuts per feddan and an increased income to the participating farmer of LE 530 per feddan. The MBF project supplied the fungicide and the pesticide for the first year only, at a cost of LE 33.91/feddan.

FIGURE 15 Peanut project in Omar Makram.

In 1982, the number of participating farmers in Omar Makram increased to 121, and the area increased to 255 feddans. The farmers carried all expenses, with MBF supplying them with the nitrogen-fixing rhizobium (prepared in the NRC) and the micronutrients. The average productivity of the land in the MBF project was 32.5 ardabs/feddan. Average productivity of nonparticipants in Omar Makram was between 10 and 12 ardabs/feddan.

In 1983, the number of participants in Omar Makram reached 204 and the area, 450 feddans. The MBF project provided the farmers with nitrogen-fixing Bacterin, prepared by NRC from five strains and fortified with micronutrients. That year, the project added training for extension service agriculture engineers in Omar Makram to allow continuity and self-reliance in the future. At the same time, work in the field proceeded with little or no supervision from NRC. Average 1983 production was 27 ardabs/feddan, the amount that can be expected from Omar Makram farmers without NRC assistance in the future. All second- or third-year participants obtained yields above average, with values as high as 36 ardabs/feddan reported. In most cases, new participants achieved below-average yields.

At Al-Tahady sector, work started in 1982. The 1981 crop had averaged 2.8 ardabs/feddan. Here, the initial aim was to identify the cause of the crop failure. That effort was successful, and by 1983, the average productivity of the 150 feddans under cultivation was 18.6 ardabs/feddan. In 1984, the area was increased to 600 feddans, which produced an average of 20 ardabs/feddan.

In 1984, the peanut project was extended to cover 750 feddans in Omar Makram and 1,250 feddans in the Al-Tahady sector. The average yield in Omar Makram was 26 ardabs/feddan and in Al-Tahady, 19 ardabs/feddan.

In 1985, the NRC staff was engaged in a national effort with the MOA. The joint program covered the entire 6,000 feddans under peanut cultivation at Al-Tahady. The NRC program on improvement of peanut productivity was implemented. The MOA has allocated LE 100,000 for the activity. The MOA also established a Committee for Development of Peanut Production; the NRC was a participant in the committee, and was also involved in a program that covered 3,000 feddans (900 in Sharkia, 900 in Giza, and 1,200 in Ismailia Governorates). The MOA allocated LE 140,000 for the activity.

Economic Feasibility

The productivity of the peanut crop in Omar Makram in the 1983 season was used to evaluate the economic feasibility of the project. A comparison of participants in the project with nonparticipants follows:

Participants

- -- Total cultivated area in 1983 = 450 feddans
- -- Average peanut productivity = 27 ardabs/feddan
- -- Price of one ardab as sold to government cooperative = LE 30
- -- Average income per feddan = LE 810
- -- Total experiences per feddan = LE 160
- -- Average net income per feddan = LE 650
- -- Net income of the entire area = LE 292,500.

Nonparticipants

- -- Average productivity of nonparticipants = 12 ardabs/feddan
- -- Average income of nonparticipants = LE 360/feddan
- -- Total expenses outside the project = LE 100/feddan
- -- Average net income = LE 260/feddan
- -- Net income for an area equivalent to that used by participants (450 feddans) = LE 117,000.

The extra income generated by the project was LE 390 per feddan, or LE 175,500 for the entire 450 feddans. The ratio of income between participant and nonparticipant was 2.5 to 1.

ANIMAL-PRODUCTION-RELATED PROJECTS

The past decade has witnessed increasing imports of meat, milk, and their products to Egypt. Per capita utilization records for the period 1974-1980 show increases in animal and poultry products of 38 percent for red meat, 67 percent for poultry, 76 percent for fish, and 41 percent for dairy products. Production during this period showed no significant increase.

Economic studies reveal that the Egyptian Government will have to pay $20 billion over the next five years to cover basic food imports, many of which are meat products. Programs that raise the productivity and improve the reproductivity of domestic livestock and poultry are desperately needed to stem the growth of imports of these foodstuffs.

The MBF project, within its modest facility, has implemented projects that could serve as model research and development systems in the development of animal wealth. The projects include: increasing the productivity and reproductivity of livestock under Egyptian village conditions; controlling parasites and diseases of animals; improving poultry productivity; and intensive rabbit production.

Project on Improvement of Poultry Productivity

Background

Increasingly, Egypt must import more and more of its food. In addition to the nation's high birth rate and limited resources, its rural sector, which has always been Egypt's food producer, is rapidly becoming a big consumer as well.

Egypt's total production of meat is about 621 thousand metric tons; in addition, it produces 2.2 million tons of milk. Egypt's imports of meat products exceed 200 thousand tons at a cost equivalent to 120 million Egyptian pounds in foreign currency.

For many years, poultry-keeping suffered from poor management, feed shortages, and improper husbandry. Aware of these problems, the government encouraged breeders to start large projects for poultry raising and egg production, and provided loans on repayment terms. In five years, Egypt became largely self-sufficient and stopped the import of chickens and eggs. However, these successful intervention projects created socioeconomic changes in rural areas. Traditionally, Egyptian farmers raised 10-15 birds for incidental profit and for family consumption. Gradually, the farmers became big consumers of the broilers and eggs produced for urban area consumption. This change threatens to counteract the measures taken by the government, since 55 percent of Egypt's population lives in rural areas.

The MBF project undertook a program to encourage the long-practiced activity of poultry-keeping by the farmer. Because raising chickens is customarily done by the farmer's wife as a sideline, such a project also encouraged the active participation of women in the village economy.

Objectives

The objectives of the MBF's poultry-keeping project included the following:

- Development of small-scale poultry production units (family size)
- Proper distribution of available feed units year round
- Increased family income and provision of a good source of protein to farmer's family
- Assessment of the nutritional impact of the project
- Increased participation by women in village productivity.

