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9. ABSTRACT

To establish whether fortification intervention is feasible in a developing country, planners need to assess such factors as nutritional need, consumer acceptance, structure of the commodity system, and costs vs. benefits. This methodology, applied to Tunisia, shows that intervention through the small local mills in Tunisia is a feasible means of fortifying wheat. The most serious problem is the high cost of such a program, and funds would need to be provided by bilateral and multi-lateral donors as well as the Tunisian government. Such funding would have to cover the initial capital costs and a major portion of the annual operating costs over an extended time. Recent dramatic increases in the price of fortificants, mainly lysine, and the lack of control over prices, means that program costs might be much higher than estimated. If only micro-nutrient fortification is undertaken, the price impact would not be as serious.

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CHAPTER 8

TUNISIAN CASE STUDY

Introduction

The Tunisian fortification experience differs from either the Guatemalan or Thailand primarily in that large, central mills have been used to fortify the cereal grain wheat. Because of this it was decided to emphasis the commodity system structure dimension of our feasibility methodology. To facilitate this, the format of the chapter is somewhat different than that in the other two chapters. Instead of discussing each of the barriers as a distinct section, the chapter first examines the various parts of the wheat system; then a final section summarizes the various barrier issues raised throughout the commodity system analysis and discusses them together in the five barrier category format.

The Tunisian Economy

In 1974 the gross domestic product of Tunisia was estimated to be 1.210 billion dinars ($2.819 billion).* The largest sector of the economy was the industrial sector, which accounted for 32 percent of the GDP. Manufacturing, the main industrial activity, earned D157 million. Services, mainly tourism, constituted the second largest sector. Agriculture accounted for only 21 percent of the GDP but employed over 59 percent of the active labor force.

*Source: At current prices, at factor cost, currency equivalent in July 1974, U.S. $1.00 - 0.429 Tunisian Dinars (D.429); D1.000 - U.S. $2.33. Unless otherwise noted, the data on the Tunisian economy and its agricultural sector are from the Tunisian Government's Ministry of Agriculture or from IBRD, The Economic Development of Tunisia, Macro-Economic Aspects, Report no. 274-TUN, Dec. 27, 1974; and Memorandum on the Economic Position of Tunisia, Report no. 767-TUN, May 23, 1975.

From 1962 to 1971 the industrial sector expanded at an average annual rate of 8.1 percent. Bad weather and the attempted socialization of the sector held agriculture's growth rate at only 1.5 percent per year. The overall growth rate of the GDP during this period was 4.7 percent. Between 1971 and 1973 the GDP growth rate reached an annual average of 9.5 percent, with industrial expansion averaging 12.2 percent and the agricultural sector, 7.8 percent.

Tunisia's main exports in 1974 were petroleum (D118 million), tourism (D72 million), and olive oil (D56 million). It imported raw materials and semi-finished products (D145 million), capital goods (D95 million), and food products (D93 million). In recent years the Tunisian economy has persistently run a balance-of-trade deficit. Tunisian workers' remittances from overseas, loans, capital grants, and foreign investment largely make up for that deficit.

Tunisia's population grew about 2.6 percent per year from 1961 to 1972; after 1972, the growth rate decreased to 2.3 percent.* The 1975 population was 5.59 million, with 49 percent of the population classified as urban and 51 percent as rural. Just over half of the population lives in the temperate northern regions of the country; 35 percent lives in the central sections, and a remaining 14 percent resides in arid southern regions.

During the last decade the real per capita income of the Tunisian people expanded extremely slowly - only 1.9 percent per year from 1961 to 1972. Per capita income in 1975 reached $489, but income distribution is thought to be highly skewed, particularly in rural areas. The latest available income distribution data - published in 1962 - estimates that 79 percent of the rural population and 44 percent of urban dwellers earn less than half of the per capita income.

Despite significant emigration of workers, the 1972 unemployment rate in the nonagricultural sectors was estimated to be 18 percent. Only about half of the agricultural workforce is thought to be fully employed. The other half is normally underemployed, although there is a shortage of labor during periods of peak demand.

*Source: Population data from the preliminary results of the 1975 census published in l'Action Tunisia, 6 July 1975.

About 55 percent of adult Tunisians are literate. Attendance rates for primary and secondary school average 73 percent and 42 percent respectively.

During the 1960's the Tunisian government attempted to socialize the economy and to manage most sectors through a system of cooperatives and state-directed public enterprises. It gradually put many businesses and much of the private farmland into cooperatives, but by the late 1960's it halted the program because of public resistance and inexperience and inefficiencies in the program's planning and implementation. The government reestablished a system of private enterprise in which it still exerts considerable authority through its planning and resource-allocation functions; controls on pricing, profit margins, and marketing; and supervision of investment activities.

This sketch of the Tunisian economy clearly suggests that it would be very difficult, if not impossible, to significantly improve the population's nutritional status without a comprehensive program of nutritional intervention. The medicore performance of the agricultural sector coupled with steady population growth eliminate the option of improving the Tunisian diet by only increasing agricultural production. Trade, too, offers only limited possibilities because of its persistant deficit and the already high value of Tunisian food imports. But any nutrition program that aims to reach lower-income groups must cast them as little as possible, for per capital income is low and poorly distributed, and many are underemployed or without any work at all. We might assume that the broad economic controls which the Tunisian government already maintains would facilitate an intervention, but its attempt to socialize the economy left a legacy of distrust, particularly in the rural areas, that makes the government cautious about undertaking unpopular actions.

The Agricultural Sector

Land Use and the Main Agricultural Regions

Tunisia is a small country with an area of about 164,000 km approximately the same size as Illinois. Workers cultivate one-third of the total land area for cereals, pastures, and fruit trees. The remainder of the land area is desert (37 percent), forests and natural pastures (20 percent), or unusable.

The northern section, which constitutes about 20 percent of the land area, includes the country's most fertile land. A temperate climate and rainfall pattern make it suitable for many agricultural activities. As a result, a large majority of Tunisia's agricultural output - including about 70 percent of cereal production - comes from the north. The equally large central section is drier. There the main agricultural activities are olive production on the coast, and in the interior, livestock grazing. In the south the population is concentrated in coastal towns, mountains, and the date-producing oases because the rest of the region is desert.

Rain fall's erratically throughout the country, varying from season to season and from year to year. Droughts and floods are frequent, and they interrupt the continuity of agricultural output and always threaten food availability.

Land Ownership and Farm Sizes

The great majority of Tunisia's cultivated land is now privately owned, although the government owns and manages about 12 percent of the total 5.7 million hectares.

The distribution of private lands is extremely uneven. Sixty-three percent of the smallest farms include only 16 percent of the land area, and 47 percent of the largest farms contain 40 percent of the land. Most Tunisian farms are very small: over 40 percent are smaller than 5 ha, and another 42 percent average 5 to 20 ha.

Agricultural Labor Force

The Tunisian agricultural labor force in 1972 included about 800,000 workers, of whom about 53 percent were full-time and 47 percent were seasonal workers. This workforce has shrunk considerably since the nation became independent in 1956. The proportion of agricultural laborers in the total workforce has also declined, from 74 percent in 1956 to 58 percent in 1972. These declines result in shortages of rural workers during seasonal periods of peak demand.

Agricultural Production

In 1974 Tunisia produced over 1.1 million tons of fruits (mainly olives, wine grapes, citrus fruits, and dates), almost 1.1 million tons of wheat and barley, and 914,000 tons of tomatoes, melons, and other vegetables. Much smaller quantities of animal products, legumes and pulses, fish, and various other industrial and food crops were also produced. Since 1960 the production of vegetables and fruits has grown most dramatically, but fish catches and the output of legumes and pulses have also increased. During the 1960's food production per capita declined, but by the mid 1970's it equalled or slightly surpassed the levels achieved in the early 1960's.

The value of agricultural production in 1974 was $670 million. Fruits contributed the largest portion of these earnings (33 percent) while animal products earned 23 percent, cereals 20 percent, and vegetables 15 percent.

Trade in Agricultural Products

Tunisia's main agricultural export in 1974 was olive oil, which contributed 65 percent of the country's total earnings from agricultural products. Fruits and vegetables earned another 8 percent, while wines contributed 6 percent. This pattern differed distinctly from that of the early 1960's, when wines, cereals, and olive oil were major export earners. The main agricultural import is cereals, mainly wheat, which in 1974 accounted for almost 30 percent of agricultural imports. Animal products (primarily for tourists), oilseeds and oils, and sugar were also major imports.

Until 1967, Tunisia was a net exporter of agricultural products, but ever since then the country has been a net importer. The deficit in agricultural trade was about $20 million in 1974, and it was expected to expand almost five times in 1975. From 20 to 25 percent of the food supply was imported during the early 1970's, including about 45 percent of the wheat, 50 to 60 percent of the dairy products, and 90 percent of the sugar.

The Tunisian Government's Role in the Agricultural Sector

Since 1970 the government has played four main roles in the agricultural sector. First, it manages the distribution, pricing, processing, and marketing

of many staple food commodities. Second, state offices supervise foreign agricultural trade and control the distribution, pricing, and processing of major agricultural export earners. The government also distributes agricultural inputs. Fourth and last, it owns and manages state farms and production cooperatives organized on land once owned by foreign colonials.

The Control of Agricultural Prices

The Tunisian government regulates the pricing and the processing and marketing margins for much of the country's supply of cereals, milk, meats, olives and olive oil, wine, sugar beets, and tobacco. It once also controlled the prices of other products (legumes, fruits, and vegetables), but now allows them to be traded freely. Regulation is intended to maintain low and stable food prices for urban consumers while providing adequate incentive and compensation to producers.

Yet despite controls, retail food price increases have exceeded other price rises in the last decade and are a major reason for the increased cost of living in Tunisia. Food prices -- particularly for staples such as cereal products -- are an important political issue.

Food Processing

The Tunisian food-processing industry, the country's largest manufacturing activity, accounts for about 26 percent of all industrial output. The most important segment of the industry includes wheat milling and the preparation of wheat products such as bread, pasta, and semolina for couscous. The production of olive oil, the canning of fruits and vegetables (mainly tomato products), and the production of wines and liquors also account for significant portions of the industry's sales.

The food-processing industry is characterized by many small, inefficient operations using old, often outdated equipment. However, Tunisia does operate some efficient modern plants: several wheat mills and noodle factories, a few canneries, some olive oil refineries, and a sugar-processing plant.

The government exerts comprehensive control over the activities of these larger facilities processing major products. Most important decisions are made by government organizations under the Minister of Agriculture, including the Office of Cereals, the Office of Oils, and the Office of Wine. However, the numerous small processing facilities for these products operate largely outside of government control.

The description of the agricultural sector highlights several factors which could be relevant to the implementation of a fortification program. First, the political importance of the relatively high inflation in food prices suggests that the Tunisian government would be reluctant to pass on much of the cost of fortification to consumers. Second, the suspicion and occasional hositility of much of the rural sector towards the government would most likely inhibit the government's willingness to impose unpopular measures to implement a fortification program. Finally, the government's lack of control over the multitude of small wheat-processing plants would significantly increase the complexity and cost of a grain fortification program that attempted to help those people who consume the grain they process.

The Office Of Cereals

The Office of Cereals is a semiautonomous government agency with four fundamental objectives: to assure a sufficient supply of wheat and barley; to minimize and stabilize the retail price of cereals; to provide an adequate income to cereal farmers; and to eliminate unnecessary or unfair distribution costs charged by middlemen. The office works to accomplish these objectives through its seven main functions:

(1) to help farmers obtain what they need for cereal production;

(2) to purchase and store all grains not consumed on the farms;

(3) to maintain national cereal reserves'

(4) to estimate consumption requirements of cereals, calculate import needs, and arrange for imports;

(5) to allocate and sell grain to the large mills;

(6) to regulate the wholesale distribution and retail sales of cereal products; and

(7) to establish and control prices and margins for inputs, production, processing, distribution, and retailing.

The office performs these functions with the assistance of several large, state-directed service cooperatives, including the Cooperative Centrale des Semince (COSEM), the Cooperative Centrale de Ble, and the Cooperative Centrale des Grandes Cultures (CCGC).*

Although the stated goal of the office is to control all grain distribution and pricing, it allows between 18 and 26 percent of the grain consumed to be traded and priced freely in the grain market.+ This grain, plus approximately the 28 percent of the crop consumed on farms, is processed in the numerous small mills. A fortification program designed like our pilot project in Tunisia -- which fortified grain only in large, government-controlled mills -- could not reach this sizable portion of the crop.

Still the importance of its functions and the profitability of its operations make the Office of Cereals one of the most powerful and independent Tunisian government organizations. Its wholehearted support would obviously facilitate a cereal grain fortification program of any design.

Cereal Production

Types and Major Uses of Cereals

The three main cereals produced in Tunisia are durum wheat (triticum durum, known as "ble-dur"), break wheat (triticum vulgare, known as "ble tendre," which resembles North American hard wheat), and barley. Durum wheat forms the basis for most traditional staple dishes. Ground, it produces semolina, large particles of the endosperm of the wheat kernal. Coarsely ground semolina serves as the basis for couscous. Finer grades go into pasta products and the home-baked

*Source: The Central Cooperative for Seeds, the Central Cooperative for Wheat, and the Central Cooperative for Major Crops.

+Data in this paragraph from Tables 8. and 8. .

Note: The data in this section is derived primarily from documents from the BPDA and the Office of Cereals.

"tabuna," an unleavened bread consumed throughout the rural areas. Tunisians use both semolina and couscous as the basis for a wide variety of other dishes, including soups, breakfast drinks, porridges, meat and vegetable dishes, and desserts.

Bread wheat flour is now used mainly by the bakeries that produce the pasteries and bread (leavened "French bread") consumed in cities and towns. Some people also buy bread wheat flour for home baking.

Durum and bread wheats are not interchangeable in the foods generally consumed in Tunisia. However, a small amount of bread wheat flour can replace some of the fine semolina flour used to make couscous, pasta, and tabuna.

Barley substitutes for durum semolina in a barley couscous, and it also finds its way into a variety of breakfast foods, soups, breads, main dishes, and desserts. These foods are consumed primarily in central and southern Tunisia by the lower-income groups which cannot afford the more expensive wheat. Thus, a grain fortification program treating only wheat products would not reach a large part of the grains consumed in Tunisia. Furthermore, most of the consumers of barley, especially the lower-income southerns, have the most deficient diets in Tunisia and are usually considered a prime target group for fortification. A fortification program should therefore include barley as well as wheat.

Area Planted in Cereals and Cereal Farm Sizes

During the past several years about half of Tunisia's cultivated land has been planted in cereals, somewhat less than the two-thirds occupied during the 1960's. The government's encouragement of diversification and intensified land use has led farmers to cultivate some of their less productive cereal lands with olives, almonds, citrus fruits, and apricots.

In 1974 farmers planted almost 60 percent of the cereal lands in durum, allowing bread wheat and barley 15 percent and 25 percent respectively. Table 8.1 shows the actual area planted in wheats and barley from 1950 to 1974. These areas have changed considerably from year to year in response to expected fluctuations in the rainfall pattern and to government pricing policies, which have increasingly favored bread wheat in relation to barley. In addition to the wheats and barley, farmers planted small quantities of oats, corn, and sorghum in most of these years.

Table 8.1

Area, Production, and Yield of Major Cereals, 1950-1974

Crop Year*	Area (1000 ha)				Production (1000 T)				Yield (T/ha)		
	Durum wheat	Bread wheat	Barley	Total	Durum wheat	Bread wheat	Barley	Total	Durum wheat	Bread wheat	Barley
1950	528	168	378	1,074	280	180	200	660	.53	1.07	.53
1951	835	167	667	1,669	200	120	50	370	.24	.72	.07
1952	952	204	740	1,896	467	220	340	1,027	.49	1.08	.46
1953	873	184	577	1,634	380	200	180	760	.44	1.09	.31
1954	1,153	205	882	2,240	435	189	170	794	.38	.92	.19
1955	834	188	541	1,563	291	104	81	476	.35	.55	.15
1956	965	223	728	1,916	332	145	156	633	.34	.65	.21
1957	1,095	202	800	2,097	366	132	185	683	.33	.65	.23
1958	1,109	174	804	2,087	414	124	282	820	.37	.71	.35
1959	1,153	175	789	2,117	419	106	236	761	.36	.61	.30
1960	1,155	198	703	2,056	360	79	136	575	.31	.40	.19
1961	830	113	428	1,371	201	42	50	293	.24	.37	.12
1962	746	103	319	1,168	321	72	103	496	.43	.69	.32
1963	978	152	589	1,719	529	123	261	913	.54	.81	.44
1964	950	160	615	1,725	431	71	130	632	.45	.51	.21
1965	938	169	582	1,689	577	100	180	857	.62	.59	.31
1966	700	145	377	1,222	432	49	80	561	.62	.34	.21
1967	652	166	338	1,156	403	50	70	523	.62	.30	.21
1968	700	133	365	1,198	425	73	130	628	.61	.55	.36
1969	600	145	260	995	301	80	80	461	.50	.55	.32
1970	750	280	410	1,440	369	150	150	669	.49	.54	.37
1971	700	250	350	1,300	400	200	140	740	.57	.80	.40
1972	920	260	385	1,565	707	258	245	1,210	.77	.99	.63
1973	975	224	360	1,559	631	236	261	1,127	.65	1.05	.73
1974[a]	796	203	340	1,340	601	208	228	1,037	.76	1.02	.67

*The crop year extends from July of the preceding year through June of the year noted. Figures include the harvest in the year noted.

[a]April 1974 estimate.

Source: Durum and bread wheat data for CY 1950-1974 compiled from Office of Cereals documents. Data for CY 1964-1974 compiled from BPDA documents. Barley data for CY 1950-73 compiled from Office of Cereals documents; and CY 1974 data from Ministry of Planning.

In the late 1960's the government introduced new high-yield varieties of bread wheat, and in 1971 it distributed the first high-yield durum. The area planted with these strains expanded so rapidly that by 1974 it totaled 28 percent of the land in bread wheat and 15 percent of land in durum.

