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Grain Production and Food Security in Arab Countries

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Abstract

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Grains are the most important group of products in the food security programs of the Arab countries. These countries suffer from a shortage of food in general and in particular a shortage of grains. This results from a rapidly growing population and growing disposable incomes.

This paper describes the grain sector in the economy of the Arab countries with special attention to its role in the national and regional food security programs. First, output and consumption of grains between 1973 and 1984 are analysed in all Arab countries, with special attention to wheat. Second, the concept of food security is discussed. Food security is defined as continuity of food supply to the whole population and unhampered access to food by all groups of the population. Food security is considered principally as a problem of short-term variability of food production and instability of imports. Food insecurity is thus measured by the size of production and consumption variability in relation to the long-term levels of consumption and production. The standard deviation and the coefficient of variation are used as indicators of the variability.

Last, strategies and policies for achievement of food security are discussed. The growing food supply gap in the Arab countries implies the need to increase grain production as an element of major importance in the development of food-security programs. Proper grain policies must foresee increases of yields, reduction of post-harvest losses, and increased capacity to handle and store grain reserves. The establishment of national and regional Arab strategic grain stocks equal to the average magnitude of harvest shortfalls is recommended as one measure of short-term strategy. The long-term strategy, in turn, focuses on development of domestic agricultural production and greater cooperation among the Arab countries.

Introduction

Grains play a major role in world agriculture and in the feeding of the world population. Grains represent one third of the total global food intake and account for more than half of the arable land used for farming. In the less-developed countries grains represent over 70% of the average per-capita intake. Since

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they are easily handled, stored and transported, grains are the most important staple food product in most developing countries.

Grains in the economy of the Arab countries

The Arab countries suffer from a deficit of all the major food commodities. The food problem in this group of countries arises from the failure of domestic food production to match the rapid population growth, which results in a growing dependence on food imports with the ensuing economic and political consequences.

The majority of the imported foodstuffs are cereals, in particular wheat which has remained the staple food of the population. The oil-rich countries have been capable of financing their rapidly increasing food imports with petroleum export revenues. The situation of countries which do not export petroleum is much more precarious, often resulting in a deficit in the balance of payments.

In terms of social and economic development, the Arab countries are a heterogeneous group in regard to agricultural employment and production (see Table 1). In the majority of Arab countries the per-capita production of food

TABLE 1

Position of agriculture in the national economy of the Arab countries

Country	Agricultural GDP		Agricultural population as % of total population	Index of food production per capita 1979–81 (1969–71 ≙ 100)	Dietary supply as % of requirements 1980	Agricultural imports as % of total imports 1981
	Percent of total GDP	US$ per person of agricultural population 1979				
Algeria	6	221	48	82	101	17
Egypt	23	185	50	90	118	36
Libya	2	940	14	141	147	12
Mauritania	23	97	82	77	90	37
Morocco	18	213	51	81	109	25
Somalia	60	194	79	64	92	92
Sudan	39	190	76	103	102	20
Tunisia	16	379	40	124	116	15
Iraq	8	454	40	89	111	14
Jordan	8	176	25	75	96	15
Kuwait	3	2818	2	—	—	16
Lebanon	—	—	9	109	100	30
Oman	3	173	61	—	—	13
Saudi Arabia	2	239	60	29	120	14
Syria	17	423	47	163	118	14
U.A.E.	1	282	61	—	—	9
Yemen Arab Republic	30	156	74	96	93	31
Democratic Yemen	—	—	58	102	86	38

Source: FAO (1982).

TABLE 2

Area harvested, yields and output of grains in Arab countries, per annum averages for 1972-1974 and 1982-1984

Coutry product	Area harvested (1000 ha)		Yield (kg/ha)		Output (1000 t)	
	1972-74	1982-84	1972-74	1982-84	1972-74	1982-84
Algeria	3 037	2 959	637	599	1 935	1 560
Egypt	1 925	1 975	3 937	4 327	7 579	8 546
Libya	378	513	529	455	200	233
Mauritania	187	99	266	274	47	27
Morocco	4 628	4 502	639	910	2 959	4 005
Somalia	454	614	682	611	310	375
Sudan	3 224	4 805	653	470	2 106	2 256
Tunisia	1 542	1 379	620	827	957	1 103
Iraq	2 129	2 018	1 169	736	2 488	1 538
Jordan	233	115	841	651	196	81
Lebanon	69	22	1 126	1 211	78	27
Saudi Arabia	336	475	1 381	1 942	464	957
Syria	2 233	2 703	838	777	1 871	2 128
Yemen Arab Republic	1 770	680	683	865	1 209	600
Democratic Yemen	58	74	1 575	1 549	91	115
Total	22 203	22 572	1 013	1 043	22 490	23 551
of which						
Wheat	9 335[a]	7 950	891	1 150	8 321	9 141
Maize	1 481[a]	1 467	2 169	2 759	3 212	4 048
Barley	4 960[a]	6 228	754	663	3 745	4 127
Rice	490[a]	490	4 894	5 157	2 398	2 527
Other grains	5 928[a]	6 437	813	576	4 814	3 708

[a]Average for the years 1973-1974.
Source: FAO Production Yearbook (1975, 1984).

during 1979–81 was below the figure for the 1969–71 base period. The base-period level was exceeded only in Syria, Libya, Tunisia, Lebanon, Sudan and Democratic Yemen. The dietary supply covered the requirements in most Arab countries in 1980 except Mauritania, Somalia, Democratic Yemen and Yemen Arab Republic, where production and imports were below total dietary needs.

