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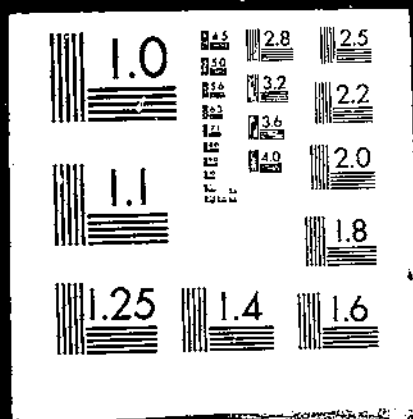
USDA/FAER-48

AGRICULTURAL DEVELOPMENT AND EXPANSION IN THE NILE BASIN: PROGRAMS--PRODUCTION--IMP-  
PLICATIONS FOR U. S. AGRICULTURE. (Foreign Agricultural Economic Report). / Cline J.  
Warren. Washington, DC: Economic Research Service. Oct. 1968.  
(NAL Call No. A281.97Ag8F)

# 1 OF 2

## USDA

### FAER-48



FOREIGN AGRICULTURAL ECONOMIC REPORT NO. 48

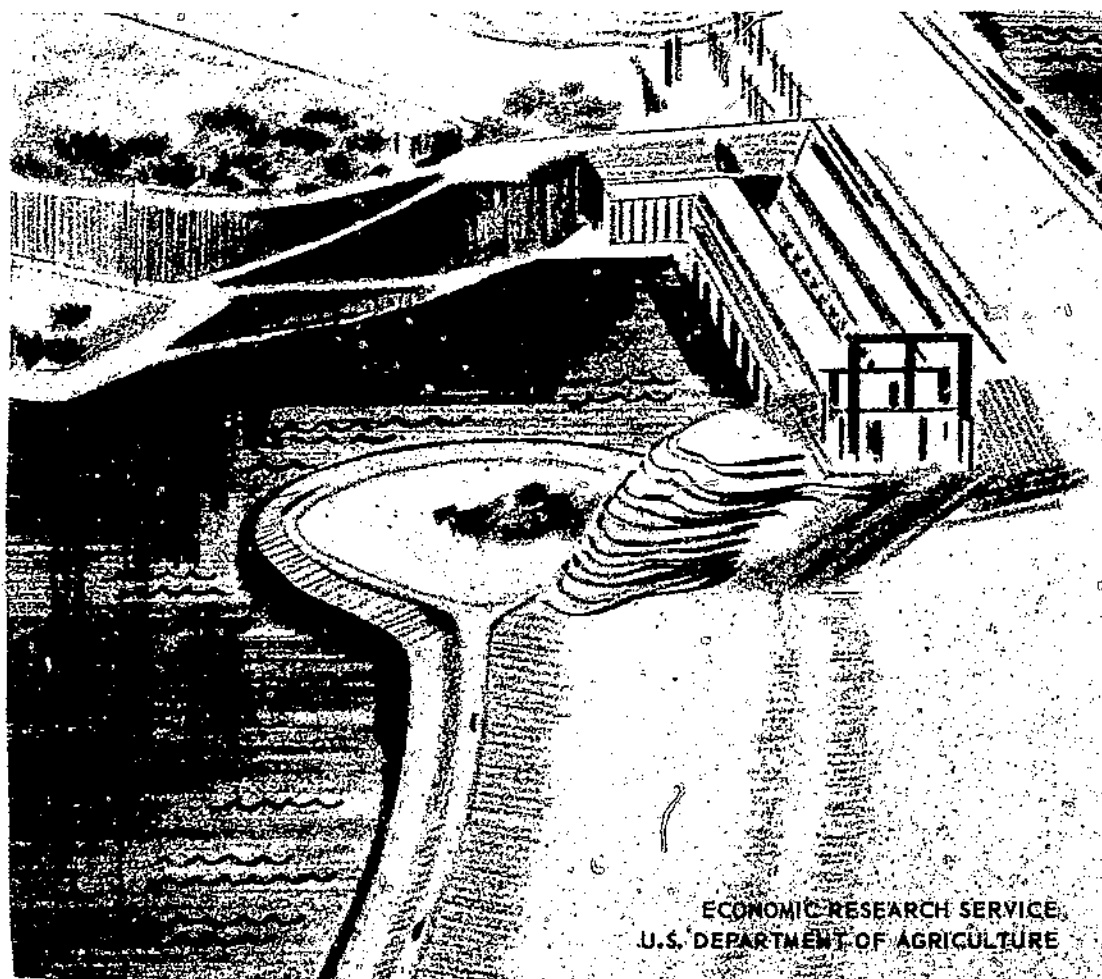
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# Agricultural Development and Expansion in the NILE BASIN

500 12th St., SW, Room 501  
Washington, D. C. 20250

Programs • Production • Implications for U.S. Agriculture



ECONOMIC RESEARCH SERVICE  
U.S. DEPARTMENT OF AGRICULTURE



## UNITED ARAB REPUBLIC

Government: The United Arab Republic has been an independent nation since 1922. Egypt merged with Syria (presently the Syrian Arab Republic) in February 1958 to form the United Arab Republic. Although Syria withdrew from the union in September 1961, Egypt continues under the official title of "UNITED ARAB REPUBLIC."

Resources: The UAR has an area of 386,000 square miles, an area about equal to Texas and New Mexico combined. Only 3 percent of this is significant for agricultural purposes; the remainder is desert. Multiple cropping is practiced, and the country's cultivable area of 6.4 million acres produces 10.6 million acres of harvested crops annually. Tourist attractions, along with the small but growing petroleum industry, must be listed with agriculture as major resources. The Suez Canal was also a leading foreign exchange earner before becoming inoperative during the Middle East crisis of June 1967.

The population of the UAR has doubled in the last three decades; by 1967 it was 31.2 million. With increased industrial development, that portion employed in agriculture is declining, now amounting to 60 percent of the total. The gross national product in 1966 was \$5.1 billion, or \$168 per person.

Agriculture: Egyptian agriculture is quite progressive; farming is intensive and depends on irrigation. Cotton is the most important commercial crop; rice and onions are important export crops. Wheat, rice, corn, and pulses are the main food crops. Livestock products contribute one-fifth of farm income.

Egyptian agriculture is subjected to strict governmental control. Land reform, reclamation, and crop diversification have been undertaken to expand food production and export crops.

Agricultural Problems: Small holdings, soil salinity, and extremely limited natural resources for expanding production are the UAR's main agricultural problems.

Foreign Trade: Over two-thirds of all of the UAR's exports are agricultural--mainly long and extra-long staple cotton, rice, and onions. Principal agricultural imports are wheat, wheat flour, coarse grain, tallow, and tobacco. As a very unfavorable balance of trade prevails, importation of essential materials and capital goods is given priority over consumer items.

## SUDAN

Government: Sudan has been an independent republic since January 1, 1956. The former Anglo-Egyptian Sudan had a national government that was something of a rarity--a condominium governed by both the United Kingdom and Egypt.

Resources: Sudan, with an area of 967,500 square miles, is the largest country in Africa and is bigger than that portion of the United States east of the Mississippi River. Its population, growing at an annual rate of 2.5 percent, reached 14.3 million in mid-1967. The economy depends heavily on agriculture, cotton production in particular. About 85 percent of the labor force is engaged in agriculture, which provides about half of the gross national product (GNP). Estimated GNP for 1966 was \$1.5 billion. Per capita GNP for 1966 was about \$106.

Physical Features: Much of the land area is a basin less than 3,000 feet above sea level and is drained by the Nile River and its tributaries, the White Nile, the Blue Nile, the Sobat River, and the Atabara River. Average monthly temperatures throughout the country are high. Desert conditions prevail in the north as compared with tropical rain lands in the south.

Agriculture: Subsistence farming is the chief economic activity in Sudan. Commercial agriculture is centered mainly around the production and foreign sale of cotton. Given political stability, a considerable potential exists for the expansion of cotton, grain, oilseed and livestock numbers.

Agricultural Problems: Greater crop diversification, inadequate labor supply, lack of expanded port and transportation facilities, and poor livestock management practices and cultural techniques are the main deterrents to agricultural progress.

Foreign Trade: Close to 95 percent of all foreign earnings come from agricultural commodities--cotton lint and cottonseed accounted for 72 percent of total exports in 1966. Other exports of less value are gum arabic, peanuts, sesame, livestock, and hides and skins.

Virtually all manufactured consumer goods, capital equipment, fuels, and building materials must be imported. Agricultural commodities account for approximately one-fifth of total imports and are confined chiefly to sugar, wheat flour, tea, and coffee.

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Washington, D. C. 20250

October 1968



## SUMMARY

Several development projects designed to increase the agricultural potential of the United Arab Republic (UAR) and Sudan are underway in the Nile Basin. Completion of three of the major projects--construction of the High Aswan Dam in the UAR and the Roseires and Kashm El Girba Dams in Sudan--will make it possible to expand the cultivated land in the area by approximately 3 million acres. The two countries will share equally the additional acreage, the major portion of which is intended to be under cultivation within the next decade. In the UAR, an additional 1.5 million acres in cultivated acreage will be equivalent to 2.6 million crop acres.

In both the UAR and Sudan, crop production will be affected by the availability of additional water from the Nile River. The pace at which available water can be utilized for expanding crop production will determine how soon benefits can be obtained from large investments already made. Completion of the High Aswan Dam will increase the total amount of water available in the UAR by 7.5 billion cubic meters, about half the amount (14.5 billion cubic meters) available in Sudan. Thus, agricultural expansion in the UAR will be limited. Sudan, on the other hand, is in a good position to substantially increase its production of sugarcane, cotton, wheat, oilseeds, and other crops that require large quantities of water.

Costs and returns will obviously have a significant bearing on what crops will be grown in newly developed areas. The limited data available for the years before 1963 indicate that onion production provided the greatest returns to land and management in the UAR. The next most profitable crops were cotton, sugarcane, and peanuts. Cotton provided the highest net returns per acre in Sudan. Agricultural specialists in the Nile Basin believe that in the more recent years, net returns for selected fruits and vegetables have compared favorably with returns for cotton and onions. Furthermore, they feel that in the future, fruits and vegetables may prove increasingly more profitable than cotton.

Land use in the UAR and Sudan has been largely determined by an agricultural policy which places great emphasis on the production and foreign sale of extra-long staple cotton. Cotton is not only the chief economic link with the outside world for both countries, but it is by far the most valuable cash crop grown locally. It will continue to be the most important crop within the Nile Basin for some years to come. However, increasing demand both locally and abroad for food commodities will undoubtedly influence future cropping patterns in the UAR and Sudan.

The current annual wheat deficit in the UAR exceeds 2 million metric tons. Indications are that a large deficit will still exist by the time the full impact of the High Aswan Dam is realized. At the same time, a surplus of rice and cotton will be available for export. Prospects are for a continued oilseed deficit in the United Arab Republic. Larger quantities of corn will very likely be available for human consumption or to meet feed requirements of an expanded livestock industry.

The largest part of the newly developed land in Sudan will probably be used to produce crops for export. Current development programs may well increase Sudanese cotton production by 75 percent by 1975. Production averaged 171,000 metric tons in 1965-66. Most of this increase will be available for export, as no major development in the cotton textile industry is anticipated during the next decade. Production of sorghum, peanuts, sesame, and pulses will more than meet domestic requirements; thus, increased quantities will be available for export. There are also indications that the country will probably become self-sufficient in wheat production.

A realization of anticipated expansion in cotton production in the Nile Basin will undoubtedly have a decided impact on the world's extra-long staple cotton situation within the next decade. Extra-long staple varieties compete with U. S. cotton exports to the extent that they are substituted for short-staple varieties by major manufacturers of textiles. Increased supplies from this area, supplemented by larger quantities from other producers of these varieties, could depress world prices of all varieties of

cotton. It is also possible that Sudan will undertake a program to expand the output of upland cotton, exports of which would compete directly with U. S. cotton on the world market.

The prospect of feed grain surpluses in Sudan could also be of significance to U. S. trade. Sudanese surplus feed grain shipments will compete with U. S. exports to Western Europe. Potential exports of oilseeds, citrus, and vegetables could also be a source of increased competition for U. S. foreign sales of these commodities. A shortage of foreign exchange earnings will probably plague both countries for some time. Nevertheless, the UAR and Sudan could provide a growing market for tobacco, tallow, and dairy products.

AGRICULTURAL DEVELOPMENT AND EXPANSION  
IN THE NILE BASIN  
Programs--Production--Implications for  
U.S. Agriculture

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INTRODUCTION

The purpose of this study is to determine how much agricultural production is likely to increase as a result of the completion of major development projects in the Nile Basin <sup>1/</sup>. Consideration is given to existing agricultural potential. The implications of increased farm production are appraised both from the standpoint of their probable impact on local economies and the international market for farm products.

More specifically, the study attempts to answer a series of questions, among which are the following: (1) What is the probability that major development projects within the Nile Basin will be completed? (2) To what degree will increased food production meet the needs of the region's rapidly growing population or eliminate the area's growing food deficit? (3) What effect will these developments have on the production and trade of products that compete with U. S. farm exports?

In arriving at an estimate of the increase in agricultural production that might be expected in the next decade, consideration is given to (1) water supply; (2) canals and drains; (3) potential cultivated area; (4) availability of labor, machinery,

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<sup>1/</sup> The Nile Basin encompasses the United Arab Republic (Egypt), Sudan, Uganda, one-third of Ethiopia, parts of Kenya, Tanzania, Rwanda, Burundi, and the Republic of the Congo. This study is limited to the United Arab Republic and Sudan, as they are the prime users of Nile waters and the only countries within the Nile Basin with major development projects currently underway to more fully utilize these waters.

fertilizers, seeds, and other production inputs; and (5) prospects for improved yields on current cultivated acreage. Attention is also given to the adequacy of the institutional structure in both countries to meet the needs of an expanding agricultural economy.

Analysis relating to the prospect of meeting local food needs is confined to the area's principal grains, since cereals make up approximately two-thirds of the total calories consumed there. Special emphasis is given to grains, cotton, and oilseeds in appraising the effect of increases in production of these commodities on products that compete with U. S. farm exports.

Consideration is given to several institutional bottlenecks that tend to hamper progress. However, no attempt has been made to provide a full or separate analysis of these institutions except as they relate to economic problems associated directly with various development projects.

The author spent most of the months of November and December 1966 in the United Arab Republic and Sudan. He visited the construction site of the High Aswan Dam, Sakha Research Farm, Kima Fertilizer Plant, and reclamation projects in the At Tahrir Province. In Sudan, he visited the Kashm El Girba and Roseires Dam sites, the Gezira Scheme, and the Wad Medani Research Station. He consulted many Government officials of both countries, as well as private agencies and individuals. Since he was in the area before the political and military conflict of June 1967, he consulted officials of the U. S. Embassy and the Agency for International Development. Before visiting the area, he held conferences with persons in Washington who had recently worked in one or both of these countries.

#### ECONOMIC IMPORTANCE OF THE NILE

The availability of water from the Nile throughout the year, combined with the area's unusually high temperatures, makes possible continuous agricultural production along its banks. The Nile River is practically the only source of water in the United Arab Republic, as rainfall is almost totally lacking and the use of underground water by wells is still in its infancy.

The Nile becomes increasingly more valuable as it makes its way from areas in the south where rainfall is abundant through the semidesert region and finally through desert areas of the north. Along both banks, throughout the desert and semidesert regions, it is an assured source of water for crops that require more water than rainfall alone can provide. Water is brought to the land either by large dams and a network of canals, or by hand-operated dippers, animal-driven water wheels, and diesel pumps. The Seluka land, low-lying areas along the very edges of the river, requires no irrigation beyond that provided by the silt-laden Nile floods. <sup>2/</sup>

Through a combination of the means just mentioned, the Nile furnishes water for about 20 percent of Sudan's total cultivated area; the remainder is rainfed. Even in those regions of Sudan where average annual rainfall is sufficient for crop production, marked year-to-year variation often makes cropping without irrigation hazardous. Although rainfall is adequate throughout the extreme southern part of Sudan for the growth of virtually all tropical plants, water from the Nile and its tributaries is almost entirely responsible for that country's total commercial agricultural production.

In addition to providing irrigation water for agriculture, the Nile serves as an important inland waterway for transport purposes. Recent improvement of air, rail, and highway facilities has generally reduced dependence on waterways as a means of transport. Even so, river steamers still remain the only transport facilities in much of the area. In the UAR, there are more than 2,000 miles of inland waterways, which are divided almost equally between the Nile and canals.

For the UAR and Sudan, the true economic importance of the Nile is far greater than the contribution of their agricultural sectors to the gross national product would indicate. The agricultural sector plays a particularly important role in providing the base on which a substantial part of the development in the industrial and service sectors of their economies has been

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<sup>2/</sup> Such practices will no longer be carried on from Aswan to the Mediterranean after the completion of the High Aswan Dam.

built. Most dams constructed along the Nile or its tributaries have included hydroelectric power plants. Along with other uses, electricity produced in the UAR is used for the manufacture of fertilizers. Hydroelectric potential from the High Aswan Dam, 10 billion kilowatt hours per year, should make for increased fertilizer production in the near future. A review of the prospect of using electricity to develop the area's fertilizer potential is given later in the discussion of production of inputs.

#### Water Resources for Irrigation

In the absence of any rainfall of significance in the UAR and much of Sudan, the flow of the Nile is determined by the topography of the Central African Highlands--Tanzania, Kenya, Ethiopia, Rwanda, Burundi, Uganda, and the Republic of the Congo. In addition to being influenced by climate and terrain, the flow of the Nile is influenced by withdrawals and releases of water from storage at a series of dams (table 1). The enormous variation in its annual flow is illustrated by the fact that since the turn of this century, annual flow has been as high as 155 billion cubic meters and as low as 42 billion cubic meters (16).

The flow of the river is also greatly influenced by the seasons. August through October is the flood period and February through June (and until the river rises in July) is the lowest supply period. Consequently, efforts have been made to regulate fluctuations and to develop irrigation facilities to suit agricultural conditions. These include the construction of dams, the latest of which are the Egyptian High Aswan Dam and Sudan's Kashm El Girba and Roseires Dams, barrages, irrigation and distribution canals, pumping stations, and drainage facilities. The additional volume of water to be made available for irrigation by 1970 is given in table 2.

According to the terms of the 1959 Nile Waters Treaty, the UAR could withdraw 48 billion cubic meters (38.9 million acre-feet) of water from the Nile's average annual flow of 84 billion cubic meters. Sudan's share was 4 billion cubic meters (3.2 million acre-feet). This left 32 billion cubic meters unallocated to flow into the Mediterranean. After allowing for evaporation, the High Aswan Dam project will conserve some 22 billion cubic

Table 1.--Dams on the Nile or its tributaries as of 1967

Name of dam	Country	Storage capacity	Comment
		Billion cubic meters	
Owen Falls (White Nile) . . . . .	Uganda	---	(1) Construction completed 1954 (2) Produces hydroelectric power
Jebel Aulia (White Nile) . . . . .	Sudan	2.5	(1) Construction completed 1937 (2) Water for the benefit of UAR
Sennar (Blue Nile) . . . . .	Sudan	.9	(1) Completed 1925 (2) Produces hydroelectric power
Kashm El Girba (Atbara River) . . . . .	Sudan	1.3	(1) Completed 1964 (2) Produces hydroelectric power
Roseires (Blue Nile) . . . . .	Sudan	2.7	(1) Completed 1966 (2) Not presently equipped to generate electricity
Aswan . . . . .	United Arab Republic	5.0	(1) Completed 1902 (2) Heightened twice (3) Produces hydroelectric power
High Aswan . . . . .	United Arab Republic	18.0	(1) To be completed in 1968 (2) To produce hydroelectric power



Table 2.--Volume of water available for irrigation, UAR and Sudan, 1959 and projections for 1970

Source	Available supply		
	: As a result		
	: of current		
	: development		
	1959	1970	projects
: -- -Billion cubic meters- -- -			
United Arab Republic:			
Jebel Aulia Reservoir . . .	2.5	2.5	--
Aswan Reservoir . . . . .	5.0	5.0	--
High Aswan Reservoir . . .	--	48.0	7.5
Withdrawal from High Nile: <u>1/</u> 40.5		--	--
Total . . . . .	48.0	<u>2/</u> 55.5	7.5
Sudan:			
Jebel Aulia Reservoir <u>3/</u> . .	.6	.6	--
Sennar Reservoir . . . . .	.9	.9	--
Roseires Reservoir . . . . .	--	2.7	2.7
Kashm El Girba Reservoir:	--	1.3	1.3
Withdrawal from river . . .	2.5	13.0	10.5
Total . . . . .	4.0	18.5	14.5
Total available for agricultural:			
use . . . . .	52.0	<u>4/</u> 74.0	22.0
Evaporation and other losses . .	32.0	10.0	--
Nile's average annual flow at			
Aswan . . . . .	84.0	84.0	--

1/ Withdrawal from river before the construction of the High Aswan Dam, a practice known as basin irrigation. 2/ Does not include 2.0 billion cubic meters from subground water and reusable drainage water. After allowances for amounts to be used by humans, livestock, and industry, only 53.8 billion cubic meters are available for agriculture. 3/ This reservoir was constructed to serve Egyptian agriculture; however, the Sudan can withdraw water from it after the water reaches a given height. 4/ No allowance was made for the use of subground water in the Sudan.

Source: (16, 20).

meters of this total. According to the revised Nile Waters Treaty of 1959, the United Arab Republic is to receive 7.5 billion cubic meters of this additional water, and Sudan the remaining 14.5 billion cubic meters. 3/ On these terms, the total amount of Nile water now available to the UAR is 55.5 billion cubic meters (45.0 million acre-feet), compared with 18.5 billion cubic meters (15.0 million acre-feet) for Sudan 4/. These amounts are measured at Aswan. Evaporation and other natural losses have been taken into account.

Sources other than the Nile are to increase the total annual water supply for Egyptian agriculture by 2.0 billion cubic meters by 1970. They include wells which are used to utilize the sub-ground water in various parts of the delta and the western desert. Another source will be reused drainage water for irrigation after a reduction of its salinity.

In Sudan, flush irrigation is practiced in the Takar and Gash Deltas. The total acreage cultivated in these areas varies each year in accordance with the volume of annual rainfall in Ethiopia.

#### Agricultural Land

There is good potential for expanding crop acreage within the Nile Basin. This potential, however, is confined almost entirely to Sudan. Less than 3 percent (6.4 million acres) of the

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3/ The agreement also established a permanent joint technical committee, including the UAR and Sudan, to coordinate the control and development of the lower reaches of the river. More recently, an informal Nile waters coordinating committee has maintained contact with these two countries and the head waters countries of Uganda, Tanzania, and Kenya. Together the five States have set up a special committee to study and plan for water conservation and development and to promote intergovernment cooperation in optimum use of the Nile.

4/ Since the Sudan will not use all the water allocated to it when the water is first available, provisions have been made whereby the UAR's annual quota can be increased an additional 1.5 billion cubic meters during 1970-75 (20).

UAR's total land area of 247 million acres is under cultivation; little more than 1 percent of the remainder is considered to be potentially productive on the basis of current technology. This critical situation is further aggravated by the fact that some 20 percent of the agricultural land is of poor quality. Its productivity is affected by a number of adverse factors, including salinity and alkalinity of the water and inadequate drainage (3c).

The Egyptian farmer has attempted in part to offset these adverse conditions by undertaking very intensive cropping practices. Climatic conditions are favorable for multiple-cropping 5/. It is not uncommon for one to three crops a year to be produced on the same area. Because of multiple-cropping, the country's 6.4 million acres of cultivated land in 1965 produced the equivalent of 10.6 million crop acres. Thus, the volume of agricultural goods likely to be produced on the 1.5 million acres of potential productive land is greater than might be first anticipated.

A thorough survey of the land in Sudan is yet to be made, but various estimates have placed the potentially productive land not now in cultivation at approximately 100 million acres (5). Very large tracts of land are unused or little used; the remainder is frequently used by the population--human and animal--in such a way that by the existing methods of cultivation and pastoralism, soil and plant resources are deteriorating (11). As of 1965, only 20 percent of the 8.1 million acres planted to the main crops were being irrigated.

Substantial progress has already been made in expanding the irrigated area. The Nile Waters Agreement with the UAR removed one of the greatest deterrents to the expansion of agricultural production. Since this agreement was signed in 1959, two dams have been built to store water for agricultural purposes. The volume of water used for irrigation has more than doubled since 1949.

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5/ Multiple-cropping is growing more than one crop per acre per year. As of 1965, Egyptian farmers produced an average of 1.6 crops each year on the same area. It has been predicted that the multiple-cropping index will reach 1.7 by 1975 (20).

Significantly, most of the increase in output in Sudan is the result of expansion in crop acreage. Less progress has been made in improving yields. In fact, during 1960-64, yields for the main crops declined 4 percent, compared with those for 1955-59. At the same time, total acreages of main crops increased some 46 percent during the last decade.