Project Development

The project on improvement of poultry productivity was designed to change poultry-keeping from a sideline operation to a family-sized production project. This necessitated introducing highly productive breeds; assessing available resources for chicken feed formulations and developing year-round distribution programs; developing small-scale production units for broilers and eggs; and training villagers in modern managerial techniques of poultry-keeping.

Kafr Al-Khadra (Menufia Governorate) and Omar Makram (Tahrir Province) were the sites selected for the project. The project began in Kafr Al-Khadra with numerous workshops on project goals. Continuous contacts at the early stages between the project's female scientists and village women was a critical factor in the project's success.

In 1980, project staff interviewed 80 prospective families, selecting 8 to join the project. Participants had to be willing to take some financial risk in purchasing the chicks and rations, and they had to have a closed room for the project. Equipment, consisting of a small heater, lamp, and feeding apparatus, was purchased by the project (at LE 70 per family). All costs were to be subtracted from sales proceeds.

During the first rotation, 800 chicks were distributed, 100 to a family. In the second rotation, the number of chicks increased to 2,000 and participating families to 10. As villagers realized that all participants were profiting, they began to gain confidence and pushed to join the project. By 1984, there were 70 families in the project, with 25,000 chicks for each of the four yearly rotations. Total production in Kafr Al-Khadra amounted to 88,000 chicks (1.5 kg, age 45-50 days).

FIGURE 16 Poultry project in Omar Makram.

The project in Omar Makram started at approximately the same time as in Kafr Al-Khadra. In 1980, ten families were provided 100 chicks each per rotation for five rotations. Unlike the Kafr Al-Khadra project, the MBF research team and the Ministry of Land Reclamation reached agreement with the Agricultural Cooperatives to provide loans of LE 1,400 to construct the confined areas needed by those lacking suitable quarters for poultry. In 1984, participating families numbered 58, with 100 chicks per rotation. The project expanded to the neighboring village of Omar Shaheen. One of the original participants now has 1,000 chicks. The project is now totally institutionalized in the village and MBF no longer carries on any direct activities.

Economic Evaluation

Economic evaluation of profitability of the poultry project is estimated as a function of equipment and investment cost, expected durability of equipment, pay-back period, interest rate, and operating costs.

Evaluation of a typical unit with 100 chicks per rotation and a total of five rotations per year, based on actual values, showed the following results:

Initial Investment

	LE
Site (10 square meters)	50
Equipment for production	73
Auxiliary equipment	7
Fixed capital	100
TOTAL	230

Annual Operating Cost/Return Analysis

a. Cost

	LE
Chicken price (500)	160
Feed price (five rotations)	270
Fuel price	5
Maintenance	5
Transportation	5
Veterinary (LE 0.02 x 500)	10
Salaries	--
TOTAL	450

b. Return

- 500 chicks x 2 percent mortality x 1.5 kg weight x LE 1.1. = LE 808.5.
- 1-1/2 cubic meters poultry manure x 5 rotations x LE 6 = LE 36.0.

TOTAL LE 8,445

c. Profit (b - a) = LE 394.5

d. Return/cost LE 1.9

e. Pay-back period = Total initial investment divided by annual profit = 0.58 year.

OTHER PROJECTS OF SIGNIFICANT IMPACT

The MBF intervention projects were directed toward increasing the production of farm crops through appropriate technologies and new practices, and subsequently improving the social, economic, and nutritional status of the village population. The projects were selected on the basis of analytical evaluation of the baseline data, requests made by the farmers, and experience of NRC staff in all aspects of implementation. This section summarizes some of the other projects implemented in Kafr Al-Khadra (Menufia), Omar Makram (Beheira), and Beni Magdoul (Giza).

Improvement of Wheat Production

Wheat is by far the most important staple in the Egyptian diet. For the past 30 years, Egypt has faced an ever-expanding gap between production and consumption of wheat so that, by 1980, 75 percent of the wheat consumed in Egypt was imported.

The wheat project was implemented in Omar Makram, where wheat annually covers 600 feddans, representing 40 percent of the cultivatable area (Figure 17). Farmers use impure breeds from their old cultivars, known as Baladi (native variety). The average yield of wheat in Omar Makram is 5 ardabs (1 ardab wheat = 150 kg) and a little over one ton of straw, compared with 8-9 ardabs of wheat and 3 tons of straw in the valley.

The objective in Omar Makram was to introduce a new, high-producing variety, Sakha 61, recommended by the MOA for sandy soil, and to provide the farmers with a package of practices that would increase the yield and income. Another objective was to assess farmers' acceptance. In 1982-1983, 24 farmers participated in the project with a total of 28 feddans. In 1983-1984, 93 farmers joined the project with a total area of 110 feddans. In the first year, farmers were given potassium fertilizer, insecticides against aphids, and leaf fertilizers (LE 10.3/feddan), in addition to the cost-free supervision offered by the team. In the second year, the team provided only supervision and training on proper practices.

The first year of program implementation provided indicators that helped the team design the second-year plan. All farmers reported a high increase in grain yields using the Sakha 61 variety. However, three major complaints were reported: the need to maintain a high straw yield, particularly by farmers who raise cattle; losses due to easy separation of grains from ears during transportation; and the rain properties--the Sakha 61 variety has a higher percentage of chaff than does the Baladi variety. In addition to the Baladi variety grown in the conventional way, the second year of wheat cultivation in Omar Makram included a group of 93 farmers using the Sakha 61 variety and implementing the complete package of services (sowing date and density, irrigation schedules, fertilization, protection, harvesting, and other management aspects). Another group of 20 farmers cultivated the conventional Baladi variety but used the newly developed package of services.

FIGURE 17 Wheat project in Omar Makram shows growth uniformity of Sakha 61.

Development of Onion Production

Onions are a major export crop, coming after cotton and rice; they are the first export crop among vegetables; the value of total onion exports amounts to LE 10 million/year. Almost 90 percent of the onion crop from Upper Egypt (Seidi) is exported to Europe. The late Behary (North Egypt) crop appears in the local market during June and July. Per capita consumption amounts to 10.94 kg/year (1981-1982).