The northern region has over 60 percent of the durum and bread wheat planted and over one-third of the barley area. The central region contains almost half of the barley, 30 percent of the bread wheat, and 25 percent of the durum area. Only 17 percent of the barley, 11 percent of durum, and 9 percent of the bread wheat are planted in the arid south.

Approximately 92 percent of all Tunisian farms produce enough cereals to supply their occupants with a major portion of their food. Durum and barley grow on both small and large farms, but large state farms and richer private farms grow most of the nation's bread wheat. The farms which produce no cereals are mainly the more prosperous, larger farms specializing in tree crops, vegetables, or industrial crops.

The average farm in the northern region (19.6 ha) is much larger than its counterparts in the center and south of Tunisia (11.6 ha). The largest, most productive cereal farms are located in the northern area, although over 80 percent of the nation's farms encompass fewer than 20 ha.

The Reliability of Cereal Production Data

Data on Tunisian cereal production are only inexact estimates. This imprecision results from the practice of basing production data on records of sales to the Office of Cereals, which purchases less than half of the total cereal crop, not on farm production records. These rough estimates must be partly based on guesses about the quantities of grain used on farms or sold to the uncontrolled free market in cereals. Although we believe the reliability of these estimates has improved somewhat in recent years, they remain inexact. The size of the noncontrolled system is especially difficult to measure because no one has ever examined it systematically.

Three organizations measure Tunisian cereal production: the Bureau of Planet Developpement Agricole (BPDA), the Ministry of Agriculture's planning unit;* the Office of Cereals; and the Institute of Statistics, part of the Ministry of Planning. These three agencies derive their estimates in different ways, using their own calculations for the cereal quantities used on farms and distributed through the noncontrolled system. The BPDA's figures are generally thought to be the most reliable because of its greater knowledge of farm operations and its more concerted efforts to make accurate estimates.

The lack of reliable cereal-production data prevents accurate measurement of the availability of cereals and actual human consumption in Tunisia. So it is also difficult to assess the population's nutritional needs and to design and implement a proper nutrition program. These data issues cause particular problems in measuring needed fortificant quantities and in creating a system to deliver them.

Cereal Production

The cereal crops of 1972 to 1974 were the largest ever produced in Tunisia. Farmers produced a record crop of 1,210,000 tons of wheat and barley in 1972, and their 1973 and 1974 output was only slightly smaller. These crops were much greater than the average crop of the previous two decades: cereal output averaged 698,000 tons annually in the 50's and, 594,000 in the difficult 60's. Durum wheat showed the largest increase. The 1970-74 average was 51 percent higher than the 1950-59 average, while the comparable data for bread wheat and barley evidence increases of only 11 and 9 percent, respectively. The output of durum bread wheat and barley from 1950 to 1974 is presented in Table 8.1.

In recent years the north has produced close to 90 percent of Tunisia's durum and bread wheat. Although barley production is increasing rapidly in the central and southern regions, the north continues to provide about half of the total barley crop.

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*Source: The Bureau of Planning and Agricultural Development. In 1975 the BPDA was renamed the Bureau de Plan, des Analyses Economigues et de l'Evaluation des Projects (Bureau of Planning, Economic Analysis, and Project Evaluation, BPAEEP).

Per capita cereal production has recently fluctuated widely, despite increased production. As Table 8.2 shows, per capita cereal production reached a peak of 233 kg during the 1920's but showed a steady decline until the record crops of 1972-74.

Cereal Yields

Since 1972 the yields of durum, bread wheat, and barley have all been at record levels. The yield improvements have been the greatest for barley, which had an average annual yield between 1970 and 1974 double that of the 1950's. For durum the 1970-74 average was almost 70 percent greater than during the 1950's. Bread wheat achieved an increase of less than 10 percent in spite of the widespread use of high-yield varieties. The yields of the three major grains from 1950 to 1974 are presented in Table 8.1.

Nevertheless, Tunisia's cereal yields are still much lower than those of other developing countries in the Mediterranean region. Tunisia's 1967-71 yields in wheats were only 75 percent of Algeria's, half those of Morocco, and only 41 percent of Turkey's (IBRD, 1974:34).

The reasons most observers cite to explain Tunisia's relatively low cereal yields are low rainfall, lack of irrigation facilities, and low fertilizer use. However, in recent years fertilizers have played an ever-increasing role in wheat production. This expansion and the increased planting of high-yield varieties that require more fertilizer are the main factors responsible for the yield improvements achieved for wheats.

Better rainfall and soil quality, as well as greater use of fertilizers and high-yield varieties, explain why the cereal yields in northern Tunisia are so much greater than those in the central and southern regions. In the early 1970's durum and bread wheat yields in the north averaged over three times as high as the yields in the center and south, while barley yields in the north were more than double those in the rest of the country.

In all three sections of the Tunisia, cereal yields vary widely from year to year. This variability is greater for barley than for wheats and is most significant in the central and southern regions, where sharp fluctuations in rainfall are most pronounced.

Table 8.2

Per Capita Production of Major Cereals, 1925-1974

Period	Production of Major Cereals (1,000 tons)[a]	Population (millions)[b]	Per Capita Production (kg)
1925-29	512	2.20	233
1930-34	543	2.45	222
1935-39	604	2.65	228
1948-52	662	3.40	195
1953-57	669	3.75	178
1958-62	589	4.10	144
1963-68	686	4.40	156
1969-70	461	5.027	92
1970-71	669	5.137	130
1971-72	740	5.240	141
1972-73	1210	5.375	225
1973-74	1127	5.46	206
1974-75	1037	5.572	186

[a]Durum, bread wheat, and barley; for 1925-68, average production for each period.

[b]For 1925-68, population at middle of each period; for single years, population at midyear of the first year in the sequence.

The Cereal Production Process

The rainfall pattern determines the timing of the cereal production. In northern Tunisia, rain falls from September to early May and stops entirely during June, July, and August. Thus, farmers plant cereals in late fall and harvest them from late May through July, with June the month of peak activity.

Almost all cereal cultivation in Tunisia is conducted under dry land farming conditions and must remain so. Limited water availability and poor soil

conditions would allow profitable irrigation of an extremely small area less than 7 percent of the lad presently cultivated in all crops. The limited irrigated area devoted to cereals is mainly reserved for the high-yielding varieties of wheat, and irrigation facilities are concentrated in a few of the larger, more prosperous farms.

The possibilities for expansion of cereal production through new technology is severely limited in Tunisia by the lack of credit, particularly for small farmers. Only 8 percent of Tunisia's farmers received any institutional credit in 1973, and another 19 percent received loans averaging $53 from the World Food Program. Only about half of these funds went to cereal farmers, and most of them were more prosperous farmers in the north. Small cereal farmers, the majority, must conduct their operations without credit.

Still, cereal production is becoming increasingly mechanized in Tunisia. Most farmers use tractor equipment for soil preparation and combines or stationary threshers for harvesting. Small farmers generally rent this equipment from larger farmers or borrow it in exchange for a portion of their crop. The shortage of farm labor during peak demand periods has made this mechanization increasingly necessary.

Although farmers may obtain seeds from the Office of Cereals and the government cooperatives for delayed payment, most use a part of their own grain stocks as seed and purchase only new and better varieties from the government.

Foreign Trade in Cereals

In recent years Tunisia has become a net importer of cereals at an average annual cost between 1970 and 1973 of D 14.6 million or $30 million. This figure is almost three times the dinar value of imports in the early 1960's, when the annual deficit averaged D 5.5 million dinars ($13 million). The approximate value of trade in different cereals from 1960 to 1974 is outlined in Table 8.3.

Note: The data in this section are derived from documents by the Office of Cereals, BPDA, Institute of Statistics, and Ministry of Planning.

Table 8.3

Volume of Cereals Traded, 1960-73 (in Thousands of Tons)

	Durum Wheat		Bread Wheat		Barley and Others[b]		All Cereals		Net Volume
	Exports	Imports	Exports	Imports[a]	Exports	Imports	Exports	Imports	
1960	144	--	--	217	65	--	209	217	-8
1961	33	38	--	519	--	69	33	626	-593
1962	37	--	--	325	--	93	37	328	-291
1963	139	10	--	210	0.03	--	139	220	-81
1964	97	--	17	101	10	37	124	138	-14
1965	14	1.5	1	194	39	33	54	229	-175
1966	91	1.4	--	224	19	38	110	263	-153
1967	1	14	--	304	--	66	1	384	-383
1968	1	86	1	222	--	27	1	335	-334
1969	--	111	0.4	338	0.7	53	1.1	502	-501
1970	1	116	4	317	8	31	13	464	-451
1971	2	60	0.7	200	--	10	2.7	270	-267
1972	--	62	1	176	1	31	2	269	-267
1973	--	--	--	292	--	73	--	365	-365

[a]Including wheat equivalent of flours.

[b]Mostly barley, but also includes small quantities of oats, sorghum, millet, and rice.

Source: Compiled from data from Office of Cereals Institute of Statistics, Ministry of Planning, and BPDA.

During the past several years, the United States and Canada have provided almost all of Tunisia's durum wheat imports, and the U.S. has also been its main source of bread wheat and bread wheat flour. The other imported cereals come from France, the U.S., and Italy. Tunisia's small volume of cereal exports has gone mainly to Libya, Algeria, and France.

During the 1960's, the U.S. provided a significant portion of Tunisia's annual wheat imports under Title II of PL 480. However, imports from this source dwindled, and by 1973 PL 480 shipments equalled only about 6 percent of Tunisia's imports of wheat and wheat products. The exact quantities of PL 480 Title I and II shipments to Tunisia from 1960 to 1976 is presented in Table 8.4.

All of Tunisia's wheat imports are milled in the eighteen large mills of the controlled system thus 4 fortification were implemented through these mills, no special provisions would have to be made to include imported wheat, which would be fortified in exactly the same manner as Tunisian wheat. Special measures would have to be devised to fortify the small quantity of wheat flour which is imported. Instead of distributing the wheat flour directly to bakeries or other factories, the government would have to take it to a central location to be fortified, most logically a mill already practicing fortification. Since the fortificants are added to the durum and bread wheat flours after milling, the imported flours could probably be fortified with the same equipment used for Tunisian flours.

The Total Availability of Cereals

To design a fortification system for Tunisia and evaluate its cost we must also learn the amount of grain processed by the controlled and noncontrolled systems. We must measure cereal consumption. These data are essential for determining fortificant quantities and costs, how parallel fortification systems might be designed, and how our systems could best reach our target groups.

The only systematic measurement of cereal consumption in Tunisia was done in the mid-1960's, and many observers think that its data are outdated and unreliable. The governement initiated a new study of food consumption in 1975, but it is uncertain when its results will be available. It is possible, however, to make reasonably accurate estimates of cereal consumption from calculations of the

Table 8.4

United States PL 480 Shipments to Tunisia, 1960-1976

(MT)

Fiscal Years	Title I Wheat	Title I Wheat Products	Title II Wheat	Title II Wheat Products	Total PL 480 Wheat	Total PL 480 Wheat Products
1960	---	---	69,508	807	69,508	807
1961	---	---	169,362	2,296	169,362	2,296
1962	214,730	---	146,338	4,902	361,068	4,902
1963	106,794	---	118,306	11,456	225,100	11,456
1964	---	---	74,543	7,335	74,543	7,335
1965	92,315	---	46,647	14,264	138,962	14,264
1966	---	---	45,222	7,955	45,222	7,955
1967	121,360	---	20,248	12,805	141,608	12,805
1968	148,700	---	29,828	29,409	178,528	29,409
1969	115,480	---	88,261	9,951	203,741	9,951
(WFP)	---	---	(1,551)	(2,086)	(1,551)	(2,086)
1970	97,780	---	126,010	19,484	223,790	19,484
(WFP)	---	---	(75,796)	(1,712)	(75,796)	(1,712)
1971	61,420	---	97,352	14,678	158,772	14,678
(WFP)	---	---	(35,871)	(581)	(35,871)	(581)
1972	66,940	---	3,575	14,944	70,515	14,944
(WFP)	---	---	(3,575)	(1,913)	(3,575)	(1,913)
1973	730	---	4,331	15,927	5,061	15,927
(WFP)	---	---	---	(1,260)	---	(1,260)
1974	---	---	5,420	13,433	5,420	13,433
(WFP)	---	---	---	(50)	---	(50)
1975	---	---	17,100	9,323	17,100	9,323
(WFP)	---	---	(17,100)	---	(17,100)	---
1976	20,000	---	23,273	3,783	43,273	3,783
(WFP)	---	---	(17,100)	---	(17,100)	---

Source: U.S. Agency for International Development.

total availability of cereals less the quantity not used for human consumption. This section analyzes grain availability in Tunisia, and the following one analyzes grain use to arrive at a reasonably precise and current estimate of human consumption.

Our measurement of the total availability of grains is based on estimates of domestic production, adjusted for imports, exports, and changes in stocks. As noted previously in this report, several Tunisian government organizations collect agricultural data; their procedures vary, and so do their estimates. To provide the broadest range of reasonably reliable projections and to cross-check their accuracy, we will present those various estimates.

Table 8.5 presents the calculations of the availability of cereals from 1960 to 1974 based on differing estimates of the various component figures. Although the data for the 1960's vary considerably, the estimates for the past several years are remarkably consistent. Of these three versions, the knowledgeable BPDA's is probably the most reliable.

The data in Table 8.5 shows a fluctuating but gradually increasing availability of all cereals during the period under examination. The average annual availability for wheats between 1971 and 1974 was about 44 percent greater than the average availability between 1961 and 1965. For all cereals, the increase was 46 percent.

The Uses of Cereals: Seed Use, Feed Use, and Human Consumption

To estimate human cereal consumption, we must subtract the volume used for other purposes from the total amount available. Besides human consumption, wheats are used as seed for future crops. Barley also serves both as seed and as animal feed.

Both the BPDA and the Office of Cereals annually estimate the cereals used as seed and animal feed. Their figures are presented with the calculations of annual availability in Table 8.6, which shows further the results of calculations of total and per capita human cereal consumption. According to BPDA data, the per capita consumption of cereals in Tunisia from 1973 to 1974 was 219 kg: 101 kg of durum, 91 kg of bread wheat, and 27 kg of other cereals, mostly barley.

Table 8.5

Estimates of the Total Availability of Cereals (in thousands of tons)

Commercial Year[a]		Durum Wheat: Production	Imports	Exports	Change in Stocks	Total Availability	Bread Wheat: Production	Imports	Exports	Change in Stocks	Total Availability	Barley and Other Cereals: Production	Imports	Exports	Change in Stocks	Total Availability	Total Availability: Wheat	Total Availability: All Cereals
1960/1:	OC	360	-	144	- 43	259	79	217	-	- 19	315	130[b]	-	65[d]	- [illegible]	71[i]	5[illegible]4	45[illegible]
	BPDA	483[a]	-			387	116				352	266				201[i]	[illegible]39	940
1961/2:	OC	200	38	33	- 43	248	42	519	-	+ 72	489	50	69[e]	-	[illegible]	119	73[illegible]	856
	BPDA	272[a]				320	42				509	49				168[i]	820	99
1962/3:	OC	321	-	37	+ 66	218	72	325	-	- 40	437	103	9[illegible][d]	-	- [illegible]	19[illegible]	655	[illegible]51
	BPDA	436[a]				333	105				470	202				295[i]	861	1,046
1963/4:	OC	529	-	139	+ 41	349	123	210	-	+ 29	364	261	-	.0[illegible]	+ [illegible]	255	[illegible]53	905
	BPDA	717[a]				537	180				361	508				502	898	1,466
1964/5:	OC	350	-	97	- 116	369	81	101	17	- 57	222	130	-	10[d]	+ [illegible][e]	11[illegible]	591	[illegible]02
	BPDA	431	-	21	- 57	467	81	190	-	+ 4	267	182	37	-	+ -	216	[illegible]34	944
1965/6:	OC	420	-	14	+ 100	306	100	154	1	+ 25	268	180	33[e]	34[f]	+ 5[e]	164[h]	5[illegible]4	[illegible]43[h]
	BPDA	577	-	100	+ 30	447	100	141	-	- 21	262	272	8	17	+ 5	258	[illegible]09	[illegible]
	MP	547	-	14	+ 99	434	111	104	2	+ 24	189	250	33	39	+ [illegible]	238	623	8[illegible]1
1966/7:	OC	300	-	91	- 83	292	49	224	-	- 14	287	80	38[d]	19[d]	- 13[h]	112[i]	5[illegible]9	[illegible]41[i]
	BPDA	432	-	3	- 28	457	49	250	0.5	+ 10	288	135	67	2	+ 16	184	745	929
	MP	390	-	91	- 83	382	54	215	-	- 13	282	110	38	19	- 1[illegible]	142	684	866
1967/8:	OC	280	14	1	- 40	333	50	304	-	+ 21	333	70	66[d]	- [illegible]	- 29[h]	16[illegible][h]	666	8[illegible]1
	BPDA	403	81	0.5	+ 12	471	50	339	0.4	+ 45	344	120	26	-	- 2[illegible]	175	815	990
	MP	364	-	-	- 40	404	56	319	-	+ [illegible]1	354	97	66	-	+ 16	147	7[illegible]8	905
1968/9:	OC	310	86	1	+ 13	382	73	222	1	+ 12	282	130	2[illegible][d]	- [illegible]	- [illegible]	15[illegible]	664	821
	BPDA	425	60	-	- 3	488	73	212	-	- 19	304	200	5[illegible]	-	+ 3[illegible]	28[illegible]	792	1,0[illegible]8
	MP	403	-	-	+ 27	376	81	294	-	+ 31	344	180	27	-	-	20[illegible]	720	92[illegible]
1969/70:	OC	245	111	-	- 1	357	80	336	-	- 2	420	80	5[illegible][d]	- [illegible]	- 19[d]	152[i]	[illegible]	929
	BPDA	301	122	-	+ 22	401	80	381	0.4	+ 8	453	116	54	0.[illegible]	- [illegible]	174	654	1,028
	MP	286	-	-	+ 10	276	86	434	-	+ 42	478	111	5[illegible]	-	- [illegible]	18[illegible]	[illegible]54	9[illegible]
1970/1:	OC	300	116	1	+ 46	369	150	317	4	+ 18	445	150	3[illegible][d]	- [illegible]	- 13[e]	19[illegible]	814	1,00[illegible]
	BPDA	369	98	0.7	+ 12	454	150	236	4	+ 4	360	207	12	8	- 1[illegible]	224	834	1,058
	MP	390	-	5	+ 47	343	150	429	-	+ 18	561	209	3[illegible]	-	+ [illegible]	23[illegible]	904	1,1[illegible]
1971/2:	OC	400	60	-	- 4	464	200	200	-	+ 14	386	140	10[d]	- [d]	- [d]	150[i]	890	1,00[illegible]
	BPDA	400	62	2	+ 4	456	200	167	0.7	- 4[illegible]	[illegible]06	160	32	-	- 2	19[illegible]	86[illegible]	1,0[illegible]
	MP	450	-	-	+ 89	361	200	272	-	+ 15	458	200	10	-	-	210	819	1,029
1972/3:	MP	707	-	-	+ 196[e]	511	258	171	1[e]	+ 14[e]	414	245	31	-	+ 22[e]	254[i]	925	1,179
	BPDA	707	76	-	+ 196	587	258	176	1	+ 14	419	280	24	-	+ 22	282	1,00[illegible]	1,2[illegible]
1973/4:	MP	655	-[e]	-[e]	-[e]	655	235	292[e]	-[e]	+2[e]	525	282	7[illegible][e]	-	- 6[e]	361[h]	1,180	1,941
	BPDA	631	-	-	-	631	235	292	-	+2	525	286	73	-	- 6	365	1,156	1,521

[a]Commercial year includes the harvest of the first year in the two-year sequence. Thus, it includes the harvest of the preceding crop year. Commercial year 1973/4 includes the harvest of crop year (CY) 1973 (1972/73).