Cereals are important for Arab people; they account for about 70% of the total area under crops and are grown on both rainfed and irrigated land. The total area of grains harvested in the Arab countries has increased slightly from 22.203 million ha in 1972–74 to 22.572 million ha in 1982–84, a growth of 1.7% (Table 2). During this 10-year period the total grain output increased by 4.7% while the yields grew by 3.3%. All of these changes were relatively small in the aggregate. Changes were pronounced within particular countries as shown by

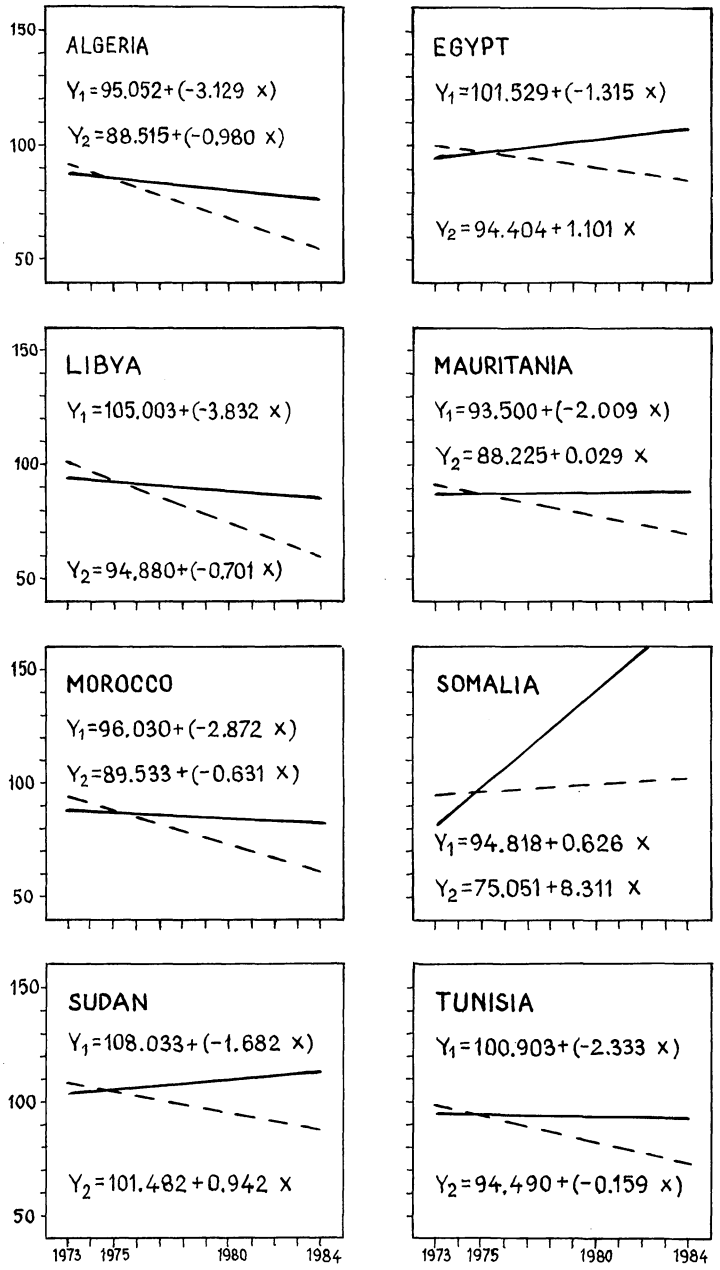

Fig. 1, which illustrates the trends in total and per-capita production of grains in Arab countries between 1973 and 1984.