#### STATUS AND GOAL OF DEVELOPMENT PROJECTS

Development programs with emphasis on expanding agricultural output are underway in the United Arab Republic and Sudan. Sizable portions of each nation's resources--water, land, and labor--are committed. With large capital outlays, it is likely that substantial gains will be made in the production of the main crops, notably cotton, oilseeds, and grains. In the process, expanded output will cause national income, public revenues, and foreign exchange earnings to increase.

The main emphasis of the agricultural policy pursued in the two countries is determined in part by the amount of potentially productive land in each. Sudan, with large areas suitable for cultivation, has traditionally given priority to expanding the agricultural land base. Only in recent years has consideration been given to intensification.

With an extreme shortage of land suitable for farming, the United Arab Republic has given equal or greater emphasis to increasing productivity on current cultivated acreage. Differences in the policies followed are illustrated by the continued upward trend in crop yields, but there has been little expansion in total cultivated acreage in the UAR. On the other hand, yields for major crops in Sudan have increased very little during the last decade (appendix tables 39-43), but crop acreage grew tremendously. Policy differences are further emphasized by the increased volume of fertilizer used in the UAR, compared with that used in Sudan (table 18).

#### United Arab Republic

The agricultural development of the United Arab Republic has progressed considerably, with production increasing at an average annual rate of about 3 percent during the last decade

(25). While this rate of growth has been slightly ahead of the population increase, it has not been made without difficulties, and the UAR is presently in a tight economic situation. The Government continues to invest in industrial and agricultural projects; however, many of these projects have not as yet produced the economic return anticipated. Increased agricultural and industrial exports were to provide the foreign exchange for required imports, but military disturbances and increased domestic consumption have caused exports to fall far short of projected levels. At the same time, foreign exchange earnings from other sources have also decreased. The Government is making a determined effort to overcome these financial difficulties so that the UAR may reap the benefits of its economic development program, the heart of which is the High Aswan Dam.

The UAR's overall development plan aims at doubling national income within the decade ending 1970. The second phase of the plan was launched in July 1967. Originally covering 7 years, it has been shortened to 3 years because of a shortage of foreign currency. Funds to carry out the plan are made available on an annual basis. The overall objective of the plan is subject to review at the time funds are made available.

The current program calls for some \$644 million to be used for agricultural development 6/. This is 6 percent less than the amount allocated to the agricultural sector under the First Five-Year Plan (1960-65), and supposedly represents close to one-fourth of all appropriations for investment (28, 29). Consideration is being given to both economic measures and social reform projects for the rural areas.

In light of extremely limited physical resources, the UAR has followed two main lines of agricultural development. These are as follows: (a) the "horizontal" development of agriculture, that is, the extension of the area under cultivation through the

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6/ This figure was published by the Egyptian Government before the Middle East conflict of June 1967. Information released since the conflict indicates that development expenditures, except those for important projects such as the High Aswan Dam and land reclamation, will be reduced.

reclamation and irrigation of desert land and (b) the "vertical" development of agriculture, the institution of measures to increase productivity of land already under cultivation through better irrigation and drainage and through greater use of fertilizers. Vertical development also includes initiation of measures to improve seed and methods of pest control. In this line of development, emphasis is given to research and extension work, credit, marketing facilities and so forth.

Finances for development purposes have come from budgetary surpluses, contributions from Government financing agencies, public borrowing, and foreign aid. But the respective share received from each is not publicized. In addition to substantial loans from various foreign countries and the International Bank for Reconstruction and Development, economic and technical assistance has come from the United Nations, the United States, the USSR, East Germany, West Germany, Japan, and Yugoslavia.

Expansion of cultivated area.--On January 9, 1960, work was officially begun on the High Aswan Dam. The dam is being built approximately 5 miles south of the present small dam at Aswan. Work is proceeding ahead of schedule, and the completion date, once set for 1970, has been moved ahead to 1968. The dam's total cost, including the cost of related projects, exceeds \$1,191 million--the equivalent of one-fourth of the country's total annual GNP (19). Of this cost, the Soviet Union reportedly supplied \$324.9 million through two long-term loans for equipment and technical assistance.

There is general agreement in recent literature relating to the dam on the potential area to be irrigated by its water (12, 20). With the 1967-68 flood season, there will be sufficient water for approximately 1.3 million new acres. Some question still remains, however, as to the total area with soils that can be reclaimed on an economical basis. For this study we have assumed that sufficient acreage for an economical use of this water is available. The climate is favorable for multiple-cropping. The Egyptian farmer produces an average of 1.6 crops each year on the same area. Thus, the 1.3 million new acres will be equivalent to 2.1 million crop acres.

Water from the dam will also make it possible for more intensive and improved practices on 700,000 acres of land in southern Egypt (an equivalent of 200,000 acres of additional cropping area). Thus, the dam will make it possible to expand the country's total cropped acreage by 2.3 million acres on the basis of the current multicropping index of 1.6. This would be equivalent to 2.6 million acres if the multicropping index of 1.7 is obtained by 1975. How swiftly these benefits can be obtained depends mainly on the speed with which canals and irrigation ditches can be provided. The current schedule is to have the full area under cultivation by 1972-73 (20).

The largest portion of the land to be reclaimed by water from the High Aswan Dam reportedly is in the Liberation Province (At Tahrir) located at the western edges of the delta from Cairo to Alexandria. This area serves as an experimental center for all phases of research associated with reclaiming desert land. Work is proceeding to determine the most feasible method of converting poor sandy soils into productive ones suitable for cultivation. Other potentially productive areas reportedly exist along various parts of the Nile.

Other reclamation projects not associated with water from the High Aswan Dam are contemplated which would increase the cultivated area by 420,000 acres by 1975. These include several small projects in the delta to utilize underground water through the use of wells. Included also is the New Valley Project in the western desert (table 3).

Created in 1952, the Ministry of Agrarian Reform was initially established to administer the program of land requisition and redistribution. More recently its scope has been enlarged to embrace the development and settlement of new lands, both in the Nile Valley and the desert. Under its general supervision have emerged two new land development organizations--the General Organization for Land Development (GOLD) and the General Organization for Desert Development (GODD). The latter is responsible for all phases of the development of desert lands outside the Nile Valley. The duties of these new agencies include the leveling of land and the provision of main canals and drains. Their responsibilities end when new lands are capable of sustaining permanent settlement.

Table 3.--Cultivated area and acreage to be reclaimed by development projects by 1975, UAR and Sudan

Country and project	Acres
	----- Thousands -----
United Arab Republic:	
Cultivated area in 1965. ....	6,400
Land to be reclaimed <u>1/</u>	
High Aswan Dam .....	1,300
Other projects .....	<u>2/</u> 420
Total land to be reclaimed .....	1,720
Cultivated area by 1975 .....	<u>3/</u> 8,120
Sudan:	
Cultivated area in 1965. ....	<u>4/</u> 8,130
Land to be reclaimed <u>1/</u>	
Roseires Dam <u>6/</u> .....	1,050
Kashm El Girba Dam .....	520
Other projects .....	<u>5/</u> 550
Total land to be reclaimed .....	2,120
Cultivated area by 1975 .....	10,250

1/ Current development program.

2/ Includes 62,000 acres to be used as pasture land in the New Valley.

3/ Because of the expected level of multiple-cropping for 1975, this acreage will be equivalent to 13.8 million crop acres.

4/ Includes irrigated, rain, and flood areas.

5/ Partly estimated; most expansion expected in rainfed areas.

6/ Some 1.1 million acres are to be irrigated by water from the Roseires Reservoir. Development of the remaining area will require a heightening of the dam.



Newly reclaimed land must be settled by farmers and other workers. This, in turn, creates many social problems and greatly increases the overall cost of reclaiming land in these remote areas. Furthermore, most of the soils away from the Nile Valley consist of calcareous sand and lacustrine clays (4). These soils are difficult and costly to develop for farming purposes.

The New Valley Project is an undertaking to reclaim approximately 300,000 acres in the vicinity of a series of oases (Kharga, Dakhla, Siwa, and Farafra) in the western desert. The area is to be developed from underground water. There are reports, however, that suggest that parts of the area could be irrigated by water under gravity flow from the High Aswan Dam. As of 1963, over 35,000 acres had been reclaimed and planted to grains, pulses, and fruits (17). Surveys have revealed that the soil in large parts of the area can be economically used for agricultural purposes. While there is general belief by some authorities that a subterranean river flows beneath the western desert, the exact origin or volume of the underground water supply has not been determined. Thus, the water supply is likely to be the major factor in determining the total acreage that eventually will be developed in this area.

In the United Arab Republic, land reclamation is considered to include land leveling, the provision of field water courses and field drains, construction of roads within the area developed, soil amelioration measures (leaching salts from the root zone), the first 2 or 3 years of cropping, and the construction of houses for farmers as well as community buildings and roads.

Improvement in yields.--Perhaps the most outstanding development to increase productivity of the current cultivated area in the UAR is the growing use of commercial fertilizers. 7/ In 1965, some 300,000 tons of nitrogenous fertilizers were used. This was equivalent to 103.5 pounds per cultivated acre. This compares with the approximately 60 pounds per acre used in 1960 (31).

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7/ See section on production inputs given later in this report.

The growing use of fertilizer is supported by Government subsidies--artificial low prices and loans in kind at no interest charges. To be eligible for such support, farmers must work through a designated local supervised cooperative. <sup>8/</sup> For a more thorough discussion of incentives used to promote modern practices, see the section on institutional structure and problem areas.

Other programs to improve yields include the selection, multiplication, and distribution of new varieties of seeds for major crops. The aim is to find those which will best respond to massive inputs of fertilizers and, at the same time, become more resistant to diseases. In 1965, private foundations, working with the Ministry of Agriculture, initiated a program for corn improvement. Experimental work has already shown that Egyptian corn yields can be more than doubled if selected varieties of seed are used along with proper fertilization, irrigation, and other improved cultural practices.

Considerable work is being done in the better use of irrigation water. It entails relocation of many feeder canals and drainage ditches, and lining feeder canals to cut down on losses through seepage. Greater attention is being given to row planting of crops and to the use of long furrow irrigation.

Other developments of importance, although still progressing slowly, are the growing use of insecticides, initiation of aerial spraying, and the combining of small holdings into units large enough to permit effective farm mechanization.

#### Sudan

Sudan has made much economic progress since its initiation in 1946 of a series of 5-year development plans. Under these plans, the irrigated area in the Gezira was extended, rural water supplies and soil conservation were improved, experimental projects in mechanized agriculture were introduced, cotton ginning and oil mill factories were constructed, veterinary and transport services were extended and improved, agricultural

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<sup>8/</sup> Cooperatives guided by Government specialists.

research centers were established, and extension services were established and expanded. Many of these projects are already providing economic returns. Progress in agricultural development is reflected in farm production which increased over 30 percent during the last decade (24).

The main goal of the current program is to increase national output by approximately 66 percent during this decade (1960 through 1970). More specifically, the aims of the plan are these: to broaden the basis of the economy by diversifying agricultural production and increasing the size of the industrial sector, to increase and vary exports, and at the same time reduce imports of commodities that can be produced locally. Efforts are also being made to improve education, health, and other social services.

The current plan, which includes over 260 projects, calls for an investment of \$1.5 billion (26). Slightly over \$287 million of this is required in the form of foreign loans. Aid has been received from the International Bank for Reconstruction and Development, the United Kingdom, the United States, West Germany, the Soviet Union, Yugoslavia, and Kuwait. Additional investment or credit has been extended by several private companies abroad.

The immediate and major area for expansion of agricultural production for commercial markets is in the development of irrigation facilities. The principal limitation to irrigation expansion has been the amount of water available during the period of low river flow from January through mid-July each year.

The recent construction of two dams--Roseires and Kashm El Girba--tripled the storage capacity for irrigation water (table 2). This increased water supply made it possible for Sudan to double the annual irrigated crop acreage of approximately 2 million acres in 1965. Along with expanded acreage, this increased water supply allows for more intensive and improved practices on current cultivated acreage.

These two dams will increase the country's annual storage supply of irrigation water by 4.0 billion cubic meters (3.2 million acre-feet). More important, they will make it possible for

Sudan to utilize its annual allotment of 18.5 billion cubic meters (15.0 million acre-feet) in accordance with the 1959 Nile Waters Agreement with the United Arab Republic. Both dams will also eventually supply hydroelectric power.

Roseires Dam.--The Roseires Dam, located approximately 300 miles south of Khartoum on the Blue Nile, was officially inaugurated on December 10, 1966. Its cost was placed at \$90 million. The gross storage of the Roseires Reservoir is 2.7 billion cubic meters (2.2 million acre-feet), net after evaporation. The reservoir will make it possible to more than double the amount of water now available for use during the annual shortage (January to July).

Officials plan to use the water from the Roseires Reservoir to convert 354,000 acres from restricted to unrestricted pump irrigation and to expand the total area under pump irrigation by 695,000 acres. Water will be available also to extend gravity irrigation to 208,000 acres of land adjoining the existing Gezira-Managil area 9/. For these purposes, only approximately 70 percent of the available water supply will be consumed. Thus, the country's irrigated acreage can be further expanded as the need arises 10/. Moreover, there is sufficient good land available for this purpose.

Information is not available as to precisely what crops are to be produced with this additional water. In addition to being used to expand sugarcane production, it will probably be used to irrigate crops similar to those now grown in the Gezira--cotton (long staple), peanuts, grains (wheat and sorghum), and lubia (a forage legume). It should be noted, however, that experimental

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9/ In various studies, this additional area is listed as the Kenana and Rahad Schemes.

10/ Total land to be reclaimed by water from the Roseires Dam is estimated at approximately 1.1 million acres. The Government proposes, however, that water from the Roseires Dam be supplemented by water from a reservoir to be built across the Rahad River. The total irrigated area could then be expanded by an additional 467,000 acres.

work is being undertaken to determine the feasibility of producing new crops such as safflower, sesame, kenaf, castor seed, and rice. The degree to which new crops will be promoted depends upon their ecological and agricultural suitability to the area, their market potential, and their price on the world market.

Kashm El Girba Project.--The Kashm El Girba development project, located approximately 400 miles east of Khartoum on the Atabara River, includes the construction of a dam. Management of the project is the responsibility of the Sudanese Ministry of Agriculture. Its goal is to bring some 520,000 acres under cultivation. It was initiated in 1961 with the purpose of providing a resettlement site for the 50,000 Nubians displaced from the banks of the Nile at Wadi Halfi by the rising waters from Egypt's new High Aswan Dam. The first settlers from Wadi Halfi arrived in the area months before the completion of the dam in 1964. By the end of that year, total resettlement had been completed.

Commercial agriculture patterned after that of the Gezira, the 2-million-acre irrigated farm located between the Blue and White Niles from their juncture southward, is being developed. Approximately 200,000 acres were already under plow as of the 1966/67 crop season. This area was planted to an intensive rotation of cotton (upland type), wheat, and peanuts. No fallow is permitted.

Sizable acreage has been set aside for sugar, vegetable, and sisal production. A refined sugar factory with an annual production capacity of 60,000 tons has been established.

Upon completing the resettlement of the former inhabitants of Wadi Halfi, the Government started a program for the settlement of nomadic tribes. Improved grazing and watering areas have been provided. The objective of this undertaking is two-fold: (a) to more fully develop the existing livestock potential, and (b) to have the seminomadic tribesmen provide an additional source of manpower.

The Government has begun preliminary investigation of one other project that would bring an estimated 520,000 acres

of land under irrigation. In the south, much of the water of the White Nile is lost in the great marshes of the Sudd region. A proposal has been made to bypass this area by constructing a canal some 180 miles long. Then water could be pumped to crops growing along its banks.

Other projects.--Funds for major development are being used to improve the transportation system. After irrigation, rail facilities were given priority during the first phase of the development program (1960-67). Better facilities were provided in the central zone of the country west of the Nile, and extensions of existing facilities were made into the south. This expansion helped in opening up new land and made larger quantities of grains, oilseed, and livestock available for export.

The second phase of the development program provides for the construction of farm-to-market and feeder roads in the rainfed areas. In addition to connecting the rainfed producing areas with the main rail line--virtually the only means of transportation for agricultural commodities destined for export--these roads will make it possible for more modern means of transportation to replace many of the donkey and camel caravans.

Programs now underway to develop ponds to preserve much of the rainfall and to drill wells to tap underground water should encourage continued expansion in the rainfed cultivated acreage. Supplemented by projects to improve range management, they will also make for immediate gains in the livestock industry.

Other programs of significance to the agricultural sector include pilot projects for mechanizing crop production; for improving research, extension, and educational institutions; and for promoting alternative cash crops.

#### FACTORS DETERMINING LAND USE

Major projects to expand agricultural land in the Nile Basin have been explained in detail in the preceding section. The matter now to be considered is what alternatives are available for utilizing these resources. Various factors will obviously have a bearing on what crop or combination of crops will be

grown. Among these are the availability of various production inputs, costs and returns, and demand in local and foreign markets.

From an economic point of view, the thought is to make the most efficient use of all available resources and, thereby, maximize returns both to the individual producers and the National Governments.

Even if it were within the scope of this study to determine what cropping practices would best meet these conditions, available data are inadequate for such an undertaking. Feasibility studies, the details of which are not yet available to the general public, have been made of only a few of the area's development projects. Therefore, it is only possible here to assess the value of the scanty historical data relating to general practices in the two countries. A rather uniform per acre yield level prevails throughout the entire arable area of the UAR. On the other hand, there is a marked contrast in Sudan between the productivity of rainfed land and that under irrigation. Expanded irrigated acreage will be responsible for the major development in Sudan's agriculture during the next decade. Practices in the Gezira have set the pattern for many other irrigation projects. <sup>11/</sup> The Gezira has soils similar to those in new areas to be cultivated. Crop yields and production costs are also considered to be about what they will be in new areas. Therefore, the Gezira will serve as a background for comments relating to practices likely to be followed on current development projects in Sudan.

#### Land, Water, and Labor Requirements

Water will remain a limitation to the expansion of Egyptian agriculture. This is illustrated by the fact that the additional water to be made available by current development projects will

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<sup>11/</sup> The Gezira Scheme lies between the Blue and White Niles from their juncture southward. This region is a flat plain of approximately 5 million acres, of which 3 million are irrigable; almost 2 million acres are under gravity irrigation. It is the largest single enterprise in Sudan--the central factor in the economy.

average only 3,410 cubic meters per acre each year for the 1.7 million acres to be reclaimed. This is little more than the quantity needed to grow one cotton crop on the total reclaimed acreage or to plant one-half the area to rice. Obviously, the total area will not be planted to crops requiring large quantities of water. Thus, water will be available to grow more than one crop per year on much of this area. To the extent that the reclamation of new lands will not immediately absorb the added supply of water from the High Aswan Dam for several years, there will be opportunity for converting large areas to crops requiring much water.

The relative importance of land and water utilization for the UAR's principal crops is given in table 4. After consideration of berseem (an Egyptian clover), the primary position of cotton, in terms of land use, is clearly indicated in column 4. Although planted to a smaller acreage than corn, cotton has a total acre per month figure (acres planted times months of growing season) of 13.0 million, compared with 6.9 million for corn. This is due to the longer growing season for cotton. Thus, just the consideration of acreage alone tends to understate the importance of cotton in the rotation relating to shorter growing crops.

After cotton, berseem has the second longest growing season of all annual crops. With such large areas planted each year to berseem, its acre per month figure greatly exceeds that for all other crops. Its total water requirements, however, are not as great as those for cotton. In addition to being the staple livestock feed, berseem helps maintain soil fertility and occupies an important place in the cropping rotation followed in all parts of the country. It is used sparingly as a green manure because of the great demand for it as livestock feed.

As significant as the long growing season is the fact that among summer crops, cotton requires relatively little water. The production of rice requires approximately twice as much water per acre as cotton. Although data on total water requirements for it are not available, sugarcane is also known to be a large consumer of irrigation water. Berseem is about twice as expensive in terms of water as the other main winter crops, the most important of which is wheat.



Table 4.--Main crops, by season, and water requirements, UAR, 1963

Crop	Season	Length of growing season	Total acre/ month <sup>1/</sup>	Share of total cropped area	Water require- ments per acre per month <sup>2/</sup>	Water require- ments for growing season <sup>3/</sup>
		Months	Millions	Percent	Cubic meters	Cubic meters
Cotton . . . . .	Summer	8	13.0	16	405	3,240
Berseem (clover) . . . . .	Winter	7	20.0	24	390	2,730
Wheat . . . . .	Winter	6	8.1	15	200	1,200
Corn <sup>4/</sup> . . . . .	Summer	4	6.9	17	550	2,200
Rice . . . . .	Summer	6	5.8	10	1,260	7,560
Horsebeans . . . . .	Winter	6	2.2	4	150	900
Peanuts . . . . .	Summer	5	.3	1	390	1,950
Vegetables . . . . .	All year	4	n.a.	n.a.	n.a.	n.a.
Fruits . . . . .	All year	12	n.a.	n.a.	n.a.	n.a.
Sugarcane . . . . .	All year	12	1.7	1	1,200	n.a.

<sup>1/</sup> Derived by multiplying the length of the growing season by the total crop area planted in 1963.

<sup>2/</sup> Requirements vary as much as 10 to 30 percent among the various regions.

<sup>3/</sup> Length of growing season times water requirements per acre per month. It is not implied that irrigation water is applied each month of the growing season.

<sup>4/</sup> Major crop. Until recently the largest corn acreage was planted during the winter season, but with additional water now available from the High Aswan Dam, the major crop has been shifted to the earlier season.

n.a. = data not available.

Source: (10).

It is noteworthy that water requirements for various crops are greatest in southern Egypt. The preliminary result of recent water utilization experiments would indicate that the difference in total requirements in southern Egypt and in the delta varies as much as 10 to 30 percent. Sugarcane is an extreme example of a crop which has high water requirements and is cultivated primarily in southern Egypt. It is generally believed that high relative humidity and heavy early morning fogs are of some importance to crop production in the delta. The humidity varies throughout the growing season; it increases from a minimum in the spring, the early months of cotton growth, to a maximum in the fall.

The Egyptian farmer has adopted a system of regular crop rotation to help maintain soil fertility and yields. It is basically built around a 3-year rotation, the general details of which are given in table 5. Since multicropping is practiced, only a general description of the rotation can be given. Cotton is given priority in the first year, followed in the second and third years by either berseem, winter cereals, or vegetables. In the rotation, summer cereals--corn, rice, and millet--or short crops of winter berseem take up most of the remainder of the crop season. Variation of a 2- or 4-year rotation will be found in the sugar lands and in small areas of the better lands of the delta.

Soil structure will also have some bearing on the most productive use of newly reclaimed lands <sup>12/</sup>. Cotton and the principal cereals grown in the UAR give highest yields when planted in the heavy black soils of the delta, which are made up of a large percentage of clay. Most of the land to be reclaimed is located along the edges of the desert and is similar to sandy loam in texture. These soils are not as fertile as the clay soil, but they have excellent drainage and reportedly produce fair crops. They give best yields for peanuts, melons, citrus, and vegetables.

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<sup>12/</sup> At best, newly reclaimed land must be considered marginal. This land is sandy in texture and requires a large volume of water for irrigation. Recent studies have shown that in the UAR, from 8 to 12 years are required to build its fertility up to normal levels (20).

Table 5.--Basic crop rotation in the UAR

Season and month <sup>1/</sup>	First year	Second year	Third year	Fourth year
Winter:				
November . .	Berseem			Berseem
	<sup>2/</sup> or			<sup>2/</sup> or
December . .	fallow			fallow
	-----	Wheat,	Wheat,	-----
January . . .		Barley,	Barley,	
		vegetables,	vegetables,	
February . .		or berseem	or berseem	
		<sup>3/</sup>	<sup>3/</sup>	
Summer:				
March . . . .				
April . . . .				
		-----	-----	
May . . . . .				
	Cotton			Cotton
June . . . . .				
Autumn:				
		Rice	Rice	
July . . . . .		or	or	
		corn	corn	
August . . . .				
September . .				
October . . . .				

<sup>1/</sup> October 31 is the official end of a crop year.

<sup>2/</sup> Short crop.

<sup>3/</sup> Main crop.

The quantity of water used is not entirely left to the individual farmer. All dams, barrages, regulators, and canals are owned and maintained by the Government. The Government

also controls the distribution of water, and thereby keeps waste to a minimum and obviates inequity which might otherwise result from local and sectional rivalries. Irrigation inspectors coordinate plans for the seasonal water budget and programs of control at the various barrages, taking into account the acreage under the principal crops, the specific needs of these crops, and the amount of water available at any given time.