[b]Based on OC data, modified according to BPDA calculation of OC underestimate.

[c]Barley alone.

[d]First eleven months.

[e]Ministry of Planning estimates.

[f]BPDA estimates.

[g]Based partly on Ministry of Planning data (as noted).

[h]Based partly on BPDA data (as noted).

[i]Based partly on Ministry of Planning and BPDA data (as noted).

[j]Rough estimate.

Source: Compiled and calculated from data from BPDA, OC, and Ministry of Planning documents.

Table 8.6

Estimates of Cereal Use, 1960-1974: Seed Use, Animal Consumption, and Human Consumption (in thousands of tons)

Commercial Year[a]		Durum Wheat: Total Availability	Durum Wheat: Seed Use[b]	Durum Wheat: Animal Consumption	Durum Wheat: Total Human Consumption	Durum Wheat: Per Capita Human Consumption (Kg)	Bread Wheat: Total Availability	Bread Wheat: Seed Use[b]	Bread Wheat: Animal Consumption	Bread Wheat: Total Human Consumption	Bread Wheat: Per Capita Human Consumption (Kg)	Barley and Other Cereals: Total Availability	Barley and Other Cereals: Seed Use[c]	Barley and Other Cereals: Animal Consumption[d]	Barley and Other Cereals: Total Human Consumption	Barley and Other Cereals: Per Capita Human Consumption (Kg)	Per Capita Human Consumption Wheat	Per Capita Human Consumption All Cereals	Estimated Population (Millions)
1960/1:	OC	259	70	-	189	47.0	315	10	-	305	75.9	71	10*	25*	36	9.0	122.9	131.9	4.020
	BPDA	387		-	317	78.9	352		-	342	85.1	201	25*	70*	106	26.4	164.0	190.4	
1961/2:	OC	248	61	-	187	45.5	489	8	-	481	117.0	119	20*	42*	57	13.9	162.5	176.4	4.110
	BPDA	320		-	259	63.0	509		-	499	121.4	168	25*	59*	84	20.4	184.4	204.8	
1962/3:	OC	218	81	-	137	32.5	437	10	-	427	101.4	196	25*	69*	100	23.8	133.9	157.7	4.210
	BPDA	333		-	252	59.9	470		-	460	109.3	295	30*	103*	162	38.5	169.2	207.7	
1963/4:	OC	349	83	-	266	61.6	304	10	-	296	68.5	255	30*	89*	136	31.5	130.1	161.6	4.320
	BPDA	537		-	454	105.1	361		-	351	81.3	502	35*	176*	291	67.4	186.4	253.8	
1964/5:	OC	369	76	-	293	66.1	222	16	-	206	46.5	111	20*	39*	52	11.7	112.6	124.3	4.430
	BPDA	467	77	-	391	88.3	267	12	-	255	57.6	210	34	80	96	21.7	145.9	167.6	
1965/6:	OC	306	63	-	249	53.8	268	13	-	255	56.3	169		59*	85	18.8	110.1	128.9	4.533
	BPDA	447	63	-	384	84.7	262	13	-	249	54.9	258	25	104	129	28.5	139.6	168.1	
	MP	434		-	371	81.8	189		-	176	38.8	238		83*	130	28.7	120.6	149.3	
1966/7:	OC	292	58	-	234	50.2	287	15	-	272	58.4	112	20*	39*	53	11.4	108.6	120.0	4.660
	BPDA	457	60	-	397	85.2	288	15	-	273	58.6	184	24	78	82	17.6	143.8	161.4	
	MP	382		-	322	69.1	282		-	267	57.3	142	20*	50*	72	15.5	126.4	141.9	
1967/8:	OC	333	59	-	274	57.2	333	12	-	321	67.0	165			59	12.3	124.2	136.5	4.790
	BPDA	471	63	-	408	85.2	344	13	-	331	69.1	175	24	82	69	14.4	154.3	168.7	
	MP	404		-	341	71.2	354		-	341	71.2	147		51*	72	15.0	142.4	157.4	
1968/9:	OC	382	59	-	323	65.6	282	15	-	267	54.2	157		55*	82	16.7	119.8	136.5	4.924
	BPDA	488	57	-	431	87.5	304	13	-	291	59.1	286	20	92	174	35.3	146.6	181.9	
	MP	376		-	319	64.8	344		-	331	67.2	207		72*	115	23.4	132.0	155.4	
1969/70:	OC	357	56	-	276	54.3	420	20	-	400	78.7	152		53*	74	14.6	133.6	147.6	5.082
	BPDA	401	65	-	336	65.1	453	24	-	429	84.4	174	25	95	54	10.6	150.5	161.1	
	MP	276		-	211	41.5	478		-	454	89.3	183			63	12.4	130.8	143.2	
1970/1:	OC	369	80	-	289	55.2	445	-	-	445	84.9	194			92	17.6	140.1	157.7	5.240
	BPDA	454	69	-	385	73.5	380	35	-	345	65.8	224	13	89	122	23.3	139.3	162.6	
	MP	343		-	274	52.3	561		-	526	100.4	232			130	24.8	152.7	177.5	
1971/2:	OC	464	70	-	394	73.3	386	30	-	356	66.2	150			52	9.7	139.5	149.2	5.375
	BPDA	456	77	-	379	70.5	406	21	-	385	71.6	194	23	75	96	17.9	142.1	160.0	
	MP	361		-	284	52.8	458		-	437	81.3	210			112	20.8	134.1	154.9	
1972/3:																			
	BPDA	587	71	-	516	94.5	419	23	-	396	72.5	282	30	124	128	23.4	167.0	190.4	5.46
	MP	511		-	440	80.6	414		-	391	71.6	254			100	18.3	152.2	170.5	
1973/4:																			
	BPDA	631	66	-	565	101.4	525	16	-	509	91.3	365	19	197	149	26.7	192.7	219.4	5.572
	MP	655		-	589	105.7	525		-	509	91.3	361			145	26.0	197.0	223.0	

[a] The commercial year extends from July of the first year in the sequence through June of the second year. Availability of cereals is based on the preceding crop year (the crop year ending in June of the first year noted in the commercial year). For example, the cereals produced in one crop year, 1973, are consumed in commercial year 1973-74. Population is given at the beginning of the second calendar year in the two-year sequence. Therefore, these population data can serve as the midyear population figures of the commercial year, the year during which the cereals were consumed.

[b] Blank spaces indicate data is unavailable. For 1960-61 through 1963-64, we use OC data for this item; after 1964-65, BPDA data is used.

[c] Blank spaces indicate data is unavailable. We use BPDA data for this item.

* Rough estimate. Animal consumption is calculated as 15 percent of total availability (BPDA estimate).

Source: Calculated from the data in Table 8.5 and from data from BPDA, Office of Cereals, and Ministry of Planning documents.

This estimate is higher than the consumption figure used by most experts on Tunisian diets, some of whom still base their analyses on the 1965-68 Food Consumption Survey which placed per capita consumption at 147 kg.

One way to cross-check the methodology used in Table 8.6 is to compare its results with those of the Food Consumption Survey for the period 1965-66. Table 8.7 shows this comparison and also includes the results of a BPDA analysis of the Food Consumption Survey data. The BPDA performed this analysis because its officials disagreed with the conversion rates used in the Food Survey. Yet comparison of the various consumption estimates for 1965-66 reveals remarkable consistency among predictions derived in completely different ways. The Food Survey estimate of total per capita consumption is almost identical to the Ministry of Planning's analysis in Table 8.6, and the BPDA's analysis of the Survey data gives results which are strikingly similar to the BPDA estimates calculated in the manner of Table 8.6. We can therefore conclude that Table 8.6's estimates and methodology are valid.

Table 8.7

Comparison of 1965-66 Cereal Consumption Estimates by Food Consumption Survey and Other Agencies
(kg per capita)

	Durum	Bread Wheat	Barley and Others	Total
Food Consumption Survey	89	44	14	147
BPDA Analysis of Survey Data	87	66	16	169
Table 8.6 notes based on data from:				
BPDA	85	55	28	168
Ministry of Planning	82	39	29	150
Office of Cereals	54	56	19	129

To define the target groups which should consume fortified grains and to design a system to reach them, it is important to assess the differences in per capita consumption among urban and rural areas and different regions of the country. The 1965-68 Food Survey provided the only in-depth analysis of urban-rural differences in consumption, and the BPDA has re-analyzed this data using different rates of conversion. These two analyses, presented in

Table 8.8, both show that cereal consumption is by far the highest in dispersed rural areas, somewhat less in rural villages and small towns, and the lowest in urban areas. The analyses also show that barley constitutes a significant portion of rural cereal diets -- about 14 percent of grain consumption in dispersed areas and 8 percent in villages and towns. Our fortification program deals only with wheats, so it would not affect the portion of the diet constituted by barley. Yet one of the probable target groups of a fortification program would be the barley-consuming inhabitants of rural areas. The two analyses also show that the consumption of bread wheat, most of which is processed by large mills, is much lower in rural than in urban areas. Conversely, durum milled in local smalls is much more popular in rural areas than in cities. Thus, it would be difficult to give rural inhabitants enough fortificants through a system using only large central mills.

The differences in the cereal consumption among various geographical regions are difficult to evaluate because no one has made a serious effort to collect data on the subject. However, bread wheat consumption is probably higher in the north than in the center and the south for the three main reasons. First, the north has the highest proportion of urban population, where bread wheat consumption is high. Second, the northern rural population has easier access to bakeries than do the rural inhabitants of the other regions. Third, the farms of the rural center and south grow little bread wheat; families make their own bread from durum and barley. For all these reasons, then, fortification of bread wheat is an ineffective way of improving the nutritional status of the rural inhabitants of the center and south, two probable target groups of any program.

The geographical differences in consumption patterns for barley are much more clear-cut than those for bread wheat, and the implications are more serious for fortification programs. It is generally agreed that barley consumption is concentrated in the central and southern regions, where dishes such as barley bread and barley couscous are frequently eaten. In contrast, barley is rarely consumed by humans in the north; they use it for animal feed. Thus, the per capita barley consumption of rural inhabitants of the central and southern regions is probably much higher than the national averages in Table 8.8. In fact, since half of Tunisia's people live in the center and south and consume almost all of the barley eaten by humans, their per capita consumption of barley

Table 8.8

Urban-Rural Differences in Cereal Consumption, 1965-66
(kg per capita)

	Durum	Bread Wheat	All Wheats	Barley and Others[a]	All Cereals
Urban:					
Cities, large towns					
Food Survey	30	98	128	1	129
BPDA Analysis	50	80	130	2	132
Rural:					
Small towns, villages					
Food Survey	80	40	120	10	130
BPDA Analysis	88	70	158	12	170
Rural:					
Dispersed, farms					
Food Survey	114	30	144	23	167
BPDA Analysis	99	60	159	24	183
Total					
Food Survey	89	44	133	14	147
BPDA Analysis	87	66	153	16	169

[a]In each case other cereals represent 1 kg or less

Source: A. Sahnoun. Comptes Ressources - Emplois (1964-69). BPDA Ministre de l'Agriculture: Tunis, Fevrier, 1971. Pp. 8-9.

is about twice the national average. When the 1965-68 Food Survey results are reinterpreted in this manner, we discover that barley constitutes about 28 percent of the grain diets of dispersed rural people in the center and south and 16 percent of grain consumption in rural villages. In conclusion it is clear that the fortification of wheats alone would leave two of the most vulnerable target groups in the country with only partial nutritional aid.

On-Farm Cereal Use

There are three main channels for the distribution of cereals in Tunisia: use at the farm level, the controlled system, and the noncontrolled system. To evaluate the effectiveness of the fortification program as presently designed we must measure the quantity and destinations of cereals distributed through each channel. Then we will know how much grain the target groups obtain through each channel. It is important also to understand the reasons for the existence of the two unofficial channels if we are to ask consumers to change their habits and only purchase the fortified grain of the controlled system. An analysis of these issues will tell us whether fortification can be implemented only through the large mills of the controlled system or whether we must also use the small local mills which process the on-farm consumption and the grain of the noncontrolled system.

Grain consumed on the farm is used in several ways: as the family's food, as seed, and as animal feed. These three activities constitute what is generally known as the on-farm consumption, or "autoconsumption," of cereals. A second category of activities encompasses the various ways in which cereals are used as in-kind payments or for barter. These activities, which may be termed "in-kind transactions," include the use of grains to pay farm workers, as rental payments to the owners of farmland and equipment, as religious donations to the poor. These in-kind transactions are sometimes included in on-farm consumption; but, because the grain changes ownership and is not actually used on the farm, and because of the uncertain legal status of these activities in Tunisia, we will consider these transactions part of the noncontrolled system.

Autoconsumption and in-kind transactions have clear rationales. It is usually cheaper and always more convenient to use the farm's own produce for seed, feed, and the family's food supply than to transport and sell produce and then purchase these items. Farmers feel it is simpler and less time-consuming to make payments in grain. Interview respondents also explained that using grain this way gave a feeling of security; grain stocks cannot be squandered like cash, so they serve as a kind of enforced savings program and represent an assured food supply and source of trading power. Another reason for autoconsumption mentioned by Tunisian farmers is that rural people prefer to consume their own grain rather than centrally processed products from other

farms. Almost all Tunisian farm families prefer locally milled grain to the controlled system's products, believing it purer, healthier, tastier, more filling, and of better quality.

The marked preference for home-grown grain suggests that rural people would resist any requirement that they eat only grain processed in the controlled-system mills, where we originally planned to implement fortification. Because of the rural sector's still-lingering hostility, to the 1960's cooperatives program, the Tunisian government would most likely be unwilling to impose any such requirements on the farming population. So, if the intended target groups of a fortification program include farm families, the program would have to be implemented through the small local mills.

It is essential that the Tunisian fortification program estimate the quantity of cereals consumed by humans at the farm level and the proporation of total consumption this quantity represents. This information is necessary to evaluate the effectiveness of a centrally implemented program and assess the need for a program involving the small mills.

Although there have been no precise measurements of the cereals used at the farm level, several estimates have been made. The 1965-68 Food Survey estimated that human autoconsumption of cereals represented almost 18 percent of total cereal consumption in Tunisia and 22 percent rural consumption. Some observers think that these are the most accurate data available, but others consider them conservative. A team studying the grain marketing system completed a more current analysis in 1974, using the Food Survey per capita consumption estimates as the basis for its calculations. According to this analysis, about 323,000 tons of cereals were consumed on farms in 1973-4, about 39 percent of the total quantity of grains consumed.

This grain marketing team analysis failed to take into account that farm families purchase a certain portion of their grain diet in the form of centrally processed pasta, crackers, cookies, and bakery bread. In fact, the Food Survey* estimated that at least 13 percent of the wheat diets of dispersed farm

*Estimate of quantity of grain consumed on farms from The Tunisian Grain Marketing System, Report No. 47. Kansas State University, Food and Feed Grain Institutes: Manhattan Kansas, 1974. Estimate of total consumption using rates from 1965-68 Food Survey (147 kg per capita) and 1973-4 population figures (5.628 million).

families and 16 percent of the wheat consumption in rural villages is composed of centrally processed products. Furthermore, in the central and southern regions, many less productive farms can provide only a portion of the family's grain supply; the rest comes from local markets, the Office of Cereals, or from central mills. When we take these facts into account and analyze current BPDA data for 1973-4, we calculate human autoconsumption of cereals to be 337,428 tons, about 28 percent of total human cereal consumption in 1973-4. When this methodology is used in the analysis of the two previous crop years, the results are striking. As a percentage of total human consumption, human autoconsumption is again 28 percent.

So we conclude that about 28 percent of the cereals consumed by humans are consumed on the farms where they are cultivated; they would not be reached by a centralized fortification program. Most of these grains are instead processed in the small local mills. If the program aims to reach these cereal producing farm families -- who constitute over 40 percent of the Tunisian population -- the small mills must participate in the program.

Because the present project includes only the fortification of wheats, we must also measure the autoconsumption of wheats alone. Although no data is available on this subject, we can estimate the levels as we did overall autoconsumption. In 1973-1974 about 29 percent of the wheat consumed in Tunisia was consumed on the farms where it was grown and, therefore, would not be reached by a fortification program implemented through the central mills.