Between 1972–74 and 1982–84, the area from which grains were harvested

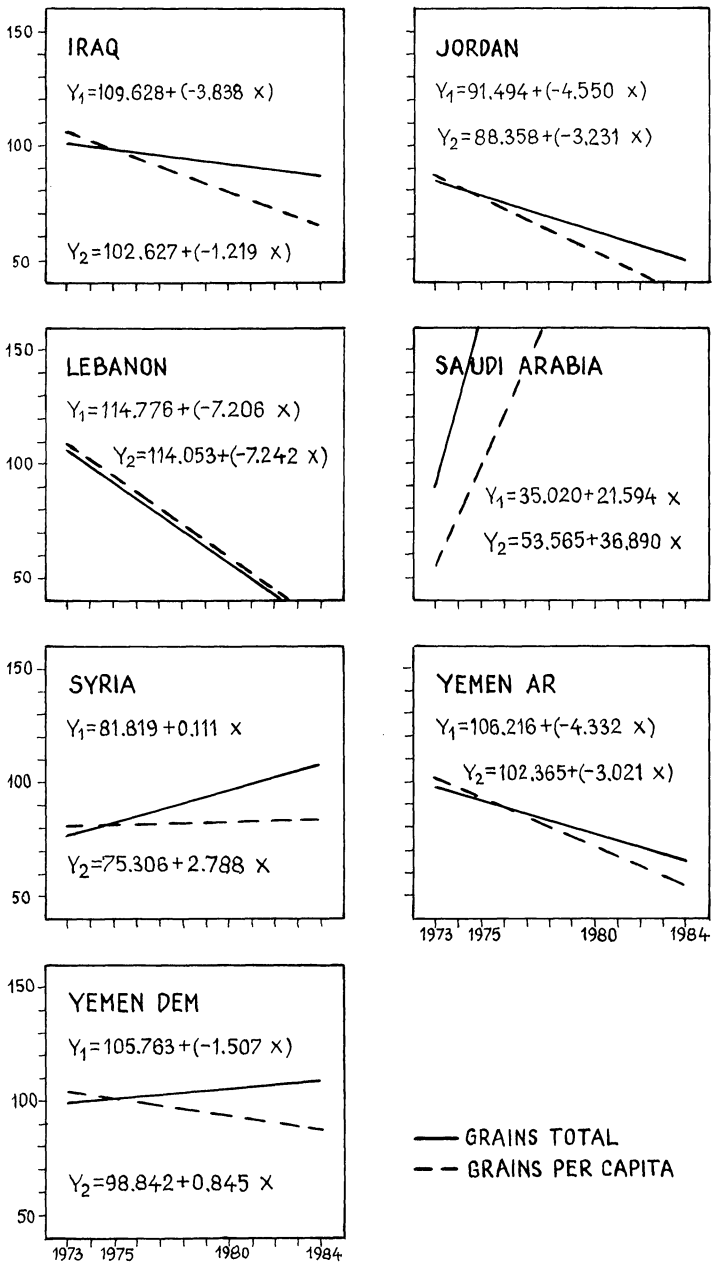

Fig. 1. Trends in grain production in Arab countries, 1973–84, index number 1974–78=100. Parameters of trend equation: $Y=a+bx$, Y_1 for grains per capita, Y_2 for grains total.

decreased sharply in Lebanon, Yemen Arab Republic, Jordan and Mauritania as well as in Algeria, Morocco, Tunisia and Iraq (Table 2). However, the area of grain harvested increased by 35–50% in Sudan, Saudi Arabia, Libya and Somalia, and between 20 and 30% in Democratic Yemen and Syria. The area planted to grains in the two big producer countries in the Arab world, Egypt and Morocco, changed little during this period.

The total grain output more than doubled in Saudi Arabia, while increasing by one third in Morocco. Grain output increased by smaller percentages in Democratic Yemen, Somalia, Libya, Tunisia, Syria, Egypt and Sudan. In contrast a sharp drop, of grains output (between 38 and 65%) was recorded in Lebanon, Jordan, Yemen Arab Republic, Mauritania and Iraq.

Also, a decreasing tendency was observed in grain yields, especially in Iraq, Sudan, Jordan, and Libya, with a smaller decrease of yields noted in Somalia, Syria, Algeria and Democratic Yemen.

Increases of yields between 27 and 42% were recorded in Morocco, Saudi Arabia, Tunisia and Jordan. Only Egypt achieved grain yields approaching world standards (Table 2). Yields exceeding 1 t/ha were also recorded in Saudi Arabia, Democratic Yemen and in Lebanon. In other countries, e.g. Mauritania, Libya and Sudan, yields are below 500 kg/ha.

The largest producer of grain among the Arab countries is Egypt, with a 36% share of the total grain output of this group of countries in 1982–84. Morocco increased its share in the decade from 13 to 17%. Sudan and Syria follow with a combined share of approximately one-tenth of the total Arab countries grain output. These four countries accounted for 65% of the total grain production in the Arab countries in 1972–74 and almost 72% in 1982–84.

Wheat accounted for 37% of total grain production in 1972–74 and almost 39% in 1982–84. Maize and barley each account for slightly over 17% of the total grain output. The share of rice has remained stabilized at 10.7% (see Table 2).

