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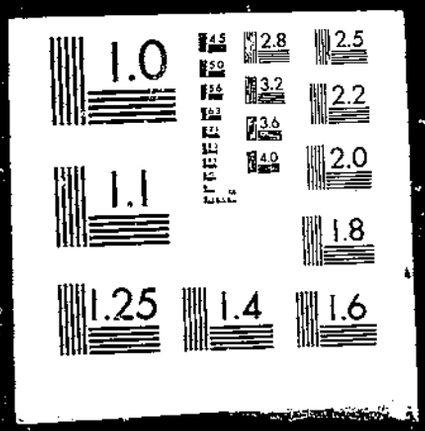

# EGYPT

## Major Constraints to Increasing Agricultural Productivity

U.S. Department of Agriculture cooperating with U.S. Agency for International Development and the Egyptian Ministry of Agriculture

Foreign Agricultural Economic Report No. 120

## PREFACE

The Egyptian-U.S. Agricultural Sector Assessment Team expresses deep appreciation for the help they received from officials of the Egyptian Government--including those at the national, governorate, district, and village levels--as well as leaders of private industry, staffs of international organizations, and farmers, in their endeavor to help assess and identify constraints to increased productivity in Egyptian agriculture. These people gave generously of their knowledge and time in discussing a wide range of agricultural topics for which members of the team are most grateful. Without the assistance of so many concerned individuals, both in and out of the Government, this report could not have been successfully concluded.

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# EGYPT

## Major Constraints to Increasing Agricultural Productivity

### INTRODUCTION

At the request of the Ministry of Agriculture and the Director of the Egyptian Mission of the U.S. Agency for International Development (USAID), a team of 10 technicians was recruited by the U.S. Department of Agriculture (USDA) to survey Egypt's agriculture and to appraise the major constraints to increasing productivity.1/ Each technician was assigned one or more Egyptian counterparts. This report is a joint product of all those involved. Many interdisciplinary discussions were held, and input to the several specialized reports in Part V was made not only by the people who wrote them but also by other Egyptian and U.S. team members and the many other persons with whom they talked.

Many general and specialized studies had previously been made of Egyptian agriculture. Results of these earlier studies were used in preparing this report when they appeared applicable. This report attempts to provide enough background to give a basic understanding of the conclusions and recommendations made. However, readers are assumed to be familiar with literature in English pertaining to Egyptian agriculture. Material given here attempts to shed new light in fields where previous reports came to conflicting conclusions, and to fill in information gaps evident in previous studies. The report is aimed primarily at assisting outside donors in appraising the potential for capital or technical assistance that relates to agriculture.

### Agriculture and the National Economy

The Nile Delta and its lifeline, the Nile River Valley extending southward some 600 miles, is one of the oldest agricultural areas of the world, having been under continuous cultivation for at least 5,000 years. Up to the beginning of the 20th century, it sustained a predominantly rural or agrarian economy, except for its export markets for cotton, rice, and a few minor crops. Domination of the country for centuries by numerous foreign powers contributed little to its agriculture or industrial development.

In many respects, Egypt entered the 20th century after the 1952 Revolution by launching numerous economic and social programs, many of which were directed specifically at the agricultural sector. Two-thirds of the population was directly or indirectly employed in the farm sector and it was designated the prime source of foreign exchange earnings needed to develop the nation's industrial sector. These agricultural policies were quite successful, and output increased at an annual rate of 3.5-4.0 percent from 1955 to 1965. Foreign currency earnings grew, food consumption per capita rose, and food prices for the urban population were held relatively low by means of public subsidies.

1/ The Team spent approximately 8 weeks in Egypt, from September 29 to November 20, 1975.

A drastic reorganization was made in the country's economic system during this period and most of these changes are still in effect. A system of controlled prices was instituted for major farm products, as well as for the major inputs. Production quotas were established for major crops to insure increased quantities for export and to minimize imports. An elaborate organizational system was set up to distribute inputs and to ensure delivery of requisition crops. Also, several governmental organizations were created to directly produce poultry, meat, and milk under a subsidized price system. In keeping with this trend in the agricultural sector, most firms in the industrial sector were nationalized in 1961, thus extending the role of the central Government across the entire economy.

The agricultural sector has faltered in the last decade, as evidenced by a leveling off in crop yields, a lower output than was expected from reclaimed lands, and a shortage of foreign exchange for needed imports of fertilizer, machinery and equipment, and feed grains. In the same period, population continued to increase at an annual rate of 2.0-2.5 percent, and rural-to-urban migration accelerated. This increased consumer demands for more and better foods, and created marketing and distribution problems which the existing system is ill equipped to handle.

As a result, in the past several years it has been necessary to import an increasing proportion of key foodstuffs, especially wheat and wheat flour, cooking oils, beef, and feed grains for domestic livestock. Sharply higher international prices in 1973-75 placed an additional burden on foreign exchange requirements that were not offset by increased earnings from exports. In 1974-75, agricultural imports represented well over half of total imports, thus limiting the funds available to import key raw materials, parts, and equipment for the industrial sector.

Massive infusions of bank credit, foreign grants, and concessionary sales of critical foodstuffs and other imports provided a short-term solution, but this also resulted in a deficit in the country's balance of payments of $2.7 billion at the end of 1974, and the deficit is projected to exceed $3 billion by the end of 1976. This potentially serious situation led the Government to curtail its use of bank credits in the first half of 1975, and to seek long-term loans from Arab and other countries to repay existing bank loans. However, public subsidies to hold down consumer food prices were budgeted at $1.26 billion in 1975, about 50 percent more than the previous year. A serious effort will be needed to reduce expenditures for imported food if additional debt is to be avoided. This need is particularly acute in view of the planned increase in public capital investment of 1,056 million Egyptian pounds (LE) in 1975, compared with LE 470 million in 1973.

The agricultural sector cannot increase its contribution toward solving the country's current financial problem in the next year or two but it is the major segment of the total economy that can make a substantial contribution over the next decade or two. Despite advances in industrialization and increased urbanization, the agricultural sector still accounts for 50 percent of the total population, 47 percent of total employment, about 30 percent of the Gross National Product, and 80 percent of export earnings.

Egypt thus faces a major challenge--how to increase the rate of growth in agricultural production to generate foreign exchange and also meet its future food requirements. Given a nearly fixed land area, this can be accomplished only by significant increases in yields and changes in cropping patterns to achieve more intensive use of land and labor. If these steps are feasible, then more emphasis can be given to producing those crops for which the country has a comparative advantage, particularly in export markets. However, if only nominal gains in agricultural output can be expected in the future, the country must direct its efforts toward achieving greater productivity in other economic sectors. This would require redirecting public investment and devising means to encourage increased domestic and foreign investment in the industrial and service sectors.

With these stark realities as a background, this report focuses chiefly on the farm production sector, examining the basic constraints of land, water, and the limited alternative cropping patterns, and points out what needs to be done to revitalize Egyptian agriculture. The potential of increased production from new or reclaimed lands is also examined, but not in sufficient depth to determine their future contribution. The costs of making these changes will be great, and no quick solutions are offered. But the thrust of the report is optimistic, given sufficient time to implement needed changes, coordination of efforts at all levels, and the commitment to achieve a modernized agriculture.

## Cropping Patterns

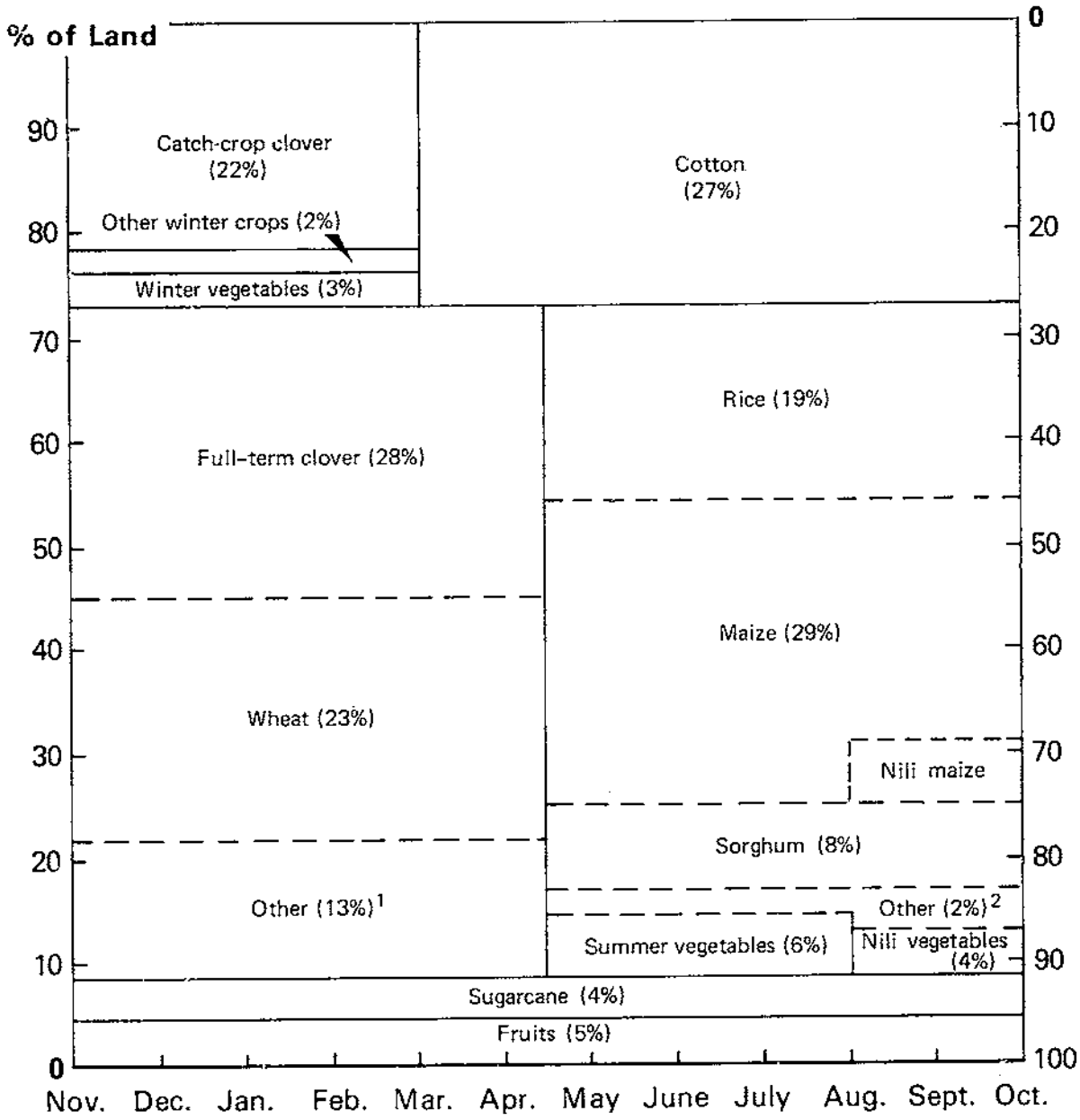
To understand Egyptian agriculture, knowledge of the basic crop rotation pattern is essential (see fig. 1). Fruits occupy the land permanently and sugarcane normally is kept for 3-5 years. Cotton, preceded by a catch crop of berseem clover or by winter vegetables, uses the land for about 12 months. Winter field crops frequently occupy a larger percentage of the land than do summer field crops, but each crop requires 4-6 months of land use. 2/ Nili (or fall) field crops are normally harvested a few months after planting. Summer vegetables in most regions occupy more area than do either winter or Nili vegetables, but each crop on the average occupies the land for 3-4 months, thus allowing three or more vegetable crops per year.

If the cotton area expands, more catch-crop berseem clover normally is produced, but both winter and summer crops are reduced. 3/ If full-term clover (called permanent berseem) is expanded, adjustments may take place only in cotton and other winter field crops. As an alternative, total land in both winter and summer crops may be expanded with a corresponding drop chiefly in land used for cotton. Two or three cuttings of catch-crop berseem clover tend to reduce cotton yields because cotton planting is delayed beyond the optimum date.

2/ In Egypt, cotton and sugarcane are counted as summer crops, whereas in this report they are treated as land-committing crops (those which occupy the land for at least a full year).

3/ Egyptian or berseem clover precedes cotton and provides one or two cuttings, hence the areas devoted to clover and cotton are about the same. If the clover is allowed to remain it provides 3-4 cuttings over a 6-month period, followed by summer or Nili crops.

# PROPORTIONATE AREA DEVOTED TO SPECIFIED CROPS, 1972-74 AVERAGE




[1]Chiefly horsebeans, lentils and onions
[2]Chiefly sesame, groundnuts

Figure 1

Rotations for the field crops including cotton typically involve 2 or 3 years. The first year is cotton preceded by a catch crop of clover. The second year in a 2-year rotation and the second and third years in a 3-year rotation involve winter and summer field crops (with at least one crop of full-term clover). It has generally been alleged in the literature that these rotations are required to maintain soil fertility. However, little but the roots of the clover are plowed under, and the agronomists on the team believe that continuous nonclover crops could be produced by appropriate fertilization, at least on the more fertile soils.

In addition to the major crops, Egypt also produces a wide variety of minor crops (table 1). The areas devoted to each of these crops are not large, but collectively they occupy a significant proportion of the total crop area. The practice of devoting only a small fraction of the land on individual farms to these crops undoubtedly contributes to inefficiencies in production and marketing. This is true especially for the 15-20 different vegetables grown. More specialization within zones, and larger areas on individual farms, would likely contribute to increased output and improved marketing practices.

## Agronomic Zones

For this study, Egypt was divided into 14 agronomic zones based chiefly on soil characteristics and cropping patterns (see fig. 2). The first eight zones primarily involve old lands, i.e., land in cultivation prior to the 1952 Revolution. New lands (those brought under cultivation since 1952) that are privately owned and surrounded by old lands are included, as are some adjacent to the Nile Valley. Zone IX covers substantial amounts of old and some new lands, and cropping patterns for each are tabulated separately. Zone XI makes use of underground water. Zone XII includes limited current production from rain-fed crops, the only agricultural area in Egypt not fully irrigated. Remaining zones consist entirely of new lands, with two involving current production and two that as of now are in a planning stage only. For Egypt as a whole, 5.7 million feddans 4/ of old lands were in cultivation in recent years and more than 0.5 million of new lands were producing crops. A discussion of each agronomic zone is given in Part IV.

## General Organization of This Report

This report begins with an overview of the essential findings of the Egyptian-U.S. Agricultural Sector Assessment Team. Part I offers the Major Findings and Recommendations of the team, and then lists the five projects the full team viewed as having highest priority. Additional projects suggested by team members are also given.

4/ A feddan equals 1.04 acres.

Table 1--Area and production of crops, 1973-75[1/]

| Crop | 1973 | | 1974 | | 1975 | |
|---|---|---|---|---|---|---|
| | Area | Production | Area | Production | Area | Production |
| | 1,000 feddans | 1,000 metric tons | 1,000 feddans | 1,000 metric tons | 1,000 feddans | 1,000 metric tons |
| Catch-crop clover | 1,284 | NA | 1,178 | NA | 1,124 | NA |
| Full-term clover | 1,590 | NA | 1,618 | NA | 1,688 | NA |
| Clover seed | (187) | 43 | (206) | 49 | (183) | 44 |
| Seed cotton | 1,600 | 1,543 | 1,453 | 1,389 | NA | NA |
| Wheat | 1,229 | 1,836 | 1,370 | 1,883 | 1,394 | 2,032 |
| Maize | 1,654 | 2,507 | 1,755 | 2,641 | 1,830 | 2,782 |
| Millet | 486 | 853 | 499 | 824 | 489 | 775 |
| Barley | 84 | 96 | 77 | 89 | 96 | 118 |
| Rice (paddy) | 997 | 2,274 | 1,053 | 2,242 | 1,053 | 2,423 |
| Horsebeans | 270 | 273 | 244 | 234 | 246 | 234 |
| Sugarcane | 198 | 7,349 | 208 | 7,018 | NA | NA |
| Lentils | 74 | 62 | 66 | 51 | 58 | 39 |
| Lupins | 9 | 6 | 6 | 4 | 8 | 5 |
| Chickpeas | 8 | 6 | 7 | 5 | 6 | 4 |
| Sesame | 36 | 21 | 27 | 14 | 33 | 17 |
| Groundnuts | 29 | 26 | 29 | 25 | 32 | 28 |
| Flax seed | 40 | 19 | 46 | 23 | 54 | 27 |
| Fennugreek | 26 | 20 | 32 | 23 | 32 | 24 |
| Onions 2/ | 45 | 528 | 63 | 730 | 44 | 572 |
| Garlic | 14 | 206 | 13 | 181 | 12 | 127 |
| Vegetables | 799 | 5,572 | 807 | 5,825 | NA | NA |
| Fruits (including dates) | 263 | 1,818 | 273 | 1,575 | 285 | 1,653 |

NA = Not available.

1/Derived from Ministry of Agriculture data.

2/Production includes onions interplanted with other crops for which no area is estimated.

# MAJOR AGRONOMIC ZONES

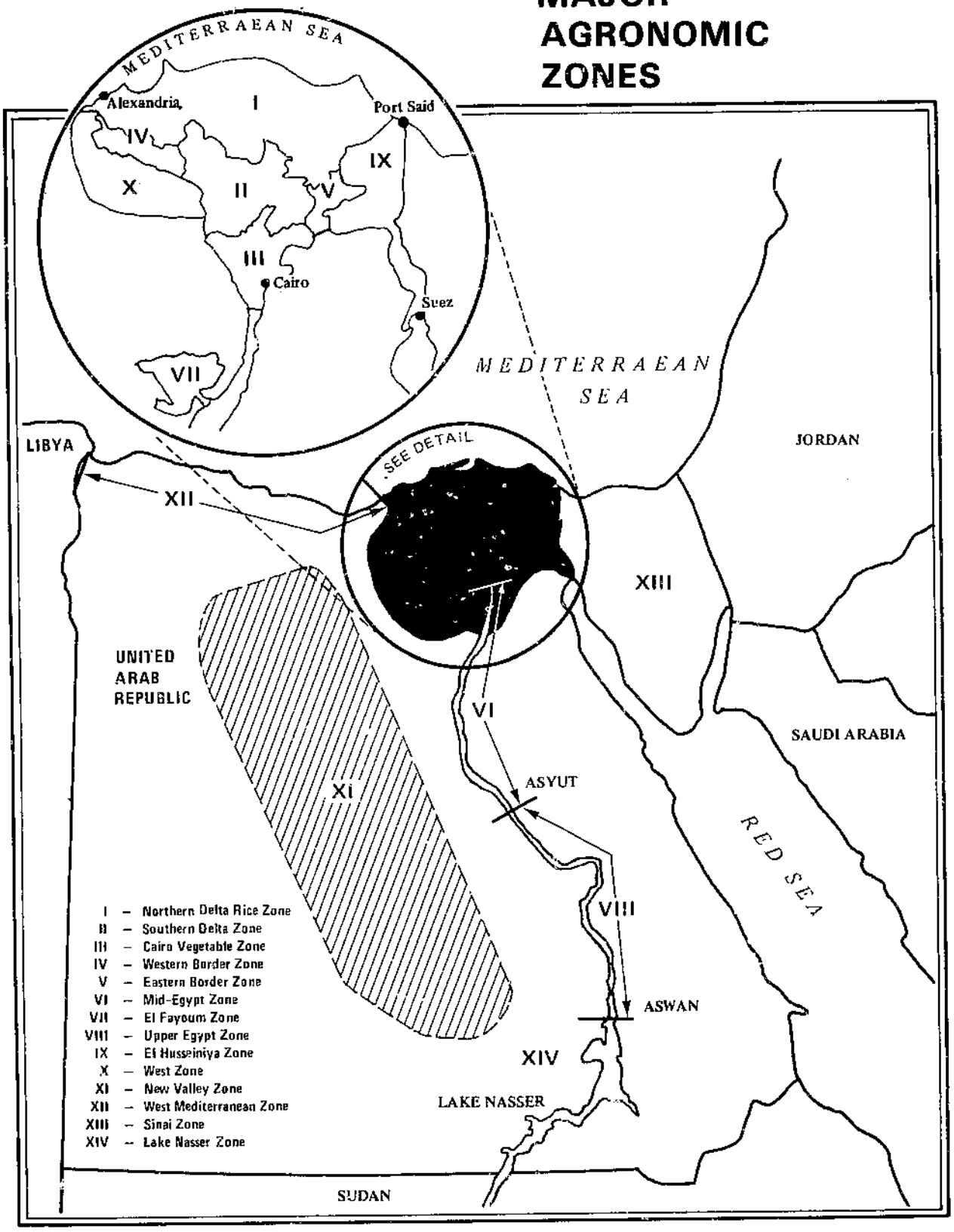



Figure 2

Parts II and III discuss and evaluate overall constraints throughout the agricultural sector and constraints in special areas.

Part IV gives specific details by agronomic zones. It describes the soils and 1972-74 cropping patterns for each, and then discusses production potentials that could be expected for 1985, if feasible programs were initiated. Water and labor requirements by months are also given.

Part V, Technical Reports, offers specific and detailed material on major constraints and opportunities for improving agricultural productivity, with thorough examination of specific problems and subsectors. The Technical Reports, based on the team's fieldwork, were written by the various technicians on their areas of expertise, and they are the basis for Parts I, II, and III.

The Appendix gives details on cropping patterns by zones.

# PART I. OVERVIEW

## MAJOR FINDINGS AND RECOMMENDATIONS

The following are highlights of the findings of the Egyptian-U.S. Agricultural Assessment Team. This selection of the most important results of the study gives an overview of what the team members saw. These points should be the most relevant ones for planners and potential investors.

### Water or Land as the Major Constraint

A central question the team had to address was whether water for irrigation or available productive land was the single major constraint for Egyptian agriculture. Studies by the Food and Agriculture Organization of the United Nations (FAO) and the Egyptian Ministry of Irrigation had indicated that water supply was not the limiting factor, at least through the year 2000. Our findings confirm this view for the foreseeable future. However, lack of proper water management is a major constraint and is discussed in detail in this report.

By the year 2000, domestic and industrial use of water is expected to quadruple to 4 billion cubic meters (billion $m^3$) annually. This increase will use only about a third of the extra 9 billion $m^3$ expected to be available from the Nile by about 1985, based on projects to begin shortly in the Nile Basin.

If the cropping ratio (average number of crops per year) increases from the present 1.9 to 2.1 in 1985 and new lands now in cultivation are brought under a more intensive cropping pattern than at present, water requirements would be only moderately higher than they are now. Improved cropping practices, water management, and irrigation facilities could raise the overall efficiency of the system from the present 51 percent to 70 percent or more. By the year 2000, even with a substantially larger area of new lands under cultivation than is now projected for 1985, and a projected increase for urban and industrial uses, water needs are not likely to exceed the additional 9 billion $m^3$ that are expected to become available from the Nile after 1985.

In most years, the full flow available to Egypt from the Nile will be released to control floods and to generate power, whether it is needed for irrigation or not.

Possibilities for large quantities of ground water may exist in the Western Desert and in the Nile Valley and Delta. This would be available by pumping to supplement water from the Nile if needed.

## Need for Improved Water Management

Year-round availability of water, combined with age-old irrigation practices, cause farmers to use excess water. Problems in this connection are accentuated because no charge is made for the water and a system of minimum control is used when water is available to the farmers. Excess water use in 1974 made a potential addition to the water table equivalent to 0.42 m (1.4 ft) of water depth over the entire area now irrigated. Excess water use causes problems of salinity and waterlogging. These problems now affect large areas and could affect 80 percent of the cropped land unless they are corrected in the near future. Two programs could correct these problems: (1) the massive program to provide drainage now underway, in part with financing from the International Bank for Reconstruction and Development (World Bank or IBRD), and (2) a similar massive program to upgrade the irrigation delivery system.

### Drainage

In recent years, high priority has been given to the installation of tile drains on old lands to check the decline in yields attributable to waterlogging and increased salinity. Only about 200,000 feddans had tile drainage prior to initiation of the World Bank program. In addition, the Egyptian Government has designated about 1.2 million feddans for its program of soil ameloriation by means of open drains, subsoiling, and soil treatment on lands not suitable for tiling because of problems in providing outlets for field drains. The two World Bank programs underway or approved involve 950,000 feddans in Lower Egypt and 300,000 feddans in Upper Egypt. Through 1973, less than 800,000 feddans had open or tile drains, mostly in Lower Egypt. Eventually, drainage will be needed on about 4.2 million feddans of old lands, but at the proposed rate of 250,000 feddans per year it would require 12 years to install drainage on all lands not yet treated. Drainage is needed also on practically all new lands, but these lands are not included in present World Bank programs. A program to expedite installation of drainage facilities on old lands is included among the high priority projects.

### Improved Irrigation

Present irrigation practices contribute directly to the drainage problem through excessive use of water. The second top priority project recommends controlled delivery of water to farms, design and construction of elevated canals to eliminate most animal-powered water wheels or mechanical pumps, and increased overall efficiency of water use.

## New Lands: Problems and Alternatives

Official policies with respect to land already reclaimed, as well as plans for new reclamation projects are receiving increased attention within the Ministries of Irrigation and Agriculture. Central issues involve (1) whether to retain new lands now under cultivation within the public sector, or distribute them to individual operators, (2) how much additional public investment should be made in lands already partially developed, and (3) the rate at which new reclamation projects should be undertaken in the future.

Some 900,000 feddans have been reclaimed since the 1952 Revolution. Major existing problems are (1) salinity and waterlogging caused by building an irrigation system first with the expectation that drainage would not be needed until 20 years later, and (2) basically poor soils. A fourth of the land is in Class III and 70 percent is in Class IV--the two lowest classes on which crops can be grown--whereas 90 percent of the old land is in Classes I, II, and III. 5/ Most of the land proposed for future reclamation would be Class IV. Some areas of old lands have also been subject to deterioration through waterlogging and increased salinity.

The team recommends that reclamation projects not yet nearing completion should be stopped until an interdisciplinary feasibility and preinvestment study is made in each area of promise and is examined as part of an overall master plan for the new lands. All new lands now developed or proposed for development should be covered by soil surveys designed to facilitate detailed planning of soil and water management. One company should be established with full responsibility for all activities involving new lands to be developed in the future, up to the point of land distribution to farmers or joint ventures.

Most soils in the new land areas require expert management and even then are likely to have relatively high production costs. On many of these, soil-building crops should be grown in 3 years out of 5. Dairy herds to use this forage and to provide organic manure would be desirable. Joint ventures should be considered on the larger tracts. Smaller tracts could be distributed to agricultural college students, tenants or workers with state-farm experience, and other individual farm operators. Based on present information, it seems unlikely that additional new land worth developing over the next 10 years or so would exceed 1 million feddans, and the actual amount may be considerably smaller than this.

## Agricultural Extension, Research, and Teaching

In order to meet Egyptian production requirements, a complete revamping and strengthening of the present structure of extension, research, and training is required. Proposals discussed in this report include the following:

1. Establishment of regional offices of the Ministry of Agriculture, each with a director responsible for coordinating all agricultural research, teaching, and extension in the region. Education currently is under the Ministry of Secondary Education and the Ministry of Higher Education. Thus, some restructuring outside the Ministry of Agriculture would be required.

5/ The Egyptian land classification system divides cultivatable land into four classes, with I including the best soils and IV including those having severe problems for crop production. Classes V and VI are unfit or unavailable for cultivation (see Technical Report on Soil and Water Constraints, p. 74).

2. Identification of students who demonstrate leadership potential at the farmer and village leader level, who would be encouraged to specialize in an extension curriculum and would then be assigned as extension workers in the region.

3. Development of improved educational programs at the elementary and secondary level to explore simple concepts relating to scientific agriculture, such as soil and water management, improved animal nutrition and breeding, etc.

4. Placement of one or more highly-trained extension workers in each village, with adequate resources for effective extension work. Staff at regional and national offices would service their needs. (Extension workers under present programs are placed at a district level or higher, and generally lack transportation facilities for frequent village contacts.) 6/

5. Coordination of university and Ministry of Agriculture research programs to concentrate on problems of farmers in the region in which they are located. Needed machinery, equipment, and up-to-date library materials should receive high priority. An in-depth survey of these and other proposals and ways in which they might be implemented by a group of agricultural administrative specialists is recommended as a priority project.

## A Recommended Dairy Development Program

At present most farmers keep one or two cows or female buffalo for workstock and milking. This results in more cattle than can be properly supported by available forage in the summer. Also, animals selected for strength tend to give little milk. Mechanization of land preparation, irrigation pumping if needed on farms, and threshing would permit a breeding program to increase the genetic potential for milk production. An incentive program should be developed to reorganize livestock into efficient-sized units to utilize modern husbandry methods. Livestock extension programs would become a necessity. A pilot program to test these concepts in a number of villages is proposed as a priority project.

## An Improved Marketing Program

Losses of 40-50 percent occur for many fruits and vegetables in the marketing system because of spoilage from poor handling, inadequate transportation, and lack of cooling facilities. A project recommended as a priority item is to improve and modernize all aspects of marketing, including assembly, wholesaling, and retailing.

6/ Government organization below the national level in descending order is made up of governorates, districts, cities and towns, and villages. Villages have no more than 20,000 people, and the largest part of the village population lives in the 2,000-10,000 size group.

## Public Sector Broiler and Egg Activities

Development of facilities for an integrated operation of broiler and egg production was initiated in 1964 as a public sector activity. A goal has been set to produce 50 million broilers and 200 million eggs by 1980. The public sector also provides feed and chicks to 500 specialized producers in the private sector, 80 cooperative broiler operations, and 5 governorate facilities. In 1974, only 17 million broilers and 56 million eggs were produced. Problems involved materials to complete houses and lack of chicks and feed for completed houses. Specialized producers and cooperatives had similar problems.

The following recommendations are made: (1) facilities now under construction should be completed; (2) a detailed cost study should be made to determine (a) private vs. public sector costs and (b) costs of importing broilers vs. producing them from imported feeds; (3) consideration should be given to using public-sector facilities to provide superior genetic stock to the private sector, rather than using public facilities for production as such; and (4) the program should be expanded to upgrade genetic stock and improve poultry husbandry in villages.

## Restructuring Cooperatives

As now operated, cooperatives are used more as a vehicle to facilitate implementation of Government policy than to meet the needs of individual farmers. They are designed to assure the Government a quota supply of major crops, to enforce crop rotations, and to provide a means of collecting payments for inputs, such as seeds and fertilizer, furnished in kind to assure the desired production. This role differs from that of cooperatives in many other countries. Between the Ministry of Agriculture and some 5,000 local cooperatives lie a multitude of diverse cooperative societies, lines of authority, supervisory agencies, and cooperative unions. Restructuring in the following way is recommended: (1) combine the present four societies at the national level into one overall society, (2) retain one multipurpose cooperative in each governorate, (3) consolidate many of the smaller village cooperatives, and (4) eliminate district cooperatives by shifting functions up to the governorate or down to the village level.

## Need for More Equitable Pricing Policies

Official prices paid to farmers for export crops have been maintained below international prices for a decade or more in order to maximize foreign exchange earnings and hold down consumer prices. Such a policy has tended to discourage production of requisition crops and divert resources to other farm enterprises where free-market prices could be obtained. Upward adjustments in official prices have been made as a result of the sharp increase in international prices in 1973-75, but a substantial gap still exists. The 1976 price for cotton was increased 25 percent over the 1975 price. A similar adjustment was made in the price of rice in 1975, but may remain unchanged in 1976. The farm price of sugarcane has doubled since 1974, whereas the official price for wheat in 1976 may remain the same as in 1975.

## Overall Government Organization

Government organization is a problem in all countries and other political entities of the world. Problems in Egypt appear to be particularly severe because (1) there is an attempt to direct from Cairo almost every phase of agricultural operations on individual farms, as well as operations in marketing channels, (2) different agencies function in seemingly closely related areas, and (3) communication and coordination by direct contact of individuals below the ministerial level is difficult. In addition, frequent changes in top personnel have resulted in the interruption or redirection of ongoing programs without adequate recognition of long-range policies.

An important change in the organization of the Ministries of Agriculture and Irrigation, initiated at the beginning of 1976, promises to improve coordination between the two Ministries and reduce or eliminate direct Government involvement in several agricultural production activities. The essential feature of the new organization is to convert several of the General Organizations, which were previously Government-operated, into companies to be operated as profit-maximizing firms. Fixed prices--the prime feature of public sector involvement in poultry, milk, and meat--will be increased gradually toward the level of prices for similar products produced in the private sector. Direct Government subsidies will be reduced accordingly. Elimination of a dual pricing system, together with public subsidies, should significantly strengthen the competitive position of the private sector.

## Education

Provisions for almost free higher education should be continued, but the guarantee of jobs for college graduates in Government should be relaxed, with more effort given to placement in the private sector. Increased emphasis should be placed on technical education at elementary and secondary levels, with adequate public-sector wages to encourage entry into skilled trade fields.

## National Land Zoning

Valuable farmland is being diverted to urban development and other nonagricultural uses. National legislation now covering public use should be extended to prevent such diversion by the private sector except under the most pressing circumstances. By having residents drive a few extra miles, new housing near Cairo and other cities could be built in the desert rather than on prime agricultural land. Expansion around cities and villages should not be at the expense of productive land.

## National Investment Policy

In the past, agriculture in the old lands has been allocated a smaller proportion of national investment than its contribution to the general economy. To implement recommendations in this report, a more equitable share of investment will be required. Some of these needs may be met by outside donors.

## Laws and Regulations Relating to Foreign Investment

New regulations designed to encourage and facilitate an open-door policy toward investment of foreign capital in Egypt were issued in 1974. A number of constraints that tend to restrict foreign investment are listed in the Technical Report on that topic. Investment regulations are in a state of flux and some of these constraints may have been reduced or modified. Egypt needs such investment. Cooperation between the Egyptian Government and potential investors to modify the most troublesome regulations would be desirable.

## Production Potentials on Old Lands

Projections of an alternative cropping pattern for old lands for 1985 were made incorporating several goals or objectives for Egyptian agriculture (table 2). The areas that could be devoted to the various crops, given existing agronomic and climatic constraints, were provided by the Egyptian team members at the national level.

The major goals incorporated in these projections included increases in cotton and rice area to maximize foreign exchange earnings; increased supply of roughage for livestock during the summer and Nili seasons; self-sufficiency in sugar, lentils, and horsebeans; and substantial increases in the areas devoted to fruits and vegetables, chiefly for export.

The projected increases in cotton and rice would necessitate a reduction in area devoted to full-term clover and to maize and sorghum for grain. Land released from these crops would be utilized for maize and sorghum production for forage, to improve the nutritional level of livestock.

Maintaining and, where possible, increasing per capita food supplies from domestic production was also recognized as an important goal of the projected cropping patterns. Per capita supplies of wheat and rice would be maintained at about the 1972-74 levels; supplies of fruits and vegetables would be substantially greater, although most of the increase would likely be for export. Self-sufficiency could be achieved for sugar, lentils, and horsebeans thereby saving foreign exchange that would otherwise be needed to import these foods. Per capita supplies of maize and sorghum grains for human consumption would be reduced, but dietary levels would be improved by the projected increase in supply of livestock products.

Because urban expansion is projected to take about 100,000 feddans of old lands by 1985, most of the increase in total physical output will need to come from increased yields. A shift toward a cropping pattern that would include more higher value crops would contribute also to an increase in the total value of farm output and thereby increase farmers' incomes. A concerted effort to reduce losses in the marketing system would have the same effect as increased crop yields in providing needed food supplies at the consumer level.

Table 2--Area, yield, production, and farm value of major crops on old lands, 1972-74 average, and projected 1985

| Crops | Area | | Yield | | Production | | Production per capita | | Value 1/ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1972-74 | 1985 | 1972-74 | 1985 | 1972-74 | 1985 | 1972-74 | 1985 | 1972-74 | 1985 |
| | 1,000 feddans | | Metric tons per feddan | | 1,000 metric tons | | Pounds | | Million LE | |
| Nonforage field crops: | | | | | | | | | | |
| Cotton (lint) | 1,535 | 1,700 | .30 | .37 | 462 | 628 | 29 | 30 | 148 | 202 |
| Wheat | 1,289 | 1,275 | 1.38 | 1.81 | 1,778 | 2,312 | 111 | 110 | 125 | 162 |
| Maize | 1,647 | 950 | 1.53 | 2.15 | 2,523 | 2,047 | 158 | 98 | 144 | 117 |
| Sorghum | 484 | 275 | 1.71 | 2.31 | 826 | 635 | 52 | 30 | -- | -- |
| Rice | 1,061 | 1,200 | 2.19 | 2.62 | 2,327 | 3,141 | 146 | 150 | 151 | 204 |
| Sugarcane | 203 | 280 | 36.10 | 45.70 | 7,336 | 12,802 | 459 | 610 | 55 | 96 |
| Other 2/ | 653 | 800 | 2.19 | 2.48 | 1,428 | 1,983 | 89 | 95 | -- | -- |
| Vegetables | 764 | 1,170 | 7.21 | 10.42 | 5.511 | 12,196 | 345 | 582 | -- | -- |
| Citrus | 139 | 170 | 6.10 | 10.00 | 848 | 1,700 | 53 | 81 | -- | -- |
| Other fruits 3/ | 120 | 130 | 5.00 | 7.25 | 599 | 942 | 38 | 45 | -- | -- |
| Forage crops: | | | | | | | Tons per AU 4/ | | | |
| Catch-crop clover | 1,230 | 1,600 | 12.0 | 15.0 | 14,710 | 24,000 | 2.7 | 4.5 | -- | -- |
| Full term clover | 1,597 | 1,100 | 24.0 | 30.0 | 38,345 | 33,000 | 7.1 | 6.1 | -- | -- |
| Maize and sorghum | -- | 1,100 | -- | 18.0 | -- | 19,800 | -- | 3.7 | -- | -- |
| Total | 10,722 | 11,750 | | | | | | | 623 | 781 |
| Cropping ratio | 1.9 | 2.1 | | | | | | | -- | -- |

-- = not reported.

1/Based on export or import prices at Alexandria, adjusted to farm level equivalent. Unit prices for 1985 were held constant at 1972-74 level.

2/Chiefly horsebeans and lentils.

3/Excludes dates for which no land area is calculated.

4/Metric tons per animal unit. The number of animal units in 1985 was assumed to be the same as in 1972-74 (5,375,000).

## HIGH-PRIORITY PROJECTS

The team chose the following five projects as having top priority for implementation:

### Program for Accelerating Installation of Drainage Facilities

Drainage programs now underway or being negotiated for financing by the World Bank cover substantial areas of old lands, but the rate of installation needs to be accelerated to prevent further deterioration from waterlogging and increased salinity. The following measures are proposed to achieve this objective: (1) Provide additional materials, laborsaving equipment, and contractors from abroad. (2) Build additional concrete manufacturing plants to supply materials for full utilization of present pipe manufacturing and contracting facilities. Improved transportation and installation equipment also would be needed. (3) Initiate a program to use plastic pipe. Manufacturing and installation facilities and some technical consultation would be needed.

### National Program for Soil and Water Management

Many trained field technicians will be required to work with farmers to obtain the needed improved soil and water management emphasized in this report. This project is designed to provide (1) needed training for such technicians, (2) necessary special equipment for such work, and (3) pilot demonstration projects which, if successful, could be widely used throughout Egypt. Pilot projects in each governorate or agronomic zone would demonstrate and evaluate large-scale field trials encompassing all phases of soil and water management. These projects would test proposed management practices against actual constraints faced on lands of cooperating farmers. Small, readily observable demonstration projects at the local level would be established by trained agricultural and irrigation technicians. A fundamental feature would be a structured training program designed to train soil and water management instructors at national centers, train large numbers of field technicians at the regional centers, and transfer this information to farmers through a trained cadre of fieldworkers. Inputs would include (1) technical assistance, including interdisciplinary teams, (2) special equipment for soil testing and moisture and water quality analysis, (3) publication of training manuals and other technical material, and (4) provision of ditch liners, pumps, and other irrigation equipment as required.

### Streamlining Agricultural Research, Teaching, and Extension

Technical expertise by senior agricultural research and extension scientists and administrators is needed to develop plans for restructuring and reorgani-

zing agricultural research, teaching, and extension services to overcome existing constraints and to increase their efficiency. Consideration should be given to the feasibility and likely success of establishing regional offices of the Ministry of Agriculture in each major agronomic zone, with a director charged with the responsibility of coordinating all agricultural research, teaching, and extension work in the zone. Emphasis would be placed on studying and solving problems of the farmers in each zone. As a part of this study, an inventory would be made of existing machinery, equipment, and literature needed for research, teaching, and extension operations, and recommendations would be outlined for needed improvements and possible sources for new items, repairs, and repair parts.

## Comprehensive Dairy Improvement Project

The livestock sector in old land areas is characterized by the use of limited feed resources for multiple-purpose animals of limited genetic potential for milk and meat production. The objective of this project is to demonstrate and test the effectiveness of various alternatives aimed at bringing about a more efficient livestock enterprise at the village level. The first step required to improve productivity of livestock involves mechanization of (1) land preparation, (2) pumping of irrigation water, and (3) threshing of grain. This would eliminate the need for animals as workstock and permit their development by breeding as efficient sources for milk and meat. Development of an effective extension program at the village level to support the introduction of modern animal production and breeding methods would be coupled with an increased mechanization program. Incentives in the form of extra concentrates or premium payments for milk would be used as inducements for individual farmers to cooperate with relatives or neighbors to form small central animal production units (10-20 cows). These approaches would be tested in pilot programs covering a number of villages. (Details are outlined in the Technical Report dealing with this project.)

## Improvement of the Agricultural Marketing System Especially for Fruits and Vegetables

The emphasis on increasing production in the past has resulted in serious neglect of the marketing system, which is now quite inadequate to compete effectively in export markets or to serve the rapidly expanding urban population. For some fruits and vegetables losses in the marketing system may be as much as 40 percent, and much of the produce reaching consumers is low quality. Consequently, high priority should be given to developing a broad overview of the present marketing system in order to determine the major constraints and the actions needed to modernize the system. Such a study should cover the following aspects: (1) optimum size, number, and location of physical facilities needed at assembly points, wholesale markets, and ports, (2) needs for cooling and freezing facilities, (3) improvements needed in grading, sorting, and packaging, and (4) need for improved transportation facilities.

Following such a study by a team of specialists, plans should be developed for a core of Egyptian specialists to receive formal training in marketing in the United States. On-the-job training should be provided for personnel in the management and operation of various types of marketing facilities. Financial assistance will be needed to construct cooling and processing facilities, relocate wholesale markets, and construct assembly point facilities. Another phase would involve development of an extension program to assist farmers in the production of better quality fruits and vegetables, and an educational program for middlemen.

## OTHER SUGGESTED PROJECTS

The following projects were submitted by U.S. and Egyptian team members. They were rated in order of priority by the 10 team members whose ratings were available for tabulation, and are listed below in the order of priority based on this tabulation.

1. Construction of main drainage channel in new lands west of the Delta (Zone X).

2. Evaluation of alternative systems to increase broiler production.

3. Agricultural water management project to evaluate and demonstrate the effects of a modernized system. This project calls for installation of a modern irrigation and drainage system for evaluation in one or more pilot areas. The system would include lined elevated canals equipped with measuring devices so that amounts of water delivered to individual farms would be known. Drainage outflow from the system also would be measured. It would supplement rather than duplicate the program for soil and water management listed among the five top priority projects above.

4. Restructuring the cooperative system. Chief input would be a temporary (TDY) team to provide detailed recommendations.

5. Control of sparrows and rats.

6. Interdisciplinary plan for developing the new lands east of the Suez Canal (Zone XIII).

7. Assessment of potential fish production in Egypt.

8. Export market potentials for fruits and vegetables to Arab and other Middle East countries.

9. Sprinkler irrigation for new and old lands. This project provides for large field trials to evaluate portable and semifixed sprinkler systems, as well as trickle and drip irrigation, on appropriate crops on permeable (sandy) soils.

10. Development of a modern national soil classification system. Inputs chiefly would involve financial assistance to obtain necessary equipment. Initial emphasis would be placed on determining which areas are suitable for reclamation, and which recently reclaimed areas are suitable for further development.

11. Modification of the Ismailia Canal to accommodate the development of new lands. This canal would provide water for Zone XIII, and is thus related to project 6.

12. Strengthening agricultural economic and statistical research.

13. Maize multiplication program. This program is designed to provide farmers with increased high-yielding hybrids and composites, for which breeder seed now is available.

14. Control of onion white rot disease and restoration of the winter onion export market.

15. Eradication of major animal diseases.

16. Integrated rural development. This project provides for a 5-year study in each of five demonstration villages of an integrated approach to rural development. Surveys would be made of the economic, physical, health, educational, and social conditions in the villages before the study and at the end of each year of operation, and local men and women would be trained as leaders of the project.

17. Genetic improvement of village flocks to increase egg production and farmers' income.

18. Pilot project to test the use of pumped ground water in the Desert Oases. This project would test the feasibility of depressing artesian pressure to reduce the presently unused flow from private artesian wells.

19. Technical training in rural elementary schools and expansion of technical training at secondary agricultural schools.

20. Development of a popular farm credit system to be owned and operated by farmers.

21. Evaluation of ground water resources in the Nile Valley and Delta.

22. Development of supplemental food production for rural people. This would provide for a pilot program in about 25 villages to encourage farmers to raise home gardens and to increase poultry and milk production for family use.

23. Assembling, cataloging, and evaluating existing soil and water data and research findings.

24. Training program for Egyptian specialists involved in soil and water development and management.

25. Pilot soil and plant testing program. Under this program, small laboratories, equipment, vehicles, and working tools would be provided or developed to make needed soil and plant analyses for more precise fertilizer and micronutrient application recommendations. A system would be developed for collecting soil and plant samples through the extension service.

The following additional studies were also recommended by team members:

1. A comprehensive study of future food requirements in relation to production capacity of Egyptian agriculture. This study would examine the projected supply-demand relationships for major food items in terms of the anticipated rate of population growth and per capita income levels. It should include such corollary studies as the following:

   (a) Relative costs and efficiencies of domestic vs. import supplies of meat, milk, and poultry products to meet present and anticipated increases in demand.

   (b) Potentials for developing agro-industrial facilities to permit exports of high value food products as a source of foreign exchange.

   (c) Marginal returns to public investment in old vs. new lands. The proposed study to determine costs and returns from large industrial-type farms and similar lands operated by private owners would make a substantial contribution toward guiding public policy regarding this issue (see footnote 9, p. 40).

2. A study to determine a development plan for the El Dabaa reclamation project. This project covers a strip of land along the coast of Egypt west of Alexandria (Zone XII). It involves extending the Nubaria Canal to the El Dabaa area for resort development along the Mediterranean Coast and for supplemental irrigation to rainfed crops in the area.

3. A study to determine the feasibility of additional land reclamation in the Komombo and similar areas in Zone VIII (see description of Zone VIII, p. 64). This might be one of the pilot areas for project 3 above, and might provide disease-free land on which onions could be grown under project 14.

## PART II. OVERALL CONSTRAINTS

This Part and Part III, Constraints in Special Areas, offer a synthesized evaluation and assessment of the constraints to increasing agricultural productivity in Egypt. They are based on the Technical Reports in Part V, which offer additional details on the specific subjects.

### PRICING POLICY AND OTHER BROAD POLICIES RELATING TO AGRICULTURE

Agriculture has been assigned by the Egyptian Government the major task of providing (1) low-cost food and industrial raw materials for a rapidly increasing population, (2) foreign exchange and investment funds to permit rapid industrialization of the country, and (3) employment for a growing work force. The chief means for accomplishing the first two goals has been to establish low prices to farmers for certain controlled agricultural products, permitting (1) sale of food products through Government-operated stores at low prices to urban consumers, (2) sale to processing industries of raw materials at low prices, and (3) export by the Government of certain items at a price that in many cases exceeds the equivalent price to farmers by severalfold. Distortions caused by this pricing system in recent years have intensified because of the sharp advance in international prices for most agricultural and industrial raw materials. The third goal has been accomplished by a continuation of labor-intensive agricultural operations that in many cases have been unchanged for thousands of years. Demand for Egyptian workers from nearby oil-rich Arab countries may reduce the labor supply, so that more efficient methods will need to be introduced. To some extent this already is taking place, as tractors are increasingly used for land preparation and there is a partial shift from transplanting to direct seeding for rice.

Results of price distortions are widely evident and openly discussed throughout agricultural circles in Egypt. Farmers use fertilizer allocated to cotton for vegetables, for which announced wholesale and retail ceiling prices admittedly are ineffective. Cotton planting is delayed to permit two or three cuttings of catch-crop clover instead of the one cutting that was standard until recently, thereby reducing cotton yields. Often the farmer is unable to meet his quota for seed cotton, and this may result in an inability to pay off his loan for cash inputs that were supposed to be used on that crop. Quota rice frequently finds its way into the much more lucrative free market. When too large a part of the quota is undelivered, the Government tends to raise the price to the farmers for the following year, perhaps returning 30 percent of the international market price instead of 25 percent, resulting in a 20-percent increase in farm prices, assuming no change in international price levels. But the foreign exchange to the Government from the undelivered quotas is gone forever, as is the extra rice consumed in Egypt (due to the low price to consumers) which might otherwise have been exported.

Another way in which quota production is reduced is by planting land in citrus or other fruits, which exempts the farmer from the requirement of planting one-third of his land in cotton or wheat, depending on his phase in the rotational pattern. Long-term value added from agriculture, based on international prices, may be thereby increased, but Egypt is deprived of much-needed current foreign exchange at least until the land comes into production.

Other types of price distortion and the resulting possible misallocation of resources are discussed in detail in other sections of this report, particularly those relating to livestock, dairy, and poultry production. Given present pricing patterns, these are the most profitable agricultural production areas in Egypt. However, expansion is held in check by a lack of feed concentrates. Free- or black-market feed prices are close to international equivalents. The official price--while equal to cost--is below the international level because of low prices to farmers for locally produced ingredients. Meat, poultry, and eggs are chiefly consumed by tourists and other non-Egyptians plus middle- and upper-class urban residents. The extent to which this consumption should be subsidized, at the expense of more widely consumed foods or commodities that could be used to generate foreign exchange, is open to question.