The last few years have witnessed a considerable decrease in the quantity and quality of onion crop due to widespread infection with white mold. This infection has drastically reduced Egypt's total onion exports. In 1982, the total area cultivated with summer and winter onions in Beheira Governorate (where Omar Makram is located) was 21,768 feddans, with an average production of 3.763 tons/feddan. Onions are also cultivated in Kafr Al-Khadra (Menufia) and Beni Magdoul (Giza), but to a much lesser extent.

The project objective was to introduce new techniques and practices in onion cultivation to improve the quantity and the quality of the crop. The project was conducted in Omar Makram, Kafr Al-Khadra, and Beni Magdoul.

TABLE 29 Economics of Wheat Production in Omar Markram (1983-1984)

Variety	Practices	Ton/Feddan		LE/Feddan		Net Income (LE)[a]
		Grain	Straw	Grain	Straw	
Sakha-61	New	1.64	3.25	197	390	585
Baladi	Conventional	0.75	1.00	90	120	120
Baladi	New	1.30	3.00	156	360	514

(a) Price of pesticide Malathion is deducted.

SOURCE: Project Team Final Report.

The project, begun early in the life of MBF in Omar Makram and Kafr Al-Khadra, showed an average increase in production from 4.2 tons/feddan in 1979 to 17 tons/feddan in 1984, for an additional income of LE 890 per feddan (see Figures 18 and 19).

The project offers a package of practices and treatments, using Giza-20 variety. Onion seeds (3 kg) were grown in beds of 3 kirats, and the resulting seedlings were transferred to an area of 1 feddan.

In 1983, 52 farmers in Beni Magdoul joined the project with 25 feddans. The seedling beds were cultivated mid-October, and the transfer took place in December. Ten farmers obtained a yield ranging from 22 to 25 tons/feddan. The overall productivity average was 15 tons/feddan compared with 6.26 tons/feddan for the entire Giza Governorate. Assuming a market price of LE 150/ton, and increased production of 8.74 tons/feddan, the additional income is about LE 1,300/feddan. The production increase encouraged other farmers to join the project. In 1984-1985, the area of onion cultivation was increased by 250 feddans in Nekla (Giza).

Improvement of Cucumber Production

Cucumbers hold second place (after tomatoes) in fresh vegetable consumption. Cucumbers are cultivated by all governorates in a total area of about 40,000 feddans, mainly as a summer crop. The increasing demand for export makes cucumbers a choice crop for high economic

FIGURE 18 Conventional production of onions in Omar Makram (top); Giza-20 onion farm in Omar Makram (bottom).

FIGURE 19 A farmer from Omar Makram. Production amounted to 20 tons of Giza-20 onions per feddan.

return. New varieties and modern technological practices offer new yield records and have contributed to production of off-season crops.

The project on improvement of cucumber production started in 1982, at the request of the farmers of Omar Makram (Figure 20). The objective was to increase cucumber productivity, improve quality, and maintain fruit uniformity through controlled agricultural practices and the introduction of a French variety called Beta Alphafilmorane. A total area of 8 feddans and 8 kirats, owned by 14 farmers, was cultivated during the first week of February with cucumber seedlings. Recommended methods of pest and insect control, leaf fertilization, and irrigation were followed, and the crop was harvested during the months of April and May. Average productivity amounted to 15 tons/feddan, compared to an average of 3 tons/feddan for conventional cultivation.

FIGURE 20 Cucumber project in Omar Makram (55 feddans). The farmer produced 27 tons of cucumber (Beta-Alpha) per feddan.

In 1983, the project covered an area of 30 feddans owned by 65 farmers. Twelve farmers reported records of 21-27 tons/feddan. The overall production average was 15 tons/feddan, compared to averages of 3-5 tons/feddan in the entire Beheira Governorate. In 1984-1985, 105 farmers joined the project with a total area of 55 feddans. Reported average production was 14 tons/feddan.

Improvement of Potato Production

In Egypt, potatoes are cultivated in a total area of about 130,000 feddans. Average productivity is about six tons per feddan, which is very low compared to world records of more than 60 tons per hectare (148.8 tons per feddan). The project started in Kafr Al-Khadra (1983) with 57 farmers who cultivated 20 feddans with a Nili

FIGURE 21 Potato project in Omar Makram, summer, 1985 (100 feddans). Average production was 18 tons/feddan.

spoon (the growing season along the Nile between summer and winter spoons--September for the potato crop). In 1984, an area of 40 feddans owned by 182 farmers was cultivated in potatoes (20 feddans in Nili spoon and 20 feddans in summer spoon). Imported potato variety Alpha was used in the summer spoon, while the Nili spoon used stored summer potatoes.

The project objective was to introduce new practices, based on field experiences of NRC staff, to improve potato crop production in Omar Makram and Kafr Al-Khadra. The project provided opportunities for on-the-job training of local agriculture extension staff and demonstrated the potential of the new technologies.

Table 30 shows the results of project implementation in the two villages.

Improvement of Mango and Grape Productions

Mango (<u>Mangifera indica</u>) is cultivated in a total area of about 26,000 feddans. During the past few years, mango orchards have faced progressive degradation that has seriously affected the quantity and quality of the crop. The NRC staff spent a full year investigating the

TABLE 30 Results of Two Potato Projects

	Kafr Al-Khadra Nili Crop	Kafr Al-Khadra Summer Crop	Omar Makram Summer Crop
Area (feddan)	20	20	30
Participants	75	125	68
Highest crop (ton)	13	18	22
Average crop (ton)	10	14	18
Governorate average (ton)	4.32	6.50	6.24
Production increase (ton/feddan)	5.68	7.95	11.76
Production increase (ton/total area)	113.6	159.0	352.80
Extra income (LE/feddan)	852.0	1192.5	1764.0
Extra income (LE/total area)	17,040	27,030	59,976
Percent increase in income	131	122	188

causes of the crop losses and designing a demonstration program to improve mango production. The program started in November 1983 in Beni Magdoul (Giza) with 22 feddans. NRC staff found that crop losses were a result of pests (acarous nematodes, insects, and fungi) and soil deficiencies in micronutrients (zinc, manganese, and iron). A comprehensive agronomic program, including pest control and leaf fertilizers, was implemented. The figures in Table 31 indicate the economic feasibility of the new program.