Grains represent more than 40% of the total food intake by the population in the Arab countries and, despite rising incomes, they will continue at about this level through the year 2000 (Jamel, 1980). Wheat accounted for about two-thirds of the total grain intake in the beginning of the 1980's, with rice representing 8.6% and maize 7.3% (Table 3). The rate of increase of the per-capita consumption of grains in the Arab countries is rather low, explained by the already large consumption of this staple food and the low elasticity of demand for grains in response to both price and income changes.

The consumption of grains in the Arab countries is gradually moving toward higher nutritional-value grains such as wheat and rice. At the same time the consumption of maize and barley is declining. These trends are expected to continue.

The demand for the basic foodstuffs in the Arab countries has been greatly affected by population growth and the rapid increase of disposable incomes,

TABLE 3

Consumption of grains in Arab countries in 1975, 1980 and 2000

Product	Consumption per capita (kg)			Growth rate of consumption volume (%)		Difference between rates of consumption and of population growth
	1975	1980	2000	1975-80	1980-2000	
Total grains	178.7	181.4	190.6	3.2	2.8	0.2
of which						
Wheat	110.3	118.8	131.8	3.4	3.0	0.4
Millet, other grains	26.7	26.8	28.1	2.9	2.8	0.2
Rice	15.2	15.7	17.6	3.5	3.1	0.6
Maize	13.8	13.2	10.3	2.0	1.3	−1.3
Barley	7.8	7.0	3.0	0.8	−1.8	−4.6

Note:The average per-annum rate of growth of the population numbers in the Arab countries between 1980 and 2000 is estimated at 2.6%.
Source: Al-Dujaili (1986).

particularly in the petroleum exporting countries. Between 1974 and 1984 the total population of the Arab countries increased from 134 to about 157 million, an annual growth rate of almost 3%. At the same time these countries have experienced massive migrations from rural to urban areas. Also, there have been migrations of labour from the non-petroleum exporting countries to the petroleum-affluent countries.

Due to the rising per-capita incomes, a corresponding increase in personal consumption may be observed. The annual rate of growth for the latter was approximately 2% for the Maghreb region countries and Lebanon, 2–3% for Libya and Egypt, 4–5% for Syria, 6–8% for Saudi Arabia and 8–10% for Iraq (League of Arab States, 1979).

The income elasticity of the demand for food in all developing countries is estimated to be between 0.5 and 1.0 (FAO, 1975). This coefficient for the Arab countries is estimated as ranging between 0.2 and 1.0. This is because grains are a basic foodstuff in some Arab countries, while in others, e.g. wheat in Yemen Arab Republic, Mauritania, Somalia and Sudan, they are considered as sa luxury and the income elasticity of the demand for wheat exceeds 1. Rice, on the other hand, is considered a quasi-luxury consumption product in the Arab countries in general but is a staple food in Egypt and Lebanon (Al-Dujaili, 1986).

The Arab countries experience some of the greatest food shortages and lowest food self-sufficiency ratios in the world. The rate of demographic growth in the last 15 years was 3%, while the average rate of agricultural production

growth was only 2.5%. During this period there was also a rate of growth of the per-capita consumption of 2% per year. Due to the growing demand for food in the 1970's it became necessary to import food, in particular grains. The values of agricultural imports to the Arab countries has more than doubled between 1977 and 1982, growing from 9.6 to 21.0 billion US$. By the end of the 1970's imports of wheat amounted to approximately 14 million t, which represented 17% of global exports in the period 1977–79. The majority of the countries discussed have gradually become importers of food. The balance of trade in agricultural products in these countries reached a deficit of 18 billion US$ in 1982.

Grains and food security

Food security may be defined in a number of ways. It may be defined as securing the continuity of food supply for thee whole population of a country and as having access to food by all strata of the population (Al-Dujaili, 1986). In many countries this is a useful definition but difficult to implement in practice. Satisfying the demand for all of the population is difficult, as there are both rural and urban groups which cannot afford to buy food even if available at moderate prices. Thus to ensure the minimum food requirements to the poorest groups generally calls for a redistribution of incomes. A more egalitarian distribution of the Gross Domestic Product may facilitate the achievement of food security.

Food security may also be defined as the capacity of the economy to meet the target level of consumption on a yearly basis (Siamwalla and Valdes, 1984). The target level of consumption may refer to a minimum as recommended by nutritional standards criteria, to an average figure for a chosen period, or to consumption growth trends. Chronic malnutrition caused by persistent poverty constitutes a long-term issue with complex dimensions and solutions. In this paper we regard food security within a framework of short-term variations in the supply of food products, as caused by instability of food production and imports. This short-term instability of food supply is experienced most acutely by the poorer strata of the population.

The focus of this article is on those elements of food supply insecurity which are associated with fluctuations in grain production. Variations of output lead to price movements and consequently to changes of the real incomes of the population. These fluctuations of incomes ultimately alter the consumption of food by farmers, agricultural hired workers, the urban labour force, and the balance of the society. The lower-income groups of households are particularly sensitive in this respect.