Widely fluctuating prices, which have characterized international markets recently, also cause production distortions. It is recommended that prices to farmers be allowed to more fully reflect longer-term expectations of international price equivalents. This might permit doing away with quotas or two-price systems, at least for many commodities, and should result in the allocation of resources in a way that would come closer to maximizing the contribution of agriculture to the Egyptian economy.

## INSTITUTIONAL CONSTRAINTS

### Education

Several aspects of the educational program act as constraints to increased agricultural and other production. In a sense, the Egyptian population is overeducated in relation to its current needs for college-trained people, at least in many fields. It is undereducated at the farmer level at present, since many if not most of the older people are illiterate. This will correct itself to some extent within one or two generations, as many children now receive at least a sixth-grade education, and discussion is underway to extend this to 8 years for all. Vocational education beyond the elementary or secondary level exists to some extent, but needs to be expanded greatly, in part to meet Egypt's rapidly growing needs and in part because of the drain of skilled Egyptian workers to neighboring countries where pay scales are higher. Additional technical training for college graduates also is needed in certain fields, and this may be a way to alleviate part of the existing surplus of college graduates.

Improved education for all of the people was one of the goals of the 1952 Revolution. Laws were passed which provided higher education at little cost to those individuals who could pass stiff examinations at various educational levels. Furthermore, all who completed college were guaranteed a job with the Government for life. This was fine in the early stages because few could qualify and many were needed as more and more activities were brought under Government regulation. Over time, more and larger colleges and universities were developed and more and more qualified young people became available. College graduates increased rapidly even though exams were made more difficult and qualifying entrance scores were raised. At present far more students are being graduated than can be placed in useful employment within the Government agencies to which they are assigned. The better qualified students tend to enter higher-paying private industry or to emigrate to other countries. Problems within the Ministry of Agriculture are particularly severe because entrance scores for colleges of agriculture are lower than for medicine, engineering, and other areas that are more highly rated by those who administer the educational system. Over 4,000 students were graduated from agriculture colleges in 1975, and this number is expected to increase to at least 5,000 per year by 1985.

The Government compensation system is such that there is little incentive, if any, for the employee to exert initiative and creativity on the job. Rather, the system is conducive to stagnation and low productivity on the part of many Government employees. Promotions depend mainly on seniority, with little emphasis on creative output or decisionmaking or other administrative abilities. We do not mean to imply that all Government workers are ineffective. The American team has worked with many who are qualified, efficient, and dedicated to their work. This includes not only those at top levels. Statisticians and scientists worked day and night to develop detailed data by zones and other material that is summarized in tables and text of this report. But evidence of inefficiency is widespread, both in Cairo and in field stations, including state farms.

Impact of the Government job guarantee to college graduates creates a largely nonproductive bureaucratic work force which places an undue financial drain on the economy's limited resources. If the inflow of college graduates into Government under the guaranteed employment provision, particularly to the Ministry of Agriculture, is not drastically reduced, it is conceivable that operations within the Ministry can be so hampered and clogged by unnecessary personnel as to create a near state of paralysis within the organization.

Recommendations: It is strongly recommended that the law guaranteeing college graduates employment within the public sector be reappraised and modified to eliminate the proviso of guaranteed employment in the public sector. Furthermore, it is recommended that the system of compensation and promotion be restructured to provide incentive to all employees for high productivity and creativity and to administrators for abilities relating to organization and decisionmaking.

A number of proposals in this report would require substantial numbers of college-trained staff for implementation. Areas of work include establishment of records and processing of semen to improve milk production by cows and buffaloes; increased testing of soil and plant material to measure deficiencies in trace elements, or to tie fertilizer applications more nearly to the needs of individual farmers or small geographic areas; and development of staff to assist with detailed drainage and water-management surveys, and to work with individual farms to improve on-farm irrigation practices. Specialized training courses might be needed to teach present graduates how to work in these areas. Many of these jobs could be handled equally well, or perhaps better, by women than by men. A need for increased coordination between teaching, research, and extension is discussed in the next section.

Vocational training needs to be greatly expanded. The educational system has long been geared to produce college graduates without too much concern for developing skilled tradesmen. Part of the problem has been the burning desire of parents to have a college education for their children, thus qualifying them for white-collar jobs. Emphasis and resources within the educational system have been directed toward academic pursuits. The skilled tradesmen who are available have been trained largely through an apprenticeship role. A limited and even decreasing supply of skilled tradesmen--mechanics, electricians, plumbers, carpenters, etc.--is seriously handicapping the Egyptian economy from functioning properly and restricting growth, particularly in the construction component. Needed mechanization in agriculture also could be hampered by a lack of skilled mechanics. Unless strong action is taken quickly to sharply increase the supply of skilled workers, the ability of the economy to expand will be severely restricted.

Recommendation: The Egyptian Government, through the Ministry of Education, should establish a number of new technical-vocational schools to teach certain skills to a highly select group of students. Skilled tradesmen for which the demand appears especially strong are equipment and tractor mechanics, truck and tractor drivers, electricians, plumbers, and carpenters. Technical schools should be established in both rural areas and urban centers accessible to large numbers of potential students. A screening and testing program based on Egyptian standards should be formulated to enroll in the technical school only those students who display certain mechanical aptitudes and skills. Also, incentives should be included in the program to attract the better students into the technical training program.

In the United States, by comparison, many blue-collar workers with such skills earn double or triple what is paid to white-collar workers with college or even Ph.D. degrees. Children of college-trained parents frequently express a desire to enter technical fields, possibly bypassing a college education, and are encouraged to do so by their parents. Some U.S. farmers have advanced degrees in esoteric subjects like philosophy or cultural anthropology, yet are skilled tractor drivers, mechanics, operators of sprinkler irrigation rigs, etc., and have knowledge of plant and animal diseases, soil chemistry, animal nutrition, and similar subjects. A comparable change in attitude toward work with one's hands may be needed here if Egypt is to fully enter the modern world.

## Agricultural Extension

True extension work was begun shortly after the 1952 Revolution, in part with U.S. assistance. This assistance was ended in 1967. An extension program was maintained in the Ministry of Agriculture with restricted budgets, limited personnel, and a low-key status. Extension staff worked with farmers to some extent, particularly on cultural practices involved in the shift from basin to perennial irrigation. They also did intensive work on cotton, corn, and sesame in some areas, and worked on the distribution of improved bulls and better breeds of poultry. Demonstration plots were maintained with cooperating farmers. In some cases, these plots were extended to cover entire villages or regions.

The Extension Service works through the Agricultural Unit at the district level and the Village Council at the village level. 7/ Of its present male staff, 100 are in the central office in Cairo, 80 at the governorate level, and 420 at the district level. There are 150 women in Cairo who go to the villages at times to attempt to improve poultry practices of the village housewives. A major gap is that no extension workers are at the village level. This contrasts with the rural health centers, which involve 2,000 physicians and several thousand other staff at the village level, and there is a comparable program for the Rural Social Units, which cover other activities to improve rural life including adult education, clubs for women and youths, and nurseries for preschool children.

A complete revamping and strengthening of the extension program will be required if Egypt is to achieve the production goals discussed in this report. A need exists for greater coordination between research and teaching at the agricultural colleges, research at the Ministry of Agriculture experiment stations, and the Extension Service in the areas covered by each of these. Regional offices of the Ministry might be established, tied in part to the agronomic zones discussed in this report, with a regional director responsible for coordinating research, teaching, and extension in that region. Teaching programs for agricultural students should involve direct participation, at least to some extent, in the research and extension program in the region. Students should be identified who show leadership potential, particularly in working with farmers and village leaders. These should be encouraged to specialize in an extension and education curriculum and, on graduation, should be assigned to work in that region if they desire public employment. Once these regional offices have been established, consideration might be given to discontinuing offices at the governorate and district levels unless a distinct need continues to exist for these.

7/ Agricultural Units are a part of the Ministry of Agriculture designed to coordinate agricultural activities at the district level. The Village Council is made up of selected leaders from each village and is supervised by the Organization for the Reconstruction and Development of the Egyptian Village in the Ministry of Local Administration.

This program would be somewhat comparable to the coordinated teaching, research, and extension work at land-grant colleges in each State in the United States, where this system is usually further broken down to a number of coordinated research and extension programs in distinct agronomic zones within the States. These programs are tied together in each county (of which a hundred or more are involved in typical States) through the Office of the County Extension Service to provide direct services to farmers. Such offices usually contain at a minimum the County Agent and an Assistant County Agent, a Home Economist to work with housewives and other consumers, and a 4-H Agent to work with young people. If special crops or livestock enterprises are important in the county, one or more specialists in these areas usually is added.

An educational program directed at young people could be of great value in Egypt because of the widespread illiteracy of adult farmers. In the United States, two programs are involved: (1) A 4-H Program for children from age 9 through high school involving specific projects relating to improved farming or homemaking and a certain amount of recreational or social activity and (2) the Future Farmers of America (FFA) program involving vocational training in high schools. In Egypt, some programs likely should be carried out at the elementary level because some potential farmers will not go beyond this. Simple concepts involving proper water and soil management and scientific care of crops and livestock could be covered. More intensive and detailed programs could be introduced at the secondary level, with some tying together scientific principles as they relate to agriculture, and others emphasizing care and repair of tractors and other machinery in common use in the region. Recordkeeping, particularly relating to breeding of livestock, might be included.

A decision is needed as to whether home economics work should be part of the Extension Service or whether this area is adequately covered by the Rural Social Units of the Ministry of Social Affairs. Extension services should be made available for village poultry activities, which are usually run by women.

Location of one or more extension workers in each village should be a firm goal. This person might coordinate work of other specialists. Areas in which work with individual farmers will be needed to implement recommendations made in other parts of this report include (1) soil testing and recommendations on the use of fertilizer and related nutrients, (2) monitoring of water use to avoid excessive applications but to assure adequate amounts in the root zone at all times, (3) spotting potential outbreaks of insects, diseases, and weeds that affect plants and application of control measures before serious damage is done, (4) encouraging use of improved crop varieties, (5) keeping adequate records on milk production to improve breeding, (6) identification of livestock and poultry diseases before they become critical, and (7) improvement of rations, including roughages, for livestock. Coordination of extension work with cooperatives would be essential in some areas if they continue current functions. Demonstration plots should be continued as an important aspect of the work.

Many of the above needs have been recognized by the Extension Service, and some limited steps in this direction have been started. Some army returnees are being trained in agriculture to work in villages. A program in extension training has been developed at several colleges. New extension personnel are assigned to work for at least 1 year with experienced agents. (This policy also is followed in the United States. All new graduates start as Assistant County Agents, not as County Agents.)

As village and youth programs are developed, staff at the regional and national offices of the Extension Service should concentrate on serving their needs. One- or two-page leaflets on specialized subjects are replacing longer technical bulletins in many of the programs in the United States. Publications and posters for illiterate farmers need to communicate chiefly with pictures or diagrams. Portable vans might be purchased, with electric generators and movie or slide projectors and loudspeakers, to supplement equipment now available in the villages. These could be taken from village to village, and perhaps used as part of a field day attended by people from nearby villages to show achievements of local farmers and their families. Radio programs are used now in Egypt to reach farmers, and they can play an important role in education and extension. They should be on at one or more fixed times daily, at a time (such as during meals) when most farmers could listen to them. They should be on timely subjects geared to problems in the area covered by each broadcasting station.

To achieve these goals, extension work will require strong support from the Ministry of Agriculture and possibly other Government agencies, and a fully adequate budget.

## Cooperatives

As now operated, cooperatives are used more as a vehicle to facilitate implementation of Government policy than to meet the needs of individual farmers. They are designed to assure to the Government a quota supply of major crops, to enforce crop rotations, and to provide a means of collecting payment for inputs, such as seeds and fertilizer, furnished in kind to ensure the desired production. Rigid price and supply controls have given rise to black markets in some items distributed by cooperatives, particularly feed concentrate and fertilizer. These controls and the part that cooperatives play in their administration have eroded the confidence of farmers in the cooperative system. This in turn impedes the effectiveness of the cooperatives.

Egyptian cooperatives are price-takers in the purest sense. Ministries outside the Ministry of Agriculture may have substantial influence on the level of price for both inputs and major outputs. Needs of the farmer frequently are overruled by other considerations. The organizational structure of the cooperative system is complex. Between the Ministry of Agriculture and some 5,000 local cooperatives lies a multitude of diverse cooperative societies, lines of authority, supervisory agencies, and cooperative unions. Although reasons existed initially for the formation of many of these, some have outlived their purpose. A concrete proposal is contained in the Technical Report on cooperatives for consolidation at the national, governorate, district, and village levels. These organizations would be designed to take advantage of economies of scale at all levels. Such consolidations should assist the village societies to expand the already beneficial social services to members and the village community. It also is recommended that cooperatives be allowed to act as autonomous units for distributing inputs and credits, and for marketing. Some experiments are underway in this direction or are in the planning stage.

Internal constraints also plague cooperative societies. The directors are hired by the Ministry of Agriculture to enforce its regulations. Boards of directors, many of whose members can barely read and write, are ineffective in "supervising" the college-trained director. Family disputes are frequently involved in elections to the board. Capital resources are small and salaries for the many required supervisory officials frequently absorb most of each year's surplus. The chief clerk, an employee of the Agricultural Cooperative Credit Bank who is responsible for the distribution of supplies and credit and the collection of debt, is frequently accused of corruption, as are members of the boards of directors, particularly those responsible for allocating machinery services. It is felt that many of these problems would be alleviated by the above-mentioned consolidations, which would provide larger incomes to the cooperative societies and might permit obtaining higher quality personnel.

Inadequate physical facilities, including office and storage space, marketing facilities, and machinery (particularly tractors) cause further problems. Only 900 out of 5,000 village cooperatives own their own stores and storage facilities. Tractor use and efficiency is limited by the lack of spare parts, competent mechanics and drivers, and effective training programs. Before additional physical facilities are acquired, proposed consolidation patterns should be taken into account, in order to maximize usefulness of existing facilities.

Further participation of cooperatives in the marketing process should be seriously considered, particularly if physical and institutional constraints are made less severe. Adequate training programs to acquire needed marketing expertise would be needed. Beginning points would likely be fruits and vegetables, broilers, and/or livestock and livestock products, all of which move to a substantial extent through uncontrolled markets.

## Need for Land Zoning Regulations

Productive land is perhaps the greatest constraint to increased agricultural production in Egypt. Pressure on the limited land resources grows stronger each year as population increases at 2-3 percent annually. Land reclamation is a slow process and the time required to bring reclaimed land up to reasonable levels of productivity under the most favorable conditions is considerable, involving from 4 to 10 years or longer. Land that is worth reclaiming is limited. At the same time that Egypt is undertaking massive projects to reclaim land at a high cost per feddan, it is annually losing a sizable number of its most productive feddans to urban development, roads, and other nonagricultural uses. The trend in losses of productive land to nonagricultural pursuits is likely to accelerate as population numbers climb and migration from rural areas to urban centers continues. Migration from farm areas to the cities will in all likelihood rise as the new thrust in education takes hold in the villages and rural areas. Under these conditions, unless the Egyptian Government acts forcibly and quickly to stem the tide of losses of productive land to nonagricultural uses, the capacity of the agricultural sector to produce food and fiber will be reduced, adding to an ever-widening foreign exchange imbalance. Some analysts believe that without such land use planning it will be difficult to achieve any net addition to agricultural land despite active and expensive reclamation programs.

Recommendation: To stop the conversion of Egypt's productive land resources to nonagricultural uses, it is recommended that national legislation be extended to prohibit the use of productive lands for nonagricultural purposes in the private sector, except under the most extenuating specified circumstances. Such a law was passed in 1973 to cover public use. The law covering private use should set forth severe penalties for violation of the intent of the legislation. The penalties should not be monetary, since they would result in escalation of land prices around urban centers.

## Opportunities and Constraints Pertaining to Foreign Investment

New regulations designed to encourage and facilitate an open-door policy toward investment of foreign capital in Egypt are contained in Law No. 43, issued June 1974. This law removed a number of restrictions that had been in effect previously, provided protection against nationalization and confiscation, and established a framework for Free Trade Zones and joint ventures. Among the activities favored for foreign investment are the reclamation and development of barren lands for intensive crop production and livestock enterprises.

Despite this generally more favorable climate for foreign investment, several obstacles remain that could be alleviated by further modifications in the present law:

1. Assurance of the same exchange rate for funds brought into the country and funds repatriated from earnings. Several different exchange rates exist now and local currency is not freely convertible into other currencies.

2. Modification of existing tax laws pertaining to the treatment of dividends and personal income taxes on foreign nationals working in Egypt.

3. Assurance that the public sector will not compete directly by producing products for sale at subsidized prices.

4. Simplification of the present procedures for appraisal and approval of investment proposals from foreign firms. The multiplicity of Government agencies with which foreign investors must negotiate, and the time required for final approval, has led to withdrawal of some proposals.

5. Granting of priorities to obtain needed local materials for the construction of facilities. Implementation of projects is now hampered by shortages of many items produced in the local economy which require long waiting periods under the present permit system.

Most of these problems have been brought to the attention of Egyptian officials and progress is being made to alleviate these constraints.

## INVESTMENT POLICY

Since the 1952 Revolution Government investment in agriculture in old lands has been far below agriculture's contribution to net value added or similar measures based on the national accounts. While this may have been desirable in the early stages while the new society was getting on its feet, a more equitable investment policy should be applied in the future. The situation likely has improved some with the massive current and planned programs for agricultural drainage systems. Substantial investments also will be required for many of the agricultural programs proposed in this report. To the extent that financing for these is provided by outside donors, agriculture will benefit at little or no cost to the rest of the Egyptian economy.

## LAND FRAGMENTATION

Breaking up large estates and distributing the land to tenants and farmworkers was a keystone of the 1952 Land Reform Program. Since land was limited and many people wished to participate in the program, distributions usually consisted of 5 feddans or less, with many being no larger than 1 feddan. Moslem inheritance laws, which provide that property be distributed between all heirs, with girls receiving half as much as boys, have resulted in further fragmentation. The Egyptian Government has recognized the problems caused by these policies and laws and has established Land Use Projects which cover 85 percent of the old lands.

Land Use Projects that apply to land under the Land Reform Program are handled as follows: Farmers involved in a 3-year rotation are given three more or less equal pieces of land in three different sections. On one large section,

all farmers plant catch-crop clover and cotton. On another large section, all farmers plant wheat in winter and rice or maize in summer. On the third large section, farmers plant full-term clover in winter and rice or maize in summer. Thus, each has one field in the traditional major crops. But plowing can be done by tractors in large blocks and spraying for insects can be done with large equipment which at times involves airplanes. If the farmer has too little land to divide this way or owns land not subject to the Land Reform Program, he grows only the rotational crops in his location and trades with another farmer for needed clover for his animals or rice or corn for his family. This block method of farming assists with sound water management, since water requirements are nearly the same for all of the one crop in the block, at least if all are planted at about the same time. One problem with this system is that land preparation for the new crop must await harvest and removal of the byproducts (straw, cotton stems, etc.) by the least efficient farmer. Another problem is that all farmers tend to be locked into a fixed rotation. If one wanted to shift to a 2-year rotation and grow certain vegetable crops in the third year, he would be unable to do so unless all the farmers were willing to do likewise.

## PART III. CONSTRAINTS IN SPECIAL AREAS

### SOIL AND WATER MANAGEMENT ON OLD LANDS

#### Water Management

A question the team knew it must answer was whether water or usable agricultural land is the single most limiting constraint to increased production. FAO concluded in an earlier study that water would not be a constraint at least through the year 2000. The Ministry of Irrigation, in studies recently summarized in newspaper stories, came to the same conclusion. Based on independent analysis and judgement, our team confirms this view. But the truth lies deeper, as is spelled out in detail in the Technical Report on Soil and Water Constraints in Part V. Although the total amount of water will be sufficient, proper use to avoid waste, waterlogging, and salinity is a crucial factor in improved productivity.

In 1974, all of the 55.5 billion $m^3$ allocated to Egypt from the Nile by agreement between Egypt and Sudan was used. The 55.5 billion figure is based on dependable yield analysis over many years; release of this amount, on the average, is necessary to protect flood storage capacity. Now that the reservoir is full, and until Sudan begins to use its full quota, a larger quantity may need to be released. In fact, actual release in 1974 was 56.0 billion $m^3$.

Total water available for use in 1974 was the 56.0 billion $m^3$ from the Nile plus 0.4 billion of pumped water from underground sources. Of this total, 82 percent is estimated to have been used directly or by diversion from the river for irrigation, 2 percent was released for industrial and domestic use, 5 percent was used for electrical power generation and navigation during the period when irrigation canals are closed for maintenance, and the remaining 11 percent was waste water pumped into the sea. About 10 percent of the irrigation water was used twice from return flow and reuse of drainage. The Nile is a closed system connected to the sea by navigation locks.

Actual evapotranspiration use of water by crops on the 6.2 million feddans of old and new lands in production in 1974 is estimated at 26.0 billion $m^3$, indicating an overall irrigation efficiency of 51 percent. 8/ This is higher than for some systems, including some in the United States, but is below the 70-percent overall efficiency that might be achieved in a large closed river system like the Nile where considerable reuse could be expected.

8/ As shown in table 10 (p. 89), 51.2 billion $m^3$ was used for irrigation. This includes direct use from the Nile, reuse, and ground water. 26.0/51.2 = 0.51 or an efficiency of 51 percent.

The pressing problem in Egypt is that farmers, who for thousands of years had access to water only during the flood season and hence hoarded all they could get at that time, use excess water now that it is available year round from the controlled flow of the High Dam. The problem is accentuated by the fact that no charge is made for the water and minimum control is exerted during the "on" periods when water is available in particular canals. Our calculations indicate that 10 billion $m^3$ remain in the system annually, a potential contribution to the water table equivalent to 0.42m (1.4 ft) of water depth over the entire 6.2 million feddans, including new lands, irrigated in 1974. Controlled availability of water permits the growing of two to three crops annually, where only one was grown before, thus increasing problems associated with excess water use.

In 1960, about 2 million feddans suffered from salinity. The area affected by waterlogging and salinity has been increasing at an alarming rate over the past 10 years since the High Dam came into operation. This has been true on both old and new lands. Approximately 80 percent of the irrigated land in Egypt will be affected by these problems to some degree before many more years of traditional irrigation. Management measures and new capital investments will be necessary on all of this land to maintain these problems at safe levels. Our team proposes that a comprehensive action program for water management in Egypt be initiated.

A massive program for drainage of the affected areas is underway, in part with World Bank financing. Tile drains were installed by the Egyptian Government on 177,000 feddans before the World Bank projects were begun. As a part of two World Bank projects, about 930,000 feddans will be added by the end of 1975. This includes 710,000 feddans in Zone II, covering 70 percent of the area in crops in recent years for that zone; 315,000 in Zone III, covering 72 percent of that area; and 40,000 each in Zones VI and VIII, covering 4 and 6 percent of the cultivated areas respectively. An additional 1,223,000 feddans are scheduled to have tile drains installed during 1976-1980. Plans and funding negotiations are underway for another 1,850,000 feddans. The total is 4,180,000 feddans, or 79 percent of the total old land area. Drains are scheduled to be installed at the rate of 250,000 feddans per year, but this rate has not been achieved in recent years.

A project is outlined in this report to speed up this installation process, since land will continue to deteriorate until such time as drainage becomes available. Major shortages that affect both this and other urgent construction projects (such as housing and hotels in Cairo) are (1) cement, (2) transportation equipment, (3) contractors and skilled labor, (4) modern equipment, and (5) port facilities to handle needed imports. A possible solution for drainage would involve the use of plastic pipe which would require manufacturing and installation equipment.

Our team believes that a massive program to upgrade the irrigation delivery system should also be started. Modern pumping systems would provide a larger flow available to the farms allowing increased capacity for improved conservation irrigation systems. The need for animal power or small mechanical pumps for on-farm irrigation would be virtually eliminated. New delivery

ditches or enlargement of existing ones would be necessary. These ditches should be lined to prevent seepage and to eliminate labor and the waste of water now associated with annual maintenance. Junction structures to split or change the direction of flow in multiple ditch systems would be required, as well as structures to measure the flow of water and control the ditch gradient. The latter could be used to reduce excess water use and to assure needed water for root zones of the various crops.

Looking ahead to the year 2000, domestic and industrial use of water is expected to quadruple to about 4 billion $m^3$ annually. Some of this could be supplied by ground water or by treatment of municipal and industrial effluent. Egypt will receive an extra 9 billion $m^3$ of water from the Nile by 1985 from projects in the Nile Basin which are expected to be initiated in 2 or 3 years. If an average of 2.5 crops per year are grown by the year 2000 instead of the present 1.9, and if land area to be irrigated from the Nile is increased by a million feddans (or 17 percent) from the 6.2 million in production in recent years, then crop requirements for irrigation by the year 2000 would increase by perhaps 30 percent over that in 1974, assuming no change in the efficiency of the delivery system. As discussed in the next section, land of sufficient quality to warrant reclamation is limited, and the increase of one million feddans used here may be optimistic, at least over the next 10 years or so. Water use per feddan for high-yielding crops actually will not be significantly different than for lower-yielding ones. Thus crop consumptive use might total 34 billion $m^3$ of water. Given an overall irrigation efficiency of 70 percent, only 49 billion $m^3$ would be required from the Nile versus the 51 billion chargeable to irrigation in 1974. At an overall efficiency of 60 percent, 57 billion would be required. The excess of 6 billion over 1974 plus an additional 3 billion for urban and industrial use would just equal the 9 billion extra from the Nile Basin water-improvement project.

Large quantities of ground water exist in artesian aquifers in the Western Desert and in alluvial deposits in the Nile Valley and Delta. Except for the New Valley (Zone XI) and some municipal purposes, little use is made of this at present. It would be available by pumping whenever needed to supplement water from the Nile.

## Soil Management

Soils in the Nile Valley and Delta are among the most fertile in the world, with 90 percent of the old lands in Classes I, II, and III. Problems of drainage and salinity have been discussed. A program for soil amelioration by use of subsoiling, deep plowing, and addition of gypsum is in effect in Zone I.

Although the present system of soil classification serves a useful purpose, more detailed soil surveys which examine the upper 150 cm, along with geologic investigations, provide a basis for detailed planning of soil and water management practices. Higher cropping intensities and management practices demand more details about soil characteristics than are provided by the present system. A modernized soil survey and classification system should be developed and put into use at the same time that high-priority reclamation

or other project areas are being surveyed and prior to the initiation of new drainage or irrigation projects. As time permits the new system should be extended to other areas.

Present allocations of fertilizer by crops are nearly the same throughout the country. Little account is taken of variability in soils, particularly in local areas. This system works fairly well with some soils with medium-level management. Optimum yields require correct balance of fertilizer and micronutrients. Acquisition of proper equipment and capability for soil testing and plant tissue analysis, together with extension service or other advice to farmers and availability of proper fertilizers, would allow higher levels of cropping management and should result in higher yields.

## NEW LANDS--PROBLEMS AND ALTERNATIVES

The reclamation and development of new lands has been a major and costly aspect of agricultural policy in Egypt for the past decade or so. The increased quantity of irrigation water available from the High Dam, mounting population pressures in old land areas, and a substantial number of landless farmers, despite the allocations made under the Land Reform Program, all encouraged expanding the agricultural land base. Thus, both economic and political pressures supported the high priority given to developing new lands. Frequently, these areas were selected without sufficient analysis and evaluation of their economic feasibility, and not enough attention was given in the overall allocation of public investment between old and new lands. Many observers now feel that in the short run, marginal returns to capital are greater for old lands than for new lands. The location of areas of reclaimed land is shown in figure 3.

The emphasis on capital investments in land, both old and new, has diverted needed capital investment from other inputs such as credit, fertilizer, extension, and research. Shortages of these items are evident, resulting in an imbalance of the key factors needed for sustained growth of the agricultural sector. Thus, a major policy issue for the next decade or so will concern the optimum allocation of public, and to a lesser extent private, capital among the several factors other than land that tend to limit agricultural productivity. Expected returns from additional investment in new lands now under cultivation and lands designated for future development should be compared with possible returns from alternative investments in old lands.

About 900,000 feddans were in various stages of reclamation as of 1975. About 200,000 have been distributed to individual farmers and another 200,000 are devoted to roads, canals, and other infrastructures. The remaining 500,000 are under the supervision of the former Organization for Land Reclamation and Development, mostly as state farms.

Of the 500,000 feddans now producing crops, about 70 percent are Class IV soils, 25 percent are Class III, and the remaining 5 percent are in Class II. Soil Classes III and IV have severe limitations for crop production, particularly Class IV, which requires special soil treatment to obtain moderate yields at relatively high cost. Added to the soil fertility limitation of the reclaimed cultivated lands is the problem of salinity and waterlogging. In fact, approximately 50,000 feddans have gone out of cultivation because of secondary salini-

zation. Not only are the reclaimed lands being affected, but in certain areas old lands lying directly downslope are being adversely impacted by waterlogging infusion.

Salinity and waterlogging on reclaimed land is basically due to the lack of an adequate drainage system. In fact in some areas there is no drainage system. When the irrigation system was planned and implemented, critical drainage problems were not expected for 10 to 15 years. Hence, no urgency was felt to implement a drainage system. The need for an adequate drainage system is now apparent. As an example, in one area of the new lands the water table has risen an average of 3 m per year for the past 6 years. Currently, the water is less than 2 m from the surface.

Most of the additional land identified for reclamation has been mapped by semidetailed aerial reconnaissance surveys. A preliminary examination of the survey data indicates that a large portion of the planned area for reclamation is Class IV soils.

Reclamation of new land has been costly. Allocation of substantial financial resources have been made over the past 13 years with relatively little return on the investment to date. Reclaiming a feddan is estimated to cost an average of LE 350 to 400, including the infrastructure, i.e., canals, ditches, roads, schools, hospitals, village housing, etc. Additional costs are incurred in cultivating and developing the land until it achieves a certain level of productivity. Total costs per feddan are not readily available, but would exceed the initial cost by a substantial margin.

## Proposed Initial Actions

Before addressing these priority questions, consideration must be given to certain recommended prior actions. They are:

1. Development of an overall master plan for the reclaimed lands. The need for a master plan becomes obvious when one views the number of different projects underway, with most of them unrelated to each other. An interdisciplinary team should be assembled and given responsibility for formulating a comprehensive plan that takes into account the following factors: (a) adequacy of water resources for each area, (b) the irrigation system and its capability to provide water as required for those crops which appear best suited for the area--citrus, grapes, olives, selected vegetables, and forage crops, (c) limitations of the drainage systems, and specific needs for developing an adequate system to meet overall drainage requirements, (d) identification of the infrastructure and determination of its capacity to handle demands placed upon it by varying populations and (e) capital needs in the new lands, including farm equipment, and possible sources for obtaining it. A careful, detailed soil survey based on modern classification procedures should be made for each area of potential interest.

## KEY TO AREAS OF RECLAIMED LAND

| Number | Region | Number | Region |
|---|---|---|---|
| East of Delta | | | |
| 1. | El Gab alasfar | 31. | Abiss |
| 2. | Enshass | 32. | Nubaria prolongation |
| 3. | Elmoulak | 33. | Elhager |
| 4. | Elmanaief | 34. | Elnahda |
| 5. | Elswissa | 35. | North Tahrir sector |
| 6. | El Bohairat elmorra | 36. | Mariut |
| 7. | Elverdan | 37. | Mechanized farm |
| 8. | Elsalhia | 38. | West of Nubaria |
| 9. | Baher-elbaker | 39. | Ferhassh |
| 10. | Wadi Tema | 40. | Elbustan |
| 11. | South Port Said | 41. | Eltahaddy |
| 12. | Hessania Valley | 42. | Elentelaak |
| 13. | Elkasabi and Berket san | 43. | South Tahir and Elfathe |
| 14. | Abo-elakhdar | Middle Egypt | |
| 15. | Elmatareia | | |
| 16. | Elserow | 44. | Wardan |
| 17. | Faraskour | 45. | Elmansouria |
| 18. | Ezbet el Burg | 46. | Kom-osheen |
| | | 47. | El Fayoum |
| Middle of Delta | | 48. | Quta |
| | | 49. | Samalout |
| 19. | Elsatamony | 50. | Tall elamarna and der abuhenness |
| 20. | Hafir shehab eldin | | |
| 21. | Prolongation of hafir shehab eldin | 51. | Asyut |
| | | 52. | West of Tahta |
| 22. | Baltem and Kashaa | 53. | Sohag |
| 23. | West Tira and El Mansour | Upper Egypt | |
| 24. | Elgawia | | |
| 25. | Shalma | 54. | Kena |
| 26. | Elborullus | 55. | Esna |
| 27. | Elsenania | 56. | Elsaida |
| | | 57. | Elradisia and Wadi Abadi |
| West of Delta | | 58. | Aswan |
| | | 59. | Komombo |
| 28. | Elboseilli | | |
| 29. | Edko and Halle elgamal | | |
| 30. | Barsik | | |

Figure 3

## AREAS OF RECLAIMED LAND

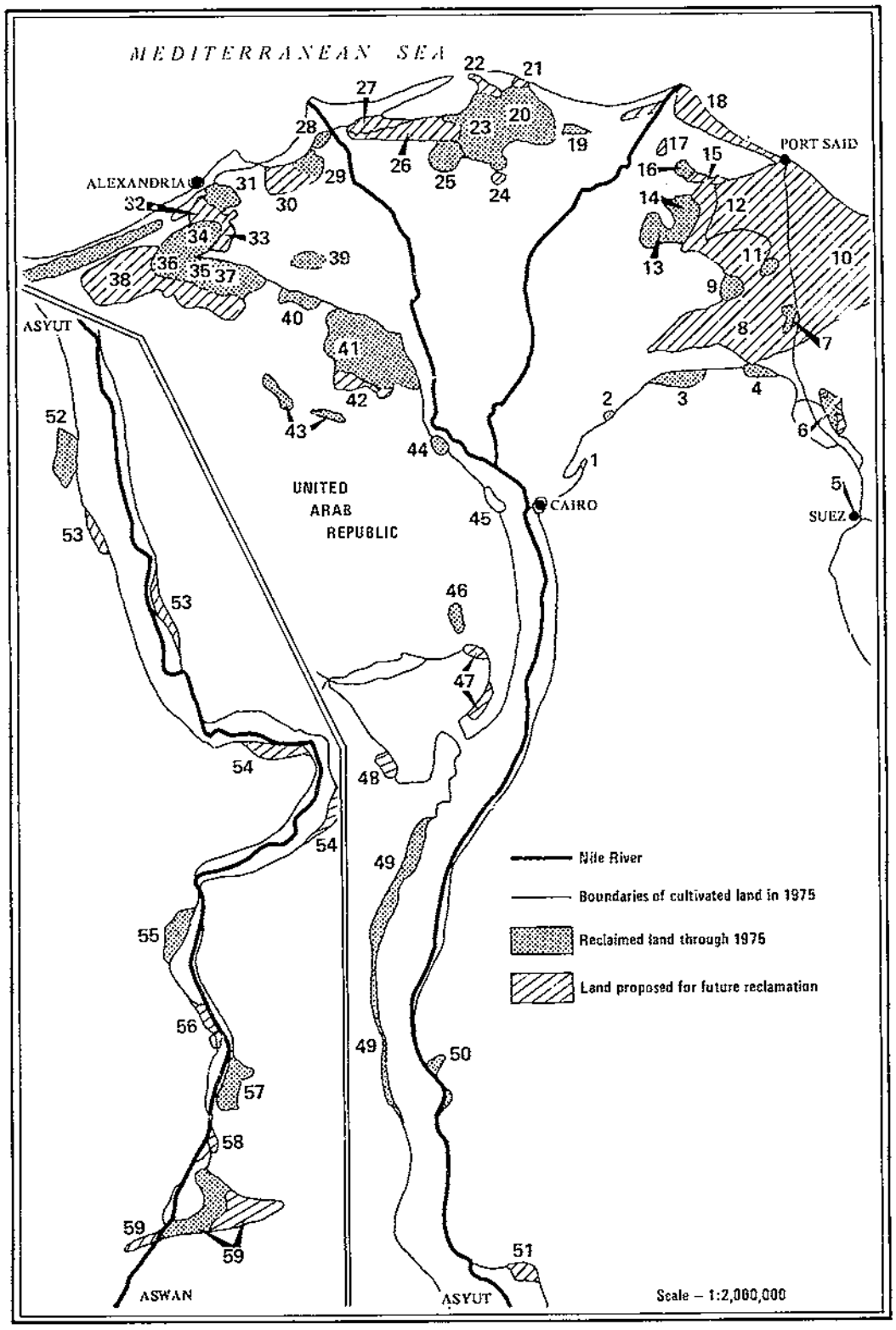



Figure 3

The master plan should be designed as a blueprint for action to be followed and implemented upon receiving approval of appropriate officials. It should provide specific recommendations for irrigation, drainage, farming operations, settlement, etc., and where possible furnish options with the cost, projected returns, and possible consequences for each option. Time frames for action for each project and needs for technical personnel--Egyptian and foreign--should be specified. The approach would provide a sound basis for decisionmaking.

2. Establishment of one body with complete responsibility for operation of reclaimed land up to the point of distribution to firms or individuals. Lodging the responsibility in one body would reduce conflict and duplication of effort, and expedite decisionmaking. Proliferation of authority and responsibility is conducive to indecisiveness and ineffective operation in any organization. Furthermore, lack of communication, particularly among different disciplines, is a characteristic of divided authority.

3. Development of an economic cost accounting system and farm management surveys. Without accurate records it is impossible to determine inefficiencies in operations or to discover where corrective action is needed. Also, it is impossible to make comparative analyses and project future budget needs. An overriding consideration is the determination of returns on investment from the reclaimed land, which cannot be made without a record and cost accounting system. One of the difficulties in evaluating the performance of reclaimed lands has been the lack of a comprehensive accounting system. 9/

## Ownership and Operation Policies

A question uppermost in the minds of Egyptian officials is what course of action should be taken concerning the lands already reclaimed, and what policy should be adopted regarding the reclamation of additional lands. For both kinds of land, a high-priority question is whether they should be operated as state farms (which have not been too successful in the past) or under some other organization or by individual operators. Consideration is being given to joint ventures which would provide access to foreign capital and know-how. A third alternative is to divide the new lands that have reached a productive stage into economically viable units and distribute it to farmers, agricultural college graduates or others.

9/ A comprehensive research project has been outlined by Dr. Ahmed A. Goueli of Zagazig University to investigate relative costs and returns from (a) state farms and (b) privately-owned land on similar soils in Zone X. This was proposed for FAO financing but we have been told that problems have arisen in this connection. Such a project would be useful in the area addressed here. Funds from some source should be found to activate it. Results would be expected within about 30 months after initiation.

The issue of what should be done regarding new lands is further complicated by the substantial investment already made in lands now only partially developed. Some projects may have reached a point where they should be completed, if agronomic studies indicate than an acceptable level of productivity can be achieved, but there are other areas that should probably be abandoned. Only careful, objective further studies can provide a basis for such policy decisions which, while difficult, are likely to be in the best interests of Egyptian agriculture in the future.

Poor soils, inadequate drainage, and ineffective management are prime factors that have contributed to the unsatisfactory performance of state farms. Problems relating to soils and drainage are discussed above.

One management problem is that as state farms have been operated in the past, monetary or other kinds of incentives were lacking for managers and workers to exert themselves to improve crop yields and livestock output. Regardless of what happens to overall output, the directors, managers, and laborers receive basically the same income. In contrast, on the privately-owned farms in the Delta and new lands, the farmer's return is directly related to his own efforts. Each farmer has a strong economic incentive to maximize his net return. Thus, he acts accordingly to achieve the goal of income maximization.

In view of the past record of crop yields and livestock output on state farms, alternative management methods for these cultivated lands should be considered. One option that should receive intensive study and high priority is to make available large tracts of cultivated land for joint ventures, and divide the outlying or isolated smaller tracts into economically viable units of manageable size for distribution to farmers (tenants), farm laborers, agricultural college graduates, or other special groups.

Under the joint venture approach, technical expertise, good management, and working capital would be available if participating firms could be located. These three components are essential ingredients, especially in view of the fragile nature of the soil, and the need to develop, finance, and coordinate a dairy industry to make use of soil-building forage crops. Through joint ventures with working capital, crop production should be geared primarily to the fresh vegetable and fruit market for export to other Arab countries and perhaps to West European outlets. It should be realized, however, that on Class III or IV land other than orchards and vineyards, cash crops should be grown in rotation with soil-building forage crops, with the cash crop planted perhaps 2 years out of 5. Output from the associated animal industry should be designed for the domestic market to increase the availability of high-quality animal protein and other needed foods. Intake of animal protein among the Egyptian population is low--less than one-tenth the per capita rate in the United States. Such use is limited, for the most part, to middle- and upper-income urban groups or to foreign nationals or tourists. A viable dairy industry is believed to offer the least-cost approach to supplying needed animal protein, since dairy animals can utilize soil-building roughage of little or no value to poultry or humans.

Assuming the joint venture approach is feasible in some form, the Egyptian Government should make certain that the interests of its people are properly protected. That is, the profit-sharing arrangements and leases should be to the extent possible mutually advantageous to the Government and the joint venture participants.

However, before joint ventures can be seriously considered or become a reality in fact, further changes are required in laws and regulations that are constraints to foreign investments. These are discussed in some detail in the Technical Report, Opportunities for Foreign Investment.

It must be recognized that foreign investors who take part in joint ventures are profit-oriented and are willing to accept the frustrations associated with developing countries only when the profit potentials are considerably higher than in their own or more developed areas. Profit potentials on the new lands in general are low due to the poor quality of the soil and the distance from, and lack of good transportation facilities to, major domestic and export markets. Lack of labor may be a problem in some areas. Thus, potential investors may be hard to locate even under optimum conditions and would tend to be turned away if too much emphasis is placed on benefits to Egyptians.

Assuming joint ventures are desirable and feasible for that portion of the new lands now farmed in large blocks, the crops best suited for production appear to be citrus, grapes, olives, figs, and selected vegetables. Joint ventures in fruit and vegetable production will require a close examination of soil types to select those crops best adapted to the particular soil, availability of necessary water for the crops selected, adequacy of drainage, and provision of the infrastructure required for marketing and perhaps elementary processing. Not to be overlooked is the necessity for including soil-building crops, which could produce forage for a complementary livestock operation. In planning fruit and vegetable production for the export markets, three basic elements of international trade must be kept in mind: (1) standardized high-quality products, (2) prices that are competitive with identical products flowing into the market from other sources, and (3) assurance of a regular flow into the market within specified seasons.

Since on many of these lands, soil-building forage crops need to be grown over half of the time in the rotation, a complementary livestock industry should be developed. For the reasons cited earlier, dairy production seems a likely choice. At present, the major forage crop in the new lands is alfalfa. Tests of the value of Napier grass as a forage crop should be made. If Napier grass shows up as a preferred crop, berseem clover would be seeded over it during the winter when it is dormant. Sorghum or barley might be produced on some land as a part of the rotation as a source of grain. The basic dairy cattle production operations should be associated with complete milk processing facilities. Additional facilities should be included to grow and fatten surplus dairy calves for meat. Number of feddans required, size of milking herds, and the relationship of forage crops to fruit and selected vegetable crops should be determined through intensive detailed study and analysis, including a careful economic evaluation of likely production costs, available markets, and likely returns.

## Reclamation of Additional Lands

Although initiation of new reclamation projects has been suspended since 1967, substantial areas have been designated for future development. The largest blocks are located on the eastern and western edges of the Delta and are considered to offer the best prospects for the development of agro-industrial complexes for production, processing, and export of fruits and vegetables, and for meat and milk for the domestic market. Lands adjacent to the Western Delta, for example, have ready access to Alexandria and its port, and the Suez area could become a major supplier of provisions for ships, as well as for exports to nearby Arab countries.

Only initial, and frequently superficial, soil surveys have been made in most of these potential areas. Consequently, U.S. team members feel that additional projects should be undertaken only after thorough feasibility and preinvestment studies have been made to provide definitive information on the following questions:

1. Availability of water resources for additional reclaimed lands.

2. Determination of soil fertility by specific locations within the area designed for reclamation.

3. Cost per feddan of reclamation, including adequate irrigation and drainage systems, necessary infrastructure, and cost of bringing the land to a productive level.

4. Determination of policies for handling reclaimed land along with specific objectives of reclamation.

5. Identification of where responsibility for additional reclaimed lands would be lodged and why.

Upon completion of the study, areas should be identified for development that are economically feasible and in the best interest of the nation. An action plan as discussed in this report then should be developed. Reclamation within broad areas should be held to economically productive soils. This means that reclamation might be spotty within specified areas. Special care would be needed in such cases to make sure that the associated infrastructure and irrigation and drainage systems could be justified on an economic basis.

# MAJOR CONSTRAINTS THAT AFFECT CROPS, LIVESTOCK, POULTRY, AND FISH

Many of the previously discussed overall constraints, particularly those relating to pricing policy, extension, cooperatives, and land fragmentation, as well as those involved in soil and water management, have important effects on crop and livestock production. In this section, constraints of a more specialized nature are discussed.

## Crops

Poor drainage and shallow plowing have major effects on crop production. Experiments indicate that improved drainage on poorly drained soils can

increase production by 50 percent or more. Deep plowing with tractors and moldboard plows can increase production by 20-30 percent above yields obtained by traditional methods. The common practice of removing virtually all organic matter from fields for either cooking fuel or livestock feed prevents the improvement of soil fertility, tilth, water-holding capacity, and drainage obtained from these crop residues in many other countries. This problem has increased in importance now that silt and organic matter from the Nile are no longer available.

Two crops per year are produced in most agronomic zones. The cropping ratio could be increased further by the development of shorter-season or earlier-maturing varieties to permit three crops in some areas. However, only a modest increase, to a cropping ratio of 2.1, is judged to be feasible by 1985. Mechanization of seedbed preparation and semimechanization of harvesting and threshing operations would be needed to shorten the turnaround time between crops.

Agricultural research at present is fragmented. Integration with other parts of the Ministry of Agriculture is weak. A comprehensive study of the entire research, teaching, and extension program is recommended, with emphasis on the practicality of establishing regional branches of the Ministry of Agriculture to coordinate these in each major zone. Machinery, equipment, and up-to-date library material is needed to facilitate the agricultural research program, since these are lacking at many of the existing institutions.

Production constraints for individual crops are discussed in some detail in the Technical Report that relates to crops. Two constraints are of particular importance. The first relates to maize, for which high-yielding disease-resistant hybrids and composites are available. However, only one-sixth of the maize production area is planted with improved varieties. A 5-year seed increase project has been initiated, but progress has been impeded by a lack of necessary machinery and seed storage and the fact that farms are small and scattered, making supervision of seed production, especially detasseling, difficult. Joint ventures with American or European seed-producing firms would be one solution to the problem. The second restraint relates to onions, the third most important export crop of Egypt. Infestation of growing areas with the soil-borne disease white rot, for which there is no cure and which persists in the soil for 7-10 years, caused production to shift to a nearby heavy clay soil from which harvest is difficult without first irrigating the soil to loosen it. The extra moisture causes a postharvest physiological breakdown which frequently results in heavy loss during shipment. Planting of onions in sandy loams which are being considered for reclamation might be the best solution, if test plots demonstrate that this is desirable.

## Livestock

Animals perform a major part of the nonhuman work involved in farming, including land preparation, pumping of irrigation water, threshing, and transportation in rural areas, and also account for 25-30 percent of the

value of agricultural output. This diverse use of livestock, combined with a dependence on residues and byproducts of the crop sector for a major portion of the feed, inhibits the development of an independent and efficient livestock industry in Egypt. The country has virtually no land that is suitable for grass and forage production only, except in newly reclaimed areas. Thus, livestock competes directly with cash crops and cereal grains for the limited agricultural land resources.

Female cattle are kept primarily for draft purposes and their limited milk production is used mainly to nourish the annual calf. Buffalo produce more milk, and their milk contains more total solids, particularly fat. Thus, buffalo are the major source of milk for drinking and processing. Sheep and goats are maintained chiefly in nomadic flocks, and they chiefly feed on crop residues not readily used for any other purpose.

Camels are kept almost exclusively for transportation of crops to and from fields and villages. Donkeys perform the task of transporting people and material for the rural family in a remarkably efficient way. Swine are of little importance, at least in part because of the dominance of the Moslem religion.

Most livestock herds consist of one or two mature females kept chiefly for workstock. Animals are suited primarily for work, not for milk production. Modern husbandry techniques are virtually nonexistent. A program to mechanize farm operations that now make use of animal power has been proposed. It is believed that such mechanization would have only a minimal effect on the demand for farm labor. But it would result in an immediate increase in milk production of about 10 percent, and would permit repeated crossbreeding of native cows with Friesian bulls which in a few generations could double milk-producing capacity. Feeding and disease control programs would need to be improved simultaneously. Crossbred calves also grow more rapidly than do native calves.

Crossbreeding is not possible for buffalo because there is no outside source of germ plasm to upgrade local stock. Hence, animals of superior genetic capacity for milk production must be identified. This will require a milk recording system to evaluate genetic merit. Such a system also would serve as an effective teaching tool, helping extension workers evaluate other husbandry practices directed at increased milk production.

Feed supply, particularly in summer, is a major constraint to the livestock sector. Livestock production, as currently practiced, is nothing more than survival during the summer, with livestock utilizing body tissue stores of energy and protein accumulated during the winter season. Such forage as is available during summer and fall consists mainly of lower leaves stripped from maize and sorghum plants. Introduction of Napier grass, or sweet sorghum or other high-yielding annual grasses, should be considered to provide needed forage in this season. The projected cropping pattern for 1985 discussed in Part IV provides for a significant increase in forage production in the summer and Nili seasons, but supplies in most zones would still fall short of optimum nutritional levels. Development of methods to carry excess supplies of forage from the winter season forward into the summer season would help close this gap, but a substantial extension effort would be required to implement such a program.

The current price structure makes livestock one of the most profitable enterprises for the small farmer who can raise clover or other forage crops efficiently. Prices for meat or milk in the private sector are much higher than prices paid producers by the public sector. The only factor that prevents more cattle from being fattened in the private sector is the supply of concentrates, which is under the control of the Government. Large specialized farms tend to market under Government contracts, while small producers operate in the private sector in a relatively inefficient way. Removal of present price constraints on the major cash crops, permitting them to be sold more nearly at international price level equivalents, would tend to reduce the profitability of livestock enterprises relative to alternative cropping systems but would likely increase the efficiency of agriculture in total.