To ascertain the extent to which the fortification program reaches the target groups, we must analyze regional patterns of autoconsumption. Little data on this subject was available, so we collected some information in field survey. There is almost no autoconsumption, logically, in the cities and large towns; few urban dwellers work as farmers. Autoconsumption does provide part of the food supply of small towns, however; some residents operate their own farms, to which they commute daily.

Autoconsumption is probably greatest in the rural areas and villages of the northern region, where families grow most of their own grain supply. Autoconsumption accounts for a smaller portion of the rural diets in the central region. Some big farms provide their operators' grain, but minor farms can produce only a minor portion of what they need. Although the pattern varies considerably within the southern region, it is safe to say that autoconsumption accounts for the smallest part of grain consumption anywhere in the nation. Rural and village families produce part of their grain supply and purchase the remainder as centrally processed products or, less frequently, as unprocessed grain from the market.

In conclusion, the urban poor probably do not obtain any of their diet from autoconsumption. And two other probable target groups -- rural inhabitants of the center and south -- produce less of their own grain supply than do northern farmers. Autoconsumption is significant enough in the center and south to decide that an effective fortification program has to work with the small mills.

The Controlled Grain Marketing System

The controlled grain marketing system is one of the three main channels for the distribution of Tunisian wheat and other cereals. The delivery of fortificants is presently planned to take place in the centralized grain processing facilities of this system. Therefore, in order to evaluate the effectiveness of this design and to determine if we should change it, we must estimate the quantity of grain this channel processes and discover who are its recipients. We must also learn now this system if we are to determine how the fortification project will affect its operations.

The Functioning of the Controlled System

The major function of the Office of Cereals is to control the distribution, processing, and marketing of wheat and wheat products. Assisted by the government-directed cooperatives COCEBLE and CCGC, the Office performs this function through several main tasks which include: (1) buying wheat from producers; (2) storing wheat until processors or consumers purchase it; (3) allocating and selling the wheat to large mills; (4) selling wheat to private consumers or to grain retailers; and (5) selling seeds, fertilizers, and insecticides to wheat producers.

The Office of Cereals and the cooperatives operate one hundred fifty centers where the wheat is received and stored, and where [inputs] and grain are sold. The total grain storage capacity of these centers is about 502,680 tons, which is one-third the nation's consumption in 1973-4. Over half of the centers and 82 percent of the total storage capacity are located in the northern region; 30 percent of the centers and 16 percent of capacity are in the center, and the south contains only 11 percent of the centers and 2 percent of capacity. Most of the largest storage facilities are located near Tunis, which receives much of the imported grain and where fifteen of the eighteen large mills are situated.

Farmers sell most of their grain to the centers immediately after the harvest, during June, July, and August. The government purchasing price remains constant throughout the year, so farmers who intend to sell to the controlled system have little incentive to store their grain for sale later in the year.

Farmers must transport their grain to the collection centers, and they receive no differential payments based on their transportation costs. They pack most grain in jute sacks weighing 80-100 kg and transport them to the centers by truck or tractor, in carts drawn by donkeys or horses, or on the backs of donkeys, camels, and horses. Farmers who cannot provide vehicles or animals must rent or borrow them. Most centers reportedly service farms within a radius of less than 30 km, although in some areas of the center and south farmers must travel greater distances. The cost of providing transportation, the difficulty of obtaining vehicles, and the time spent traveling to the centers are three main reasons for selling grain to the noncontrolled system instead of to the government.

When the sacks of grain are received at the centers, the grain is graded and the price determined. For quantities of less than 100 qq, farmers are usually paid on the day of delivery. For larger quantities, farmers generally wait a minimum of a week for payment because it must be processed in the Office of Cereals headquarters in Tunis. These delays are another important reason why farmers often chose not to sell their grain to the government centers.

The purchased grain is stored temporarily at the centers until it can be transported to central storage elevators and to mills for processing. So limited is indoor storage space at many of the collection centers that during the summer much of the grain must be temporarily stored out-of-doors in sacks sometimes covered by a waterproof tarpaulin. Although there is rarely any summer rainfall, this out-of-doors storage has occasionally resulted in considerable grain losses. Apparently the system is not equipped to handle a greater portion of the grain supply than it presently handles. These space restrictions, as well as the limited capacity of large wheat mills, are two reasons why the government tolerates the noncontrolled system.

At the direction of the Office of Cereals, the grain is shipped from the collection centers to the twelve central terminal elevators for later transfer to the large mills. The grain is transported by truck or railroad. Railroad service is reportedly relatively fast, reliable, and available. Truck service, which is usually rented from government companies is limited and sometimes causes delays, overcrowded storage conditions and grain losses at the centers, and grain shortages at the large mills.

The central terminal elevators, which also store imported grain, are almost all located near the main ports where seventeen of the mills are located. However, two of the elevators are situated inland in the main wheat region near the eighteenth large mill.

Besides performing these distribution functions, the centers also sell various inputs to producers. Although most inputs are also available on the free market, some farmers prefer the centers because they are more conveniently located, sometimes provide more credit than private retailers, and handle more new seed varieties. However, the limited storage space in many of the centers restricts the quantity of inputs they can sell.

Some centers also sell grain to be consumed as food, and others willingly sell to wholesale distributors or retailers who plan to resell the grain at a higher price. The centers have a variety of different policies toward such sales. To simplify their administrative role, many centers have established minimum limits ranging from 100 kg to 1 kg. Officials in other centers express their responsibility to the poor by providing whatever quantities the poor can afford.

There is also reportedly a maximum limit of 300 kg on sales. Regardless of their policies, few offices have grain available throughout the entire year; the stocks of some centers are exhausted as early as a month after the harvest.

The Size of the Controlled System

The controlled system includes the cereals sold to the government collection centers less a small quantity they sell to individuals. Imported cereals and cereal products also are processed and distributed through the controlled system.

The Office of Cereals and BPDA have in the past formulated estimates of the size of the controlled system, and although no current estimates are available, we can derive them from other data. Between 1962 and 1972, the Office of Cereals annually estimated the proportion of total wheat production sold to the controlled system. The Office calculated that an average of 34 percent of the durum wheat crop was sold to the government during this period, from 19 percent in 1970 to 46 percent in 1966. For bread wheat the proportions are higher -- an average of 48 percent, with a low of 29 percent in 1968 and a high of 63 percent in 1970. Using the Office of Cereals proportions for each year, their production data, and their estimates of the centers' sales to individuals, we can calculate the quantity of grain processed by the controlled and non-controlled systems. When compared with BPDA estimates of consumption for each year, these data show that the controlled system processed an average of 30 percent of the durum and 85 percent of the bread wheat consumed from 1962 to 1972, while the average for both wheats combined was 57 percent. According to these calculations, then, an average of 43 percent of the wheat consumed during this period was processed outside the controlled system and would not be reached by a centralized fortification program.

The Office of Cereals data further suggests that the proportion of wheat sold to the controlled system increases during good harvest years and decreases when harvests shrink. This fluctuation is due mainly to the stability of government prices, which only change in response to long-range trends, whereas the prices in the noncontrolled system fluctuate freely according to crop size and the current availability of grain. Thus, in years of good harvest, the price in the noncontrolled system usually drops below the government price and encourages farmers to sell more of their output to the government. Conversely,

in bad years the free market price rises above the government price and farmers naturally sell more of their crop to the noncontrolled system.

For the years 1965 to 1970 the BPDA has published data estimating the total quantity of grain processed by both the controlled and the noncontrolled systems. When we compare this data, presented in Table 8.9, with BPDA estimates of total consumption, we see that an average of 64 percent of the wheat and 54 percent of the barley consumed during the period was processed by the controlled system, while the remainder flowed through the noncontrolled system.

Although estimates of this sort have not been published recently, we can come up with comparable estimates from data that is available. The 1973-4 Office of Cereal records of the purchases by and sales from the collection centers are presented in Table 8.10, with BPDA data concerning trade in cereals, grain stocks, and consumption. According to these figures, about 48 percent of total consumption during this year was processed by the controlled system and 52 percent processed through the noncontrolled system.

The Participants in the Controlled System

The large farmers in the most productive northern farms reportedly sell most, if not all, of their output to the controlled system. This is partly because they are recipients of most government loan funds and thus are more familiar to officials than small farmers. Most small farmers probably sell part of their output to the government after harvest time, when prices in the noncontrolled system are generally at their lowest point. Nevertheless, the small operators who constitute the great majority of Tunisian farmers sell much, if not all, of their output to the noncontrolled market. We will discuss the reasons for these practices later in this chapter.

The processed products of the controlled system constitute a varying portion of the diet of all Tunisians. The 1965-8 Food Consumption Survey evaluated the intake of bakery bread and pasta made from centrally processed grain, but did not assess consumption of centrally processed semolina. Nevertheless, the survey results are useful because they estimate that bakery bread and pasta account for 65 percent of the wheat intake of urban dwellers and

Table 8.9

Estimate of Durum, Bread Wheat, and Other Cereals Processed by Controlled System, Cm. Y 1973-1974 (in quintals)

	Durum Wheat	Bread Wheat	All Wheats	Barley and Others	All Cereals
(a) Purchases by:					
OC	971,680	261,567	1,233,247	357,322	1,590,569
CCGC*	393,668	219,756	613,424	47,576	661,000
COCEBLE	394,221	220,054	614,275	47,620	661,895
Total:	1,759,569	701,377	2,460,946	452,498	2,913,444
(b) Sales to individuals from collection centers:**					
OC	14,575	7,062	21,637	3,573	25,210
CCGC	5,905	5,933	11,838	476	12,314
COCEBLE	5,913	5,941	11,854	476	12,330
Total:	26,393	18,936	45,329	4,525	49,854
(c) Grain remaining in the CS (a-b)	1,733,176	682,441	2,415,617	447,973	2,863,590
(d) Trade (imports)	-	2,916,000	2,916,000	72,500	2,988,500
(e) Change in stocks	-	24,000	24,000	(56,000)	(32,000)
(f) Grain processed by CS [(c + d) - e]	1,733,176	3,574,441	5,307,617	576,473	5,884,090
(g) Human consumption	5,650,000	5,110,000	10,760,000	1,450,000	12,210,000
(h) Grain processed by CS as a percentage of human consumption (f-g)	30.7 percent	69.9 percent	49.3 percent	39.8 percent	48.2 percent

*Only data for all cereals was available, so the proportion of durum, bread wheat, and others are assumed to be equal to the proportions of COCEBLE.

**Estimated to be 1.5 percent for durum and 2.7 percent for bread wheat, on the basis of the figures for Cm. Y 1974-1975 sales from OC centers (the only available data). No data for sales for barley and other cereals was available; these were roughly estimated to be 1.0 percentage.

Sources: a: Annexes 10-12
b: Based on Annex 13
d, e: Table 7.01
g: Table 8.02
c, f, h: Calculated

Table 8.10

Estimate of Durum, Bread Wheat, and Other Cereals Processed by the Controlled System 1973-1974 (in qq)

	Durum Wheat	Bread Wheat	All Wheats	Barley and Others	All Cereals
(a) Purchases by:					
OC	971,680	261,567	1,233,247	347,322	1,590,569
CCGC*	393,668	219,756	613,424	47,576	661,000
COCEBLE	394,221	220,054	614,275	47,620	661,895
Total:	1,759,569	701,377	2,460,946	452,498	2,913,444
(b) Sales to individuals from collection centers:**					
OC	14,575	7,062	21,637	3,573	25,210
CCGC	5,905	5,933	11,838	476	12,314
COCEBLE	5,913	5,941	11,854	476	12,330
Total:	26,393	18,936	45,329	4,525	49,854
(c) Grain remaining in the Controlled System (a-b)	1,733,176	682,441	2,415,617	447,973	2,863,590
(d) Trade (imports)	-	2,916,000	2,916,000	72,500	2,988,500
(e) Change in stocks	-	24,000	24,000	(56,000)	(32,000)
(f) Grain processed by Controlled System [(c + d) - e]	1,733,176	3,574,441	5,307,617	576,473	5,884,000
(g) Human consumption	5,650,000	5,110,000	10,760,000	1,490,000	12,250,000
(h) Grain processed by Controlled System as a percentage of human consumption (f-g)	30.7 percent	69.9 percent	49.3 percent	38.7 percent	48.0 percent
(i) Grain processed by non-controlled system as a percentage of human consumption (100%-h)	69.3 percent	30.1 percent	50.7 percent	61.3 percent	52.0 percent

*Only data for all cereals was available, therefore the proportion of durum, bread wheat, and others was assumed to be equal to the proportions of COCEBLE.

**Estimated to be 1.5 percent for durum and 2.7 percent for bread wheat, based on the figures for CM.Y 1974-1975 sales from OC centers (the only available data). No data for sales for barley and other cereals was available; these were roughly estimated to be 1.0 percent.

Sources: a,b: Office of Cereals data
d,e,g: BPDA data
c,f,h,i: Calculated

almost 19 percent of the wheat consumption of rural inhabitants. Most of the remainder of the cereal intake of urbanites is composed of centrally processed products, although some poor residents of the cities and large towns reported that some of their semolina brought by relatives or friends from the countryside is processed in small local mills.

Although a centrally implemented fortification program would therefore be fairly effective in urban areas, it would have only limited effect in rural areas. It would probably be least effective in the northern rural areas where most cereal products are milled locally and prepared at home. In the central and southern regions locally processed cereal products constitute a smaller, but nevertheless significant portion, of the diets. Thus, in these probable target areas, coverage would be better than in the norther rural areas but would still be only partial.

Controlled System Prices

We must now consider the cereal prices and how they are determined in both the controlled and noncontrolled systems. This information is essential for deciding whether any of the fortificant cost could be borne by the cereal producers, processors, distributors, or consumers. Information on prices would also help us design the program, for prices are a basic reason for the existence of the noncontrolled system and a major determinant of the flow through the parallel systems.

Controlled System Purchasing Prices to Cereal Producers

The controlled system's prices to cereal producers are determined yearly by Office of Cereals officals in consultation with representatives of other government offices, farmer and miller organizations, and the national bank. The producer prices are announced at harvest time. Base prices are kept uniform during the entire year, throughout the country, with no differentials paid for transportation or storage costs. Fixed premiums are paid for higher quality cereals, and reductions are made for impurities, damaged grains, and insects. During years of shortage, premiums are also occasionally paid during the months immediately following the harvest to encourage early delivery.

The controlled system's cereal prices have maintained extremely stable levels during recent years. Since Tunisia's independence in 1956, wheat prices have been changed only four times and barley prices six times. The 1974 price changes amounted to a 27 percent increase for durum and bread wheats and a 43 percent increase for barley.

The Tunisian Government taxes cereal farmers according to the quantity of cereals they sell to the collection centers. In 1974, this marketing tax amounted to about 7 percent of the base price of cereals. As Table 8.11 illustrates, after the deduction of the marketing tax, the net price to producers is D 5.622/qq for durum, D 5.102/qq for bread wheat, and D 3.701/qq for barley.

Table 8.11

Controlled System Prices to Cereal Producers
(D/qq)

	Durum	Bread Wheat	Barley
Base price to producers	6.100	5.500	4.000
Marketing tax	(0.438)	(0.398)	(0.299)
Net price to producers	5.662	4.102	3.701

The marketing tax and the absence of a price differential to cover transportation costs discourage farmers from selling to the controlled system and increase the flow of grain to the noncontrolled system. Similarly, the uniformity of government prices throughout the year and the lack of compensation for storage costs encourage producers to sell to the government only at harvest time.

During the 1960's, Tunisian base prices to wheat producers were set at levels considerably higher than import prices although Tunisian farm prices were equivalent to or lower than base prices in other importing countries in the Mediterranean region. Then, in the early 1970's, world wheat prices increased dramatically, and although Tunisian prices also were raised in 1974, they remained significantly below the European import price (45 percent below for barley, and 35 percent for bread wheat). In the case of barley, Tunisian farm prices during the 1960's and early 1970's were consistently lower than import

prices, and by 1974 increases in the world price for barley left Tunisian base prices 54 percent below the European import price.

The Tunisian government has kept farm prices at these relatively low levels to prevent significant price increases to cereal consumers. However, these artificially low prices may have discouraged production, taxed the farm population for the benefit of urban consumers, and encouraged the diversion of grain to the noncontrolled system.

Controlled System Cereals Selling Prices to Individual Purchasers

The controlled system prices for cereals sold at collection centers to individuals are the sum of the basic producer price plus a marketing margin to cover the costs of the centers and a transport cost for cereals sold at centers other than the original purchasing site. In 1974 a special subsidy for consumers was deducted from the basic selling price, resulting in final prices of D 6.050-6.300/qq for durum, D 5.450-5.700/qq for bread wheat, and D 3.950-4.200 for barley (Table 8.12). Actual prices varied somewhat from these basic prices depending on the quality of the grain; and higher fees were also often charged for small purchases (less than a quintal) and for long distance transport charges, thus making prices highest in the south. In addition, further price increases of one or two dinars per quintal are sometimes caused by the decreased availability of grain, again particularly in the southern centers.

Controlled System Cereals Selling Prices to Mills

The controlled system grain setting prices to the large mills are based on the desired ultimate retail prices to the consumers. In order to maintain the retail prices at an acceptably low level, the government has effectively subsidized the grain selling prices to the mills and sold the grain to the mills at lower prices than those paid to producers and charged to individual purchasers. A comparison of these various prices is presented in Table 8.13. The data show that the usual subsidy to the mills is from one to two dinars per quintal, although in 1974 the subsidy was reduced to individual producers.