In a study of the food consumption, variability (Valdes, 1981), was mea-

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billion (US) = 10^9.

TABLE 4

Variability of staple foods consumption in selected Arab countries between 1961 and 1976

Country	Staple foods consumption instability		Probabilty of actual consumption falling below 95% of trend (%)
	Standard deviation (t×10)	Coefficient of variation (%)	
Algeria	667	24.6	42
Egypt	1164	12.6	34
Jordan	88	21.2	40
Libya	115	16.2	38
Morocco	933	19.3	40
Syria	360	18.7	39

Source: Siamwalla and Valdes (1984).

sured using the standard deviation and coefficient of variation for staple food consumption from time series data as indicators of variability. In all countries included in the Siamwalla and Valdes study (see Table 4), a high level of variability of food consumption was observed. Only in Egypt was the coefficient of variation below 13% while in other countries it ranged from 15 to 25%. In all of these countries consumption would be reduced by supply shortage more than 5% below the long-term consumption trend once every $2\frac{1}{2}$ years, while in Egypt this occurred every 3 years.

In this study we will assume that shortfalls in domestic production are the basic causes of food insecurity. This need not be the case if the country in question has the capacity to adjust the volume of its food imports to compensate for the variability of production. However, such capacity is found only in some of the petroleum-exporting Arab countries, while the majority have to rely more heavily on domestic production.

The high instability of food consumption and production in the Arab countries in the 1961–76 period continued in the following years, though most of the countries in question have undertaken various actions and programs to improve their food security (Al-Dujaili, 1986). Calculations for the period 1972–83 show that in all Arab countries, with the exception of Yemen Arab Republic, an upward trend in agricultural and food production as well as in both parts of agricultural production (crop and livestock) has been noted. However, a growth of all kinds of production per capita was noted only in Syria and Saudi Arabia. In Lebanon an upward trend in agricultural, food and livestock production was accompanied by a downward trend in crop production per capita. A growing trend in livestock production per capita has been noted in such countries as Libya, Morocco, Tunisia and Jordan, while in Sudan and Mauritania the level of per-capita production was practically stable. In general, only Syria and Saudi

TABLE 5

Variability of agricultural and food production per capita in Arab countries between 1972 and 1983

Countries	Coefficient of variation (%)				
	Agricultural production	Food production	Crop production	Animal production	Grain production[a]
Algeria	11.5	11.6	17.4	2.2	30.8
Egypt	4.5	3.7	3.1	2.7	6.0
Mauritania	28.7	7.2	14.3	7.3	37.0
Libya	11.8	11.8	10.9	15.8	30.9
Morocco	8.9	8.9	15.2	7.2	27.8
Somalia	18.0	18.1	20.5	17.6	11.7
Sudan	6.0	4.9	9.8	3.6	21.2
Tunisia	7.4	7.7	8.3	8.9	18.3
Iraq	10.3	10.4	17.5	4.7	25.6
Jordan	16.2	16.4	25.5	7.7	84.2
Lebanon	20.2	20.9	12.2	32.9	41.6
Saudi Arabia	21.8	21.5	19.7	22.9	80.3
Syria	17.4	20.7	17.0	25.6	35.8
Yemen Arab Republic	10.8	11.0	15.5	5.4	26.3
Democratic Yemen	7.2	6.6	6.6	5.4	7.0

[a]Index numbers for the period 1973–84.

Source: Calculated on the FAO Index Numbers 1972–74 ≙ 100 from the FAO Production Yearbook (1983).

Arabia improved their coefficients of domestic food supply between 1972 and 1983, while in Sudan and Mauritania the level of domestic food production per capita remained unchanged. In the other Arab countries the relation of domestic food production to the population number deteriorated. The negative impact of this was further aggravated by the high variability of production in the majority of the countries studied.

A high instability of food production per capita, exceeding 20%, was found in Saudi Arabia, Syria and Lebanon, these being the countries where the highest increases of production per capita were recorded (Table 5). This variability was affected principally by the high instability of the livestock production (23–33%). High instability of food production per capita — between 10 and 20% — was recorded in Jordan, Somalia, Algeria, Libya, Iraq and Yemen Arab Republic. The lowest level of instability in all kinds of production was in Egypt (3–5%), Democratic Yemen (5–7%), as well as in Sudan and Tunisia.