The overall animal health program is quite effective. Vaccination is in effect for all serious diseases and Animal Health Units operate within each governorate. Parasites are a major problem. Mastitis likely will increase in importance as milk production per cow increases. Artificial insemination is widely used. A high rate of infertility (40 percent) in the female population is a major constraint. Research relating to its cause is recommended.

## Poultry

Chickens and eggs are popular items in the diets of upper- and middle-income urban consumers and provide needed animal proteins to improve dietary levels. A shortage of these food items developed in the early 1960's and production of broilers and eggs was undertaken by the public sector in 1964. Broiler and laying houses, feed-mills, hatcheries, and slaughter plants were built to establish a fully integrated system. A goal of 50 million broilers and 200 million eggs by 1980 has been set. Feed and chicks also were supplied by the public sector to about 500 specialized producers in the private sector, 80 cooperative broiler operations, and 5 governorate facilities. Performance has been far short of the goal. In 1974, 17 million broilers and 56 million eggs were produced. Many broiler houses are not yet in operation due to a shortage of materials. Use of space in completed buildings is low due to a lack of chicks and feed. Increased slaughter facilities for the private sector appear desirable. A comprehensive cost study is recommended to determine whether further expansion of the public sector is justified, since essentially all feed must be imported. Consideration should be given to the alternative of taking the public sector completely out of direct broiler production, by making use of existing facilities and those being built to maintain and propagate a strain of birds of superior genetic potential to be distributed to specialized producers in the private sector. Arrangements to provide high-quality feed would be essential. Upgrading the genetic quality of chickens in village flocks and introduction of improved husbandry also is desirable, in part to increase the cash income of farmers. Small amounts of commercial-type feeds would be needed here also.

## Fish from Lake Nasser

The 1967 and 1973 Wars seriously disrupted fishing activities in portions of the Mediterranean and Red Seas. Sardine catches near the mouth of the Nile have also declined, in part because the flow of silt and organic matter has been reduced following completion of the High Dam. To offset these losses to fish production, interest has been expressed in the potential of Lake Nasser as a source of fish production. Present production from this lake is 12,000-15,000 tons annually. This might at least be doubled by using more adequate catching and processing facilities. Plans have been proposed to do this. The potential sustained yield of fish from the lake has not as yet been determined. Since the lake contains little organic matter near the surface, fish yields are not expected to be large. A careful study of the productive capacity of the lake is recommended, together with the determination of cost/benefit ratios from increased capital investments at this site relative to other alternatives such as the Mediterranean, the Red Sea, or irrigation canals and coastal lakes. Fish ponds as a source of increased production should also be considered, but these would compete with poultry and livestock for available feed supplies.

## CONSTRAINTS RELATING TO AGRIBUSINESS AND MARKETING

Major improvements are needed in the marketing system, particularly for highly perishable items like fresh fruits and vegetables and fluid milk. The wholesale fruit and vegetable market in Cairo is badly congested, and plans exist for relocation. Transportation into and out of the market often consists of donkey- or horse-drawn open carts that offer little protection to produce from the hot sun. Improved shipping containers and facilities for cooling would substantially reduce waste and spoilage, which is estimated at 40 percent or more for a number of major items. Fluid milk is chiefly assembled by local dealers and reaches consumers in an unpasteurized form distributed by street vendors, often on bicycles, or small private stores. Less then 2 percent of the milk moves through the modern plants operated by the public sector.

Domestic demand for processed food is minimal except for a few items. In 1974, canned and dehydrated output was 30,000 tons, consisting mainly of tomato products, citrus and mango juice, and fishery products. Some items are exported, particularly to nearby Arab countries. The market for specialty and ethnic items may offer opportunities for expansion, particularly as more Egyptians migrate to other countries where such items may be difficult to obtain. Lebanon, for example, produces such items in volume for export and local sale, some of which move to the United States.

About 20 percent of the orange crop is exported, mainly to Eastern Europe and nearby Arab countries. Substantial improvements in quality and handling would be required to ship in volume to Western Europe or other similar markets in competition with Spain, Italy, and other Mediterranean countries. A detailed study should be made of the export potential for both fresh and

processed fruits and vegetables to nearby Arab countries, similar to a study made by the Ministry of Agriculture for Western Europe. Transportation and handling facilities in importing countries as well as in Egypt would need to be considered. The Aswan area (Zones VIII and XIV) can produce winter vegetables 1-2 months ahead of the Delta and has undeveloped soils believed to be suitable for vegetables. Air shipment to export markets or sales to the expanding local tourist trade are areas that should be explored.

Pricing and distribution problems that affect feed and fertilizer are discussed in other sections of this report and hence are not covered here.

## CONSTRAINTS RELATING TO RURAL DEVELOPMENT

An exploding population is the most serious problem facing Egypt today. Population is growing at the rate of 2-3 percent per year, with a significant shift by migration from rural to urban areas. For projection purposes, growth rates of 5 percent were used for major cities including the Suez area and 3 percent for other urban areas, implying a growth of less than 1 percent for rural areas. Since birth rates are higher in rural than in urban areas, this assumes a continued substantial migration from villages to cities. Migration from Egypt to nearby Arab countries is increasing but is not expected to have much effect on the overall in-country growth rate.

Based on these assumptions, population by 1985 is expected to reach 46 million, compared to 36.8 million in 1975 (table 3). By the year 2000, a level of 60-70 million is anticipated. Thereafter, projections differ greatly. Under the most optimistic assumptions about birth control, growth could stabilize at around 90 million by 2050. A more likely development is a continuing rise in population beyond that date. Some careful analysts project an accelerating growth rate that would reach 140 million by 2030. Family planning programs operate under the leadership of the Ministry of Health. However, as in other developing countries, incomes of the lower classes, including rural people, will need to improve before such programs are likely to have much effect.

Other major problems face the Egyptian rural community. Poor nutrition is widespread, causing anemia, retarded growth, high death rates, and low school attendance among children. Rural diets are low in consumption of meat, poultry, and dairy products. The health of the people is further adversely affected by some serious endemic diseases, overcrowded houses, and lack of sanitation. Programs underway to solve these problems are discussed in detail in the Technical Report on Constraints and Possibilities for Rural Development.

Most rural people in Egypt live in villages of 1,000-20,000 people and travel to and from their farm plots. Perhaps no other villages in the developing world have been subjected to the impact of as many different service institutions. The result was overlapping, lack of coordination, and sometimes conflict, which alerted authorities to the urgent need for integration of services. Consequently, a new organization under the Ministry of Local Administration was established for that purpose. Its objective is to obtain a total integrated development of the rural community, working through the local Village Councils. By 1975, operations covered 128 villages, and by 1980 all

Table 3--Approximate population by zones, 1972-74 average and projected 1985 1/

| Zone | Urban | | Rural | | Total | |
|---|---|---|---|---|---|---|
| | 1972-74 | 1985 | 1972-74 | 1985 | 1972-74 | 1985 |
| | Million | | | | | |
| I plus IV: Alexandria | 2.2 | 3.9 | -- | -- | 2.2 | 3.9 |
| Other | 1.0 | 1.4 | 3.5 | 3.7 | 4.5 | 5.1 |
| II plus V | 1.9 | 2.8 | 6.8 | 7.4 | 8.7 | 10.2 |
| III: Cairo | 5.5 | 9.9 | -- | -- | 5.5 | 9.9 |
| Other | 1.5 | 2.1 | 2.1 | 2.2 | 3.6 | 4.3 |
| VI | 1.0 | 1.4 | 3.4 | 3.6 | 4.4 | 5.0 |
| VII | .2 | .3 | .8 | .9 | 1.0 | 1.2 |
| VIII | 1.0 | 1.4 | 3.2 | 3.4 | 4.2 | 4.8 |
| IX | .9 | 1.6 | .2 | .2 | 1.1 | 1.8 |
| Total | 15.2 | 24.8 | 20.0 | 21.4 | 35.2 | 46.2 |

-- = Does not apply.

1/Based on annual growth rates of 5 percent for Alexandria, Cairo, and Zone IX urban, 3 percent for other urban, and 2.3 percent for the total. This implies an annual growth rate of less than 1 percent in rural areas, suggesting continued large rural-to-urban migration. These projections may be too low, particularly in rural areas.

of the 755 communities that have Village Councils are expected to be covered. An integrated approach of this type could be of great value as extension work expands to assist with the modernization of Egyptian agriculture.

## PART IV. SOILS, CROPPING PATTERNS, AND PRODUCTION POTENTIALS, BY AGRONOMIC ZONES

Most previous studies of Egyption agriculture have dealt only with national data on crops and livestock, thereby implying a greater degree of homogeneity within the country than actually exists. Discussions with Egyptian specialists indicated that significant differences exist with respect to soils, climate, and cropping patterns. Thus, the delineation of agronomic zones was judged to be a useful tool for more detailed analysis of the production potential of the nation's agriculture. Identification of the cropping patterns and the particular problems in each zone should facilitate design of programs and allocation of resources needed to achieve specific goals more efficiently than if the country is viewed as a single production area.

Data on crops and livestock for districts and governorates were compiled by the Ministry of Agriculture for the various agronomic zones. Additional data were assembled pertaining to soils, drainage, and water and labor requirements to provide a basis for a general description of each agronomic zone for 1972-74. Using this information as a base, projections of an alternative cropping pattern for 1985 were made for each zone which incorporated several goals for Egyptian agriculture specified by Egyptian team members.

The first chapter in Part IV lists these goals and describes the procedures followed in developing the projected cropping pattern for 1985. The next chapter describes each zone in terms of its soil characteristics and problems, 1972-74 and projected cropping pattern, and available supplies of roughage for livestock. The last chapter gives data on labor and water requirements by months. Data pertaining to crop areas by zones and seasons, on which the descriptive analysis of each zone is based, can be found in the Appendix tables.

### PRODUCTION POTENTIALS--1985

Given the nearly fixed area of old lands, and the projected increase in population, much attention has been directed in recent years to vertical expansion of output through increased yields and possible changes in cropping patterns to achieve a larger output of food and fiber. Shifts in cropping patterns could be directed toward such alternative goals as producing the maximum quantities of crops for export, increasing per capita supplies of foods that must now be imported, improving the nutrition level of livestock to increase meat and milk supplies, or using land and labor resources more intensively.

Some of these goals conflict with others; for example, an increase in cotton production for export would reduce land area available for domestic food production. Likewise, it is not possible to achieve an optimum level of livestock feed supplies and also become self-sufficient in food production for direct human consumption. Such conflicts can be minimized in a formal linear programming model if adequate data are available, particularly with respect to costs and returns from the various crops at international price levels. Constraints can also be imposed on the maximum areas to be devoted to specific crops in view of climatic and agronomic limitations, the probable rate of adoption of new technology, available supplies of labor and water, and various institutional limitations.

The 1985 projections included in the zone descriptions that follow do not incorporate such refinements because time was limited and sufficient data were not available. Instead, Egyptian team members provided judgement estimates of the areas of the various crops at the national level they believed to be feasible by 1985 and which incorporated several goals for Egyptian agriculture. These goals were as follows: (1) increase cotton and rice areas to maximum agronomic limits to increase foreign exchange earnings, (2) increase supply of roughage for livestock during the summer and Nili seasons, (3) expand the areas devoted to sugarcane, lentils, and horsebeans to achieve self-sufficiency, and (4) further expand production of vegetables and fruits, chiefly for export markets. The additional land needed to implement these increases would be obtained by reducing the area devoted to full-term clover, and maize and sorghum for grain. The Egyptian team members also provided estimates of increases in yields they believed to be attainable by 1985.

The percentage changes in the projected national totals for various crops were applied to the 1972-74 area of each crop in each zone to obtain a first approximation. Within each zone, the areas devoted to cotton, catch-crop clover, and orchards were allocated first. Next, the area to be devoted to vegetables was allocated by seasons. Finally, the remaining area was allocated to field crops, giving priority to minor winter crops, wheat and clover, and finally to summer field crops. Livestock nutritional levels were then computed for each zone and the areas of the various roughages adjusted to obtain a more even seasonal distribution. Other adjustments had to be made to ensure that the sum of the areas in a specific crop for the various zones was consistent with the previously established national total.

Only modest changes in the projected cropping pattern for 1985 compared with 1972-74 resulted from implementing these goals and constraints. For example, it was not judged feasible to significantly increase the area of crops grown in the Nili season until earlier maturing varieties of crops can be developed and adopted, and turnaround time between crops can be reduced significantly. There are serious technological and institutional constraints associated with implementing each of these measures by 1985.

Only old lands were included in the projections because there are numerous uncertainties with respect to the production potentials of reclaimed lands that have not yet reached their maximum level. Although plans exist to initiate additional land reclamation projects within the next 5-10 years, most of these projects will require detailed soil surveys and feasibility studies to determine whether they are economically sound and, if so, what crops can be grown most efficiently for domestic and/or export markets. In any event, it does not seem likely that the approximately 900,000 feddans of reclaimed land now in various stages of development will be contributing more than 10 percent to total agricultural output by 1985.

## Assumed Increases in Yields

Crop yields vary considerably among agronomic zones as a result of differences in soils and climate (see table 4). Although the potentials for increasing yields are likely also to vary among zones, the indicated

Table 4 --Crop yields by agronomic zones, 1972-74

| Crop | Agronomic zone | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX |
| | Metric tons per feddan | | | | | | | | |
| Fruit 1/ | 5.2 | 6.1 | 6.2 | 6.0 | 5.1 | 5.1 | 4.0 | 5.0 | 4.2 |
| Sugarcane | 27 | 29 | 33 | -- | -- | 37 | -- | 37 | -- |
| Cotton (lint) | .27 | .30 | .63 | .23 | .31 | .32 | .23 | .36 | .42 |
| (seed) | .49 | .75 | .47 | .41 | .52 | .58 | .44 | .62 | .39 |
| Catch-crop clover | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Winter crops : | | | | | | | | | |
| Clover | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Wheat | 1.3 | 1.6 | 1.6 | 1.0 | 1.4 | 1.5 | 1.2 | 1.2 | 1.0 |
| Horsebeans | .98 | .98 | .98 | .7 | .9 | 1.1 | .9 | 1.0 | .8 |
| Lentils | -- | -- | -- | -- | -- | .8 | -- | .8 | -- |
| Barley | -- | -- | -- | 1.0 | 1.2 | -- | -- | -- | .9 |
| Onions | -- | -- | -- | -- | -- | 5.9 | -- | 10.4 | -- |
| Other | 2.3 | 3.0 | 3.9 | 3.0 | 1.2 | 5.6 | 2.2 | 1.3 | 1.9 |
| Tomatoes | 4.5 | 4.7 | 3.9 | 3.8 | 3.8 | 4.5 | 6.0 | 5.6 | 3.8 |
| Other vegetables | 6.8 | 7.6 | 6.8 | 1.5 | 6.8 | 5.4 | 6.4 | 4.0 | 5.4 |
| Summer crops : | | | | | | | | | |
| Rice | 2.2 | 2.2 | 2.1 | 2.2 | 2.2 | -- | 1.7 | -- | 1.8 |
| Maize | 1.6 | 1.8 | 1.65 | 1.6 | 1.7 | 1.6 | 1.4 | 1.5 | 1.4 |
| Sorghum | -- | -- | -- | -- | -- | 2.0 | 1.5 | 1.7 | -- |
| Other | 1.9 | 4.8 | 2.4 | 3.9 | 1.0 | 1.2 | 5.5 | 0.8 | 1.0 |
| Tomatoes | 6.8 | 6.6 | 7.0 | -- | 6.7 | 6.2 | -- | -- | 6.1 |
| Other vegetables | 9.6 | 8.0 | 9.3 | 8.0 | 7.9 | 8.3 | 8.5 | 7.2 | 12.2 |
| Nili crops : | | | | | | | | | |
| Maize | 1.2 | 1.3 | 1.3 | 0.8 | 1.1 | 1.2 | 0.9 | 1.1 | 0.8 |
| Tomatoes | 7.4 | 7.6 | 7.1 | 9.0 | 6.8 | 6.7 | 7.7 | 6.7 | 5.5 |
| Other vegetables | 6.77 | 6.2 | 7.0 | 3.1 | 8.4 | 5.8 | 6.8 | 6.4 | 6.7 |

-- = not reported.
1/Excluding dates.

increases in yields at the national level were applied to actual yields in each zone to obtain estimates of total farm output of the various crops in 1985.

Substantial increases in yields were assumed for 1985 which are believed to be technically feasible if the several recommendations made elsewhere in this report are implemented. Improved drainage and the adoption of improved seeds will be especially critical factors in achieving these increases.

Yield of maize was assumed to increase from 1.5 tons per feddan in 1972-74 to 2.0 tons by 1985, an increase of 33 percent. This was based on the expectation that corn breeding work now underway will result in hybrids suited to local conditions and that farmers will adopt them. The increase in wheat yields is judged to be somewhat less, about 25 percent, because substantial progress has already been made in the introduction of improved varieties. Yield increases for all major crops are shown below. These percentage increases were applied to the actual yields by zones during the 1972-74 base period to obtain projected total production for 1985.

| | 1972-74 yield | Increase | 1985 yield |
|---|---|---|---|
| | Metric tons per feddan | Percent | Metric tons per feddan |
| Cotton (lint) | 0.30 | 20 | 0.36 |
| Wheat | 1.40 | 25 | 1.75 |
| Maize | 1.50 | 33 | 2.00 |
| Rice (paddy) | 2.20 | 20 | 2.64 |
| Sorghum | 1.70 | 20 | 2.04 |
| Sugarcane | 36 | 25 | 45 |
| Catch-crop clover | 12 | 25 | 15 |
| Full-term clover | 24 | 25 | 30 |
| Sweet sorghum fodder | -- | -- | 18 |
| Maize green fodder | -- | -- | 18 |
| Barley | 1.14 | 20 | 1.37 |
| Lentils | 0.80 | 20 | 0.96 |
| Horsebeans | 0.98 | 20 | 1.18 |
| Fennugreek | 0.74 | 20 | 0.89 |
| Flax (seed) | 0.49 | 20 | 0.59 |
| Flax (straw) | 2.50 | 20 | 3.00 |
| Onions | 8.86 | 20 | 10.63 |
| Vegetables | 7.20 | 50 | 10.80 |
| Fruits | 7.10 | 40 | 9.94 |

## Livestock-Feed Balance

Egyptian livestock specialists and outside observers are concerned that the feed supply is inadequate to achieve increases of meat and livestock products necessary for an expanding population. There is some evidence that if the

available feed supplies were allocated to a smaller livestock population, total output would actually increase. But reductions in numbers are not judged to be feasible until substantial progress has been made in mechanization of some farming operations, and long-held attitudes of farmers regarding the desirability of owning livestock can be modified. Consequently, numbers of livestock in 1985 were held constant at the 1972-74 level even though trends evident between 1961 and 1971 indicate that numbers will likely be higher by 1985. Livestock numbers by zones are given in table 5.

The projected changes in cropping patterns would provide more forage in the summer and Nili seasons than at present and raise the overall annual supply from about 11 tons of roughage in 1972-74 to 15 tons in 1985. Total nutritive value, as measured by starch equivalent, would increase from 1.0 tons to 1.8 tons as a result of substituting sorghum and maize fodder in the summer and Nili seasons for full-term clover. However, it is not possible to increase roughage supplies in all zones to the national average. The projected increase in cotton area requires more catch-crop clover, which accentuates the existing over-supply of roughage in the winter season. Development and implementation of a program to carry this excess forward into the summer would save valuable land for nonforage crops in the summer season.

## An Alternative Model

An alternative production possibility model was developed which incorporated somewhat different objectives than the model included in this report. This alternative model sought to increase forage production to achieve an optimum level of animal nutrition in all zones and also to maintain the 1972-74 level of per capita supplies of domestically produced food crops. To meet these objectives it was necessary to assume that two crops of rice could be produced as a result of introducing earlier maturing varieties. The areas devoted to wheat and sorghum for grain would also be increased substantially. Increased forage supplies for livestock would be achieved by growing sweet sorghum and Napier grass in the summer and Nili seasons.

The area devoted to cotton would be somewhat less than in 1972-74 whereas vegetable and fruit areas would be held constant. Neither of these results would be consistent with the objectives incorporated in the model that was used for the projections given here. Also, the changes in cropping patterns that would be required in the various zones under the alternative model were judged too drastic to be implemented by the target date. Egyptian team members also were doubtful that two crops of rice would be feasible by 1985.

Field studies will be needed to determine the feasibility and benefits that can be expected from the changes in cropping patterns proposed here, as well as from other alternatives that should be considered. Such studies would be especially desirable for each of the agronomic zones to identify which have the greatest potential for increasing total output. Such studies should be focused on ways of reducing turnaround time between crops, improvements needed

Table 5--Estimated livestock numbers on old lands by zones, 1970, and total animal units, 1970 and 1972-74 average 1/

| Zone | Livestock in 1970 | | | | | | | | Total animal units 2/ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cattle | Buffalo | Sheep | Goats | Donkeys | Camels | Horses | Mules | 1970 | 1972-74 3/ |
| | 1,000 head | | | | | | | | 1,000 AU | |
| I + IV | 587 | 507 | 392 | 105 | 349 | 21 | 15 | 2 | 1,346 | 1,390 |
| II + V | 636 | 657 | 392 | 166 | 431 | 37 | 7 | 2 | 1,617 | 1,672 |
| III | 161 | 237 | 99 | 57 | 125 | 11 | 4 | 1 | 499 | 517 |
| VI | 329 | 310 | 290 | 233 | 206 | 22 | 3 | 1 | 818 | 844 |
| VII | 86 | 46 | 47 | 26 | 59 | 3 | 1 | -- | 173 | 178 |
| VIII | 275 | 246 | 377 | 304 | 169 | 31 | 4 | 1 | 708 | 730 |
| IX | 27 | 8 | 13 | 9 | 13 | 1 | -- | -- | 43 | 44 |
| Total | 2,101 | 2,011 | 1,610 | 900 | 1,352 | 126 | 34 | 7 | 5,204 | 5,375 |

-- = None reported.

1/Approximate allocations based on totals by governorates.

2/Animal units are based on the following multiplicative factors: Camels--1.1; buffalo, horses, mules--1.0; cattle, donkeys--0.8; sheep and goats--0.1. Pigs are negligible in relation to total animal units.

3/Allows for an upward trend projection on cattle and buffalo.

in cultural practices to maximize yields, and modifications needed in the pricing system for inputs and outputs to provide sufficient incentives for farmers to implement the desired changes. More attention would need to be given also to labor and water requirements of alternative cropping patterns.

## ZONE DETAILS

Production data for Zones I through VIII include old lands and the areas of new lands still under the supervision of the Organization for Land Reclamation and Development. No quantitative information is available for the limited production in Zone XII. Zones XIII and XIV currently have virtually no production. Irrigation water for all zones except XI is chiefly from the Nile; underground water is used entirely in Zone XI and if needed could be used in some other zones.

### Zone I. Northern Delta Rice Zone 10/

This zone extends across the northern Nile Delta from Alexandria almost to Port Said, and includes almost 1.7 million feddans (MF) of cropland or about 30 percent of the total cultivated land in Egypt. Old lands account for about 90 percent of the 1.7 MF and about 175,000 feddans are new lands. Another 55,000 feddans reclaimed through 1975 are not yet in production. Several additional areas in the zone have been identified for reclamation in the future.

Three geomorphological soil areas can be identified. A northern coastal belt is composed of marine soils and sandy beaches frequently inundated by the sea. These soils are mostly in Class IV--the lowest for agricultural use--or Class V, which is nonagricultural. In the central part of the zone, very dark brown soils containing over 60 percent clay predominate. Some depressions are below sea level. The southern portion of the zone consists of more recent alluvial deposits with a deep profile of dark to very dark soils containing 50-60 percent clay. Salinity, alkalinity, and a high water table cause severe problems in the north. These problems moderate toward the south but nearly three-fourths of the soil for the zone is rated III and IV, the two bottom productivity classes. Lack of drainage reduces crop productivity throughout the zone. Rice is fairly salt tolerant, a major reason for its concentration in this zone. Compacted soils are a

10/ Includes all the following governorates: Alexandria, Kafr El Sheikh, and Damietta and districts indicated for the following governorates:

El Beheira: Abu Hummus, Damanhur, Rashid, Kafr El Douar, El Marmudiya
El Garbiya: Kotour, El Mahalla El Kubra
El Dakahlia: Bilqas, Dikirnis, El Mahmudiya, El Sinbillawein, Timai El Amadid, Shirbin, Talkha, El Manzalaa, El Mansora
El Sharkia: Awlad Saqr, Kafr Saqr

serious problem and the Ministry of Agriculture has an active program of soil amelioration, including subsoiling and application of gypsum. This is necessitated by the low elevation above sea level in the northern part of the zone which makes tile drains unfeasible. Elsewhere, tile drains are being installed under World Bank financing.

## Cropping Patterns--1972-74

This zone accounts for 73 percent of the nation's production of rice, about one-third of the cotton, and about one-fourth of the wheat and vegetables. It is also one of several important citrus areas and produces grapes, figs, guavas and pears. About one-fifth of the nation's date production comes from this zone.

The zone had an average of 3.3 MF of crops in 1972-74 from its 1.7 MF of cropland, for a cropping ratio of nearly 2.0. About 2.1 MF of crops were grown in the winter season, dominated by catch-crop clover (21 percent), cotton (25 percent) and wheat (17 percent). An additional 30 percent of the winter crop acreage was devoted to full-term clover, followed by maize and vegetables in the summer season. Vegetables, chiefly tomatoes, are a relatively minor winter crop.

Rice occupied about 70 percent of the summer crop area of 1.1 MF, with the balance of the land devoted to maize and vegetables. Tomatoes and watermelons are the major vegetable crops, with smaller areas devoted to potatoes, cucumbers, and squash.

Fall or Nili season crops are chiefly maize and vegetables but the total Nili area is only 3 percent of the annual crop area. The dominance of rice in the summer season, which is not harvested until late September and October, sharply limits the crops that can be grown following rice. Winter frosts present an occasional hazard to the winter tomato crop.

This seasonal pattern of crop production results in sharp peaks in labor and water requirements. The high month for labor is June, which requires 6 times as many man-days as the average for the 3 lowest months. Total annual labor requirements were about 145 million man-days in 1972-74. The rural population was 3.5 million or about 18 percent of the national rural total. Water requirements reach their peak in July, chiefly because of rice; requirements in this month are 7.5 times the average for the 3 lowest months.

## Livestock-Feed Balance

Zone 1 has a relatively low livestock population of .75 animal units (AU) per feddan of land area, and an abundance of winter and early summer forage from catch-crop and full-term clover. The total quantity of roughage was about 17 tons per AU, with a starch equivalent of 1.7 tons or about the level needed for adequate animal nutrition. As is the case in most other zones, the winter supply exceeds requirements in that season, but means of carrying this surplus forward to supplement shortages later in the year are not widely used.

Projected Cropping Pattern--1985

The total area in crops would increase 133,000 feddans, resulting in a slight increase in the cropping ratio. Most of this increase would be in cotton, catch-crop clover, and wheat in the winter season and rice in the summer season. Roughage for livestock would be more adequate in the summer and Nili seasons, but the winter surplus would be greater than in 1972-74 because of the increase in catch-crop clover as a result of the larger cotton area. Available starch equivalent would increase from 1.7 tons per AU in 1972-74 to 2.3 tons, suggesting that livestock numbers could be expanded for a larger production of meat and milk than at present, or the surplus shipped to other zones deficient in roughage.

## Zone II. Southern Delta 11/

This area is a continuation of the northern Delta comprising about 1.0 MF of cropland on which about 2.0 MF of crops are grown. Soil quality averages much higher than in Zone I, with over 60 percent rated Class II or better. Soil problems other than those caused by inadequate drainage are minimal. Through 1975, tile drains were installed, in part with World Bank financing, on 710,000 feddans, or 70 percent of the total area in cultivation. Additional areas will be covered by drainage programs now underway or being negotiated with the World Bank.

Cropping Pattern--1972-74

This is the second most important rice area in the country with 12 percent of the national total. Cotton is also an important crop accounting for 22 percent of the national area and 17 percent of the annual cropped area in the zone. Catch-crop and full-term clover take up 600,000 feddans or nearly one-half the winter and early summer crop area. Rice and maize are the dominant summer crops and totaled over 500,000 feddans or five-sixths of the total summer crop area. As in Zone I, Nili season crops are chiefly maize and vegetables but these account for only 3 percent of the annual crop area.

More than half the vegetables are grown in the summer season, and about 30 percent of the annual vegetable area of 130,000 feddans is in tomatoes. Numerous other vegetables, including potatoes, cucumbers, watermelons, and dry French beans also are grown. Potatoes are also a minor Nili crop.

Citrus is the chief fruit, with 36,000 feddans--of which about 7,000 feddans were not yet of bearing age. Grapes and bananas are other minor fruit crops.

11/ Includes districts indicated for the following governorates:
- El Beheira: Ityai El Barud, Shubra Khit, Kom Hamada
- El Garbiya: Basyun, Zifta, Sammanud, El Santa, Tanta, Kafr El Zayat
- El Dakahlia: Aga, Mit Ghamr
- El Menoufia: El Bagur, Berka El Sabh, Tala, Shibin El Kom, El Shuhada, Quwesna, Menouf
- El Sharkia: Diarb Nigm, El Zagazig, Minieh El Kamh, Hehya

June is the peak month for labor requirements, as in all the other Delta zones. Total annual labor requirements were about 85 million man-days, about the same ratio to cropland area--43 days per feddan--as in Zone I and other Delta zones. About two-thirds of the annual labor input is required for winter crops, cotton, and fruits, whereas relatively little labor is required during the Nili season.

Livestock-Feed Balance

Zone II has the highest ratio of livestock to land area of any zone--1.4 AU per feddan of land area. Roughage production per AU is significantly lower than in Zone I, particularly during the summer and Nili seasons, with only 0.8 tons of starch equivalent per AU available annually. About 1.8 tons are needed to provide an adquate level of nutrition. Thus, the area devoted to feed crops would need to be increased substantially to meet this level, but this could be done only at the expense of higher priority crops, such as cotton and rice.

Projected Cropping Pattern--1985

Adjustments are very similar to those indicated for Zone I. Cotton, catch-crop clover, and wheat would increase somewhat, but the area in maize for grain would be cut in half. Most of this area would be shifted to sweet sorghum and maize for fodder, thereby increasing the nutritional level of livestock significantly above the 1972-74 level. Vegetable area would increase substantially, mostly in the Nili season.

## Zone III. Cairo Vegetable Zone 12/

Occupying the southernmost portion of the Delta, this zone of 436,000 feddans is one of the most fertile areas in Egypt. Because of its proximity to the Cairo market at the southern end, this zone accounts for about one-fifth of the total vegetable area in the country and vegetables occupy 17 percent of the annual crop area in this zone.

About 70 percent of the soils are Class II or better and only 5 percent is in Class IV. Class III soils mostly are in the eastern part and consist of sandy to sandy loams with up to 8 percent calcium carbonate. Increased use of irrigation water likely has downgraded the Class I and II soils to some extent but the World Bank tile drainage program that has been recently implemented should stabilize or upgrade soils now subject to waterlogging. Tile drains have been installed on 315,000 feddans, or 72 percent of the cultivated land area.

12/ Includes all of El Qalioubieh Governorate and the districts indicated for the following governorates:

El Menoufia: Ashmun
El Sharkia: Belbeis
El Giza: Imbaba, El Giza, El Saff, El Maadi

## Cropping Pattern--1972-74

Cotton and rice are of only minor importance; their combined area is less than that devoted to vegetables. A substantial area (148,000 feddans) is devoted to full-term clover, and the area of catch-crop clover exceeds the cotton area. Maize (chiefly for grain) is the major summer crop, occupying two-thirds of the summer crop area. Vegetables are important in all seasons totaling 148,000 feddans for the year. In addition to tomatoes, which represent about one-fourth of total vegetables, a wide range of other vegetables are grown, including cabbage, squash, lettuce, green peas, and carrots in the winter season. Summer vegetables include watermelons, potatoes, cucumbers, eggplant, and sweet melons. Cabbage, squash, potatoes, and green beans are grown in the Nili season.

This zone has the largest area of fruit in the country, consisting chiefly of citrus, although mangoes and bananas also are grown. More than 20 percent of the citrus is not yet of bearing age and hence increased production can be expected in the future as these groves come into production. Practically all the fruit and vegetables grown are sold in the nearby Cairo market.

The seasonal pattern of labor requirements is similar to other Delta zones, although somewhat more labor is required per feddan because fruits and vegetables are more important than in other Delta zones. The proximity to Cairo results in greater competition for farm labor than farther north, thus exerting upward pressure on farm wage rates. Urban encroachment is also apparent, and has removed from production a considerable area of choice vegetable land.

## Livestock-Feed Balance

The livestock population per feddan is somewhat lower than in Zone II, but roughage supplies are only fractionally higher per AU. The relatively large area of full-term clover improves feed supply somewhat in the summer, but total supplies on an annual basis are still deficient. However, considerable additional roughage is available from green leaves picked from maize, and maize stalks. Other wastes suitable for livestock feed are available from the various vegetable crops.

## Projected Cropping Pattern--1985

Cropping patterns would change very little in Zone III. Production of maize for grain would decline by 100,000 feddans to permit an expansion in vegetables and fruit, but other crops would not change much. A part of the area occupied by full-term clover would be shifted to green fodder crops in summer and Nili seasons. Annual roughage supplies would be increased slightly, but would not be sufficient to provide calculated minimum requirements.

## Zone IV. Western Border Zone 13/

This zone covers three districts that lie to the west of the northern part of Zone II and directly south of the western part of Zone I. It comprised an average of 153,000 feddans of cropland in 1972-74 from which 296,000 feddans of crops were produced. Soils are mostly in Classes III and IV, with none in Class I. In the northwest, soils are clay to clay loam to a depth of 20-120 cm over a layer of shell fragments mixed with coarse sand. Soils in the southern part are of a sandy calcareous type. Drainage is inadequate. Some vineyards have been ruined by rising ground water and salinity; special management is needed to prevent further deterioration.

### Cropping Pattern--1972-74

There is less crop specialization in Zone IV than in other Delta zones. Cotton and rice are grown but the area is nominal--about 25,000 feddans each. Horsebeans and barley are grown to a greater extent than in other zones. About twice as much maize as wheat is grown. Vegetables occupy about 18 percent of the annual crop area, with watermelons the primary summer vegetable. Only about 17,000 feddans are devoted to permanent crops, about equally divided between citrus and grapes.

### Livestock-Feed Balance

Roughage supplies are relatively good, chiefly because of the low ratio of AU's to land area. Clover is grown on 71,000 feddans, and crop wastes from horsebeans and other minor crops provide some additional roughage.

### Projected Cropping Pattern--1985

Total cropped area would be increased by only about 25,000 feddans in Zone IV. Some of this would be in fruit, but most of the increase would be forage production in the Nili season. Some forage production would shift from the winter to the summer season, resulting in a nearly adequate supply on an annual basis.

## Zone V. Eastern Border Zone 14/

This zone consists of three districts to the east of Zone II comprising 173,000 feddans, slightly larger than Zone IV, but similar in many respects. Soils are mostly in Classes II and III. Except to the south, they are a deep alluvial dark to very dark brown, light to heavy clays. In the southern part, the soil is brown or dark brown sandy loam to clay loam over a yellow sand flat. Moderate to high salinity occurs in scattered spots throughout the area. Barren lands

13/ Includes the following districts in El Beheira Governorate: Abu El Matamir, Hosh Issa, El Dillingat.

14/ Includes the following districts in El Sharkia Governorate: Abu Hammad, Abu Kebir, Faqus.

are scattered throughout the zone. Main drains and field drains frequently are not deep enough, compacted layers exist, and salinity problems could become alkaline.

Cropping Pattern--1972-74

Clover occupies the largest area during the winter and early summer seasons, followed in importance by about equal areas of cotton and wheat. Rice and maize take up more than 80 percent of the summer crop area. A limited area of horsebeans is also grown in the winter season. Vegetables, grown mostly in the winter and summer seasons, represent only 7 percent of total annual area. Tomatoes account for about one-half of total vegetable area.

Oranges and mangoes are the major fruits, although the area devoted to all fruits is quite small. Date tonnage is about the same as for oranges.

Livestock-Feed Balance

Livestock numbers are high in relation to land area, resulting in the second lowest level of roughage per AU of all zones. Supplies are short in the winter season, despite the normal area of catch-crop clover associated with cotton, and are also short in the summer and Nili seasons.

Projected Cropping Pattern--1985

Only minor shifts are indicated for this zone, consisting chiefly of a reduction in full-term clover and an increase in the area devoted to forage crops in the Nili season. This would improve the seasonal distribution of roughage and increase total supplies toward minimum requirements. Small increases were indicated for orchards and vegetables. The cropping ratio, already rather high (2.05), would increase only slightly.

## Zone VI. Mid-Egypt Zone 15/

This zone covers the narrow Nile Valley from just south of Cairo through the Asyut Governorate. Over 1 MF of deep alluvial light clay soils are used for crops. Over three-fourths are rated in Class II or above, although some deterioration may have taken place since these soil surveys were made, as newly-reclaimed lands (about 10,000 feddans) have caused drainage problems in some of the old lands. The water table has tended to rise in sugarcane fields due to heavy irrigation and an inadequate drainage system. Ditches on sandy soils near the edge of the valley are a source of excess seepage.

Through 1975, tile drains had been installed on about 40,000 feddans, or about 4 percent of the land in cultivation in recent years. Additional drainage programs are planned or are under negotiation with the World Bank.

15/ Includes all of the following governorates: Beni Sueif, El Minya, and Asyut, and the districts indicated for El Giza Governorate: El Badrashein, El Aryat.

## Cropping Pattern--1972-74

Nearly one-third of the land area is devoted to cotton and the zone contributes about 22 percent of the total national cotton area, about the same proportion as Zone II. In addition to cotton, wheat and horsebeans are important winter crops, along with catch-crop and full-term clover which account for about one-fifth of the annual crop area total. Summer season crops are almost entirely maize and sorghum for grain. Watermelons are the major summer vegetable crop, along with tomatoes, sweet melons, potatoes, and okra. Tomatoes and potatoes dominate the small Nili vegetable crop. Maize for grain and forage is the other important Nili crop.

A small area of sugarcane is grown in the southern portion of the zone adjacent to Zone VIII, the major cane area. Citrus and grapes are the major fruit crops, but the area devoted to them is relatively small. The tonnage of dates exceeds that of any other zone, accounting for about one-third of the national total.

Peak labor requirements occur in September, rather than in June--the peak month in the Delta zones. With no rice grown, the September peak results from the substantial area of cotton to be harvested, together with the maize and sorghum crops. However, the spread in labor requirements between the high and low months is not a great as in the Delta zones.

## Livestock-Feed Balance

The livestock population is relatively low at 0.8 AU per feddan. Cattle and buffalo are about equal in number, followed by sheep and goats. Roughage supplies per AU are slightly below the national average, particularly in terms of starch equivalent in the summer and Nili seasons. Crop wastes from horsebeans, maize and sorghum probably are used to some extent to fill the gap.

## Projected Cropping Pattern--1985

The cropping ratio in this zone could be increased from 1.76 in 1972-74 to 2.12 by 1985 as a result of more intensive land use in all three seasons. More catch-crop clover would be grown, partly as a result of an increase in cotton area; less full-term clover would be grown to make land available for an increased area of horsebeans and lentils. The area devoted to wheat in the winter season and to maize in the summer and Nili seasons also would increase. The Nili vegetable crop would about double, and be centered chiefly in the southern portion of the zone where climatic conditions provide a longer Nili season.

# Zone VII. El Fayoum Zone 16/

This is a depression created thousands of years ago that lies to the west of the Nile Valley about 120 km southwest of Cairo. It receives irrigation

16/ Coincides with El Fayoum Governorate.

water via a diversion canal from the Nile. The lower part of the depression at Lake Karum is some 44 m below sea level. The lake has served as an outlet for drainage canals for many years and has a high salt content as a result of evaporation. Most of the soils are deep alluvial loams to clays. Very heavy calcareous clays are found around the fringes. Soils are moderately saline except in areas south of Lake Karum where salinity and drainage problems are severe. Over three-fourths of the soil for the zone is in Classes III and IV. The heavy clays become very compact, particularly at the subsoil level, and the calcareous soils require special management. Both main and field drains are inadequate. Around 50,000 feddans, or 18 percent of the land in production, are new lands and additional areas around the perimeter of the basin have been identified for future reclamation.

Cropping Pattern--1972-74

About 300,000 feddans were used for crops in 1974 from which 585,000 feddans of crops were harvested, for a cropping ratio of 2.0. About one-fourth of the land area was in cotton in 1972-74 and about equal areas in catch-crop clover and in full-term clover. Rice and maize make up the relatively small summer crop pattern. Unlike other zones, the Nili crop area exceeds the summer crop area, and is devoted chiefly to maize, sorghum and vegetables. Tomatoes dominate both the winter and the Nili vegetable crop areas but are not grown to any significant extent in summer when watermelons are the major crop. Although the fruit area is small, this zone is the chief source of apricots in the country and also produces small quantities of grapes, limes, and olives.

Livestock-Feed Balance

Livestock numbers are relatively low per feddan and the roughage supply is more nearly adequate than in most other zones, especially in the summer and Nili seasons.

Projected Cropping Pattern--1985

Total area in crops would increase by 22 percent, mostly in the summer season, by shifting maize and forage crops from the Nili season. Small increases would occur in cotton and wheat by reducing the area devoted to full-term clover. Winter and Nili vegetable areas would also increase, mostly in tomatoes. Such shifts would increase the cropping ratio to 2.45, the highest for any zone.

## Zone VIII. Upper Egypt Zone 17/

This zone encompasses the three most southern governorates in the Nile Valley. It includes slightly more than 700,000 feddans of cropped land on which 1.2 MF

17/ Includes all of the following governorates: Sohag, Qena, and Aswan

of crops were grown in 1972-74. This is the lowest cropping ratio in the country because of the large area of sugarcane. Soils are fertile, with about 75 percent in Class II and only 7 percent in Class IV. Due to increased irrigation associated with sugarcane, the water table has been rising. An extensive program to install tile drains has been started based on World Bank financing, with drains installed on about 40,000 feddans through 1975. About 200,000 feddans of presently unused land exists in a number of valleys in this zone, some of which is adjacent to land now in crops. These soils are chiefly sandy loams that should be more productive than the sandy and/or calcareous soils in many other areas being considered for reclamation.

## Cropping Pattern--1972-74

This zone has more than 80 percent of the total area of sugarcane in the country. The crop occupies nearly one-fourth of the crop area of the zone, and is retained for 3 to 5 years before replanting; yields are relatively high by international standards--36 tons per feddan. Winter crops, consisting of wheat, clover and cotton, account for about one-half the annual crop area. Horsebeans, lentils and onions are other minor winter crops. Summer crops are dominated by grain sorghum and much smaller areas of maize and sesame. Fruits and vegetables currently occupy only minor amounts of land but a significant tonnage of dates is sold.

## Livestock-Feed Balance

The supply of roughage is the lowest per AU of any zone. It is especially short in the summer and Nili seasons when most of the land is devoted to sorghum and maize for grain. The high proportion of land in sugarcane also reduces the area available for forage crops.

## Projected Cropping Pattern--1985

Most of the increase in sugarcane needed to achieve national self-sufficiency would occur in this zone because it is best adapted to cane. A sharp reduction would be needed in wheat area as well as in full-term clover to release the land needed for cane. Part of the area now devoted to sorghum for grain would be shifted to green fodder crops to provide forage for livestock.

Development of new lands was not included in the cropping pattern for 1985, but the potential of the 200,000 feddans of presently undeveloped lands appears promising. It is believed that adequate yields could be obtained within 1 or 2 years after installation of an irrigation and drainage system and infrastructure, in contrast to the 10-15 years required in most other reclamation areas. Potential crops from the new lands in Zone VIII would be (1) winter vegetables and flowers for sale in Europe if economic transportation facilities or routes can be found or developed, or for local sale as tourism increases, (2) winter onions relocated from clay soils in this zone, and/or (3) increased forage to expand milk production. Income per capita is low in this zone and additional rural development and employment opportunities are urgently needed.

## Zone IX. El Husseiniya Zone 18/

This zone covers both old and new lands to the east of Zones I and V, with the Suez Canal constituting the eastern border. Old lands chiefly are in the El Husseiniya District of the El Sharkia Governorate. Much smaller land areas in the three governorates that border the west bank of the canal also are included. Most soils north of the city of El Husseiniya are recent alluvial dark to very dark light to heavy clay. Some scattered areas are sandy subdeltic deposits. Soils are moderately to very highly saline in the south. The soils near Manzala Lake are frequently flooded. In the southern part of the zone soils are nonsaline sandy plains and dunes. Many areas are barren. With the exception of about 10,000 feddans of citrus and mango orchards and tomatoes near the city of Ismailia, productivity of the cultivated lands is poor to moderate.

Land constraints in the northern part of this zone involve high salinity, a high water table, compacted layers, poor drainage, and insufficient water for leaching. In the southern part, high water tables and problems of salinity and alkalinity will limit productivity until corrective measures and improved management are applied.

### Old Lands: Cropping Pattern--1972-74

Slightly more than 135,000 feddans of old lands were used to produce 268,000 feddans of crops in recent years, for a cropping ratio of 1.96. Slightly more than one-half the crop area is utilized for permanent and winter crops, with cotton, wheat and catch-crop clover of about equal importance. Of the land devoted to summer crops, maize and rice each use about one-third and groundnuts use most of the remaining area. Small areas of vegetables are produced in all three seasons, with watermelons dominant in the summer season.

Livestock numbers per feddan are the lowest of any zone, and roughage supplies exceed the indicated minimum.

### Old Lands: Projected Cropping Pattern--1985

Only minor changes are indicated for this zone. Full-term clover would be reduced to permit an increase in other summer crops, and the area devoted to vegetables could be increased. The total supply of roughages would be reduced.

### New Lands

About 10,000 feddans of new lands were in production in recent years, out of a total reclaimed area through 1975 of over 40,000 feddans. In 1972-73, 67 percent was in permanent clover or alfalfa but this was reduced to 60 percent

18/ Includes all of the following governorates: El Ismailia, El Suez, and Port Said and districts indicated for El Sharkia Governorate: El Husseiniya, San El Hagar, and El Mulak.

the following year. Barley was the major winter field crop in 1972-73, but nearly equal areas were devoted to barley, wheat, and a combination of beans in 1973-74. Rice was the major summer field crop. Small areas were devoted to cotton and summer vegetables. Yields per feddan in general were much lower than for old lands. The cropping ratio was 1.3 on new lands.

## Zone X. West Zone (All New Lands) 19/

This zone lies to the west and south of Zone IV. Over 300,000 feddans were reclaimed through 1975, but only 153,000 were in production in 1972-73. Land in crops dropped to 117,000 feddans in 1973-74, reflecting increased salinity and waterlogging due to poor drainage. An additional 250,000 feddans are proposed for reclamation during 1976-80. This area was surveyed largely on the basis of physiographic and geomorphic characteristics. Most would be in Class IV.

Soils in the northern and major part of the zone contain medium to high calcium carbonate (6 to more than 60 percent). The soils are variable in texture, mostly calcareous marl. Loam increases toward the sea. Concretions and layers of calcium carbonate, calcium sulfate, calcium chloride, and gypsum can be found. When the area was mapped the water table was below 150 cm, with a depth of 20 m in many areas. The water table has risen as much as 3 m per year in places during the past 6 years, reflecting irrigation with lack of drainage.

Sandy soils are found in many parts of the zone. These do not lend themselves to flood irrigation. Use of sprinkler or drip irrigation is indicated. By using adequate amounts of fertilizer, proper rotations, and sound soil and water management, these soils can produce fairly high yields. When crops that are traditionally grown in the Delta are planted on new lands, they generally yield less than one-third of what is obtained on old lands, based on traditional rotation patterns and practices.

Many highly complex soil types and soil conditions are found in the zone. Soils range from coarse sands to silty and loamy soils to almost pure calcium carbonate. A detailed soil survey, designed to delineate important differences in soil characteristics, would be a useful tool to identify areas of potential value for reclamation and to indicate the type of management required. Such a survey would update and modernize previous surveys. A number of vegetable and fruit crops, as well as certain forage crops, are tolerant to calcareous soil conditions. These include artichokes, peas, dates, olives, figs, grapes, peaches, plums, almonds, apricots, pomegranate, quince, and mulberry. Sugarbeets also are tolerant where restrictive layers do not prevent nitrate movement in the soil. Rotations that include forage crops half or more of the time are desirable. Application of organic manure is highly beneficial.

19/ Includes the following districts: Western North Delta, Mariut, West Nubaria, Northern Tahrir, Southern Tahrir, Southwestern Tahrir, and Emtdad Mariut.

Studies on soil and water management are underway in this area by FAO and the National Academy of Scientific Research and Technology in Egypt. Preliminary results from these projects are not expected before 1977.

Cropping Pattern--1972-74

In 1972-73, 73 percent of the land was in permanent clover or alfalfa. This dropped to 57 percent the following year. Land use in every other category increased, so that all the reduction in land in production came out of these permanent soil-building crops. In 1973-74, winter field crops used about a fourth of the land and summer field crops used about a fifth. A wide variety of both winter and summer field crops were grown.

Winter vegetables, dominated by green peas, and summer vegetables, dominated by watermelons, each used about 4 percent of the cropped land. Fruits, dominated by grapes and citrus, used 13 percent of the cropped area. The cropping ratio was 1.2. Yields per feddan were far below those on old lands.

## Zone XI. New Valley Zone (All New Lands)

The following depressions, all below sea level, are included in this zone: Siwa, El Bahriya, El Frafrah, El Dakhla, El Karga, South Karga, and El Natrun. All are in the desert west of the Nile and depend on ground water, in many instances from privately owned artesian wells, for irrigation.

In recent years, about 20,000 feddans have been in production out of about 50,000 feddans reclaimed through 1975. About one-fourth of the land in production is in clover or alfalfa. Winter field crops use nearly half, dominated by barley and wheat. Summer field crops use about a third, with forage crops nearly twice as important in area as are sunflowers. About 4 percent of the land is used for winter and summer vegetables, and about 9 percent for orchards. The cropping ratio is 1.4.