In the past, the agricultural labor supply appears to have been always more than sufficient in all sections of the country. Under the present cropping system, there are only two rush periods for farm laborers. The first comes in May and June, when wheat and barley must be harvested, and the second from July to October, the main cottonpicking season. The relative requirements of labor by various crops can be obtained in part from appendix tables 27-33. They show that returns to labor used in cotton production are approximately 4 times returns to labor used in wheat production.

The Egyptian agricultural labor force has centuries of experience on the land; the supply of hired labor is usually large in relation to demand. It is believed to be more than adequate for work needed on the new lands. This is true even for such labor intensive crops as cotton and vegetables. Traditionally, the cost of Egyptian labor has been relatively low when compared with that of other production inputs. While wages received by Egyptian farmworkers still remain low, they have increased in recent years because of newly enacted minimum wage laws. It should be noted, however, that some difficulties could be encountered in getting adequate labor to move to the new lands.

As previously noted, land available for agricultural expansion is not the main problem in Sudan. Admittedly, much of the Sudanese land suited for agricultural production is a great distance from the Nile or its tributaries. Soil surveys have shown that much of it could be as productive as that along the banks of the Nile. Therefore, newly reclaimed lands should give yields comparable to those in current irrigated areas.

Lately farmers have tried especially hard to use increasing supplies of the additional water available on land already under cultivation. Intensification has come through more use of land

which would otherwise lie fallow for the full year. But the level of intensification now in Sudan is by no means comparable to that in the UAR. Intensified efforts have made for more efficient use of the main canals, and thereby reduced to some extent capital outlays required for digging new canals.

Experimental work on a more intensive rotation now under-way in the Gezira is likely to set the future pattern of land use in Sudan. A 4-course (actually an 8-course) rotation is practiced in the Gezira, the basic form of which is given in table 6. While this rotation is wasteful with regards to land use, it has been generally successful in maintaining yields of most crops at an acceptable level and in controlling weeds and disease.

Table 6.--Rotation system of the Gezira in Sudan <sup>1/</sup>

Period	Plots <sup>2/</sup>							
	1	2	3	4	5	6	7	8
First year . . .	C	F	F	D	F	For L	C	F
Second year. . .	F	C	F	For L	C	F	F	D
Third year . . .	D	F	C	F	F	C	F	For L
Fourth year. . .	For L	F	F	C	D	F	C	F
Fifth year. . . .	F	C	D	F	For L	F	F	C
Sixth year. . . .	C	F	For L	F	F	C	D	F
Seventh year. . .	F	D	F	C	C	F	For L	F
Eighth year. . .	F	For L	C	F	F	D	F	C

<sup>1/</sup> This rotation is practiced only in the Gezira, and since 1960 has included small acreages of wheat and peanuts. A 6-course rotation is practiced in Managil and pump schemes.

<sup>2/</sup> Symbols: C - Cotton, F - Fallow, D - Durra, and L - Lubia.

Note: Holdings normally cover 40 feddans (41.5 acres), but recently many tenancies have been subdivided and now over one-half are of 20 feddans.

To promote greater intensification, a 3-course (actually 6-course) rotation is practiced on the latest 800,000 acres to be placed under irrigation in the Gezira. <sup>13/</sup> The sequence is as follows: Cotton - durra (sorghum) - fallow - cotton - lubia (pulses) or durra-fallow.

In addition to making for greater crop acreage for a given time period, the 3-course rotation provides more compactness and, thereby, makes for easier supervision.

Extensive studies are now underway to determine which rotation offers the greatest advantages in the long run. Indications are that the 3-course rotation will be followed on land reclaimed by waters from the Roseires Dam.

The length of the growing season does not severely restrain land use in Sudan, since multicropping is not practiced. Of far greater importance in the past has been the lack of a perennial storage facility for water. Completion of the Roseires Dam provides some relief from this situation.

In the past, tree crops could not be grown in the Gezira because of the lack of an annual water supply. In light of the increased water potential, consideration is now being given to what role tree crops might play in areas to be irrigated.

A cropping pattern has developed in Sudan which permits the greatest use of the Nile's water from July through September, a period known as the high Nile. This pattern is illustrated by the months of planting and harvesting for the main crops grown in the Gezira given in table 7. With a more adequate supply of water now available throughout the entire year, some changes in the cropping pattern are indicated. Early sowing, not feasible before the dam's construction, will raise yields of some crops substantially, as has been demonstrated in trials by the Gezira Agricultural Research Board.

Of all crops grown in the Gezira, cotton utilizes the greatest amount of water. It consumes twice that required for

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<sup>13/</sup> Mianagil Scheme.

Table 7.--Sudan: Main crops of the Gezira, by season, and water requirements

Crop	Planting period	Harvesting season	Water requirements per acre
			Cubic meters
Cotton . . . . .	August	January/February	5,600
Durra (sorghum) .	July	October/November	2,300
Lubia (pulse) <sup>1/</sup> .	September	March	2,800
Peanuts . . . . .	July	October	2,000
Wheat . . . . .	November	February/April	2,250

<sup>1/</sup> Lubia and other forage crops.

Source: (30).

pulses, the second largest user. The additional water made available to Sudan by the 1959 Nile Waters Agreement is equivalent to that needed to irrigate 2.5 million acres of cotton.

There exists within the Gezira area a supply of trained manpower well acquainted with the basic practices involved in the irrigation of land. It is not possible to put a precise numerical value on the size or on the potential working output of this labor force. In the past, however, it has had to be supplemented by migratory workers.

Some estimates place the proportion of work performed by hired labor in the main irrigation projects as high as 50 percent during the planting and harvesting season for cotton (29). There are two reasons why such a large percentage of the work is done by hired labor. One is that the labor supply within the farmer's family, even if more efficiently utilized, is inadequate during these periods. The other is that strongly rooted social traditions have had a considerable influence in promoting the use of hired labor.

Maintaining a continuous supply of adequate labor is a matter of concern. Migrant workers from neighboring countries will continue to be of importance. A rapidly growing population, at a rate close to 3 percent each year, should provide some relief. Provision of more incentives should also help. Labor needed for new irrigation projects and to intensify work on current cultivated land is not likely to be provided this way. Thus, the prospect of an inadequate labor supply must be considered in appraising Sudan's development projects.

#### Costs and Returns

From an economic point of view, the cropping pattern to be followed on new lands will be determined to a large degree by net returns from the various crops. The extent to which this will be true, however, will depend on future Government policies. Wheat and cotton production in the United Arab Republic illustrates the influence of government policy on comparative returns. <sup>14/</sup> Moreover, Hansen and Marzouk (10, p. 53) have noted certain rigidities in Egyptian agricultural operations due to social and technical considerations which tend to impede the shift from one commodity to another solely on the basis of net returns.

Although little precise information on comparative costs and returns for fruits and vegetables is available, there is a general belief among agricultural specialists that these commodities will prove increasingly more profitable in the future. Much of this belief is no doubt based upon the general success the UAR has had during the last decade in developing rather productive citrus groves and vegetable gardens on highly sandy soils.

A summary of returns to land and management for major crops in the UAR for 1962 and 1963 are given in table 8. A more

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<sup>14/</sup> Since 1955, a system of acreage control has been in effect for cotton and wheat. In any given year, not more than one-third of the total cultivated land may be planted to cotton and not less than one-third to wheat. Yet, cotton gives a much higher net return to labor, land, and management than wheat (appendix tables 28 and 31).



Table 8.--Returns to land and management, by crop, UAR, 1962 and 1963

Crop	1962 <sup>1/</sup>	1963 <sup>2/</sup>
----- Dollars per acre -----		
Onions . . . . .	199.50	201.10
Cotton . . . . .	136.90	128.90
Sugarcane . . . . .	130.10	124.70
Peanuts . . . . .	98.70	74.20
Wheat . . . . .	58.40	52.87
Rice . . . . .	62.50	50.50
Sesame . . . . .	62.45	51.50
Corn . . . . .	28.25	25.15

<sup>1/</sup> Based on Egyptian pound valued at U. S. \$2.52.

<sup>2/</sup> Based on Egyptian pound valued at U. S. \$2.30.

Source: (19).

detailed listing, by items making up income and expenses for these crops, is given in appendix tables 27-33.

Onion production, giving a net return of approximately \$200 per acre, provides the greatest returns to land and management of all crops considered. This is significant in that increased acreage can be planted to onions during the winter months without competing in the rotation with the two next most profitable annual crops--cotton and peanuts. The advantageous position Egyptian onions have had in the European market is also important. Climatic conditions are such that Egyptian onions mature early and are therefore available for export before those in other major exporting countries.

Cotton is by far more profitable than the UAR's two other major field crops, wheat and corn. During 1962 and 1963, cotton provided an average return of \$133 per acre, as compared with \$55 for wheat and \$27 for corn. On the basis of data available, sugarcane and peanuts give substantially greater returns than wheat. Returns for rice and sesame compare favorably with

those for wheat and are substantially above those for corn. In fact, returns per acre for corn are the lowest of all.

Data on comparative costs and returns do not reveal the entire role or importance of fruits and vegetables in the UAR's total agricultural economy. Corn is the principal staple food in the rural areas. As a food grain, it is more important than wheat. Therefore, in the rotation system, corn is more important as a subsistence crop than as a commercial crop. Rice, corn, and cotton compete for irrigation water during the same months of the year. On the other hand, wheat competes more directly with cotton for land and not for irrigation water. An area once planted to either of these crops cannot be planted to the other during the same crop year. It is these relationships, along with net returns, that will have a bearing on the choice of crops to be grown on new lands in the United Arab Republic.

As for Sudan, the best picture that can be pieced together clearly indicates that of all crops grown, cotton has consistently provided the highest net returns. Tenants in the Gezira received an average annual net return of \$130 per acre from 1951 to 1961. After cotton, the peanut crop is the one most likely to yield the highest net returns per irrigable acre. There is little difference between returns for durra and those for wheat. Returns for lubia (a pulse crop) are extremely low, compared with those for other crops. Its foliage is cut once or twice or grazed for fodder, and before the final grazing-off, a crop of beans is taken. The lubia crop is often used to attract cottonpickers to the area being offered as grazing for their animals.

Average gross and net returns to tenants in the Gezira for main crops are given in table 9.

#### Local and Foreign Markets

Cotton is by far the most important agricultural export from the UAR and Sudan. Table 10 shows that exports of raw cotton account for approximately three-fourths of total agricultural exports from the UAR and for 60 percent from Sudan. In fact, it is more important in the UAR because textiles are considered an industrial export. The growing importance of rice in the UAR and oilseeds in Sudan as export crops is also illustrated in tables 11 and 12.

Table 9.--Sudan: Estimated gross and net returns for main crops grown in the Gezira 1/

Crop	Returns	
	Gross	Net
	----- Dollars per acre -----	
Cotton, . . . . .	193	130
Peanuts, . . . . .	71	48
Wheat, . . . . .	52	27
Durra (sorghum), . . .	33	24
Lubia (pulse) . . . . .	16	11

1/ Based on average harvest and price from 1951 to 1961.

Table 10.--Percentage select commodity exports represent of total agricultural exports, UAR and Sudan

Country and commodity	1955-58 average	1964 <u>1/</u>	1966 <u>3/</u>
	----- Percent -----		
UAR:			
Cotton . . . . .	85	74	79
Rice . . . . .	4	19	12
Fresh vegetables . .	3	4	6
Sudan:			
Cotton . . . . .	59	60	n.a.
Oilseeds <u>2/</u> . . . . .	12	20	n.a.
Hides and skins . . .	2	2	n.a.
Feed grains, . . . . .	--	2	n.a.

1/ 1963 data for Sudan.

2/ Includes vegetable oils.

3/ January through November.

Land use in the UAR and Sudan is determined by an agricultural policy which places great emphasis on the production and foreign sale of cotton. Cotton is not only the chief economic link of these two countries with the outside world, but is also by far the most valuable cash crop grown in terms of income derived locally.

In addition to fitting well into the economies of the two countries, cotton grows well under the prevailing climatic conditions and on the heavy black clay soils along the banks of the Nile. Furthermore, a highly specialized labor force is not required for cotton cultivation. Cotton is also easy to store and to transport, essentials for Sudanese and Egyptian cash crops.

Cotton production within the Nile Basin is limited almost solely to G. Barbadense, or a cotton commonly called Egyptian cotton. <sup>15/</sup> Only recently has Sudan undertaken a program to increase the small quantity of G. Hirsutum, or American upland, cultivated in various parts of the country. The continued promotion of Egyptian cotton can be explained in part by the comparative advantage enjoyed by the UAR and Sudan over major producers because of environmental factors. Coupled with favorable growing conditions has been the price advantage enjoyed by extra-long staple varieties in the international cotton markets.

The principal physical properties of Egyptian varieties that contribute to their utility as the highest quality cotton for the manufacture of textiles are: (1) extra length of staple, (2) exceptional strength of fiber, and (3) high luster. To spinners, advantages of the use of extra-long staple over use of short-staple cotton are mainly (1) increased yarn strength, particularly in the finer yarns; (2) improved luster and general appearance of yarns and fabrics, especially in fine plied or fold yarns; and (3) lower processing costs, even for the coarser yarns.

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<sup>15/</sup> In official reports and estimates by the Egyptian Ministry of Agriculture, Egyptian cotton varieties are generally classified by staple length into three groups: (1) Extra-long staple (over 1 3/8 inches), (2) medium-long staple (1 1/4 to 1 3/8 inches), and (3) ordinary-to medium-long staple (1 1/8 to 1 3/16 inches) (1).

The use of longer staple cottons in the finest and strongest yarns has tended to decrease in recent years. Furthermore, recent studies have noted that prospects for world trade in raw cotton or textiles are not very favorable (3). Cotton fibers received increased competition from synthetics during the last decade. In some instances, certain technological developments that permit synthetic and cotton blends have tended to reduce the overall demand for raw cotton. There are few indications that this trend will change in the near future.

The world market for Egyptian cotton has been further aggravated by the rapid rise in acreage planted to these varieties since 1945. During World War II, production in Sudan more than tripled and more than doubled in the UAR. At the same time, production increased substantially in the United States, Peru, and other smaller producing countries.

The increased production of extra-long staple cotton has been absorbed in the world market at prices which, in relation to prices for other growths of cotton since the mid-1950's, have steadily declined. Exports of extra-long staple cotton averaged 13 percent of the world's exports of all cotton in 1958-62, compared with over 11 percent in the late 1940's. The big decrease in prices, which accompanied the relatively small increase in marketing of Egyptian cotton, indicates a drop in world demand for these fine cottons.

These factors will obviously have some bearing on future land use in the UAR and Sudan. Sudan has already undertaken a program to establish American cotton in the Kashm El Girba area. The shorter staple varieties are still prohibited in the UAR, but the UAR has attempted to cope with the declining demand for extra-long staple cotton by using larger quantities locally for the manufacture of textiles for export (table 11). There are some indications that in 1966 the UAR exported slightly over two-thirds of the total amount of cotton produced, compared with 75 percent during 1957-59.

A positive factor in cotton's favor is the recently established International Institute of Cotton. To bolster the competitive position of cotton in relation to that of synthetic fibers, extensive international research and promotion programs are

Table 11.--Production and net trade of selected commodities, UAR, average 1957-59, annual 1964-66

Commodity and period	Production	Net trade		Supply avail- able for domestic use	Net trade as per- centage of production
		Imports	Exports		
		----- 1,000 metric tons -----			Percent
<b>Main export crops</b>					
Cotton:					
Average 1957-59..	436		-325	111	75
1964 .....	504		-261	243	52
1965 .....	518		-296	222	57
1966 .....	479		-325	154	68
Rice (paddy):					
Average 1957-59..	1,396		-375	1,021	27
1964 .....	2,036		-812	1,224	39
1965 .....	1,862		-508	1,355	27
1966 .....	2,000		-693	1,307	35
Onions:					
Average 1957-59..	601		-168	333	34
1964 .....	646		-188	458	29
1965 .....	679		-170	500	25
1966 .....	690		-185	505	27
Peanuts (unshelled):					
Average 1957-59..	33		-9	24	27
1964 .....	46		-7	39	15
1965 .....	50		-7	43	14
1966 .....	56		-6	50	11
<b>Main import crops</b>					
Wheat:					
Average 1957-59..	1,441	1/ +1,107		2,548	77
1964 .....	1,499	1/ +1,888		3,387	126
1965 .....	1,600	1/ +2,077		3,677	136
1966 .....	1,620	1/ +2,500		4,120	154
Corn:					
Average 1957-59..	1,584	+80		1,664	5
1964 .....	1,934	+425		2,359	22
1965 .....	2,100	+220		2,320	10
1966 .....	2,200	+237		2,437	11
Cottonseed:					
Average 1957-59..	826	+16		842	2
1964 .....	912	3/ +304		1,216	33
1965 .....	975	3/ +330		1,305	34
1966 .....	900	3/ +430		1,330	48
Sesame:					
Average 1957-59..	15	+3		18	20
1964 .....	23	+7		30	30
1965 .....	22	+7		29	32
1966 .....	2/ 23	+15		38	65

1/ Includes wheat equivalent of flour imported.

2/ Estimated.

3/ Seed equivalent of oil imports.

being initiated under its auspices. There is general belief that broadening research and promotion programs in western and certain Asian countries are sure to benefit all cotton. The actual impact of these efforts remains to be seen, however, especially the impact on consumption of Egyptian cottons.

The more favorable prospects for economies of the UAR and Sudan are the growing markets for foods due to rising population and an expected increase in per capita income in both these and other countries. Prices for Nile Basin products such as wheat, durra, rice, vegetables, citrus, and livestock, therefore, may be assumed to rise rather than decline over the next decade or so. As in the past, most of these products will be consumed locally at prices not directly related to corresponding world prices.

Developing market opportunities both locally and abroad for these products account for a newly emerging trend that will undoubtedly have increased influence in determining future cropping patterns in the UAR and Sudan. Table 11 indicates that already in the UAR the expansion in rice and onion production is of sufficient magnitude to allow for greater exportation and local consumption simultaneously. Although complete data are not available, a similar situation is believed true for citrus. On the other hand, demand for wheat in both countries and for oilseed, coarse grain, and livestock products in the UAR continues to exceed local production.

The UAR grows a relatively wider range of fruits and vegetables for export than Sudan. Future limitation to the increase in exports from both countries must be considered one of demand rather than production potential. There are factors, however, adverse to greatly increased exports of fruits and vegetables in the immediate future. They apply with varying force to the different countries and different commodities, but are of a general nature. The perishability of these products is certainly a factor to be considered. Distance from the major importing areas of Western Europe, poor transportation and communication links, and inadequate cold storage facilities all combine to make a formidable obstacle, even if it is one that can be overcome in time. Prospects for exporting vegetables to Europe depend partly on the selection of varieties more suitable

to consumers' tastes in that area. Excess supplies from other exporting countries could make for a downward pressure on prices in the world market for fruits and vegetables. Finally, access to markets, particularly those in the EEC, may become a more serious factor militating against an expansion of exports (3).

There are also favorable factors, and the outlook is not as bleak as the last paragraph may suggest. Both countries have recently established drying plants to keep certain fruits from spoiling rapidly. Other forms of processing, such as freezing, canning, or the preparation of juices, are already in their beginning stages in the UAR and might be more widely introduced. Seasonal differences could be exploited by taking advantage of the slackening of import restrictions into the EEC during the "off-season" of winter and spring. Furthermore, with improved marketing efficiency, neighboring Middle East countries could become important markets.

Oilseed production in the Nile Basin has increased tremendously in recent years. With greater cotton production has come an increase in cottonseed output. In Sudan, production of cottonseed and peanuts combined practically doubled between 1958 and 1965, and sesame production has increased considerably (table 12). This expansion has been sufficient to fill the growing demand for vegetable oils within Sudan and to permit the export of oilseeds. The UAR, on the other hand, is a growing net importer of oilseeds.

Agricultural specialists think that a sizable acreage of the newly developed land within the Nile Basin will be planted to oilseeds. It also seems justified to assume a substantial increase in oilseed processing in both countries. In the past Sudan has exported very little oil, but a surplus supply of oilseeds. A recent study of the vegetable oil situation in the Middle East concludes, however, that the percentage of surplus oilseeds exported from Sudan as oil could be increased by more than 40 percent by 1975 (3).

The value of exports, by country and by product groups, is shown in table 13. The largest share of Sudan's oilseed exports goes to European countries; sizable quantities go to the UAR and Lebanon. As a region, the Middle East is a net importer



Table 12.--Sudan: Production and net trade for selected commodities, average 1957-59 and annual 1964-66

Commodity and period	Production	Net trade		Supply avail- able for domestic use	Net trade as per- centage of production
		Imports	Exports		
		----- 1,000 metric tons -----			Percent
<u>Main export crops</u>					
Cotton: 1/					
Average 1957-59 .	101	2/ -120	--		--
1964 . . . . .	152	2/ -173	--		--
1965 . . . . .	163	-117	46		72
1966 . . . . .	169	-106	63		63
Durra (sorghum):					
Average 1957-59 .	1,155	-54	1,101		5
1964 . . . . .	1,320	-69	1,251		5
1965 . . . . .	1,325	-112	1,213		8
1966 . . . . .	800	n.a.	--		--
Peanuts (unshelled):					
Average 1957-59 .	125	-77	48		62
1964 . . . . .	277	-216	61		78
1965 . . . . .	280	-216	64		77
1966 . . . . .	170	n.a.	--		--
Cottonseed:					
Average 1957-59 .	194	-133	61		68
1964 . . . . .	285	-147	138		52
1965 . . . . .	318	-145	173		46
1966 . . . . .	295	-157	138		53
Sesame:					
Average 1957-59 .	138	-39	99		28
1964 . . . . .	170	-101	89		59
1965 . . . . .	175	-71	104		41
1966 . . . . .	180	n.a.	--		--
<u>Main import crops</u>					
Wheat:					
Average 1957-59 .	27	+88	115		326
1964 . . . . .	37	3/ +112	149		303
1965 . . . . .	56	3/ +115	171		205
1966 . . . . .	63	3/ +107	170		170

1/ Trade data do not reflect illegal sales across border.

2/ Net trade exceeds production, indicating withdrawal from stocks.

3/ Includes wheat equivalent of flour imported.

Table 13.--Value of exports of oilseeds and oilseed products, 1958, 1962, 1964 and projected value for 1975, UAR and Sudan

Country and commodity	1958	1962	1964	1975 <sup>1/</sup>
----- Million dollars -----				
UAR:				
Oilseeds . . . . .	3.3	2.1	2.5	--
Oils . . . . .	.5	.6	.2	--
Oilcakes . . . . .	2.2	1.5	9.0	29.9
Total . . . . .	6.0	4.2	10.2	29.9
Sudan:				
Oilseeds . . . . .	21.6	41.4	50.0	60.6
Oils . . . . .	--	2.3	3.2	20.5
Oilcakes . . . . .	3.4	7.1	11.2	14.6
Total . . . . .	25.0	50.8	61.3	95.7

<sup>1/</sup> Projections given in (3, p. 65).

of vegetable oils. Therefore, as the processing industry is further developed in Sudan, intraregional markets could provide a growing outlet for surplus oil supplies.

Cereal requirements in the Nile Basin have substantially outplaced local production during the last decade. Several factors contribute to the growing need for imports. Among these are rapid population growth, urbanization, low subsidized food prices, and the failure of local production to keep pace with effective demand. The growing demand for bread grains has been largely confined to urban areas--Khartoum, Cairo, and Alexandria. Rural areas produce the major portion of the food needed in both countries. But unlike urban areas, where wheat is the main staple food, corn makes up the larger part of the diet in rural areas of the UAR and durra (sorghum) is the main food of rural people in Sudan.

The UAR accounts for the largest share of the deficit. The pace at which this deficit is growing is indicated by the

fact that the UAR was self-sufficient in grain as recently as the early 1950's. By the end of 1966, annual wheat and wheat flour imports, in terms of wheat equivalent, approached 2.5 million metric tons. In addition, annual coarse grain imports averaged approximately 400,000 metric tons. The small quantities of wheat and wheat flour imported by Sudan are received on a commercial basis. The volume of surplus coarse grains is 4 to 5 times greater than the volume of these imports during years of normal harvest.

In spite of the growing cereal deficit, the UAR has found it advantageous to promote rice exports. As a result, these shipments have almost doubled during the last decade and amounted to 35 percent of total production in 1966. Water already being made available by the High Aswan Dam is being used to expand rice output. Rice is likely to receive even greater attention in the immediate future, since prospects for local and international trade appear very favorable.

In spite of the growing deficit in bread grains, there are those that argue that there is no justification for the use of any of the new agricultural land for production of wheat in the Nile Basin (15), and that the promotion of a policy to do so tends to obscure the real cost in terms of opportunities foregone. Wheat will probably play an important role in the cropping pattern to be adopted for newly developed lands, if for no other reason than that the Government wants to maintain the highest level of self-sufficiency possible. At any rate, local requirements for wheat and wheat flour are likely to exceed anticipated increases in production.