The data presented in Table 5 show that the variability of grain production per capita is greater compared to that of other products in all countries discussed except Somalia. Particularly high coefficients of variation of grain production per capita were found in Jordan and Saudi Arabia but in the latter

TABLE 6

Variability of area under grains, yields and grains output in Arab countries between 1973 and 1984

Countries Crops	Area		Yield		Output	
	Standard deviation (1000 ha)	Coefficient of variation (%)	Standard deviation (kg/ha)	Coefficient of variation (%)	Standard deviation (1000 t)	Coefficient of variation (%)
Algeria	334	11.5	102	17.5	408	24.0
Egypt	56	2.8	263	6.3	376	4.6
Libya	97	17.9	315	53.0	44	17.6
Mauritania	38	29.2	108	34.2	19	47.6
Morocco	183	4.1	219	24.8	981	24.6
Somalia	101	20.7	67	10.9	64	21.5
Sudan	593	13.5	109	17.3	598	21.8
Tunisia	196	13.2	191	26.2	182	17.2
Iraq	428	20.3	124	14.6	470	26.0
Jordan	55	34.3	269	48.2	75	78.4
Lebanon	24	52.7	210	17.9	23	45.3
Oman	2	64.3	387	27.2	2	46.5
Saudi Arabia	106	27.5	584	47.5	362	76.2
Syria	181	6.9	384	48.0	888	38.3
Yemen Arab Republic	278	28.3	70	7.9	249	28.0
Democratic Yemen	6	8.8	81	5.1	10	9.8
Total	828	3.6	70	6.7	2230	9.3
of which						
Wheat	756	8.5	130	12.9	1008	11.3
Maize	45	3.0	251	10.2	338	9.1
Barley	529	9.2	163	21.9	990	23.1
Rice	19	3.7	206	4.1	137	5.4

Source: Calculated using FAO data in FAO Production Yearbooks for various years.

country this instability was linked with an upward trend in production, while in Jordan high variability accompanied a downward trend in production of grains. Production of grains is more affected by weather fluctuations than other crops. The grains are cultivated mostly on rainfed areas where the impact of changing weather is substantially greater than on irrigated areas. This is well evidenced by the case of Egypt, where all land is irrigated and the instability of grain production is lowest among the Arab countries.

Production was also relatively stable in Democratic Yemen (see Tables 5 and 6). In Tunisia, Somalia, Sudan, Morocco and Iraq the coefficient of variation was moderately high, around 20–25%. These countries are quite big producers of grains among the Arab countries. Together with Egypt they produce approximately 75% of all Arab grains output. Among the big grain producers only Syria had a higher coefficient of variation at about 40%. Even higher coefficients were found in Lebanon and Mauritania, two countries which are relatively smaller producers of grains.

For the operation of the food security system the absolute magnitude of the shortfall is of critical importance. A country like Egypt has a relatively low level of instability (4.6%) but quite a high figure of absolute standard variability, amounting to 376 thousand t. In Morocco, second grain producer after Egypt, the absolute variability exceeds 980 thousand t, in Syria it is about 890 thousand t and in Sudan about 600 thousand t. Hence, the large countries and bigger producers, even those which experience a relatively low level of instability of production measured by relative coefficients (coefficient of variation), may represent a high demand for imports on the international grain markets.

The aggregate standard deviation of grain production for the Arab countries was 2.2 million t. However, if we total the absolute figures of production variability in all countries discussed (standard deviation of output in Table 6), we obtain a sum of 4.75 million t. The amount between these two figures must be supplied to the main consumption centres as security against a bad crop, disaster or emergency. This figure accounts only for the sheer variability of production, disregarding the constraints of transportation links, distance between supply, storage and distribution areas, which will obviously hamper assistance in case of disaster or food shortage. Clearly, the size of the security supplies, which can take a form of grain stocks, imports or food aid, must be increased to take into account the above.

The high variability of grains production in the Arab countries has resulted principally from the instability of yields and to a lesser extent from changes in the area under grains. The coefficient of grains area variation of 25% or more was found in Lebanon, Jordan, Mauritania, Yemen Democratic Republic and Saudi Arabia (Table 6). However, yields fluctuated strongly in such countries as Libya, Jordan, Saudi Arabia, Syria having a coefficient of yield variation exceeding 45%.

Among the particular grains the highest variability was manifested by barley and the lowest by rice. The coefficient of variation for barley in the period 1973–84 was about 9% for the area harvested, 22% for the yields and 23% for the output. The fluctuations of areas planted to grains, output and productivity in the particular Arab countries were higher than in the aggregate.

Strategies for achieving food security

A study conducted by the Arab Organization for Agricultural Development (League of Arab States, 1980) showed that the deficit of grains may increase from 11.2 million t in 1975 to 13.2 million t in 1980 and 26 million t in the year 2000 (Table 7). The rate of self sufficiency was projected to decrease from 67% in the beginning of the 1980's to 63% in 2000. The rate of self sufficiency for wheat is projected to be as low as 48%.