TABLE 31 Economic Feasibility of Mango Program

	New Program	Outside the Program
Highest production (tons)	3.88	0.60
Lowest production (tons)	1.44	0.30
Average (tons)	2.66	0.45
Cost (LE/feddan) of fertilizers, pesticides	650	244
Net benefit[(a)]	LE 1611	138.5 LE

[(a)]Wholesale price (LE/ton): 850

The 22 feddans cultivated with mangoes in the 1983-1984 season served as a demonstration site to convince nonparticipating mango growers to implement the new program and seek the services of the NRC team. Several contracts for services were made between mango growers and the NRC in the 1984-1985 season.

A similar program for improvement of grape production was implemented at the same time and by the same team in Kafr Al-Khadra. Grapes occupy the second position, after citrus fruits, as to total production. In Kafr Al-Khadra, the area cultivated with grapes dropped by 33 percent in two years' time because of crop losses. The research team identified the causes of the deterioration, and in 1983-1984 conducted a demonstration program on an area of 11 feddans and 6 kirats owned by 29 farmers. The program resulted in an average increased productivity of 6.3 tons/feddans over the average crop of nonparticipating farms, amounting to an additional income of about 1,500 LE/feddan. These results made grape growers eager for the NRC services. In the 1984-1985 season, the research team expanded their activities in three governorates, Giza (Beni Magdoul and Kafr Al-Gabal), El-Minia (Samalout), and El-Gharbia (El-Santa), over a total area of 200 feddans. Contracts for services to followup on program applications cost LE 50 per feddan.

Improvement of Dairy Production

Egypt's total milk production amounts to about 2.2 million tons/annum (buffalo and cow milk). Only 10 percent of that milk is processed by modern factories and under sanitary conditions. More than 90 percent of the total milk is produced, processed, and consumed under primitive and unsanitary conditions. Problems contributing to low production or poor quality also include limited transportation, inefficient cooling, and labor shortages. Daily animal production is extremely low compared with international standards. One-fourth of the total milk production is consumed during calving.

Dairy production is practiced by nearly two-thirds of the agricultural community of Omar Makram. Buffalo milk is dominant in dairy production at Kafr Al-Khadra and represents half the milk used at Omar Makram. Major dairy products in both villages are white karish cheese, ghee, and butter; full-cream cheese is produced in very limited quantities.

The dairy project in Omar Makram and Kafr Al-Khadra has focused on the establishment of demonstration facilities in both villages. The objectives are to:

- Improve the quality of processed dairy products and to prevent contamination during all steps from milking through processing
- Introduce an economical fermentation method by using a suitable starter to produce homofermentation
- Establish a "milk producer society" trained in proper management and processing of locally produced milk, thus creating better market potential for its dairy products.

In Omar Shaheen, near Omar Makram, a building owned by the women's association of Tahrir Province has been provided for a model plant that can serve three to five villages. At the model plant, people learn to manage the production themselves and to avoid unsanitary conditions, especially health hazards during the hot season. A similar unit has been established in Kafr Al-Khadra on a public facility offered by the village council. Both units have a capacity of four tons a day.

It was decided early on that village women would be responsible for implementing the project. In Omar Makram, an influential local woman was hired as local organizer. Her job was to assist in the dairy production, to work with the women in milk separation, and to instruct women in newer and cleaner methods of production.

To improve the cleanliness of the home-produced milk products, the MBF project encouraged the use of a new, quicker acting starter, and the adoption of cheesecloths to replace the mats on which cheese traditionally has been drained. Lectures on dairy hygiene and on-the-job training took place. A mechanical separator was introduced to replace manual separators, and women used the facility, free of charge, to separate their milk. Butter churners were also introduced. Women were encouraged to sell some of the skim milk to the dairy, which would then process it into cheese and other products for sale in the community or to institutions such as schools.

The project involved the local cooperatives in all activities, because they will eventually take over the project from the NRC.

The project is establishing a mini-dairy pilot plant in Beni Magdoul, with a capacity of 2.5 tons/day. The facility was designed and fabricated by Misr Office for Engineering and Importation.

Development of Beekeeping and Sericulture Practices

Beekeeping is a very old practice, and begins with the construction of suitable hives to collect and protect bees. The value of beekeeping lies in the nutritional and therapeutic use of its products, in its potential as a source of income, and in the use of bees to ensure the fertility of some fruit species through cross-pollination. Honey has a high nutritive value; it contains fructose and glucose (which are easily digestible sugars), amino acids, and vitamins B_1, B_2 B_6, nicotinic acid, and folic acid. The royal jelly produced by the queen bee is a high energy source with vitamins, minerals, fats, easily assimilated sugars, and proteins. Beeswax is an important pharmaceutical ingredient.

In Egypt, the nectar-bearing plants are clover, citrus fruits, and cotton plants. At Kafr Al-Khadra and Omar Makram, farmers had little or no experience with beekeeping, although some mud hives were used at Omar Makram and very old hives at Kafr Al-Khadra had been placed near stagnant water. Farmers were unaware of the dangers of wasps and hornets to bees and were not concerned with building their hives in safe areas (such as areas far from grape plantings).

The planners for this project saw beekeeping as a good opportunity to demonstrate new and appropriate techniques to the villagers. The project was developed to educate and train village beekeepers to:

- Increase the yield of products by using modern apiaries and farms
- Protect the bees
- Place hives near clean water and pollen supplies
- Provide shelters against wind damage for the apiary
- Choose an appropriate site.