Only small quantities of coarse grains presently enter the commercial trade of the UAR or Sudan. Several Middle East countries are deficient in feed grain and offer a market of growing importance for surplus quantities that might be produced. More intensive development of the livestock industry within the Nile Basin could also cause greater local demand for concentrate feeds. At present, most of the feed for livestock in Sudan comes from grazing and semiarid rangeland and, to a smaller extent, from grazing crop residues. In the UAR, however, cultivated crops (mostly clover) are the principal sources of livestock feed.

## INSTITUTIONAL STRUCTURE OF AGRICULTURE

Institutional structure covers a wide range of subjects, including land tenure, services for providing production requirements, the rural credit system, facilities for marketing and storage, an effective system of price incentives, the extension service, and the organization for agricultural research and demonstration. No attempt is made here to provide a full and separate analysis of all of these topics. Instead, those factors that are likely to have a direct bearing on the effectiveness of the various development projects within the Nile Basin are highlighted.

Information available on the current level of agricultural technology within the Nile Basin is limited and as yet very general. Yield, although generally influenced by soil and climatic conditions, provides broad indications of the level of applied technology. Yield levels for major crops are given in table 16.

### Land Tenure

An assessment of the impact of current development projects on greater farm output requires some consideration of the main feature of the Egyptian agrarian economy, the critical relationship between population and arable land (fig. 1).

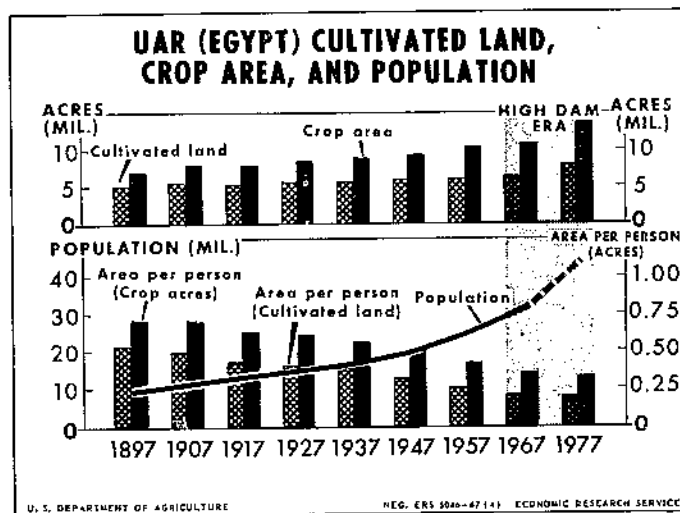


Figure 1

The magnitude of this urgent problem is illustrated by the fact that cultivated land per capita now amounts to only 0.20 acres. On the basis of the present population growth rate, close to 3.0 percent per year, the per capita availability of cropland will be smaller by the end of the next decade. This remains true even if scheduled programs to reclaim land are successful. <sup>16/</sup>

Most of the cultivated land in the UAR is privately owned, and less than 10 percent is State domain or set aside for religious or charitable organizations. In spite of an intensive agrarian reform program from 1952 through 1963, a large portion of the rural population remains landless. Others hold uneconomical fragmented units. According to the 1960 census, some 94 percent of the country's approximately 3.1 million landowners have holdings of less than 5 feddans (5.2 acres) (31). This situation is caused in large part by the Muslim law of equal inheritance, which has often led to such a multiplicity of beneficiaries that the share of each has been reduced to an insignificantly small holding.

The Egyptian Government has promoted programs to consolidate small holdings and fragmented units. This action was undertaken to gain the economies of a large-scale operation. According to current policy, reclaimed lands are distributed in units of from 2 to 5 feddans (11). Quality of land and size of the farm family are factors considered in determining the ultimate size of farming units made available. It has been estimated that the present number of farms will increase by 365,000 by 1975 (3). With only 1.7 million to be reclaimed during the next decade, this would average less than 5 feddans per unit. It is unrealistic, however, to assume that total reclaimed land will be available for distribution to private owners. Instead, a sizable portion of the reclaimed land will probably be held by the Government for sugar and fruit production. Therefore, the individual farm unit is likely to be much smaller than 5 feddans.

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<sup>16/</sup> The objective of the Egyptian development program is to expand the total cropped area by 2.6 million acres within the next decade. (See discussion on the expansion of cultivated area given earlier in this report.)

Agrarian reform has greatly altered the role previously played by large landlords. Many left the supervision of their domains to managers. These supervisory services are now provided through Government-managed cooperatives.

Indications are that the policy to distribute reclaimed lands to smallholders will be continued. Only those areas, probably less than 20 percent of the total, used for citrus and sugar production are likely to be held by the Government in large units.

Land tenure practices to be followed on newly developed areas in Sudan will probably be similar to those followed in the Gezira. Before the Gezira Scheme was launched, land registration identified the original owners, and the State received the right to either purchase or rent the land. The land was then redistributed to the farmer on a tenant basis. Priority in allotments was given to the former landowners. Tenancy agreements are on a 1-year basis, with the understanding of automatic renewal if the farmer is not found guilty of neglect in the cultivation of his crop. Not following the instructions of the scheme officials can also be grounds for termination of tenancy. In other words, the farmer's right to cultivate the land allotted him can be terminated only if he is evicted or abandons the land of his own accord.

In the Gezira, the general practice has been to limit individual holdings to 40 feddans (41.5 acres), or 80 feddans at the maximum. In the Managil extension, tenancies of 15 feddans are given. For new areas, however, consideration is being given to allowing even larger holdings than those in Gezira for farmers with a great deal of initiative. Larger holdings have permitted more efficient utilization of mechanical equipment. On the other hand, it has been shown that the proportion of work performed by a farmer's family tends to decrease as the size of his holdings increases. The growing dependence on hired labor is of significance in light of the country's inadequate labor supply. <sup>17/</sup> At any rate, it appears unlikely that the majority of holdings in newly developed areas will exceed 40 feddans.

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<sup>17/</sup> See section of report on labor requirements.

### Agricultural Research and Extension

Agricultural research in both countries has been excessively orientated towards developing and maintaining high-quality cotton. Along with research on the selection and breeding of high-yielding strains of good quality long-staple cotton, effort has been given to combating disease and insect pests and to the nutritional needs of the cotton plant grown in rotation mainly with oilseeds, cereal, and fallow.

The UAR has maintained a corps of well-trained agriculturists and for years has been a main source of agricultural technicians for other Arab countries. Private foundations have worked with the Egyptian Government in securing and developing top-ranking management for agriculture and related sectors of the economy.

Limited agricultural research and experimentation was being conducted at 26 centers in main agricultural areas of the UAR in 1965. The Ministry of Agriculture, although deeply concerned with promoting all types of research, has largely confined its activities to applied research. Research of a basic nature has been left largely to the colleges of agriculture and science and the National Research Center. In addition to cotton research, increased attention is being given to land reclamation, irrigation techniques, and drainage. With the continued recent growth in the country's bread grain deficit, more emphasis is being given to cereal crops. Experimental work by the Ministry of Agriculture in cooperation with the private foundations has recently shown that Egyptian corn yields can be more than doubled if selected varieties of seed are used along with proper fertilization, irrigation, and other improved cultural practices. The margin for improving wheat yields is not as wide as that for corn. Nevertheless, experimental work now underway clearly indicates that considerable progress can be made for this crop also.

Both quantity and quality are given emphasis in the Egyptian extension service. In 1965, there were 103 agricultural extension centers. To make the most efficient use of lands to be reclaimed, it was proposed that some 22 additional centers be established by 1970 (11). As of 1965, there were reportedly 10,083 extension

workers in the UAR, of which all but 50 were at the district or village level. This was equivalent to one extension worker for every 540 farm families. Since intensive farming is possible, the Egyptian Government is reportedly aiming for a ratio of 1 to 500 by 1970 (3). On this basis, the total number of extension workers would approach 7,500 by that date. This does not include 1,500 anticipated senior supervisory personnel. There should be no difficulty in meeting these quotas, since over 1,300 students reportedly graduate annually from the school of agriculture.

The UAR has well-established institutions for training agriculturists. The country has 18 agricultural secondary schools located in the various provinces; higher training in the various fields of agriculture is offered in five colleges of agriculture and two colleges for veterinary medicine. Agricultural training is also provided by six institutions which differ from colleges in that they place major emphasis on practical training and graduate skilled agricultural laborers and foremen.

The extension service is the weakest link between the limited research being carried on in Sudanese schools and experiment stations and the logical beneficiary of this work, the farmer. Although the Ministry of Agriculture has a field staff, most of its time is devoted to administrative and regulatory work. The Ministry is now in the process of organizing a separate extension service.

Extension and supervisory services are presently limited to major irrigation projects. They are far from adequate, even for these areas, because of the lack of trained personnel. To provide one extension specialist for every 500 farm families on irrigated farms alone, an additional 500 to 550 workers will be needed by 1975 (3). For nonirrigated farms, an additional 2,500 extension agents will be needed to provide a ratio of one agent to 1,000 farm families. These needs will not be met under present programs. Less than 50 agricultural students graduate each year from the country's two institutions offering higher education in agricultural subjects, and they must cover all phases of the agricultural sector. As crop acreage expands, extension facilities are likely to become more inadequate.



Agricultural research in Sudan, though generally of high quality, is characterized by two deficiencies -- insufficient staff and excessive orientation towards cotton. The principal research station is at Wad Medani in the Gezira and is the headquarters of the research division of the Ministry of Agriculture. Four other smaller stations are located in the central and southern parts of the country. Only the Wad Medani and Kashm El Girba stations are doing research related to the expansion of production under irrigation.

The Sudanese Government has been partially successful in recruiting agricultural scientists from various foreign countries, but the number and quality of the staff have deteriorated in recent years. This kind of recruitment could be used more extensively in the future. Even so, the lack of an adequate extension and research staff is likely to hamper Sudan's future agricultural progress.

#### Credit

The role of the noninstitutional lender as a source of investment capital for Egyptian and Sudanese farmers is declining. Instead, the State is becoming the main source of credit for producers. This is true for all Egyptian agriculture and the major irrigation projects in Sudan. Not only is institutional credit made available at more reasonable interest rates, but it is also normally accompanied by supervision which sees that it is not used for nonproductive purposes. These facilities are being extended to producers of newly developed areas in both countries.

There is still considerable margin for expansion in the use of fertilizers, improved seeds, pesticides, and modern farm equipment within the Nile Basin. Most of these supplies must still be imported. Therefore, future expansion of production credit to farmers is associated in some degree with the availability of foreign exchange. These imports are used mainly for the cultivation of crops which contribute to the growth of export earnings and have therefore been given priority in the past. It should be noted here that the future agricultural development of both countries depends upon larger quantities of these supplies being made available to producers. This report assumes that they will be.

The agricultural credit system in the UAR has been completely reorganized since 1960. All farm loans are now channeled through cooperatives. The principal credit institution is the Agricultural Credit and Cooperative Bank, which advances money free of interest to the cooperatives. The cooperatives use this money to buy fertilizers, seeds, and other requisites, which are then loaned to the individual farmers. A fee of up to 5 percent is charged for this service. The individual farmer thus receives most of his credit in kind rather than in cash (table 14).

Table 14.--Loans granted to Egyptian farmers by the Agricultural and Cooperative Credit Bank, average 1952-56, and annual 1957-62 <sup>1/</sup>

Year	Loans in kind			Cash	Total
	Seeds	Fertilizers	Insecticides	loans	loans
	----- 1,000 dollars -----				
Average:					
1952-56 . . .	3,725	18,761	<sup>2/</sup>	27,446	49,932
1957. . . . .	4,121	19,984	<sup>2/</sup>	33,883	57,988
1958. . . . .	3,969	23,772	<sup>2/</sup>	42,502	70,243
1959. . . . .	4,598	29,484	<sup>2/</sup>	50,334	84,416
1960. . . . .	5,685	36,185	3,415	59,980	105,265
1961. . . . .	6,762	42,332	4,879	59,240	113,213
1962. . . . .	8,161	53,300	17,503	74,782	153,746

<sup>1/</sup> One Egyptian pound equals U. S. \$2.87 for 1952 through 1961, and U. S. \$2.5217 for 1962.

<sup>2/</sup> Loans for insecticides are cash loans.

Source: (11).

Table 14 also illustrates the continued increase in demand for agricultural credit. Although data are only available through 1962, the upward trend in total loans is believed to have continued through 1966; it will probably increase more as producers are resettled on newly reclaimed lands.

As might be expected, loans from institutional sources were made primarily to finance crop production. Also, approximately 80 percent of them were short-term loans that averaged \$140 in

1960 (22). The following tabulation shows other purposes for which loans were secured and the percentage of loans made for each purpose.

<u>Purpose of loan</u>	<u>Percentage of loans made</u>
Crop production . . . . .	82.6
Livestock production . . . . .	5.1
Marketing, including processing . . . . .	3.0
Improvement to land and buildings or purchase of machinery and draft animals . . . . .	9.3

The Gezira Board and the Agricultural Bank of Sudan are the main sources of credit for Sudanese farmers on irrigation schemes. Noninstitutional agencies are of considerable significance as purveyors of credit to farm people in nonirrigated areas.

The task of administering crop production loans in Sudan has been facilitated by the fact that lending agencies are also tied to marketing of the farmer's produce. With cotton, for instance, all technical inputs for production and marketing of the crop are made available by the Gezira Board. Their cost, plus a small interest fee, is withheld from returns when the crop is later sold. The rates of interest for these loans and for those in the UAR are given in table 15. It will also be noted that credit per

Table 15.--Annual rates of interest on loans from public institutions, credit per ton of output in wheat equivalent, 1961, and annual compound change in crop output, UAR and Sudan, 1958-65.

Country	Rates of interest on loans	Credit per ton of output in wheat equivalent	Annual compound change in crop output
	<u>Percent</u>	<u>U. S. dollars</u>	<u>Percent</u>
Sudan . . . . .	6-8	3.2	4.1
UAR . . . . .	3-7	7.7	2.5

Source: (22, 25).

ton of output (in wheat equivalent) is less than one-half that in the UAR. This ratio would suggest that institutional credit is more widely used by Egyptian farmers.

Detailed quantitative data distinguishing the kind and volume of credit used by Sudanese farmers are not available. Such data as are available would suggest that credit facilities for farmers on irrigation projects seem adequate. It should be expected that the Agricultural Bank would play an active role in providing assistance to future agricultural development projects.

#### Incentives

Only limited information is available on the response of producers in the Nile Basin to production incentives. Price, along with other incentives, has been used on a limited scale to stimulate the individual farmer to show more initiative and to become more responsible so as to increase production and thereby improve his income. But the policy to promote increase in income in direct proportion to increase in yields has been limited to the main export crops in the United Arab Republic and to cotton only in Sudan. Quality and the degree to which pre-established production quotas are met are factors considered in determining prices of Egyptian cotton. In addition to receiving the established price for different varieties of cotton, growers receive a bonus of from 1 to 5 cents per pound (U. S. money) for quality production (23). A bonus has been paid farmers who deliver onions meeting export standards before a given date.

The United Arab Republic has recently initiated a program to support the increase in agricultural incomes as an incentive to increase food production. Land cultivated for fruit and vegetable production has for that reason been exempted from taxes (14).

Besides improved extension and demonstration efforts, other measures are taken indirectly to promote greater output. Improved seeds are sold for select crops at reduced prices. Efforts are also taken to supply other necessities--fertilizers, credit, pesticides, and so forth--at the proper time and at prices within the limits of the purchasing power of smallholders. Irrigation water is supplied at no fee or without the imposition of a special land tax.

### Production Inputs

The full value of irrigation water will not be realized until there is an optimum combination of irrigation water and other aids to production. The other aids include improved seeds, better cultivation methods, and the prevention of crop losses from pests and disease.

Modern technology is becoming increasingly important in Egyptian and Sudanese agriculture. The growing use of technological improvements is reflected through yield data given in table 16. Greatest progress has been made in the UAR. This data suggest that the level of agricultural technology in the UAR compares favorably with that in the United States. All agricultural land in the UAR is under irrigation; in the United States, only a small portion of land is irrigated.

Yields in the United Arab Republic exceed those in Sudan for all crops considered. However, it should be noted that Sudanese crops are grown mostly under rain conditions. The only major exception is cotton. Even so, Egyptian cotton yields are almost twice those in Sudan. The downward trend in cotton yields is of great concern in Sudan.

Compared with those in neighboring countries, Egyptian crop yields are high, but they are far below those in most other areas of the world where intensive irrigation is also practiced (table 17). Rice yields in the UAR averaged 5,290 kilograms per hectare (rough basis) during 1960-64, comparing favorably with those of several of the important rice producers of the world but considerably below yields in Spain (6,260 kilograms per hectare). Wheat yields during this period were 26.0 kilograms, only 60 percent of those in the Netherlands. Corn yields were 24.7 kilograms per hectare, compared with yields of 39.0 kilograms per hectare in the United States. Similarly, cotton yields in Israel, which has a similar climate, almost doubled those in the UAR.

These data suggest that there is considerable margin for expanding crop yields in the Nile Basin. This is particularly true for grains.

Table 16.--Average annual yield per hectare of wheat, corn, sorghum, rice, sesame, and cotton in the United Arab Republic, Sudan, and the United States, 1950-54, 1955-59, and 1960-64

Commodity and country	1950-54	1955-59	1960-64
	----- 100 kilograms -----		
Wheat:			
Sudan. . . . .	13.1	15.0	15.7
United Arab Republic .:	19.8	23.0	26.0
United States. . . . .	11.6	14.9	17.1
Corn:			
Sudan. . . . .	12.1	12.2	6.2
United Arab Republic .:	21.1	20.9	24.7
United States. . . . .	24.8	30.6	39.0
Sorghum:			
Sudan. . . . .	8.1	12.5	7.2
United Arab Republic .:	28.1	30.3	33.7
United States. . . . .	12.0	17.7	26.6
Rice (paddy):			
Sudan. . . . .	1/	1/	1/
United Arab Republic .:	37.1	52.3	52.9
United States. . . . .	27.0	35.8	41.7
Sesame:			
Sudan. . . . .	5.1	5.1	4.5
United Arab Republic .:	8.2	8.6	9.6
United States. . . . .	--	--	--
Peanuts:			
Sudan. . . . .	6.1	7.8	8.3
United Arab Republic .:	18.1	20.1	20.4
United States. . . . .	9.9	12.0	15.2
Cotton lint:			
Sudan. . . . .	3.5	3.4	3.3
United Arab Republic .:	5.1	5.2	6.1
United States. . . . .	3.3	4.8	5.3

1/ Not available.

Source: (8).

Table 17.--Yields per hectare for selected crops, UAR and selected countries, 1955-59 and 1960-64

Commodity and country	1955-59	1960-64
- - - 100 kilograms - - -		
Wheat:		
United Arab Republic. . . . .	23.0	26.0
Netherlands. . . . .	38.5	44.1
United Kingdom. . . . .	32.7	39.1
New Zealand. . . . .	28.4	31.7
Corn:		
United Arab Republic. . . . .	20.9	24.7
United States. . . . .	30.6	39.0
New Zealand. . . . .	35.5	47.0
Australia. . . . .	20.5	21.1
Rice (paddy):		
United Arab Republic. . . . .	52.3	52.9
Japan. . . . .	48.7	51.8
Australia. . . . .	55.4	62.4
Spain. . . . .	60.6	62.6
Cotton lint:		
United Arab Republic. . . . .	5.2	6.1
Peru. . . . .	4.7	5.6
Israel <u>1/</u> . . . . .	8.4	10.1
United States <u>2/</u> . . . . .	5.8	5.6

1/ Not strictly comparable since crop includes some upland cotton.

2/ Extra-long staple only.

Source: (8).

Nitrogenous fertilizer consumption in the two countries has more than doubled within the last decade (table 18). Good progress in the use of other fertilizer nutrients has also been made. But it must be realized that fertilizer is used almost entirely on commercial crops. Literature on agriculture in the Nile Valley has almost no information on response to the application of fertilizers. Instead, it suggests that considerable margin exists for improving yields by greater application of plant nutrients. Experimental work by FAO (Food and Agriculture Organization) experts has suggested that sizable gains can also be made through improved methods of application (6). Trial applications indicate that Egyptian rice yields increased 9 percent when fertilizer was worked into the soil before the crop was planted rather than scattered over the field later.

In Sudan, farmers use approximately 12 kilograms of fertilizer nutrients per hectare of arable land; in the UAR they use approximately 125 kilograms per hectare. Dependence on foreign sources of supply undoubtedly has been one of the major obstacles to a greater use of fertilizer.

The increase in fertilizer use in Sudan is due primarily to three things: (1) The Gezira Scheme's expansion from 400,000 hectares to over 700,000 hectares, (2) increase in application of fertilizer per hectare of land, and (3) the emergence of the Agricultural Bank of Sudan, which now makes fertilizers available to farmers who had previously not been able to obtain them.

Sudan produces no chemical fertilizer. But to meet the growing need for fertilizers in the immediate future, officials are reportedly considering construction of two plants. The production capacity of the proposed plants is not known. Few raw materials are available in Sudan. There has been no discovery of fossil fuels, and the only sources of energy are wood and electric power. In spite of increased electric power potential from the recently completed Roseires and Khashm El Girba Dams, Sudan's major supply of fertilizer in the future will probably be imported.

The agricultural bank is the most important distributor of fertilizers in the UAR, responsible for over 90 percent of total distribution in 1965. Increasingly the distribution of fertilizer



Table 18.--Consumption of plant food nutrients, UAR and Sudan, average 1948-53 and 1955-59, annual 1960-65

	: 1948-53 :	: 1955-59 :	: 1960 :	: 1961 :	: 1962 :	: 1963 :	: 1964 :	: 1965 :
	:	:	:	:	:	:	:	:
	----- <u>Metric tons</u> -----							
Nitrogenous fertilizers (N):	:	:	:	:	:	:	:	:
Sudan.....	4,700	13,694	18,575	24,450	18,663	24,133	23,053	31,000
UAR .....	98,200	135,589	176,633	191,872	196,126	227,144	260,000	300,000
Phosphate fertilizers (P <sub>2</sub> O <sub>5</sub> ):	:	:	:	:	:	:	:	:
Sudan.....	65	273	315	257	523	<u>1/</u>	500	500
UAR .....	16,700	20,769	35,961	48,407	41,584	49,953	43,100	50,000
Potash fertilizers (K <sub>2</sub> O):	:	:	:	:	:	:	:	:
Sudan.....	<u>1/</u>	<u>2/</u> 82	360	1,178	<u>2/</u> 3,800	<u>2/</u> 5,000	6,000	8,000
UAR .....	<u>2/</u> 600	1,403	3,250	<u>1/</u>	1,252	1,025	900	<u>1/</u>

1/ Not available.

2/ Partly estimated.

Source: (2).

has gone through cooperatives, not directly to the individual farmer. Fertilizers are sold at a price set by the Ministry of Industry. In an effort to increase the use of fertilizers, supplies have been made available to individual farmers at prices slightly below the cost of production.

Fertilizer requirements will increase substantially within the immediate future. Estimates of additional fertilizer needs are based on trends in consumption per unit of cultivated area and the development of new lands. One of the objectives of the country's current development plan is soil improvement, which involves fertilizer application at a faster than usual rate. The fact that the High Aswan Dam will retain the mineral-rich silt which once passed down the Nile and onto the fields will also make it necessary to increase fertilizer requirements.

Local production accounts for less than 60 percent of total commercial fertilizers used. If present and planned projects are completed, the United Arab Republic will be producing most of its fertilizers within the next decade. Byproducts from the growing petroleum industry, along with increased capacity to produce electricity, will make available two of the essentials needed for the production of nitrogenous fertilizers. The degree of self-sufficiency that will be achieved in the production of fertilizers will be closely associated with the economic stability of the country. Future supply will also depend on the Government's finding both the funds and technical and management resources to create the fertilizer industry it has planned.

The extent to which fertilizers will be used in the future will depend on their availability and price at the farm level. From the limited data available it would appear that Egyptian farmers pay less for plant nutrients than Sudanese farmers (table 19). Fertilizer prices at the farm level in the UAR were reduced substantially after 1959 and by 1962 compared favorably with those in the United States (2).