Some semidetailed mapping has been completed by the Desert Institute, and reconnaissance aerial surveys cover all areas. Soil textures generally are sandy to calcareous. Salinity is moderate to severe. These are residual soils. Drainage flows to the lowest point in each closed-basin depression. Water quality at Siwa and El Natrun is poor. The water table in many places is less than 1 m from the surface. Most soils would be classified III and IV. A detailed soil survey would be desirable before additional land is brought into production.

## Zone XII. West Mediteranean Coast Zone

This is the only rain-fed area in Egypt. It covers the north desert coast west of Alexandria to a depth of about 15 km from the sea. Rainfall averages about 192 mm (8 in) per year, mostly during the winter months.

Some rain-fed barley, castor beans, figs, grapes, olives, and almonds are grown. No production data are available. Some 50,000 feddans were mined during World War II, but these have been deactivated.

Soils derived from limestone and calcareous sandy soils (some in dunes) dominate the area. Most soils would be classified IV, with some Class III soil interspersed. An aerial reconnaissance survey covered 600,000 feddans in the Alexandria-Alamein coastal area. Detailed soil surveys would be desirable if this area is to be further developed.

FAO studies are in progress to determine optimum crops for this area and the best ways to use available rainfall. Some results may be issued by 1977.

## Zone XIII. Sinai Zone (All New Lands)

This zone lies to the east of the Suez Canal. No data are available on current agricultural production, but it is believed to be small. Proposals have been made to reclaim 480,000 feddans during 1976-80. Soils are mostly sandy, so that flood irrigation should not be used. Citrus orchards with proper management should be successful.

Small areas have been mapped. A modern detailed soil survey would be highly desirable before this area is developed. Most soils likely would be in Class IV.

## Zone XIV. Lake Nasser Zone (All New Lands)

This zone covers land adjacent to the banks of Lake Nasser south of Aswan. Agricultural production currently is negligible. Reconnaissance and semi-detailed soil surveys indicate that some Class II and III land exists in some of the wadis and in the lower Nubia Plains. Some 200,000 feddans west of the lake have been suggested for possible reclamation. No infrastructure exists at present. A major highway is in a planning stage.

Land along the banks of Lake Nasser will be flooded between August and February each year when water behind the Aswan Dam is at its maximum height. As the water recedes during the spring and summer, it has been suggested that crops could be grown on the previously flooded area using the residual moisture in the soil. Opportunities along this line are believed to be limited for the following reasons:

1. Fertility and water-holding capacity of these residual sandy soils is low.

2. No silt would be deposited as was the case when basin irrigation was used in the Nile Valley and Delta during the annual floods.

3. These soils are low in organic matter.

4. The choice of crops that would grow fast enough to keep their roots in the proper moisture zone would be limited.

5. Igneous rock outcrops and shallow windblown sand over rocks occur in many places.

6. Supplemental irrigation would be required for most crops.

Trees such as cottonwood and poplar might be considered for these areas of fluctuating water levels as they are able to thrive under such conditions, including low soil fertility.

Further interdisciplinary investigations, including detailed soil surveys, are desirable in developing plans for this area. Its relative isolation from the rest of Egypt, requiring development of a complete infrastructure, high transportation costs, and a likely need to import settlers and/or labor, all make it imperative that careful economic feasibility studies be used.

## ESTIMATED WATER AND LABOR REQUIREMENTS BY MONTHS

Data on water requirements per feddan by crops, months, and zones were developed by U.S. team members based on information from the Ministry of Agriculture and reports issued by FAO. For Nili crops, only those presently produced were included. Labor requirements per feddan per month for major crops other than vegetables were furnished by the Ministry of Agriculture. These were available by season and were assumed to apply uniformly in all zones. Data for selected fruits were also furnished. In each case, these factors were multiplied by 1972-74 average area in crops for each zone and a total obtained for each month. Blowup factors were applied to adjust for items for which these technical factors were not available. These totals are shown in table 6. Water requirements are adjusted to take account of the existing efficiency of the delivery system.

Water requirements in all zones reached a peak in June or July, with lows in September, October, or January. Labor requirements reached a peak in May or June in all zones except VI and VII. For these, the peak was reached in September. Lows occurred in November or January. A rough measure of seasonal variability in these requirements can be obtained by computing the ratio between the high and low month by zones for each item. As ratios are highly sensitive to small divisors, an average of the three low months was substituted for the low month. Results are shown in table 7. For water, these ratios range from 2.8 for Zone VII to 7.5 for Zone I, with an average of 4.7 for Zones I through VIII. For labor, the ratios range from 3.1 for Zone IV to 5.9 for Zone I, with an average of 4.5. These ratios help to explain the controversy over whether there is a surplus or shortage of farm labor. A shortage frequently exists in peak months; surpluses occur in many other months.

Table 6--Labor requirements on old lands by major cropping seasons, by zones, 1972-74 average

| Zone | Winter | | | | Summer | | | Nili | | | Longer-term | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Clover | Other field crops | Vege-tables | Total | Field crops | Vege-tables | Total | Field crops | Vege-tables | Total | Cotton | Sugar-cane | Fruits |
| | Million man-days | | | | | | | | | | | | |
| I | 18.0 | 11.3 | 2.4 | 31.7 | 50.4 | 5.8 | 56.2 | 1.2 | 4.0 | 5.2 | 43.6 | 0.6 | 7.5 |
| II | 9.6 | 7.4 | 1.4 | 18.4 | 22.1 | 4.3 | 26.4 | .7 | 3.0 | 3.7 | 29.0 | .3 | 6.6 |
| III | 4.0 | 2.7 | 2.9 | 9.6 | 9.0 | 3.8 | 12.8 | .5 | 2.5 | 3.0 | 5.9 | .3 | 8.7 |
| IV | 1.2 | 1.0 | .3 | 2.5 | 2.7 | 3.1 | 5.8 | .5 | .4 | .9 | 2.2 | -- | 3.5 |
| V | 1.5 | 1.4 | .7 | 3.6 | 5.6 | .7 | 6.3 | .2 | .4 | .6 | 2.8 | -- | 2.3 |
| VI | 6.5 | 9.5 | 1.6 | 17.6 | 22.0 | 3.9 | 25.9 | 3.4 | 1.9 | 5.3 | 29.1 | 2.9 | 5.0 |
| VII | 2.4 | 2.6 | .7 | 5.7 | 4.6 | .8 | 5.4 | 3.4 | 1.0 | 4.4 | 6.3 | -- | 2.7 |
| VIII | 2.3 | 9.2 | .7 | 12.2 | 20.9 | 1.1 | 22.0 | 1.4 | .5 | 1.9 | 9.5 | 18.3 | 1.7 |
| IX | 1.3 | .9 | .5 | 2.7 | 4.2 | 1.1 | 5.3 | .2 | .3 | .5 | 1.9 | -- | 1.2 |
| Total | 46.8 | 46.0 | 11.2 | 104.0 | 141.5 | 24.6 | 166.1 | 11.5 | 14.0 | 25.5 | 130.3 | 22.4 | 39.2 |

-- = None grown.

Table 7--Water and labor requirements on old lands: High month as ratio to average for 3 lowest months, 1972-74 average

| Zone | Water requirements 1/ | | | | Labor requirements 2/ | | | |
|---|---|---|---|---|---|---|---|---|
| | High month | | Average for 3 low months | Ratio | High month | | Average for 3 low months | Ratio |
| | Month | Amount | | | Month | Amount | | |
| | Billion cubic meters | | | | Million man-days | | | |
| I | July | 2.62 | 0.35 | 7.5 | June | 27.75 | 4.69 | 5.9 |
| II | June | 1.27 | .22 | 5.8 | June | 13.77 | 2.45 | 5.6 |
| III | June | .55 | .13 | 4.2 | June | 5.23 | 1.16 | 4.5 |
| IV | July | .19 | .04 | 4.8 | June | 1.75 | .56 | 3.1 |
| V | July | .26 | .05 | 5.2 | June | 2.75 | .57 | 4.8 |
| IX | July | .20 | .04 | 5.0 | June | 1.87 | .36 | 5.2 |
| Total Delta | July | 4.94 | .82 | 6.0 | June | 53.12 | 10.19 | 5.2 |
| VI | June | 1.14 | .28 | 4.1 | Sept. | 11.16 | 2.48 | 4.5 |
| VII | June | .22 | .08 | 2.8 | Sept. | 3.00 | .92 | 3.3 |
| Total Mid-Egypt | June | 1.37 | .41 | 3.3 | Sept. | 14.16 | 4.01 | 3.5 |
| VIII | July | 1.02 | .29 | 3.5 | May | 9.29 | 2.25 | 4.1 |
| Total Mid-Egypt | June | 1.37 | .41 | 3.3 | Sept. | 14.16 | 4.01 | 3.5 |
| VIII | July | 1.02 | .29 | 3.5 | May | 9.29 | 2.25 | 4.1 |
| Grand total | June | 7.31 | 1.55 | 4.7 | June | 72.32 | 15.97 | 4.5 |

1/After adjustment for estimated efficiency of the delivery system.
2/Excludes labor used to produce vegetables.

Labor requirements per feddan for selected vegetables were also available from the Ministry of Agriculture. These were assumed to be the same for each season for all zones. Table 7 shows computed labor requirements by seasons by zones for major crop groups. For all except Zone VII, peaks occur in summer and are 33 to 132 percent above winter requirements. Total labor needed for Zones I through VIII in the Nili period is only 15 percent of the labor needed in summer and 25 percent of winter requirements. Since projected cropping patterns result chiefly in expanded crop production in the Nili period and to a lesser extent in the winter period, the proposed new cropping patterns should result in a more even use of labor between months, with little if any increase in the present peak months.

## PART V. TECHNICAL REPORTS

## SOIL AND WATER CONSTRAINTS

### Climate

Egypt is characterized by a warm and almost rainless climate. The air temperature frequently rises to over 40°C (104°F) during the day in summer and seldom falls as low as 80°C (46°F) at night in winter.

The average rainfall ranges from practically zero at Aswan to 24 mm at Cairo to 192 mm (about 8 in) at Alexandria. Most of the rainfall occurs during the winter months. Agriculturally, Egypt is practically a rainless country, depending on irrigation to produce crops. The only exception is the north desert coast to a depth of about 15 km from the sea where some rainfed crops are grown.

The mean monthly relative humidity ranges from about 60 to 77 percent in the Delta and 18 to 41 percent at Aswan.

The average annual lake surface evaporation ranges from about 0.9 m at Alexandria to 2.1 m at Cairo to 2.7 m at Aswan.

### Surface Water

Except for a narrow band of rainfed agriculture along the north desert coast, all surface water use in Egypt is from the Nile River. Annual flow of the river at Aswan ranges from 65 to 130 billion $m^3$, with an average of 84 billion.

Daily discharges of the river vary greatly with the season. The average annual maximum and minimum daily flows recorded at Aswan are 750 and 50 million $m^3$ respectively. A maximum value of 1,200 million occurred in 1878 and a minimum of 42 million occurred in 1914.

The Aswan High Dam has regulated the total flows in the Nile River below Aswan since 1969. The following tabulation shows storage purposes for the reservoir created by the dam:

| Storage purpose | Elevation Meters | Capacity Billion cubic meters |
|---|---|---|
| Dead (500-year sediment) | 147 | 30 |
| Conservation | 175 | 97 |
| Flood | 182 | 37 |
| Total | | 164 |

The operation plan for the reservoir permits storage of water for beneficial

use in the flood pool, but requires evacuation prior to the flood season each year. Floods occur in August and September. Thus the water surface elevation on August 1 should not exceed 175 m. Prior to construction of the High Dam, occasional floods caused severe property damage along the river below Aswan.

Total regulation of the waters of the Nile River make it possible to manage the 84 billion $m^3$ average annual flow. These waters are allocated by agreement between Egypt and Sudan in the following amounts:

| | Billion cubic meters |
|---|---|
| Egypt | 55.5 |
| Sudan | 18.5 |
| Evaporation and seepage | 10.0 |
| Total | 84.0 |

Plans for water conservation projects in Sudan upstream of the High Dam have been formulated. Construction of these projects is expected to be initiated within 2 or 3 years. Studies indicate that these projects will increase the annual average dependable yield of the Nile River by 18 billion $m^3$. By agreement, Egypt would receive half of this. Thus Egypt's total Nile water resource is expected to reach 64.5 billion $m^3$ before 1985.

With flow in the Nile River totally controlled by the High Dam, flow patterns can be regulated to serve specific priority demands. Rural and urban household and industrial water requirements and water consumed by livestock may be expected to receive highest priority. Of the estimated 1 billion $m^3$ currently used for these purposes, most is from surface water sources. In any water use plan, projected requirements must be considered. By the year 2000 the Egyptian population is expected to have increased to 60-70 million people. Improved standards of living will result in higher per capita use of water. These increases, along with an expanded industrial sector, will require nearly 4 billion $m^3$ of water annually by the year 2000. Some of this could be supplied by ground water. Because of inadequate treatment facilities, most of the municipal and industrial effluent is not returned to the system. With improved treatment facilities, more than 1 billion $m^3$ could be salvaged by the year 2000.

Although irrigation use of water has high priority, the needs for hydroelectric power generation and navigation must be met. These uses are not consumptive and do not significantly reduce the supply when properly administered. Present plans and facilities permit the use of all water released from the High Dam for irrigation except during a 20-25 day period in December and January, when irrigation water delivery canals are dried for maintenance. During this period, fresh water is passed into the sea. Also a small amount of surface water is used to operate the exit navigation lock to the sea. These uses total about 3 billion $m^3$ annually. Over 90 percent of this occurs during the canal maintenance period. This loss can be reduced by lining irrigation canals so that the annual drying

for maintenance would not be required.

Irrigation tailwater and drainage water from upstream areas are returned to the delivery system for use downstream. In the Lower Delta, usable drainage and irrigation waste water is pumped back into the system. In 1974 about 6 billion $m^3$ of drainage water with salinity concentration ranging form 400 to 2,000 parts per million (p/m) was pumped into the sea. Improved irrigation practices would conserve a large part of this for beneficial use and would reduce the cost of pumping drainage water into the system and sea.

Based on gauge and pump records, the available water resources for 1974 were as follows:

| | Billion cubic meters |
|---|---|
| Release from Aswan Dam | 56.0 |
| Return flow | 2.3 |
| Reuse of drainage water | 2.5 |
| Ground water use | .4 |
| Total | 61.2 |

The total irrigation water consumptive requirement for 1974 is estimated to be 26 billion $m^3$. This analysis indicates that about 30 billion $m^3$ of water (56 available minus 26 used) was not consumed. More efficient delivery systems and better on-farm water management would reduce this loss.

Table 8 shows estimated water requirements at Aswan to irrigate 6.3, 7.1, and 8.0 million feddans by months. This table was prepared by the Ministry of Irrigation. These estimates indicate that water supply for the irrigation of 8 million feddans will be available when the total potential of the Nile River is developed. The requirements shown in the table reflect a more efficient irrigation system than the one now in operation. Requirements for Egypt as a whole, estimated in a way that considers system efficiency in more detail, are given in table 10.

## Ground Water 20/

### Major Sources

Ground water occurs primarily in artesian aquifers of the Nubian sandstone throughout much of the Western Desert and in the alluvium and delta deposits of the Nile Valley. Elsewhere, ground water is found mostly in the alluvium of wadis and in moderately permeable underground deposits that can be supplied from occasional high-intensity rainstorms. The Nile Valley and Delta, and desert areas adjacent to the Nile Valley such as El Fayoum and the new lands receive ground water mostly as seepage from the Nile River, canals, and irrigated fields.

20/ Based largely on material prepared by Thomas E. Eakin, Consulting Hydrologist.

Table 8--Water requirements at Aswan (assuming all basins converted)

| Period | | With area of 6.3 million feddans | With area of 7.1 million feddans | With area of 8.0 million feddans |
|---|---|---|---|---|
| | | Million cubic meters | | |
| Jan. | 1-10 ..... | 800 | 800 | 800 |
| | 11-20 ..... | 800 | 800 | 800 |
| | 21-31 ..... | 880 | 880 | 880 |
| | Total ..... | 2,480 | 2,480 | 2,480 |
| Feb. | 1-10 ..... | 1,260 | 1,410 | 1,570 |
| | 11-20 ..... | 1,080 | 1,220 | 1,360 |
| | 21-28 ..... | 840 | 940 | 1,050 |
| | Total ..... | 3,180 | 3,570 | 3,980 |
| Mar. | 1-10 ..... | 1,030 | 1,160 | 1,290 |
| | 11-20 ..... | 1,030 | 1,160 | 1,290 |
| | 21-31 ..... | 1,140 | 1,280 | 1,420 |
| | Total ..... | 3,200 | 3,600 | 4,000 |
| Apr. | 1-10 ..... | 1,030 | 1,160 | 1,290 |
| | 11-20 ..... | 1,030 | 1,160 | 1,290 |
| | 21-30 ..... | 1,150 | 1,290 | 1,440 |
| | Total ..... | 3,210 | 3,610 | 4,020 |
| May | 1-10 ..... | 1,270 | 1,420 | 1,580 |
| | 11-20 ..... | 1,380 | 1,560 | 1,740 |
| | 21-31 ..... | 1,600 | 1,800 | 2,000 |
| | Total ..... | 4,250 | 4,780 | 5,320 |
| June | 1-10 ..... | 1,570 | 1,760 | 1,960 |
| | 11-20 ..... | 1,690 | 1,900 | 2,110 |
| | 21-30 ..... | 1,780 | 2,000 | 2,230 |
| | Total ..... | 5,040 | 5,660 | 6,300 |

Continued

Table 8--Water requirements at Aswan (assuming all basins converted) - Continued

| Period | | With area of 6.3 million feddans | With area of 7.1 million feddans | With area of 8.0 million feddans |
|---|---|---|---|---|
| | | Million cubic meters | | |
| July | 1-10 | 1,820 | 2,040 | 2,270 |
| | 11-20 | 1,950 | 2,190 | 2,440 |
| | 21-31 | 2,280 | 2,570 | 2,860 |
| | Total | 6,060 | 6,800 | 7,570 |
| Aug. | 1-10 | 1,980 | 2,220 | 2,470 |
| | 11-20 | 2,000 | 2,250 | 2,500 |
| | 21-31 | 2,000 | 2,250 | 2,500 |
| | Total | 5,980 | 6,720 | 7,470 |
| Sept. | 1-10 | 1,900 | 2,130 | 2,370 |
| | 11-20 | 2,020 | 2,270 | 2,530 |
| | 21-30 | 1,910 | 2,150 | 2,390 |
| | Total | 5,830 | 6,550 | 7,290 |
| Oct.. | 1-10 | 1,910 | 2,140 | 2,380 |
| | 11-20 | 1,920 | 2,160 | 2,400 |
| | 21-31 | 1,750 | 1,970 | 2,190 |
| | Total | 5,580 | 6,270 | 6,970 |
| Nov. | 1-10 | 1,330 | 1,500 | 1,670 |
| | 11-20 | 1,330 | 1,500 | 1,670 |
| | 21-30 | 1,330 | 1,500 | 1,670 |
| | Total | 3,990 | 4,500 | 5,010 |
| Dec. | 1-10 | 1,330 | 1,500 | 1,670 |
| | 11-20 | 1,170 | 1,320 | 1,470 |
| | 21-31 | 880 | 880 | 880 |
| | Total | 3,380 | 3,700 | 4,020 |
| | Grand total | 52,170 | 58,240 | 64,430 |

Nile Valley.--From Aswan to Cairo the Nile Valley alluvium ground water reservoir commonly is from 5 to 15 km wide. Depth of the alluvium is about 20 m near Aswan, increasing to about 250 m in the Asyut area and decreasing to about 50 m near Cairo. It is conservatively estimated that 27 billion $m^3$ of water are in storage in the Nile Valley alluvium. The chemical quality of this ground water generally is less than 500 p/m of dissolved solids.

Nile Delta.--The Nile Delta covers a triangular area of about 25,000 square kilometers ($km^2$). The ground water reservoir is coextensive. The thickness wedges out on the lateral margins and is variable, reaching about 500 m in the vicinity of Tanta and probably exceeding that near the coast.

It is estimated that 75 billion $m^3$ of ground water is stored in the upper 15 m of the reservoir. The upper 15 m is only a fraction of the total reservoir depth; this estimate only serves to show the vastness of the total reservoir.

The chemical quality of ground water varies substantially throughout the Delta.

Lake Nasser Region.--With planned operation, the storage level of Lake Nasser will range from about 65 to 100 m, above the river level. This significantly affects the adjacent ground water system. Storage in the ground water body beneath the banks of Lake Nasser (called "bank storage") may be several hundred million $m^3$. The chemical content of this bank storage water will remain low.

Western Desert.--The region is underlain in large part by the aquifer systems of the Nubian sandstone series. Ground water from the Nubia is discharged naturally and artificially in the oases. This natural discharge has created water management problems in the New Valley.

The amount of water stored in the upper 150 m of the aquifer system is 2,340 billion $m^3$. Since the aquifer is much deeper than this, the total water stored in the Nubia must be very large. Potential recovery of the water development in the New Valley might well be on the order of 234 billion $m^3$. This ground water generally contains less than 500 p/m dissolved solids.

Other Areas.--Usable ground water resources in other areas are not well defined but the total quantity is not expected to be large.

Present Development of Ground Water

Prior to construction of the Aswan High Dam, water from wells was used to supplement Nile River water in the Valley and Delta. Since completion of the dam, the demand for water from this source has decreased.

Presently, ground water is used to supplement the water supply in certain main and secondary canals. About 350 million $m^3$ of ground water was used in 1974.

The discharge from wells in the Western Desert is largely concentrated in the El Dakhla and El Karga Oases. Annual discharges have ranged from 224,000 $m^3$ in 1960 to 739,000 in 1969.

Ground water development has occurred to a lesser extent in Wadi El Natrun, Tahrir Governorate, and the West Coast Zone.

Potential for Development of Additional Ground Water

Undoubtedly the greatest potential areas for development of additional ground water are in the Nile Valley and Delta. Current usage is estimated to be 350,000 $m^3$ annually. As additional quantities are needed, a total annual withdrawal of as much as 1 billion $m^3$ may be possible.

Ground water can be developed in the area of Lake Nasser. This source is "bank storage" and its quantity fluctuates with changes in the lake stage. In some areas it may be appropriate to develop such ground water for local use.

Additional ground water can be developed in the New Valley. Basically, development of the resource must be premised on mining of water in storage. As such, there is a finite life to the system. Based on present knowledge of the aquifer it would supply 1 billion $m^3$ annually for several hundred years.

Other areas are capable of providing limited supplies of relatively good water. Locally, these could be important and should be developed with adequate regard to the physical and chemical systems in which they occur.

## Land Resources

General Summary

The total land area of Egypt is 238 million feddans. In spite of this large area, good land for crop production is scarce. The best cropland is in the Nile Valley downstream from the Aswan High Dam, and in the Delta downstream from Cairo. Ninety percent of the old lands are classified I, II, and III. 21/ Serious soil deterioration of these lands is widespread, mainly through rising ground water and increasing salinity.

21/ The system of land classification used in Egypt is described in the following sections. A detailed discussion of soil characteristics for each Zone appears in Part IV.

These problems hamper efforts to increase production through the use of increased cropping intensity, more fertilizers, better varieties, and other management improvements. An unprecedented drainage program to halt and reverse the effects of waterlogging and increased salinity has been initiated. In addition, a program for soil amelioration by use of subsoiling, deep plowing, and addition of gypsum has been initiated in the lower Delta. The potential for soil improvement is large. Plans are to treat 150,000 feddans in this way in 1976, and 250,000 feddans per year starting in 1977.

Since the early 1960's a search has been going on to find around 2 1/2 million feddans of suitable new land that can be successfully irrigated with Nile water from Lake Nasser. More than 65 million feddans have been studied. To date little more than 300,000 feddans downstream from the Aswan High Dam have been classified as I and II and some 600,000 as Class III. The vast majority fall in Class IV with very severe limitations for crop production. Lack of additional good cropland with few to moderate limitations is the primary constraint for horizontal expansion along the Nile and near the Delta. Areas that show promise are discussed in the section of this report on new lands (p.36) and in the zone summaries for new lands in Part IV.

Opportunities exist for land reclamation west of Lake Nasser. Some Class II and III land has been mapped in semi-detail by the Desert Institute. The better soils in the New Valley depressions are in Classes III and IV. Lands in the West Coast Zone are mostly Class IV.

Pior to a national decision involving development of any of these lands, an in-depth evaluation including detailed modern mapping of the soil and geologic investigations should be made.

### Need for Soil Testing and Plant Tissue Analysis

The potential of new and old crop varieties cannot be reached unless the required plant nutrients are made available.

Currently, generalized recommendations and allocations of fertilizer are made through the cooperative system for major crops grown. These recommendations are based on available research findings tempered with costs, experience of farmers or cooperative administrators, and availability of the various forms of fertilizer elements. This system works fairly well with some soils with medium level management.

Optimum yields require correct balance of fertilizer and micronutrients. Acquiring the capability and proper equipment for soil testing and tissue analysis would enable higher levels of cropping management and should result in higher yields.

## Soil Classification Systems

### Classification of Old Lands

Soil surveys are the responsibility of the soil survey section of the Soils Department of the Ministry of Agriculture. The system in use in

Egypt was developed in 1955. Essentially all the cultivated lands have been mapped. A report and cadastral maps at a scale of 1:2,500 have been prepared for every village. Individual mapping sheets are contained in an album in the village. For each village and district seven single-value maps at a scale of 1:10,000 are available, showing soil properties, productivity, etc. Units too small to report are omitted. Each governorate has a report covering the lands in the governorate plus maps on a 1:100,000 scale.

Soil profiles were dug to a depth of 150 cm or to the depth of inhibiting layers such as rock or the water table. An average of one profile per 60 feddans was dug as a basis for the semidetailed surveys. More detailed surveys are made in localized areas whenever needed, for example as a basis for evaluating and planning proposed drainage projects. Soil color, texture of the surface soil, texture of the subsoil, and compacted or other layers are noted. Laboratory analysis is used to determine salinity and alkalinity of the surface soil and subsoil, salinity of the ground water, soluble N and $P_2O_5$, pH, organic matter content, and many other factors. From the composite data, a system of land productivity classification has been developed. All the cultivated lands irrigated by Nile water have been classified. Other interpretations can be made from the soil survey data including need for drainage, leaching, subsoiling and deep plowing, gypsum requirements, and other land treatment measures. Soils with similar properties are grouped into productivity classes.

Land Productivity Classification

This classification into six groups is based upon the economic and agronomic properties of land according to these factors: soil profile properties, present productivity, and cost of management. The following is a brief description of the six land classes.

Class I.--This class of land has few limitations and comprises soils that are suitable for raising all kinds of crops. The yields of various crops are high, while the relative cost of production is low. It is supplied with adequate water. The land is well drained. The profile is deep, and the average texture of the soil is medium. The soluble salts do not exceed 0.2 percent or the conductivity of the saturated extract is not more than 4 milliohms/cm at 250°C. 22/ The percent of sodium saturation on the exchange complex is less than 15, and the pH is below 8.5.

Class II.--Soils of this class are suitable for most crops and give good yields. Limitations are slight to moderate and relatively easy to overcome. These soils are well drained and have a good supply of irrigation water. Their texture is fine, and the total soluble salts is between 0.2 and 0.5 percent or the conductivity of the saturated extract is between 4 and 8 milliohms/cm at 25°C. The present sodium saturation of the clay complex is less than 15 and the pH is below 8.5.

22/ A milliohm = $\frac{1}{1,000}$ ohms.

Class III.--These have severe limitations. Only special kinds of crops can be grown on these soils without special treatment. The yield is moderate to good and the cost of production is relatively high. The texture of these soils is very fine or coarse. The soluble salt content is less than 1 percent or the conductivity of the saturated extract is between 8 and 16 milliohms/cm at 25°C. The present sodium saturation is below 15, and the pH is less than 9.

Class IV.--The soils of this class have very severe limitations and produce satisfactorily only if certain environmental conditions are improved. The cost of production on these soils is relatively high. Drainage conditions are usually impaired. This class includes:

1. Sandy soils which contain more than 90 percent sand.
2. Coarse calcareous soils which contain more than 20 percent calcium carbonate.
3. Very heavy soils rich in soluble salts.
4. Alkali soils.
5. Soils with high water table.
6. Soils with very shallow profiles.
7. Soils which contain a clay or hardpan that limits root growth and decreases soil permeability.
8. Soils that are still under reclamation.

Class V.--This class includes barren soils and soils covered with water.

Class VI.--This class comprises all soils which are not suitable for cultivation such as rocky areas, dunes, and public utilities.

Classification of New Lands

Aswan North.--In a search for new land suitable for irrigation from the Aswan dam, 14.3 million feddans were surveyed. 1.8 million feddans were studied on a semidetailed basis (scale 1:50,000). The remaining 12.5 million feddans involved reconnaissance surveys covering about 0.6 million feddans in the Alexandria-Alamein coastal zone (scale 1:100,000), with 11.9 million feddans at 1:200,000.

Of the 2.2 million feddans classified, only 305,000 were considered definitely suitable for development as Classes I and II. Class III included 605,000 feddans, and 1,292,000 were Class IV, with serious limitations for irrigated agriculture.

Western Desert.--A reconnaissance aerial survey of 53 million feddans has been completed. These surveys cover the New Valley areas including Siwa, El Bahriya, El Frafrah, and El Dakhla Oases, and El Karga and South Karga Depressions. Further studies are in progress to determine the most economical method for irrigation.

Eastern Desert and Sinai.--Little mapping has been done in this area.

Aswan South.--Through efforts of a regional planning group in Aswan and the Desert Institute, semidetailed soil surveys were made of Wadi Kurkur in 1972, Lake Nasser Region and its environs in 1973, and El Allaqui, Tushka, and El Dakka areas in 1974. These reports suggest that some 200,000 feddans show potential for reclamation.

Table 9 shows agricultural land by classes by zones for old lands. For Egypt as a whole, Class II is the largest class with 46 percent of the total, followed closely by Class III with 39 percent. Class I made up 6 percent, and Class IV made up 9 percent. For new lands, 25 percent is in Class III and 2 percent is in Class IV.

Table 9--Old Lands in cultivation: Soil classes by zones

| Zone | Soil class (based on surveys made 1959 to date) | | | | | Land in crops 1972-74 |
|---|---|---|---|---|---|---|
| | I | II | III | IV | Total | |
| | 1,000 feddans | | | | | |
| I | 9 | 419 | 980 | 221 | 1,629 | 1,691 |
| II | 85 | 545 | 340 | 51 | 1,021 | 1,005 |
| III | 73 | 203 | 102 | 18 | 396 | 436 |
| IV | - | 19 | 102 | 40 | 161 | 153 |
| V | 3 | 77 | 80 | 14 | 174 | 173 |
| VI | 116 | 719 | 214 | 56 | 1,105 | 1,072 |
| VII | 10 | 62 | 188 | 55 | 315 | 285 |
| VIII | 37 | 535 | 143 | 53 | 768 | 715 |
| IX 1/ | - | 5 | 50 | 33 | 88 | 137 |
| Total | 333 | 2,584 | 2,199 | 541 | 5,657 | 5,667 |

1/ El Husseiniya District only for old lands.

## Alternative Soil Classification Systems

Soil surveys of a reconnaissance or semidetailed intensity serve a useful purpose in determining prospective land uses and other related useful functions. More detailed soil surveys which examine the upper 150 cm, along with geologic investigations, provide a basis for detailed planning of soil and water management practices. Other interpretations can be made, including suitability for specific uses.

The current system of land productivity classification has limitations. Some factors surveyed, such as soil texture, remain constant. Other factors such as depth to ground water may fluctuate from month to month. Salinity and alkalinity are not necessarily constant. It follows that productivity classifications based on factors that interact and are subject to change may be correct at the time of mapping. It cannot be said with certainty that such classifications are accurate at a later date unless they are checked. Obvious changes such as increased salinity or alkalinity would tend to lower the classification of land originally in Classes I, II, and III. On the other hand, improvements in variable factors could raise the productivity of land in Classes II, III, or IV.

Soil maps, as such, have not been compiled for Egypt. Boundaries of appropriate mapping units have not been established. Separation and grouping of soils on pedogenetic principles have been applied to a very limited extent.

Higher cropping intensities and management practices to improve agricultural productivity demand more details about soil characteristics than those given by the present classification system.

A modernized soil survey and classification system should be developed and put into use at the same time as high-priority proposed project areas are being surveyed in more detail, and prior to the initiation of significant drainage or reclamation projects on new lands. These surveys should cover engineering classifications of soils, including grain size and plasticity. Such surveys are particularly needed for the more complex residual desert and desert fringe soils. As time permits, this new classification system could be extended to areas for which soil problems are not severe, but such extension should be on a low-priority basis.

## Drainage

The construction of the Aswan High Dam has provided opportunity to manage the flow of the Nile River. It is natural that with a year-round supply of water, a rapid increase in crop irrigation in the old lands would occur. Also it follows that with an excess of water above requirements to irrigate the existing cropland, new land areas would be sought. Unfortunately, adequate interdisciplinary planning of drainage and other agricultural water management measures has not kept abreast of the expanding irrigated agriculture. Hence potential yields have been reduced by slight to severe amounts on about 80 percent or about 4.2 million feddans of the old lands. The area having slight reduction will regress to severe unless drainage measures are applied promptly.

The Egyptian Government has placed high priority on the installation of drainage systems. Two World Bank (IBRD) projects to improve the drainage systems have been approved and the installation of the tile drains and

their outlet works are proceeding at a rapid rate. The first approved projects were for 950,000 feddans in Lower Egypt and 300,000 feddans in Upper Egypt. The following progress is being made:

| Installation period | Lower Egypt | Upper Egypt |
|---|---|---|
| | Thousand feddans | |
| Prior to IBRD project | 177 | 0 |
| Prior to 1975 with IRBD funds | 689 | 0 |
| 1975 schedule | 160 | 80 |
| 1976-80 schedule | 900 | 323 |

Funds for a new project involving 350,000 feddans in Upper Egypt are being negotiated with the World Bank. The estimated cost is $123 million. Plans will be developed and funding negotiations begun in 1976 for the installation of drainage systems on 1,000,000 feddans in Lower Egypt.

Engineering personnel and facilities to develop plans and provide installation services are available for a more rapid installation rate, but materials, transportation facilities, and local contractors are not available. This constraint can be remedied by providing additional materials and equipment from abroad, provided port facilities are available, and by utilizing contractors from other countries. An alternative would be to build materials-manufacturing plants and organize new local contractors.

Presently, concrete pipe is manufactured in more or less portable plants operated by the public contractors. These plants are located in the general area of drainage projects and are moved to new locations when conditions warrant. Three nonmovable concrete pipe manufacturing plants are being built at the present time. These plants will manufacture pipe at a rapid rate, but some of the pipe will have to be transported long distances. More and better transportation and installation equipment will be required. Also, additional sources of cement will be needed.

Another procedure for removing the drainage constraint is the use of plastic drainage pipe. This pipe is easier to transport and can be installed with modern equipment much more rapidly than concrete pipe.

The installation of drainage facilities on about 4.2 million feddans of old lands will not totally remove this constraint on agricultural production. Many of the drainage problems have been encouraged if not caused by poor water and soil management practices. This is especially true in areas with inherent production restraints such as high water tables, salinity, and low fertility. In these areas, it is imperative that a total interdisciplinary plan be prepared and followed.

A large investment has been expended on the new lands lying west of the Delta (Zone X). Much of the irrigation system is built. Roads, utilities, housing, and other support facilities are complete. The soil and water management plan was not adequate and severe salinity problems have arisen. Presently, research programs are studying the problem, but first results will not be available before 1977. Even then few definite conclusions are likely. In the meantime action programs can be initiated. The main drainage outlet, an open channel which generally parallels the Nubaria canal, has been located and construction plans have been prepared. A short section at the outlet end is under contract. The location and general plan of this principal drainage channel and some of the major laterals are not dependent on the results of the current research programs. These would be open ditches and, except for irrigation canal flumes and bridges, would not use the critically short supply of cement.

At the same time the main channels are being constructed, a plan of development involving all resources should be made. It is likely that segments of the plan could be constructed prior to completion of the research program.

The reclamation of about 500,000 feddans is planned for the area immediately west of the Suez Canal (Zone XIII). Modification of an existing irrigation canal to deliver water to the area has been initiated. This area has some lands that will require intensive soil and water management practices. A feasibility study shows that the area would be feasible for agricultural development. An interdisciplinary plan for soil and water management should precede the installation of single-purpose measures. Interdependent measures such as irrigation and drainage should be installed concurrently.

## Irrigation and Water Management

### General Discussion

Irrigation in Egypt has been catagorized as either basin irrigation or perennial irrigation. Basin irrigation was developed as a means to capture the floodwaters of the Nile and to release them after a period of ponding. Adapted crops were then grown on the residual soil moisture of this single wetting of the land. Perennial or year-round irrigation was practiced where possible for more effective crop production by diversion of water from the Nile. This method of irrigation has been augmented from time to time by the construction of barrages located along the river system and by storage facilities which have been periodically increased at Aswan in Upper Egypt.

With the advent of the High Dam, perennial irrigation became possible throughout Egypt and the practice of basin irrigation as described herein was discontinued. Projects to remove the remaining system of dikes constructed to form the basins and to establish a year-round system were initiated and have been completed. The major thrust during the recent

period of conversion was to establish an irrigation network and the capability to deliver year-round water to the entire valley of the Nile and to additional developable new lands.

The emphasis on expanding the country's irrigation system to provide for multiple-cropping capability on all lands was brought about by increased pressure on the limited available land due to an exploding population and the creation of a dependable year-round water flow from the Aswan High Dam. The immediate need for expanding the water distribution system relegated lesser importance to companion water management practices such as drainage systems and improved on-farm water management. The pressing felt need was to provide the year-round water to the land, with a belief that necessary associated measures could somehow be provided as required. Most authorities did not expect the impact of waterlogging and salinity to occur as rapidly and extensively as they are in Egypt at the present time.

The solution to these water-associated problems is not simple, nor can any one combination of remedial measures be expected to be successful in every situation. The most immediate benefits can be achieved through drainage and soil amelioration practices. Dramatic results have been recorded when drainage and soil improving practices have been applied to lands affected by high water table, soil salinity, and plowpan conditions.

Unfortunately, drainage and soil amelioration practices do not prevent the overuse of irrigation water. Many water-related problems can still be expected to occur in localized areas, including overtaxing of the irrigation systems, unless effective water management practices are also utilized. A water management program for the irrigation distribution system and, more importantly, on farms, will be needed to provide a lasting and effective water-use program for increased crop production in Egypt in the years to come.

Irrigation as practiced in Egypt today makes inefficient use of its available water resource. Carl Lee, USAID consultant and participant in this agricultural assessment, reviewed the water released from the Aswan High Dam and the recoverable losses for the 1974 water year. He concludes that overall irrigation efficiency ranges from 44 to 58 percent. This is a low figure for a river system such as the Nile from which many of the losses are recoverable.

Release rates from the High Dam, crop and other water requirements, and losses including amounts escaping to the Mediterranean Sea can be analysed in a number of ways. One analysis was presented in table 8. A more detailed analysis is shown in table 10, which indicates the volume of water required for irrigation in Egypt and the losses encountered. The overall irrigation efficiency in this analysis is 51 percent. The first line of table 10 represents the volume of water used by 1974 crops through evapotranspiration. To this figure are added additional losses and other uses, to arrive at the actual volume of water released from the High Dam in that year.

Table 10--Estimated water use from Aswan High Dam, 1974

| Item | Amount | |
|---|---|---|
| | Billion cubic meters | |
| Crop consumptive use for 6.2 million feddans | | 26.0 |
| Losses in the system: | | |
| On-farm 1/ | 14.0 | |
| Conveyance 2/ | 11.2 | |
| Total | | 25.2 |
| Required diversion and direct use from the Nile | | 51.2 |
| Supplemental water: | | |
| Return flow | 2.3 | |
| Reuse of drainage | 2.5 | |
| Ground water | .4 | |
| Total | | 5.2 |
| Total required released from Aswan Dam for irrigation | | 46.0 |
| Required release for other uses: | | |
| Industrial, domestic, etc. | 1.0 | |
| Navigation and power (January) | 3.0 | |
| Total | | 4.0 |
| Pumped into the sea | | 6.0 |
| 1974 release from Aswan High Dam (actual) | | 55.0 |

1/ Estimated at 65% efficiency, with a range of from 50% for rice to 75% in El Fayoum Governorate and some other areas.
2/ Estimated at 20%.

Table 11 further illustrates the seriousness of waterlogging and associated problems in the country. In this calculation, the amount of water remaining in the system and contributing to the ground water is estimated.

The potential contribution to the water table of 10 billion $m^3$ is equivalent to 0.42 m (1.4 ft) of depth over the total irrigated area in 1974.

USDA/FAER-120

EGYPT: MAJOR CONSTRAINTS TO INCREASING AGRICULTURAL PRODUCTIVITY. (Foreign Agricultural Economic Report). Washington, DC: Economic Research Service. Jun. 1976.

(NAL Call No. A281.9/Ag8F)

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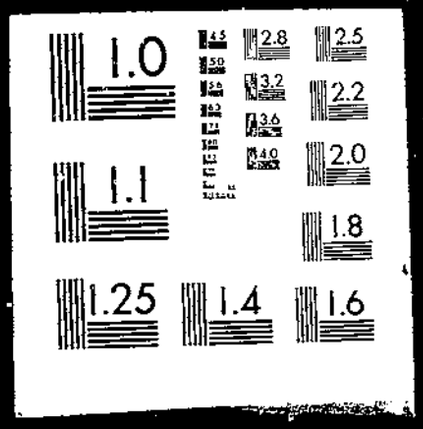


Table 11--Estimated annual ground water excess, 1974

| Item | Amount | |
|---|---|---|
| | Billion cubic meters | |
| 1974 release from Aswan High Dam | | 56.0 |
| Direct use: | | |
| Crop consumption | 26.0 | |
| Non-crop evaporation and other losses | 10.0 | |
| Industrial and domestic | 1.0 | |
| Total | 37.0 | |
| Discharge into the sea: | | |
| Navigation and power (January) | 3.0 | |
| Pumped | 6.0 | |
| Total | 9.0 | |
| Total direct use and discharge | | 46.0 |
| Water remaining in the system (potential annual contribution to the water table) | | 10.0 |

The above estimates of how water is being used in Egypt point out two basic facts. First, all the authorized water available from the Aswan High Dam (55.5 billion $m^3$) is now being used, and second, water losses to the ground water are high.

If the existing water supply is to be utilized for development of additional new lands or increased cropping on old lands, this water must come from (1) improved irrigation efficiencies through a water management program, (2) reduction of canal losses by lining areas of high seepage, or (3) increasing the amount of reuse from the drainage system, including ground water withdrawal.

Projects to add irrigation water by increasing the annual flow into Lake Nasser are also being pursued.

## Drainage of Irrigated Lands

An integral part of any irrigation system is an adequate and complementary drainage system. As stated previously, drainage can provide immediate relief to serious waterlogging problems but its existence does not ensure an efficient water-use system.

Even the best planned and installed irrigation systems are only about 75-85 percent efficient, so that a certain degree of drainage is normally required. Some amount of excess moisture must be lost to deep percolation or to surface runoff as the result of normal applications of water in refilling the soil profile. In arid climates, particularly in Egypt where there is little or no rainfall, a leaching fraction must be included in the irrigation application to prevent a buildup of salts in the root zone of the crop.

A properly designed and installed drainage system will prevent waterlogging and salinity problems from occurring. In areas with fine textured soils and high water table, such as in the Nile Valley or Delta, a uniform pattern of closely spaced open or closed drains is usually required in affected areas. In the more permeable soil encountered on much of the new lands and in some other places, more attention should be given to a system of interception drains to collect and dispose of excess and often poor quality water.

Improved Irrigation Systems

The excessive use of irrigation water has been identified as one of the primary factors in the deterioration of agricultural lands currently being experienced in Egypt. Significant rises in water table levels and associated increases in salinity have occurred in the new lands and these problems have occurred in direct relationship to increased availability of water for irrigation in the lands of the Nile Valley and Delta. Although drainage is of immediate importance to reverse the effects of waterlogging, efficient use of irrigation water is one of the most important essential agricultural water management practices needed in Egypt today.

The bulk of Egypt's agricultural land is irrigated by traditional methods. Over the years, a system of small basins formed by a network of low dikes or bunds, into which water is delivered by a series of small hand-dug ditches, has developed for perennial irrigation. Most cultivators must lift water from the depressed irrigation canals to the level of the farm by means of a shadoof (a counterbalanced bucket) or an Egyptian water wheel powered by a farm animal and servicing from 1 to 10 farm units. In recent years, some small mechanical pumping units have been installed to improve on these methods. Irrigation water is available to some areas by gravity flow. Other facets of the existing irrigation scheme relevant to water management are (1) the rigid system of water rotation requiring the farmer to receive his water at fixed intervals of time and (2) the lack of a direct cost of the water except for the lifting requirements from the canal.

The traditional irrigation system, as it has evolved in Egypt, has proven to be an effective means of dealing with the constraints of minor land irregularities, small flows of water lifted from the canal, and the smallness of the individual land holdings. In light of the increased demands on the land and current problems due to overirrigation, much interest exists in developing more efficient methods of applying water to the land.

Some of the factors contributing to the inefficiencies of traditional irrigation practices are (1) excessive use of land by bunds and field ditches, (2) the small stream of water delivered to the farm plot, (3) variation in the land surface resulting in uneven ponding depths, and (4) the inability to provide irrigations as often as needed during periods of peak consumptive use by the crop.

Efficient use of irrigation water through improved and controllable delivery systems, improved irrigation methods, and on-farm water management is extremely important to the long-range water program in Egypt. It is true, of course, that much of the water lost to inefficiencies in application can be recovered for reuse either in the river or canal system downstream or by pumping from the drainage system. Both efficient water use and reuse of recovered water will be needed if agriculture in Egypt is to make the best use of its water resources.

Irrigation Delivery Systems.--An improved irrigation delivery system should be considered an integral part of modernization schemes for irrigation. Areas to consider in improving systems in Egypt are (1) the method of raising water to the field level, group, or individual plot, (2) a system of diversion and check structures, and (3) a suitable and workable method of controlling releases to the farm.

Small pumping facilities providing gravity flow to a group of cultivators would coincide with a program to release farm animals from being the required source of power for the water wheel. Pumping systems would provide a larger flow available to the farm, allowing increased capacity for improved conservation irrigation systems. Pumps serving a large group would most likely be more economical than those for individuals or small groups. New delivery ditches or enlargement of existing ones would be necessary. Irrigation structures will need to be installed to raise water in the delivery ditch and divert it by gravity to a farm ditch or to the field directly. Also needed are junction structures to split or change the direction of flow in multiple ditch systems, and structures to measure the flow of water and control the ditch gradient. These and other structures will be required to ensure effective water distribution and a viable control system.

A flexible water rotation program based on crop needs, adequate but not excessive allotments of irrigation water, and a workable method of monitoring the quantity and timing of farm diversions are essential factors of an irrigation control system. It is usually not adequate to assume that the cultivators will be able to equitably police and control their group delivery system themselves. A well-trained canal inspector likely would be needed for each of the major channels of distribution to individual farms.

Irrigation Methods.--Any improved method of irrigation should provide a uniform depth of application in the proper amount to replenish the moisture-holding capacity of the crop root zone of the soil. A minimum additional amount should be applied to provide for leaching of the salts contained in the irrigation water below the root zone.

Basin or flood irrigation can be a highly efficient method of water application. This type of application as it is generally practiced in Egypt can be made more efficient by modernization of techniques in conjunction with improved water delivery.

Graded irrigation with either borders or furrows can be an efficient method of surface irrigation. For this method, the land must be leveled to a uniform gradient and a surface drainage system established. Introduction of gradient irrigation would be applicable for efficient water application in many areas of Egypt.

Sprinkler irrigation with portable or fixed systems can be used effectively for efficient irrigation on undulating topography or sandy soils. Maintenance and good management are required for this mechanical method of water application. Stealing of the brass sprinkler nozzles has been reported as a problem in Egypt. Higher wages and returns for farmers and farmworkers might help to eliminate this problem.

On-farm Water Management.--Satisfactory delivery of water and controlled releases in adequate amounts to the farm do not, in themselves, insure that efficient irrigations will take place. Water must be applied before the moisture in the soil is depleted to levels that will materially reduce full plant growth. It must be applied at the proper rate and for the required length of time consistent with the area being irrigated and soil characteristics. The interval between irrigations should be in accordance with crop evapotranspiration rates and the readily available moisture in the soil.

Each irrigator should have a basic concept of the physical characteristics of on-farm water management. This can be achieved only through education at the village level by agricultural or irrigation technicians with formal training in this area.

Constraints to Improving Irrigation Systems.--Constraints to improved irrigation systems other than the obvious items of cost and limited resources in certain materials and equipment are as follows:

1. The inherent desire of a majority of farmers to continue traditional methods of irrigation. Most farmers find it difficult to change their ways when a particular system has persisted over hundreds or thousands of years. Usually, they must see with their own eyes and observe in no uncertain terms that a new practice will be successful before they are convinced.

2. Fragmentation of land into small and separated holdings. Not only do small parcels of land limit the establishment of efficient irrigation methods, but also each individual desires to have his own delivery ditch. Unless land areas can be combined, modernization of irrigation methods will have to be planned at much greater cost for the small areas.

3. Availability of irrigation water at no direct cost to the farmer. This system does not provide an incentive for the farmer to economize on water use. The need to lift water from the canal to field level does provide a certain limitation on overuse, but it apparently has not been enough of a deterrent. Additional controls are needed to prevent excessive use of the water resource.

4. The rigid system of water rotation. A plant uses moisture from the soil reservoir in varying amounts during its growing season. Effective irrigation for full-crop growth should not deplete the available soil moisture below 50 percent at any time. The water rotation system should be flexible enough to provide the required soil moisture replenishment during the period of peak consumptive use of the crop, as well as at all other times.