Work began in Kafr Al-Khadra in 1980, with 5 farmers and 40 bee colonies. The farmers used langstroth hives and learned how to protect bees from wasps and from diseases. The honey that was extracted from the demonstration colonies was distributed throughout the village (Figure 22). Empty combs were fumigated with the moth repellent Paradix and stored for the winter; during this time, the bees were fed sugar syrup. NRC researchers discovered the presence of acarine, which was later controlled using disease prevention measures. Villagers were taught to control the oriental hornet. By February 1981, additional swarms had been sold to other interested farmers, and the village bee colonies increased to 50. In September 1981, the empty combs were collected and the winter cycle began.

At Omar Makram, NRC researchers followed the same procedure of introducing new beekeeping practices and donating 50 bee colonies to interested villagers. The

FIGURE 22 Beekeeping.

number of colonies decreased to 34 because some weak colonies had to be added to the stronger ones. Nectar was collected from citrus orchards and 310 kg of honey was extracted and sold to the villagers. A water pump was placed near the apiary as a source of clean water. Efforts to encourage beekeeping are continuing in both villages: project plans call for training opportunities for villagers, provision of loans, and development of adequate extension services.

The other project, on development of sericulture practice (the rearing of cocoons and silkworms in order to manufacture silk), was primarily directed at Kafr Al-Khadra, though the project was also extended to Omar Makram. The Menufia Governorate, especially the area to which Kafr Al-Khadra belongs, recently had been a center for sericulture activity and once had a small factory for manufacturing the silk ribbons used in traditional dresses and costumes. However, for some reason, that activity was discontinued. The project, therefore, was an effort to revive the practice.

Because the silkworm depends on mulberry leaves, sericulture also concentrates on growing mulberry trees. The objective of the sericulture project was to improve

FIGURE 23 Silkworm project in Kafr Al-Khadra.

the quality and quantity of mulberry trees and the variety of the silkworm larvae through practical and appropriate technology. Mulberry seedlings were planted in both villages and, at Kafr Al-Khadra, seedlings were offered to some families. Six experienced families were given larvae. All participants were instructed in the proper way to rear the larvae and to cultivate mulberry trees to achieve optimum results. At Omar Makram, villagers and NRC researchers prepared a site for rearing silkworms, using a donated hall furnished with rearing stands and trays.

By November 1981, the sericulture experiment showed tangible returns. Each family was able to raise 12-21 grams of eggs to obtain a production of LE 8/100 cocoons over a period of 35 days.

HEALTH AND NUTRITION STATUS AND IMPACT OF THE MBF PROJECT

The high rates of infant and preschool mortality are two of Egypt's most severe public health problems. The interactions of poor prenatal nutrition, inadequate sanitation, and poor weaning practices are considered to be the root causes.

Weaning problems can be attributed to three factors. First is the mother's low food intake, which results in inadequate milk production. Second is the mother's lack of knowledge about appropriate food preparation for weaning children (even when the food supply itself is ample). Finally, poor sanitary practices in the home result in high rates of exposure to disease and infection.

Although only 10-12 percent of Egyptian infants have below-normal birth weights, serious problems arise even for normal birth weight children at about 4-6 months. The supply of breast milk becomes inadequate, and mothers are unable to supplement the infant's diet with nutritionally appropriate foods. The decline in nutrition coupled with exposure to an unsanitary environment result in the child's becoming increasingly sickly, which, in turn, produces malnutrition, growth stunting, nutritional anemia, and, in the extreme, death.

Iron deficiency anemia is also a serious problem, manifested in about 40 percent of infants and lasting through the school years. Although it is not clear whether anemia is more often caused by insufficient dietary iron or by parasitic infection, it is clear that children's diets should contain additional sources of iron.

Although the MBF project was designed as an agricultural undertaking, it was assumed at the outset that the project, by increasing the amount and quality of food and of available income, would improve the nutritional status in the participating households. In this section, then, we examine the nutritional status of two villages that participated in the MBF project and describe some interventions that resulted.

Data indicating malnutrition are based on anthropometric measures (height and weight) and clinical and biochemical measurements; morbidity and mortality rates are also used.

Village Characteristics

When Kafr Al-Khadra and Omar Makram were selected for the project in 1978, a health and nutrition component was introduced into the baseline data instruments; this was done to ensure that information would be available for studying the project's impact on the socioeconomic and health status of the target population.

Kafr Al-Khadra was the more agricultural of the two communities, as well as the more traditional. Seventy-five percent of the households surveyed there were primarily engaged in agriculture, compared with 38 percent in Omar Makram. Families in Kafr Al-Khadra relied heavily on subsistence production to meet a portion of their household food needs, whereas fewer than 10 percent of the households in Omar Makram produced their own staples (wheat, maize, dairy products, or poultry). About half the Kafr Al-Khadra households produced all of their own wheat, maize, and dairy products, and almost one-quarter produced some or all of the poultry they consumed (see Table 32).

Comparison of household characteristics in the two villages revealed that Kafr Al-Khadra families had relatively greater per capita income and land holdings, and somewhat smaller household size (Table 33). Households in both communities reported spending more than 70 percent of their household income on food.

Adequacy of Diet

The adequacy of a diet is determined by converting the foods consumed to figures that, in our study, represent the energy, protein, and iron intake. In the case of the two villages studied, these conversions were based on the Food Composition Tables of the Middle East, and then compared to the recommended intakes (adjusting for age and sex composition of the household) in the World Health Organization's Food and Agriculture Organization's standards.

Thus, the percentage of overall household requirement that is met is a function of a report given by each household on what had been consumed throughout a 24-hour period. This measure of "relative adequacy" of the diet was taken at the beginning of the project, and is reported in Table 34.

The variables (for example, energy, protein, animal protein, and iron) were selected because they are the most important factors in the deficiency diseases and conditions found throughout Egypt. Energy and protein levels reflect primarily the quantity of food available; animal protein and iron are indicators of the quality of the diet.