This long term outlook for the food products market presents a major chal-

TABLE 7

Balance of grains and rates of self sufficiency in Arab countries in 1975, 1980 and 2000

Group of grains	1975		1980		2000	
	Balance of grains[a] (1000 t)	Rate of self sufficiency (%)	Balance of grains[a] (1000 t)	Rate of self sufficiency (%)	Balance of grains[a] (1000 t)	Rate of self sufficiency (%)
Total grains	−11 161	67.4	−13 233	67.0	−26 089	62.7
of which						
Wheat	−8 778	49.3	−10 314	48.4	−19 181	47.6
Maize	−945	77.9	−1 429	73.0	−3 469	60.9
Rice	−812	76.7	−1 002	75.8	−3 267	56.2
Barley	−346	91.6	−365	92.7	−259	96.3
Other	−280	94.4	−42	98.8	+28	100.9

[a]Deficit (−) or surplus (+).
Source: League of Arab States (1980, The Food Economy in Arab Countries).

lenge for food production in the Arab countries. Unless the production development programs progress at a rate exceeding the recent experience, the dependence on food imports will increase, entailing additional social and economic risks.

The growing food supply gap in the Arab countries underlines the importance of increasing production of grains in food security programs. Several programs and actions have been undertaken by the Arab Organization for Agricultural Development (AOAD), the Arab League, and other organizations. The 1978 meeting of the AOAD Council in Rabat recommended actions to be undertaken at national, bilateral and regional levels to reduce the food supply gap and achieve food security.

One of the most important steps in agricultural and rural development programs is the elaboration of a proper food strategy. Such strategies may differ from country to country but their central theme must always be to secure increased and stable food supplies. A national food strategy should include the following major objectives: (a) growth of output and improved productivity of the agricultural and food sectors; (b) more balanced distribution of incomes, this being achieved primarily through effective generation of employment opportunities; (c) securing and maintaining an acceptable nutritional status for the entire population, i.e. through the provision of a minimum level of supply of the basic food products; and (d) providing adequate security of food supply in case of a poor harvest, natural disasters or vagaries of global food and agricultural products markets.

This paper will focus on the last of the objectives enumerated, with special regard for grain policies. Although food security may assume many forms, the

heart of any national food security policy should be to make it possible for the country concerned to survive a poor crop or natural disaster with only minimal external assistance. The basic requirements of such a policy include measures for increasing grain production through increased yields, reduction of post harvest losses, and increasing the capacity to handle and store the necessary quantities of reserve stocks of cereals. While the primary responsibility for these objective rests with the individual countries, emphasis must also be placed on closer cooperation among the Arab countries for their accomplishment. An example of international cooperation in this field may be the early worning system against crop failures and the information systems of food situation assessment (FAO, 1973, 1974, 1976, 1978).

In the majority of the Arab countries we find considerable potential for expansion of agricultural output. More rapid growth of cereal production may be achieved through extension of irrigation, decreasing soil salinization, increasing use of fertilizers, cultivation of high yielding grain varieties, adoption of improved farming practices, and the involvement of small farms in technological change. A number of projects oriented at increasing agricultural output and productivity both in the short and in the long run have already been elaborated in different countries and in the Pan-Arab organizations (FAO, 1979, League of Arab States, 1980, 1981). The greatest attention was paid to vertical and horizontal expansion of grain cultivation.

There are 33 specific grain projects, the majority located in Sudan (8), Somalia (6), Syria (4), Tunisia (4) and Yemen Arab Republic (League of Arab States, 1980). In some of the projects the production of grain is combined with that of oilcrops. The fulfillment of food security programs depends on the availability of investment capital, in addition to the funds required for current operations. National grain projects were planned valued at 904 million US$ in 1985, 395 million US$ in 1990, 696 million US$ in 1995 and 1060 million US$ in the year 2000. The average increase of the current costs of the grain projects is estimated to be 1.1% per annum, while the expected corresponding rate of growth of output is to be 3.3%. The share of the grain programs in the overall national agricultural development programs was 25%, while for the inter-Arab projects this figure was 12%.

These programs assumed achieving an increase of grains production of 17.8% by 1980 and by 28% by the year 2000. One of the implications of the fulfilment of the food security programs objectives is an achievement of a higher rate of self sufficiency in food products. Among the different grains the degree of self sufficiency in sorghum and barley is planned to increase by the year 2000 to 128% and 112%, respectively. In the balance of the grains a continuation of the gap is projected (Table 8).

If the programs discussed succeed, some countries will achieve a surplus of grain products. For instance, Iraq and Tunisia should have surplus of wheat, while Sudan, Iraq and Syria a surplus of sorghum.

TABLE 8

Projected food supply gap and rates of self sufficiency with and without Food Security Programs in Arab countries by the year 2000

	Without the programs	With the programs	Without the programs	With the programs
	(million t)		(%)	
Total grains	26.32	14.00	62.6	80.1
of which				
Wheat	19.50	12.95	47.3	65.2
Rice	3.36	2.59	55.5	65.8
Maize	3.30	2.13	62.6	76.8
Millet/sorghum	+0.10	+2.83	101.0	128.3
Barley	0.26	+0.84	96.3	112.0

Source: League of Arab States (1980, Studies upon Food Security in the Arab Countries).