5. The limited number of technicians trained in soil and water management. To initiate an extensive program in soil and water conservation, a cadre of technicians trained in the art should be available to provide field guidance in farm practices. As a temporary measure, special training courses might be established for presently available college graduates, particularly those who have taken some of the basic science courses that underlie sound soil and water management.

6. Difficulty in operating and managing modern and complex mechanical irrigation equipment. Many difficulties have been encountered in operating sprinkler irrigation systems in Egypt. Successful development of the new lands will depend heavily on the use of this kind of equipment. Solutions to these serious problems will require mechanical maintenance and a well-trained and strictly managed labor force. Special training centers may well be required.

## RESTRAINTS TO CROP PRODUCTION

### Introduction

High efficiency in the production of crops probably constitutes the single most important factor in the overall success of the agricultural sector of any country. In actual crop productivity, Egypt is high even when compared with the so-called developed countries. The fertile alluvial soils

of the Nile Valley and Delta coupled with adequate fresh water from the river, the high photosynthetic potentials from intense sunlight, weather that permits year-round cultivation of the land, and highly skilled farmers are the vital components that result in high levels of crop productivity in the country.

Despite these rather unique favorable factors, there remain several serious constraints to maximized crop production. Among these constraints are the following:

Most Serious

1. Poor drainage of most soils. 23/
2. Losses from diseases, insects, and nematodes.
3. Lack of adequate farm machinery necessary for timely land preparation and harvesting.
4. Improper water management. 23/
5. A pricing policy that is not evenly applied to all agricultural commodities. 23/
6. Small land holdings. 23/

Serious

1. Losses from overplanting of seed.
2. Losses caused by sparrows and rats.
3. Lack of adequate rapid transportation facilities and market-level storage. 23/
4. Lack of timely and adequate essential inputs of pesticides and herbicides.

Important

1. Losses from weeds.
2. Losses in handling, packaging, and marketing.
3. Lack of an overall land-use policy.
4. Delayed application of agricultural technology by farmers. 23/

23/ These topics are discussed in detail in other parts or Technical Reports in this publication. Some are not discussed in this chapter.

5. Inadequate support for agricultural research or for possible strengthening of the organizational structure.

6. Need to increase the germ plasm base.

7. Need for microelements affecting soil fertility.

## Poor Drainage

Experiments at the Sakha Experiment Station have shown that yields of crops could be increased by 50 percent or more by proper drainage. At that location, drainage alone improved productivity of Class III land to the degree that it could be considered Class I soil. By monitoring the runoff water from the outlet tiles, an estimated 3 tons of salt per feddan was removed during the first year after tile drains were installed. Water requirements, though high during this initial season, returned after the first season to levels comparable to those before the tile was installed. The improvement of soil drainage by tile drains can be one of the most effective means of improving crop production throughout a major part of the old lands. Drainage is especially needed in the new lands.

A temporary improvement in soil drainage can be achieved in some soil types by use of subsoiling. This process requires powerful tractors and equipment, and must be repeated every 3-5 years. An active program of this type by the Ministry of Agriculture is underway in Zone I.

## Losses from Diseases and Insects

Accurate measurements of losses from diseases and insects are not available because such losses vary with the surrounding environment and cropping systems. A totally satisfactory system of determining such losses has not yet evolved even in the United States. Losses from diseases and insects normally are estimated based on judgment factors made by specialists in plant pathology and entomology. In general, when these estimates are applied to production they represent losses from potential yields and not from the actual reported yields. Losses from marketed and stored crops, on the other hand, represent a reduction from reported yields in most cases. Losses from diseases and insects are discussed below under most of the sections on individual crops.

## Lack of Adequate and Timely Land Preparation and Crop Harvesting

To achieve a maximum output, it is essential to (1) shorten the turnaround time between crops and (2) increase the number of crops per year that can be grown on a given area of land.

Much of the soil preparation in the country is still being done with animal power using primitive equipment. This is particularly true on the smaller plots. Plowing by this method is shallow, and any surface organic matter cannot be properly incorporated into the soil. Deep plowing with suitable heavy tractors and moldboard plows would not only reduce the period of time required for land preparation, but would enable plowing to a greater depth and permit the turning under of crop residues, which together would increase crop yield by 20 to 30 percent or more. At present, practically all crop residues are removed from the fields. An increase in organic matter improves soil fertility, tilth, water-holding capacity, and drainage. The loss of organic matter, particularly cotton stems, by removal and burning for cooking fuel, is a practice that is wasteful of organic matter. It is probable that farmers would quickly appreciate the need of organic matter if it were explained to them and if improved mechanical means were available for shredding crop residues and incorporating them back into the soil. Electricity from the High Dam or other sources of fuel for cooking would be required. Corn and sorghum stovers now are chiefly used as fuel, but most straws from rice, wheat, and other grains and some other crop residues are used for livestock feed. Consideration should be given to their relative value as a source of organic matter for the soil or as a source of nutrients to animals.

Weeds are a potential problem related to land preparation. Weeds have become a serious problem on many of the experimental farms where the cost of labor has prevented proper hand weeding. Conceivably, the increasing cost of hand weeding could by 1985 result in a weed problem for the larger privately owned farms. One way to reduce weed losses is by deep plowing with a moldboard plow. Chisel plows, on the other hand, are relatively ineffective for weed control.

The slow removal of the crop from the field at harvest contributes to longer turnaround time. Partial mechanization of harvesting operations for small farms could speed up harvesting operations by replacing the slow hand-cutting methods, so that the crop could be removed from the land and temporarily stored for subsequent threshing. Suitable methods of mechanization would reduce the time now required between crops by affecting both harvest and land preparation operations. In addition, timely or early planting of many crops such as maize is essential to reduce insect and disease losses, and to take advantage of essential daylength and crop-thermal unit requirements for summer crops.

On the average, 1.9 crops per year are obtained from each feddan. This cropping efficiency ratio could be further increased by 1985 or sooner by locating or breeding shorter season or earlier maturing crops and using mechanization, with the ultimate aim of growing 2 1/2 crops on the average per year. In parts of China, two crops of rice and a crop of wheat are

grown by using earlier maturing varieties. To achieve such an improved cropping efficiency by breeding would require that immediate steps be taken because crop breeding requires several plant generations as a minimum to combine earliness with other essential agronomic and horticultural requirements such as high yields, adaptability, and market quality. For most crops, more than 10 years of intensive breeding will be required to bring about any marked improvement in earliness. Full use should be made of germ plasm with such characteristics available from the several international plant-breeding centers. Such new improved early varieties, coupled with mechanization to reduce turnaround time to a minimum, could have a major impact on the total food and feed output of the country by 1985 or sooner. Many early maturing varieties for major crops are now available and need only be tested to assure that they can be used successfully in specified areas.

## Losses from Overplanting Seeds

Crop seeds are generally broadcast or planted by hand in Egypt. Broadcasting seed is wasteful because it is impossible to spread the seed uniformly. Even with hand-planting in rows, seed tends to be wasted due to uneven distribution. Mechnical planters and drills, on the other hand, can place the seed with precision at a given spacing and depth. These planters and drills may range from simple hand-propelled planters for small land areas to sophisticated tractor-drawn planters for large areas. Examples of such seed savings are shown below:

| Crop | Seed required for-- | | Difference | Annual Total |
|---|---|---|---|---|
| | Broadcasting | Mechanical planters | | |
| | Kg per feddan | | | 1,000 tons |
| Wheat | 60-70 | 35-40 | 30 | 40 |
| Maize | 20 | 12 | 8 | 10 |
| Lentils | 60 | 40 | 20 | 1 |
| Groundnuts | 25 | 15 | 10 | 0.3 |
| Flax | 80 | 40 | 40 | 2 |
| Clover | 15-20 | 10-15 | 5 | 14 |

Equally important, mechanical seeders reduce the time required to plant the crop, thus shortening the period the land lies idle between crops, and they save labor.

Poor seedbed preparation also contributes to losses in seeds.

## Losses from Sparrows and Rats

Sparrows are numerous in the countryside and are especially noticeable in the crops near harvest time. In the nearby trees and buildings they occupy almost every available nesting space. Farmers attempt to protect their crops from sparrow predations by various devices, such as using bits of cloth waving in the wind, or even placing young children throughout the fields to scare away the birds. One crop expert believes the number of these pests has increased in the last 3 years, largely because sparrow predators have decreased in numbers as a result of insecticides. The sparrows, however, thrive in spite of the insecticides. It is estimated that average losses from sparrows amount to 10 percent for the major cereal crops--wheat, rice, barley, maize, and sorghum--and are even higher on some crops such as sunflowers.

Losses from rats are not so evident, but must be substantial if one observes their numbers in fields and buildings. These animals also pose a potential threat to poultry, especially young chicks. They cause huge losses in crops stored after harvest.

At 1974 production rates, a 10-percent loss from sparrows amounts to about 7.3 million tons of cereal grains. This vast amount of food could be retrieved for use, at least in part, if adequate biological and eradication control were initiated. It is recommended that a team of appropriate experts (on a temporary duty basis) be assigned to study this problem and develop measures to reduce this loss.

## Lack of Timely Crop Inputs

Crop losses by diseases, insects, and weeds can be greatly reduced by appropriate chemicals. To be effective, such chemicals must be applied before the disease or insect has built up large populations, which they do by almost geometrical proportions. A matter of hours can be critical in diseases such as late blight of potatoes, and the delay of a day or two can be critical in the case of many insects. The key to the control of most pests, including weeds, is to control them when the population is first noticed and before the first burst of population growth. For this reason insecticides, fungicides, and weed killers should be stockpiled and readily available to every farmer, along with proper aid in identifying the problem and applying the right remedy. Too often, by the time the needed chemical is located and obtained, it is too late to use it.

## Losses from Weeds

Weeds have become a serious constraint along irrigation and drainage canals by impeding the flow of water and choking the canals. At present the only adequate control is by hand cutting, an expensive operation even when inexpensive labor is available. In addition, seeds from the weeds on canal

and ditch banks are carried in the irrigation water and contaminate farmers' fields. Chemical weed control methods for canal banks and irrigation ditches are needed. Caution in this regard is necessary, because both people and animals drink out of the canals.

Although the average farmer controls weeds satisfactorily by hand pulling or hand hoeing, this process is becoming more expensive, and the weed problem can therefore pose a serious threat to Egyptian agriculture by 1985.

## Adequate Support for Agricultural Research and Possible Strengthening of the Organizational Structure

The development and application of new technology in Egypt is essential if the agricultural sector is to achieve a dynamic and strong improvement in crop yields.

Over a period of many years Egypt has invested huge sums of money in training people in agriculture and agricultural research. Today there are in the country a tremendous number of graduates of agricultural colleges who could be gainfully used in an effective and successful research organization. Despite this potential, agricultural research in Egypt is suffering from serious constraints of inadequate support. The lack of financial support to the research organizations not only hampers the development of new technology, but has a damaging effect upon research initiative and morale of some segments of the organization, especially the younger graduates who more or less languish doing menial duties with few actual responsibilities. Members of the U.S. assessment team found instances of laboratories with no functional equipment, research plots reduced in size for lack of field and irrigation equipment, and libraries almost devoid of any recent journals or books.

To exploit the heavy Government investment in agricultural training, immediate steps are needed to strengthen and expand all existing research facilities. Critically needed are farm machinery, some laboratory equipment, research periodicals and books for reference libraries, greenhouses and plant growth chambers for controlled atmosphere research, seed and cold storages to protect vital genetic germ plasm and breeding lines, and machinery to conduct essential field plot research. In order to encourage the best qualified persons to accept positions in field research stations, housing and transportation facilities must be provided. For example, one field research station is located 15 km from the nearest village, and since none of the staff owns a car there is inadequate transportation for the children to attend school, and no means of obtaining groceries and supplies--to say nothing of the lack of other amenities which would ease the hardship of such a location. Such field station workers should be given offsetting incentives to facilitate recruitment of good people for such locations. Strong research programs in these field stations would strengthen the extension service by providing necessary on-the-spot information and know-how

to extension workers in the area.

To strengthen agricultural research, an inventory of equipment, machinery, and library and capital improvement needs should be developed, as a basis for determining funds required both in foreign exchange and local currency. As a second step, negotiations with the proper Egyptian authorities should be undertaken to meet these needs by appropriate action.

A strong and efficient research organization is vital in providing new technology, the key to maximizing production in Egypt in future years. It is strongly recommended that an in-depth review be made of the organization and administration of agricultural research to overcome some of the serious constraints which appear to restrict the efficiency of the present research organizations.

Some of these constraints could be summarized as follows:

1. Lack of close liaison with the various extension departments.

2. Lack of actual applied experience for most of the junior staff who could replace the present senior staff. There is a tendency to require higher degrees in order to obtain promotions, and the university training in many cases is directed toward pure academic research which requires less time to meet the requirements for a degree than would field surveys and/or experiments.

3. Lack of good housing, transportation, and social facilities on most of the experiment stations.

4. Lack of up-to-date laboratory equipment in the experiment stations or in the main station at Giza.

5. Lack of active coordination between ongoing research work of the Ministry of Agriculture and the universities.

6. Need to strengthen interdisciplinary groups to work on research problems, especially at the experiment stations.

In brief, all Government programs in agricultural research, agricultural extension, and agricultural university teaching should be reorganized and restructured to bring these key organizations into one centralized and closely knit administrative unit. This point is discussed in some detail in the section on agricultural extension in Part II (p.26 ).

## Need to Increase the Germ Plasm Base

Some of the most promising, high-yielding crop varieties in Egypt have been developed by combining exotic germ plasm with the best germ plasm selected

from local varieties. To support this successful program, a continued and expanded program of introduction of crop germ plasm from other parts of the world, particularly the International Agricultural Research Centers, should be supported. An important result of this program is the broadening of the genetic base for the crops grown in Egypt, thus reducing the genetic vulnerability of crops to the sudden appearance of new diseases and pests, or new, more pathogenic strains of existing pests. In addition, new introductions could provide strains with increased earliness.

## Increasing Problems of Minor Soil Element Deficiencies

A recent, and unexpected, constraint to maximized agricultural production is the realization that some Egyptian soils are deficient in minor elements such as magnesium, iron, and zinc. Deficiencies in these minor elements result in unthrifty plant growth and lack of good response to macronutrients such as nitrogen and phosphorus.

Prior to the building of the High Dam, minor elements were supplied to the soils in the form of silt and sediment carried in the irrigation water from the Nile. With the building of the dam, the mineral soil deposits are dropped in Lake Nasser, forming a delta-like deposit at the southern end of the lake. As a consequence, the Nile River and its irrigation water no longer provide a yearly replenishment of these elements.

To meet these changed conditions, expanded facilities for regional soil testing and leaf analyses will be required. Increased research must be initiated to find methods of detection and means of remedying minor element deficiencies.

## Details by Crops

### Cotton

Cotton is considered the most important of Egyptian crops because it occupies about a third of the land available for crops and, as the major export crop, it is a source of foreign exchange. In addition, cottonseed is the prime indigenous source of vegetable oil for human consumption in the country, and cottonseed cake is the primary local source of livestock concentrate feed. Egypt at present grows only long staple cotton, namely varieties of *Gossypium barbadense*. Cotton is grown throughout the country except in the Aswan Governorate. The country is divided into 10 variety areas. Over 40 percent of the crop is marketed domestically, while the balance is for export. Normally, slightly over half goes to East European markets, with the USSR by far the largest importer, one-fifth goes to Japan, and the balance goes to Western Europe.

The cotton breeding program in Egypt has been highly successful in developing improved varieties with a range of long staple length, fineness, strength, and spinning qualities. Early maturing varieties have been developed to escape damage by the cotton bollworm. All varieties now grown in the country are fusarium resistant.

High-quality seed is produced for planting the crop. Essential parts of this program are (1) the efficient and effective seed increase program from breeder's seed through certified seed, (2) the system of ginning only one variety through any given gin, and (3) a system of premium payments to growers for the best quality seed, financed through the Egyptian Cotton Improvement Fund by a tax on all ginned cotton. Egypt may well have one of the best programs in the world for assuring high quality and proper varieties of seed to growers.

The overriding constraint to maximized production is the lack of adequate insect control. This is also true in the United States. The primary insects are cotton leaf worm (Spodoptera littoralis), spiny bollworm (Earias insulama) and pink bollworm (Pectinophora gossypiella). Aphids, thrips, and spiders have become much more serious than they were one or two decades ago. Small sprayers and readily available insecticides are needed for immediate control of insects as soon as they appear, although spraying by airplane is used in some concentrated areas. Stockpiling of insecticides to make them readily available is recommended.

Another constraint to maximized production arises from the nature of the regulations of cotton acreages and cotton prices. Cotton is bought solely by cooperatives for the Government, and prices are too low to make this crop plus catch-crop clover as remunerative as certain other combinations of crops. Hence the grower tries to reduce cost of production by saving labor and neglecting some important agronomic practices, which reduces the overall yield per feddan. Grower prices in 1973 were one-third of the international price equivalent and in 1974 were two-fifths of the international price equivalent. Cotton prices should be increased to make cotton more competitive with other alternatives available to the farmer. Cotton production also could benefit from small implements for planting and weed control.

To increase the amount of premium-priced long staple cotton available for export, there is a trend toward importing the lower-priced, but higher yielding, upland cotton for domestic textiles. A complete cotton research station in the Aswan Governorate is proposed to facilitate the development of high-yielding cotton varieties other than Egyptian cotton.

## Wheat

Wheat is the principal winter cereal crop in Egypt, occupying in 1972-74 1.3 million feddans in all zones of the old lands. The entire crop meets less than half of domestic needs, and these will grow in direct relationship

to population growth. Wheat is not adapted to the reclaimed lands, so any increased production must come from either improving the efficiency of production in the present land, or increasing the area devoted to this crop in the old lands. The latter adjustment could be accomplished only at the expense of reduced land for clover, other winter crops, or cotton.

Past progress in improvement of yields has come primarily through improved varieties and increased fertilization. The yield index on wheat has increased from 100 for the 1948-52 period to 191 in 1973. The most promising recent new varieties are Giza 155 and Giza 156. More recently, the dwarf high-yielding, fertilizer responsive varieties from Mexico have provided germ plasm for greater yield increases. This new germ plasm is being incorporated into types suitable for Egypt, since the Mexican varieties shatter badly under Egyptian conditions, losing at least 20 percent of the grain. An important objective in the breeding program is increased quantity and quality of protein.

Hand broadcasting of seed, as practiced here, requires 30 to 40 percent more than would mechanical planting. These losses amount to about 2,000 tons of wheat for seed.

Three rust diseases (stem rust, leaf rust, and stripe rust) cause losses in occasional years, but are kept in control by continually breeding for resistant varieties. However, epidemics may occur upon the emergence of new virulent races of rust. No serious insect or nematode problems exist. Weeds are a serious problem and, based on experimental data, have reduced yield potential in control plots by 22 percent and on the overall crop by about 10 percent.

Barley

Barley is a minor cereal crop in Egypt, but is important in some areas. It is a fairly important crop in Zones IV, V, and IX on old lands, and Zones IX, X, and XI on new lands in soil types that are calcareous. In the Sinai (Zone XIII) and the West Coast Zone (Zone XII), barley is the main cereal crop for food and feed. About 15,000 tons are used for malting purposes, but the primary use is for livestock feed. Recent experiments have shown that one cutting of barley yielding 2 to 3 tons of forage per feddan could be taken 50 days after planting without affecting subsequent grain yields.

In recent years, increased emphasis has been given to the development of high-yielding dwarf varieties that respond to high rates of fertilizer. Two promising lines are nearing release. Meanwhile, the conventional tall-growing varieties are found in the country. The most promising of the dwarf types is Giza 119 released in 1973, which has average yields of about 1,440 kg per feddan, as compared to 840 to 960 kg per feddan for varieties released in previous years. In addition Saharaway, an early maturing variety

adapted for production in areas with 150 to 200 mm of rainfall, yields about 360 kg per feddan under these dryland conditions.

The primary constraint to maximized production efficiency in barley are the five diseases, net and spot blotch, barley stripe, powdery mildew, and rust. These five diseases result in reduction of potential yields of 10 to 15 percent. Genetic resistance is found in barley germ plasm in the country to all these diseases. Hence it is feasible by plant breeding to develop commercial varieties with this resistance.

Rice

The rice grown in Egypt is the short-grain or japonica type. It is the leading summer field crop in Zone I and in a number of other zones. The predominant variety, Nahda, is grown on 85 percent of the crop area. Two new short-grained varieties, Giza 171 and Giza 172, have been named for release in 1977 and these two varieties along with IR 579-48, a long-grained or indica type from the International Rice Research Institute (IRRI), are expected to replace Nahda in the near future. Another variety, Giza 159, is salt tolerant and is grown largely in the new lands.

Rice is grown as paddy as a summer crop, primarily in Zones I and II. Most of the crop is transplanted because this method of planting gives the highest yields and the crop can be planted later in the field. However, with the increasing shortage of labor there is a corresponding increase in direct seeding. This crop is a heavy user of water. Experimental data indicate rice requires about 31,000 $m^3$ of water per feddan for transplanted rice and about 38,000 $m^3$ per feddan for direct seeded rice.

The most serious pests are blast disease caused by Piricularia oryzae and stem borers (Chilo agamemnon). These two pests cause about a 5-percent reduction in potential yields. Other constraints to maximized production are bird losses, harvest losses, and milling losses. Milling losses in the private sector, which uses primarily the inefficient huller-type milling process, amount to about 5 percent. The private sector mills account for nearly half the entire crop.

Maize (Corn)

Maize is extensively used in Egypt for human consumption in bread, especially in rural areas. White varieties are preferred for this use. This crop is grown throughout the country and is the leading summer field crop in many zones and an important Nili crop in some. A yield increase of over 50 percent was achieved directly by a shift in planting dates to May through June instead of July through August. The earlier planting reduces the losses from maize rust and three species of stem borers.

Maize follows winter crops in the rotation. In order to plant the maize crop early, it is urgent that land preparation and planting be done as early as possible, including removal of winter crops such as wheat and clover. The lack of rapid land preparation is therefore a serious constraint.

Another major constraint to greater production is the fact that only about one-sixth of the maize production area is planted with improved varieties. The bulk of the crop is grown from low-yielding, white dent varieties, the seed of which is maintained by individual farmers. Improved hybrids and open-pollenated composite varieties have been developed by maize breeders. These include four double-cross hybrids GH 19, 175, 186 and 355; two composites Shedwan 3 and Giza 108; and two intervarietal crosses 69 and 80. All of these varieties are high yielding and all except 175 and 186 are resistant to late wilt disease caused by Cephalosporium maydis.

In order to provide seed of these improved varieties sufficient to plant at least two-thirds of the area devoted to maize (about 1 million feddans) a 5-year seed increase project has been initiated. The progress of this project has been impeded by the lack of sufficient machinery, including tractors, plows, harrows, ridgers, planters, shellers, cleaners, seed graders, and seed storage. In addition, the farms producing the improved seed are small and scattered, making supervision of seed production, especially detasseling, difficult. Consideration should be given to the concentration of seed production in an area of larger farms with adequate machinery and storage facilities on each farm.

Lower leaves are stripped from maize and sorghum to feed livestock. Yields of grain from such stripped plants are not reduced appreciably if the upper leaves are left intact, and if the leaves are not stripped until after the "dough" stage of the kernel has been reached. Some Nili plantings of maize may be used for livestock fodder.

This report recommends that planting of maize in the Nili period be discontinued due to high losses and lower yields in that period. It also recommends that forage crops be grown in summer and fall so that maize and sorghum leaves can be left on the plant until maturity is reached.

Grain Sorghum

Grain sorghum is an arid land crop which succeeds in the hotter areas that are marginal for corn production. Grain sorghum is used mainly for human consumption. About 485,000 feddans are grown in the country, mainly in Zones VI, VII, and VIII. The major variety is Giza 114, a selection from domestic stocks; it accounts for nearly 60 percent of the crop area. It is a tall, white-grained variety with good disease resistance. Giza 3, a variety developed by hybridizing local with exotic germ plasm, was released in 1975. It has higher protein content (12 percent) than Giza 114, is medium high, and resists lodging. Breeding research to increase the quantity and quality of protein could increase the value of this crop for both food and feed.

Primary constraints for this crop are inadequate sparrow and weed control.

Food Legumes

Food legumes include a considerable number of bean-like crops that are used for human consumption as a source of protein. Chief among these are horsebeans (Vicia faba), lentils (Lens culinaris), fenugreek (Trigonella foenum-graecum), dry peas, and soybeans. Groundnuts (peanuts), also a high protein crop, are considered primarily an oil crop, although most are currently consumed directly for food. With the exception of soybeans (a summer crop), food legumes are grown as winter crops. They are grown to some extent throughout the country; however lentil production is concentrated in Zones VI and VIII, and beans in Zones II, III, V, VI, and VIII. Land area devoted to these crops has declined by about 20 percent since 1955, largely because these crops compete with more profitable ones.

Grain legumes are second to cereals as food crops. Stewed horsebeans, bean cakes, lentil soups, lentil-rice mixtures, and bean-lentil curries constitute an important part of the diets of that part of the population that cannot afford livestock protein. Protein in Egypt is mainly of plant origin; only 13 percent of protein consumed in the country as a whole is from animal origin. This percentage would be much smaller for the low-income groups. Hence these crops, with protein content ranging from 28 to 30 percent, are sometimes known as the poor man's meat. Imports of beans and lentils in 1975 amounted to 91,000 and 33,000 tons respectively.

Three improved varieties of horsebeans (Giza 1 and 2 and Rebaya 40) and one variety of lentils (Giza 9) account for all of these crops. Yield increases from the improved varieties in the last 5 years have amounted to up to 50 percent for horsebeans and nearly 30 percent for lentils.

About 15 percent of the potential horsebean crop is lost to weeds and diseases, particularly chocolate spot (caused by Botrytis fabae), rust (caused by Uromyces faba), and broomrape (caused by Oronbanche genus). Chocolate spot and rust can be controlled somewhat by delaying planting until the first week in November, but there is no satisfactory control to date for broomrape, a parasitic seed plant that attacks the roots. No good source of genetic resistance has been found to these three pests.

The soybean has been recently introduced to Egyptian agriculture but is not yet well established. About 10,000 feddans were grown in 1975. The available soybean meal is used primarily for poultry feed after expressing the oil. Being a summer crop, it competes for land with cotton, maize, and rice, a serious economic constraint. In addition, nodulation by nitrogen-fixing bacteria is almost nil throughout the country, hence soybeans must have heavy nitrogen fertilization of at least 40 kg per feddan.

A major constraint to maximized production of horsebeans, in addition to pests, is the shedding of the buds, flowers, and pods of up to 90 percent. A solution to this problem could double yields on the average.

In brief, the major keys to improved production efficiency in these crops are disease and plant pest control, nodulation (especially in soybeans), and prevention of physiologic flower shedding. Cooking quality and protein improvement would require development of an adequate laboratory to analyze protein content. Because these plants are an important source of protein, consideration might be given to a specific project which addresses these constraints.

Oil Crops

Egypt is short of edible oils of plant origin. Cottonseed is currently the sole indigenous source of oil, but it meets less than half the present consumption requirements. Groundnuts, sesame, and sunflowers are the primary oil crops, but currently are used almost entirely as whole or ground seeds, which represent an important source of protein in diets.

The oil crops are grown in the summer, primarily in Zones VI, VIII, and IX. Improved varieties have been released in the last 10 years for these three crops; they represent 90 percent of the entire land area devoted to groundnuts and 35 percent of the area devoted to sesame.

Although diseases reduce potential yields to some degree, a major constraint in these crops are weeds, which reduce plant stands by 50 percent. Chemical weed control is badly needed. Birds are a serious constraint for sunflowers, sometimes causing a total loss to this crop, with an annual average loss of 40 to 50 percent.

An economic aspect to the production of oil crops is that current oil production is less than half of requirements, whereas more cottonseed cake is produced than is needed to meet the protein requirements for livestock. Since efficient livestock management calls for less rather than more livestock for Egypt, two possible solutions to meet oil needs are available: (1) import oil as at present or (2) increase production of oil seeds. In either case, Egypt would gain by exporting cottonseed cake not needed to meet protein needs of livestock and using this foreign exchange to purchase feed grains. With the limited land available, careful consideration should be given before production of oilseeds is expanded, except for those that are used directly as seeds or nuts or related products for human consumption since these seeds can make improtant protein contributions to diets.

## Fiber Crops Other than Cotton

The most important fiber crops grown in Egypt other than cotton are flax (Linum usitatissimum) as a winter crop, kenaf (Hibiscus cannabinus) as a summer crop, and sisal (Agave sisalana) as a perennial crop. Flaxseed is also a source of oil for domestic use and protein concentrate for export. Hence Giza 4, the primary flax variety, is a dual-purpose type grown for both fiber and seed. Lack of mechanization can delay harvest and cause losses of about 40 percent in fiber quality and seed.

Kenaf as a summer crop competes in the rotation with maize. Present varieties are photoperiodically sensitive and come into flower as soon as daylength drops below 12 1/2 hours. This characteristic of existing germ plasm is a constraint on its widespread cultivation.

Sisal should be considered as a crop for Egypt because it can be grown as a nonirrigated crop under dryland conditions in Zone XII, and with minimum water requirements in the new lands. Despite the need to import 1,000 tons of sisal annually for making rope and twine, there is no sisal produced in Egypt at present because of the high cost of decortication (fiber separation) by manual labor. By hand methods, only 2 to 3 leaves can be processed per minute, while mechanized operations process 200-300 leaves per minute. Consideration might be given to establishment of one or more plants for decortication and twine and rope manufacturing if domestic and export outlets appear large enough to justify this.

## Onions

Onions are the third most important export crop of Egypt, exceeded only by cotton and rice. In Egypt, they are considered a field crop rather than a vegetable crop. Two main onion types are the major Saiedi grown as a winter crop in Zones VI and VIII for export, and the minor behairy type grown in Zones I and II as a late winter crop for domestic use. Onions for domestic use are also interplanted with cotton in Zones I, II, and III. The export market was built up on the production of pungent, hard, long-keeping onions as exemplified by the world-famous Giza 6, and a more recently improved strain released in 1957 as Giza 6 Mahassan. The rapid spread of the soil-borne disease white rot, caused by Sclerotium cepivorum, coupled with changed irrigation practices since the building of the Aswan High Dam, poses a serious threat to this vital export crop.

The lighter sandy soils where onions have been traditionally grown have become infested with the white rot disease. Once the soil is infested, the disease persists in the soil for 7 to 10 years. Consequently, winter onion production was of necessity moved to heavier soils. In these heavier soils it is impossible to lift the bulbs at maturity without first irrigating the heavy soil to loosen it. The extra moisture in the mature bulbs at harvest causes a postharvest physiological breakdown. As a result almost entire shipments of onions are lost en route. The losses en route are

further increased by allowing the bulbs to lie in the sun on open railroad platforms, and by shipping in unventilated cars which become overheated in transit.

Grading is done at the farm level at the time the tops are removed by hand cutting. At this time bolters, diseased, injured, off-type, and sprouted onions are removed.

In order to correct the problem of poor keeping quality of the winter or Saiedi onion and protect the important export potential of the crop, it is recommended that a team of plant pathologists, soils specialists, and biochemists be assigned to the problem, and that present plant breeding research to find an onion germ plasm resistant to white rot be greatly expanded to develop onion varieties tolerant or resistant to the disease. These specialists might also consider the feasibility of onion production in the sandy loams that are being considered for reclamation in areas adjacent to the Nile Valley north of Aswan. Other possible locations would be Nubaria, Ismailia, and El Sharkia.

Sugarcane

Sugarcane is grown primarily in Zones VI and VIII. The Ministry of Agriculture is interested in expanding production to the extent possible because Egypt now is on a net import basis for sugar, and existing sugar mill capacity is adequate to meet full consumption requirements.

With the achievement of a means of inducing flowering, and the subsequent production of true seed, sugarcane breeders now have the means to develop improved varieties better adapted to Egyptian conditions. Prior to this breakthrough, the country was dependent on germ plasm introduced from abroad. This one breakthrough is expected in the next 10 years to result in a yield increase of at least 25 percent. Coupled with an expected increase in sugar content, this one research result could mean an annual increase of approximately 150,000 tons of refined sugar from existing land area in cane.

A prime constraint to maximized production is the ratoon stunting disease, which reduces optimum production by an estimated 15 percent annually. This disease can be controlled by hot water treatment of vegetative seed pieces. Lack of equipment to conduct the required hot water treatment is a serious limiting factor. A second constraint is scarcity of suitable land area for sugarcane, with the result that the crop cannot be rotated as often as desired. The recommended rotation practice is to follow the plant crop with two ratoons, but in actual practice three to five ratoons are taken with an attendant decrease in yields. Reclamation of up to 200,000 feddans of sandy loams in Zone VIII would permit shifting some field or vegetable crops now grown in the Nile Valley to these. Drainage of the heavy clay soils in the valley then could upgrade these to a point where they could be used to grow sugarcane, permitting more prompt rotation of this crop.

It should be reemphasized that poor soil drainage is by far the major constraint to maximized sugarcane production in Egypt. Plans or programs are underway to provide tile drainage throughout these areas.

Forage Crops

Berseem clover (Trifolium alexandrinum) is the main forage crop, grown throughout the country during the winter crop season on about 2.8 million feddans. Approximately 45 percent of this land is used for clover as a catch crop before planting cotton. Usually one or two cuttings of clover are taken from this catch crop before the land is prepared for cotton planting. The rest of the berseem area is left until late May for forage and seed production. Three or four cuttings of clover are taken from this area, with seed taken from part of the last cut. Yields average about 6 tons per cutting. Berseem clover is a host for cotton leaf worm and by governmental decree must not be irrigated after May 1 each year.

Berseem clover and other winter forage crops meet most of the livestock feed needs during the winter season. However, during the summer season, nonforage summer crops occupy nearly all the land area. As a result, there is a critical shortage of livestock forages during the summer. Ways of meeting forage needs on old lands in summer and fall are considered in the chapter on projections.

There is great potential for increasing forage and pasture crops, especially alfalfa, in Zones IV, V, IX, X, and XI. Alfalfa is not grown in the Nile Valley or Delta areas because it is a land-committing crop and is a host for cotton leaf worm. However, in the newly reclaimed lands it is an excellent crop because it builds up fertility and increases the water-holding capacity of the soil prior to planting the area to other crops.

In addition to alfalfa, Napier or elephant grass (Pennisetum purpureum) offers potential as perennial forage in the new lands. It is suitable both as cut forage or as grazing for pasture. At least six cuttings can be made during March to November, with total reported yields (on Delta soils) as high as 100 tons of green forage per feddan per year. Napier grass becomes dormant during the winter. Experimental trials indicate that berseem clover can be planted in winter over the dormant Napier grass, thereby obtaining year-round forage production. This crop also should be considered as a potential source for summer fodder needs in other areas. Evaluation of the potential of Napier grass in the new lands is urgently needed to study crop rotations and the potentials of establishing permanent pastures with berseem clover and alfalfa.

Problems of using the new lands for forage production include the following:

1. It is difficult to establish forage crops in the calcareous soils because the poor soil structure impedes seedling emergence.

2. These soils have poor water-holding capacity, and irrigation water sometimes is limited.

3. Weeds are serious during seed emergence and early seeding growth.

4. There is a shortage of pollenating insects for seed production of clover and alfalfa in these areas.

5. Salinity and poor drainage limit yields.

Vegetable Crops 24/

A wide range of vegetable crops are grown throughout the country. Three of these compose about two-thirds of the production--tomatoes 35 percent, watermelons 14 percent, and potatoes 12 percent. Other relatively widely grown vegetable crops include green peas as winter vegetables and peppers as a summer vegetable, both grown for domestic consumption.

A primary constraint to vegetable production is lack of concentrated and specialized production areas. The small plots, usually less than a feddan in size, prevent good control of pests and inhibit development of centralized packing and marketing facilities. Also, most consumers prefer to purchase vegetables from small neighborhood stands or directly from farm wagons because they are lower in price and people have little interest in a packed and graded product. Despite their highly perishable nature, vegetables are often left on hot unshaded platforms in midsummer, awaiting shipment or distribution to domestic markets. Losses of 25 percent or more have been recorded by improper handling and packing and poor transportation facilities.

Although many of the vegetable diseases and pests can be controlled, needed chemicals are not being applied adequately. The small grower finds it easy to neglect his small plots. Estimates indicate that yields of tomatoes for example could be doubled by adequate control of insects (white flies and fruitworms) and late blight disease. Many growers do not demand the chemicals because of their high prices. Extension information about new technology for vegetable crops is almost nonexistent.

Many of the vegetables move to market over bumpy country roads which, coupled with improper shipping containers, add to marketing losses and poor quality when vegetables arrive at the market.

A World Bank loan is being considered to provide for (1) vegetable seed production on 23,000 feddans in West Nubaria, including field equipment and machinery for processing seeds, (2) construction of four cold storages for potato seed with a capacity of 6,000 tons, (3) development of export markets

24/ Onions and garlic are considered as field crops. Onions are covered in a separate section. Melons are treated as vegetables in Egypt.

for vegetables (primarily tomatoes, peppers, green beans, and muskmelons), including construction of two packing houses and three cold storages (one each at Cairo, Alexandria, and Port Said) and four citrus packing houses to double citrus export, and (4) development of a main drainage system into the Mediterranean and adequate field drainage. An interesting modification at the request of the World Bank was to add livestock to the project in West Nubaria, along with production of alfalfa seed.

Feasibility studies by the Ministry of Agriculture and related agencies suggest that export markets could be developed for a number of vegetable crops. Quality control vastly superior to that for domestic markets would be required. A careful study of the export potential to neighboring Arab countries, where competition might be less intense than in Western Europe, is recommended. This would need to include physical and economic evaluations of transportation and marketing facilities on both the sending and receiving ends.

Tomatoes.--Tomatoes are by far the most important vegetable crop in Egypt. In general they are grown throughout old land areas as a winter, summer, and Nili crop. Tomatoes are grown mainly for domestic use and appear on the market throughout the year, with April and September being the two months of lowest supply. Little of the crop is exported, though a very small tonnage is now being shipped to Europe.

Varieties include Moneymaker (for export), Pritchard, Ace, Pearl Harbor, Marmande Strain B, and Giza 1, the latter from Egyptian breeding programs. Although some tomato seed is imported yearly, the bulk of the seed comes from that salvaged at processing plants. This seed is a mixture of varieties, and hence creates a nonuniform crop.

Increased production of tomatoes would be desirable, not only to provide for domestic consumption in the spring but for development of an export and processing market. However, in the present area of production there is need for growing the crop under low-cost protective covers, as winter yields are much reduced because of frost damage. In addition, consideration should be given to producing winter crops of some tender vegetables in Zones VI and VIII, and developing a plan for rapid transportation to both domestic and foreign markets. Tomato losses are high--25 percent to leaf curl virus, early and late blights, and nematodes; about 25-40 percent to postharvest handling; and 2-8 percent in storage. One estimate is that tomato yields could be doubled if disease losses were controlled and farmers followed recommended practices.

Watermelons.--Watermelons are grown as a summer crop throughout the country. They are almost entirely for domestic consumption, although about 6,000 tons annually are exported, largely to Arab countries by way of Lebanon. Giza 1 represents the most widely grown variety. It is resistant to fusarium root rot which, along with blossom end rot, are the primary diseases of

this crop. Other varieties are Sugar Baby, Crimson Sweet Congo, and Charleston Grey. Disease losses amount to 20-25 percent of the watermelon crop. Other losses are 5 percent in shipping and 2-7 percent in marketing and storage.

Potatoes.--Potatoes, the third most important vegetable crop, are planted twice each year, as a summer crop mainly in Zones I, II and III, and as a Nili crop in Zones I, II, III, IV, and VI. The summer crop is planted in the spring almost entirely from seed imported each year from Europe, while the Nili crop is grown from seed kept in either cold storage or common (nowallah) storage. No improved varieties have been developed in Egypt, and the entire crop is grown from a large number of European varieties. About 85,000 tons are exported to the United Kingdom, France, East Germany, and Arab and Eastern European countries. The primary constraint is loss of 20 to 30 percent of the seed in common storage. Yield losses may also result from the lack of vigor from seed stored in this manner. Virus diseases cause field reductions of about 10 percent in the Nili crop in cases where the seed has not been rogued to reduce the incidence of virus carryover in the seed potatoes. A program of seed certification has been effective in reducing these losses. Tuber moth causes loss of 10 to 15 percent of the crop in the field.

Green Beans.--Green (French) beans are planted both as a summer and Nili crop in scattered areas of Zones II, IV, and VI. This crop is often allowed to grow to maturity and then harvested and marketed as dry beans. Limited exports to Western Europe are made from the Nili crop. Only about 15 percent of the seed is from that distributed to growers, the bulk of the crop being grown from farmer-produced seed. Giza 3 represents 75 percent of the area grown, with Contender and Seminole making up the rest. Field losses, mainly from common bean mosaic and rust, amount to 15 percent of the potential production.

Fruit Crops.--Fruits in Egypt represent land-committing crops and once planted occupy the land for many years, except for peaches, which are replanted after 7 to 10 years. Thus, melons are treated as vegetables. The major fruit crops are oranges, grapes, and mangoes. Small areas of bananas, limes, olives, guavas, peaches, apricots, plums, pears, apples, and figs are also grown. In addition about 8 million date palm trees are scattered around the country. Only a few are cultivated in plantations.

Citrus.--Citrus, predominantly oranges, represent by far the major fruit crop enterprise in Egypt. Citrus, as well as all other fruits, are land-committing crops, i.e. the land is not part of a year-to-year crop rotation. Interplanting of citrus with other crops is commonly practiced, although clean cultivation is also found especially on larger plantings. Cover cropping is usually done in young plantings to add organic matter to the soil. About 200,000 tons or about 20 percent of the orange crop is exported, mainly to East European countries. In addition to oranges, grapefruit, limes, lemons, and mandarins are grown in small quantities for domestic

consumption or for export. Leading varieties of oranges are navels, Egyptian Baladi, and Valencia. The entire citrus crop is budded on sour orange, because it has proved to be the best rootstock for all locations and soils. Oranges are grown in all parts of the country on both old and new lands. Flood irrigation is followed.

Losses to insects and diseases in citrus are small. Although the devastating tristaza disease has not affected Egypt, the crop is vulnerable because this disease attacks citrus on sour orange rootstocks. To ensure against such a disease attack, testing, evaluation, and possible use of other rootstock should be expanded.

Citrus crops for domestic use are most commonly sold on the tree and are marketed in bulk directly by fresh fruit buyers without any grading or sizing. Export oranges are washed and graded for size. Eight plants in the country pack for export, and there are plans to develop 11 more in the near future in anticipation of a continually expanding export market. About 6,000 feddans of new plantings per year are planned for the next 5 years to provide for this growth, although actual plantings may be less. A major constraint is lack of drainage on older plantings, but this will be remedied as tile and other drainage programs now underway or planned are completed.

Grapes.--Grapes are grown throughout the country, but occur especially in Zones I, II, VI, VII, and VIII. They are largely consumed as fresh fruit. Thompson Seedless and Red Roumi are the main varieties and account for nearly 70 percent of the entire crop. Grapes in Egypt are propagated by cuttings, in contrast to the U.S. practice, where budding or grafting is done largely to control phylloxera. Many of the newer plantings are being made on calcareous soils in the reclaimed lands. The crop is handpicked and sold without grading. Market losses are extremely high, largely because the crop is packed in deep containers which cause damage to the botton layers. Mildew is the most serious disease. Nematodes are found in some vineyards but are not a serious problem.

Mangoes.--About 25,000 feddans of mangoes are grown, representing about 8 percent of the total land devoted to fruit. The area devoted to this crop is increasing. All the crop is presently locally consumed, but a potential market exists in Europe, as well as for flowers, early or winter vegetables, and other fruits, according to a recent study made by an Egyptian team. The feasibility of processing this fruit should be studied. Most of the plantings are in Zones III and IV, primarily on marginal sandy soils.

## LIVESTOCK INDUSTRY AS NOW ORGANIZED

### Introduction

The livestock industry in Egypt plays an important role in the total agricultural economy, in spite of its fragmentation and lack of organized

structure. The value of livestock products during the 3-year period 1972 through 1974 increased from LE 311 million to LE 397 million, accounting for 25-30 percent of the value of agricultural output. This does not include the value of work performed by animals in such tasks as land preparation, pumping of irrigation water, harvesting and threshing of crops, and as the primary mode of transportation in rural areas. The diverse use of livestock in the agricultural sector, coupled with dependency on residues and byproducts of the crop sector for feed, inhibits the development of an independent and efficient livestock industry. Egypt has virtually no land area suitable only for grass or forage production, except in newly reclaimed areas. But forage can be produced the year round on any of the irrigated land. Thus, livestock competes directly with cash crops and cereal grains for the limited agricultural land resource. Under these conditions, feed and forage crops are a candidate for land use to the extent consumer demand is willing to pay a competitive price for milk, meat, cheese, and/or eggs.

In addition, livestock converts many byproducts to high quality food, utilizes the nation's abundant labor, and finally produces much needed organic matter for depleted soils.

A number of reports on livestock in Egypt have been previously published. It is obvious that the main constraint on livestock production is availability of feed, especially roughage during the summer season. The objective of this report is to identify constraints in livestock production from the restricted supply of feed that would be consistent with feasible crop rotations as discussed in Part IV.

## Production and Animal Numbers

Production of animal products for the 1972-74 period is summarized in table 12. Red meat and milk output have both increased, whereas poultry production, especially poultry meat, has shown a decline. The decrease in poultry production has occurred in spite of Government programs to substantially increase production. The increase in production of the major animal products for human food, as contrasted with the decrease for poultry products, is a reflection of the ability of the farmer to increase production of berseem clover, which is the primary feed for livestock and makes up nearly 82 percent of the total forage supply. Poultry is dependent upon the availability of processed feed, which is in short supply and under strict Government control.

Table 12--Production of animal products, 1972-74

| Product | Actual production | | | Change from preceding year | |
|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1973 | 1974 |
| | 1,000 tons | | | Percent | |
| Red meat | 285.0 | 290.2 | 295.1 | + 1.8 | + 1.7 |
| Poultry meat | 102.5 | 101.6 | 94.1 | - 0.9 | - 7.4 |
| Milk | 1,626.2 | 1,652.0 | 1,678.4 | + 1.6 | + 1.6 |
| Eggs | 54.4 | 58.3 | 56.1 | + 7.2 | - 3.8 |
| Wool | 3.3 | 3.4 | 3.5 | + 3.0 | + 2.9 |
| Honey | 7.5 | 6.9 | 8.7 | - 8.0 | + 26.1 |

The last complete census of animals in Egypt was in 1961, and less thorough counts were made in 1968 and 1970. Accurate census data for poultry are not available. Total livestock numbers in 1970 summarized by sex and age groups are in table 13. Cattle and buffalo are approximately equal in number but differ in both age and sex distribution. Male buffalo in all age groups are considerably fewer than females, confirming that a potential meat source is being lost through slaughter of male buffalo at a very young age. This results from two factors: first, the adult male buffalo tends to be mean and dangerous and is not suitable for draft purposes; and second, the milk of buffalo is in greater demand for human consumption in rural areas than is the milk from cattle. In this regard, in November 1975 the Meat and Milk Organization was engaged in a project to fatten male buffalo to a weight of 400 kg at less than 2 years of age. Trends in the number of hides processed based on tax records indicate that the number of young male buffalo being slaughtered is decreasing by about 50,000 head annually.

Female cattle are kept primarily for draft purposes and their limited milk production is used mainly to nurse the annual calf. Male cattle are allowed to nurse and are fattened to a weight of 350 to 400 kg to a much greater extent than are buffalo. This is indicated by the larger number of male cattle in all age groups (table 13). The milk-producing ability of the native cow is less than that of the buffalo, and the milk contains considerably less total solids, especially fat, than buffalo milk. For this reason, the development of native cattle especially for milk production must be accomplished by introducing genetic potential for milk production from outside through importation of cattle or preferably semen. This improvement would be brought about chiefly by repeated crossings of cows with Friesian bulls.

Table 13--Total livestock by sex within age groupings, 1970

| Class | Adult | | | Yearlings | | | Young stock | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| | 1,000 head | | | | | | | | | | | |
| Cattle | 103 | 986 | 1,089 | 208 | 387 | 596 | 154 | 276 | 430 | 465 | 1,649 | 2,114 |
| Buffalo | 40 | 1,254 | 1,294 | 60 | 358 | 417 | 65 | 233 | 298 | 165 | 1,844 | 2,010 |
| Sheep | 223 | 1,272 | 1,494 | | | | 178 | 390 | 569 | 401 | 1,662 | 2,063 |
| Goats | 150 | 631 | 780 | | | | 128 | 248 | 376 | 278 | 879 | 1,157 |
| Camels | 87 | 40 | 126 | | | | | | | 86 | 40 | 126 |
| Donkeys | 572 | 787 | 1,359 | | | | | | | 572 | 787 | 1,359 |
| Horses | 16 | 17 | 33 | | | | | | | 16 | 17 | 33 |
| Mules | - | - | 6 | | | | | | | - | - | 6 |
| Swine | 5 | 10 | 15 | | | | | | | 5 | 10 | 15 |

Sheep number slightly over 2 million head and there are 1.2 million goats. Most of these animals are maintained in nomadic flocks, feeding on crop residue and other roughages not readily utilized for any other purpose. Camels total 126,000 and are now maintained almost exclusively for transportation of crops and other agricultural products to and from the fields and villages.

Nearly 1.4 million donkeys are kept in Egypt and they play a central role in rural village life. They serve as the primary mode of transporting both people and material for the rural family. Donkeys perform this task in a remarkably efficient way because of their ability to move along narrow paths. Replacement of the donkey with alternative forms of transportation would be a most difficult task and would result in considerable loss of valuable cropland to provide roadways for access to fields now reached by donkey.

Horses and mules make up a relatively small fraction of the total animal population. Swine are of virtually no importance in Egypt, at least in part because of the dominance of the Moslem religion.