Table 8. 12

Controlled System Basic Cereals Selling Price to Individual Purchases: July 1974 (D/qq)

	Durum Wheat		Bread Wheat		Barley	
	At Purchasing Center	At Other Centers	At Purchasing Center	At Other Centers	At Purchasing Center	At Other Centers
(a) Base purchasing price to producers	6. 100	6. 100	5. 500	5. 500	4. 000	4. 000
(b) Transport cost	-	. 250	-	. 250	-	. 250
(c) Marketing margin	. 440	. 440	. 380	. 380	. 345	. 345
(d) Basic selling price (a+b+c)	6. 540	6. 790	5. 880	6. 130	4. 345	4. 595
(e) Special subsidy	. 490	. 490	. 430	. 430	. 395	. 395
(f) Special selling price (d-e)	6. 050	6. 300	5. 450	5. 700	3. 950	4. 200

Table 8. 13

Comparison of Controlled System Prices to Farmers, Individual Purchasers, and the Large Mills: July 1974 (D/qq)

	Durum Wheat	Bread Wheat	Barley
(a) Base price to producers	6. 100	5. 500	4. 000
(b) Net price to producers	5. 662	5. 102	3. 701
(c) Basic selling price to individuals*	6. 540-6. 790	5. 880-6. 130	4. 345-4. 595
(d) Special subsidized selling price to individuals (a-b)	6. 050-6. 300	5. 450-5. 700	3. 950-4. 200
(e) Selling price to mills	5. 271	4. 726	2. 300
(f) Effective basic subsidy to mills (c-e)	1. 269-1. 519	1. 154-1. 404	2. 045-2. 295
(g) Effective subsidy to mills in 1974 (c-e)	. 779-1. 029	. 724- . 974	1. 650-1. 900

*When price ranges are indicated, the lower price does not include transport charges and the higher price includes transport charges of D 0. 250/qq.

The Controlled System for Processing Wheat: The Large Mills

The annual capacity of each large mill of the controlled system averages about 36,855 tons of wheat input per year, compared with a typical capacity of 876 tons for a small mill.* The large mills operate under the direct control of the Tunisian government. The major features of its control are: (1) the requirement that wheat be purchased only from the government collection centers or from government stocks of imported grain; (2) government determination of the volume and source of each mill's grain purchases; (3) the strict regulation of the prices of grain inputs and the output of processed wheat products; and (4) the government's ability to veto plans for expanding mill capacity. Small local mills do not operate under these restrictions.

The total maximum capacity of the eighteen large mills was about 663,385 tons/year in 1974, an increase of approximately 33 percent since 1968. The size of the individual mills varies considerably, with capacities ranging from about 5000 to over 73,000 tons/year. Office of Cereals officials believe that all of the large mills operated at maximum capacity in 1974, but a comparison of the available capacity data with output revealed actual utilization rates in three Tunis mills of 96 percent, 88 percent, and 83 percent; and rates in three mills outside Tunis of 93 percent, 47 percent, and 36 percent.

The large mills contain standard processing equipment like that in modern American mills, although some operations are still performed manually. The age and efficiency of their equipment varies; some have the most modern equipment available and others rely on older equipment. The Office of Cereals carefully regulates equipment changes in the mills by issuing and withholding permits for the import of milling equipment. Funds for the maintenance and purchase of equipment come from a 5 percent rebate on grain purchases from the Office of Cereals.**

Fortification equipment has little, if any, affect on the operations of the mills participating in the Tunisian pilot project. The fortification takes place

*Capacity estimates for both large and small mills based on operations for twenty-four hours/day, seven days/week. We could obtain capacity data for only six of the eighteen large mills; we estimated the capacities of the remaining mills from output data from each mill. Small mill capacity estimate based on the operation of one grinder.

**Kansas State University. Ibid. Pg. 38.

between the last step in processing and the sacking operations; feeders are installed to the chutes that deliver the wheat to sacks. No extra labor is required to operate the feeders, although quality control personnel periodically monitor them to ensure that they are delivering the proper quantities of fortificant.

Although some millers initially resisted the fortification pilot project, their opposition diminished after the project began and they saw how little fortification affected their own operations. In fact, some millers became outspoken enthusiasts for the program, expressing eagerness to expand it so that it might benefit all of Tunisia's poor.

Large Mill Output Estimates

According to Office of Cereals data, the total output of the eighteen large mills in 1973-4 was about 445,340 tons, including about 208,099 tons of durum semolina and 237,241 tons of bread wheat flout. Since 1957, the earliest year for which data is available, the total output of the large mills has fluctuated considerably. Although the 1973-4 output was the largest on record, it was only 5 percent larger than total production in both 1962 and 1967. The 1974 output of bread wheat flour was, in fact, lower than production in several years since 1957. In contrast, durum output clearly increases during the period (Appendix T).

The lack of output growth in the larger mills suggests that there has been no significant production shift away from the small mills. In fact, since wheat production and consumption have increased significantly, the output of the large mills may be expanding less rapidly than overall production in the small mills.

Appendix U presents the 1973-4 monthly output from each of the large mills. The data show that about 89 percent of overall output was produced in the fourteen Tunis mills, 2 percent in the northwestern mill at Ebba Ksonr, and 9 percent in the three central mills at Sousse and Sfax. Most of the mills produced both durum semolina and bread wheat flour, although a few specialized exclusively or almost exclusively in one product. Monthly production shows considerable variation in many cases, suggesting that these facilities are either not fully used or suffer from various inefficiencies hampering output. These fluctuations and possible inefficiencies might prevent effective implementation of a fortification program, for they could make it difficult to deliver quotas of fortified products on time.

Office of Cereals officials also made available to us detailed data on 1973-74 monthly deliveries of wheat products from each mill to the gouvernorats and their various delegations.* This data, shows that the northern region received almost all of its wheat products from the Tunis mills (although Lekef received much of its wheat products at Ebba Ksonr, which is within the gouvernorat). The central and southern regions received somewhat less of their deliveries from the Tunis mills, but they still produced over half of the processed products for these regions. A summary of the source of the deliveries to each gouvernorat is presented in Table 8. 14. This data, as well as the statistics concerning the deliveries to each delegation within the gouvernorats would help planners design a centralized fortification program, for they would enable fairly precise targeting of specific geographical groups, reducing program costs by decreasing excess coverage. That is, if certain gouvernorats or even delegations were designated as target groups, fortification could be implemented only through the mills which supply those areas.

Estimates of Wheat Inputs into the Large Mills

The most accurate way to evaluate the proportion of total wheat consumption processed by the noncontrolled system is to compare wheat inputs into the large mills with total consumption. For the years 1965-70 this analysis was presented in Table 8. 9, which showed that an average of 41 percent durum consumption, 93 percent of bread wheat consumption, and 54 percent of barley consumption was processed annually by the central mills. For the years since 1970, data on the actual inputs into the large mills could not be obtained, although estimates can be derived from output data. But because the extraction rates used in the mills are not uniform, it is impossible to calculate the exact quantity of wheat inputs; only rough estimates can be made.

Using the extraction rates recommended by the government (83 percent for durum and 77 percent for bread wheat), we estimated wheat inputs for 1971-74; these results are presented in Table 8. 15 and compared with BPDA estimates of total consumption.

*Until 1974, Tunisia was divided into thirteen gouvernorats (equivalent to American states) which, in turn, were subdivided into delegations, equivalent to American counties. In 1974 the boundaries of the various units were altered, but the basic governmental structure remained the same.

Table 8. 14

Percentage of Deliveries of Wheat Products to Each Gouvernorat from Different Mills, 1973-4

Source of Deliveries	Mills in Northern Region		Mills in Central Region	
Region	Tunis (14 mills)	Ebba Ksour (1 mill)	Sousse (2 mills)	Sfax (1 mill)
Northern Region				
a. Tunis, Nabeul Bizerte, Beja, Jendouba	almost 100	--	--	--
b. Le Kef	38	62	--	--
Central Region				
a. Sousse	62	--	37	--
b. Sfax	71	--	9	22
c. Kairanan	56	--	44	--
d. Kassenne	32	48	20	--
Southern Region				
a. Gafsa	82	12	6	1
b. Gabes	97	--	3	--
c. Medenine	92	--	8	1

Source: Office of Cereals data, presented in Statistical Annex to this chapter.

Table 8.15

Estimates of Proposition of Consumption of Wheat Processed by Large Mills, 1971-4 (tons)

	Durum Wheat			Bread Wheat			Total, Both Wheats		
	Output of processed products	Input of grain	Input as a percentage of consumption	Output of processed products	Input of grain	Input as a percentage of consumption	Output of processed products	Input of grain	Input as a percentage of consumption
1970-1	189,700	228,557	59	160,800	208,831	61	350,500	437,385	60
1971-2	164,500	198,193	52	201,400	261,558	68	365,900	459,751	60
1972-3	176,400	212,530	41	214,400	278,442	70	390,800	490,972	54
1973-4	208,099	256,710	45	237,241	314,560	62	445,340	571,270	53
Average			49			65			57

The estimates of the proportion of consumption derived here for 1973-4 are somewhat higher for durum and lower for bread wheat than the analysis based on grain purchases by the controlled system in 1973-4 and presented in Table 8. 10. These differences may reflect the use of the wrong extraction rates in this analysis or inaccurate official estimates of the various other items. Other factors might be the timing of processing and the possible carryover or storage of grain stocks; that is, the data concerning the actual amount processed in 1973-4 might differ from the figures for the purchase and use of grain in the controlled system. Yet despite some data differences in the two analyses, their results are similar in magnitude; thus, this comparison of estimates derived in different ways confirms that the controlled system processed only about half of the wheat consumed during 1973-4. A fortification program implemented only in the large mills would therefore not reach about half of the wheat consumed, the proportion which is milled in the small local mills.

The Distribution of Wheat to the Large Mills

The Office of Cereals determines the quantity of grain processed by each mill in response to requests submitted by mill officials. The Office also names the particular central storage facility from which the mills obtain each shipment. Although the mills are all located near some of the main storage facilities, grain reportedly must often be obtained from more distant centers, resulting in extra transport costs to the mills. This inconvenience is most frequently a problem for the four mills outside Tunis, although the Office of Cereals partially compensates them for extra costs.

The mills report frequent delays in obtaining grain supplies because of occasional shortages of transportation facilities. There are no bulk handling facilities presently available, so the grain is transported in sacks. There is little, if any, mechanical equipment available for handling these sacks, although chutes are usually used when the grain is headed to lower levels. The sacks are handled manually by mill workers who carry the 50-100 kg (110-220 lb) sacks on their backs.

At the mills the sacks are stored inside buildings or small silos or outside in covered shelters, under tarpaulins, or in covered, open-air spaces. Most mills reportedly have inside and outside storage space for ten to twenty days' production, although they generally keep less than that in storage.

The Extraction Rates Used in the Large Mills

The Office of Cereals determines the official extraction rates for wheat milling by the large mills. These rates apparently serve as recommended maximum rates; each mill chooses its own actual rates. The official extraction rates are about 82 or 83 percent for durum semolina and 77 percent for bread wheat flour. The actual rates used for durum range from about 77 percent to 95 percent, although most mills probably use rates falling between 80 and 90 percent.* For bread wheat flour, extraction rates range from about 70 to 80 percent, the maximum rate at which the flour retains its white appearance.

By using higher extraction rates a mill can produce more from a given wheat input. However, products milled at the lower extraction rates, particularly bread wheat flour, are of higher quality, and the controlled pricing system does allow some price differential for quality variations. Some consumers greatly prefer the products milled at the lower rates - bread wheat flour is whiter and semolina seems purer and "cleaner." In fact, retailers and consumers display a keen sensitivity to the type of flour and semolina produced by each mill. They look on the products from some mills with great favor, while some say that they would never buy the products of certain other mills.

Wheat products milled at the higher extraction rates retain much more of their original nutritive value. At lower rates, the proportions of protein, fat, fiber, vitamins and minerals decrease. The exact rate of nutritive-value change varies according to the type and grade of wheat and milling techniques.

In order to assure the maximum effectiveness of a fortification program and to eliminate unnecessary fortificant expenditures, the extraction rates used in the

*However, one milling expert recalls an occasion when 103 kg of semolina were produced from 100 kg of durum, an apparent extraction rate of 103 percent. It was surmised that water or other foreign materials were added to the output. The data concerning extraction rates was obtained from interviews with officials from seven individual mills and with processing experts from Tunisia and other nations.

mills might have to be standardized. An alternative potentially less objectionable to millers would be to require individual mills to use the same rate each day, to calculate different add-rates appropriate for the extraction rates in each mill, and then to gauge the fortificant feeders accordingly.

The Products of the Large Mills

When the mills receive wheat, the shrunken and broken grains are usually culled and often sold as animal feed. Milling offals, the by-products consisting mainly of bran, are also generally sold for use as animal feed.

Mills usually produce several grades of bread wheat flour. The finer grades are sold mainly to bakeries for use as pastry and cake flour, and the less fine grades are used in breadmaking. There is a much greater variety of durum wheat products - individual mills produce as many as seven different grades. Several of the finer grades are used as flour in the preparation of durum cakes, breads, and pasta. The various rougher grinds go into manufactured couscous and are sold for homemade couscous.

Large Mill Margins and Selling Prices for Processed Products

The Office of Cereals strictly controls the margins and profits of the large mills. The Foocie allows the mills a "fixed grinding margin," a set amount to cover the cost of operations and profit. The margin was fixed at D 0.525/qq from 1948 until the early 1970's, when the level was raised slightly. During the 1960's this margin was considered generous and, in fact, was accuesed of encouraging inefficiency and the expansion of the noncontrolled system (Dahl, 1972). By 1974 the millers were complaining that the margin was not generous enough to cover rising costs. This dissatisfaction suggests that it would be highly improbable that the Tunisian government would require that any of the costs of fortification be covered by a reduction of these margins.

The selling prices for processed wheat products from the large mills are also determined by the Office of Cereals. Different prices are set for each of the various grades of milling. For example, the rougher grades of semolina are sold at D 7.600-7.960/quintal depending on the grade, and the finer grades are priced at about D 6.900.

The Controlled System Distribution of Processed Wheat Products

An analysis of the distribution system for centrally processed wheat products is essential in order to name their consumers and define the extent to which target groups could be reached through the system. In addition, a description of the present system will help us evaluate any changes necessary for the implementation of the fortification program.

There are two main types of channels through which the processed wheat products are distributed: wholesale/retail channels and government food distribution. The operations of the various distribution channels included in these categories, and their relation to the other components of the controlled system, are diagrammed in Figure 8.1 and explained in the following discussion.

Wholesale and Retail Distribution

Most of the bread wheat flour produced by the large mills is sold to bakeries for the production of "French" bread and other breads, cakes, and pastries. A portion of the flour is also sold to wholesalers and retail merchants, whose customers prepare their own bread dough at home and have it baked in local bakeries.

Most of the large mills' semolina output goes to wholesalers and retailers, who resell it in small quantities to consumers preparing their couscous at home. The remaining semolina output is sold to factories which produce pasta, crackers, cookies, and ready-made couscous.

No current, reliable data numbers the bakeries, factories, wholesalers, and retailers that purchase processed wheat products. However, in the late 1960's it was estimated that there were 1412 bakeries, 32 major pasta and/or couscous factories, 10 main manufacturers of crackers and cookies, and from 4500 to 6500 small and medium-sized retail stalls or shops.* In addition, several large department stores sell food products in the main cities, and regional consumer cooperatives operate in several gouvernorats.

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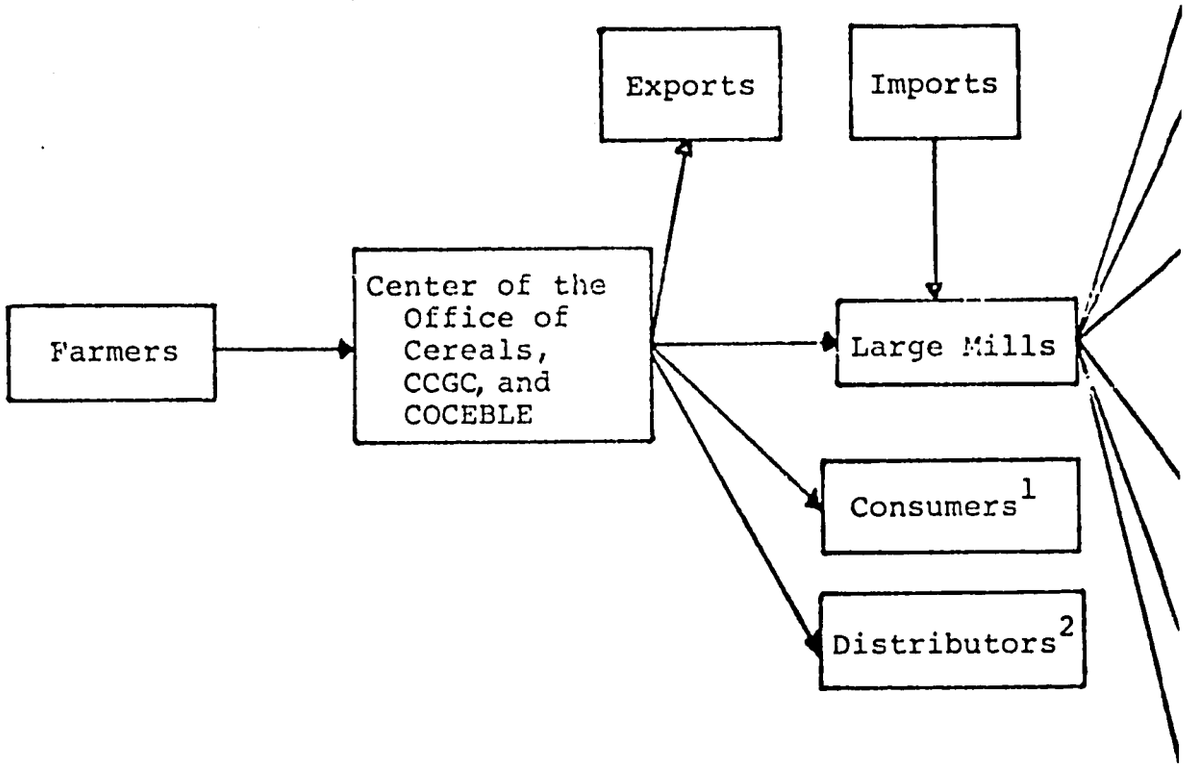
*International Milling Company, Ibid. Pg. 46.