Table 34 presents the means and standard deviations for selected nutrition variables at the beginning of the project. Households in both communities reported food intake adequate for presumed requirements in energy and total protein. The proportion of protein from animal sources, however, was much higher in Kafr Al-Khadra than

TABLE 32 Household Food Consumption from Own Production (Percent of Households)

	Omar Makram			Kafr Al-Khadra		
	Percent of Own Production					
Product	None	Some	All	None	Some	All
Wheat	92	1	7	39	19	42
Corn	92	1	7	46	2	52
Dairy Products	95	1	4	51		49
Poultry	93		7	77	6	17

TABLE 33 Baseline Sociodemographic and Economic Variables for the Two Village Samples

(Average ± Standard Deviation)

	Omar Makram (N = 100)	Kafr Al-Khadra (N = 104)
Number of persons in household	6.8 ± 2.3	6.0 ± 3.0
Per capita land ownership (feddan)	0.2 ± 0.3	3.1 ± 3.1
Per capita animal ownership (animals)	0.1 ± 0.3	0.2 ± 0.3
Income (LE/year/capita)	161 ± 97	206 ± 114
Percent of household income spent for food	77 ± 11	72 ± 10
Percent of children in household	49 ± 20	39 ± 25
Number of persons per room in house	3.0 ± 1.1	4.3 ± 2.3

Note: The communities differ from each other at $p \angle .05$, based on one-way analysis of variance.

TABLE 34 Relative Adequacy of Household Food Intake (Percent of Requirements)

	Mean ± Standard Deviation	
	Omar Makram	Kafr Al-Khadra
Energy	144 ± 52	133 ± 32
Total Protein	179 ± 70	191 ± 62
Animal Protein	65 ± 45	144 ± 83
Iron	20 ± 38	44 ± 34

in Omar Makram. Iron intakes were quite low in both villages, but more than twice as high, on average, in Kafr Al-Khadra as in Omar Makram. It should be borne in mind that the dietary methodology used here does not allow interpretation of results in terms of nutritional adequacy for any individual. Assuming that any biases operate for all households equally, however, these data should allow the comparison of households with relatively better and poorer food consumption, both quantitatively and qualitatively.

Analysis of characteristics of households with relatively better and poorer diets revealed different circumstances for two villages. In Kafr Al-Khadra, reliance on the household's own production for part of the food supply was positively associated with dietary quality (Table 35). Households that produced some of their own poultry for consumption had better diets (in terms of all

TABLE 35 Production-Consumption Variables and Differences[(a)] for Households with High and Low Dietary Adequacy, Kafr Al-Khadra

Production and consumption of:	Associated with adequacy of:
Poultry	Energy, total protein, animal protein, iron
Wheat	Total protein
Maize	Total protein, iron
Dairy Products	Total protein

(a) $p < .05$

four dietary variables) than did households that produced none of their own poultry. Reliance on self-production of other staples was also important. Per capita income was a significant predictor of protein, animal protein, and iron adequacy (dietary quality), but not of energy (food quantity). Larger land holdings and smaller household size were significant predictors of energy adequacy. In Omar Makram, smaller household size, higher per capita income, and a higher percentage of income expended for food were the only significant predictors of dietary adequacy.

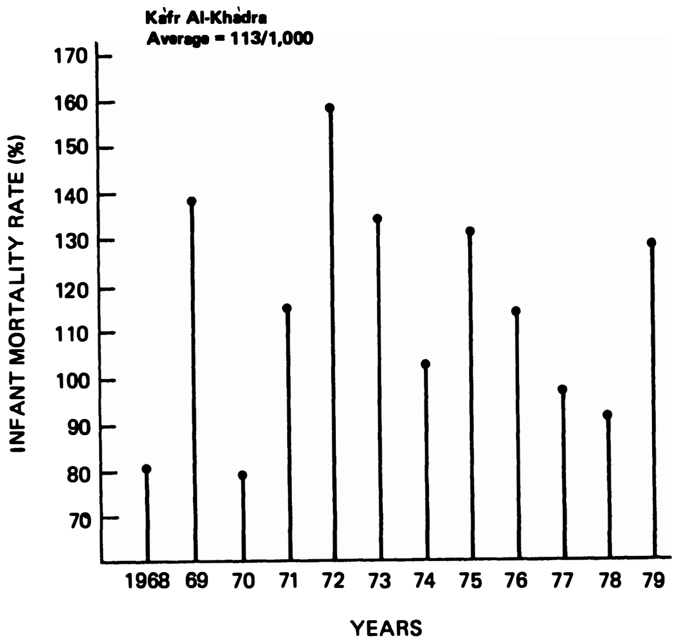
Child Health

The data on infant mortality rates (from official death records from the health units) were reviewed. In Kafr Al-Khadra, the average infant death rate over the 13 years before 1980 was calculated to be 113/1,000. No specific trend during that time was noticed. The minimum rate of 75/1,000 was recorded in 1978 and the maximum (160/1,000) in 1972. In 1979 the death rate was 130/1,000 (Figure 24).

The infant mortality pattern in Omar Makram was much different than in Kafr Al-Khadra. An accelerating death rate peaked in 1977 at 119/1,000, with a decline thereafter during 1978 and 1979 to 54/1,000 and 84/1,000, respectively. In 1975, five years earlier, the rate had been 102/1,000. This pattern does not necessarily represent a consistent trend, unless we agree that a decline has occurred after 1977. A theoretical projection of the situation for the next two years might show a death rate of around 65/1,000 (Figure 24).

The infant mortality rates are not a sensitive index of nutritional status, because of the small size of the populations considered here and the resultant wide fluctuations in rates. However, they do indicate that the infant health situation in these villages was typical of rural Egypt.

Birth rates over the life of the project were in the range of 170-210 per year in Kafr Al-Khadra and 164-210 per year in Omar Makram. Although birth rates in the two villages were similar, the death rate in Kafr Al-Khadra exceeded that of Omar Makram. Recording birth weights in the two villages served as an index of nutritional status during gestation and as an internal monitoring system to document variation in nutritional status over time. Table 36 shows the distribution of birth weights in Kafr Al-Khadra during the first six months of the project. Twenty-five infants were born; their weights were within the normal range and showed a normal distribution. Infants were not weighed at birth in Omar Makram.