## Sources of Increased Meat and Milk Production

The lack of recent and precise livestock census data makes it difficult to determine if the increased output of red meat and milk is due to an increased number of animals, increased productivity per animal, or a combination of both. One estimate of population growth is an increase of 27,500 cattle and 36,000 buffalo per year between 1961 and 1971. If this growth rate is used to project the 1970 population data to 1972-74, production of red meat and milk per animal remains essentially constant. This implies that the increase in production of red meat and milk that occurred during this period is simply a reflection of increase in animal population rather than improvement in productivity of each animal unit. This is due to the low genetic potential of the existing livestock population for both milk and meat production even when adequate feed is provided. The trend of increasing production of milk and meat by maintaining a larger livestock population is the major constraint to the livestock industry in Egypt. A major effort should be made to accomplish vertical expansion of livestock production rather than the horizontal expansion which is occurring at the present time. Elimination of animals as a source of power for individual farmers is a necessary first step in this process.

## Constraints to Vertical Expansion of Livestock Production

### Use of Cattle for Draft Power

Livestock production in the old lands of Egypt is characterized by fragmentation of animals into small herds of two or three mature females plus one or more young stock owned by an individual farmer with limited land resource. Cattle and buffalo are used for work, milk production, and

ultimately for meat. The most obvious first step in the direction of greater productivity in terms of food production would be to mechanize those functions which are performed by livestock power at the present time. Livestock are used primarily for land preparation, threshing, and the pumping of irrigation water, whereas donkeys and camels are used for transportation. If land preparation, pumping, and threshing were fully mechanized, the cattle and buffalo would not be required for work and would be free for the production of milk and meat. A proposal for pilot programs to test the feasibility of mechanizing these functions is discussed in the next chapter. Assuming that mechanization is feasible, one of the greatest potential benefits would be in the area of livestock productivity.

FAO has conservatively estimated that milk production would be increased by 160,000 tons annually from the same animal and feed resource if mechanization could be fully implemented. This represents a 9.5-percent increase in milk yield over present output resulting from mechanization alone with no other improvements in animal husbandry.

Lack of Modern Husbandry Techniques

A second constraint in livestock production is the virtual absence of modern husbandry techniques. Husbandry is defined here in its broadest terms to include breeding and selection, nutrition, reproduction, disease control, and general management of the livestock enterprise--all directed toward maximizing animal productivity from available resources. Although the technology for improved animal husbandry is available in the country in the form of personnel and experience at Ministry of Agriculture farms, other Government farms, and at the universities, there is a breakdown in the delivery of this information at the farm level. No coordinated extension program to assist the small farmer in the livestock sector exists. Consequently, animal husbandry practices are much the same as they have been for centuries. There are some exceptions to this, notably in the area of disease control, but for the most part, the livestock sector has been ignored.

A considerable amount of research in breeding and selection has been completed which demonstrates the superior milk-producing potential of the offspring of native cows sired by Friesian bulls imported from Europe. For example, native cows at Ministry of Agriculture farms produced 2,300 to 2,800 lbs of milk whereas first generation Friesian crossbreed cows produced 3,000 to 4,500 lbs of milk per lactation. Second generation crossbred cattle averaged 4,000 to 5,000 lbs and pure Friesian cows averaged 5,000 to 6,000 lbs. The milkproducing ability of native cattle could be doubled within three or four generations by an intensive crossbreeding program.

To realize the full benefits of crossbreeding, feeding and disease control must be improved simultaneously with genetic capacity for milk production. Crossbred cattle are more susceptible to disease and will suffer more from poor or inadequate feeding, but this is the biological cost of animals of high genetic potential for milk yield. A side effect of crossbreeding is that male crossbreed calves grow more rapidly than native calves when they have the benefit of improved nutrition and disease control. One constraint

to the application of crossbreeding of native cattle at the present time is that crossbreds are not suitable for draft purposes when compared to the native breed or buffalo.

No production testing program exists in Egypt to measure milk output in a systematic manner. Production records are essential in any breeding and selection program. Crossbreeding is of no value for buffalo because there is no outside source of germ plasm that can be used to upgrade the local population. Therefore, animals of superior genetic capacity for milk production must be identified to be used in a selection program if progress is to be made. This identification cannot be accomplished without a milk recording system to be used in the objective evaluation of genetic merit. An additional benefit of a milk recording system is that it serves as an effective teaching tool for extension workers in evaluating other husbandry practices directed at increased animal productivity.

Feed Supplies

Feed supply is a major constraint to the livestock sector. A recent (1970) evaluation of the nutritional status of livestock in Egypt by Kotb and co-workers estimated an annual shortage of 2.5 million tons of starch equivalent (SE), which is a measure of energy, and a surplus of 69,000 tons of digestible protein (DP). The nutritional status is worse than these figures indicate because of the seasonal distribution of feed supply and virtually no conservation of feed from one season to another. During the winter season when berseem clover is grown, energy is deficient by only 153,000 tons of SE with a surplus of 393,000 tons of DP. During the summer season, however, requirements for both SE and DP exceed supply by 2.3 million and 323,000 tons, respectively. Livestock production as currently practiced is nothing more than survival during the summer, with livestock utilizing body tissue stores of energy and protein laid down during the winter season. This is one of the most inefficient ways of conserving "surplus" feed during the winter season. The above figures may not fully take account of the common practice of stripping lower leaves from maize and sorghum plants as a source of livestock feed in summer, but they do illustrate the basic problem that faces the livestock industry. Other data on feed supply by season is discussed in Part IV. Conservation of clover during the winter as silage has been tried and is successful when practiced on farms of the Ministry of Agriculture, but failed where field application was attempted. Although difficult to determine, it appears that this failure was due in large part to an inadequate extension program at the village level.

Another solution which has been proposed to resolve the problem of seasonal food supply is introduction of a green fodder rotation which makes use of Napier grass (Pennisetum purpureum). This crop is reported to yield over 100 tons of fresh forage per feddan from April to November, but has the disadvantage of being a permanent crop. Clover can be sowed as a cover crop during its dormant period. The real advantage of this cropping system is the reported annual yield of nearly 12 tons of SE per feddan which is

3 to 4 times the energy yield from any cropping rotation currently in use. A second alternative is the planting of summer forage crops such as sweet sorghum or other high-yielding annual grasses which grow rapidly during the hot summer season. This alternative has the advantage that these crops fit into the rotation system much better than would a permanent forage crop. This alternative, along with some shift by 1985 to the use of clover and maize or sorghum silage, is discussed in the projections chapter.

Present Pricing Policies

The current price structure in Egypt makes livestock production one of the most profitable enterprises for the small farmer who can raise clover or any other forage crop efficiently. The value of livestock when sold in the private sector, either for meat or milk, is higher than prices paid to producers by the public sector under various contracting arrangements. For example, the price of fattened cattle in the private sector is currently near 60 piasters per kg (p/kg) live weight, whereas the Ministry of Supply purchases fattened cattle at 44 p/kg with an additional penalty of 18 kg deducted from actual live weight at the time of sale for shrinkage.

The only factor that prevents more cattle from being fattened in the private sector is the supply of concentrates, which are under the control of the Government. In order to obtain adequate amounts of concentrate for fattening cattle, a livestock producer must contract with the Government and sell at a fixed price of 44 p/kg. Terms of the contract include (1) the purchase of insurance at a cost of 75 p/head, (2) inclusion of a minimum of 2 animals per individual and 20 animals per village, (3) inspection of animals two or more times during the 6-month fattening period, and (4) a date of delivery to the Ministry of Supply specified according to their requirements, rather than the farmer's. In return, the farmer may purchase 1 ton of concentrate at the current price of LE 23 per ton. The alternative to contracting is to purchase concentrates on the black market at a variable price which currently averages LE 60 per ton and to take a chance on its availability.

Under these price relationships, the public sector is slightly more profitable than the private sector. The end result is that large specialized farms tend to market under contract whereas small village farmers market in the private sector. The small farmer who produces the majority of fattened cattle tends to utilize as much forage (clover) and as little concentrate as possible. In addition, he tends to divert allocated concentrate from his mature cow and female buffalo to the fattening calf. This has a negative effect on milk output, which has a more efficient marginal return in the form of human food than does fattening. Thus the overall contribution of livestock to the economy is reduced. Furthermore, these practices are resulting in great pressure for an increased area to be alloted to clover production at the expense of cash crops, especially cotton and wheat. This is due also to the artificially low fixed price for these crops. Removal of price constraints on the major cash crops likely would have

a major effect on reducing the profitability of the livestock enterprise relative to alternative cropping systems, particularly over the next few years. The whole area of pricing policy is discussed in Part II (p. 22).

A similar pricing situation exists in the marketing of milk. The MISR Dairy Products Company operates approximately 300 milk collection centers in the old lands, each with a capacity to cool 5 to 10 tons of milk per day. Milk delivered to these centers is paid for on the basis of fat content, averaging 7 p/kg for milk from cattle and 11 p/kg for buffalo milk. During the winter the farmer receives the privilege of purchasing 1/2 kg of concentrate per kg of milk and during the summer 1 kg of concentrate per kg of milk sold to the collecting station and receives payment once each week for the milk delivered. In contrast, the private sector picks up milk from the farmer and pays for it daily, usually on a week to week verbal agreement basis, and the farmer receives about 15 p/kg irrespective of whether it is cow or buffalo milk. Therefore, when concentrates are relatively low in price on the black market or clover is in plentiful supply, most milk is marketed through the private sector. Only when the black market price for concentrate becomes high does any significant quantity of milk from the village farmer reach the collecting station. At the present time 95 percent of the milk is marketed through the private sector with virtually no refrigeration or quality control while the government collecting stations are operating at about one-third of capacity.

Excess Animal Numbers

Another approach to the resolution of increased animal productivity from the restricted supply of feed is a national program to reduce the total number of animals so that each animal that survives would have enough feed to meet its requirement for maximum productivity during all seasons of the year. A number of factors are present which prevent this from occurring. One is the artificial price structure which makes livestock production one of the most profitable enterprises for the small farmer. A second factor is the lack of an alternative source of power for the performance of many agricultural functions, discussed previously. A third important factor is the low genetic potential of the livestock population for milk production. Elimination of the overpopulation constraint would require an integrated program of mechanization and improvement of the genetic capacity of the livestock population for production of milk and meat. In addition, the farmer must be convinced that it would be to his advantage to move in this direction. First, he must have a dependable alternative to the animal as a source of power so that land preparation, irrigation, and threshing can be accomplished easily and efficiently. Second, the farmer must be convinced that he can be separated from his animal physically and, in many cases, permanently so that some centralization of livestock can occur to take advantage of economies of scale and specialization. Third, the genetic capability of livestock must be upgraded through crossbreeding and selection. Finally, the introduction of modern techniques of animal husbandry must occur to take advantage of the increased genetic potential

for production. Failure to achieve success in any one aspect of the program would diminish the overall benefit to be derived. An effective livestock extension program sensitive to the needs of the farmer is the key to the success or failure of any such undertaking.

In the section on projections, livestock numbers are held constant at the 1972-74 average level. The projected cropping pattern for 1985 would provide substantially more feed for this number than was available in the 1972-74 period.

## Need for a Coordinated Approach

Fragments of the proposals discussed above are already present in Egypt, but no coordinated and integrated program with a specific goal in mind has been attempted to date. For example, mechanization is not new to Egypt, but where mechanization has been introduced, it has been only in land preparation in one case (and then possibly only on the larger blocks of land), or an irrigation pump has been introduced in another place, and mechanical threshing in a third. The result has been that a farmer still had to keep his animal for one or more of these operations. Similarly, crossbreeding to Friesian bulls is not new and is available to most farmers at the present time. Part of the failure to accept this potentially beneficial service is the preference of the farmers for native cattle for draft purposes. No effective program has existed to encourage the farmer to change by demonstrating the benefits to be derived. Another program has recently been started to encourage consolidation of milking herds through allocation of additional concentrates to groups of 10 or more lactating crossbred or buffalo cows, with no restriction on how the milk is marketed. What is lacking is a coordinated program where all of these segments are tied together in a packaged program with a specific goal in mind. A real constraint is that too many different Government agencies are involved in the livestock sector, with no coordination of their individual programs. A pilot program to introduce a consolidated effort in this area is discussed in the following chapter on dairy improvement.

## Animal Health and Artificial Insemination

The animal health system in Egypt is quite effective in terms of its overall program. A vaccination program is in effect for all of the serious diseases that threaten the livestock population, and judging from the lack of major outbreaks in recent years, this program is a success. The program, administered through the Veterinary Services of the Ministry of Agriculture, has regional Animal Health Centers located in each of the 24 governorates of the country. Twenty or more animal health units are located within each governorate with two to three veterinarians in each unit. At present each unit serves a total of 10 to 12 villages, with one veterinarian assuming responsibility for treatment and general practice including artificial insemination and the second responsible for vaccination programs. Where possible, a third veterinarian in the unit assumes responsibility for poultry disease control and treatment. The ultimate goal is to have an

animal health unit and a veterinarian located in each village of the country. All services are provided free of charge.

Brucellosis is still a problem in the country, occurring in about 3 percent of the cattle and buffalo herd. Eradication of this disease is being carried out only on Government farms due to lack of funds to reimburse farmers for animals slaughtered because of infection.

A similar situation exists with regard to the eradication of tuberculosis (TB) from the cattle and buffalo herd. The incidence of TB is 3 percent and total cost for reimbursing farmers for the value of animals slaughtered in a nationwide eradication program is conservatively estimated to be LE 24 million.

A major problem relating to animal health is that of parasites, both internal and external. In the sheep population this problem is fairly well under control through a program under which each sheep is treated four times a year for internal parasites. A significant proportion of the native cattle carry a chronic infestation of parasites, which could be eradicated if the supply of medicine were adequate and transportation available to the field veterinarians so they could carry out a systematic treatment program to break the life cycle of these parasites. The high rate of infertility in cattle is thought to be due in large part to this problem.

At present mastitis is not a major disease problem in Egypt due in part to the low level of milk production and small animal herds. As production levels increase, mastitis will undoubtedly become a more serious problem as it has on Ministry of Agriculture farms. Any integrated program to increase milk yield through crossbreeding or selection should include a mastitis control program.

The artificial insemination (AI) program is administered through the Sexual Health Control and Artificial Insemination Division of Veterinary Services of the Ministry of Agriculture. Therefore, the animal health unit veterinarian is responsible for AI at the village level. Farmers bring the female to the animal health unit for insemination, which gives the veterinarian an opportunity to give a complete reproductive tract examination at the time of insemination, and to observe the animal for any other health problems that might exist.

A major constraint in the livestock population is the high rate of infertility in the female population, that is, 40 percent of the adult female buffalo are infertile and 30 percent of adult female cattle are. The effectiveness of artificial insemination, crossbreeding, and selection are all seriously hindered as long as infertility remains at this high level. Infertility is not a simple problem and is not caused by any one factor. It may be due in part to generally poor nutrition, a specific nutritional deficiency (especially phosphorus), infestation with parasites, hormonal imbalance, or a number of other factors including diseases of the reproductive tract. A program to improve fertility of female livestock must be a part of any plan to improve livestock production.

The AI system is operated through 162 main centers in the provinces. Each center is supplied with 4 to 10 bulls, 50 percent Friesian cattle and 50 percent buffalo, to produce semen for collection and distribution to local animal health units. At present fresh semen is being used for AI because of lack of liquid nitrogen at regional AI centers. A pilot project under the United Nations Development Program (UNDP) is just getting underway to introduce the use of imported frozen semen on a limited basis. Use of fresh semen greatly restricts the number of potential offspring from a given bull. This is not a serious constraint generally, but does become serious when a particularly outstanding bull has been identified. The storage life under refrigeration of fresh semen is not more than 3 days, which requires that semen be collected, extended, and distributed 3 times per week. Thus, a good deal of the limited transportation resource available to the veterinarian is being tied up by the need to transport fresh semen. Frozen semen can be kept much longer, but would require availability of proper storage equipment at each center.

## Sheep and Goat Production

Sheep and goat production is the most extensive form of livestock production in Egypt. The sheep consist chiefly of three breeds of fat-tailed, coarse-wool types, namely Ossimi, Ruhmani, and Barki. Rather extensive importation of fine-wool merino sheep has taken place in recent years for crossing with the native breeds to improve wool quality and to retain the mutton-producing ability of the native breeds. Raising merino sheep for crossing with the Ossimi breed to improve both meat and wool production is one of the major projects of the Meat and Milk Organization. The recent development of a vaccine for blue tongue disease will greatly aid this program.

The major constraint to sheep production in Egypt is availability of feed. At present sheep are maintained mainly on crop residue and by grazing narrow strips of land along irrigation canals and drainage ditches. It would seem inadvisable to divert any significant amount of the limited high-quality feed resource to increase the scale of the sheep and goat industry owing to their relative lower feed efficiency when compared to cattle and buffalo.

Goats are of no distinct breed in Egypt and are generally maintained as a part of the sheep flock. Milk produced by goats as well as sheep is used to make cheese.

## A Recommendation for Improved Government Livestock Programs

At present too many different organizations within the Government have an effect on the livestock industry. In many cases, this has resulted in duplication of effort and at times in the promotion of programs that are

not consistent with a common goal. It is suggested that serious consideration be given to developing some means of consolidating agencies, or at least programs, for livestock production. One suggestion that has been offered is the formation of an advisory council for livestock programs, made up of personnel from the Ministry of Agriculture and universities throughout the country. One of the functions of this body should be to aid in the development and coordination of an effective extension program in livestock production, which would make use of the considerable technical expertise available in the universities of the country.

## A COMPREHENSIVE DAIRY IMPROVEMENT PROJECT

As the previous chapter has indicated, the livestock sector in the old lands of Egypt is characterized by limited feed resources, multiple-purpose animals of limited genetic potential for milk and meat production, fragmented or small herds, and a virtual absence of the application of modern methods of animal husbandry at the farm level. The reasons for the continuation of this form of livestock production in a country that has technical staff and knowledge to support a modern livestock industry are complex. Any project designed to bring about change in the livestock sector must take into account external factors that tend to work against the development of an efficient livestock industry.

Given the limited areas for crop and roughage production in Egypt, the primary function of livestock should be the production of human food of high protein content and quality to balance the cereal-based diet. The animal population, although not increasing at the same rate as the human population, is nevertheless increasing and the competition for land use is becoming increasingly acute. It is time for an integrated approach to improve livestock productivity from the scarce resources available.

Introduction of mechanization to relieve the burden of land preparation and irrigation from livestock is a logical first step in this direction. To provide a maximum contribution to Egyptian agriculture, mechanization must be accompanied by the introduction of a breeding program designed to increase the genetic potential of livestock for milk production. Incentive programs should be developed to encourage the consolidation of livestock into production units of a size large enough to take advantage of modern husbandry methods. Animal numbers must be reduced in order to maximize animal output from the limited feed resources available. Finally a rural education or extension program must be developed for the effective initiation and execution of any such integrated approach to rural development.

Improved management and husbandry of crops and livestock, including livestock nutrition and disease control and eradication, should be introduced, and a changed crop rotation program to provide more forage in summer and fall is highly desirable.

Alternative feasible approaches in a number of areas are available and should be tested to arrive at an optimum overall program. The general philosophy of the project should be one of making resources, both physical and educational, available to a village unit and allowing the village adequate freedom to choose how to utilize those resources. Appropriate statistics must be generated within each village to be used both as criteria to evaluate progress and as an educational tool by extension personnel. Some of these statistics also will be needed for the breeding program.

This approach, consisting of pilot programs in a number of villages, should be thought of as a demonstration. Nearby villagers, as well as Government officials, should be invited to observe firsthand the project in operation. Assuming that the project is successful, requests for extension to other villages would be expected. Expansion of the program would be carried out by the Extension Service and other Government agencies.

The following is an outline of the major steps in improving the Egyptian livestock industry:

Mechanization

1. Land preparation for seeding.

2. Pumping of irrigation water from canal to field delivery system where gravity systems are not available.

3. Threshing of grain, that is, separation of grain from straw plus removal of chaff from grain.

4. Grinding and milling of grains for consumption at the village level.

5. Mechanical seeding of those crops where precise seed-fertilizer placement will result in significant increase in productivity and/or more efficient utilization of scarce resources (seed and fertilizer).

Livestock Production

1. Production response upon removal of draft or work requirement.

2. Breeding program to upgrade genetic potential for milk production.

   a. Use of artificial insemination (AI) especially, and frozen semen for wide distribution from genetically superior bulls.

   b. Crossbreeding of native cattle to Friesian bulls.

   c. Selection program to increase milk yield of native buffalo.

d. Development of a record system to measure output of livestock and, more important, to identify animals of superior producing ability for breeding stock. Records are also an effective teaching tool in the extension program.

3. Consolidation of livestock into efficient production units.

   a. Incentive program in the form of supply of concentrates and other services.

   b. A gradual means to break tradition of self-sufficiency of each farmer so that not every farmer is a livestock producer; the ultimate goal here is a net reduction in livestock numbers.

   c. Sanitation of product produced, including facilities to cool milk rapidly and under more sanitary conditions, and to market milk more efficiently.

   d. Consolidation of forage resources with an eye towards uniform forage supply throughout the year either through conservation or alteration of the cropping pattern.

   e. Disease control and eradication programs.

4. Extension Program

   a. Teaching simple principles of livestock production--breeding, records, nutrition.

   b. Instruction on how to use services provided--disease control detection and what to do prior to the arrival of a veterinarian. Also, use of records and other management techniques at an elementary level.

   c. Aid in human adjustment required by mechanization, such as consolidation of livestock, utilization of credit, or any other social ramifications of the project.

   d. Education in human nutrition, sanitation, disease awareness, etc.

## Mechanization

### Background

Pumping water from canals to irrigation ditches and preparing land for seeding in the old lands of Egypt are done to a substantial extent by animal power, basically the same way they have been done for the past several thousand years. Another farming operation, the separation of grain from straw, is done by animals pulling a primitive thresher or by the

wheels of a large tractor. On the average, one mature cow or female buffalo is kept for each 3 to 6 feddans of land used for crops. These animals produce milk and calves, some of which are fattened for meat. But a major part of their energy is used as a source of animal power. The time has come in the development of Egyptian agriculture to mechanize, as a minimum, the following activities:

1. Pumping of water,

2. Preparation of land for seeding, and

3. Threshing of grains.

The rationale for mechanization to this extent is based on the premise that total net output from the agricultural sector will increase with relatively little, if any, overall net displacement of labor in agricultural pursuits. Cattle used for irrigation are blindfolded and move round and round on their own or in response to switches administered by small children. Labor required for land preparation would be reduced by mechanization, but this would be offset in part by the need for repair and service facilities and, more importantly, by increased multiple cropping and larger harvests. Deeper plowing obtained by mechanized means has proven effective in obtaining higher crop yields; and more satifactory seedbeds can lower the seeding rate per feddan. It is reliably estimated that as much as 25 percent overseeding regularly occurs in grains, in part attributable to inadequate seedbed preparation. Mechanization of the threshing operation holds definite promise of substantially increasing grain output per feddan by decreasing losses that occur with present practices. Placing a mechanized thresher in the field would tend to eliminate losses incurred by moving the grain and straw to a central location, but would increase the turnaround time between crops. This is an area where alternative methods need testing to develop an optimum program for each zone. Mechanized threshing would decrease cracked kernels and reduce the chances for introduction of dirt and other foreign matter into food grains.

It is desirable to concurrently mechanize water pumping, land preparation, and threshing. Otherwise, the farmer has the excuse to maintain an animal unit to do one or another of these tasks. Unless animals are permanently freed from this power function, a substantial part of the potential benefits to increased productivity is lost.

## An Approach to Mechanization

A first step in mechanization is to determine accurately the present supply and condition of machinery. Several estimates have been offered as to the number of tractors currently found on farms. Estimates range from a total of 22,000 to 27,000 tractors in various operating conditions, with approximately 12,000 to 14,000 in a satisfactory state of repair. The present tractor population was acquired for the most part from the USSR and Eastern Europe, and procurement of spare parts has been difficult and costly. Ownership of tractors is largely in the private sector, with an estimated 3,000 to

4,000 owned by cooperatives. Once a tractor and equipment survey has been completed, identifying the make, type, power, and operating conditions of tractors and equipment, a project should be undertaken to obtain or manufacture a stockpile of parts most often needed to maintain common makes and types.

Along with stockpiling of parts, manuals on operation and maintenance should be developed in Arabic relying primarily on pictorial displays, diagrams and charts, so as to be useful to persons of limited literacy. A project to repair the current tractor and equipment population to place them in operable condition also must be considered a basic component of any effort to intensify mechanization of pumping, preparation of land, and threshing. Tractors now are used extensively for land preparation of large fields. How best to handle smaller fields, whether by further consolidation or by introduction of small "walk-behind" tractors, is an area to be investigated.

A second step in the area of mechanization would be to undertake a manageable pilot program through contract with a private U.S. or European firm that has the ability and experience required. Such pilot projects should be of sufficient size and duration to yield accurate results for wide application under average farm conditions. A suggested pilot program should allow for the following:

1. Enough villages to cover 150,000 to 200,000 cropped feddans in the old agricultural lands for each pilot area.

2. An operational period of 24 to 30 continuous months, with predetermined evaluation of the program every 6 months.

3. A management and organizational infrastructure of proprietary interests or existing cooperatives within the villages. Strong and forceful management controls would be required by the direct involvement of the contractor personnel at the local level in all phases of the operation, involving allocation of equipment, direction, supervision, accounting, reporting, etc. for the entire period.

4. A practical training program encompassing all aspects of repairing, servicing, and maintainance, as well as teaching how to operate equipment. The training program would be provided for a selected group of Egyptians having mechanical aptitudes as determined by necessary testing. Development of a test for persons of limited literacy and limited experience with mechanical equipment would be one phase of the project. Upon acceptance into and completion of the training program, the student would be expected to serve at the village level for a period of 3 years in equipment maintenance, repair, and operation, but adequate wages to encourage this would be provided. Graduates of the training center would be expected to teach other students as well as to maintain and service equipment. This procedure would generate a continuous flow of trained mechanics and equipment operators into the system.

Instruction and course content should emphasize practical aspects and be based largely on audiovisual techniques. A byproduct of the training course would be the development of simplified instructional manuals in Arabic on repairing, servicing, and operating equipment.

5. Establishment of four tractor and equipment centers, strategically located throughout the land area covered by the pilot project. Each center would have adequate classroom space for instruction of approximately 50 students at a time, and be equipped with such basic instructional tools as overhead projectors, tool kits, a combustion type engine for assembling and disassembling, electrical and combustion type pumps, and a mechanical thresher. Besides classroom space, each center should have repair bays for simultaneously repairing 10 tractors and 20 small engines.

6. Acquisition of 400 20-60 horsepower tractors of not more than three different makes, with basic accompanying equipment including a varied mix of chisel and reversible ploughs, subsoilers, heavy-duty disc harrows, land levelers, and trailers. Implements should be acquired in sufficient number to allow for flexibility in use among farmers serviced out of each center.

   Each center should be allowed approximately 100 tractors and the necessary accompanying equipment. One function of the project would be to determine how many feddans can be efficiently handled by each tractor of a specified size and type, what equipment should be provided for each, etc. These questions should be determined for major crops and rotational patterns used in each major zone. The contractor would estimate this initially as a means of establishing a land/tractor ratio for the pilot program.

7. An experiment to ascertain whether it is practical and feasible to utilize a type of motor for pumping water that might readily and quickly be converted to other uses, such as running a feedgrinder, turning a thresher, or even propelling a simple vehicle.

8. A stockpile of spare parts for pumps, tractors and accompanying implements, and threshers. The size of the stockpile should be based on those items most frequently requiring attention and replacement. One trained clerk should be placed in each center with responsibility for proper cataloguing and inventorying parts.

9. A continuing appraisal and evaluation of elementary mechanization of Egyptian agriculture as reflected through the pilot project. This would include but not necessarily be limited to:

a. An accounting system which identifies cost of training per student; cost of repairs, service, and maintenance on each piece of equipment; hours of operation and down-time by each piece of equipment; etc.

b. Use of labor by type and number, laborers displaced by use of equipment, and expanded requirements for labor due to changed rotations and larger harvests.

c. An assessment of the cost and efficiency of installing and operating electric versus gasoline/diesel pumps.

d. An evaluation of the desirability of refresher courses from time to time for trained mechanics and equipment operators.

A similar detailed program should be developed to cover improved livestock husbandry as discussed above.

### Extension Program

The goals of the livestock program will require the development of an effective livestock extension program at the village level. First, a complete assessment of the program requirements will be made by qualified technical experts in rural education and extension programs. The objectives should be to determine the requirements of an effective program to insure delivery of necessary educational and advisory programs. Educational material will have to be developed that takes into consideration illiteracy and limited formal education of the target population in the project area. Recognition must be given to sociological adjustments that will be required within the villages, particularly the fact that cattle are a symbol of status and wealth, and there is a security for the farmer in knowing that land preparation and irrigation can be performed by his own animals if alternative mechanical sources break down or otherwise are not available.

## THE POULTRY INDUSTRY

Increased production of chickens and eggs offers great promise as a means of meeting the increasing demands for animal proteins to improve dietary levels. Poultry is responsive to genetic improvement within a short timespan and is an efficient converter of feed into meat and eggs.

These potentials are difficult to achieve in traditional village flocks of 10-50 chickens that scavenge their feed and receive no special care. Despite these circumstances, about 90 percent of all chickens and eggs come from these flocks. Annual production is only 50-60 eggs per hen and chick mortality is 50-60 percent. About 575 village hatcheries provide chicks and obtain eggs for hatching from village flocks. This system perpetuates low-producing strains

which, together with lack of feed and care, offer little hope for increased production unless significant changes are made in the system.

It was with this background in mind that broiler and egg production was undertaken as a public-sector enterprise in 1964. Established as a General Organization in the Ministry of Agriculture, its goal was to produce 50 million broilers and 200 million eggs by 1980. Broiler and laying houses were built, together with feedmills, hatcheries, and slaughter plants to establish a fully-integrated factory system. This organization now also provides some feed and chicks to about 500 specialized producers in the private sector, 80 cooperative broiler operations, and five governorate facilities. There is also an arrangement to provide such services to villages through agricultural and combined units.

Contractual arrangements are made to provide feed and chicks to the cooperatives and specialized producers and the resulting production can be sold in the free market. Processed broilers produced by the general organization are sold to the Ministry of Supply for 42 p/kg, and these are sold through retail Government stores at 45 p/kg, or about one-half the price of live chickens sold by private retailers. The latter are chiefly village chickens, rather than broilers. Broilers in the Government stores are available only on certain days and on those days are rationed at one or two to a customer. Even so, the supply usually is exhausted before all customers are supplied.

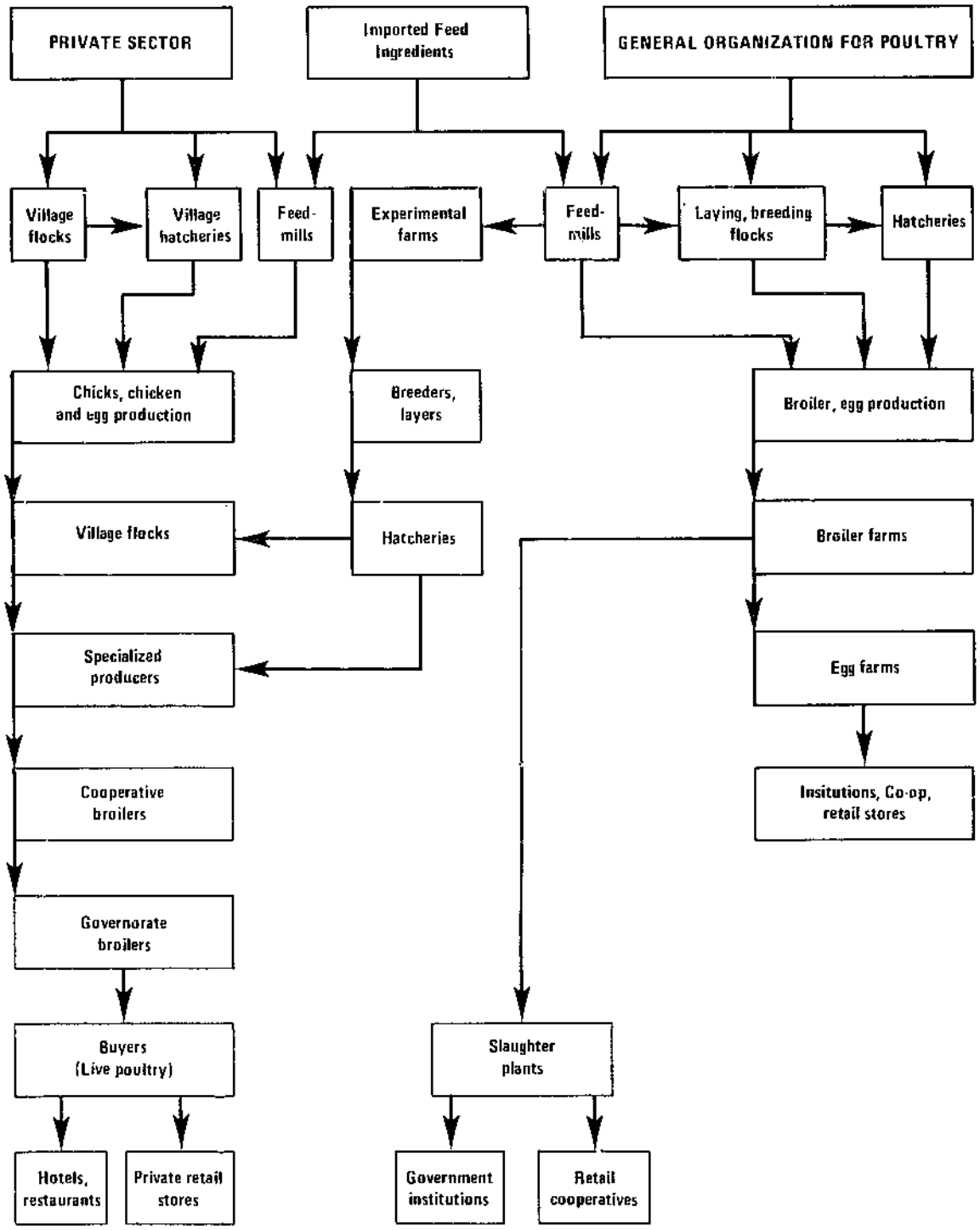
Figure 4 shows the structural organization of the private and public sectors involved in the production and marketing of poultry and eggs. Direct production operations of the General Organization have fallen substantially short of their potential. Output was 17 million broilers and 56 million eggs in 1974. Many broiler houses in the public sector are not yet in operation because key building materials are lacking to complete them. Utilization of space in completed buildings has been low because shortages of feed and chicks have delayed recycling between lots. Specialized producers and cooperatives have had similar problems because they have no independent source of supply for feed and chicks.

Present slaughter plant capacity appears to be sufficient only for birds produced in the public sector. Two additional plants are under construction which would about double existing capacity and provide an outlet for some production from cooperatives and independent producers. These producers must now sell much of their output live in a market dominated by five or six buyers who can depress prices.

## Recommendations

High priority should be given to completing the houses now owned by the General Organization, and the additional feedmills and slaughter plants now under construction. Additional foreign exchange for imported feed ingredients also will be needed to achieve a balanced production system.

# PRODUCTION AND MARKETING SYSTEM FOR POULTRY AND EGGS[1]




[1] As of November 1975

Figure 4

At an early date, a comprehensive cost study should be made to determine whether further expansion by the public sector is justified. The essential question at issue is whether it is better to import broilers or to import feed to produce broilers, given the relatively low feed conversion rates attained by Egyptian broiler producers. With respect to the public sector a further question is involved, namely whether they can produce as efficiently as the private sector. Consideration should be given to the alternative of getting the public sector completely out of direct poultry production by making use of existing facilities for the maintenance and propagation of strains of birds of superior genetic potential to be distributed to specialized producers in the private sector, as was originally planned. The present substantial price subsidy to consumers should also be reexamined.

The cooperatives and private producers need a dependable source of feed and chicks if they are to compete effectively with the public sector. Whether these support facilities should remain under the control of the public sector, or a separate organization should be established, possibly as a cooperative, needs to be examined in considerable detail.

The potential for direct marketing of broilers through fast food outlets in major cities has not as yet developed, except on a limited pilot basis. The success of such outlets depends on an assured supply of birds of uniform weight and quality. Such standards will be difficult to achieve unless freezing facilities are available to even out disruptions to production caused by intermittent shortages of feed and chicks.

Upgrading the genetic quality of chickens in village flocks offers considerable potential for increasing egg production and providing additional cash income to farmers. It would also result in some increase in poultry meat, but of a different type than from broilers.

The experimental poultry farms are in a key position to initiate a program to improve village flocks. Their research has shown that egg production from native breeds such as Fayoumy can be doubled after two generations of selection, even under village conditions. Implementation of this program would require modernizing and expanding structures, equipment, and hatching capacity on these farms. This would provide an increased supply of improved chicks and eggs for village hatcheries and a relatively rapid improvement in egg production from village flocks.

Such a program would need the support of an effective village extension program to reduce chick mortality and to encourage better management practices. Women college graduates in agriculture and veterinary medicine, now frequently underutilized, represent an available resource to implement the extension program.

Such a breed improvement program could be started on a relatively small scale and expanded as resources became available. Initially, concentration in a few villages would be preferable to more widely dispersed efforts. Such concentration would also facilitate collection, shipping, and other measures needed to deliver higher quality eggs to consumers than is now possible from traditional flocks. Small amounts of commercial-type feeds would be needed also, specially formulated to supplement locally available feed.

## FISH PRODUCTION FROM LAKE NASSER

The fishing industry in Egypt has been adversely affected by several circumstances. The 1967 War closed certain areas in the Red Sea and the Mediterranean to fishing, and the fishing fleet and associated facilities deteriorated. Completion of the High Dam reduced sardine catches near the mouth of the Nile, and larger boats were needed to located them in deeper waters.

These factors have focused attention on the potentials of fish production in Lake Nasser. Present production is about 12,000 to 15,000 tons, which might be at least doubled if more adequate catching and processing facilities could be developed. Although such an increase would not satisfy the large potential demand for fish by the domestic population, it would make some contribution toward fulfilling the need for more animal protein in the diet.

Fishing in Lake Nasser is now done by small, unpowered boats which can operate only in relatively shallow waters. Fish caught by these boats are delivered to collecting vessels stocked with ice, but their efficiency is limited by both ice and fish capacity. The fish collected by these boats are delivered to a processing plant for rail shipment, using ice rather than refrigerated cars. Some fish are salted.

Plans have been proposed to supply outboard motors to the catching boats to increase their range of operation into deeper waters. Also, larger collecting vessels are needed to serve the smaller boats. A processing and freezing plant also would be needed to compensate for the seasonal nature of fish production and to facilitate rail shipment of filleted fish via refrigerated cars.

Further study may be required to determine the potential for a sustained yield of fish from the lake and its productivity in terms of food supply for fish, as well as the potential for introducing species best adapted to the lake environment. A study also is needed to determine cost/benefit ratios from increased capital investments in fishing and processing facilities in the lake in comparison with alternatives in the Mediterranean or other production areas such as irrigation canals, coastal lakes, and the Red Sea.

In the broader context of increasing the supply of animal proteins, a comparative cost study should be made in which the cost of fish protein is compared with other protein sources such as broilers or meat animals. Although feed conversion ratios for fish production are favorable in comparison with alternative sources of protein, capital investment, transportation, and labor costs must also be considered.

### Constraints

The shoreline of Lake Nasser presently has no vegetation or settlements. Fishermen must live in their boats or camp on shore while they are away from their permanent location. Fish are caught by handlines, rather than by nets. This is necessitated both by the small size of the boats and the fact that freshwater fish do not move in schools like ocean fish.

There are also significant logistical problems in the physical movement of larger boats into the lake because there are no locks to provide entry from the Nile. Thus, the size of boats is limited to those that could be brought in by rail and moved by trailer to the lake, or those brought into the lake through Sudan. The construction of a boatbuilding facility above the dam would offer a possible alternative.

## THE ROLE OF COOPERATIVES IN EGYPTIAN AGRICULTURE

At first glance, cooperatives would seem to play a major role in Egyptian agriculture. All farmers are members of at least one cooperative, and the village cooperative society is a focal point for social and community betterment. Primary agricultural inputs--fertilizer, pesticides, seeds and insecticides--are funneled through the cooperative system. Farmers are provided credit in cash or kind. All of the cotton and substantial quantities of rice, sugarcane, onions, garlic, wheat, groundnuts, beans, and lentils are marketed through cooperatives.

But for an accurate perspective, the cooperative role must be viewed in relation to Government intervention and control over cooperative activities. Prices of farm inputs and most of the output of major crops are fixed and rigidly controlled. The Government is the sole producer, importer, and distributor of fertilizers and pesticides. Seeds for the major crops (cotton, rice, onions, and wheat) are distributed by the Government. Cooperatives provide credit, but are acting on behalf of the Agricultural Cooperative Credit Bank. Farmers must sell all of their cotton crop and varying proportions of specified other crops to the cooperatives at fixed prices. And the cooperative also must sell those products at fixed prices to the Government.

As such, the cooperative system is used more as a vehicle to facilitate implementation of Government policy than to meet the needs of individual farmers. Most cooperatives in Egypt were not organized by farmers wishing

to improve their lot. Rather, they were created by the Government to assure a certain supply of major crops, to enforce crop rotations and acreage allotments, and to provide a means of collecting payment for inputs used in that production. Cooperative membership is compulsory for all farmers since there is no other way to obtain inputs. However, farmers play little or no part in the decisionmaking process. With a considerable degree of accuracy, it has been stated that cooperatives are little more than a bookkeeping operation for the Government.

The important point to recognize here is that cooperatives in Egypt do not fit the definition of cooperatives in most other countries. They cannot make supply purchasing decisions, and except for limited participation in the free commodities (fruits, vegetables, flax, and livestock), they are not permitted to address the marketing question. Any discussion of cooperative constraints on agricultural productivity should consider these distinctions.

This report will focus on those constraints and what might be done, if anything, to lessen their impact. Three areas of constraint are considered: institutional, internal, and physical. A final section will summarize suggestions for improvement.

## Institutional Constraints on Cooperatives

Effectiveness of cooperatives in Egypt is reduced by at least three interrelated institutional factors: price policy, the decentralized network of decisionmaking, and the structure of the cooperative system itself.

### Price Policy

One element of Egypt's overall developmental strategy is transfer of resources from agriculture to industry. That transfer is evident in the goals of price management. Management of prices paid and received so consumers receive basic foods at low, stable prices and industry receives a low-cost source of raw materials is one of these goals. Another is accumulation of maximum foreign exchange earnings by maintaining the widest possible spread between farm and international prices for export commodities.

It is the latter goal, or more correctly the means of attaining it, that is the source of the problem. Farm prices for certain basic commodities--especially cotton and sugarcane--are maintained at levels far below equivalent export prices. The wide spread between those levels generates considerable foreign exchange for direct use by the Government but results in production inefficiency and distortions in resource allocation. These shocks create special problems for cooperatives in their relationship with farmers on the one hand and attempts to carry out Government policy on the other.

For example, effects of rigid price and supply controls and resulting misallocation of resources has given rise to a large and growing black market for agricultural inputs. This market is supplied from two sources. First, those farmers who recognize that the fixed price is too low to be profitable may purchase their input quotas but not use the entire amount (or perhaps none). Resulting lower yields are of little concern to the farmer since price for his output is too low anyway. Their attitude is, "It's the Government's crop, not mine." Excess fertilizer is sold at higher prices to other farmers in need of fertilizer for the same or other crops.

The second source of black-market supplies comes from various points throughout the distribution channels. Inputs (especially fertilizer) are occasionally siphoned from the system before reaching the stores, village cooperative societies and the Agricultural Cooperative Credit Bank. Such diversions also occur at local storage and distribution sites. Quantities and chemical make-up of fertilizer distributed for agricultural use is predetermined on the basis of soil productivity and type of crop, and each farmer supposedly receives a fixed amount especially suitable for his individual cropping needs. But in some cases, the farmer receives less than his quota simply because he is denied availability of the entire amount at the village store. His only recourse then, if he wants the correct amount of fertilizer, is to purchase additional quantities in the black market at high prices.

It is important to note that the first black market supply source--farmer purchase and resale--is more prevalent than the second. But both are serious, and both indirectly involve the cooperative system as the sole supplier of agricultural inputs.

The existence of a black market for farm inputs in an otherwise rigid, price-controlled sector serves as a constraint on agricultural productivity. If farmers are denied the correct quantities of inputs, and refuse to purchase them on the black market, productivity is reduced through lower yields. And if production levels are maintained through purchasing additional inputs, net income is reduced because of higher costs. The only winners in this situation are those who siphon supplies from the public sector for sale in the black market.

Certain side effects of a black market might also limit productivity. For example, a farmer who receives fertilizer suitable for cotton might sell that fertilizer to another farmer for use on vegetables. The proportion of elements in the fertilizer may not be appropriate, or may even be detrimental, to this use.

There is also some evidence that some farmers are bypassing cooperative (Government) channels in marketing certain basic crops. Although they are subject to penalty, some farmers feel it is worth the risk since prices outside the controlled sector are substantially higher. 25/ By itself, this free market

25/ Cotton is an exception. It has little market value until it is ginned, and the gins are owned and controlled by the Government. There simply is no private sector in cotton marketing and processing.

for basic commodities is not a constraint on cooperatives, nor is it caused by them. However, it does reflect on cooperatives since they are supposed to be the vehicle to carry out Government marketing policy. And such diversions do tend to reduce Government foreign exchange earnings from certain crops since free-market supplies move only to the domestic market.

Another problem that relates to price policy and rigid controls is lack of confidence in cooperatives by farmers. The Egyptian farmer is astute. He knows his cooperative is functioning to a large extent as a control element. And he doesn't like it. As a result, many farmers have little or no incentive to go along with the system to which their cooperative belongs. Avoidance of that system, regardless of the consequences, seems more attractive.

Under these conditions, farmers cannot be expected to support--legally, financially, or morally--the cooperative societies. And without support from their members, cooperatives cannot be expected to totally fulfill whatever goals they may have.

Decentralized Decisionmaking

Two areas are considered: decisions made outside agriculture which affect cooperatives, and multiorganizational input into cooperative activities.

Egyptian cooperatives are price-takers in the purest sense. Prices paid for inputs and prices received for production are determined outside the system. A further problem exists since those prices are determined outside the Ministry of Agriculture. Agriculture does not have the final word on setting prices for major inputs and output, although it does influence the decision process through a committee of involved ministries. Final decisions rest with the Ministry of Industry for fertilizers and cotton, the Ministry of Economy for wheat, and the Ministry of Supply for feed concentrates. The Agricultural Cooperative Credit Bank, on behalf of the Ministry of Supply, collects quotas of basic crops from cooperative members.

Various agencies are interested in these prices for different reasons. The Ministry of Agriculture wants an equitable price for the farmer. The Ministry of Trade wants low farm prices to maintain the spread between those costs and international prices. The Ministry of Industry, which operates the spinning and weaving mills, wants low raw material costs and high prices for exports. To keep consumer prices low, the Ministry of Supply wants low prices on basic foodstuffs. And the Ministry of Finance controls the purse strings for all of them.

Conflicts exist among agencies more directly concerned with cooperatives and some organizations within the cooperative system itself. The Egyptian General Agricultural Cooperative Organization (EGACO) strictly supervises the cooperatives to assure compliance with the laws. It operates under the Ministry of Agriculture, which recognizes that farmers need higher prices for certain crops. The Cooperative Union would like to see the

cooperatives free of Government controls. And the Agricultural Cooperative Credit Bank wants to get its money back. Everyone seems to be interested in cooperative affairs, except perhaps the farmer who is a member of that cooperative.

Cooperative Structure

The fuctional and organizational structure of the cooperative system is not easily untangled. Between the Ministry of Agriculture and some 5,000 local cooperatives lies a multitude of diverse cooperative societies, lines of authority, supervising agencies, and cooperative unions. Some have no discernible functions, others duplicate each other, and still others unnecessarily compete for authority, self-respect, and political power.

Figure 5 partially illustrates the fragmentation in the present cooperative structure. General Societies at the republic level (in Cairo) for land reclamation, agrarian reform, special crops, and old lands supervise separate cooperatives at lower levels. The General Agricultural Cooperative Society (for old lands) administers cooperatives at the governorate, district, and village levels. The General Society for Land Reclamation has village cooperatives but none at the district or governorate levels. Agrarian reform cooperatives are at all levels, except the governorate. Special crop cooperatives are only at the republic and governorate levels. 26/

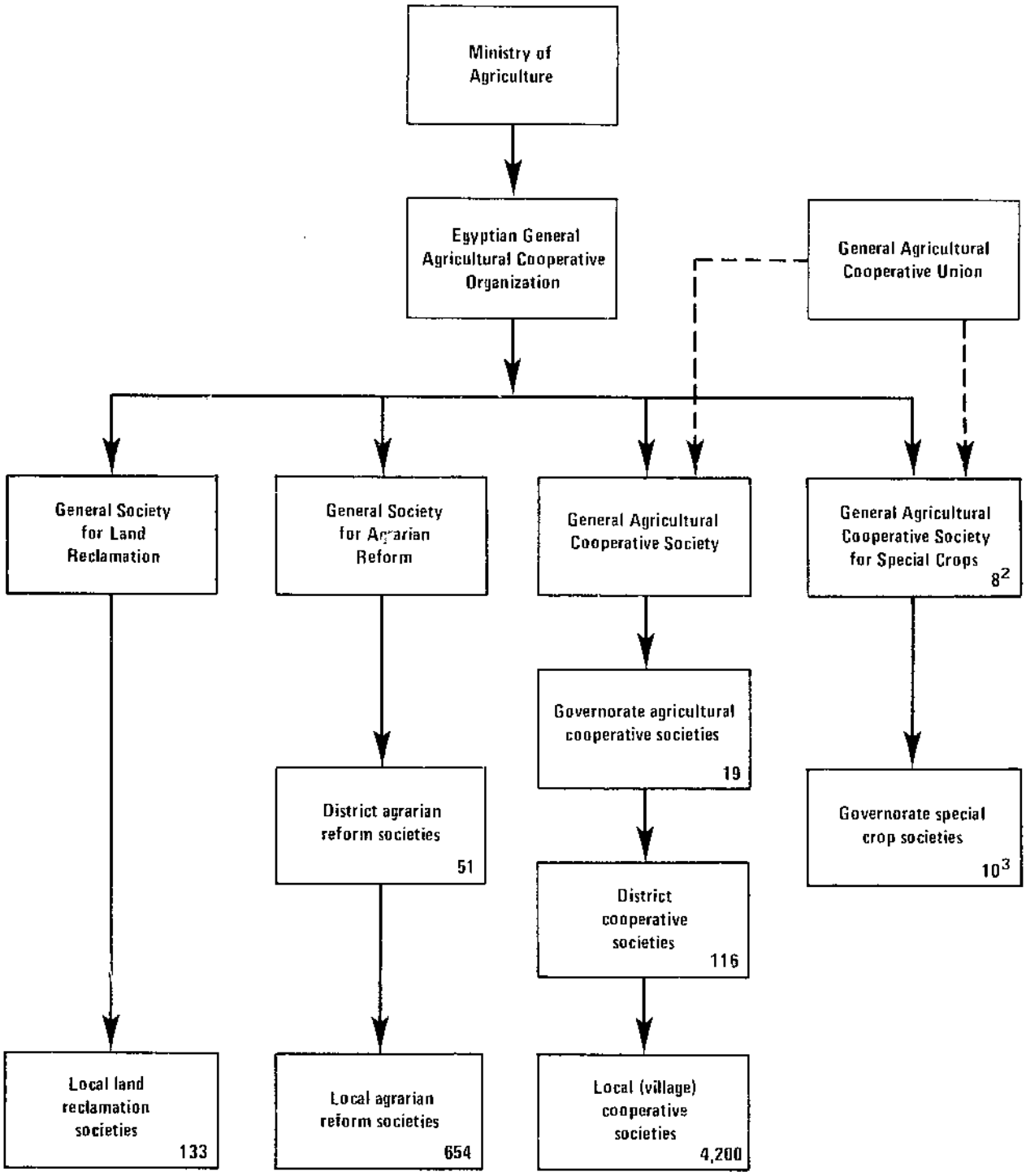
The General Agricultural Cooperative Union performs auditing, training, and promotion functions for cooperatives. 27/ The EGACO also does accounting and auditing, supervises cooperative activities, and makes sure cooperatives carry out Government policies. In essence, the Union is supposed to represent the people, while the EGACO represents the Government.