A greater use of improved seeds would do much to expand yields within the Nile Basin. A recent study noted that 36 percent of the increased rice yield in the UAR from 1952-58 through 1960-62 can be contributed to the use of better seeds (22). This compared with 39 percent of the increased wheat yield and 15

Table 19.--Prices paid by farmers per 100 kilograms of plant nutrient, UAR, Sudan, and United States, 1959 and 1962-64

	Sudan				United Arab Republic				United States			
	1959	1962	1963	1964	1959	1962	1963	1964	1959	1962	1963	1964
	U. S. dollars											
Nitrogenous fertilizers:												
Ammonium sulphate.....	1/	32.1	32.1	32.0	42.6	31.3	31.3	31.3	30.6	28.6	27.4	27.8
Ammonium nitrate.....	--	--	--	--	42.9	31.5	31.5	--	26.8	26.7	26.2	25.9
Sodium nitrate.....	--	--	--	--	56.5	37.0	37.0	37.0	40.9	41.4	41.4	41.3
Urea.....	1/	20.6	20.6	28.7	--	--	--	--	--	--	--	--
Phosphate fertilizers:												
Superphosphate (P <sub>2</sub> O <sub>5</sub> ) below:												
25 percent.....	--	--	--	--	21.9	17.0	--	--	20.7	21.7	22.2	22.3
Superphosphate (P <sub>2</sub> O <sub>5</sub> )												
25 percent or over.....	--	--	--	--	--	--	--	--	19.3	19.7	19.8	19.7
Potash fertilizers:												
Potassium sulphate.....	--	22.5	22.5	22.5	17.0	11.5	11.5	11.5	--	--	--	--
Muriate (K <sub>2</sub> O) 60 percent..	--	--	--	--	--	8.9	8.9	--	9.3	9.8	9.9	9.8

1/ Not available. Source: (2, 22).

percent of the corn yield. The study also indicated that no more than 30 percent of total acreage was planted to high-quality rice. The proportion of the area planted to improved varieties of wheat and corn was 35 and 7 percent, respectively. The improved situation for cotton is clearly shown in table 20.

Sudan has undertaken a program to improve seed quality and distribution. Although information is not available on progress made in improving seed quality, it is thought to be equal to the gains the UAR has made in improving long-staple varieties of cotton. Efforts thus far have been limited almost entirely to improving the quality of cottonseed.

Recent experimental work by the Egyptian Ministry of Agriculture suggests that the application of genetic principles to plant breeding could do much to increase the yield of major cereal crops grown in the Nile Basin.

A greater use of improved farm machines and implements has contributed to increasing agricultural output and productivity in the now economically advanced nations. Many modern implements, however, represent relatively large capital investment, and are used mostly to save labor. In the UAR the scarcity of capital for labor severely limits the economic value of mechanical innovations requiring much capital. Therefore, the extensive use of modern machinery in Egyptian agriculture has been confined to operations that cannot be easily performed with traditional implements.

Some 11,000 tractors (mostly the wheel type) were reported in use in Egyptian agriculture during 1964. Crawler tractors are used mainly for land reclamation, leveling, digging irrigation canals, and sugarcane cultivation. Only 60 combines were reported in use. Within the last few years, the number of pumps used for irrigation purposes has increased. Plans to begin production of modern machinery have been announced, but only simple plows, pumps, hand sprayers, spades, hoes, and similar farm tools were manufactured as of 1966.

The introduction of more tractors and tractor-drawn machinery has helped Sudan to exploit larger areas of land. Land preparation in all major schemes is now mechanized, as are

Table 20.--Seed status of wheat, rice, and cotton; area under crop and area under improved varieties, UAR, 1964 <sup>1/</sup>

Commodity	Plant breeding	Use of improved varieties	Production of improv- ed seeds	Seed certi- fication	Seed testing	Seed dis- tribution	Seed laws	Area under crop	Area under improved varieties
								1,000 hectares	Percent
Wheat. . . . .	2	2	3	3	3	3	5	600	30
Rice. . . . .	3	3	3	3	3	3	5	250	35
Cotton . . . . .	1	1	2	3	3	2	4	830	80

<sup>1/</sup> The ratings 1, 2, 3, 4, and 5 designate excellent, good, fair, poor, and none, respectively.  
Source: (22).

sowing and harvesting operations of most cereal crops. Cotton is harvested by hand. Efforts are now being made to promote the mechanization of cotton harvesting. In recent years, foreign firms have been hired to spray the cotton crop by plane. With the newly acquired potential for expanding cultivated acreage, Sudan will probably make greater use of modern implements.

Given the expansion expected in the agricultural area, the number of tractors must be greatly increased to maintain the 1964 ratio of cultivated acreage to number of tractors. Data are given in table 21 that show the upper limits which must be reached by 1975 if a ratio of one tractor to 250 acres is to be maintained 18/. It appears very unlikely that this level of mechanization will be reached. After tractors, the machines likely to be increased in number are combine harvesters and implements for land preparation. Successful expansion of mechanization and progress from simple to more complex operations, however, are likely to depend mainly on three factors:

1. Cost and availability of farm labor.
2. The availability of types of machinery which are adaptable to local farming patterns.
3. The attainment of a progressively higher level of mechanical knowledge.

Both Egyptian and Sudanese farmers often suffer heavy crop losses because of attacks by pests. Use of insecticides and pesticides is limited to combating locust and various pests attacking the cotton crop. Picking insects from the crop by hand and burning cotton and corn stalks are still widely practiced. Lately, several control units have been established to procure insecticides and spraying equipment. Like fertilizers and farm machinery, most insecticides, fungicides, and disinfectants are imported. Expenditures on pest control in the UAR reportedly amounted to \$39 million in 1965; about 90 percent was spent on the control of cotton pests (10). The level of expenditures for

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18/ This level would be near the level of mechanization reported for Spain and Greece in 1964 (3).

Table 21.--Ratio of area cropped to number of tractors in 1964 and needs for 1975, UAR and Sudan

Country	1964		1975 <sup>1/</sup>	
	Gross area:	Tractors	Ratio of:	Gross area:
	cropped		cropped:	needed
			area to:	for
			tractors:	cropping
	1,000			1,000
	acres	Number	Acres	acres
				Number
United Arab				
Republic .	10,782	11,000	980	13,804
Sudan . . . .	8,489	1,000	4,823	10,250

<sup>1/</sup> Number needed to obtain a ratio of one tractor to 250 acres.  
Source: (3).

such supplies in Sudan is unknown. Sudan has recently contracted with foreign private firms for assistance in the control of insects affecting its cotton crops. Increased use is being made of air-planes to carry on this work.

Modern pest control methods of this magnitude have not been employed in the UAR. One of the main features of land tenure in the UAR is the small size and multiplicity of land-holdings. Under these circumstances, field crops are generally planted in small parcels and small areas of different crops. Many crops are interplanted or exist side by side, a situation causing difficulties in efficient use of chemical control. Irrigation practices whereby the agricultural land is crisscrossed with irrigation ditches and earthen embankments have limited the use of modern pest control equipment and favors the use of simple knapsack sprayers.

Another important factor influencing acre yield in the Nile Basin is the level of the subsoil water table. In northern Egypt, where canal irrigation is practiced, the underground water level in many places is near the surface. Larger quantities of irrigation water with more intensive cropping must be accompanied by an improved drainage system. Otherwise, irrigation special-

ists indicate yields will decline (15). <sup>19/</sup> Data are unavailable on the amount of water drained. The volume is of such magnitude that a comprehensive tile drainage project is being contemplated in some areas.

The productivity of irrigated soils in Sudan has been less affected by salt accumulation and high water table than by other factors. Continuous irrigation has raised the salt content of the soil, but the rate of accumulation remains relatively low. Recent experimental work has shown that crops can be grown more intensively in the Gezira before the sodium level is raised sufficiently to affect yields (30). It has also been noted that with such large areas in fallow, it is unlikely that the subsoil water table will rise enough in the near future to influence yields.

#### PRODUCTION AND CONSUMPTION REQUIREMENTS

The major factors relating to the volume of production by 1975 have been discussed. In light of previous discussion, the problem now is one of determining how much production will increase and to what extent resulting supplies will meet local requirements.

The first step in estimating the future level of production for selected crops in the United Arab Republic and Sudan was to fit least-squares regression lines to data on production, acreage, and yield for the years 1948 through 1966. Trends for these years were then extrapolated to 1975. The following equation was used:

$$\text{Log } Y_C = a + b (T)$$

where:

log  $Y_C$  equals production, acreage, or yield, and T equals time

These extrapolations are not considered true indications of future acreage or yield levels; they can be considered only as

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<sup>19/</sup> Irrigation canals also serve as a drainage system in much of the Egyptian delta. Irrigation water is delivered to the farmer at a depth (meter) below the level of the land. With the Persian water wheel (saqiya), counterbalance dipper (shaduf), or Archimedes screw wheel, water is lifted to the cultivated area. Where possible, excess water is returned to the canal.



bench marks for use in making future estimates. They are based on historical series and, therefore, do not reflect the expansion expected in crop acreage when current development projects are completed, the adoption of modern farm technology, or improved agricultural practices.

Official data are not available on either the total acreage to be made available for cultivation as a result of the new dams or what specific crops are to be planted on this additional land. Therefore, the introduction of judgment information was necessary in estimating more realistic levels of output.

Specific factors on which judgment was necessary in deriving production estimates for individual commodities were the following:

1. The willingness and ability of farmers to fully exploit available facilities for increasing agricultural production.
2. The probable introduction of improved farming technology such as more intensive use of mechanized equipment, fertilizers, and improved seed; insect and disease control; and improvements in other general farming practices. The introduction of improved technology requires consideration of the future cost and availability of production factor inputs such as land, labor, and capital.
3. The effectiveness of Government incentive programs aimed at expanding production to achieve national self-sufficiency in the production of a commodity, or the expansion of foreign markets.

Estimated levels of production are compared with projected consumption requirements for 1975--the differences reflecting anticipated deficits or surpluses.

Two basic assumptions underlie projected consumption requirements: (1) per capita availability of various commodities will be maintained at the 1959-61 level and (2) population growth for the UAR and Sudan will continue at an average annual rate

close to 3.0 and 2.5 percent, respectively. The 1959-61 level of consumption must be considered only a first approximation. Any apparent conflict between these assumptions and current trends has been noted in the discussions of various commodities.

A study made by officials of the U. S. Department of Agriculture (24) shows that in 1959-61 per capita consumption in both countries was close to 2,300 calories. Some increase in total caloric intake might be expected, but it is anticipated that major efforts in the immediate future will be directed at improving the composition of the diet. Lacking both variety and volume, the diet of most Egyptians and Sudanese consists largely of grains and other starchy foods.

#### United Arab Republic

In an earlier section, this report establishes the fact that the cultivated area in the UAR could reach 8.1 million acres by 1975. This would mean an increase of 1,720,000 acres over total cultivated acreage for 1965. Such an expansion will be equivalent to 2,924,000 acres if the predicted multiple-cropping index of 1.7 is attained. It would be more than equivalent to the total expansion in Egyptian farmland from 1900 through 1965.

Much of this will be marginal land. Therefore, it will take several years to increase its fertility to a normal degree. Thus, it is unrealistic to expect overall yields for Egyptian crops to progress at the same pace during the next decade as they have since 1948.

The balance between projected production and demand for selected commodities is shown in table 22.

Grains.--Grains normally account for 45 to 50 percent of the UAR total crop acreage. Principal grains are wheat, corn, and rice. Only small quantities of sorghum and barley are grown. Rice is the only cereal that is significant as an export crop.

Wheat is grown in all agricultural areas of the country. In fact, the geographic distribution of wheat is the most uniform of all crops grown in the UAR. This, in part, is due to the fact

Table 22.--Projected requirements and level of production by 1975, selected commodities, UAR

Commodity	: Quantity required to main- : tain per capita availability : : at the 1959-61 level <u>1/</u> :		Projected level of production		: Surplus (+) or deficit (-) : supplies	
	: Per capita :	: Total :	: Based on :	: Judgment :	: Based on :	: Judgment :
	: Kilograms	: 1,000 metric tons	: trends	: estimate	: trends	: estimate
			1,000 metric tons	1,000 metric tons	1,000 metric tons	1,000 metric tons
Wheat. ....	105.0	4,205	2,150	2,500	-2,055	-1,705
Rice (paddy) ....	40.0	1,600	3,100	3,630	+1,500	+2,030
Corn ....	62.0	2,490	2,450	3,050	-40	<u>2/</u> +560
Peanuts (unshelled) .....	1.3	55	75	95	+20	+40
Cottonseed .....	30.0	1,160	1,100	1,100	-60	-60
Cotton .....	3.4	<u>3/</u> 135	560	560	<u>4/</u> +425	<u>4/</u> +425

1/ Per capita availability was obtained on the basis of data from (24). 2/ Likely to be used domestically by livestock industry. 3/ Includes textile exports. 4/ Includes only raw cotton; expansion of the textile industry could reduce the quantity of these exports.

that each farmer is required by law to plant one-third of his total crop acreage to wheat each year; for other Egyptian farms it is a traditional crop to be grown in the rotation inherited from the past.

The UAR was a net exporter of wheat in 1946. Although production has increased, at the end of 1965, annual wheat and wheat flour imports exceeded 2 million metric tons (table 23). These imports increased at an average annual rate of 200,000 metric tons during the last decade. The growing demand for wheat imports has been largely confined to the country's two largest cities--Cairo and Alexandria. Rural areas produce the major portion of their needs.

In spite of the growing demand for wheat and laws requiring a given acreage to be planted each year, the area sown has in

Table 23.--Imports of wheat and wheat flour, UAR, 1954-65

Year	Wheat	Wheat flour	Wheat equivalent
----- 1,000 metric tons -----			
1954.....	10	49	78
1955.....	--	1/	1/
1956.....	242	51	313
1957.....	710	93	839
1958.....	774	279	1,162
1959.....	730	424	1,320
1960.....	631	473	1,288
1961.....	661	431	1,260
1962.....	860	510	1,568
1963.....	972	815	2,104
1964.....	810	776	1,888
1965.....	1,230	610	2,077

1/ Less than 500 metric tons.

general tended to decrease since 1955. This decrease averaged 0.4 percent annually from 1948 through 1966. Should this trend continue, the area planted to wheat by 1975 would equal little more than 1.4 million acres--some 220,000 acres less than that planted to wheat in 1966. The decline in acreage, however, has been more than offset by increased yields. The net result has been an average annual increase in wheat production of 2 percent (fig. 2 and appendix table 34).

Should present acreage and yield trends prevail, wheat production will approach 2.2 million metric tons by 1975. This level of output will be only about one-half total requirements to maintain per capita availability at the 1959-61 level of 105 kilograms (table 22). In light of the country's growing bread grain deficit, larger rather than smaller acreage will probably be planted to wheat in the immediate future. However, there are those who argue that none of the new agricultural potential as a result of completion of the High Aswan Dam can be justified for use in producing wheat (15). <sup>20/</sup> Nevertheless, recent difficulties in obtaining adequate wheat supplies in the international market, along with the country's mounting bread grain deficit, would give support to the belief that larger acreage will be planted to wheat in the immediate future. <sup>21/</sup>

Faced with the prospect of a continued grain shortage, the Egyptian Government appears to have three or a combination of

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<sup>20/</sup> Owen argues that the promotion of a policy to expand wheat acreage tends to obscure the real cost to the UAR in terms of opportunities foregone. He indicates that these opportunities include (1) the saving of foreign exchange by expansion of local production of farm commodities, which are, or can be, more competitive with imports than is local wheat production, and (2) the promotion of other basic food crops for which the UAR has a greater comparative advantage, as well as a greater self-sufficiency capability than is true for wheat.

<sup>21/</sup> As of September 1967, the UAR Government announced that for the coming year wheat acreage would be increased and cotton acreage would be reduced (28). The exact magnitude of these changes was not given.

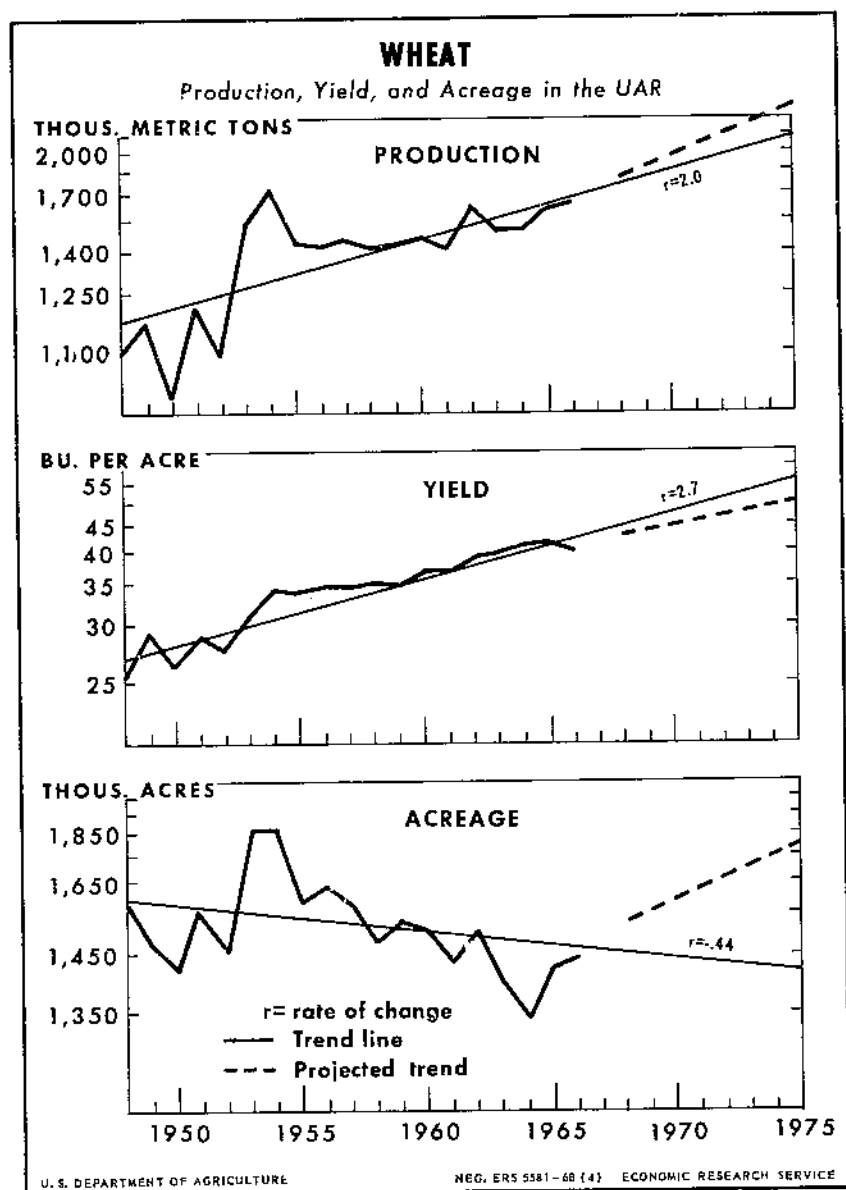


Figure 2

three alternatives available to it in its effort to meet future needs. These are as follows: (a) to increase production to a level higher than that forecast, (b) to curtail wheat consumption, and (c) to continue to receive larger imports of wheat.

Even with the anticipated expansion in yields, current acreage would have to be almost doubled to meet total local requirements. It is questionable if wheat acreage can be expanded that much by 1975 without a reduction in the area allotted to the major export crops--rice, cotton, and onions. There is also the possibility of extending grain acreage at the expense of berseem (a clover crop) acreage. Reduced berseem acreage, however, would limit the volume of livestock feed produced. This, in turn, would make for smaller livestock numbers and thus a reduction in the country's critical supply of food high in protein. At the same time, any expansion in wheat acreage at the expense of berseem acreage would increase the need to replace plant nutrients normally provided by berseem with chemical fertilizer.

There is also the possibility that yields could exceed projected levels with a greater application of modern technology and research and an increase in production inputs. The outlook could be greatly improved, for example, if the new variety of wheat known as Sonora, the "Mexican wonder wheat," is adopted on a widespread basis and proves to be as successful as it has been in other Middle East countries. Improved varieties of wheat are presently being grown on a limited scale; however, if these varieties prove successful, they probably will be used at an accelerated rate. Therefore, it is likely that production will increase faster than that indicated by the historical trend.

Historically, the Egyptian Government has promoted a consumer-orientated pricing policy which permits increased food supplies to be made available for the masses at extremely low prices. Wheat is the preferred bread grain; therefore, it would seem unrealistic to expect efforts to be made to reduce wheat consumption.

Most of the United Arab Republic's food imports during the last decade have been made available under concessional terms. Without such arrangements in the future, it is questionable if the country will be in a financial position to obtain large supplies on a commercial basis.

Rice has proved to be a very profitable export for Egyptian farmers in recent years. This, in part, explains why rice acreage has, in general, increased and reached an alltime high of 1.2 million acres in 1966 (fig. 3 and appendix table 35). Total rice acreage has fluctuated more from year to year than that for any other major Egyptian crop. It has varied mainly because of the availability of water during the spring months for irrigation. Completion of the High Aswan Dam will supposedly eliminate this problem by making a supply of water available throughout the year. As additional water became available on the completion of the first phase of the dam, rice acreage expanded at a faster rate than the historical trend of 3.3 percent annually.

A study of yield and acreage data for some time before 1960 would suggest that the supply of water available for irrigation was the major factor in determining the overall level of production. This is illustrated in the data for 1952 and 1958. During those years, acreage had to be reduced because of inadequate water. Yields were also down. But in the 1950's, when water was sufficient for an expansion of acreage, yields increased. On the other hand, it would appear that since 1962 rice acreage has expanded at such a pace that production inputs other than water (improved seed, fertilizer, and insecticides) were insufficient to maintain yields at previously established levels.

Rice does not compete directly in the rotation with wheat or cotton. Now that water is available, the area planted to rice in the future is likely to be substantially more than that indicated by the historical trend line in figure 3. The following factors tend to support this belief: (a) the favorable outlook for rice in the international market, (b) the growing importance of rice as an earner of foreign exchange, and (c) the large returns to land and management from rice production. Farm prices for rice are supported by the Government, which will buy all rice offered at a guaranteed minimum price.

The historical trend suggests that 1.6 million acres will be planted to rice by 1975 and that yields will reach a level of 56 hundredweight per acre. Egyptian rice yields compare favorably with those in the United States and Japan, but have lagged behind those in Spain and Australia in recent years.



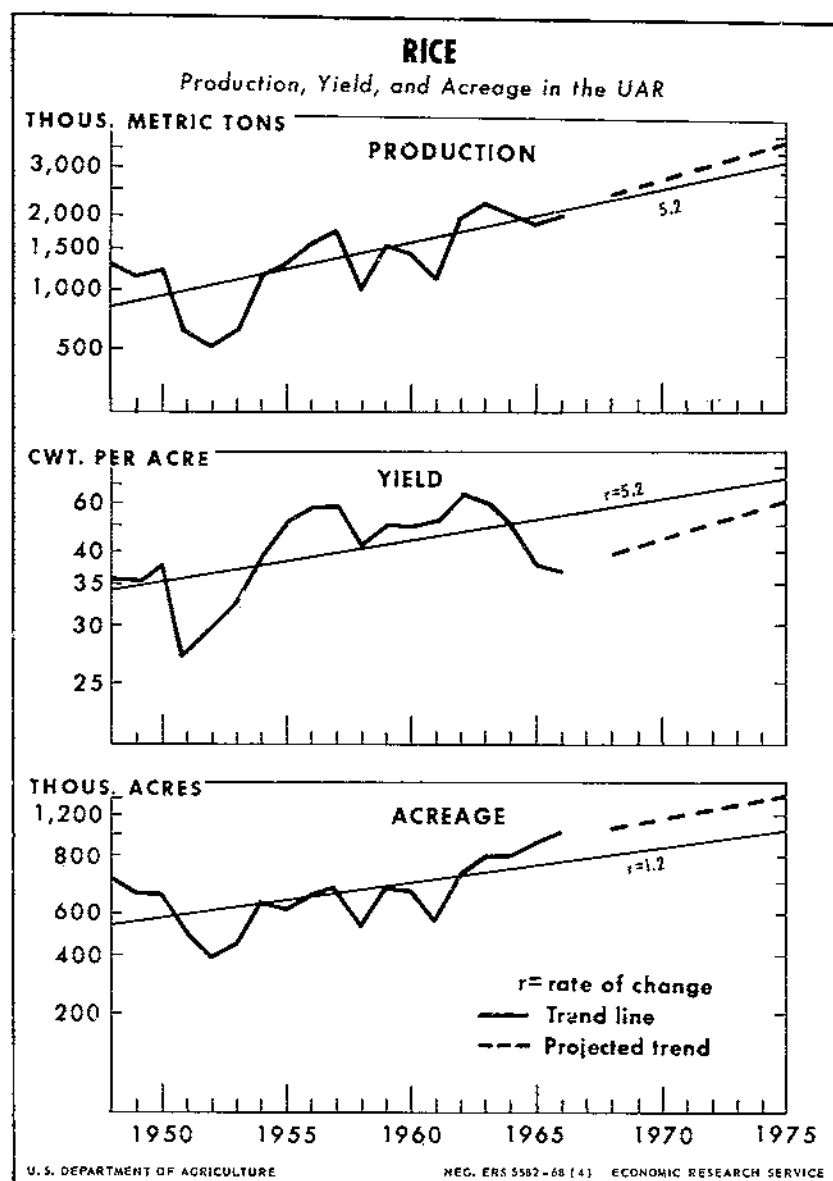


Figure 3

Rice is of less importance in the Egyptian diet than wheat and corn. One-third of the crop is normally exported. After allowance was made for exports, the amount of rice available per capita during 1959-61 amounted to approximately 40 kilograms (rough basis). If the same level of per capita consumption is maintained through 1975, local requirements will equal 1.6 million metric tons. On the basis of current area and yield trends, substantially large quantities would be available for export by 1975. Average annual exports amounted to 700,000 tons for 1963-66. It is believed that in the future, rice yields may lag behind those indicated by the historical trend. Expansion in acreage, however, is likely to be of such magnitude that production could well exceed the projected level by 530,000 tons.