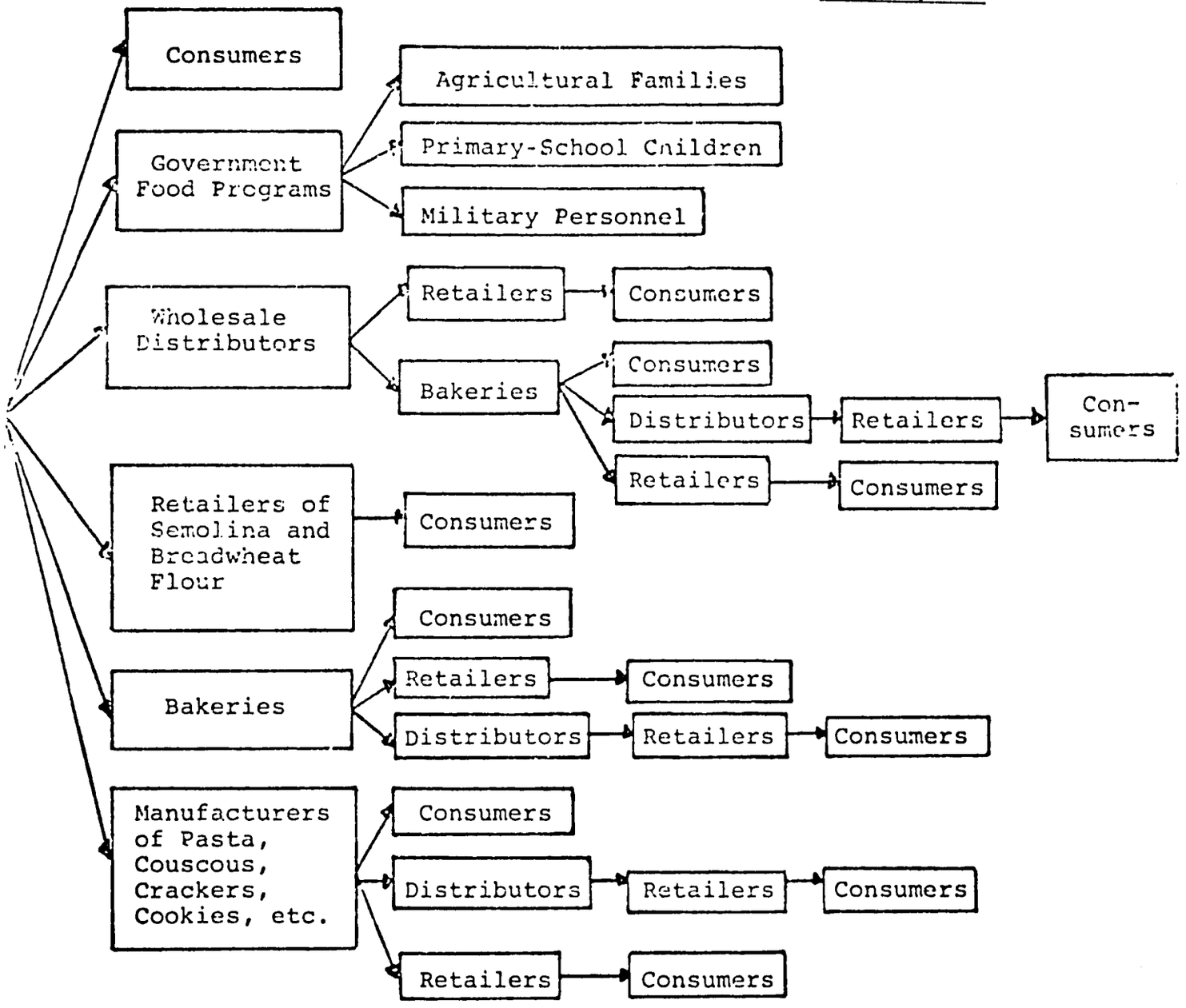
Note: Solid lines denote sales.

[1] Purchasers of grain from the collection centers have the grain part of the noncontrolled system.

[2] Grain sold to distributors becomes part of the noncontrolled system; of these distributors.

Figure 8.1

The Controlled Distribution and Retail System



processed at small local mills, which are defined as

see Figure 8.2 for a diagram of the transactions

Most of the large mills set a minimum limit on the quantity of flour and semolina any one consumer can purchase. The limit at one mill was 10 quintals (1 ton), while another mill's minimum quantity was 0.5 quintal (50 kg). The flour and semolina are sold in 50-100 kilo sacks, and are generally repackaged by wholesalers and retailers into smaller lot sizes that better suit the needs of their customers. Some retailers repackage semolina into sacks of as little as 1 kg each; others allow their customers to measure out the exact quantity they need.

Some mills extend credit for most of the purchase value. One of the largest mills reports giving thirty days for repayment with no interest charges. Purchasers must pick up the products and provide their own transportation, but distributors who must travel long distances reportedly receive a freight subsidy from the government to equalize their costs and margins.

After placing their orders, buyers must usually wait several days before picking them up. Several distributors report waiting a week or more for their purchases. Other wholesalers and retailers say that the mills in the central region cannot produce enough to fill all their orders; thus, they have to accept smaller quantities then they want or travel to Tunis to fill their orders.

Supply limitations at the mills lead to retail shortages. Numerous consumers, particularly in villages and small towns, report that their local retail stores run out of semolina and bakery bread and cannot meet customer demand. In one farming town near Tunis without a bakery, bread is brought in from other towns; the supply is always inadequate and is depleted every day before customer demand is satisfied. Other villages with no bakeries are less lucky: they purchase supplies of bread at all.

When customers cannot obtain enough semolina, they often eat more pasta. Thus, they do not change the quantity of centrally processed products they consume; so if these products were fortified, a reduction of coverage for these consumers would not be likely. However, when bakery bread is unavailable, families generally make homemade tabura bread. Although this product can be made from centrally processed durum, it is almost always made from locally ground wheat. A shortage of bakery bread therefore does decrease the

consumption of centrally processed products and divert consumers to the noncontrolled system. If fortification were implemented only through the large mills, this diversion would have undesirable nutritional consequences for some groups.

Distribution through Government Food Programs

Government food programs distribute a small proportion of the wheat processed by the large mills to certain groups. These programs include a Food for Work program, the feeding of preschool children in municipal centers, a primary school lunch program, and the distribution of powdered milk and weaning foods through maternal/child health centers. In addition, the government distributes semolina and bread wheat flour to the military for its soldiers.

Although the Tunisian government now supplies most of the food for these programs, in the past it was provided mainly by the United States PL 480 Title II program, with a smaller quantity donated by the World Food program. Contributions from these sources have declined dramatically in recent years; for example, Title II grain imports averaged 85,969 tons in 1970 and 1971, but dropped to an average of 4,442 annually from 1972 to 1974.

The largest government food program is the Food for Work program, the "Lutte Contre le Sous - Developpement" (LCSD) or "Fight Against Underdevelopment." Initiated in 1958, the program has no explicit nutritional goal but aims to provide jobs for the unemployed, raise agricultural production and train workers. The participants are usually given a daily wage of semolina (usually 1.5 kg) as well as a cash payment which averages about D 0.200 per day. In 1974 the total value of the food and cash wages were estimated to be about D 0.500 per day, four-fifths of the minimum wage in agriculture.* At its peak in 1962, the LCSD program employed 231,870 workers and distributed 108,156 tons of semolina. By 1972 there were only 200,000 participants, less than 2.5 percent of the agricultural workforce, and the quantity of semolina distributed was 21,000 tons.

*IBRD. The Economic Development of Tunisia, Macro-Economic Aspects. Pg. 44.

In 1973-4 the LCSD program distributed a total of 15,487 tons of semolina. The two least prosperous gouvernorats in the central region, which include about 14 percent of the country's population, received 22 percent of these shipments. The three southern gouvernorats, which include another 14 percent of the country's inhabitants, received 26 percent of the distributed semolina.

This semolina is milled in the large mills and thus could easily be included in any fortification program. In 1973-74 eleven of the eighteen large mills processed the LCSD semolina, and precise data on which mills handled the semolina for each gouvernorat and delegation is available. Therefore, if a fortification program were to cover only certain areas of the country, it would be relatively easy to fortify only the semolina designated for these locations.

The only institutional feeding program which distributes significant quantities of wheat products is the primary school lunch program, which in 1973-74 reached 525,000 children aged 6 to 12 years. About 422 tons of flour distributed through this program was milled in the large mills in 1973-74; in addition, some wheat flour imported under PL 480 Title II was also included in the program. The wheat milled in Tunisia would be automatically included in a centrally implemented fortification program, although special provisions would have to be made to fortify the imported flour before its distribution. However, the necessary provisions would probably not be complicated or costly. It might be possible to fortify this flour with the equipment designed for the fortification of products milled in Tunisia.

The Production and Consumption of Bakery Products, Pasta, and other Manufactured Wheat Products

The production of bakery products (mainly bread) and ready-made couscous expanded significantly since the early 1960's, and the production of pasta also shows moderate increase. Reliable data concerning the output of these and other manufactured wheat products are not available, but the Tunisian government estimates that since 1963 the production of bakery goods expanded 65 percent to a 1974 level of 285,000 tons, while the output of pasta products, which was about 50,000 tons in 1963, increased to only 54,000 tons in 1974. The level of

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* Data for 1962 from A. Grissa, Politiques Agricoles et Emplor: Etude de Cas: La Tunisie OECD: Paris, 1973. Pg. 161. Data from IBRD op. cit.

couscous production is less clear, but it is certain that during the late 1960's and early 1970's total output expanded dramatically in response to increasing consumer preference for convenient, time-saving foods.

No one has made a detailed analysis of changes in per capita consumption of manufactured wheat products during the last decade. The only rigorous attempt to analyze consumption patterns of these foods was undertaken as part of the 1965-68 Food Consumption Survey. The survey data, which are presented in Table 8.16 are still very useful because they show that a significant portion of the wheat diet of the entire population is consumed as manufactured wheat products. At least 65 percent of the wheat intake of urban people is provided by bakery bread and pasta in central urban areas. Probably almost all of the rest is centrally processed semolina, ready-made couscous, and other manufactured products such as crackers and cookies. In poorer urban areas, part of the remaining 35 percent of wheat intake is probably consumed as locally milled wheat from the countryside. Nevertheless, a centralized fortification program would achieve almost total coverage of the grain diets of the central urban areas and would reach most, but not all, of the wheat diets of the residents of the poorer urban fringe areas.

In the rural areas manufactured wheat products constitute a less significant, but still important, component of the wheat diet. In small towns and villages, about 36 percent of the wheat diet is provided by bakery bread and pasta. In dispersed rural areas, the proportion is almost 13 percent. In both areas, some of the remainder of the wheat intake is provided by manufactured products. Thus, a centralized fortification program would reach part of the wheat diets of rural inhabitants. For some residents of villages and small towns, a majority of their wheat products might be fortified although less than half of the wheat diet of dispersed rural families would be reached. Therefore, if rural inhabitants were the prime target of fortification, it would be essential that the fortification be implemented through the small mills.

Table 8.16

Food Consumption Survey Analysis of Per Capita Consumption of Manufactured Wheat Products (1965-1968)

	Urban		Rural						Total	
	Cities and large towns		Small towns, villages		Dispersed inhabitants		Subtotal, rural		Urban and rural	
	kg	Percentage	kg	Percentage	kg	Percentage	kg	Percentage	kg	Percentage
Bread from bakeries	58	45	31	23.3	10	6.0	16	10.4	27	18.4
Pasta	24	18.6	17	12.8	11	6.6	13	8.4	15	10.2
Other wheat products[a]	47	35.4	85	63.9	146	87.4	125	81.2	105	71.4
Total	129	100	133	100	167	100	154	100	147	100

[a] Both manufactured and homemade.

Source: Institute National de la Statistique. La Consommation et Les Depenses de Menages en Tunisie 1965-68. Pg. 393.

Controlled System Distributors' Margins and Retail Prices for Processed Wheat Products

The Tunisian government determines the margins for the distributors and manufacturers of processed wheat products and the retail prices for manufactured wheat items distributed within the controlled system. Because the retail prices are an important political issue, the government rigorously enforces its regulations and most distributors adhere to them. Because the distributors are accustomed to operating in a regulated system, we can safely assume they would not strongly oppose the imposition of some additional controls for a fortification program.

Retail prices for processed wheat products are kept very stable and have only been changed a few times since 1963. Similarly, prices for most products increased only about 10 or 20 percent from 1963 to 1974. In 1974 the retail prices per kg for major products were as follows: coarse semolina, D 0.085 (19.8¢); fine semolina, D 0.080 (18.6¢); breadwheat flour, D 0.104 (24.2¢); ready-made couscous, D 0.104 (24.2¢); pasta, D 0.100 (23.3¢); and bakery bread ("French bread"), D 0.055 (12.8¢).

The government maintains the lowest possible retail price for wheat products to ensure that even the poorest groups can afford them. These retail prices are also considered to have important political significance, and the government is reluctant to anger the main purchasers of processed wheat products, the urban population. For these reasons, it is improbable that the government would permit much of the cost of fortification to be covered by retail price increases for the fortified products.

Many observers think that the retail prices for wheat products are set at artificially low levels. These critics contend that urban consumers receive the main benefits of the controlled prices at the expense of the rural population, particularly wheat farmers. Other observers take the opposite view, thinking that the retail prices for wheat products are set too high. They offer the existence of the noncontrolled system as proof of their contention.

In fact, both of these views are sometimes valid and sometimes invalid, depending primarily on the season and the section of the country one talks about. For example, in the northern region, wheat prices in the noncontrolled

system stay so low through most of the year that it is usually cheaper to make wheat products at home than to purchase them. In the central region, this is true during the summer and fall, but in winter the supply of grain in the noncontrolled system diminishes and prices increase. Then it is cheaper to purchase processed products from the controlled system. Similarly, in the south there is little grain available in the noncontrolled system and grain prices are high most of the year, so buying from the controlled system is more economical.

The Participants in the Controlled System

The market for the processed wheat products of the controlled system can be divided in five ways: by product, by income group, by region of the country, by season of the year, and according to whether the consumers live in rural or urban areas. Although all Tunisian families consume some centrally processed products, the exact proportion of their diet represented by these items varies according to each of these five dimensions.

Because of the complexity of their interaction, it is difficult to summarize consumer participation in the noncontrolled system succinctly. However, a brief description of the main participants is presented in Appendix V. As it shows, most of the wheat products consumed in the central urban areas of the north are centrally processed products. This is also true for most of the nonagricultural, middle- and upper-income families in small cities, towns, and villages. In the poorer fringe areas of Tunis, families consume bakery bread made with centrally processed flour, but some of their couscous and other semolina dishes are made with locally processed semolina obtained from friends or relatives outside the city. Nevertheless, a centralized fortification program would result in coverage of most of their wheat diet. However, for northern rural families, the poorer inhabitants of villages, towns, and the fringe areas of other cities, fortification of centrally processed products would be highly ineffective. Most of the wheat products they consume are processed in the small local mills.

In the central region, as in the north, the residents of central urban areas, the upper- and middle-classes, and nonagricultural inhabitants of towns and villages consume most of their wheat in the form of centrally processed products. Thus, a centrally implemented program would effectively reach their diets, although the barley they sometimes substitute for wheat would not be reached unless the program also fortified it. In the central rural areas and among the poorer inhabitants of central towns and villages, locally processed wheat and barley are consumed in the summer or fall. In winter and spring, when grain stocks are depleted and prices rise in the noncontrolled system, they turn to more centrally processed wheat products. A fortification program working through the large mills would probably reach most of the grain consumed by these groups for only half of the year.

In the southern region, centrally processed wheat products are widely consumed by all income groups in the cities and towns, and in the villages in the datepalm cases in the region's northwestern section. A centralized program would effectively reach these groups, again with the exception of their barley. The lowland agricultural villages throughout the south grow part of their grain supply and thus purchase most of their centrally processed wheat products during winter and spring. But even then, they eat a great deal of barley, so their fortification coverage would be incomplete the entire year. The inhabitants of the central mountain villages of the southern region, many of whom are almost self-sufficient in grain production would also not benefit from a centrally implemented program because it would reach only a very minor portion of their diets.

The Noncontrolled Wheat Distribution System

The third channel of distribution for wheat in Tunisia is the noncontrolled system; through this channel, together with the controlled system and the on-farm utilization of cereals, all the wheat which is consumed in the country is distributed. Thus, if a fortification program were to be implemented only through the large mills of the controlled system, it would be essential to perform analysis not only of on-farm utilization but also of the noncontrolled system in order to ascertain the proportion of total consumption which would not be reached by a centralized program, and the particular groups of people who would not be included in such a program. Further, an investigation of the reasons for the existence of the noncontrolled system, as well as the government's policy towards the system might indicate the feasibility of modifying or reducing participation in the noncontrolled system so that the designated target groups of a fortification program might be reached by the wheat products of the controlled system. Alternatively, an analysis of the operations of the noncontrolled system would enable planners to decide whether a fortification program might be implemented through the small local mills. Although most nutritionists believe that a decentralized fortification program would not be feasible in most developing countries, if the participants of the noncontrolled system in Tunisia are defined as target groups of a fortification program, then the implementation of the program through the local mills must be considered.

Definition of the Noncontrolled System

Tunisian government regulations specify that all wheat and barley which is not used by the farm family must be sold to the Office of Cereals or to the two government-controlled cooperatives. Thus, on-farm utilization of cereals, narrowly defined to include the use of cereals as seed, animal feed, or as food for the farm family, is clearly legal and is not part of the noncontrolled system. Cereals used as payments in various in-kind transactions are also sometimes considered to be part of the legal, on-farm utilization of cereals; however, although these activities are generally tolerated by the government, they are probably not strictly legal and thus are included as part of the noncontrolled system in this report.

The noncontrolled system consists partly of these traded cereals, but mainly of the cereals which are sold to anyone other than the Office of Cereals and the two cooperatives. This second category includes both the grain which is sold within Tunisia, to private individuals, distributors and retailers, and also the unreported exports of grain, which go mainly over the borders to Algeria and Libya.

The term, the "noncontrolled system" is derived from Tunisian Ministry of Agriculture documents which call this grain the "marche noncontrolle" (the noncontrolled market). Other terms which are frequently used in Tunisia are "le marche tolere" (the tolerated market), "le marche parallel" (the parallel market), and "la commercialisation clandestine" (clandestine sales or trading).