Cooperatives at the district level have the function of providing common services for the local cooperatives in that district. Similarly, governorate cooperatives are supposed to render services which cannot be rendered either by the combined or local cooperative. The General Agricultural Cooperative Society is responsible for distributing supplies down through the system.

26/ There is little special about special crop cooperatives. Originally they were formed to market (handle for the Government) requisitioned crops, but they have been expanded to other crops. Ten fruit and vegetable cooperatives operate in the governorates, while eight special crop societies are at the republic level. They involve cotton, rice, fruits and vegetables, groundnuts, sugarcane, flax, potatoes, and onions.

27/ Livestock and poultry cooperatives are not affiliated with the Union or even with the cooperative structure. They were under the auspices of the General Organization for Meat and Milk and the General Organization for Poultry, as of November 1975.

# AGRICULTURAL COOPERATIVE STRUCTURE[1]




[1]Number of societies is indicated, if more than one. As of November 1975.

[2]Cotton, rice, fruits and vegetables, groundnuts, sugarcane, flax, potatoes, onions, and garlic.

[3]Cover fruits and vegetables.

Figure 5

Other than providing jobs for Government employees, there seems to be little need for such a massive, complicated cooperative structure. Some levels could be consolidated and others completely eliminated with no detrimental effect on cooperative performance.

Further evidence of structural deficiencies emerges from the large number of cooperative societies in the villages. Some villages have two or more local cooperative societies, which are often under different General Society authorities. Although the locals may perform exactly the same functions, the fragmented structure above them causes an uneven flow of information, instructions, and physical supplies down through the system.

In addition, most local cooperatives are too small to be efficient economic units. Each society must accommodate several Government employees, regardless of its size. Each is carefully supervised and audited by Government officials. Each has office space and storage requirements. Diseconomies (especially in management) permeate the entire cooperative structure.

## Internal Constraints

Several problems within the cooperative societies themselves limit their effectiveness in serving farmers, the rural community, and the Government. Many problems reflect the interrelationships among the director (manager), supervisor, board of directors, chief clerk, and the membership. Others are caused by lack of capital. Still others surface as a result of illiteracy, election disputes, and corruption.

It is difficult for farmers to relate to their cooperative and the cooperatives have difficulty relating to farmers. The director is an employee of the Ministry of Agriculture. His role, and that of the supervisor(s) who assist him, is one of enforcing crop rotations, planting dates, and the amount of crops to be sold to the Government, and controlling the distribution of inputs. The manager can fine cooperative members for noncompliance, although such fines are rare. He carries out the plans and policies of his employer (the Ministry of Agriculture), while the cooperative pays him 20 percent of his total salary for his work in the cooperative. The board of directors elects him from among several candidates chosen by the Ministry of Agriculture. Given these conditions, producer-members have little reason to trust the cooperative director for guidance, advice, or leadership.

Relationships are further hampered through widespread illiteracy in rural areas. The board of directors manages the affairs of the cooperative and "supervises" the director. The board members are elected by the general assembly (the membership). One requirement is that at least 80 percent of the board members farm 10 feddans or less. This results in the cooperative director, a college graduate, being supervised by a board that is pre-

dominantly illiterate. 28/ Regardless of how dedicated the board might be, illiteracy could obviously constrain their effectiveness.

Some observers might even doubt the dedication of all board of director members. Local elections are often a reflection of family disputes, with three or four of the more influential families resorting to any means possible to get the person of their choice represented. And their reasons are not always to improve the cooperative.

Individual village societies and the cooperative system as a whole suffer from lack of capital resources. Total profits for all cooperatives in Egypt was only about LE 8 million in 1974; of that, LE 2 million went to the General Agricultural Cooperative Union. Expenses related to salaries for local government officers have risen sharply, due to both higher salaries and more officials. Salaries are a major part of total cooperative expenses since several Government officials work at each society, no matter how small it is. Most cooperative societies serve a relatively small area. The poor financial position of cooperatives is reflected in shortages of equipment (especially tractors) and shortage or inadequacy of buildings and storage facilities. Their source of capital is through subsidies to cooperatives on equipment purchases (5 percent) and society retention of 1.5 percent of receipts due farmers. However, low farm prices for basic commodities and unavailability of equipment cause the capital source to be insufficient.

Although rare, personal greed on the part of local officials or board members may hamper cooperative effectiveness. The chief clerk (an employee of the Agricultural Cooperative Credit Bank) at the cooperative is responsible for distributing supplies and credit and for collecting debts. 29/ Reports of "reallocating" fertilizer supplies and charging excessive interest sometimes occur. The high illiteracy levels make many farmers easy victims for this type of activity. Farmer confidence in the cooperative is further eroded. And to make matters worse, some cooperatives must also pay the chief clerk 20 percent of his salary for services rendered to the cooperative.

This type of activity is not limited to Government officials. Some board of director members, who are responsible for allocation of cooperative tractor services, have also been accused of misdealings--overcharging for services, favoring family or friends, or private use of tractors. Cooperative machinery services are already plagued by shortages of tractors and spare parts, delayed or cancelled service, and legitimate stiff competition from private tractor owners. Practices of this type can only further tarnish the image of the cooperative as a provider of machinery services.

28/ Board members are supposed to be able to read and write. However, many barely meet this test.

29/ He is assisted in physical distribution by the storekeeper, an employee of the cooperative.

## Physical Constraints

A third set of constraints to increased productivity relates to inadequate physical facilities. These facilities fall into these categories: office and administrative, storage, marketing, and machinery.

Due partly to the controlled nature of the cooperative sector, each operating society must accommodate several Government officials to carry out supervisory, regulatory, bookkeeping and distribution functions. Space must also be made available for regular and part-time employees, to say nothing of sufficient room for general assembly (membership) meetings. Working space is severely restricted or nonexistent in many cooperatives, as is availablity of office and accounting equipment and supplies.

Perhaps more critical is the shortage of adequate cooperative storage facilities for farm inputs. Only about 900 of the 4,200 village cooperatives own their own stores and storage facilities. The others rent--often at prohibitive prices--and many facilities are unsuitable for protecting the supplies.

Coordination of input movements from the Agricultural Cooperative Credit Bank to and through the cooperative stores is hampered by inadequate storage facilities. Shipments from central stores are frequently delayed due to lack of space in the villages and the resulting fear of damage and theft. During certain periods of the crop rotation, the same facilities are needed for more than one input (fertilizer, seed, and pesticides, for example). Again, inadequate handling and shortage of storage facilities prevents the coordination of deliveries to meet farmer needs.

Shortages of machinery and spare parts, especially tractors, limit the effectiveness of cooperatives in providing mechanized services to members. Cooperatives own only 3,000 to 4,000 tractors, or an average of less than one per society. Government authorities estimate that more than half of those are either not running or are operating inefficiently. Lack of spare parts, competent mechanics, and effective training programs are factors that limit increased tractor efficiency.

These are purely physical problems associated with cooperative machinery services. Their solution in no way would solve the administrative and social problems of tractor management mentioned in the previous section. Nor would adequate numbers of tractors, spare parts, and training programs provide an answer to who should provide mechanization services--private owners or cooperatives.

It may not seem that lack of marketing facilities is a constraint on cooperatives, since cooperatives do not perform the true marketing function. However, marketing does take place in Egypt and the marketing

system does suffer from many physical deficiencies. For that reason, it may be helpful to point out some of the problem areas. Also, if cooperatives participate more fully in the marketing process in the future, they will need to confront and ameliorate these problems.

The main facility needs are in the areas of handling, processing and transportation. A sizeable proportion of agricultural production is never consumed. 30/ While some marketing losses can be attributed to harvesting methods and timing, many are due to lack of cooling and drying facilities and slow transportation. With the exception of onions and potatoes, virtually all vegetables moving into the major cities are hauled by open carts pulled by donkeys or horses. Handling methods, assembly techniques, and the speed of delivery all contribute to significant losses.

Facility deficiencies are also evident for export commodities. Lack of grades and standards limit quality control possibilities. For example, lint cotton bales lose moisture and weight, and oranges frequently cannot be sold in discriminating markets due to lack of degreening processes.

While few of these marketing facility shortages directly affect cooperatives, excessive costs in an inefficient marketing system are indirectly borne by the farmers, all of whom are members of a cooperative.

## Suggestions for Removing or Lessening Constraints

Some of the problems faced by cooperatives could be reduced considerably; others are more difficult to solve. This section summarizes what might be done. It is assumed that present Government policies and goals will continue, but perhaps with some farm price adjustments for basic crops to bring them closer to international price equivalents.

An appropriate starting point is to look at the structure of the cooperative system. That structure was built up over the years as needs arose, and for the most part, the needs justified additions to the structure. For example, after the land reform it became essential to provide previously landless peasants with adequate credit, production supplies, and marketing facilities. The existing cooperatives were relatively weak and were unable to take on the additional burden. The General Society for Agrarian Reform and district and local agrarian reform cooperatives were established to serve the needs of new landowners. The General Societies for Land Reclamation and Special Crops were similarly created to serve special purposes. All seemed justified then.

But as time passed, the responsibilities and functions of the cooperatives under various lines of authority grew closer together, and today many perform similar functions. Although the structure is still there, responsibility has become fragmented, diseconomies have developed, and many efforts are duplicated.

30/ For example, tomato loss from farm to retail store is estimated at 50 percent. Leafy vegetables may suffer even larger spoilage.

It would seem beneficial to consolidate the cooperative structure in an effort to reduce these problems. A logical sequence would be:

1. Combine the four Societies--General Agricultural Cooperative Society, General Agricultural Society for Special Crops, General Society for Land Reclamation, and General Society for Agrarian Reform--at the republic level into one overall Society.

2. Retain one multipurpose cooperative society in each governorate.

3. Combine the economic activities of a sufficient number of village societies to form an economic unit. 31/

4. Move the functions of district societies up to the governorate level or to the village economic units.

The potential advantages of such a change are numerous. Overhead and administrative cost of supervision and enforcement would be greatly reduced on all levels. Flow of information, credit, and production inputs through the system would be improved. Election disputes would be minimized and the quality of directors elected could be improved. Training programs for directors, supervisors, and cooperative employees could be centralized. Economies of size would be realized through the formation of local units. Since only the economic activities of the local cooperatives would be combined, the village societies would retain and perhaps expand the already beneficial social services to members and the community.

This type of structure also would put cooperatives in a better position to perform true marketing functions, if that opportunity presents itself. With lines of authority simplified and clearly established, and with units of an economical size, cooperatives could gradually move into marketing their members' products. That leads to another suggestion for improvement: cooperatives should be allowed to act as autonomous units for distributing inputs and credits and marketing farm products. This simply means that cooperatives would act on behalf of their members in receiving credit and supplies, distributing them, collecting from farmers as a unit, and then repaying loans as a unit. The same concept holds for joint marketing of members' products. Today each farmer generally deals separately with the chief clerk from the Agricultural Cooperative Credit Bank for credit and supplies. The bank must also be a party to contracts signed between public trading companies and cooperatives at the governorate level.

31/ From an economic standpoint, this is the most promising area for consolidation. The average village cooperative society now serves about 1,500 feddans--much too small an area to realize economies of size or management. An economic unit formed through consolidation of several local cooperatives and consisting of 8,000 to 10,000 feddans would be more meaningful. Obviously, the economic units in the Delta would encompass a larger area than those in the Nile River Valley.

Experiments are already underway in certain governorates to test similar types of arrangements. In Kafr El Sheikh, for example, the cooperative is allowed to contract directly with rice companies without the Agricultural Credit Bank acting as intermediary. Other experiments are in the planning stage. Further moves in this direction would lead to increased marketing efficiency and serve as a training model for the future extension of true cooperative marketing. Equally important is imparting a feeling among farmer members that they can do something for themselves. To a large extent, success of future cooperative marketing efforts hinges on support from members.

Success also depends on finding or developing the required marketing expertise. The role of cooperatives in marketing decisions is largely confined to signing contracts with trade companies and the Agricultural Credit Bank. Little or no opportunity exists for developing markets, coordinating functions, negotiating prices, or other marketing skills. If cooperatives were to become more involved in marketing, those talents would need to be acquired. Hiring successful private sector merchants as managers or teachers would be one possiblity. Public trading companies might be another source. In any case, training programs for existing and future cooperative management would need to be strengthened. Central training schools might need to be established.

Many of the internal constraints mentioned above would be alleviated by adopting the suggestions presented thus far. Enlarging the area served by each society (through consolidation) would spread out overhead costs and enlarge the capital base. In dealings for credit and supplies, the farmer would work with the cooperative as an autonomous unit, rather than the chief clerk at the bank. Since the cooperative structure would be streamlined and more responsive to needs, training centers for cooperative management or machinery services could be more effective. Family disputes and other election difficulties would be reduced since directors would represent larger areas.

A critical requirement for more effective cooperative marketing is to provide additional physical facilities and upgrade present ones. Need for office and administrative space would be partially alleviated through combining local societies. Decisions to build additional storage facilities for farm inputs and assembly centers for output also should be coordinated with the emerging consolidation patterns. Machinery service centers could be located in each of the economic units with large-scale training and distribution centers at the governorate level. While additional physical facilities are obviously needed, the size, location, and management of those facilities will play a major role in their effectiveness.

Further cooperative entry into the marketing process should be seriously considered, especially if the institutional and physical constraints mentioned here are removed or made less severe. Cooperatives could assume a larger role in coordinating production with the marketing and processing sectors and perhaps take part in direct marketing themselves. A likely

place to begin is in the relatively free commodity areas--fruits and vegetables and livestock products. For example, the fruit and vegetable region surrounding Cairo and Alexandria would seem to offer cooperatives the opportunity to assume a significant coordinating role. Already one cooperative in the Alexandria area is moving in that direction. Cooperative ownership and operation of packing, grading, or even processing plants should not be completely ruled out.

Another possibility for cooperative participation is in the private sector for broilers. Most of the broilers consumed in Egypt are produced by the private sector but no slaughtering facilities or distribution systems have been developed. The retail price-supply relationship between broilers and live birds suggests a closer look at this potential.

Finally, cooperative potential in livestock and livestock products should be carefully examined. Cooperative pooling and management of consolidated livestock herds might be a partial solution to problems of excess animal population and low animal productivity.

## THE AGRO-INDUSTRIAL STRUCTURE OF EGYPT

The infrastructure needed to produce and distribute farm inputs, collect farm output, process agricultural raw materials, and coordinate food exports and imports is an essential component of the food system in every country. It often receives less attention in developing countries than does production at the farm level. Yet both components of a food system must develop with some degree of balance if maximum food output at the user level is to be realized.

The extent of Government involvement in providing facilities and services for the farm sector depends on a number of circumstances. Where an industrial base is lacking, as is usually the case in developing countries, direct Government involvement is needed to produce essential inputs or to allocate public capital for imports. When both domestic raw materials and foreign exchange are limited, the Government must perform the function of allocating short supplies among several economic sectors, including agriculture.

Most of these characteristics are evident in the agro-industrial structure of Egypt. Although the system is not as yet fully developed, substantial progress has been made in increasing production of fertilizer, chemicals, and seeds, and in establishing a distribution system. Problems still exist with respect to pricing policies, the physical movement of supplies to farmers and farm products to consumers and obtaining an adequate feed supply for dairy, poultry, and meat production.

The public sector has made relatively little progress in facilitating mechanization, strengthening livestock production and marketing, or improving the marketing system for fruits and vegetables. These activities remain chiefly in the private sector, which lacks capital to reduce waste and the profit incentive to deliver a higher-quality product to consumers.

## Production Inputs

The manufacture and distribution of annual inputs--chiefly fertilizer, feed, and pesticides--are almost entirely in the public sector, but are subject to controls by several different Government agencies. Allocation of foreign exchange for imports is determined by the Ministry of Finance whereas actual manufacture of feed and fertilizer is under the control of the Ministry of Industry. Fertilizer is allocated by the Ministry of Agriculture to the governorates at uniform rates per feddan for each major crop, and distributed to farmers through local cooperatives. There is little variation in these prescribed rates at the governorate and district levels, and virtually none among individual farmers at the local level. Consequently, farmers are not able to optimize rates of application to meet their individual soil conditions or production practices. Some redistribution is done through the black market, whereby farmers who do not use their allocations resell them to others. This also takes place for feed concentrates and cottonseed cake.

Feed allocations for dairy, animal fattening, and poultry production are used to encourage production of specific commodities. Rations for cattle raising and fattening are heavily subsidized, whereas prices for poultry rations appear to be closer to actual costs of ingredients. Where rations are provided at less than cost, there is a requirement that the farmer sell a portion or all of his output to the Government at the controlled price, which is substantially less than the free-market price. A recent change in this policy permits the sale of a specified portion of his output on the free market.

The necessity to import most feed ingredients, especially fish and soybean meals, antibiotics, and premixes for poultry rations, as well as the limited capacity of the domestic feed industry, are serious constraints for the livestock sector. Disruptions in the flow of ingredients as a result of foreign exchange restrictions, congestion in the ports, or unsettled world market conditions have interrupted broiler production and contributed to a low rate of utilization of existing broiler production facilities.

The fact that only two basic rations are produced--one for poultry and one for cattle--also is a production constraint, especially for milk production where some seasonal adjustment in energy requirements should be recognized. The use of a fixed ration throughout the year may contribute in part to the relatively low level of milk production, even in purebred herds under

good management. The standard ration for poultry limits the possibility of adjustments to compensate for nutritional deficiences in individual flocks.

The ample supply of cottonseed cake, about 580,000 tons in 1972, is utilized in liberal amounts in formulating the feed concentrate ration for livestock. The protein level is excessive for normal requirements and a portion is used by the animal as a substitute for carbohydrates. Some research has indicated that an excess level of protein adversely affects animal fertility. A better-balanced ration could be achieved by exporting surplus oilseed cake and replacing it with imported feed grains. A Ministry of Agriculture employee stated that they were reluctant to recommend oilseed cake exports because they had no assurance that funds would be allocated to import feed grains.

## Farm Machinery

The existing inventory of farm machinery and equipment (table 14) includes a high degree of obsolescence and disrepair. Some equipment such as water wheels, threshers, and implements for land tillage and leveling are of local manufacture or improvised by farmers from available materials. Animal-drawn plows are essentially of the same design as those used for the past 1,000 years or more. Most tractor plows are of the chisel type. Our agronomists have a strong preference for the moldboard type, in part because of better weed control.

A limited number of diesel tractors are assembled from imported parts and a line of chisel plows, subsoilers, ditchers, harrows, and threshers is produced by a quasi-public company. A small (7-8 hp) stationary diesel engine is manufactured domestically, but most engines of this type have been imported. Plans are underway to import the parts for local assembly of such engines.

Plans have been developed which call for the addition of 2,000 to 3,000 tractors a year to replace existing tractors and to increase inventory. Specifications have been developed and bids have been invited from several foreign manufacturers. Table 15 shows the present inventory of tractors by horsepower classes, and table 16 gives the number of feddans by zones per land-tilling tractor. The most common type is the 36-50 hp class. Feddans per land-tilling tractor by zones range from 191 to 1,038 with an average of 370 in terms of cultivated land area and from 364 to 1,977 with an average of 702 in terms of crops grown. It must be realized that a sizable part of the present inventory is not in operation due to a lack of spare parts. These data emphasize the need (discussed elsewhere in this report) for a strong program to repair existing tractors and other machinery to supplement any programs that might involve purchase of new tractors.

Table 14 --Farm machinery: Estimated numbers, selected items, 1974

| Kind of equipment | Number |
|---|---|
| Tractors: | |
| State farms | 4,000 |
| Cooperatives | 3,500 |
| Private owners | 18,900 |
| Tillage equipment: | |
| Chisel plows | 25,000 |
| Ditchers | 2,000 |
| Irrigation pumps: | |
| Mobil pumps and motors | 54,000 |
| Stationary pumps and motors | 2,000 |
| Tractor-powered pumps | 6,000 |
| Spraying equipment: | |
| Hand pressure tanks | 162,000 |
| Tanks with pumps | 12,700 |
| Knapsack dusters | NA |
| Threshing equipment: | |
| Threshers | 8,000 |
| Separators | 6,700 |
| Thresher-separators | 500 |

NA = not available.

Essentially no harvesting equipment is in use except on state and experimental farms. Grain is cut with sickles, tied in bundles by hand, and transported by animals to threshing floors or stationary threshers, most of which simply remove the grain from the straw. Grain is separated from chaff either by winnowing or by small hand-powered fanning mills. Some of these separators are tractor powered.

Spraying of pesticides is performed chiefly by small pump-type tank sprayers and knapsack dusters. Larger areas make use of tank sprayers with small diesel engines. A considerable amount of hand-picking of the cotton leaf worm takes place. Aerial spraying is being used under a contract arrangement with a foreign firm, but is limited to cotton in those areas where land consolidation provides large enough target areas for adequate control.

Table 15 --Agricultural tractors in horsepower, by zones, 1975 1/

| Item | Horsepower | | | | Used chiefly for land preparation 2/ | Total |
|---|---|---|---|---|---|---|
| | 35 or less | 36-50 | 51-70 | 71-100 | | |
| | Number | | | | | |
| Private and cooperatives | | | | | | |
| Old lands: | | | | | | |
| Zones I + IV | 1,043 | 3,374 | 922 | 23 | 4,296 | 5,362 |
| Zones II + V | 1,787 | 4,020 | 2,247 | 42 | 6,267 | 8,096 |
| Zone III | 226 | 838 | 250 | 4 | 1,080 | 1,318 |
| Zone VI | 935 | 1,508 | 708 | 19 | 2,216 | 3,170 |
| Zone VII | 175 | 190 | 174 | -- | 364 | 539 |
| Zone VIII | 256 | 532 | 457 | 58 | 989 | 1,303 |
| Zone IX | 12 | 45 | 87 | -- | 132 | 144 |
| Total | 4,434 | 10,507 | 4,845 | 146 | 15,352 | 19,932 |
| New lands | 37 | 55 | 21 | 17 | 76 | 130 |
| Public use | | | | | | |
| Used for agriculture | 83 | 490 | 1,830 | 120 | 2,320 | 2,523 |
| Used for land reclamation | 877 | 807 | 2,257 | 49 | - | 3,990 |
| Grand total | 5,431 | 11,859 | 8,953 | 332 | 17,748 | 26,575 |

1/Approximate allocation by zones based on data by governorates furnished by the Ministry of Agriculture.
2/Tractors of 36-70 horsepower, excluding public tractors used mainly for land reclamation.

Planting equipment is not available for any significant area. Rice is transplanted from nursery beds by hand, whereas wheat and clover are broadcast, resulting in higher rates of seeding than with mechanical equipment. The loss of seed from overseeding and from birds is said to be substantial.

## Constraints on Wider Use of Farm Machinery

The small number and variety of mechanical equipment produced in the country, and the resulting need for foreign exchange for imports, represent major obstacles to increased mechanization. Dependence on imports also creates problems in obtaining and stocking spare parts and complicates training of

Table 16 --Feddans per tractor by zones, 1972-74

| Zone | Land-tilling tractors | Land in crops: Total area | Land in crops: Total crops | Area per tractor: Total area | Area per tractor: Total crops |
|---|---|---|---|---|---|
| | Number | ----1,000 feddans---- | | ------Feddans----- | |
| I + IV | 4,296 | 1,844 | 3,616 | 429 | 842 |
| II + V | 6,267 | 1,178 | 2,317 | 188 | 371 |
| III | 1,088 | 436 | 870 | 401 | 800 |
| VI | 2,216 | 1,072 | 1,886 | 484 | 851 |
| VII | 364 | 285 | 562 | 783 | 1,544 |
| VIII | 989 | 715 | 1,203 | 723 | 1,216 |
| IX 1/ | 132 | 137 | 268 | 1,038 | 2,030 |
| Total or average | 15,352 | 5,667 | 10,722 | 369 | 698 |

1/Old lands only.

mechanics and maintenance personnel. Repair manuals are not available in Arabic, for example, and the intermixing of different makes of tractors at equipment stations and state farms adds further to the problem of maintenance. Wage rates prescribed for Government employees for repair and maintenance work are low in comparison with alternative employment opportunities in the cities, or in other Arab countries.

More attention has been given to making tractor services available for land preparation than any other phase of mechanization. About 2,000 cooperatives have one or two tractors plus a thresher to perform these services for their members but the program has not been entirely effective because of management problems. Using tractors owned by individual farmers (estimated at about 19,000), many of whom perform custom services for others, or by specialized firms that provide equipment and operators, is a more successful system, and could become the primary means of implementing mechanization on a broader scale than at present. However, land fragmentation, numerous canals and drainage ditches, and narrow access roads to individual plots seriously restrict the use of medium-size tractors (50-65 hp) on much of the old lands. Even where land holdings have been consolidated for cropping purposes, not all farmers owning tracts within

the block are likely to be be ready for land preparation at the same time. Thus, a high degree of coordination of planting, cultivation, and harvesting on the numerous plots within a block will be necessary if the turnaround time from one crop to the next is to be significantly reduced by the use of tractors.

## Domestic Market for Fresh Fruits and Vegetables

The marketing system for fresh fruits and vegetables is reasonably well coordinated with production. Both are on a small scale and a minimum of intermediate facilities such as grading, packing, and cooling is needed. However, substantial losses occur because of the lack of these intermediate facilities, and the quality of products available to consumers is relatively low. Elasticity of demand for quality is also low, and thus there is little economic incentive for participants in the marketing system to work toward improved grading and packing.

Wholesale fruit and vegetable markets in Cairo and Alexandria serve to assemble supplies from small production units and also perform a pricing function. Produce is also shipped out of the Cairo market to other areas. Maximum wholesale and resale prices are set weekly by a committee of merchants and the office of the director of the market. Most dealers operate on a commission basis but some buy and sell for their own accounts.

The Cairo wholesale market is badly congested, and plans exist for relocation. Transportation facilities into and out of the market area range from bicycles and donkey carts to large trucks and trailers. Produce is transported from nearby production areas in small loads, thus adding to congestion in city streets. Assembly in or near production areas and greater use of trucks would reduce this problem. The development and use of better shipping containers specifically designed for various products and the use of cooling facilities would substantially reduce waste and spoilage. To date, far more attention and emphasis has been focused on increasing production, rather than on more efficient marketing. A shift in emphasis toward delivering maximum quantities to consumers from available supplies may well be a better use of public capital than continuing to focus on increased production, particularly for highly perishable items. This problem is likely to become more apparent in the next decade or so as the urban population continues to grow and exert greater pressures on food requirements.

Table 17 shows the area and production of major fruits and vegetables in Egypt.

Table 17 --Major fruits and vegetables: Area and production on old lands, 1974

| Item | Area | Production |
|---|---|---|
| | 1,000 feddans | 1,000 tons |
| Fruits: | | |
| Oranges 1/ | 130 | 819 |
| Dates | - | 390 |
| Grapes | 39 | 221 |
| Bananas | 11 | 110 |
| Mandarins | 15 | 90 |
| Mangoes | 23 | 86 |
| Guavas | 12 | 65 |
| Limes | 10 | 50 |
| Vegetables: 2/ | | |
| Tomatoes | 280 | 1,729 |
| Watermelons | 109 | 1,212 |
| Potatoes | 95 | 709 |
| Garlic | 30 | 181 |
| Green peppers | 17 | 115 |
| Green beans | 12 | 41 |
| Green peas | 15 | 30 |

1/Excludes 10,000 feddans and 75,000 tons of production on new lands.
2/Winter onions are considered a field crop. In 1974, 39,000 feddans produced 359,000 tons of winter onions, of which a substantial part were exported.

## Oranges

The area in orange groves on old lands increased by about 10,000 feddans between 1972 and 1974, and production in 1974 totaled 819,000 tons. About 67 percent of this production is in the Delta and Cairo agronomic zones, relatively close to both domestic and export markets (see table 18). In addition, about 75,000 tons were produced on new lands. Most of the increased plantings in recent years were by private landowners. Many of these individuals are city residents who view citrus as an attractive alternative to producing crops subject to requisition at relatively low controlled prices. Planted area in 1974 exceeded harvested area by 24,000 feddans, indicating that nearly 20 percent of the trees are not yet of bearing age.

Table 18 --Oranges: Area planted and harvested, and total production, by zones, average 1972-74

| Zone | Area | | Production |
|---|---|---|---|
| | Planted | Harvested | |
| | 1,000 feddans | | 1,000 tons |
| I | 21.8 | 18.5 | 145 |
| II | 33.2 | 26.8 | 209 |
| III | 32.0 | 24.7 | 197 |
| IV | 9.0 | 7.7 | 64 |
| V | 6.0 | 4.6 | 32 |
| VI | 12.9 | 11.2 | 66 |
| VII | 2.7 | 1.3 | 11 |
| VIII | 3.1 | 2.4 | 15 |
| IX | 3.6 | 2.8 | 18 |
| Total | 124.3 | 100.0 | 757 |

Nearly 80 percent of total production of oranges is consumed fresh in the domestic market, while 20 percent is exported. Figure 6 pictures the distribution channels for oranges. Only 2 percent is processed as juice. The value of exports in the 1972-73 period was about LE 10 million, or 46 percent of the total exports for all fresh fruits and vegetables.

Until recently, nearly 80 percent of total exports of oranges went to the USSR and Eastern Europe, but shipments are increasing to other Arab countries. Few, if any, are sold to the West European market.

Marketing problems, especially for export, are attributable to the small-scale fragmented production pattern and the lack of facilities for degreening. Fruit is harvested prematurely and lacks both color and juice content in the early part of the season. These are not serious problems in the present export market but represent a barrier to entry into the West European market where fruit from Spain, Italy, and other Mediterranean countries has high consumer acceptance.

# DISTRIBUTION CHANNELS FOR ORANGES

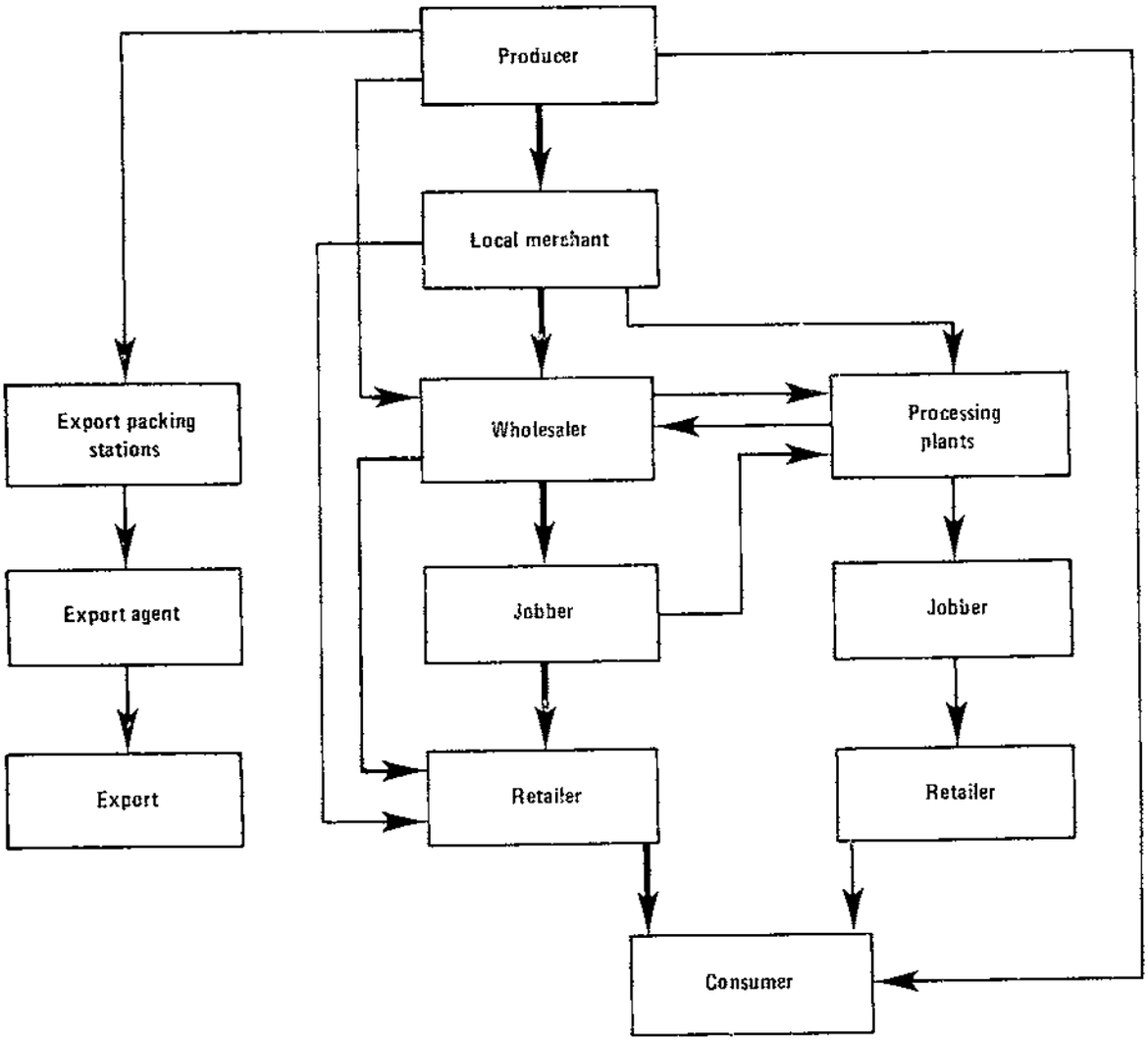



Figure 6

Technical aspects of production such as pruning, cultivation, and fertilization, and the proper use of insecticides appear to have lagged because of the relatively minor importance of the crop. Better varieties, now limited to navels and Valencias, could be introduced if suitable root stock was available. Importations are limited because of stiff regulations to prevent the introduction of plant diseases.

It seems likely that oranges will continue to be produced chiefly for the domestic market unless large-scale plantings with associated grading and packing facilities can be developed. Several joint ventures of this type have been proposed by foreign firms on partially reclaimed lands. Constraints exist also with respect to the terms of trade imposed by the Government on sales to hard currency countries. Although such exports can now be handled by firms in the private sector, Government controls are still exercised with respect to prices and the sharing of hard currency earnings between the Government and the exporter.

Marketing arrangements for export involve contracts between the export firms and the larger-scale producers, and with local merchants who in turn contract to buy fruit from growers. Such buyers may provide credit and grove care, as well as fruit picking and transportation from the orchard. Most fruit for sale in domestic markets is bought on-tree well in advance of harvest. The dealer assumes responsibility for the crop once the contract has been signed.

Tomatoes

Tomatoes are the leading vegetable on old lands. Total production averaged 1,586,000 tons per year during 1972-74 (see table 19). About 702,000 tons are produced in the Nili season, 512,000 tons in the summer season, and 372,000 tons from the winter crop. Although tomatoes are grown in all agronomic zones, nearly two-thirds of the total tonnage is in the Delta and Cairo areas. Average production ranged between 4.3 and 7.1 tons per feddan in the various zones and averaged 6.1 tons for the country as a whole. In addition to production on old land, about 70,000 tons on the average are produced on new lands.

Market prices exhibit considerable seasonal variation. Prices are sharply higher in March and April, reflecting earlier frosts, after seasonal lows in February.

A high percentage of the crop is marketed fresh, but small quantitites at seasonal peaks of production are processed as tomato paste (about 1,100 tons in 1972), or canned. As with most vegetables, production is fragmented on small plots, and this hampers quality control needed for processing or export as well as assembly and transportation to plants or

Table 19 --Tomatoes: Area planted and production by seasons and zone, average 1972-74 1/

| Zone | Total area (3 crops) | Production | | | |
|---|---|---|---|---|---|
| | | Winter | Summer | Nili | Total |
| | 1,000 feddans | 1,000 tons | | | |
| I | 86.8 | 98 | 206 | 253 | 557 |
| II | 39.4 | 43 | 91 | 122 | 256 |
| III | 40.1 | 63 | 99 | 68 | 230 |
| IV | 3.1 | 6 | -- | 14 | 20 |
| V | 14.4 | 26 | 24 | 26 | 76 |
| VI | 37.8 | 26 | 66 | 71 | 163 |
| VII | 22.2 | 51 | -- | 106 | 157 |
| VIII | 10.8 | 37 | -- | 28 | 65 |
| IX | 12.5 | 22 | 26 | 14 | 62 |
| Total | 267.1 | 372 | 512 | 702 | 1,586 |

1/Does not include production on new lands which in 1972-74 averaged about 70,000 tons.

ports. The same problem is evident in the fresh market distribution system, where waste and spoilage are substantial.

## The Food Processing Industry--Status, Potentials, Constraints

The food processing industry has not developed to any significant extent for several basic reasons. Over half the population lives in villages (of less than 25,000 people) and depends chiefly on locally produced foods, many of which are consumed in unprocessed forms. Villages tend to be self-sustaining with respect to flour milling, baking, and rice milling where these crops are grown. Milk and meats are either consumed where produced, or obtained from other nearby farmers who have surpluses. Thus, purchases of processed foods by village people from outside sources are limited to cooking oils and sugar, and wheat or rice flour where local production is inadequate.

The almost year-round availability of fresh fruits and vegetables and the dietary preference for the fresh product greatly limits both the supply of, and demand for, these products in a processed form. Cash income levels in the villages are low, and a substantial proportion of the urban population cannot afford the usually more expensive processed foods. Domestic demand for canned foods is limited chiefly to fruit juices, tomato and fishery products, and small quantities of canned fruits and preserves. Relatively low prices for both fresh fruit and vegetables during most of the year, at least in major urban markets, is a further factor restricting the demand for processed items.

The General Organization for Food Industries under the Ministry of Supply consists of 24 companies engaged in food processing, tobacco manufacture, processing of other consumer and industrial products from agricultural raw materials (chiefly cotton and sesame seed), and certain prepared food products. Sugar refining and processing of edible and inedible oils and tobacco (wholly imported) accounted for about one-half of total output of LE 483 million in 1974. A small amount of milk is processed by one of the companies in the General Organization, but its output represents less than 2 percent of total dairy products. The public sector accounts for a major fraction of most other commodities, ranging from 100 percent for sugar and tobacco to smaller fractions for other products. Table 20 shows production of selected processed agricultural products for 1972.

Total output of the canning and dehydrating companies was 30,000 tons in 1974, valued at LE 12 million. Although most domestic fruits and vegetables are processed in some form, tomato products, citrus and mango juice, and fishery products are most important. Most of the processed tomato products are consumed in the domestic market during periods when supplies of fresh tomatoes are limited and prices are high, whereas juices and fruits are chiefly exported. Table 21 indicates the extent of food processing under the General Organization.

Obtaining supplies of raw materials for processing in competition with the demands for fresh consumption and the fragmented production pattern are significant constraints on the industry at present. Supplies are obtained chiefly from wholesalers and dealers who have contracts to deliver specified products and quantities to the canneries. Direct contracting with producers is limited, except for citrus, because of small quantities and lack of control over varieties and quality. The state farms represent a potential source of supply, but the volume available from this source is not yet sufficient to support a fully integrated facility. Officials of the canning companies believe that such fully integrated production and processing units either on state farms or by joint ventures will be needed to support further expansion. Considerable inefficiency now exists in processing plants because of the poor quality of raw materials and erratic delivery schedules.

Table 20 --Production of selected processed agricultural products, 1972

| Product | Amount produced |
|---|---|
| | 1,000 tons |
| Sugar products: | 292 |
| Sugar | 271 |
| Molasses | 271 |
| Cane syrup | 52 |
| Oilseed products: | |
| Cake | 581 |
| Cottonseed oil | 145 |
| Hydrogenated oil | 72 |
| Dairy products: | |
| White and processed cheese | 135 |
| Pasteurized milk | 31 |
| Canned items: | |
| Vegetables | 4.7 |
| Meats | 3.4 |
| Sardines | 2.1 |
| Tomato paste | 1.1 |
| Dehydrated vegetables | 2.8 |

Prospects for expansion in food processing depend more on the development of export markets than on the domestic market. Although migration to the cities is expected to continue as the industrial sector expands, demand for processed foods is likely to be minimal until the supermarket type of retail food store is developed. Upper-income areas in major cities could undoubtedly support these kinds of stores at present, but the mass market is limited by lack of refrigeration at home, limited storage space, and the traditional pattern of making almost daily food purchases at local, specialized retail stores. Consequently, there is not likely to be sufficient potential demand for processed foods in the near term to justify the substantial capital investments that would be necessary to develop such an industry.

The export market, especially to nearby Arab countries, offers some potential if production and assembly problems can be solved. Exports are now limited to canned juices, fishery products, and dehydrated products.

Table 21 --Food processing plants 1/

| Major group | Number of plants | Capacity or output |
|---|---|---|
| Sugar | 6 mills, plus 1 under construction<br>1 refinery | 5.3 million tons per year<br>1,200 tons per day |
| Edible oils (chiefly cotton-seed) | 25, plus several under construction | NA 2/ |
| Further processing | 6 companies | Soaps, detergents, hydrogenated oils, margarine |
| Food preservation: | | |
| | | Per year |
| Fish (chiefly sardines) | 1 plant | 10 million cans |
| Frozen shrimp | 6 plants | 4,000 tons |
| Dehydration | 9, plus several for dates | Onions, 6,000 tons; raisins, 2,500 tons; also dates and garlic |
| Frozen vegetables | NA | 500 tons |
| Canned fruits, vegetables | 6 canneries | 30,000 tons |
| Dairy products (public sector only) 3/ | 2 cheese | 45,000 tons |
| | | Per day |
| | 6 fluid milk | 265 tons |
| | 1 dried milk | 25 tons |

NA = Not available.
1/Companies affiliated with the General Organization for Food Industries, Ministry of Supply.
2/Mills are being converted from screw press to solvent extraction process.
3/Public sector accounts for about 1.5 percent of the total dairy industry.

However, processed Egyptian vegetable products are facing stong competition from China and Japan in terms of both price and quality, but there is a good demand for mango juice. Prices in export markets are said to be somewhat lower than in the domestic market but the benefits from receipts in hard currencies more than offset the price difference in terms of policies relating to Egypt's total economy.

The potential market for specialty and ethnic food products for export should not be overlooked. Such a demand could expand as a result of migration of Egyptians to other countries where traditional native food items may not be obtainable. For example, a special preparation of horsebeans is now being processed for this market and other products, such as sauces made from sesame seed or chickpeas, could be developed. Products of this type presently are produced in volume in Lebanon for export or local sale. Concentration on processed foods for special consumer preferences may offer a better potential in export markets than attempting to produce food items for mass markets where competition is substantially greater.

The production and distribution of improved vegetable seeds is a prerequisite for improving quality and expanding production, whether for domestic or export markets. A World Bank loan now being considered would establish a base for the production of vegetable seeds. The loan would also finance construction of cold storage facilities for seed potatoes, and packing and cooling facilities for exporting vegetables, primarily tomatoes, peppers, green beans, and muskmelons.

A detailed study should be made of the export potential for both fresh and processed fruits and vegetables to nearby Arab countries similar to a study that has been made of the West European market. Such a study should examine alternative means of transportation, as well as the existing and needed facilities in the importing countries to receive and distribute fresh produce. Such a study should precede detailed planning to determine the best production areas and the facilities needed in Egypt to best serve such markets. The Aswan area, for example, can produce winter vegetables 1-2 months ahead of the Delta and has undeveloped soils believed to be suitable for vegetables. Air shipment of high-valued products from this area to export markets might be more profitable than shipment by rail or truck to central or northern domestic markets in Egypt. The Aswan area is now deficit with respect to many products needed by the tourist industry, which is expected to expand. The local domestic market might provide alternative outlets for quantities in excess of export requirements if such were needed.

## Milk and Dairy Products

Dual private and public systems exist for milk and dairy products (see figure 7). Only about 30,000 tons of milk are produced by the public sector, compared with 1.6 million tons by village cattle and a small number of specialized herds. Both sectors are dependent on the same feed source, but only a small proportion of milk from the private sector is processed in Government-owned plants. These plants produce pasteurized milk, white cheese, and a small amount of dried milk. Prices for these products are substantially lower than for similar milk products produced in the private sector, but quantities are limited.

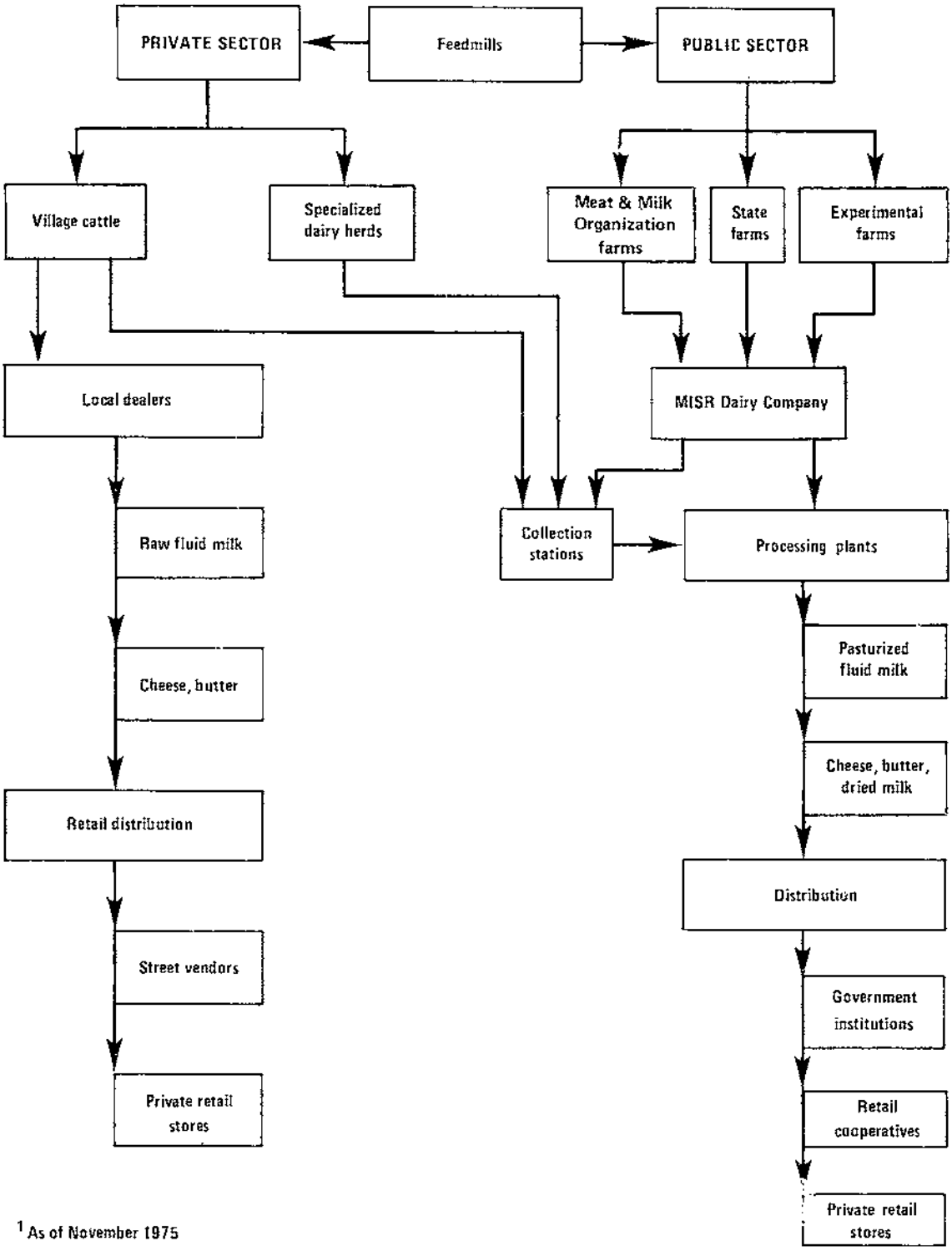
Collection stations have been established to assemble milk from the one or two cows village producers typically keep. However, these facilities are operating at only about half capacity because of price policies and other constraints. Milk must be delivered to the collecting stations, and farmers are paid at the end of each week. Thus, most of the milk from village cattle is sold to local dealers who collect milk from the village and pay in advance.