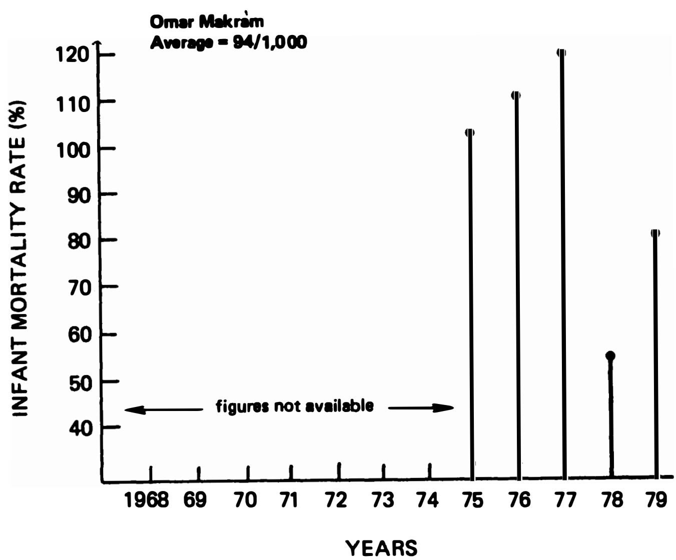


FIGURE 24 Infant mortality rate.

TABLE 36 Distribution of Birth Weights
Kafr Al-Khadra, 1980 (N = 25)

Percentile of International Reference (Iowa Growth Standards)			
25th	25th - 50th	50th - 75th	75th
N = 2	N = 10	N = 8	N = 5

In utilizing information from recorded heights and weights of children in the two villages, malnutrition was assessed by the two main conventional methods, viz: the Gomez and the Waterlow classifications. The first, which uses the weight-for-age relationship, was used for Omar Makram. Third degree (severe) malnutrition was not detected in any of Omar Makram's children: the vast majority of children were normal, although first degree (mild) malnutrition was found in 25 percent of the children examined. Most of that group were between 6 and 9 months of age. Second degree malnutrition was found only in 4 percent of the population, all of whom were between 36 and 48 months (see Figure 25). It is important to note that at ages 3-6 months no malnutrition was detected.

In Kafr Al-Khadra, the Waterlow classifications of height-for-age and weight-for-height was used to define nutritional status. Very few of the children were in the critical category of combined wasting and stunting. Malnutrition was most severe at the age of 30 months, although a secondary peak was noticed at 6 months. Retardation of linear growth (height or length) was greatest at the age of 9 months, with a secondary peak at 30 months (Figure 26).

Nutritional Intervention

Based on the findings with regard to nutritional status, the project activities concentrated on health and nutritional problems of children between 1 and 12 years. We focused on finding solutions to these problems and improving the general food quality. It was shown that 50 percent of school children ages 6 to 12 had anemia. A treatment program was established with the coordination of a pharmaceutical company to give 60 mg/day of iron sulfate tablets to the targeted students. The program was directed to 300 students daily for 3 weeks. About 80 percent responded to the treatment with an increase in blood hemoglobin levels. The level of hemoglobin remained higher (than before treatment was begun) for

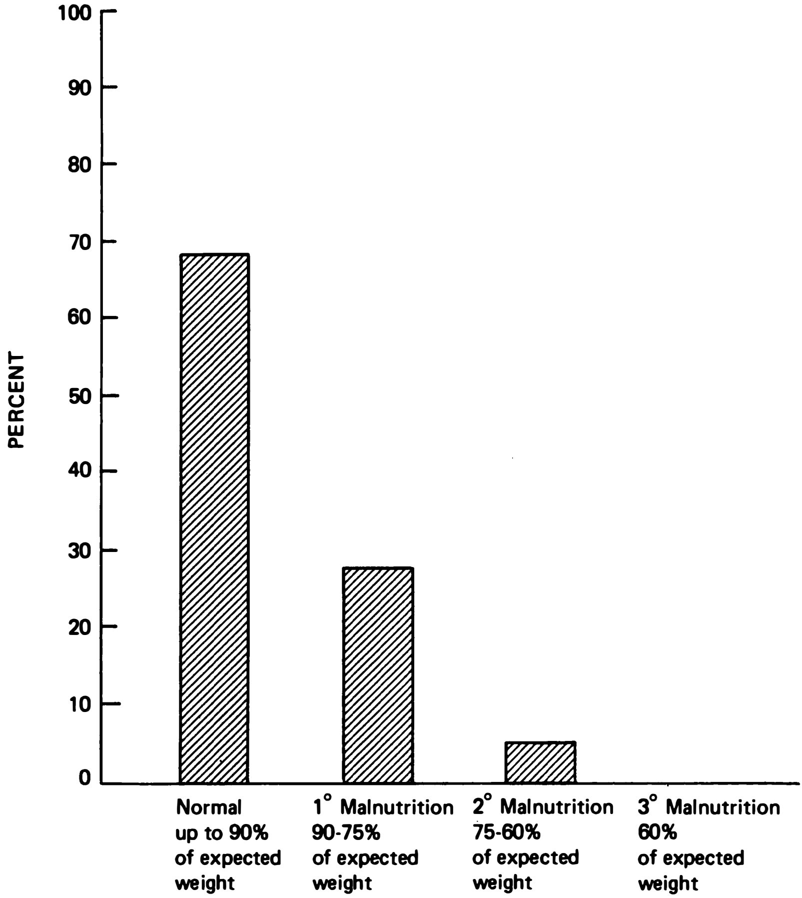
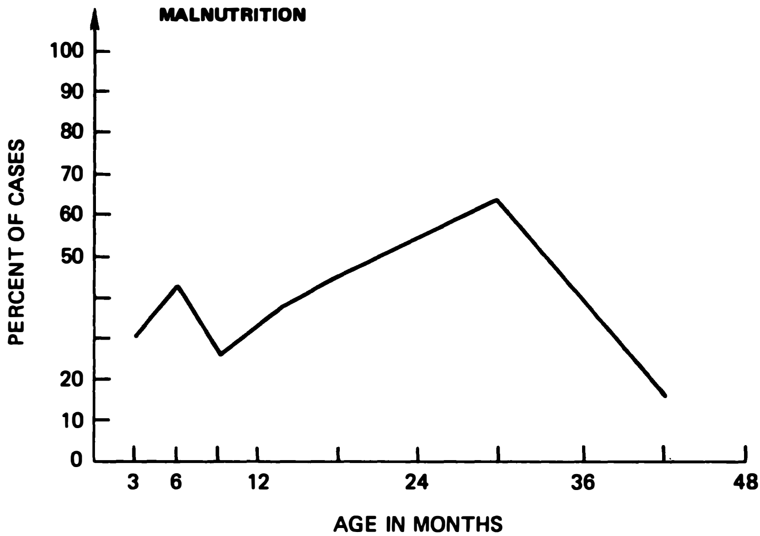


FIGURE 25 Percent of malnutrition in Omar Makram.