Corn normally competes with cotton for the largest acreage planted to field crops. As a food grain, it is more important than wheat. Corn is the principal staple food in the rural areas, and is produced mostly for home consumption. Relatively small quantities enter commercial trade channels. About two-thirds of the crop is produced in the delta. The area planted to corn decreases as one goes south, and is of relatively little importance in the extreme southern one-third of the country.

The general practice has been to plant most of the corn crop (77 percent in 1963) at the beginning of the flood season in July. This late crop (flood or "Nili" corn) reportedly yields 20 to 25 percent less than the crop planted in May and June. Now that additional water will be available during the dry season, the Government has promoted a policy to encourage the planting of the major share of the crop in May and June. Locally this is labeled the "summer crop." The increase in corn yields since 1964 partially reflects the shift to earlier planting. Farmers will probably continue early planting after the High Aswan Dam is completed.

Experimental work recently undertaken by the Ford Foundation in cooperation with the Ministry of Agriculture would indicate that corn has a great potential in the UAR. Informed technicians suggest that yields could be doubled with improved practices. The degree of progress that can be made is indicated by the fact that Egyptian corn yields averaged 49.8 bushels per acre in 1965, compared with 73.1 bushels per acre in the United States.

Only a small acreage of hybrid corn is presently grown. However, the growing need for increased bread grain is likely to stimulate interest in a wider use of hybrid seed in the immediate future. In addition to the practice of early planting and use of improved seeds, yields can also be increased considerably with better pest and disease control measures.

The maturing date for corn comes at a time when the supply of other forage crops is extremely limited. Thus, there is the general tendency to strip the corn stalk of its fodder for feeding purposes. It is believed that yields could be greatly improved if the grain were allowed to fully mature before the fodder was removed from the stalk, as is now done in many areas.

Corn acreage has, in general, tended to decrease since 1953. Annual fluctuations in acreage have been of such magnitude that the significance of the historical trend line is questionable (fig. 4). By 1975, planted acreage could well reach 2 million acres. Corn has proved too unprofitable for the Egyptian farmer to voluntarily produce surplus quantities for the commercial market. Instead, most of the expanded crop area in the summer will probably be planted to rice and vegetables.

Recent progress would tend to suggest that yields will exceed the projected trend level of 52 bushels per acre by 1975. For the reasons already noted, yields could reach and surpass 60 bushels per acre. Even with the lower level of yields, the country could become self-sufficient in corn by 1975 (assuming per capita availability of 62 kilograms). With higher yields and more corn acreage, supplies could exceed food requirements. It is unlikely, however, that any surplus supplies would be available for export. Instead, corn would probably play a greater role as a livestock feed. Larger quantities would undoubtedly be used for human consumption, in light of the large deficit forecast for wheat. Thus, the amount of corn consumed annually will probably exceed the 62 kilograms per capita reported for the 1959-61 period.

Oilseeds.--Oilseed production in the UAR centers mainly around cottonseed and peanuts. Other oilseeds of minor importance include sunflower, sesame, pumpkin, castor, and gourd. While total oilseed production has increased in recent years, the

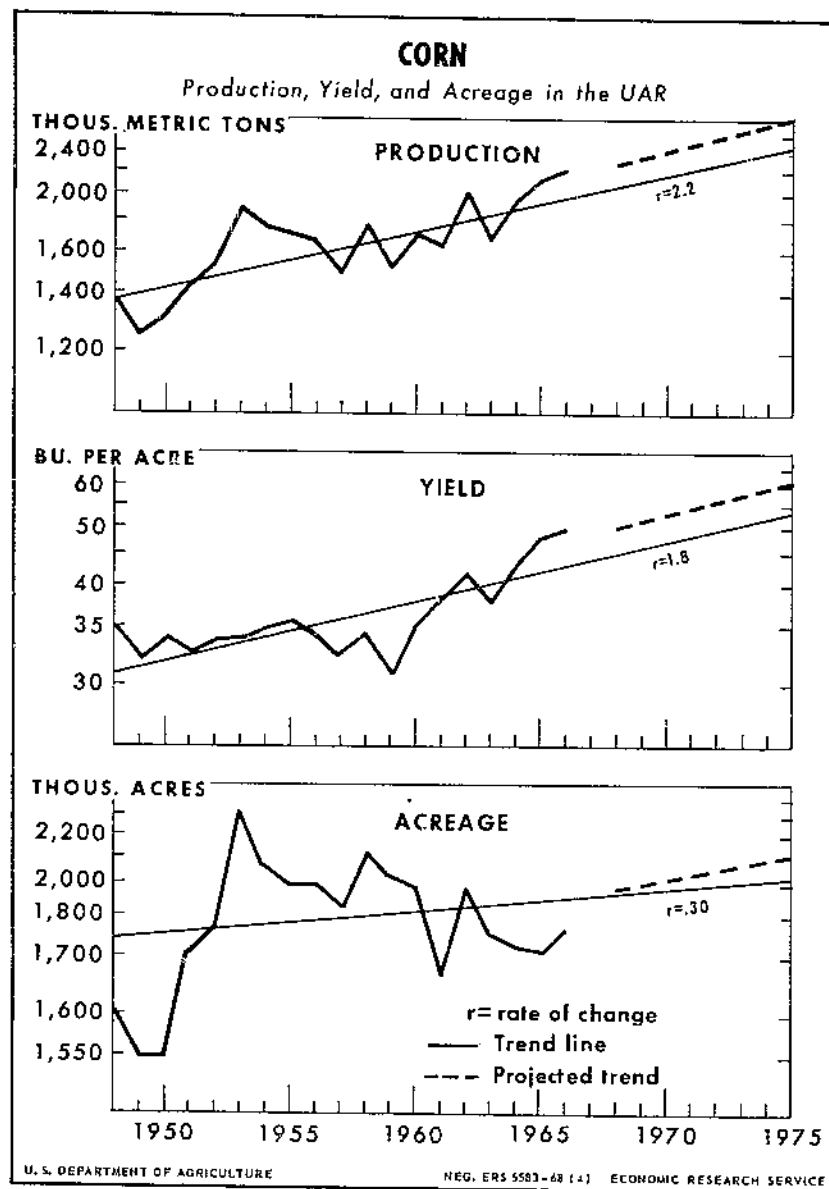


Figure 4

supply has not kept pace with the country's growing requirements. As a result, vegetable oils and oilseeds are being imported in increasing quantities.

Peanuts are especially useful in the Egyptian economy, both as a raw or cooked food and as a source of oil. For cooking purposes, peanut oil is second to cottonseed oil in importance. Until recently, a sizable proportion of total peanut production was exported. Total production is now needed locally to help meet the growing requirements for vegetable oils.

After rice and cotton, peanuts are among the most profitable summer crops grown. They are planted in April and May and harvested in October and November. Production rose at an average annual rate of 6.3 percent between 1948 and 1966. In 1965, 50,000 metric tons (unshelled) were produced. Continued expansion in production is the result of larger acreage and improved yields (fig. 5 and appendix table 37). Yields compare favorably with those in major producing countries in Europe and North America.

Peanuts are likely to play a greater role in the Egyptian rotation in the immediate future. Where water is available, many of the areas with predominantly sandy soils have proved productive for growing peanuts. As additional water becomes available, it is believed the acreage planted to peanuts will be somewhat higher than that indicated by the extended trend line. There is no reason to believe, however, that yield will advance at a faster pace than the average annual rate of 1.4 percent. On the basis of current trends, production could approach 75,000 metric tons by 1975. With greater expansion in acreage than is now indicated, production could well reach 95,000 tons. This volume of production would be more than adequate to maintain the 1959-61 per capita level of consumption of 1.3 kilograms. It is unlikely that surplus quantities will be exported. Instead, they will probably be used as a substitute to help compensate for the deficit in other vegetable oils. In any case, substantially larger quantities of oilseed cake will be available for export.

Cottonseed is an important byproduct of the cotton industry. Cottonseed oil supplies 85 percent or more of the country's total edible oils, and comprises more than half of the vegetable oils

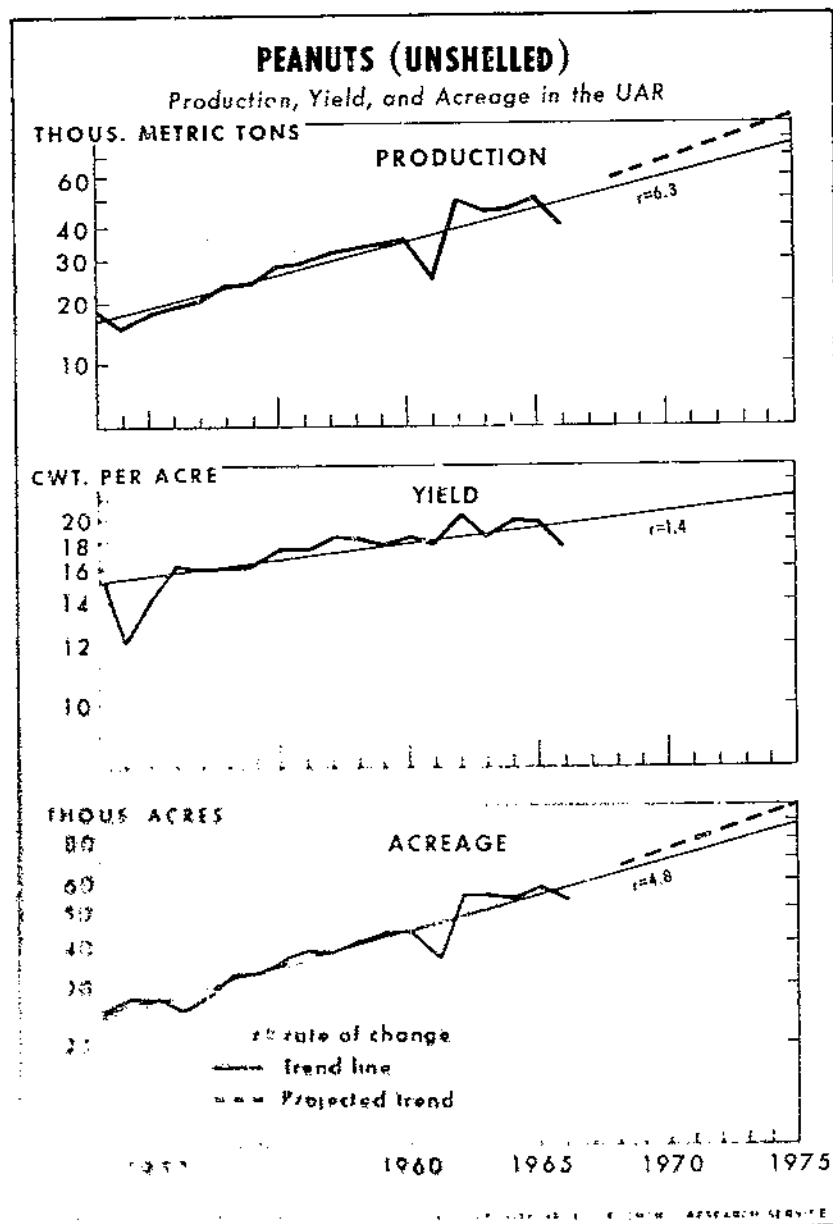


Figure 3

used industrially. Seed production has increased substantially since 1961, largely because of higher cotton yields.

The level of cottonseed production expected for 1975 is a residual of projected cotton output. With a ratio of 1 to 1.9 between cotton lint and seed production, some 1.1 million metric tons of cottonseed would be produced if the projected goal of 560 metric tons of raw lint is reached. During 1959-61, per capita availability of cottonseed (local production plus imports of seed and oil) amounted to 30 kilograms. Thus, to maintain this level, anticipated production will fall some 160,000 metric tons short of requirements. A deficit of this kind could be offset by expanding the production of other oilseed crops. There is also the possibility that efforts will be made to reduce consumption requirements. In any case, the UAR will probably remain a vegetable oil deficit country unless greater effort is made to expand oilseed output.

Cotton.--The major question regarding future Egyptian agriculture is whether the arable land created by completion of the High Aswan Dam will increase cotton acreage or will be used for food production. There are no indications that the United Arab Republic will greatly expand cotton acreage when the dam is completed. Nevertheless, it is an understatement to say that cotton is likely to be a major crop in the UAR for many years to come. The area planted to cotton increased at an average annual rate of 0.4 percent between 1948 and 1966, and averaged 1.8 million acres during the 5-year period 1960-64. It is believed that Egyptian cotton acreage will approximate that of the historical trend line and average close to 1.9 million acres by 1975.

There is growing evidence to support this belief. In general, there is a strong desire to reduce the dependence of the economy on this single crop which has constituted over two-thirds of the country's foreign exchange earnings during recent years. Planners have also expressed some concern over the future trend in the world market for extra-long staple cotton, especially in view of the expanded areas being cultivated in other countries. Also of growing concern is the rapid pace of technological advances in the processing of short-staple cotton. All are factors which would appear to discourage substantially larger Egyptian cotton acreage.

As stated earlier in this report, the prospect for long-staple cotton is sufficiently uncertain, and the availability of alternative land use opportunities sufficiently attractive to lend general support to the policy of not deliberately expanding cotton areas. A policy to improve the country's overall self-sufficiency in food supply will also tend to curtail expansion of cotton acreage.

Even at current world prices, cotton remains a profitable crop in the UAR. In spite of the recent discovery of substantial oil deposits in the western desert, the Egyptian economy will very likely need to continue to look to cotton to supply the bulk of its critical foreign exchange requirements for many years to come. Furthermore, there would appear to be little cause to deemphasize cotton for fear Egyptian cotton will lose its premium value in relation to long-staple cotton of other producers, provided sufficient attention is given to the continued improvement of production and marketing procedures.

It would appear, then, that no significant change in cotton acreage is likely in the immediate future. Instead, greater effort will be made to improve quality and yields and thereby retain the competitive advantage of Egyptian cotton in the extra-long staple cotton market. This means that farmers will be highly selective in choosing varieties to be promoted.

The curtailment of cotton acreage will permit greater expansion in grain, fruit, and vegetable acreages. Expanding local and foreign markets are already improving the relative position of these commodities in relation to cotton in recent years.

Egyptian cotton yields compare favorably with those in other countries producing extra-long staple varieties. Pima S-1 and S-2 varieties in the United States give greater yields than Egyptian extra-long staple varieties. However, average Egyptian cotton yields during the 1960-64 period amounted to 538 pounds per acre, compared with an average of 477 pounds for all types in the United States. Despite high averages, yields have varied considerably since 1948 (fig. 6). Insect pests have accounted for some of the worst Egyptian crop failures. In 1961, the trouble was army worms.



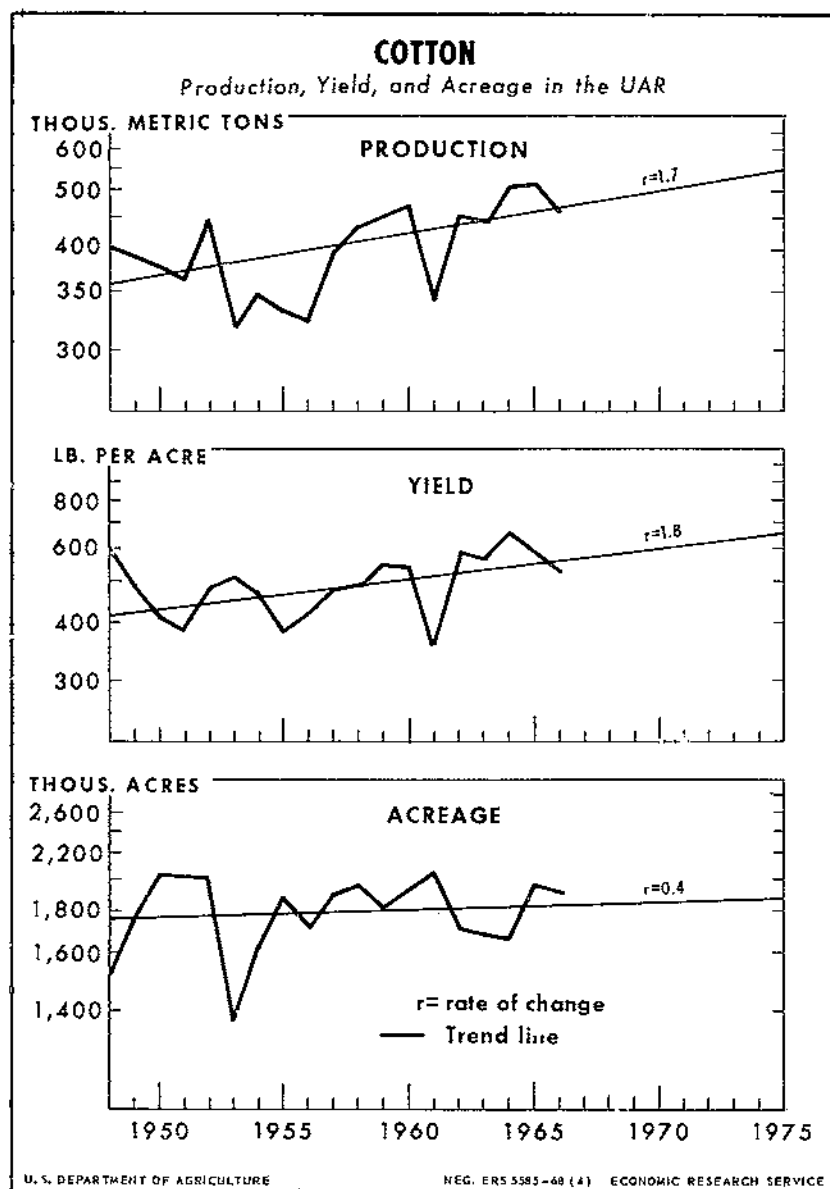


Figure 6

The historical trend indicates that annual increases in yields have averaged 1.8 percent. In the absence of better insect control measures, gains in average yields from the present high base may be difficult to achieve. Improved methods of cultivation, greater use of nitrogenous fertilizers, and improved seed production and distribution will, no doubt, be helpful. But there is no indication of a major breakthrough in the immediate future. The prospect for 1975 seems to be about 650 pounds. This would still be slightly below the alltime high of 665 pounds reported for 1964.

Should the assumptions for acreage and yields outlined prove true, Egyptian cotton production will approximate 560,000 metric tons in 1975 (fig. 6 and appendix table 12). This amount would be 26 percent larger than the 1960-64 average of 443,000 metric tons. The major share of this production would be available for export. Internal consumption of raw cotton during 1959-61 averaged 3.4 kilograms per capita. This compared with 2.8 kilograms in 1954 and 2.5 kilograms in 1938 (1). Much of this supply was processed locally and exported as textiles. The Egyptian cotton textile industry has expanded significantly in recent years, and there is reason to believe that expansion will continue. Thus, if the per capita cotton consumption reaches 5 kilograms by 1975, there would still be some 360,000 metric tons of raw cotton available for export. 22/

#### Sudan

In a previous section on the status and goal of development projects, this report establishes the fact that the irrigated area in Sudan could be expanded some 1.5 million acres by 1975. It also proves that on the basis of current practices, water supply will be more than adequate for this acreage. With abundant water, it is physically possible to increase crop acreage and production by using land more intensively. Under present practices, about two-fifths of the area in the main irrigation schemes lies fallow each year.

The lack of trained technicians and an inadequate labor supply are the main deterrents to further expansion of Sudanese

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22/ Per capita consumption for 1975 is projected at 4.8 kilograms in (3).

agriculture. Sudan's total cropped area was expanded by 2.5 million acres (16) from 1955 through 1964. With continued use of foreign technical assistance and a more efficient utilization of the labor force, significant progress is likely in the immediate future.

A summary of anticipated levels of production and requirements for the principal crops by 1975 is given in table 24. Production projections are based on acreage and yield data for rainfed and irrigated areas.

Grains.--Durra, a grain sorghum, is Sudan's main food crop. It is grown in all provinces under both rain and irrigation cultivation and is highly resistant to drought and heat. Some 85 percent of the 3.3 million acres grown in 1964 was rainfed, compared with 78 percent of total grains produced. While durra is considered a good livestock feed, most Sudanese farmers find it uneconomical for this purpose because of its high market value. Each year some durra is exported, the quantity in recent years averaging slightly over 100,000 metric tons.

The historical trend would indicate that durra acreage by 1975 could reach 5.4 million acres (fig. 7 and appendix table 39). This would mean an average annual growth rate of 4 percent. Yields are subject to wide variation and are projected at 17.5 bushels per acre. Such a yield level would be only 2.5 bushels per acre over the 1961-65 average. Such an area and yield level would produce 2.4 million tons of grain. This would be equivalent to 138 kilograms per capita for the projected 1975 population of 17,335,000. Per capita grain consumption is expected to increase during the next decade. It is anticipated, however, that wheat will make up the major share of this increase. Thus, if the per capita availability of sorghum remains at the 1959-61 level of 115 kilograms, a surplus would exist. Most of the surplus would probably be available for export.

Wheat is the grain most likely to receive major attention in the immediate future. Increased attention to it might not be fully justified if it were an export crop, but it is being promoted as an import substitute. At present, little more than one-third of the country's rapidly rising wheat requirement is produced locally. In 1965, imports of wheat and wheat flour exceeded 100,000

Table 24.--Sudan: Projected situation for selected commodities by 1975

Commodity	Quantity required to maintain per capita availability at the 1959-61 level <u>1/</u>		Projected level of production <u>2/</u>		Surplus (+) or deficit (-) supplies	
	Per capita	Total	Based on trends	Judgment estimate	Based on trends	Judgment estimate
		1,000	1,000	1,000	1,000	1,000
	<u>Kilograms</u>	<u>metric tons</u>	<u>metric tons</u>	<u>metric tons</u>	<u>metric tons</u>	<u>metric tons</u>
Sorghum (durra) . . . . .	115.0	1,990	2,420	2,420	+430	+430
Wheat . . . . .	6.0	105	85	135	-20	+10
Sesame . . . . .	11.0	190	290	290	+100	+100
Peanuts, unshelled . . . . .	9.5	165	680	650	+515	+485
Cottonseed . . . . .	20.0	350	440	570	+90	+220
Cotton . . . . .	2.0	35	230	300	+195	+265

1/ Per capita availability was obtained on the basis of data from (24).

2/ Production from irrigated and nonirrigated areas.