The Size of the Noncontrolled System

There have been no rigorous attempts to measure the size of the noncontrolled system. The most comprehensive analysis was done as part of the Study of the Tunisian Grain Marketing System where the quantity of grain in the noncontrolled system in 1973-74 was estimated by subtracting the quantity of grain purchased by the controlled system plus autoconsumption from total grain production. By this method, it was estimated that the NCS included 283,000 tons of grain, or about 19 percent of total grain availability.* When this estimate is modified by adjusting for changes in stocks and sales of grain from the purchasing centers, the data show that the noncontrolled system included about 319,641 tons of grain, 21 percent of grain availability or 26 percent of human consumption.

A second method of estimating the size of the noncontrolled system is to add the total quantity of grain in the controlled system, including imports, plus autoconsumption; then this quantity can be subtracted from the total availability of grain. For the year 1973-74 this method is presented in Appendix T where three varying estimates of autoconsumption are used, including the analysis from the estimate of the 1965-68 Food Consumption Survey, and data from the Study of the Tunisian Grain Marketing System. According to these three analyses, the quantity of grain distributed through the noncontrolled system equalled from 18-26 percent of grain availability or from 22-32 percent of human consumption of grain in 1973-74.

*Study of the Tunisian Grain Marketing System, ibid., p. 78.

The size of the noncontrolled system (NCS) is thought to very from year to year, depending largely on the size of the harvest, the resulting variations in NCS purchasing prices offered to farmers, and expected sale prices to consumers. The proportion of the total grain supply in the noncontrolled system probably increases during the years of smaller harvests, when the prices to the farmers are higher than the controlled system prices. Conversely, in the years of good harvest, the proportion of grain in the noncontrolled system is thought to decrease, since the NCS purchasing prices are generally lower than the government prices. However, it should be noted that even though the proportion of the grain supply in the NCS may decrease in years of large harvest, the actual quantity in the NCS may not decrease or may actually increase.

The Reasons for the Existence of the Noncontrolled System: Farmer and Consumer Attitudes Towards the Controlled and Noncontrolled Systems

No in-depth research concerning the reasons for the existence of the noncontrolled system in Tunisia has ever been conducted. Therefore, it was decided that one of the main goals of the research conducted for this report should be to define these reasons more precisely and to elaborate them in greater detail. In order to accomplish these aims, a small survey was conducted, in which 226 individuals throughout Tunisia were interviewed; among the survey respondents were 110 cereal farmers, 63 small mill operators, and a variety of other people including cereal wholesalers and retailers, government employees, policemen, small business people, students, factory workers, and people engaged in various service operations. While this survey was not sufficiently refined to provide a precise statistical analysis of the issues under consideration, the interviews do constitute a very valuable source of information concerning the variety of kinds of reasons why wheat farmers and consumers participate in the noncontrolled system. The survey results can be used to help to define more precisely the groups who participate in the noncontrolled system and who thus could not be reached by a centralized program of fortification. The results could also serve as useful guidelines to nutrition planners who might evaluate the feasibility of reducing participation in the NCS and encouraging increased consumption of foods presently fortified in the large mills. Or alternatively, the interview results can assist planners in evaluating the need for designing programs which reach the grain which is not handled by the large central mills but is processed in the small local mills.

The main reasons for the existence of the noncontrolled system and autoconsumption can be categorized into three main types of issues: 1) why farmers sell their grain to the noncontrolled system instead of to the controlled system; 2) why consumers consume locally milled wheat products instead of centrally milled products; and 3) why consumers who prefer locally milled products buy grain from the noncontrolled system instead of from the government purchasing centers.

Why Farmers Sell Their Grain to the Noncontrolled System Instead of the Controlled System

Most Tunisian government officials and foreign experts attribute the presence of the noncontrolled system to the desire of many farmers to avoid paying the government's production tax. This tax, which equals slightly more than 7 percent of the base farm price can be evaded if grain is not sold to the government purchasing centers, but is sold to the noncontrolled system or is used in in-kind transactions. By avoiding this tax, farmers can often obtain a higher net price for their grain in the noncontrolled system than in the controlled system.

The cereal farmers and the small millers who were interviewed in the survey concurred that the avoidance of the production tax and the better prices in the noncontrolled system were important reasons why many farmers sell to the NCS.* However, they also offered a wide variety of additional reasons, some of which were considered to be more important than the tax and price factors. Furthermore, some respondents explained that the prices to farmers are not always higher in the NCS, but because of various factors not related to price, they still prefer to sell to the noncontrolled system.

The survey respondents explained more than 20 additional reasons why some farmers prefer to sell their grain to the NCS. The reason most frequently cited was that the farmers are unwilling to pay the cost of transporting their grain to the purchasing centers. Many farmers do not own any vehicles but have only bicycles, donkeys or camels, which are slow and can carry only one or two sacks (1-2 qq) of grain at a time. For larger loads or for trips of more than a few kilometers, trucks must usually be rented, resulting in out-of-pocket cash expenditures.

*Only cereal farmers and operators of small mills were asked why farmers sell to the NCS. The small millers were judged to be knowledgeable on this subject, since most live in or near farming areas and much of their work is done for cereal farmers.

Several respondents emphasized that it is extremely bothersome to have to look for vehicles, which are usually in scarce supply. Other farmers said that it is impossible to obtain vehicles and thus they can only sell their grain to their local market which is much closer than the nearest government purchasing center.

The reason which was cited by the second largest group of respondents concerned their annoyance at the time-consuming and complex procedures for selling their grain to the purchasing centers, and their unwillingness to wait for the future receipt of their payment. Several farmers mentioned that there are long waits in line at the centers and that there are confusing papers to be filled out and complicated procedures to follow. There was also frequent criticism of the waiting period for receipt of funds which at some centers was reported to vary from 7-30 days and at other centers was said to be as high as 2-3 months. A third factor frequently mentioned by respondents was distance to the government centers; aside from the issues of the cost and availability of transportation, these people think that it is an inconvenience to have to travel more than a few kilometers. These farmers said that they are particularly reluctant to suffer this inconvenience if they have only a small quantity of grain to sell (15-30 sacks).

Some small farmers said that they sell their grain to the NCS because they usually have only a small quantity for sale and they think that it is acceptable to the government for farmers to make small sales, but not large sales to the NCS. Even a few of the larger northern farmers, who generally sell their output to the controlled system said that in bad years when they have only a small surplus, they usually sell it to the NCS.

The farmers and millers also indicated that one of the basic reasons for the sales to the NCS is the higher price which is often obtained. Particularly in years of bad harvest, the base price in the NCS is sometimes higher than the controlled system base price, even before the production tax is deducted. Several other respondents said that they often hold their grain until the fall or winter when prices in the NCS increase to a point which is considerably higher than the controlled system prices, which are held constant throughout the year.

A final factor mentioned by several different farmers was their depts to the government centers. They explained that they sometimes wish to avoid having to make repayments for credit issued by the centers and thus sell their grain to the NCS.

Six other reasons for selling to the NCS which were cited by respondents are as follows: First, many farmers prefer to have frequent small payments for their grain, rather than a few larger payments or a single large payment, which some farmers fear they might spend all at once on unwise purchases. Thus, these respondents prefer to sell to the NCS, where the greater convenience made frequent small sales more feasible. Second, some farmers said that it is much easier to sell to the NCS because the various buyers (distributors, retailers, and consumers) come directly to the farmers to make the purchases; the farmers thus do not have to provide any transportation for the grain. Third, a few respondents said that they do not sell to the controlled system because they dislike going to the "city" to make the sales; they expressed a sense of discomfort with and mistrust of "urban" areas and business which is conducted with city people. Fourth, some growers said that they prefer to dispose of their grain to the NCS because of the convenience of being able to simply trade the grain in the marketplace or at small stores for whatever goods they need. Similarly, other farmers who sell their grain instead of trading it still see an advantage in being able to make their purchases in the same location - the same store or nearby stores. Fifth, a few people said that they do not sell to the CS because they think that the purchasing centers have higher standards for grain and thus more frequently make deductions for low-quality grain. Other respondents thought that the centers almost always make these deductions, regardless of the quality of the grain. By selling to the NCS instead, the farmers thought that they could be assured of payments appropriate to the quality of their grain. And finally, some farmers did not seem to realize that they are supposed to sell to the controlled system. Some said that the only reason for selling to the centers was to make payments for credit extended by the government; since they had received no such credit, they never sell to the controlled system. Other farmers said that they had always sold their grain to the local market or to local commercants (distributors), they weren't sure why they did this but they saw no reason to change their practices.

Although most farmers interviewed said that they sell some or all of their grain to the noncontrolled system, a few farmers explained that they sell part or all of their output to the controlled system. They gave four main reasons for this decision, which are as follows: (1) they had to sell their output to the purchasing centers because they were obligated to repay credit extended by the center; (2) they

are unable to sell most of their bread wheat crop to the NCS, where most of the demand is for durum wheat, so they sell most of their bread wheat to the controlled system; (3) in years of good harvest when the supply of grain is abundant in the NCS, they receive a better price in the controlled system and thus sell most of their output to the controlled system; and (4) it is easier to sell low-quality grain to the noncontrolled system, since the purchasing centers will buy even the worst quality, which merchants in the NCS would not buy since they would consider it difficult or impossible to sell.*

It is clear from all of these explanations that there are numerous reasons why many farmers sell their grain to the noncontrolled system instead of to the government collection centers. It is also clear that most of these reasons are highly rational and derive from farmer dissatisfaction with the way in which the controlled system is designed and functions. Thus, some farmers might change their practices and sell their grain to the controlled system if improvements were made in the operation of the purchasing centers, if there were additional centers and they were more conveniently located, if price differentials were provided to cover transportation costs, if more transportation facilities were available, if the government prices were higher or if taxation were imposed through some other means than on the quantity sales to the controlled system. However, it would be extremely costly to make most of these changes, most likely more costly than the probable expense of implementing a fortification program through the local mills, where this grain is presently being milled. The government could, as an alternative, simply impose stringent requirements that farmers sell to the controlled system; however, this action would probably arouse such vehement opposition in rural areas that the GOT would most likely be unwilling to impose such a policy. Furthermore, the enforcement of this policy would be enormously costly and would require skilled manpower in quantities which are not currently available in Tunisia. Finally, even if the government could afford to provide adequate economic and noneconomic incentives to induce farmers to sell more of their output to the controlled system, another perhaps more serious, usually overlooked,

*Consumers observed in the market displayed a marked sensitivity to quality differences in wheat. There are numerous grades available in the market and purchasers inspected the different grades carefully and often expressed vehement disgust with the lower grades.

problem remains: many consumers prefer locally milled products to those which are centrally milled, for the reasons explained in the following sections.

Why Individuals Consume Locally Milled Wheat Products Instead of Centrally Milled Products

As explained above, most officials and scholars attribute the existence of the noncontrolled system to the desire of farmers to avoid the government production tax and the higher prices which can sometimes be obtained in the NCS. Obviously, this explanation deals only with supply factors; very little attention or concern has been given to the demand aspects, the factors which have led to the creation of consumer demand for the products of the noncontrolled system. An analysis of these demand factors must deal with two major issues: first, the reasons why many individuals prefer locally milled, "homemade" wheat products rather than the centrally milled products of the controlled system; and second, why most consumers who prefer locally milled products and do not grow their own grain purchase their grain in the noncontrolled system rather than at the government purchasing centers. The first of these issues is discussed below and the second is presented in the next section.

As part of the survey, a variety of individuals were questioned about their grain products purchasing and consumption practices and the reasons for these practices. Specifically, they were asked about whether and why they consume controlled system semolina bread and other products or whether or why they purchase or grow their own whole grain wheat; they were also questioned in detail about their perception of the differences between controlled system products and "homemade" wheat products and why they prefer certain products to other items.

The respondents who replied that they consume locally milled products were first asked to explain in detail why they prefer locally milled semolina to centrally processed semolina. The most frequent responses, listed in order of frequency, were as follows:

(a) Reasons Individuals Consume Locally Milled Semolina, Instead of Centrally Processed Semolina

(1) Homemade couscous, made from locally milled semolina, tastes much better than couscous made from government semolina.

(2) Homemade semolina is necessary for certain special dishes. This response was given almost exclusively in the southern region, where whole grain wheat is generally much more expensive than processed semolina. Nevertheless, even poor southern families will purchase wheat for certain dishes which are considered special in the south although they are consumed daily in the northern and central regions.

(3) Homemade semolina makes heavier couscous, which is much more satisfying and filling than couscous made from government semolina, which is too light and nonfilling.

(4) Government semolina has a bad taste; respondents don't like government semolina.

(5) Homemade semolina is cleaner.

(6) Homemade semolina is purer; government semolina is not pure wheat, but is mixed. Many consumers are certain that government semolina is mixed with a ground corn or other relatively less expensive products in order to lower the cost of production. This dilution was permitted in the past but has not apparently been practiced in the past few years.

(7) Respondents are used to locally milled wheat products; have always eaten these products, have no desire to change.

(8) Government semolina is sometimes not available in their area. (Response given only in northern and central regions.)

(9) Homemade semolina is healthier and has more vitamins.

(10) Homemade semolina is fresher.

(11) Local milling gives more flexibility; a variety of grades can be milled, and there is feed left over for the animals.

(12) Local milling enables the consumer to maintain control over the milling grade and the exact grades needed can be produced.

(13) Government semolina is made from low-quality wheat; the consumer has no control over the quality; cannot select the grade of wheat desired.

(14) Government semolina includes imported wheat, which is not as good as Tunisian wheat.

The respondents who said that they purchase centrally processed semolina instead of having their grain milled locally were also interrogated about the reasons for their practices. Their responses are listed below, in order of frequency of the responses.

(b) Reasons Individuals Consume Centrally Processed Semolina Instead of Locally Milled Semolina

(1) Centrally processed semolina is cheaper (response given almost exclusively in the southern region).

(2) People don't want to spend the time necessary to take wheat to the mills and then sift the output at home (the usual practice). People save time by purchasing processed semolina.

(3) At certain times, whole wheat is not available.

(4) In years of bad harvest when low-quality wheat is produced, government semolina is better.

(5) Now people have more money; can afford higher priced government semolina. (Response given mainly in central region.)

(6) Not enough wheat is produced so people must supplement diet with government semolina (response given exclusively in southern region).

(7) Woman are more modern and don't like to bother with having wheat milled and sifted.

(8) Government semolina is better.

(9) Homemade semolina is too heavy.

After being questioned about their consumption patterns, all respondents were asked to describe the differences between homemade couscous made from locally ground wheat and couscous made from government semolina. The interviews show that a large majority of the respondents, even those who buy centrally processed semolina for the reasons listed above, felt that homemade couscous displays more favorable characteristics than couscous made from centrally processed semolina. The respondents described homemade couscous as being tastier, stronger and heavier, purer, fresher, better, more filling, healthier, cleaner, whiter, and coarser, with larger grains. (The responses are listed in order of frequency.) In contrast, the respondents described couscous made from centrally processed semolina as being less good than homemade couscous; bad-tasting; lighter, less satisfying, and less filling; less clean; less fresh; more stick; and less healthy, with fewer vitamins. In addition, couscous made from controlled system semolina was said to have a "different," less good taste; a bad color, which according to some is more yellow, and to others, more black; a similar taste to the taste of homemade couscous; and smaller, finer grains.

In addition to being questioned about their semolina and couscous purchasing practices and preferences, the respondents were also asked whether they make homemade bread from locally milled grain or whether they buy controlled system bakery bread and the reasons for their choices. The individuals who generally make their bread from locally milled grain gave the following reasons: (1) homemade bread is cheaper (response given mainly in northern and central regions); (2) there are no bakery facilities nearby and thus bread must be made at home; (3) homemade bread is tastier; (4) homemade bread is cleaner; (5) homemade bread is purer, wheat flour is not mixed with corn flour, as is the case with much bakery bread; (6) their bakery functions only for limited periods (e.g., during winter for the school lunch program); and (7) homemade bread is preferable - they have always eaten it, are used to it, and see no reason to change their behavior.

The respondents who said that they buy bakery bread rather than making bread at home with locally milled semolina attributed their behavior to six main factors: (1) there is not enough firewood for home ovens to bake homemade bread (response given in central and southern regions; bread is baked in outdoor clay

ovens, fueled by firewood); (2) people have more money now, can afford more expensive bakery bread; (3) women are more modern, do not want to bother baking bread at home; (4) bakery bread is cheaper than homemade bread (response given in central and southern regions); (5) bakery bread is better; and (6) people who live in towns cannot have the outdoor ovens which are necessary for the baking of homemade bread, and thus must purchase their bread from bakeries.

As the variety of responses to all of the above questions indicates, Tunisian consumers display an extremely high degree of sensitivity to the differences between various wheat products and marked preferences, for clearly articulated reasons, for various items. These factors and their influence on consumer behavior, specifically on the choice of whether to buy the processed products of the controlled system or whether to have grain milled locally have been largely ignored by both agricultural analysts and nutrition planners in Tunisia. As can be seen from the answers presented above, most of the respondents, who were primarily from rural areas, towns and from the poorer fringes of large cities, expressed a preference for homemade products made from locally milled wheat. Many of these people thus rarely if ever buy the products of the controlled system. Other people who prefer homemade products still buy processed semolina and bakery bread for a variety of reasons. It is critical that the planners of a nutrition program which uses as its vehicle the processed products of the controlled system understand which groups of people are consuming these products and whether the designated target groups are actually being reached. Alternatively, sensitivity to and understanding of people's attitudes about food is important in order to determine whether their consumption patterns could be changed and how this might be accomplished. Such changes would obviously be necessary in Tunisia if planners hope to reach, through the vehicle of centrally processed products, individuals who do not presently consume these products. The adamant way in which these respondents expressed their preferences suggests that in Tunisia attempts to change their patterns, to induce consumers presently buying whole grain or farm families who grow their own grain, to consume only centrally processed products would be met with great dismay, opposition, and resistance. It also seems clear that after the complete upheaval in the rural sector caused by the socialization attempts of the 1960s, the Tunisian government would be highly unlikely to approve or attempt any program which might again stimulate such resistance and disruption. Thus if the fortification program intends to reach the

large group of people who presently grow or buy grain for local milling, fortification cannot only be performed at central points but must be located at the local level, most likely in the local small mills. Although it is most likely that fortification would be implemented at the point of milling, if it is agreed that fortification through the small local mills is not feasible, it might be possible to add the fortificants, perhaps in the form of tablets or granules, to the grain before it is sold to the consumers. This could most easily be accomplished with the grain which is sold at the controlled system collection centers and, in order to evaluate the probable effectiveness of such a scheme, it would be useful to evaluate where consumers who prefer locally milled products buy their grain and the reasons for their behavior. This information would also be valuable in determining the ease or difficulty with which the consumers who buy from the NCS might be persuaded to alter their buying patterns and buy from the collection centers.