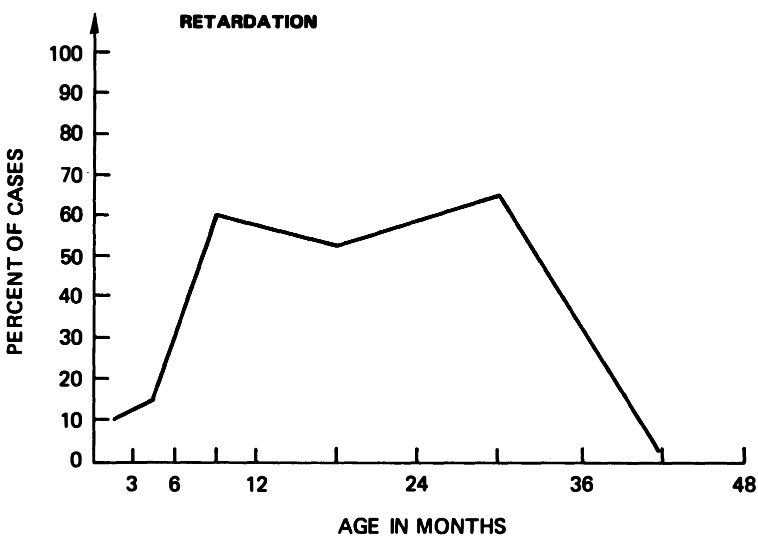


FIGURE 26 Measures of nutritional problems in Kafr Al-Khadra.

9 months and then declined. Based on this finding, a balanced meal (high in protein, fortified with iron and zinc, and enriched with vitamin A) was developed. This meal consisted of a 130 g cake made from wheat flour and 5 percent powdered whole milk. It contained 15 mg iron, 10 mg zinc, 18.7 percent protein, 17 percent fat, and 61 percent carbohydrates, as well as a high content of calcium and phosphorus. The meal was given daily to 500 students for 4 months. This led to a 50-70 percent decline in the anemia incidence and increased the average hemoglobin levels to 12.3 gm/100 ml. In addition, growth rates increased and stunting declined in 25 percent of schools during that short period.

Studies were conducted to implement a nutritional program to meet the nutritional needs of preschool children using the following approaches:

- Improvement in the properties of Superamine (a prepared weaning food) and prolonging its shelf life.

- Processing of a biscuit containing 12 percent protein and enriched with iron and zinc. It was distributed in packages of 100 g and was given to children age 1-3 years (the cost of one package was 5 piasters or 3.5¢).

- Preparation of a weaning food that was appropriate for infants of 6-12 months. It contained higher proteins and was fortified with vitamins and minerals.

Nutritional Impact

The results of the nutritional status survey of both Kafr Al-Khadra and Omar Makram are consistent with national findings for similar areas. Factors such as infant mortality rates, birth rates, population growth, and birth weights are also close to national data. Some nutritional similarities between Kafr Al-Khadra (considered a typical Egyptian village in the Valley) and Omar Makram (a village in a reclaimed area) are surprising, since the geographic and demographic characteristics of the villages are quite different. It would appear that when the reclaimed area (Omar Makram) was being planned 25 years ago, the nutritional impacts of agricultural projects were not carefully considered. We urge, therefore, that a nutrition component be introduced in the planning for all areas that are to be reclaimed in the future.

The analysis of the nutritional impact of an agricultural project required a data collection design that would capture the nutritional benefits of increased productivity of food of both plant and animal origin. The design in the More and Better Food Project concentrated on the economic and social factors that interact to produce improvements in the quality of life. The major assumption was that increased production of food and its use by the household members would improve their nutritional status. It was also thought that increased production would increase real income, thereby giving residents greater purchasing power in the food markets. This would also result in improved nutritional status.

The MBF study looked at one aspect of nutrition--iron deficiency anemia. The hemoglobin level in blood of students (6-12 years) was used as an indicator of the prevalence of anemia. During the five years of the study, the various interventions implemented at the school level produced great improvements in the iron levels in these children, which had a positive effect on their growth rates during the period of intervention.

A further important observation was that the students sustained and maintained their high levels of hemoglobin during periods when specific interventions were discontinued. This raised the possibility that the subprojects were having a positive effect on the iron levels, particularly the poultry project, which was the most popular. Table 37 shows the numbers of household participants who involved themselves in the various projects between the years 1979 and 1982.

TABLE 37 Number of Participants in the Subproject in Kafr Al-Khadra

	1979	1980	1981	1982
Poultry	8	20	40	40
Tomatoes	1	1	0	0
Maize	0	1	4	0

The spread of the poultry subproject increased the animal protein production in the village which, in turn, must have increased the availability of the iron from animal protein utilized by the student; this greater access to animal protein is thought to have resulted in students' sustaining blood iron at higher levels than they did originally.

A nationwide effort to improve the school lunch programs was based on the Kafr Al-Khadra experiment. The cake used in Kafr Al-Khadra was the basis for the national program, and has been used since October 1985. It is expected to show its impact on the nutritional status of students throughout Egypt within a year or two. Thus, the MBF Project has had an impact far beyond its original geographic boundaries.

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