Little reliable information is available concerning the extent of losses in the post harvest stages of production, storage, transport, processing etc. It is however generally recognized that these losses vary greatly, depending on the type of commodity, the conditions in which the food is handled, the storage time, storage facilities, temperature and humidity, pest infestation levels, transportation systems, milling and processing capacities etc. Studies have determined that the total losses in the particular countries range from 10 to 25% of the crop (Al-Dujaili, 1986). The reduction of losses in the post harvest stage would contribute greatly to improved availability of food for the population. Better programs are therefore required to reduce losses as much as possible and in this way contribute to bridging the gap in food in Arab countries. These programs will involve reduction of losses on farms, in marketing networks, in processing and storage of grains. The latter is closely linked to the programs for establishment of food products stocks.

The Food and Agriculture Organization of the United Nations Plan of Action on Food Security adopted in 1979 called upon the participant countries to develop national stock policies. The national stocks should be released in case of a widespread crop failure, natural or man made disasters or growing prices in order to, inter alia, maintain a regular supply of food products to the market and secure their stability.

In spite of the progress made, the food security stocks in most Arab countries still cannot be considered as adequate. Many of the cereal importing countries find it particularly difficult to implement their food security reserves programs due to the shortage of foreign currencies to finance grain imports and insufficient grain storage and handling facilities. In every case when the international

grain market tightens, prices rise and problems arise with transportation. Some evidence is mounted from national and regional reserve stocks to provide greater food security. Storage and transportation networks must be designed to bridge the gap between harvests in years of poor crops and secure supply in case of emergency to all strata of the population. So far the attention of the Arab countries has been focused on the expansion and improvement of commercial storage networks for cereals. However, more emphasis needs to be placed on storage on the farms, where a large part of the harvest is kept. More attention could be devoted to establishment of strategic storage facilities at seaports and production surplus depots. Networks could be developed to distribute food at or near the place of actual consumption, especially in rural areas, where the dominating majority of the lower incomes population groups live, and where supplies cannot be delivered quickly in case of emergency short supply. Algeria, Democratic Yemen, Libya, Mauritania, Morocco, Sudan, Syria and Tunisia, have announced explicit national policies for establishment of national cereals stocks policies (Al-Dujaili, 1986). Iraq, Saudi Arabia and Lebanon were in the course of formulating such policies.

The objective of the inter-Arab strategic food storage programs is to establish a pan-Arab reserve stock of grains in the first stage, to be followed by corresponding projects for other foodstuffs. The program foresees at first an establishment of strategic reserves of wheat, maize and sorghum in quantity enough to supply the Arab countries for a period of about 3 months. The construction of silos appropriate for this purpose has been planned at ports and inland locations in several Arab countries.

Early warning and food information systems should form part of any food security program designed to caushion the effect of crop failures or other disasters on the domestic supply. An early awareness of unfavourable crop conditions, close monitoring of the size and movements of the stocks available, and timely information about harbor and internal transportation systems are vital for managing strategic food supplies. Twelve Arab countries, Iraq, Algeria, Bahrain, Egypt, Jordan, Lebanon, Morocco, Quatar, Saudi Arabia, Somalia, Sudan and Syria, are members of the Global Warning and Information System which was established after the World Food Conference of 1974. While the establishment of the national early warning systems is a long term task, a number of steps have already been made to improve the current flow and availability of information. Some countries have received FAO assistance in setting up their own national early warning systems. The FAO Food Security Assistance Scheme may also play a catalyst role in helping countries to formulate and establish their national food security programs. Nevertheless, further efforts oriented at achieving self reliance within the Arab countries group are in order to sustain and further strengthen the rate of growth of food production and establishment of stocks. A minimum level of economic integration in the

field of agriculture among the Arab countries would contribute to easing their food problems.

Conclusions

The production of grains in the Arab countries is not projected to grow at a rate high enough to meet future demands for food. The gap between the effective demand and the domestic output will broaden. The growing deficit of grains will have to be covered by increasing imports and food aid, which will entail social, political, and economic problems.

To cope with the high variability of grain production in a situation of a declining self sufficiency, an integrated concept of food security on a national and on a regional scale is recommended. In the short run the establishment of national and pan-Arab strategic grains stocks reserves may be required. The amount of grain storage required depend upon a thorough economic analysis of program alternatives and the degree of cooperation that can be established among Arab countries.

In the long run, the food security strategies should stress efforts aimed at development of the national agricultural sectors. The problem of food security cannot be resolved without integrated support of all economic sectors. Solving the food problem will also involve investment in education of farmers, changes in the distribution and use of farmland, joint investment undertakings among countries, and a more integrated policy in the sphere of agricultural and rural development.

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