A new program to increase milk production was initiated in mid-1975 which offers 120 kg of feed per head for herds of 10 cows or more, provided they are Friesian or Friesian crosses of native cattle, or buffalo. By late 1975, 150,000 tons of feed concentrate had been delivered under this program. Participants are not required to deliver their milk to the Government collection stations. This development, together with a proposal that the Agricultrual Credit Banks provide credit to finance larger dairy operations in the private sector, indicates a relaxation of efforts to expand production in the public sector.

The principal processed dairy product from both the private and public sectors is white cheese, with production of 126,000 tons in 1972. Fluid milk assembled by local dealers reaches consumers in unpasteurized form and is distributed by street vendors and in private stores.

Farm prices for milk and meat increased 30 and 22 percent, respectively, between 1972 and 1974, but output increased only 3 to 4 percent. Prices of these two products are subject to much less control than crops subject to requisition so livestock has become increasingly profitable. This has encouraged diversion of land to forage crops at the expense of traditional crops, particularly cotton and wheat. It has also increased the demand for feed concentrates which are in short supply because the imported ingredients require foreign exchange and hence imports have been restricted.

# PRODUCTION AND MARKETING SYSTEM FOR MILK AND DAIRY PRODUCTS[1]




[1] As of November 1975

Figure 7

## CONSTRAINTS AND POSSIBILITIES FOR RURAL DEVELOPMENT

### Population Control

An exploding population is the most serious problem facing Egypt today. Total population in 1975 was 36.8 million, of which slightly over half lived in rural areas. Population growth is estimated at between 2 and 3 percent per year depending on which set of statistics is used. Population has been shifting from rural to urban areas, and the proportion in rural areas was reduced from 76 percent in 1937 to 55 percent in 1974. A further reduction to about 46 percent by 1985 is projected. Cairo has been growing at a rate of 4.5 to 5 percent per year, about one-third of this due to in-migration. Over the past 10 years, 70 percent of all net migration from other governorates was to Cairo, and 15 percent to Alexandria. With the reopening of the Suez Canal, a shift of population to that area is underway.

Careful projections suggest that population by 1985 will be in a 43-50 million range and by 2000 will be around 60 to 70 million or more. After that, projections differ greatly. Some analysts project a slowing in the growth rate to a peak of around 90 million by 2050. Others assume a rise to 140 million by 2030, and an acceleration thereafter.

Population growth in Egypt is particularly critical because of the small area available for crop production. The present ratio of people to agricultural land is about six people per feddan based on land used for crops, and about three per feddan in terms of crops grown, one of the highest in the world. Even if cropping intensity were to increase from the present level of 1.9 crops per year to 2.1 by 1985, and reclaimed lands were to contribute an additional 10 percent to total output, the increased food requirements for the 30-percent population increase projected for 1985 would be substantially greater than can be expected from this amount of horizonal expansion. Thus, increased yields represent the best prospect for maintaining present per capita production levels.

A possible source for relief is out-migration of blue- and white-collar skilled labor from Egypt to nearby oil-rich Arab countries or of farmers and farmworkers to Sudan and possibly other areas where land in cultivation is expected to expand sharply. Such a movement already is underway, but the loss of skilled blue-collar workers is having a serious impact on the growth and industrilization of the Egyptian economy.

A family planning program has been in operation in Egypt for several years under the leadership of the Ministry of Health. Experience has shown that village people, when approached through their men and women leaders and educated about the subject, are not averse to using birth control methods. Such education campaigns could be carried out by the resident health officer, the nurse, and the schoolteachers. Also educated youth, especially girls, could be trained and enlisted in the program. The effectiveness of the birth control program will be of prime importance in determining population growth rates from the year 2000 forward. Increases in per capita income also will tend to reduce the birth rate. Middle-class urban residents now generally have only two or three children--a rate which over time would result in zero growth if attained by all groups.

## Health and Sanitation

Prior to 1942 no organized rural health program existed in Egypt and little medical service was available for rural people. They suffered heavily from a number of endemic diseases, leading among which were bilharzia, malaria, pellegra, dysentery and other intestinal diseases, trachoma, and others. Sanitary facilities were missing, and people drank polluted water from irrigation canals. As a result death rates were high, especially among children, the vitality of the people was sapped, and their productive capacity reduced.

Rural health centers first were established in 1942. At present, 587 centers are located in central villages and 1,591 units are in the surrounding smaller settlements. The staff of each center consists of one or two physicians, one sanitarian, one laboratory technician, one graduate nurse, two assistant nurses, and four assistant midwives; and each Unit has one physician and four assisting staff. Total staff in the rural health program in 1975 are 2,178 physicians 5,247 nursing staff, and 4,380 other staff. Hospital care is available to a limited extent at the village level and more adequately at the district and governorate levels. A comprehensive program of health service is carried out at each center--curative medical care, family planning, mother and child care, sanitation, hospitalization, and training of people in health matters. Preventive medicine and health education are emphasized. Also, complete dental care is available at 400 centers. Special effort is directed toward the treatment and control of serious endemic diseases--bilharzia, malaria, and dysentery. There are plans to expand the program by adding 600 units in the next 5 years.

Doctors and other medical personnel are expected to be available for that purpose.

Despite the large benefits afforded by these health services, an unsatisfactory health situation still prevails in the rural areas. People still suffer from the serious endemic diseases, which cause death or sickness over long periods of time, sap human vitality, reduce productive capacity, and inflict misery on rural life.

Medical authorities, researchers, and specialists have been concerned with these serious diseases and have been cooperating with counterparts in other countries to find adequate solutions. Recently, an international conference was held in Cairo on bilharzia.

Levels of sanitation prevailing in most villages are much below what some progressive villages have attained. People still drink polluted water in many villages, and in general are ignorant of sanitary practices. Many villages grow without plan or design, and the houses are overcrowded and contain inadequate facilities.

Mobile clinics are recommended to reach the 29,000 small settlements that surround the 4,200 central villages. Increased supplies of medicines and other facilities are needed at existing health units. Emphasis should be placed on preventative medicine and educating people about disease and sanitation.

## Food and Nutrition

Since the 1952 Revolution, diets have improved among the rural people but they still remain low by FAO standards, or in relation to the urban population in Egypt or averages in developed countries. Daily per capita intake in rural areas has increased from around 1,800 calories to 2,200 compared with an average of 2,700 for all of Egypt. Consumption of rice, wheat flour, and vegetables and fruits has increased. But consumption of animal proteins--meat, poultry and dairy products, and fish--remains far below the requirements for good health. Clear indications exist of high incidence of nutritional anemia, rickets, and retarded growth among rural children. Half of the deaths among children below 6 years of age are due directly or indirectly to nutritional deficiencies.

The Nutrition Institue of the Ministry of Health has been working on the food problem in both urban and rural areas for years. It has concentrated efforts on children and mothers, but its resources and personnel are limited for the task involved. One of its achievements was to develop a food item consisting of flour mixed with fish meal, which has been accepted readily.

Another was the development of a balanced food item for children. The United Nations Children's Fund (UNICEF) and the American Catholic Relief Service have been assisting substantially in the national program of providing lunches for schoolchildren. Also, the World Food Program has been assisting with food donations on a large scale in resettlement projects.

Higher income to farmers might cause them to use more of their products, particularly milk and eggs, for their families rather than converting them to cash. A program to urge farmers to use small garden plots for home use is recommended.

A careful survey of food consumption by lower income farmers and urban residents, with breakdowns for men, women, and children if possible, would be highly desirable to measure exactly where and by how much diets are deficient.

## Rural Education

In spite of the effort exerted by authorities to expand school education in rural areas, rates of illiteracy are still high, perhaps in the range of 65 to 75 percent for men and 80 to 90 percent for women. About 5.5 million of those aged 15 to 35 are illiterate. Even though elementary education is compulsory with a total enrollment of close to two million, a significant percent of the school-age children do not attend schools. About twice as many boys attend as girls, but many boys do not attend. School space and facilities are not yet adequate, and many schools operate two or three sessions a day. Some of the farmers prefer to have their children assist in farmwork either fully or seasonally, and there is a high percentage of dropouts and absentees. At the same time it must be noted that many rural parents have been awakened to the value of education, and increasing numbers of rural children have been going up the educational ladder to the college level. To help make education more widely available, authorities have begun operating simple one-room, one-teacher schools for small outlying communities. Agricultural training is included in the curriculum in these schools and school gardens are available but they are not well used. A serious program to wipe out illiteracy has been in operation for several years under the direction of the Ministry of Education.

A program of secondary agricultural education is operated by the Ministry of Education. At present the program covers operations of 55 secondary agricultural schools. In 1975, total enrollment equalled 39,000 students, including 360 girls, and 10,800 students were graduated in 1974-75. The students are selected from graduates of elementary schools and are trained for 3 years to earn the diploma of Assistant Agricultural Engineer. The training program of the school emphasizes manual, practical aspects. In fact, students cannot graduate if they fail the manual part,

even though they may be excellent in learning from books. Each school adjusts its operations according to its own environment; there is no rigid centralized direction. Graduates have been much in demand, and have readily found jobs in Egypt and abroad. Their practical training includes the operation of farm machinery. Each school has a farm of 25 to 70 feddans, used for training and profitable production at the same time and the program is self-supporting.

This program constitutes a successful and highly promising endeavor to meet a serious need in Egypt--bridging the traditional gap between the college graduates (agricultural engineers) and the operations of agriculture at the level of the farmer or farm worker. The program should be given substantial support so that it can increase the number of such schools and expand its operations to include training in industries related to agriculture. Graduates of these schools should be placed where they are crucially needed rather than assigning them to office jobs.

Vocational training also should be strengthened and expanded in rural areas, possibly as part of the elementary and secondary agricultural education program. The need is urgent to train village people in repair and maintenance of farm implements and machinery, carpentry, housebuilding, welding, blacksmithing, weaving, and other skills. This can be expedited by using skilled artisans available in villages to train the youth there. The demand for skilled people is increasing sharply, both in Egypt and in neighboring countries.

## Economic Status of the Farmer

Prior to the 1952 Revolution, the economic status of the Egyptian peasant farmer was extremely low. In most cases he did not own the land, but cultivated it as a renter or daily laborer. As a renter, he paid high rents and as a laborer his wages were low. His income was marginal, just enough to enable him to subsist on a low standard of living. After the revolution that dismal situation began to improve. Farmers were given land to own through the land reform program, their rights as renters were improved and made secure, and their labor wages were increased. As new lands became available for cultivation, they were given increased opportunity to own, rent, and/or work on them.

Still, the present picture is not bright, mainly because there is just not enough land to go around. The average size of a holding is 2 feddans, 94 percent of all owners have less than 5 feddans each, and only 0.2 percent have at least 50 feddans each. 32/ The total number of owners is 3 million,

32/ Under present land reform laws, no individual can own more than 50 feddans, but families can own up to 150 feddans.

out of a total rural population of 20 million. If there are five persons per family, the rural population consists of 4 million families. This means that about one million farmers and their families are left without land. They are either renters or daily laborers. The income the farmer can derive from his few feddans, with a few head of livestock and some chickens, is still relatively low, roughly LE 210 per family per year. Also the wages for agricultural labor are low, compared with urban wages, although they have been increasing in recent years, and are presently 45 piasters per day for men, 25 piasters for women, and 15 piasters for children. Average wages paid in urban centers are about double these levels. Furthermore, other sources of income in rural areas are relatively insignificant, with scattered exceptions where some rural industries have been developed. Consequently, rural people have been emigrating to urban centers or leaving the country in increasing numbers, seeking better incomes and better living conditions.

One way to raise rural incomes would be to develop cottage industries of various types, such as poultry raising, dairying, food processing, artisan crafts, etc. Initiation of and training for such industries could be done to a large extent by joint effort of several institutions in the rural areas--the Village Council, the cooperative society, the Rural Social Center, and the Extension Service.

## Housing

The typical Egyptian village gives a striking impression of a compact mass of mud houses, growing upon themselves, seemingly in a haphazard manner. A compelling reason for this situation is that there is too little land available to permit an outward growth. Consequently, the village becomes crowded with people, ranging from 1,000 to 20,000 or more in each. Rooms are few, and houses are crowded with large families. Mud bricks are used for construction in most cases. Facilities inside the house are inadequate for comfortable living and available running water is a rare exception.

The situation is quite different in newly developed lands, where the authorities have built well-designed and well-structured villages or have assisted the settlers in building improved houses.

The recently established Organization for the Reconstruction and Development of the Egyptian Village has begun a physical improvement program with the participation of the people in each village through the Village Councils. The organization also assists individuals with improved designs to build their houses. Furthermore, it arranges with the Village Council to have a small area of land close to the village designated for future growth. The individual who needs to build a house and wishes to move out-

side the old, crowded village can buy a plot in the designated area and choose from a number of house designs offered by the Organization. He pays 20 percent of the cost, the Organization pays 20 percent, and the farmer receives a loan of 60 percent of the cost to be paid in 20 years without interest. This is believed to be a practical and reasonable socioeconomic approach within the limited means of the farmer. It will permit a gradual improvement of the village as it is and assist those individuals who wish to move ahead in building their new houses.

## Rural Social Service

The Rural Social Center is another institution that operates in the village, extending its varied services to many rural people. These centers are under the supervision of the Ministry of Social Affairs.

There are now 760 Rural Social Centers, each serving some 15,000 people, plus 37 in the desert areas. They work through the Village Councils and an increasing number of community development committees, of which there are now 1,733. The operations of this growing movement of Government and people cover several types of activities for the improvement of rural life, including literacy courses for adults, vocational training, home industries, women's and youth clubs, nurseries for preschool children, social security, and health care and sanitation (where no independent health unit exists). The thrust of the program may be summarized as follows: to educate people about their problems and potentials and help them to help themselves in solving those problems and improving their living conditions. At present these Rural Social Centers serve 60 percent of the rural people, and there are plans to establish 80 new centers in 1976, with a continued increase until all rural areas are covered by 1980.

## Extension Service and Cooperatives

These two institutions at present play important roles in village life and could play much more active roles in the future. These activities are not emphasized here, since they are described in some detail elsewhere in this report.

## Integrated Rural Development

Perhaps no other villages in the developing world have been subjected to the impact of so many service institutions as have Egyptian villages. Village Councils, village schools, and cooperative societies are practically universal, and other institutions such as Rural Social Centers, rural health centers and units, Agricultural Units (including extension) cover a large

number of villages and are steadily moving into the rest. The relationships between these various entities can best be described as a mixture of cooperation, separation, overlapping, and sometimes conflict. The village community, however, is a complex whole, with social, economic, religious, and physical features integrated into the total pattern of rural culture. Any change in one feature creates repercussions in the others, and the effective way to introduce improvements in village life is the integrated approach, with all agencies working together toward the attainment of the common objective of rural development.

It is encouraging to note that an integrated approach has been recognized and initiated in Egypt. For some time, the Rural Social Centers and the Combined Units (which group under one organization all services offered in the village) have operated on the basis of the integration principle. More recently, a project of integrated rural development has been launched near Alexandria in cooperation with the UNDP. In 1973 a most promising move was made in that direction with the establishment of the Organization for the Reconstruction and Development of the Egyptian Village (ORDEV) in the Ministry of Local Administration. Its central objective is to obtain a total integrated development of the rural community by coordinating the services of all agencies working in the village. It focuses its operations through the Village Council, which is charged with the responsibility of proposing development projects on the basis of free discussion and decision by the people. Proposals of various Village Councils are considered by a coordinating committee at the governorate level, and are sent to the central ORDEV, which is guided by a national committee representing all ministries concerned with rural development. Approved projects are sent to the village level for execution.

ORDEV began its coordinating operations in 1974 and concentrated on 17 villages in 15 governorates. In 1975 it began expanding operations in 128 villages, with plans to cover over the next 5 years 755 communities that have Village Councils. An integrated approach of this type could prove of great value in expanding extension-type activities, as discussed in other parts of this report, to fully modernize Egyptian agriculture.

## OPPORTUNITIES FOR FOREIGN INVESTMENT

### Introduction

Prior to the October 1973 War, non-Arab investment was actually discouraged, except for the petroleum sector. Since that time the Government has launched its open-door policy to encourage and facilitate investment of foreign capital to strengthen economic development.

The new policy and regulations were contained in Law 43, issued in June 1974. 33/ This law greatly modified previous legislation pertaining to

33/ Arab and Foreign Investments and the Free Zone Authority, Law No. 43, June 1974.

taxation, employment practices, and repatriation of profits and capital. It also gives protection against nationalization, confiscation, and sequestration. Another section of the law establishes the framework for free trade zones and for joint ventures.

Among the areas favored for foreign investment are the following:

1. Industrialization, mining, energy, tourism, transportation.

2. Reclamation of barren lands and cultivation thereof under long-term leases not exceeding 50 years, with renewal for up to another 50 years. Projects for developing animal production and irrigation facilities are also included.

3. Projects for housing and urban development. Such activities are limited to Arab capital.

4. Investment companies and banks, and reinsurance companies with activities limited to free currencies.

5. Banks engaged in local currency transactions in which Egyptian capital equals at least 51 percent.

Activities permitted in the free trade zones include storage of transit goods, and indigenous goods destined for export on which taxes have been paid. Manufacture, assembly, and processing of both domestic and foreign raw materials are also permitted. However, when such products are transferred to the domestic market, import duties must be paid because they are treated like conventional imports.

Considerable interest on the part of foreign investors has been evident since the passage of Law 43. Among the attractions in the agricultural and food sectors are the large areas of partially reclaimed land, a year-long growing season, low-cost labor, and proximity to export markets in nearby Arab countries with food deficits and hard currencies. Most members of the Organization of Petroleum Exporting Countries (OPEC) have established investment offices in Cairo and have funds available for joint ventures with Western countries. Programs offered by the Overseas Private Investment Corporation (OPIC) are in effect and a U.S.-Egypt tax treaty is being negotiated.

The domestic market is the largest in the Middle East and can be expected to expand further as industrialization increases and migration to the cities continues. Poultry, dairy products, and meats are the foods most in demand.

Investment proposals totaling more than $3 billion have been approved since January 1, 1974 but very few of these projects have actually been started. U.S. investment is estimated at $250 million, almost entirely in petroleum exploration and development.

## Constraints on Foreign Investment

Despite these attractions and the encouragement given by the new legislation, several problems exist which are likely to deter many foreign investors. Some are of special concern to foreign firms seeking entry into food production and processing, while others are general and apply to all business ventures in Egypt.

Foremost among the general constraints are those associated with the inconvertability of the local currency and adherence to the offical exchange rate (LE = $2.55) rather than the more realistic parallel exchange rate. Investors need assurance that they will receive consistent exchange rates in the future, i.e. the same rate for funds invested and for repatriation of capital and profits. There exists a possible loss of 40 percent of invested capital because of the present differential between the two rates.

The tax treatment of dividends represents another problem area. Although dividends are exempt from Egyptian taxes for the first 5 to 8 years, thereafter profits of the company are taxed, as are the dividends transferred out of the country. Another provision exempts the taxation of dividends only if such dividends are not subject to tax in the country where the shareholder resides. This is contrary to the tax laws in most industrialized countries. Tax treatment of the wages and salaries of foreign nationals employed by firms with operations in Egypt would likely discourage recruitment and staffing. Domestic tax rates are more steeply graduated than in most other countries and hence would bear heavily on the higher salaries that would be needed to attract technical and managerial people. The income of foreign workers in free trade zones is tax-exempt, and a similar exemption is needed for personnel working outside these zones.

## Need for Export Markets

The economic viability of most foreign investments in Egypt depends, in large measure, on production for export to markets with convertible currencies. Such foreign exchange is needed for raw materials, foreign debt service, and payments for royalties, licenses, and dividends.

Production for the domestic market can be undertaken only when it can be shown that a net benefit accrues to the Egyptian economy through import substitution and consequent savings in foreign exchange. For example, if a domestic venture requiring $10 million in foreign exchange for raw materials resulted in a saving of $15 million for imports of finished goods, a net saving of $5 million would result. It would also create employment and its attendant multiplier effects, as well as technical and managerial expertise. Such opportunities are quite limited in the food sector because the value-added component is usually less than for manufactured goods.

## Price Structure

The dominance of the public sector in many agricultural commodities and the associated subsidized price structure represents a further constraint on ventures that would be feasible under a competitive pricing system. This problem is most apparent in the domestic market where Government policy has long been aimed at maintaining low prices to consumers. Although some regulated commodities reflect competitive prices to varying degrees, assurances will be needed that production in the public sector will not be expanded to the extent that prices in both sectors are forced below production costs.

Production efficiency in the public sector is usually evaluated in terms of meeting physical quotas, rather than maximizing return on investment. This is evident with respect to the state farms on new lands, where only direct costs are recognized. Capital costs for land development have been substantial, but no charge is made for them under the present system of accounts. Thus it is difficult, if not impossible, to compare production costs on state farms with similar operations in the private sector.

The multiplicity of Government agencies with which foreign investors must negotiate and the time required to obtain final approval add still another dimension to the problem for foreign investors. The committee system is widely used to reach decisions, and much time is consumed in obtaining unanimous agreement, even though there is no such legal requirement. Officials appear to be sensitive to possible charges of corruption or collusion in dealing with foreign firms and consequently have been reluctant to aggressively pursue major investment projects.

Foreign investors face more frustrations in implementing ventures after approval is obtained. For example, transportation and communications facilities reflect a decade or more of neglect, and many basic domestic raw materials are in short supply and under an allocation system. This is especially evident for cement, steel, and electrical equipment.

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# STATISTICAL APPENDIX

Appendix table 1--Crop areas by seasons, land area, and cropping ratios, old lands, 1972-74 average, by agronomic zones

| Zone | Permanent crops 1/ | Cotton | Annual crops: Winter 2/ | Annual crops: Summer | Annual crops: Nili | Total | Land area | Cropping ratio |
|---|---|---|---|---|---|---|---|---|
| | 1,000 feddans | | | | | | | |
| I | 56 | 514 | 1,521 | 1,122 | 103 | 3,316 | 1,691 | 1.96 |
| II | 52 | 341 | 907 | 610 | 64 | 1,974 | 1,005 | 1.96 |
| III | 64 | 69 | 376 | 303 | 58 | 870 | 436 | 2.00 |
| IV | 21 | 26 | 123 | 106 | 24 | 300 | 153 | 1.96 |
| V | 14 | 33 | 159 | 126 | 11 | 343 | 173 | 2.05 |
| VI | 56 | 343 | 845 | 498 | 144 | 1,886 | 1,072 | 1.76 |
| VII | 15 | 74 | 267 | 83 | 123 | 562 | 285 | 1.97 |
| VIII | 3/ 176 | 112 | 512 | 347 | 56 | 1,203 | 715 | 1.68 |
| IX | 8 | 23 | 120 | 103 | 14 | 268 | 137 | 1.96 |
| Total | 462 | 1,535 | 4,830 | 3,298 | 597 | 10,722 | 5,667 | 1.89 |

1/Orchards, vineyards, sugarcane, excluding dates.
2/Includes catch-crop clover.
3/Chiefly sugarcane.

Appendix table 2--Area in permanent and winter crops, 1972-74, averages, by agronomic zones

| Zone | Orchard | Sugar-cane | Cotton | Clover 1/ | | Wheat | Other field crops | Vegetables | | Total crop area |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Catch | Permanent | | | Tomatoes | Other | |
| | 1,000 feddans | | | | | | | | | |
| Old lands: | | | | | | | | | | |
| I | 51 | 5 | 514 | 430 | 628 | 361 | 62 | 22 | 18 | 2,091 |
| II | 49 | 3 | 341 | 302 | 309 | 246 | 29 | 9 | 12 | 1,300 |
| III | 61 | 3 | 69 | 80 | 148 | 80 | 22 | 16 | 30 | 509 |
| IV | 21 | -- | 26 | 29 | 42 | 19 | 26 | 2 | 5 | 170 |
| V | 14 | -- | 33 | 36 | 53 | 39 | 21 | 7 | 3 | 206 |
| VI | 30 | 26 | 343 | 171 | 223 | 210 | 2/ 216 | 17 | 8 | 1,244 |
| VII | 15 | -- | 74 | 71 | 78 | 76 | 32 | 9 | 1 | 356 |
| VIII | 10 | 166 | 112 | 84 | 70 | 236 | 2/ 110 | 7 | 5 | 800 |
| IX | 8 | -- | 23 | 27 | 46 | 22 | 17 | 6 | 2 | 151 |
| Total | 259 | 203 | 1,535 | 1,230 | 1,597 | 1,289 | 535 | 95 | 84 | 6,827 |
| New lands: 3/ | | | | | | | | | | |
| IX | -- | -- | 0.7 | -- | 6.9 | 0.5 | 2.7 | -- | -- | 10.8 |
| X | 14.5 | -- | 0.3 | -- | 89.7 | 8.0 | 18.3 | -- | 4.1 | 134.9 |
| XI | 1.8 | -- | -- | -- | 4.5 | 3.6 | 0.6 | -- | 0.6 | 17.1 |

-- = Not reported.

1/Egyptian, or berseem clover. Catch-crop clover follows cotton and provides one or two cuttings before a new crop of cotton is planted. Permanent or full-term clover yields 3-4 cuttings over a 6-month period.

2/Chiefly horsebeans and lentils.

3/Averages for 1972-73 and 1973-74.

Appendix table 3--Area in summer and Nili crops, 1972-74, averages, by agronomic zones

| Zone | Summer | | | | | | Nili | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rice | Maize | Other field crops | Vegetables | | Total | Maize sorghum | Vegetables | | Total |
| | | | | Tomatoes | Other | | | Tomatoes | Other | |
| | 1,000 feddans | | | | | | | | | |
| Old lands: | | | | | | | | | | |
| I | 775 | 234 | 25 | 30 | 58 | 1,122 | 40 | 34 | 29 | 103 |
| II | 131 | 404 | 5 | 14 | 56 | 610 | 24 | 16 | 24 | 64 |
| III | 17 | 210 | 16 | 14 | 46 | 303 | 16 | 10 | 32 | 58 |
| IV | 25 | 39 | 2 | -- | 40 | 106 | 17 | 2 | 5 | 24 |
| V | 58 | 54 | 4 | 4 | 6 | 126 | 6 | 4 | 1 | 11 |
| VI | -- | 246 | 1/ 194 | 11 | 47 | 498 | 111 | 11 | 22 | 144 |
| VII | 17 | 13 | 42 | -- | 11 | 83 | 107 | 14 | 2 | 123 |
| VIII | -- | 62 | 1/ 269 | -- | 16 | 347 | 49 | 4 | 3 | 56 |
| IX | 38 | 33 | 20 | 4 | 8 | 103 | 7 | 3 | 4 | 14 |
| Total | 1,061 | 1,295 | 577 | 77 | 288 | 3,298 | 377 | 98 | 122 | 597 |
| New lands: 2/ | | | | | | | | | | |
| IX | 1.4 | -- | 1.0 | 0.2 | 0.3 | 2.9 | -- | -- | -- | -- |
| X | -- | 5.9 | 17.8 | -- | 4.1 | 27.8 | -- | -- | -- | -- |
| XI | -- | -- | 7.2 | -- | 0.7 | 7.9 | -- | -- | -- | -- |

-- = None reported.
1/Chiefly sorghum for grain.
2/Averages for 1972-73 and 1973-74.

Appendix table 4--Production of permanent and winter crops on old lands, 1972-74 averages, by zones

| Zone | Orchards 1/ | Sugar-cane | Cotton | | Clover 2/ | Wheat | Other field crops | Vegetables | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lint | Seed | | | | Tomatoes | Other | |
| | 1,000 metric tons | | | | | | | | | |
| I | 267 | 124 | 141 | 255 | 20,250 | 459 | 141 | 98 | 124 | 21,859 |
| II | 298 | 74 | 105 | 257 | 11,025 | 395 | 88 | 43 | 94 | 12,379 |
| III | 382 | 102 | 25 | 33 | 4,515 | 132 | 86 | 63 | 203 | 5,541 |
| IV | 126 | -- | 6 | 11 | 1,350 | 20 | 34 | 6 | 7 | 1,560 |
| V | 70 | -- | 10 | 17 | 1,705 | 55 | 22 | 26 | 17 | 1,922 |
| VI | 156 | 951 | 111 | 202 | 7,400 | 311 | 3/ 384 | 75 | 43 | 9,633 |
| VII | 62 | -- | 18 | 33 | 2,730 | 93 | 44 | 51 | 7 | 3,038 |
| VIII | 51 | 6,085 | 40 | 70 | 2,680 | 291 | 3/ 289 | 37 | 18 | 9,561 |
| IX | 34 | -- | 6 | 9 | 1,430 | 22 | 18 | 22 | 10 | 1,551 |
| Total | 1,446 | 7,336 | 462 | 887 | 53,085 | 1,778 | 1,106 | 421 | 523 | 67,044 |

-- = None reported.
1/Excluding dates, for which no land area is computed.
2/Includes both catch-crop and full-term clover.
3/Chiefly horsebeans and lentils.

Appendix table 5 --Production of summer and Nili crops on old lands, by zones, 1972-74 averages

| Zone | Summer | | | | | | Nili | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rice | Maize | Other | Tomatoes | Other veg. | Total | Maize and sorghum 1/ | Vegetables Tomatoes | Vegetables Other | Total |
| | 1,000 metric tons | | | | | | | | | |
| I | 1,719 | 367 | 47 | 206 | 552 | 2,891 | 47 | 253 | 193 | 493 |
| II | 287 | 724 | 103 | 91 | 451 | 1,656 | 32 | 122 | 212 | 366 |
| III | 36 | 345 | 67 | 99 | 429 | 976 | 21 | 68 | 226 | 315 |
| IV | 56 | 62 | 9 | -- | 317 | 444 | 14 | 14 | 17 | 45 |
| V | 130 | 91 | 16 | 24 | 50 | 311 | 6 | 26 | 9 | 41 |
| VI | -- | 399 | 2/ 367 | 66 | 388 | 1,220 | 125 | 71 | 125 | 321 |
| VII | 30 | 18 | 45 | -- | 91 | 184 | 94 | 106 | 13 | 213 |
| VIII | -- | 95 | 2/ 414 | -- | 117 | 626 | 52 | 28 | 22 | 102 |
| IX | 67 | 44 | 20 | 26 | 136 | 293 | 6 | 14 | 7 | 27 |
| Total | 2,325 | 2,145 | 1,038 | 512 | 2,531 | 8,601 | 397 | 702 | 824 | 1,923 |

-- = None reported.
1/Chiefly for forage.
2/Chiefly sorghum for grain.

USDA/FAER-120

EGYPT: MAJOR CONSTRAINTS TO INCREASING AGRICULTURAL PRODUCTIVITY. (Foreign Agricultural Economic Report). Washington, DC: Economic Research Service. Jun. 1976.

(NAL Call No. A281.9/Ag8F)

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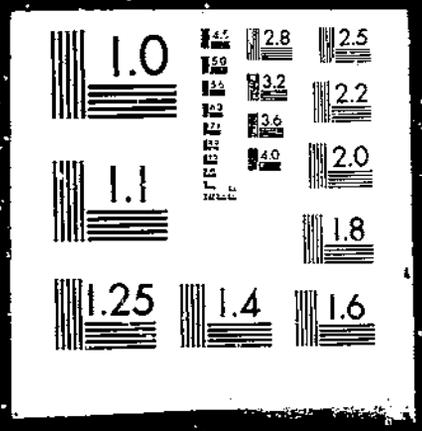

Appendix table 6--Number of animal units and available roughage on old lands, by agronomic zones, 1972-74

| Zone | Animal units AU 1/ | Roughage available: Winter | Roughage available: Summer and Nill | Roughage available: Total | Roughage per animal unit: Winter | Roughage per animal unit: Summer and Nill | Roughage per animal unit: Total | Starch equivalent 2/: Winter Total | Starch equivalent 2/: Winter Per AU | Starch equivalent 2/: Summer and Nill Total | Starch equivalent 2/: Summer and Nill Per AU | Starch equivalent 2/: Total Total | Starch equivalent 2/: Total Per AU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,000 | 1,000 tons | | | Tons | | | 1,000 Tons | Tons | 1,000 Tons | Tons | 1,000 Tons | Tons |
| I | 1,275 | 16,475 | 5,793 | 22,268 | 12.9 | 4.5 | 17.4 | 1,383 | 1.08 | 762 | 0.60 | 2,145 | 1.7 |
| II | 1,425 | 9,950 | 1,786 | 11,736 | 7.0 | 1.3 | 8.3 | 855 | 0.60 | 250 | 0.17 | 1,105 | 0.8 |
| III | 517 | 3,625 | 1,081 | 4,706 | 7.0 | 2.1 | 9.1 | 304 | 0.59 | 199 | 0.38 | 503 | 1.0 |
| IV | 115 | 1,100 | 338 | 1,438 | 9.6 | 2.9 | 12.5 | 92 | 0.80 | 41 | 0.35 | 133 | 1.2 |
| V | 247 | 1,386 | 501 | 1,887 | 5.6 | 2.0 | 7.6 | 116 | 0.47 | 101 | 0.41 | 217 | 0.9 |
| VI | 844 | 6,062 | 1,902 | 7,982 | 7.2 | 2.3 | 9.5 | 509 | 0.60 | 247 | 0.29 | 756 | 0.9 |
| VII | 178 | 2,260 | 672 | 2,932 | 12.7 | 3.8 | 16.5 | 190 | 1.07 | 84 | 0.47 | 274 | 1.5 |
| VIII | 730 | 2,680 | 503 | 3,183 | 3.7 | 0.7 | 4.4 | 225 | 0.31 | 116 | 0.16 | 341 | 0.5 |
| IX | 44 | 1,152 | 390 | 1,542 | 26.2 | 8.9 | 35.1 | 97 | 2.20 | 47 | 1.07 | 144 | 3.3 |
| Total | 5,375 | 44,690 | 12,984 | 57,674 | 8.3 | 2.4 | 10.7 | 3,771 | 0.70 | 1,847 | 0.34 | 5,618 | 1.0 |

1/An approximate measure of the nutritive value of various types of forage, which varies from 8.3 percent for full-term clover to 24.0 percent for horsebean stalks. For all forage crops combined, the starch equivalent is about 10 percent of the gross tonnage. A level of 1.8 tons per year of starch equivalent is required per AU.

Appendix table 7--Crop areas on old lands by seasons, 1985, proposed land area, and cropping ratios, by agronomic zones

| Zone | Permanent crops 1/ | Cotton | Winter 2/ | Summer | Nili | Total | Land area | Cropping ratio |
|---|---|---|---|---|---|---|---|---|
| | 1,000 feddans | | | | | | | |
| I | 66 | 529 | 1,614 | 1,085 | 155 | 3,449 | 1,680 | 2.05 |
| II | 60 | 391 | 930 | 539 | 154 | 2,074 | 990 | 2.10 |
| III | 75 | 79 | 345 | 266 | 166 | 931 | 420 | 2.22 |
| IV | 24 | 30 | 126 | 96 | 47 | 323 | 150 | 2.15 |
| V | 16 | 38 | 154 | 116 | 44 | 368 | 170 | 2.16 |
| VI | 71 | 393 | 994 | 601 | 197 | 2,256 | 1,065 | 2.12 |
| VII | 18 | 85 | 262 | 177 | 145 | 687 | 280 | 45 |
| VIII | 3/241 | 128 | 469 | 341 | 203 | 1,382 | 710 | 1.95 |
| IX | 9 | 27 | 126 | 99 | 19 | 280 | 135 | 2.07 |
| Total | 580 | 1,700 | 5,020 | 3,320 | 1,130 | 11,750 | 5,600 | 2.10 |

1/Orchards, vineyards, sugarcane, excluding dates.
2/Including catch-crop clover.
3/Chiefly sugarcane.

Appendix table 8--Permanent and winter season crops on old lands, 1985 proposed area, by agronomic zones

| Zone | Orchard | Sugar-cane | Cotton | Clover 1/ | | Wheat | Other field crops | Vegetables | | Total crop area |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Catch | Permanent | | | Tomatoes | Other | |
| | 1,000 feddans | | | | | | | | | |
| I | 59 | 7 | 529 | 484 | 614 | 400 | 71 | 24 | 21 | 2,209 |
| II | 56 | 4 | 391 | 367 | 265 | 240 | 34 | 10 | 14 | 1,381 |
| III | 71 | 4 | 79 | 79 | 28 | 99 | 22 | 41 | 76 | 499 |
| IV | 24 | -- | 30 | 30 | 11 | 24 | 45 | 4 | 12 | 180 |
| V | 16 | -- | 38 | 38 | 24 | 34 | 34 | 18 | 6 | 208 |
| VI | 35 | 36 | 393 | 365 | 84 | 242 2/ | 275 | 19 | 9 | 1,458 |
| VII | 18 | -- | 85 | 82 | 30 | 90 | 38 | 19 | 3 | 365 |
| VIII | 12 | 229 | 128 | 128 | 32 | 140 2/ | 139 | 18 | 12 | 838 |
| IX | 9 | -- | 27 | 27 | 12 | 6 | 67 | 8 | 6 | 162 |
| Total | 300 | 280 | 1,700 | 1,600 | 1,100 | 1,275 | 725 | 161 | 159 | 7,300 |

-- = None reported.

1/Egyptian or berseem clover. Catch-crop clover follows cotton and provides one or two cuttings before a new crop of cotton is planted. Permanent or full-term clover yields 3-4 cuttings over a 6-month period.

2/Chiefly horsebeans and lentils.

Appendix table 9--Summer and Nili crops on old lands, 1985, proposed area, by agronomic zones

| Zone | Summer | | | | | | | Nili | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rice | Maize | Green fodder 1/ | Other field crops | Vegetables: Tomatoes | Vegetables: Other | Total | Green fodder 1/ | Vegetables: Tomatoes | Vegetables: Other | Total |
| | 1,000 feddans | | | | | | | | | | |
| I | 875 | 55 | 50 | 15 | 31 | 59 | 1,085 | 35 | 92 | 28 | 155 |
| II | 148 | 202 | 104 | 3 | 16 | 66 | 539 | 124 | 30 | 65 | 154 |
| III | 19 | 126 | 40 | 10 | 17 | 54 | 266 | 87 | 18 | 61 | 166 |
| IV | 28 | 20 | -- | 1 | -- | 47 | 96 | 34 | 3 | 10 | 47 |
| V | 65 | 12 | 25 | 2 | 5 | 7 | 116 | 35 | 7 | 2 | 44 |
| VI | -- | 315 | 98 | 2/ 120 | 13 | 55 | 601 | 136 | 20 | 41 | 197 |
| VII | 16 | 95 | 10 | 2/ 43 | -- | 13 | 177 | 50 | 26 | 4 | 145 |
| VIII | 24 | 74 | 68 | 2/ 156 | -- | 19 | 341 | 50 | 8 | 6 | 203 |
| IX | 25 | 51 | 5 | -- | 4 | 14 | 99 | 10 | 6 | 3 | 19 |
| Total | 1,200 | 950 | 400 | 350 | 86 | 334 | 3,320 | 700 | 210 | 220 | 1,130 |

-- = None reported.
1/Sweet sorghum and maize.
2/Chiefly sorghum for grain.

Appendix table 10-Projected 1985 production of permanent and winter crops on old lands, by agronomic zones

| Zone | Orchard 1/ | Sugar-cane | Cotton lint | Cotton seed | Clover 2/ | Wheat | Other field crops | Vegetables Tomatoes | Vegetables Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1,000 Metric tons | | | | | | | | | |
| I | 450 | 236 | 169 | 312 | 25,680 | 676 | 119 | 162 | 214 | 28,018 |
| II | 486 | 145 | 141 | 352 | 13,455 | 499 | 46 | 70 | 160 | 15,354 |
| III | 628 | 165 | 60 | 44 | 2,025 | 206 | 68 | 240 | 775 | 4,211 |
| IV | 203 | -- | 8 | 15 | 780 | 31 | 59 | 23 | 27 | 1,146 |
| V | 123 | -- | 14 | 24 | 1,290 | 62 | 44 | 103 | 61 | 1,721 |
| VI | 279 | 1,665 | 149 | 275 | 7,995 | 472 | 3/ 155 | 128 | 73 | 11,191 |
| VII | 107 | -- | 24 | 45 | 2,130 | 140 | 56 | 171 | 29 | 2,702 |
| VIII | 102 | 10,591 | 55 | 95 | 2,880 | 218 | 3/ 581 | 151 | 72 | 14,745 |
| IX | 54 | -- | 8 | 13 | 765 | 8 | 74 | 68 | 36 | 1,026 |
| Total | 2,432 | 12,802 | 628 | 1,175 | 57,000 | 2,312 | 1,202 | 1,116 | 1,447 | 80,114 |

-- = None reported.

1/Excluding dates.

2/Egyptian or berseem clover. Catch-crop clover follows cotton and provides one or two cuttings before a new crop is planted. Full-term clover yields 3-4 cuttings over a 6-months period.

3/Chiefly horsebeans and lentils.

Appendix table 11--Projected 1985 production of summer and Nili crops, old lands, by agronomic zones

| Zone | Summer | | | | | | | Nili | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rice | Maize | | Other | Tomatoes | Other veg. | Total | Maize Grain | Sorghum fodder | Vegetables | | Total |
| | | Grain | Fodder | | | | | | | Tomatoes | Other | |
| | 1,000 Metric tons | | | | | | | | | | | |
| I | 2,310 | 117 | 900 | 34 | 316 | 847 | 4,524 | -- | 630 | 1,021 | 284 | 1,935 |
| II | 391 | 483 | 1,872 | 17 | 158 | 796 | 3,717 | -- | 2,232 | 342 | 606 | 3,180 |
| III | 46 | 276 | 720 | 29 | 178 | 751 | 2,002 | -- | 1,566 | 192 | 644 | 2,402 |
| IV | 74 | 43 | -- | 5 | -- | 561 | 683 | -- | 612 | 40 | 46 | 698 |
| V | 171 | 27 | 450 | 2 | 50 | 83 | 783 | -- | 630 | 71 | 25 | 726 |
| VI | -- | 671 | 1,764 | 276 | 121 | 683 | 3,516 | -- | 2,448 | 240 | 354 | 3,042 |
| VII | 33 | 177 | 180 | 87 | -- | 166 | 643 | -- | 900 | 300 | 41 | 1,241 |
| VIII | 60 | 158 | 1,224 | 331 | -- | 205 | 1,978 | -- | 3,402 | 80 | 58 | 3,540 |
| IX | 54 | 95 | 90 | -- | 37 | 256 | 532 | -- | 180 | 50 | 30 | 260 |
| Total | 3,141 | 2,047 | 7,200 | 781 | 860 | 4,349 | 18,378 | -- | 12,600 | 2,336 | 2,088 | 17,024 |

-- = None reported.

Appendix table 12--Projected roughage available on old lands in 1985, by agronomic zones

| Zone | Animal units AU 1/ | Roughage available | | | Roughage per animal unit | | | Starch equivalent 2/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Winter | | Summer and Nili | | Total | |
| | | Winter | Summer and Nili | Total | Winter | Summer and Nili | Total | Total | Per AU. | Total | Per AU. | Total | Per AU. |
| | 1,000 | ----1,000 Metric tons---- | | | ------Metric tons------ | | | 1,000 tons | Tons | 1,000 tons | Tons | 1,000 tons | Tons |
| I | 1,275 | 21,075 | 3/8,415 | 29,490 | 16.5 | 6.6 | 23.1 | 1,771 | 1.39 | 1,184 | 0.93 | 2,955 | 2.32 |
| II | 1,425 | 11,468 | 3/6,830 | 18,298 | 8.0 | 4.8 | 12.8 | 968 | 0.68 | 1,100 | 0.77 | 2,068 | 1.45 |
| III | 517 | 2,025 | 2,519 | 4,544 | 3.9 | 4.9 | 8.8 | 172 | 0.33 | 469 | 0.91 | 641 | 1.24 |
| IV | 115 | 780 | 732 | 1,512 | 6.8 | 6.4 | 13.2 | 66 | 0.57 | 132 | 1.15 | 198 | 1.72 |
| V | 247 | 1,290 | 1,227 | 2,517 | 5.2 | 5.0 | 10.2 | 109 | 0.44 | 244 | 0.99 | 353 | 1.43 |
| VI | 844 | 7,365 | 3/5,788 | 13,153 | 8.7 | 6.9 | 15.6 | 628 | 0.74 | 1,056 | 1.25 | 1,684 | 1.99 |
| VII | 178 | 1,905 | 1,559 | 3,464 | 10.7 | 8.8 | 19.5 | 162 | 0.91 | 459 | 2.58 | 621 | 3.49 |
| VIII | 730 | 2,880 | 4,976 | 7,856 | 3.9 | 6.8 | 10.7 | 245 | 0.34 | 913 | 1.25 | 1,158 | 1.59 |
| IX | 44 | 675 | 3/464 | 1,139 | 15.3 | 10.5 | 25.8 | 57 | 1.30 | 80 | 1.82 | 137 | 3.12 |
| Total | 5,375 | 49,463 | 32,510 | 81,973 | 9.2 | 6.0 | 15.2 | 4,178 | 0.78 | 5,637 | 1.05 | 9,815 | 1.83 |

1/Assumed to remain the same as 1972-74 average.

2/An approximate measure of the nutritive value of various types of forage which varies from 8.3 percent for full-term clover to 24.0 percent for horsebean stalks. For all forage crops combined the starch equivalent is about 10 percent of the gross tonnage. A level of 1.8 tons per year of starch equivalent is required per AU.

3/Includes carryover of fourth cutting of full-term clover from winter to summer.

Appendix table 13--Water and labor requirements on old land by zones, by months, 1972-74 1/

| Zone | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water requirements -- billion cubic meters 2/ | | | | | | | | | | | | |
| I | 0.34 | 0.42 | 0.63 | 0.82 | 2.19 | 2.47 | 2.62 | 1.99 | 1.25 | 0.30 | 0.40 | 0.56 | 13.99 |
| II | .21 | .25 | .36 | .54 | 1.07 | 1.27 | 1.16 | .63 | .32 | .19 | .25 | .33 | 6.59 |
| III | .12 | .13 | .19 | .26 | .44 | .55 | .51 | .27 | .15 | .14 | .17 | .18 | 3.10 |
| IV | .04 | .04 | .06 | .07 | .16 | .19 | .19 | .14 | .09 | .05 | .05 | .06 | 1.13 |
| V | .05 | .05 | .08 | .09 | .22 | .26 | .26 | .18 | .11 | .04 | .05 | .06 | 1.45 |
| IX | .04 | .04 | .06 | .07 | .17 | .19 | .20 | .14 | .08 | .03 | .04 | .05 | 1.13 |
| Total Delta | .79 | .93 | 1.39 | 1.86 | 4.24 | 4.93 | 4.94 | 3.34 | 2.00 | .75 | .96 | 1.24 | 27.38 |
| VI | .32 | .37 | .50 | .58 | .92 | 1.14 | 1.02 | .50 | .22 | .30 | .34 | .41 | 6.63 |
| VII | .07 | .09 | .12 | .15 | .22 | .22 | .20 | .18 | .16 | .16 | .11 | .09 | 1.76 |
| Total mid-Egypt | .39 | .46 | .62 | .73 | 1.14 | 1.37 | 1.22 | .68 | .38 | .46 | .45 | .50 | 8.38 |
| VIII | .21 | .32 | .43 | .51 | .73 | 1.01 | 1.02 | .63 | .49 | .34 | .34 | .33 | 6.36 |
| Grand total | 1.39 | 1.71 | 2.44 | 3.10 | 6.11 | 7.31 | 7.18 | 4.65 | 2.86 | 1.55 | 1.74 | 2.07 | 3/42.13 |
| | Labor requirements--million man-days 4/ | | | | | | | | | | | | |
| I | 3.06 | 6.30 | 5.88 | 10.43 | 18.07 | 27.75 | 14.30 | 5.82 | 14.53 | 15.05 | 6.26 | 5.18 | 132.62 |
| II | 1.81 | 4.22 | 3.89 | 7.28 | 10.49 | 13.77 | 8.35 | 4.11 | 9.96 | 6.26 | 2.24 | 3.31 | 75.70 |
| III | 1.01 | 2.22 | 1.54 | 2.99 | 4.19 | 5.23 | 2.98 | 2.41 | 3.33 | 2.48 | .93 | 1.86 | 31.16 |
| IV | .62 | .72 | .54 | 1.07 | 1.12 | 1.75 | 1.04 | .80 | 1.14 | 1.06 | .52 | .68 | 11.07 |
| V | .50 | .65 | .55 | 1.11 | 1.87 | 2.75 | 1.38 | .84 | 1.34 | 1.43 | .66 | .65 | 13.73 |
| IX | .23 | .49 | .40 | .77 | 1.22 | 1.87 | .99 | .62 | .97 | 1.11 | .60 | .46 | 9.73 |
| Total Delta | 7.23 | 14.60 | 12.80 | 23.65 | 36.96 | 53.12 | 29.04 | 14.60 | 31.27 | 27.39 | 11.21 | 12.14 | 274.01 |
| VI | 1.94 | 3.87 | 5.46 | 8.27 | 9.80 | 10.32 | 8.05 | 5.66 | 11.16 | 8.53 | 2.33 | 3.16 | 78.56 |
| VII | .75 | 1.04 | .96 | 1.83 | 2.62 | 2.58 | 2.17 | 1.96 | 3.00 | 2.64 | 1.14 | 1.27 | 21.96 |
| Total mid-Egypt | 2.69 | 4.91 | 6.42 | 10.10 | 12.42 | 12.90 | 10.22 | 7.62 | 14.16 | 11.17 | 3.47 | 4.43 | 100.52 |
| VIII | 2.45 | 4.11 | 6.45 | 7.67 | 9.29 | 6.30 | 4.21 | 4.57 | 6.67 | 7.37 | 1.97 | 2.32 | 63.36 |
| Grand total | 12.37 | 23.62 | 25.67 | 41.42 | 58.67 | 72.32 | 43.47 | 26.79 | 52.10 | 45.93 | 16.65 | 18.89 | 437.89 |

1/High and low months are underlined. Totals are based on unrounded numbers.
2/After adjustment for estimated efficiency of delivery system.
3/If approximately 4 billion cubic meters are required for new lands, this figure is consistent with the 46 billion cubic meter estimate of required release from the Aswan High Dam for irrigation in 1974.
4/Labor used to produce vegetables is omitted. Total requirements for each of the three vegetable crops are shown in text table 7.

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