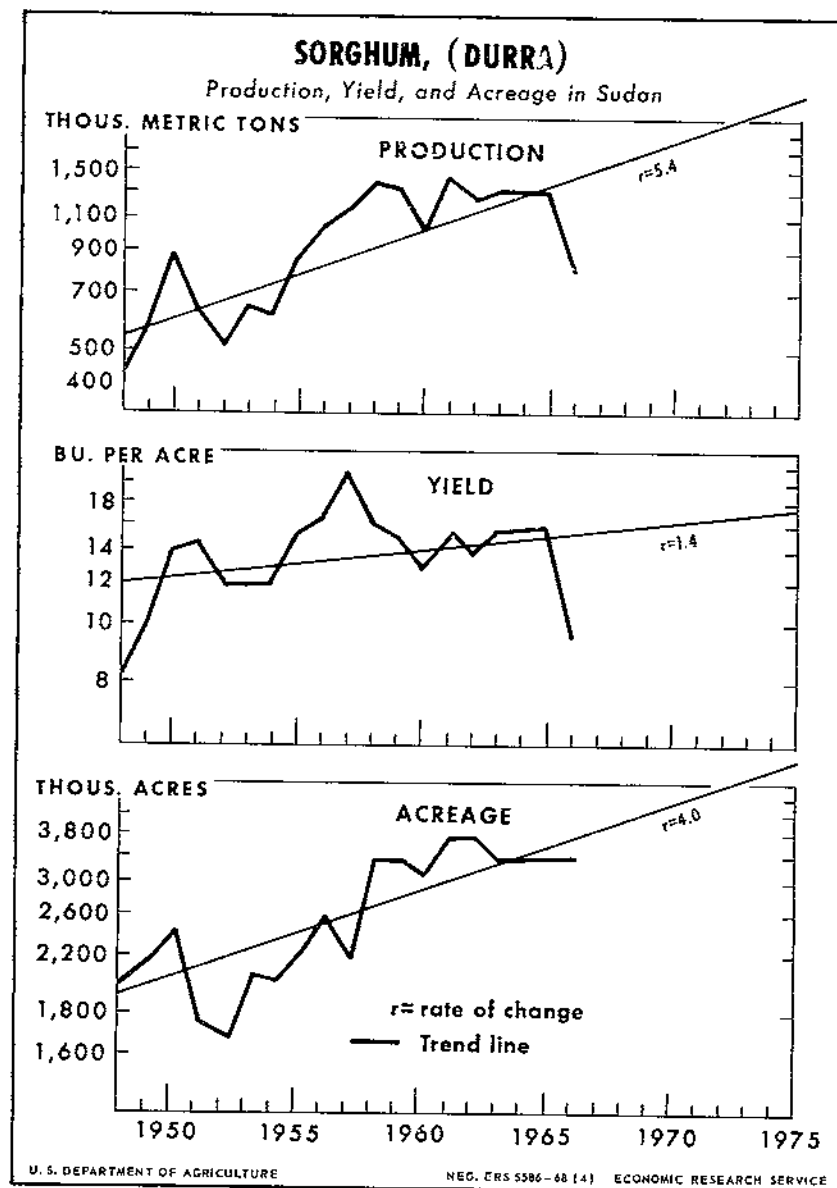


Figure 7

metric tons (wheat equivalent); during the 1948-52 period they averaged only 27,000 tons. By 1975, wheat acreage and yields could well exceed those noted by historical trend lines. Data for 1963 through 1966 suggest that new trends are in the making (fig. 8). From 1953 to 1963, yields averaged approximately 23 bushels per acre. This compared with close to 30 bushels for 1964-66. Like cotton, most wheat is grown under irrigation. Continued gains are likely as improved farming practices are adopted. Historical trends suggest that the country will continue to have a deficit by 1975 if the 1959-61 per capita availability of 6.0 kilograms is to be maintained. Contrary to these trends, Sudan has adequate resources to more than meet these needs. Wheat production is becoming increasingly mechanized. Therefore, the lack of a sufficient labor force will probably have less effect on the expansion of wheat production than on expansion in the production of other crops. With water now available for crop expansion, a policy of greater self-sufficiency in bread grains will almost certainly be pursued in the future. In fact, it is believed that total wheat needs will be met by local production by 1975.

Other grains of significance in Sudan include corn and millet. Both are grown to meet certain needs in several areas of the country. Neither is of importance in commercial trade and there are no indications that they will be in the near future.

Oilseeds.--Oilseeds are next to cotton in importance as an earner of foreign exchange. The country's main oilseeds include sesame, peanuts, and cottonseed. Exports are limited to seeds, since the processing industry is still practically new.

Sesame use and cultivation are widespread. Some patches are grown under irrigation along the Nile north of Khartoum, but the major producing areas lie west of the White Nile across the sand dunes of Kordofan and Darfur Provinces. It is also grown in the hilly regions throughout the south. Sesame, like peanuts and cottonseed, is of importance for local consumption and as an export crop.

Sesame acreage has tended to increase since 1951. The growing importance of the production of sesame in recent years is indicated by the average annual acreage increase of 7.6 per-

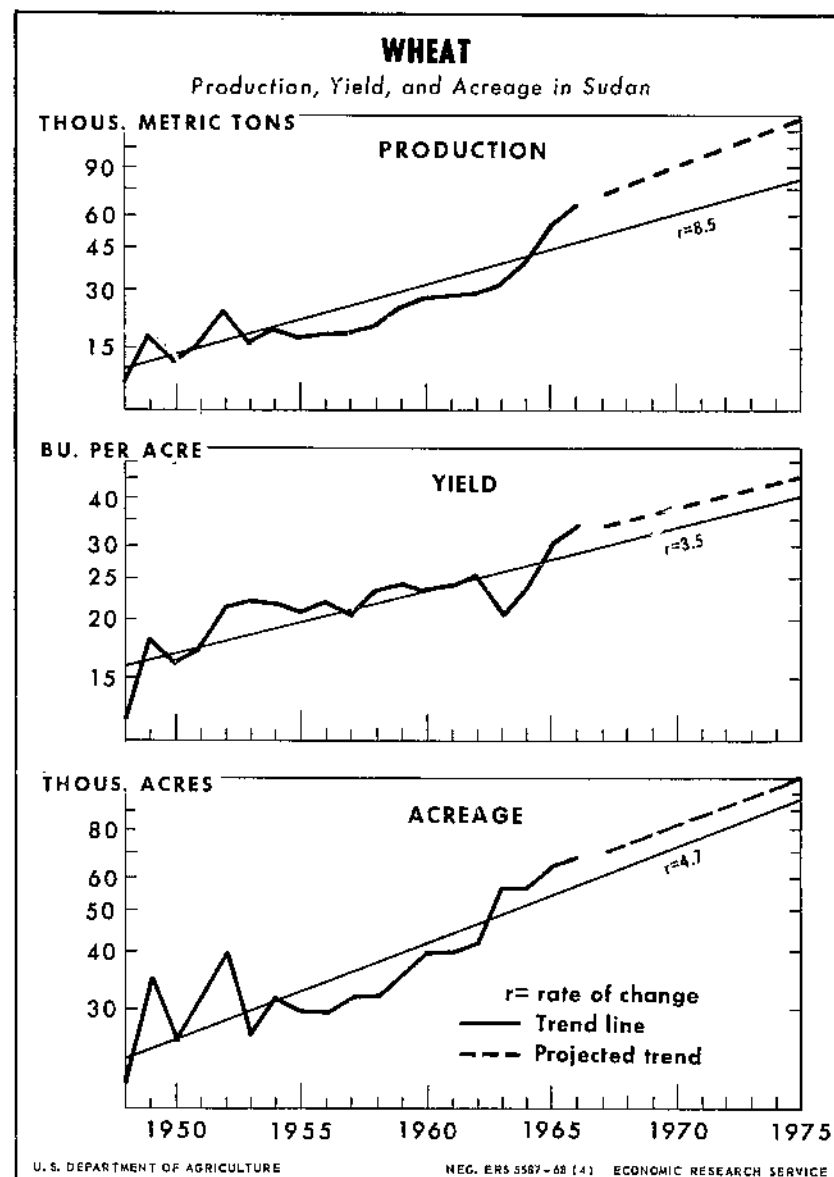


Figure 8

cent during the last two decades. Indications are that sesame acreage will continue to expand at an equal or higher rate in the immediate future.

Increased acreage has been of sufficient magnitude to offset declining yields and to permit continued expansion in overall production (fig. 9 and appendix table 41). Only a small portion of the crop is irrigated. A larger percentage will probably be under irrigation in the future; these practices could help to arrest the downward trend in yields. At any rate, the projected production of 290,000 metric tons for 1975 appears reasonable. This level of production would equal 1959-61 levels of consumption and leave an additional 100,000 metric tons available for export. This would compare with exports that averaged slightly over 70,000 metric tons in 1961-65. There are also possibilities that with favorable conditions in the world market for sesame, efforts would be made to exceed projected levels.

Peanuts may well be considered a twin to sesame in Sudan; for wherever sesame is grown so are peanuts. Production has increased so in recent years that sizable quantities are now exported.

The rapid expansion in acreage and output for recent years is shown in figure 10 and appendix table 42. During the next decade, it is questionable if acreage can be continuously expanded at the pace indicated by the historical trend line. These trends would suggest that peanut acreage could exceed 2 million acres by 1975. In light of the growing demand upon the country's limited production inputs by other crops, it is unlikely that peanut acreage will increase to such an extent by that time. It does not appear unrealistic, however, to expect peanut acreage to approach 1.6 million acres by 1975.

From 1948 through 1966, peanut yields increased at an average annual rate of 3.7 percent. A closer examination of the data for that period shows that yields have in general tended to decrease since 1960. This trend will probably be reversed as larger quantities of water, improved seed, and fertilizer become available. Less than one-third of the crop is presently grown on irrigated land. If anticipated expansion is realized, production



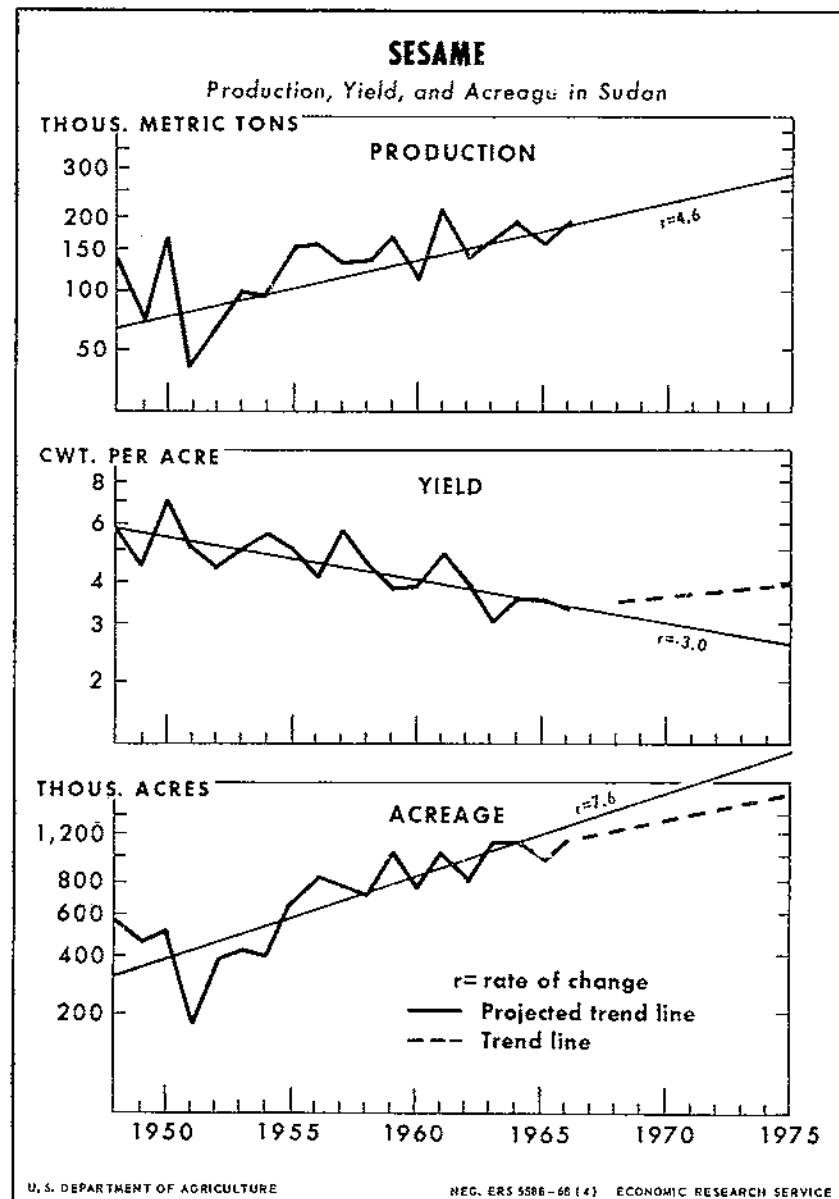


Figure 9

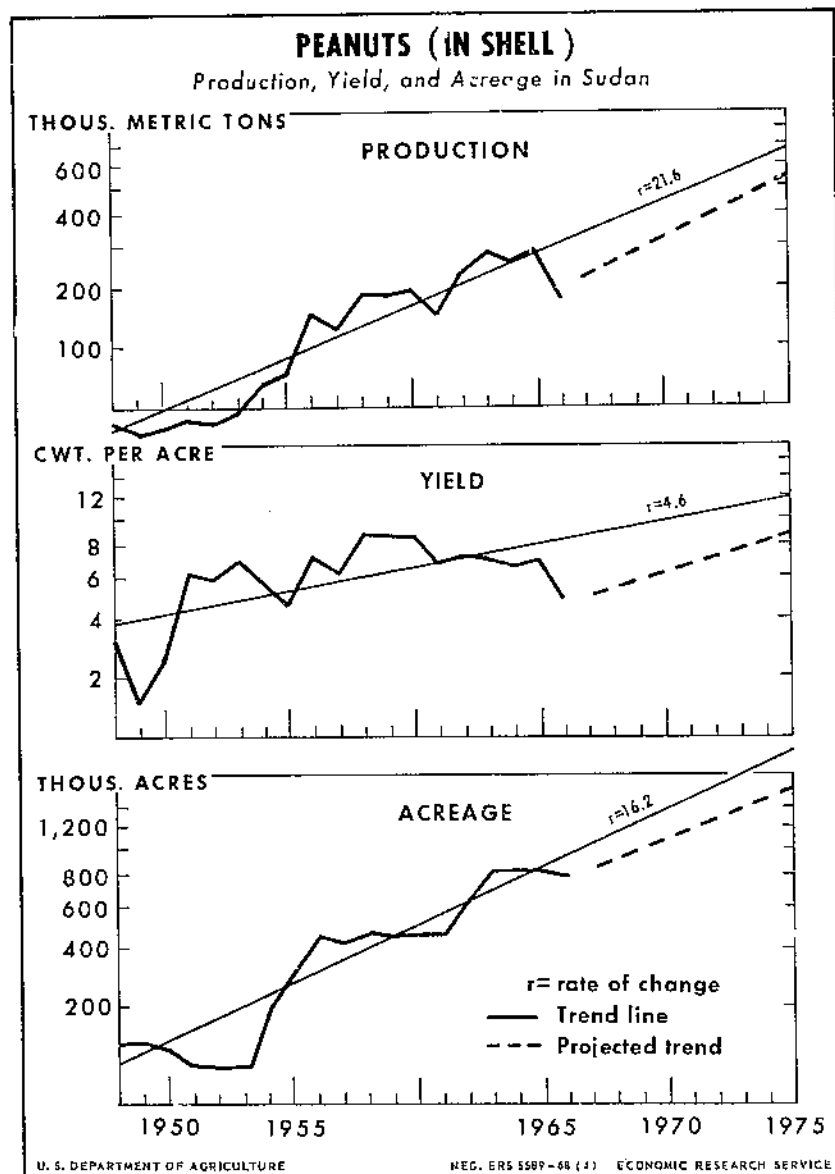


Figure 10

will be sufficient to maintain the 1959-61 level of per capita consumption and also to provide larger quantities for export. It is doubtful, however, that production will reach the level indicated by the historical trend.

Cottonseed is an important byproduct of the cotton industry in Sudan. With a ratio of 1 to 1.9 between cotton lint and seed production, agriculturists anticipate that some 440,000 metric tons of cottonseed will be produced if the indicated 230,000 metric tons of raw lint are produced. During 1959-61, annual per capita consumption of cottonseed averaged close to 20 kilograms. Thus, to maintain this level of consumption, anticipated production will exceed requirements by close to 200,000 metric tons. As the oilseed industry is developed, larger supplies are likely to be used locally. At any rate, Sudan should have no difficulty in disposing of any oilseed surpluses in neighboring Middle East countries.

Cotton.--All Egyptian cotton in Sudan is grown under irrigation and accounts for approximately 70 percent of all cotton acreage. On the other hand, little more than 3 percent of American cotton is grown under irrigation. The difference in yields from the two types is illustrated by the fact that American cotton accounts for 30 percent of all acreage planted but for only 11 to 15 percent of total production. Agricultural experts anticipate that both acreage and yields for this type of cotton are likely to increase in the near future as larger areas are irrigated. The degree to which American or upland cotton will be promoted at the expense of Egyptian cotton will depend, in part, upon the price spread between the two. This spread has been narrowing since the late 1950's and has resulted in shorter staple varieties becoming more competitive with extra-long staple varieties in major cotton markets of the world.

There are still uncertainties about the extent of expansion in cotton acreage that will be feasible as a result of new irrigation projects. There can be little doubt, however, that there will be additional increases in plantings of cotton.

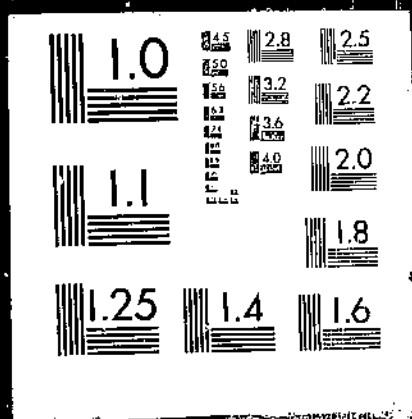
Since cotton appears to be more profitable than any other Sudanese crop, the tendency probably will be to increase cotton acreage to the maximum that production inputs will allow.

USDA/FAER-48

AGRICULTURAL DEVELOPMENT AND EXPANSION IN THE NILE BASIN: PROGRAMS--PRODUCTION--IMPLICATIONS FOR U. S. AGRICULTURE. (Foreign Agricultural Economic Report). / Cline J. Warren. Washington, DC: Economic Research Service. Oct. 1968.

(NAL Call No. A281.9/Ag8F)

# 20F.2 USDA FAER-48



Doubts are raised from time to time about the large area of fallow land in the main cotton areas. Even so, more intensification of cotton in the rotation appears unlikely in the immediate future.

The historical trend indicates acreage could increase by 60 percent by 1975. In spite of past successes in expanding acreage and the various projects underway to increase the water supply, it is questionable if expansion of this magnitude can be achieved. The outlook for alternative crops, labor supply, degree of mechanization, and prospective cotton markets would all tend to support the belief that such a projection is over-optimistic.

In Sudan, production per acre of cotton fluctuates widely. Since 1948, it has tended to drop, with an average annual decline of 0.6 percent (fig. 11 and appendix table 43). This downward trend and the great variation from year to year have recently become the cause for much concern among Sudanese officials. There is no cause, however, for expecting a sharp upward trend in yields or a decrease in the year-to-year variation in the immediate future. Total cotton yields averaged 320 pounds per acre during the 1964-66 period. Yields will probably increase in the future. They could reach the level of 380 pounds per acre by 1975. At any rate, they will probably continue to lag behind those of other major producing countries. Larger portions of the crop will be under irrigation; this alone should help to make for improved yields.

Present trend lines indicate Sudanese cotton production could reach 230,000 metric tons by 1975. This is equivalent to a 72-percent increase over the 1962-66 average of 164,700 metric tons. Sudan will be almost entirely dependent on export markets for this expanded production. On the assumption that per capita consumption of raw cotton is not likely to exceed 2.0 kilograms, only 35,000 tons would be used internally. It is very probable that production could approach 300,000 metric tons by 1975. If such a level of production is reached, even larger quantities would be available for export.

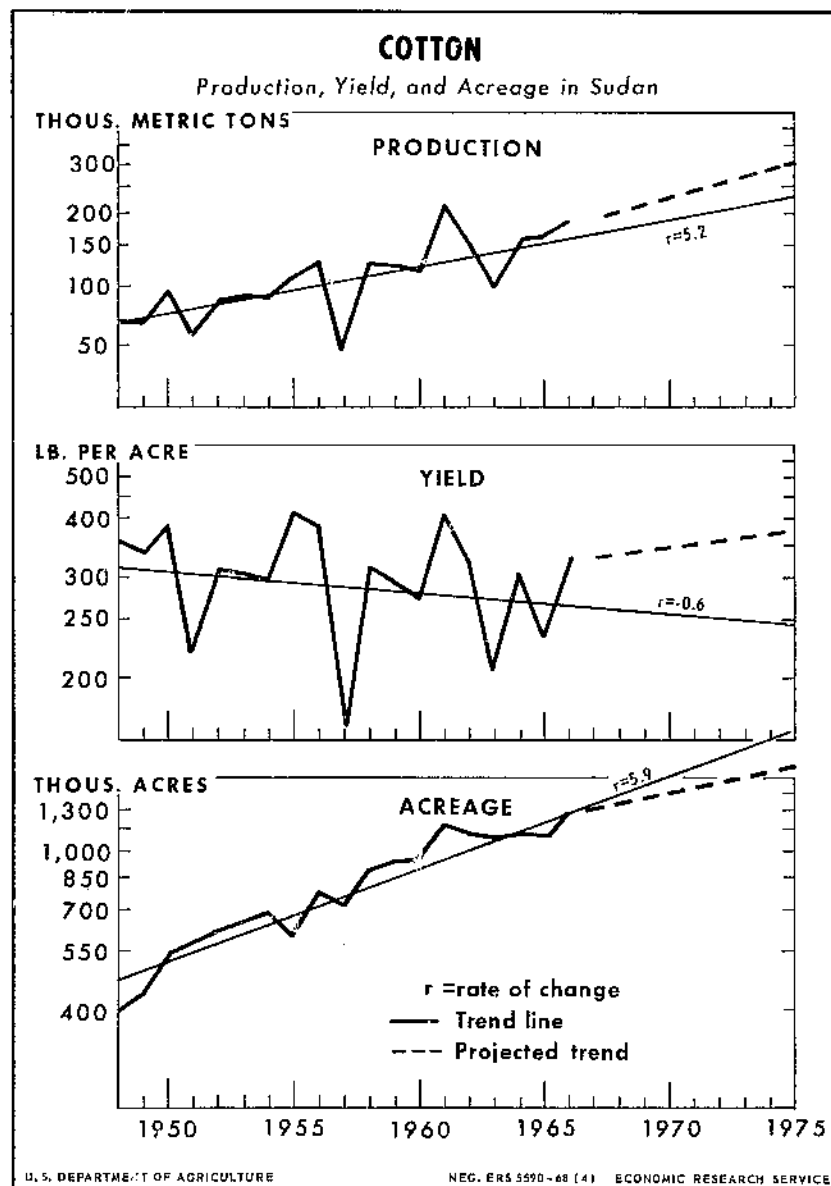


Figure 11

## EFFECTS OF AGRICULTURAL DEVELOPMENT IN THE NILE BASIN ON U. S. FARM EXPORTS

In world markets, the cotton, citrus, oilseed, and vegetables of the UAR and Sudan compete with U. S. farm products. The most important of these commodities is cotton.

Both countries have concentrated on the production of long and extra-long staple cotton. These varieties are competitive with U. S. cotton exports to the extent that they are substituted for short staple varieties by major manufacturers of textiles. Some agriculturists believe that larger exports of long staple cotton have tended to depress world prices of all varieties of cotton in recent years. Furthermore, if the anticipated expansion in production of Egyptian cotton is realized in the Nile Basin, the world's extra-long staple situation during the next decade will undoubtedly be greatly affected. Substantially larger quantities will be available for export, as expansion of the textile industry in both countries is not likely to keep pace with increased cotton production in the immediate future.

The small quantity of short staple cotton exported annually by Sudan is more directly competitive with U. S. cotton on the world market. Should the price margin between the two types of cotton continue to narrow, American upland cotton will probably be given greater emphasis in Sudan. Shipments of American upland cotton from Sudan have normally gone to countries of the Far East and Europe. In some years they have completely replaced U. S. cotton sales to Ethiopia.

The major share of cotton exports from the UAR and Sudan is now shipped to East European countries and Communist China. This remains the case in spite of recent efforts to promote greater trade with Western Europe, formerly the traditional market for most Egyptian and Sudanese cotton exports.

The growing potential for rice exports in the UAR could in the future also be of greater significance to U. S. agricultural exports. Of equal or greater importance are the prospects for feed grain surpluses in Sudan. These shipments could compete directly with U. S. exports in Western Europe.



The Nile Basin is currently a net importer of vegetable oils. However, if the agricultural expansion projected for the immediate future is realized, local production will be more than adequate to compensate for the UAR's vegetable oil deficit. Sizable quantities, mostly from Sudan, will be available for export. These exports compete in the importing countries with U. S. sales of soybeans, other oilseeds, and vegetable oils. Furthermore, the Nile Basin has provided a growing outlet for U. S. vegetable oils during the last decade.

The Egyptian citrus industry has expanded substantially since 1955. Citrus now competes with U. S. fruit exports to Europe. The Nile Basin enjoys certain export advantages in West European markets because of its geographic location; climatic conditions are such that varieties that mature early can be produced.

The production and export of vegetables--tomatoes, onions, potatoes, peppers, and pulses--in the UAR and Sudan are approaching new levels. With continued effort to provide more efficient organization and management, greater gains are likely in the immediate future.

Total U. S. agricultural shipments to the UAR and Sudan were valued at \$145.3 million in 1966 (tables 25 and 26). This was more than 4 times the value of U. S. farm exports received by these countries in 1955. Leading U. S. items were grains and grain preparations (predominantly wheat). With the termination of P. L. 480 agreements with these countries, indications are that efforts will be made to expand local production. Until such expansion can take place, greater use will probably be made of bilateral agreements to obtain these supplies.

If normal channels of trade are maintained, these countries should provide a growing outlet for U. S. tobacco exports. Average sales to the UAR in 1965 and 1966 amounted to 15.2 million pounds and were valued at \$9.6 million. For the same period, Sudanese purchases averaged slightly over one-half million pounds at a value of \$486,000. A shortage of foreign exchange earnings will probably plague both countries for some time. Even so, indications are that they will provide a growing market for tallow and dairy products also.

Table 25.--Quantity and value of U.S. agricultural exports to the UAR, 1965 and 1966

Commodity	Unit	Quantity		Value	
		1965	1966	1965	1966
		Thousands		1,000 dollars	
Meat and meat preparations . . .	Pound	5,259	36	1,786	16
Beef, fresh and frozen . . .	Pound	3,983	0	1,475	0
Chicken, fresh and frozen . . .	Pound	1,191	31	281	13
Dairy products . . . . .	Pound	24,154	--	4,023	566
Milk and cream . . . . .	Pound	24,149	3,113	4,021	537
Nonfat dry milk (relief) . . .	Pound	22,221	2,185	3,713	373
Grains and grain preparations:	-	--	--	65,209	105,753
Wheat . . . . .	Bushel	25,029	39,884	40,632	66,179
Corn . . . . .	Bushel	4,112	67	5,884	98
Wheat flour . . . . .	Hundred-	4,101	8,991	16,214	38,382
: weight :					
Wheat flour (relief) . . . . .	Hundred-	1,034	1,261	4,548	6,089
: weight :					
Bulgar wheat (relief) . . . . .	Pound	10,381	9,502	576	533
Rolled wheat (relief) . . . . .	Pound	5,163	0	270	0
Cereal preparations . . . . .	Pound	1,559	304	1,087	204
Fruits, vegetables, and nuts . .	-	--	--	58	255
Sugar and sugar preparations:	Pound	53	15	43	6
Coffee, cocoa, spices, etc. . .	Pound	25	17	17	16
Animal feed . . . . .	Short Ton	2	2	170	244
Miscellaneous food . . . . .	-	--	--	61	14
Beverages . . . . .	Gallon	47	65	39	54
Tobacco . . . . .	Pound	18,386	12,009	11,004	8,197
Hides and skins . . . . .	Number	3	17	22	142
Oilseeds . . . . .	Pound	46	--	8	1
Crude rubber . . . . .	Pound	0	12	0	5
Material fibers . . . . .	Pound	0	6	0	2
Crude animal and vegetable					
material . . . . .	Pound	352	271	315	226
Animal oils and fats . . . . .	Pound	79,989	92,728	7,549	7,889
Tallow, inedible . . . . .	Pound	79,731	92,728	7,524	7,889
Vegetable oils . . . . .	Pound	45,321	98,052	6,324	14,319
Soybean oil . . . . .	Pound	7,537	55,782	1,364	8,153
Soybean oil (relief) . . . . .	Pound	7,328	4,408	1,324	801
Cottonseed oil . . . . .	Pound	37,746	42,278	4,949	6,165
Cottonseed oil (relief) . . . .	Pound	2,127	2	425	1/
Animal and vegetable oils . . .	Pound	4,321	912	601	129
Organic chemicals . . . . .	Pound	3	27	2	6
Essential oil . . . . .	Pound	2	1/	2	2
Starches, etc. . . . .	Pound	4	12	7	6
Total agricultural . . . . .	-	--	--	2/97,239	137,848
Nonagricultural . . . . .	-	--	--	60,327	51,167
Total exports . . . . .	-	--	--	157,566	189,015

1/ Less than 500. 2/ Added before rounding.

Table 26.--Quantity and value of U. S. agricultural exports to Sudan, 1965 and 1966

Commodity	Unit	Quantity		Value	
		1965	1966	1965	1966
		Thousands		1,000 dollars	
Meat and meat preparations. . . . .	Pound	0	1	0	1
Dairy products. . . . .	Pound	322	57	70	11
Nonfat dry milk. . . . .	Pound	278	54	36	10
Nonfat dry milk (relief). . . . .	Pound	136	54	21	10
Grains and grain preparations. . . . .	-	--	--	7,548	6,271
Wheat. . . . .	Bushel	2,101	1,837	3,659	3,304
Wheat flour. . . . .	Hundred-weight	1,213	804	3,876	2,946
Fruits and vegetables	-	--	--	5	11
Sugar and sugar preparations. . . . .	Pound	77	104	167	238
Coffee . . . . .	Pound	1	1/	1	1/
Miscellaneous food. . . . .	-	--	--	45	50
Beverage . . . . .	Gallon	13	9	16	10
Tobacco . . . . .	Pound	390	621	355	617
Oilseed. . . . .	-	--	0	6	0
Crude rubber. . . . .	Pound	3	24	1	7
Vegetable seeds. . . . .	Pound	7	21	9	51
Tallow, inedible. . . . .	Pound	1,186	1,883	128	190
Vegetable oil. . . . .	Pound	2	18	1/	3
Starches, glutens, etc. . . . .	Pound	1	6	1	2
Total agricultural	-	--	--	8,352	7,462
Nonagricultural . . . . .	-	--	--	6,122	6,385
Total exports . . . . .	-	--	--	14,474	13,847

1/ Less than 500.

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# APPENDIX

Table 27.--Onions, winter crop: Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <sup>1/</sup>	1963 <sup>2/</sup>
-- <u>Dollars per acre</u> --		
Income:		
Ripened and green onions . . . . .	272.87	285.44
Expenses:		
Land preparation . . . . .	5.94	5.85
Seeds . . . . .	27.72	38.42
Manure . . . . .	6.07	6.33
Chemical fertilizers . . . . .	8.58	7.78
Irrigation water . . . . .	2.48	2.70
Miscellaneous . . . . .	1.52	1.60
Total expenses . . . . .	52.31	62.68
Returns to labor . . . . .	21.08	21.67
Returns to land and management. . . . .	199.48	201.09
Returns to labor, land, and management.:	220.56	222.76

<sup>1/</sup> Based on Egyptian pound valued at U. S. \$2.52.

<sup>2/</sup> Based on Egyptian pound valued at U. S. \$2.30.

Source: Agricultural Economic Bulletin, December 1965, UAR Ministry of Agriculture, Cairo.

Table 28.--Cotton: Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <sup>1/</sup>	1963 <sup>2/</sup>
-- - Dollars per acre - -		
Income:		
Cotton, raw. ....	198.75	186.29
Stalk . . . . .	3.98	5.44
Total . . . . .	202.73	191.73
Expenses:		
Land preparation . . . . .	10.17	8.98
Seeds. . . . .	2.51	2.39
Manure . . . . .	4.21	3.52
Chemical fertilizers. . . . .	9.50	10.39
Irrigation water. . . . .	4.66	4.37
Miscellaneous <sup>3/</sup> . . . . .	1.22	1.25
Total expenses . . . . .	32.27	30.90
Returns to labor . . . . .	33.59	31.94
Returns to land and management . . . . .	136.87	128.89
Returns to labor, land, and management :	170.46	160.83

<sup>1/</sup> Based on Egyptian pound valued at U. S. \$2.52.

<sup>2/</sup> Based on Egyptian pound valued at U. S. \$2.30.

<sup>3/</sup> Hand tools, picking sacks, etc.

Source: Agricultural Economic Bulletin, December 1965, UAR  
Ministry of Agriculture, Cairo.



Table 29.--Sugarcane: Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <sup>1/</sup>	1963 <sup>2/</sup>
	-- - Dollars per acre - -	
Income:		
Cane. ....	242.25	230.22
Expenses:		
Land preparation .....	10.02	10.50
Seeds .....	11.06	9.90
Manure, .....	2.07	1.34
Chemical fertilizers .....	30.29	34.58
Irrigation water .....	23.15	15.61
Miscellaneous .....	1.99	2.13
Total expenses .....	78.58	74.06
Returns to labor .....	33.59	31.49
Returns to land and management. ....	130.08	124.67
Returns to labor, land, and management.:	163.67	156.16

<sup>1/</sup> Based on Egyptian pound valued at U. S. \$2.52.

<sup>2/</sup> Based on Egyptian pound valued at U. S. \$2.30.

Source: Agricultural Economic Bulletin, December 1965, UAR Ministry of Agriculture, Cairo.

Table 30.--Peanuts: Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <sup>1/</sup>	1963 <sup>2/</sup>
-- Dollars per acre --		
Income:		
Nuts. . . . .	144.10	116.98
Vines. . . . .	5.23	5.54
Total. . . . .	149.33	122.52
Expenses:		
Land preparation . . . . .	7.43	6.63
Seeds . . . . .	5.04	3.89
Manure. . . . .	5.52	5.74
Chemical fertilizers . . . . .	3.66	2.93
Irrigation water . . . . .	3.37	3.34
Miscellaneous . . . . .	6.33	5.97
Total expenses . . . . .	31.35	28.50
Returns to labor . . . . .	19.33	19.32
Returns to land and management . . . . .	98.65	74.20
Returns to labor, land, and management :	117.98	94.02

<sup>1/</sup> Based on Egyptian pound valued at U. S. \$2.52.

<sup>2/</sup> Based on Egyptian pound valued at U. S. \$2.30.

Source: Agricultural Economic Bulletin, December 1965, UAR Ministry of Agriculture, Cairo.

Table 31.--Wheat: Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <u>1/</u>	1963 <u>2/</u>
-- - Dollars per acre - -		
Income:		
Grain. ....	81.72	76.15
Straw. ....	16.39	14.41
Total .....	98.11	90.56
Expenses:		
Land preparation. ....	8.84	8.76
Seeds. ....	7.30	6.56
Manure .....	2.85	2.68
Chemical fertilizers. ....	3.97	8.23
Irrigation water. ....	1.75	1.40
Miscellaneous. ....	1.10	.87
Total expenses. ....	30.81	28.50
Returns to labor. ....	8.86	9.19
Returns to land and management .....	58.44	52.87
Returns to labor, land, and management :	67.30	62.06

1/ Based on Egyptian pound valued at U. S. \$2.52.

2/ Based on Egyptian pound valued at U. S. \$2.30.

Source: Agricultural Economic Bulletin, December 1965, UAR Ministry of Agriculture, Cairo.

Table 32.--Rice: 1/ Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <u>2/</u>	1963 <u>3/</u>
-- - Dollars per acre - -		
Income:		
Grain. . . . .	115.61	99.85
Stalk . . . . .	2.47	3.19
Total . . . . .	118.08	103.04
Expenses:		
Land preparation. . . . .	13.84	12.83
Seeds. . . . .	7.43	7.07
Manure . . . . .	3.11	1.22
Chemical fertilizers. . . . .	7.54	6.91
Irrigation water <u>4/</u> . . . . .	--	--
Miscellaneous. . . . .	1.17	1.07
Total expenses. . . . .	33.09	29.10
Returns to labor. . . . .	22.47	23.48
Returns to land and management . . . . .	62.52	50.46
Returns to labor, land, and management :	84.99	73.94

1/ Summer crop (approximately 70 percent of total annual harvest).

2/ Based on Egyptian pound valued at U. S. \$2.52.

3/ Based on Egyptian pound valued at U. S. \$2.30.

4/ There are no charges for water used during flood season; there are charges for water used during Nili season. In light of latest Government policy, rice should become more profitable in the future.

Source: Agricultural Economic Bulletin, December 1965, UAR Ministry of Agriculture, Cairo.

Table 33.--Corn: 1/ Estimated production costs and returns per acre, UAR, 1962 and 1963

	1962 <u>2/</u>	1963 <u>3/</u>
-- - Dollars per acre - -		
Income:		
Grain. ....	65.99	59.06
Stalk. ....	4.17	4.22
Total. ....	70.16	63.28
Expenses:		
Land preparation. ....	5.49	5.68
Seeds. ....	2.67	2.48
Manure. ....	8.92	7.76
Chemical fertilizers. ....	8.69	8.48
Irrigation water <u>4/</u> . ....	--	--
Miscellaneous. ....	4.01	2.53
Total expenses. ....	29.78	26.93
Returns to labor. ....	12.13	11.20
Returns to land and management. ....	28.25	25.15
Returns to labor, land, and management:	40.38	36.35

1/ Nili crop.

2/ Based on Egyptian pound valued at U. S. \$2.52.

3/ Based on Egyptian pound valued at U. S. \$2.30.

4/ There is no charge for irrigation water during Nili crop.

Source: Agricultural Economic Bulletin, December 1965, UAR Ministry of Agriculture, Cairo.

Table 34.--Wheat: Area, yield, and production, UAR, 1948-66 and projection for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Bushels per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	1,573	103	25.2	73	1,080	75
1949. . . . .	1,470	96	29.2	84	1,167	81
1950. . . . .	1,423	93	26.3	76	1,018	71
1951. . . . .	1,554	112	28.6	82	1,209	84
1952. . . . .	1,455	95	27.5	79	1,089	76
1953. . . . .	1,857	122	30.6	88	1,547	107
1954. . . . .	1,862	122	34.1	98	1,729	120
1955. . . . .	1,581	104	33.7	97	1,451	101
1956. . . . .	1,630	107	34.9	101	1,547	107
1957. . . . .	1,571	103	34.3	99	1,467	102
1958. . . . .	1,480	97	35.1	101	1,412	98
1959. . . . .	1,531	100	34.6	100	1,443	100
1960. . . . .	1,512	99	36.4	105	1,499	104
1961. . . . .	1,435	104	36.8	106	1,436	100
1962. . . . .	1,509	99	38.8	112	1,593	111
1963. . . . .	1,396	93	39.3	113	1,495	104
1964. . . . .	1,344	98	41.0	118	1,500	104
1965. . . . .	1,427	93	41.2	119	1,600	111
1966. . . . .	1,495	98	39.8	115	1,620	112
1975. . . . .	1,800	118	50.0	144	2,452	170

Source: (5, 8).

Table 35.--Rice (paddy): Area, yield, and production, UAR, 1948-66 and projection for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Hundredweight per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	815	119	35.4	78	1,308	92
1949. . . . .	729	107	35.3	78	1,168	82
1950. . . . .	726	106	37.7	83	1,242	87
1951. . . . .	506	74	27.0	59	620	44
1952. . . . .	388	57	29.4	65	517	36
1953. . . . .	440	64	32.7	72	652	56
1954. . . . .	632	93	39.0	86	1,118	79
1955. . . . .	622	91	46.4	102	1,309	92
1956. . . . .	716	105	48.4	106	1,573	112
1957. . . . .	758	111	49.7	109	1,709	120
1958. . . . .	538	79	42.1	93	1,028	72
1959. . . . .	756	110	44.8	98	1,536	108
1960. . . . .	734	107	44.6	98	1,486	104
1961. . . . .	558	82	45.1	93	1,142	80
1962. . . . .	862	126	52.1	115	2,039	143
1963. . . . .	982	144	49.4	109	2,213	155
1964. . . . .	998	146	45.0	99	2,036	143
1965. . . . .	1,100	161	37.3	82	1,862	131
1966. . . . .	1,200	175	36.7	81	2,000	140
1975. . . . .	1,600	234	50.0	110	3,630	255

Source: (5, 8).

Table 36.--Corn: Area, yield, and production, DAR, 1948-66 and projection for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Bushels per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	1,610	83	34.5	107	1,409	89
1949. . . . .	1,551	80	31.7	98	1,250	79
1950. . . . .	1,507	78	34.1	106	1,306	82
1951. . . . .	1,717	89	32.6	101	1,421	100
1952. . . . .	1,769	92	33.5	104	1,506	95
1953. . . . .	2,216	115	32.9	102	1,853	117
1954. . . . .	1,976	102	34.9	108	1,753	111
1955. . . . .	1,902	98	35.5	110	1,714	108
1956. . . . .	1,904	99	34.2	106	1,652	104
1957. . . . .	3,835	95	32.1	99	1,695	94
1958. . . . .	2,028	105	34.1	106	1,758	111
1959. . . . .	1,929	100	30.6	95	1,500	95
1960. . . . .	1,890	98	35.2	109	1,691	107
1961. . . . .	1,662	86	38.3	119	1,617	102
1962. . . . .	1,899	98	41.5	129	2,004	127
1963. . . . .	1,759	91	37.5	116	1,675	106
1964. . . . .	1,724	89	44.2	137	1,934	122
1965. . . . .	1,712	89	48.3	150	2,100	133
1966. . . . .	1,764	86	49.1	152	2,200	139
1975. . . . .	2,000	104	60.0	188	3,050	193

Source: (5, 8).



Table 37.--Peanuts (in shell): Area, yield, and production, UAR, 1948-66 and projection for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Hundredweight per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948.	25	63	15.9	88	18	55
1949.	27	68	12.2	67	15	46
1950.	27	68	14.7	81	18	55
1951.	25	63	16.8	92	19	68
1952.	27	68	16.3	90	20	61
1953.	32	81	16.5	91	24	73
1954.	32	81	16.5	91	24	73
1955.	35	88	17.6	97	28	86
1956.	37	93	17.3	95	29	89
1957.	37	93	18.5	102	31	95
1958.	40	101	18.2	100	33	101
1959.	42	106	17.8	98	34	104
1960.	42	106	18.4	101	35	107
1961.	35	88	15.7	87	25	77
1962.	54	136	20.0	110	49	150
1963.	54	136	18.4	101	45	148
1964.	52	131	19.5	107	46	141
1965.	57	144	19.3	106	50	153
1966.	52	131	17.0	93	40	122
1975.	95	237	22.0	122	95	288

Source: (5, 8).

Table 38.--Cotton: Area, yield, and production, UAR, 1948-66 and projection for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Pounds per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	1,497	79	589.1	116	400	92
1949. . . . .	1,756	93	490.9	97	391	90
1950. . . . .	2,047	108	411.4	81	382	88
1951. . . . .	2,055	108	389.4	77	363	83
1952. . . . .	2,040	108	482.0	95	446	102
1953. . . . .	1,373	72	510.6	101	318	73
1954. . . . .	1,638	86	468.4	92	348	80
1955. . . . .	1,885	99	391.8	77	335	77
1956. . . . .	1,714	90	418.0	82	325	75
1957. . . . .	1,887	100	473.2	93	405	93
1958. . . . .	1,976	104	497.6	98	446	102
1959. . . . .	1,825	96	552.1	109	457	105
1960. . . . .	1,944	103	542.1	107	478	110
1961. . . . .	2,060	110	359.6	71	336	77
1962. . . . .	1,719	91	586.1	115	457	105
1963. . . . .	1,689	89	576.9	114	442	101
1964. . . . .	1,672	88	664.5	131	504	116
1965. . . . .	1/ 1,972	104	581.3	115	520	119
1966. . . . .	1/ 1,930	102	527.7	104	462	106
1975. . . . .	1,900	100	650.0	128	560	128

1/ Preliminary.

Source: (5, 8).

Table 39.--Sorghum (durra): Area, yield, and production, Sudan, 1948-66 and projections for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Bushels per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948.	2,060	70	8.3	48	432	34
1949.	2,193	74	10.0	57	559	44
1950.	2,445	82	14.0	80	867	68
1951.	1,734	59	14.4	83	634	50
1952.	1,697	57	11.9	68	515	40
1953.	2,154	73	11.9	68	653	51
1954.	2,006	68	12.0	69	613	48
1955.	2,216	75	15.3	88	860	67
1956.	2,586	87	16.2	93	1,067	84
1957.	2,144	72	20.9	120	1,139	89
1958.	3,374	114	16.0	92	1,372	108
1959.	3,374	114	15.3	88	1,313	103
1960.	3,181	107	12.6	72	1,015	80
1961.	3,648	123	15.5	89	1,434	112
1962.	3,648	123	13.7	79	1,266	99
1963.	3,359	113	15.4	89	1,310	103
1964.	$\frac{1}{2}$ 3,370	114	15.4	89	1,320	104
1965.	$\frac{1}{2}$ 3,375	114	15.5	89	1,325	104
1966.	$\frac{1}{2}$ 3,300	111	9.5	55	800	73
1975.	5,400	122	17.5	101	2,420	190

$\frac{1}{2}$ / Estimated.  
Source: (5, 8).

Table 40.--Wheat: Area, yield, and production, Sudan, 1948-66 and projections for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Bushels per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	22	67	11.7	52	7	34
1949. . . . .	35	106	17.9	79	17	84
1950. . . . .	27	82	16.3	72	12	59
1951. . . . .	32	97	17.2	76	15	74
1952. . . . .	40	121	21.1	93	23	114
1953. . . . .	27	82	21.8	96	16	79
1954. . . . .	32	97	21.8	96	19	93
1955. . . . .	30	91	20.8	92	17	84
1956. . . . .	30	91	22.0	97	18	88
1957. . . . .	32	97	20.7	91	18	88
1958. . . . .	32	97	23.0	102	20	98
1959. . . . .	35	106	24.1	107	23	114
1960. . . . .	40	121	23.0	102	25	123
1961. . . . .	40	121	23.9	106	26	128
1962. . . . .	42	127	25.4	112	29	143
1963. . . . .	57	183	20.0	88	31	152
1964. . . . .	57	183	23.9	106	37	182
1965. . . . .	1/ 65	197	31.7	140	56	276
1966. . . . .	1/ 68	206	34.0	150	63	310
1975. . . . .	110	333	45.0	199	135	675

1/ Estimated.  
Source: (5, 8).

Table 41.--Sesame: Area, yield, and production, Sudan, 1948-66 and projection 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Hundredweight per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	548	74	5.7	123	141	94
1949. . . . .	375	50	4.6	99	79	53
1950. . . . .	514	69	7.2	156	168	112
1951. . . . .	170	23	5.1	110	39	26
1952. . . . .	338	45	4.4	95	67	45
1953. . . . .	437	59	5.0	108	100	67
1954. . . . .	393	53	5.6	121	99	66
1955. . . . .	659	88	5.0	108	150	100
1956. . . . .	823	110	4.1	89	153	102
1957. . . . .	524	70	5.6	121	132	88
1958. . . . .	684	92	4.5	97	139	93
1959. . . . .	1,028	138	3.8	82	179	119
1960. . . . .	719	97	3.9	84	127	85
1961. . . . .	1,015	136	5.0	108	232	155
1962. . . . .	805	108	3.9	84	142	95
1963. . . . .	1,136	152	3.0	65	155	103
1964. . . . .	1,158	155	3.5	76	184	123
1965. . . . .	983	132	3.6	78	160	107
1966. . . . .	1/ 1,160	156	3.4	73	180	120
1975. . . . .	1,600	215	4.0	87	290	193

1/ Estimated.  
Source: (5, 8).

Table 42.--Peanuts (unshelled): Area, yield, and production, Sudan, 1948-66 and projections for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Hundredweight per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	114	24	3.3	42	17	10
1949. . . . .	114	24	1.7	22	9	5
1950. . . . .	104	22	2.5	32	12	7
1951. . . . .	72	15	6.1	78	20	12
1952. . . . .	67	14	5.9	76	18	11
1953. . . . .	79	17	7.0	90	25	16
1954. . . . .	210	44	5.7	73	54	32
1955. . . . .	309	65	4.6	59	64	38
1956. . . . .	477	100	6.7	86	146	87
1957. . . . .	464	98	6.1	78	129	77
1958. . . . .	482	101	8.6	111	189	112
1959. . . . .	479	101	8.6	111	186	111
1960. . . . .	489	103	8.7	112	192	114
1961. . . . .	489	103	6.7	86	149	89
1962. . . . .	721	152	7.0	90	229	136
1963. . . . .	842	177	7.1	91	273	162
1964. . . . .	1/ 850	179	6.6	85	254	151
1965. . . . .	1/ 865	182	7.1	91	280	167
1966. . . . .	1/ 800	168	4.7	60	170	101
1975. . . . .	1,600	475	9.0	259	650	385

1/ Estimated.  
Source: (5, 8).

Table 43.--Cotton: Area, yield, and production, Sudan, 1948-66 and projection for 1975

Year	Area		Yield		Production	
	1,000 acres	Index (1957-59=100)	Pounds per acre	Index (1957-59=100)	1,000 metric tons	Index (1957-59=100)
1948. . . . .	403	47	355.6	141	65	65
1949. . . . .	430	50	338.4	134	66	66
1950. . . . .	538	63	389.3	155	95	95
1951. . . . .	571	67	220.1	87	57	57
1952. . . . .	620	73	309.4	123	87	87
1953. . . . .	652	77	307.7	122	91	91
1954. . . . .	684	80	286.9	114	89	89
1955. . . . .	598	70	409.2	163	111	111
1956. . . . .	763	90	384.3	153	133	133
1957. . . . .	729	86	142.1	57	47	47
1958. . . . .	887	104	315.7	125	127	127
1959. . . . .	941	110	297.5	118	127	127
1960. . . . .	941	110	271.8	108	116	116
1961. . . . .	1,178	138	406.1	161	217	216
1962. . . . .	1,107	130	324.6	129	163	162
1963. . . . .	1,089	128	206.5	82	102	102
1964. . . . .	1,107	130	302.7	120	152	151
1965. . . . .	1,090	128	329.7	131	163	162
1966. . . . .	<sup>1/</sup> 1,300	152	330.0	132	179	178
1975. . . . .	1,740	204	380.0	151	300	299

<sup>1/</sup> Estimated.  
Source: (5, 8).