Almost all of the interview respondents said that they purchase their grain in the noncontrolled system - from farmers, from distributors, from markets, or from small retail outlets. Very few individuals who were interviewed purchased their grain from the collection centers even though the prices are often cheaper than in the NCS.* Many were even unaware that such purchases could be made. The people who do buy grain from the centers said that they do this buying only when grain is not available in the NCS, primarily in wintertime.

When asked why they prefer to buy grain from the NCS instead of the collection centers, respondents gave the following reasons:

(1) Much of the government's wheat is of very bad quality. This is partly because the government buys even the worst quality wheat from farmers.

(2) At the collection centers consumers cannot choose the particular quality of grain which they prefer, but must take what the officials give them. However, in the NCS, consumers can carefully select the quality which they want.

*These results were confirmed by the OC records which show that in 1974-75 2,432 tons of wheat were sold to private individuals. This represents far less than 1 percent of total wheat consumed by humans. Data on barley sales from OC centers were not available.

(3) The minimum quantity which can be purchased from the OC is larger than the amount which most consumers want to buy. The minimum quantity limits vary among regions; in the north they are larger according to respondents, as high as 3 qq (300 kg) and 5 qq (500 kg), and in the south, the minimum purchase lots are as low as 1 qq (100 kg) and 10 kg. However, many consumers prefer to buy smaller quantities because they personally must carry the grain home with other purchases or because of limited storage space at home. Other people with limited cash resources must restrict their purchases to very small quantities at any given time. Several of these respondents said that they prefer to buy a gelba (17 kg), a "saa" (4 kg), or even less at any given time. Purchases of this size must usually be made in the NCS.

(4) The nearest collection center does not sell grain to private individuals.

(5) The local center does not always have grain available for sale, but sometimes runs out of stock.

(6) The NCS prices are usually lower than the government prices. (Response given only in the north.)

(7) The centers are too far away; for the farmers selling grain, the markets and stores are much closer. Most respondents specified that distances of over 10 kilometers were considered too far away, but some people were unwilling to travel distances of 5-10 kilometers.

(8) The Office of Cereals insists on cash for all grain purchases, whereas the markets and stores will give credit.

(9) It is very time-consuming and bothersome to buy from the centers; usually buyers must stand in lines, must wait for their orders to be processed, and sometimes must return a second time to pick up their grain.

(10) The controlled system grain is usually very dirty - full of rocks, twigs, and other debris.

(11) Buying from the NCS is much more convenient, since people go frequently to the markets and stores, grain can be bought or traded when other purchases are made. However a special trip must be made to the collection centers, which are often located on the outskirts of the towns.

Thus, as these responses indicate, there are a variety of economic and non-economic reasons why most consumers who buy grain for local milling buy this grain from the noncontrolled system rather than the government centers. Although the GOT could stimulate increased buying from the centers by dropping the price, many of the consumers would still prefer to buy from the NCS; it is improbable that this behavior could be changed without great expense and some degree of coercion, directed towards the consumers, the sellers, or the farmers. However, it seems highly improbable that the Tunisian government would be willing to exert such coercion against any of these groups. Yet, even if the GOT were to attempt to force all farmers, sellers, and buyers to operate through the controlled system in order to fortify at the point of sale, the grain retained for autoconsumption would still not be reached and much of the rural population would still remain unaffected by the program. Therefore, if the rural areas are defined as target areas, it seems imperative that fortification of grain in Tunisia takes place at the local level, most likely in the small mills, as well as the large mills of the controlled system.

The Participants in the Noncontrolled System

There has been considerable speculation about the location of the participants in the noncontrolled system, but there have been no vigorous attempts to provide data to support these theories or to delineate in precise terms the percentage of the overall population or the particular groups who consume locally milled products. However, one foreign expert with extensive experience in Tunisian agriculture has provided some rough estimates of the location of the participants and proportion of grain consumption provided through the noncontrolled system. According to his analysis, in the northern and central regions about 80 percent of the wheat consumed outside the large cities is derived from autoconsumption and the NCS. In the north, about 80 percent of this wheat is probably supplied by autoconsumption with the remainder traded through the NCS. In the center, the proportion of this wheat provided on the farm was probably about 70 percent with the remaining 30 percent derived from the NCS. In the cities, the proportion of

noncontrolled grain is much smaller - about 3 percent of consumption in central Tunis, up to 10 percent in the central areas of the other northern cities, and from 20-30 percent in the cities of the central region. According to this rough estimate, in the south about 90 percent of the grain consumed in rural areas and small towns is either homegrown or obtained through the NCS; the large majority of this grain is most likely derived from the NCS since few areas in the south can grow more than a small proportion of their grain supply. In the central urban areas of the south, it is estimated that about 20-30 percent of the grain is obtained through the NCS.

The limited amount of research which was possible for this study does not enable a more scientific quantitative measurement of the size of the noncontrolled system and autoconsumption. However, during the survey all of the cities of Tunisia, most of the large towns, and over 100 small towns and villages throughout Tunisia were visited. During these visits numerous grain markets and small retail outlets selling NCS grain were observed, and the farmers, distributors, and retailers who handle the NCS grain, as well as the millers and consumers of NCS and homegrown grain, were interviewed throughout the country. These individuals were questioned about the functioning of the NCS and autoconsumption only in their own immediate locale. While these observations and interviews do not permit a precise measurement of the NCS and autoconsumption in each region, they do provide invaluable information which helps to define with greater detail the groups who participate in the noncontrolled system in the different regions of Tunisia.

According to the explanations of the survey respondents and the observations of the interviewers, the following outline of the participants and location of the NCS can be delineated. Most of the grain in the NCS is grown in the small and medium-sized farms in the northern and central regions of the country. The larger farms in these sections sell most, if not all, of their surplus grain to the controlled system. Almost all of the northern farms produce enough grain to supply all of the families' own consumption needs. However, in the central region, many of the smaller farms, especially in the western and southern sections, are able to produce only part of the grain required for the farm families' consumption. Only a small portion of the NCS grain is grown on southern farms, where most families grow enough wheat and barley to provide for only a minor portion of the families' grain needs.

A description of the buyers of NCS grain is much more complex; the participating groups vary not only according to region but also according to a variety of interrelated factors such as means of livelihood, income level, season of the year, cultural practices, personal preference, the size of the crop, and place of habitation.

Appendix U provides an outline of the various groups who participate in the noncontrolled system or consume homegrown grain, as well as those who purchase controlled system products. As the outline demonstrates, in the northern and central regions, NCS and homegrown grain are consumed mainly by the poor on the fringes of the cities and large towns; in small towns, villages, and rural areas these products are consumed by almost everyone, except middle-class employed people and wealthy people not involved in farming. In addition, in the central areas of cities and large towns, some wealthier people bring NCS grain from the countryside for use in special dishes, and middle-class and poor people often obtained NCS grain whenever they visit the rural areas. Furthermore, much of the grain consumed in the southern part of the central region and in the south is barley, which is substituted for wheat in a wide variety of dishes. Much of this barley is also homegrown or purchased in the noncontrolled system.

In the southern region, where NCS grain prices are usually higher than in the rest of the country, the lower income groups generally buy NCS grain mainly in summer or fall, before the prices have risen; in winter and spring, few of these people seem to be able to afford NCS grain except for special occasions. Many rural people grow as much of their grain as possible, but usually must buy a significant portion of their grain supply from the controlled system. There are, however, two main exceptions to these generalizations: (1) the inhabitants of the mountainous villages of the central section of the south; many of these villages are entirely self-sufficient in wheat and barley, and (2) the Bedouins, often nomads, who are said to be wealthy and to purchase all of their grain in the NCS and do their own grinding at home.

Once the exact target groups for a fortification program has been designated, it is essential to evaluate whether they could be reached by fortified controlled system products or whether they can be reached only through fortification through the noncontrolled system. It has been suggested that the target population in Tunisia might be one or more of the following groups: (1) the lower income

population of the southern and central regions; (2) the urban poor throughout the country; or (3) the poor in rural areas and villages throughout the country. As the discussion above indicates, the first category could probably be reached most effectively through controlled system products, although the coverage would be only partial, since a certain portion of the diet is provided by homegrown grain and NCS wheat, particularly in the summer and fall, and barley products are consumed. Furthermore, most mountain farm families, and some lowland farming groups, which comprise a significant portion of the population, would hardly be reached, if at all. If instead a target group were defined to include only the urban poor throughout the country, coverage would be almost complete in central Tunis, but would probably not effectively reach the poor in the poor fringes of Tunis and in the other cities and towns of Tunisia. Finally, if the designated target group were to be the rural poor in the northern and central regions, as well as the south, the effectiveness of fortification through centrally processed products would be almost minimal, since most of the grain products consumed by these groups are processed locally in the small mills. If this third group were designated, it would be imperative that fortification take place at the local level, most likely in the small local mills.

The Tunisian Government's Policy Towards the Noncontrolled System

While published government directives stipulate that farmers must sell the wheat and barley which their families do not consume to the purchasing centers at set prices, in fact, the Tunisian government makes little attempt to enforce this regulation and offenders are punished only in rare circumstances in certain sections of the country. The attitude of government towards this technically illegal "black market" is so relaxed and tolerant that some observers call the NCS the "marche tolere," the tolerated market.

Two high Office of Cereals officials each explained that this tolerance is partly the result of the 1960's cooperatives program, and the hostility and resistance stimulated in rural areas by the government's attempted enforcement of the multitude of regulations concerning the production, distribution, and marketing of grain. Since 1969, when private enterprise was re-established in rural areas, the government has been unwilling to risk stimulating serious opposition in these areas by vigorously enforcing all existing laws. As one high Office of Cereals official, noted for his bureaucratic toughness, explained with a whimsical smile,

"On est maintenant un peu plus souple," (We are now a little more flexible). A second top official elaborated, in a separate interview, that the office does not presently have, nor could it reasonably be expected to obtain the resources which would be necessary to divert the grain from the NCS to the controlled system; there simply are not enough police agents, detectives and vehicles available for this task. Similarly, at the present time the government lacks adequate storage and milling capacity to handle the grain which is presently in the NCS; government storage space is already inadequate and the large mills are operating at close to maximum capacity. The first top official concluded by saying that as long as the NCS remains "small" (presumably its present size), and the large mills have enough wheat (presumably to operate at close to maximum capacity), the non-controlled system will continue to be tolerated.

The Office of Cereals and the police do try to place some restrictions on the trading of grain in the NCS, but these restrictions are unclear and vary according to different regions and different Office of Cereals and police officials. However, the actions which officials generally agree are not to be tolerated are: (1) the unreported exports of grain over the border to Algeria and Libya, unusually in small quantities at night, often by mule or camel over isolated paths where police vehicles cannot follow; (2) the sale of "large" quantities of grain by a single individual; however, the term "large" is left undefined; (3) the movement of grain from one region to another; it is agreed that sellers are allowed to obtain the prevailing price in their region but should not attempt to seek the higher prices of a different region; and (4) charging "unreasonably" (undefined) high prices.

The Office of Cereals and the police do make a limited attempt to enforce these (general) regulations. The Office has a small group of agents (a total of four agents in 1974, according to top officials) who are aided by local police throughout the country. They are particularly concerned with monitoring the known distribution routes where late at night the large and long-distance shipments are usually carried by truck, with the grain often hidden under other goods. When these offenders are apprehended, their grain is usually confiscated and they can be fined up to five times the value of the grain shipment. A high Office official reported that in 1971 about 1,162 qq of grain was confiscated in this manner, and in 1972, 990 qq were confiscated.

The observations of the author of this study confirm many of these statements by top Office of Cereals officials. Grain sellers were seen in the marketplaces of every city of Tunisia (except central Tunis and central Sousse) and in almost all of the towns and villages visited throughout the country. A particularly large grain market was observed in the central city of Kairouan, where in a secluded courtyard reportedly as many as 100 merchants sell grain and where the author saw several hundred sacks of grain awaiting sale. Similarly in Sfax several dozen merchants openly sell a variety of different types of grain; policemen were also observed strolling by ignoring the proceedings. However, in other areas sellers and buyers were not so casual; on an isolated northern dirt road at midnight, the author encountered a group of farmers with about 40 sacks of wheat, awaiting a pickup from a wholesale merchant. They explained that it was necessary to make the sale clandestinely, late at night, in order to avoid being apprehended by the police. The only areas where NCS grain is not generally available is in a few small southern towns, including several where the pilot fortification project was being implemented.

Several policemen and officials of small purchasing centers who were interviewed all expressed approval of grain trading through the NCS and showed sincere sympathy for the inability of "poor" people to pay government grain prices or conform to government minimum purchase regulations. One northern policeman said that he had no orders to stop any wheat sellers or buyers, regardless of the quantity being traded. Another northern policeman said that he confiscates any loads of over 20 sacks, but if the quantities are less than 20 sacks, he explained that the police "shut their eyes" so that the poor people can buy through the NCS the small quantities of wheat which they can afford. This was, he elaborated, the only way that the poor people can survive. Finally, officials in purchasing centers in two central towns expressed almost identical opinions: "If it weren't for the NCS, the poor people would starve."

The farmers, distributors, and retailers of NCS grain described a variety of experiences with the government and opinions about the legality of the noncontrolled system. Some of these individuals thought that only one sack of grain could be traded at a time in their area, while others thought that the sale of as many as twenty sacks would be tolerated. As one Kairouan distributor said, "I know that

it [trading] is against the law, but the government lets us do it anyway since the poor can't afford to buy from the government. The government allows us to trade only small amounts."

In addition, although most traders agree that there are limits on the distance which the wheat can be transported, the opinions on those limits vary. Some distributors said that wheat could only be traded in the local area (within about a 10 km radius), while several others reported transporting NCS grain to areas from 100-150 km away. A few distributors said that as long as they did not cross the boundaries of their gouvernorat they would not usually be apprehended, and several other traders reported that they had been frequently apprehended by the police and had their grain confiscated.

The Noncontrolled Distribution and Retail Systems

The channels of distribution and the system of grain retailing through the noncontrolled system are diagrammed in Figure 8.1. As the figure shows, there are four main ways in which grain becomes part of the NCS. First, some of the grain output from each farm is usually given to the farm workers as wages. Second, a smaller quantity is sometimes used in barter in the local marketplace, stores, or with other farmers. A third channel of only moderate significance is through the Office of Cereals itself; some purchasing centers allow distributors to buy grain which will then be resold through the NCS in markets, retail outlets or to individuals. The fourth channel, which is by far the largest, includes direct sales by farmers to a variety of NCS participants. These include: (1) private individuals who come to the farms; (2) individuals or dealers at border areas who plan to illegally import the grain into Algeria or Libya; (3) owners of souk (market) stalls or boutiques (small retail outlets); (4) individuals through souk stalls and/or boutiques which are owned by the farmers themselves; (5) traders who then resell the grain to souks or through boutiques owned by the traders themselves, to individuals planning illegal export and import of the grain across the border and to other distributors who then repeat any or all of these selling activities.

In some cases farmers provide their own transportation, as when they take their grain to the souks or boutiques for barter or sale, to the Office of Cereals, or to border areas for illegal export. But in many cases transportation is provided by the distributor, who usually picks the grain at the farm and transports

it to other points of wholesale distribution or retail sales. Some traders own their own small trucks, while others rent them for prices reported to be D3.000 for a 10-15 km trip (for a truck with a 23 qq capacity), D4.000 for a 20 km trip, or D0.200 per qq. Other distributors use mules with carts and reportedly pay D1.200-1.500 for a 10-15 km trip; the usual cart capacity is about 12 qq. Some dealers also use horses or camels, particularly for clandestine border trading. The distances travelled by distributors transporting grain vary widely; many traders who were interviewed reported that short trips of up to 30 km were most frequent, while others specialized in trips of from 50-200 km, and some reported that they brought grain from 250-400 km away. While most distributors probably restrict their trips to under 100 km, because they often sell to other distributors who in turn may sell to others, the grain may actually be transported much greater distances - specifically from the northern wheat surplus regions to the deficit areas in the central and southern regions.

One of the government's primary objectives in the controlled grain system is to eliminate these middlemen and prevent them from exploiting farmers and consumers by taking unreasonable profit. While these distributors may, in fact, be exploitative in certain cases, nevertheless they do perform several valuable functions, often in the most efficient and cheapest way presently possible. Their most important function is in providing transportation facilities, which farmers feel unable to obtain or consider too time-consuming and bothersome. And because the dealers usually pick up small amounts of grain from numerous farmers, the dealers are probably able to provide this service at a lower unit cost than farmers with their small lots could obtain. The distributors also are probably more efficient than the government in transporting grain. Not only does the government system suffer from shortages of rail cars and trucks, frequent delays, and sometimes unreasonably long shipping times, but its centralization and inflexibility often result in costly double shipping of grain and other unnecessary extra transportation costs. The distributors also provide other useful services to the farmers, like buying the small lots which the government will not purchase, saving the farmer travel and waiting time, bringing to the farm goods for barter, such as oil, sugar and salt. Finally, the dealers provide an important service to consumers and even to the Office of Cereals by selling small lots of grain, often for credit, to low-income people. One respondent in the southern town of Zarzis explained that this was precisely why some purchasing centers allow grain to be

sold to distributors; the center officials do not want to be bothered with selling the grain in small lots and are not allowed or do not want to provide credit for such purchases.

The souks (marketplaces) are the main retail outlet for NCS wheat and barley. Souks selling grain are located in almost every city and town in Tunisia (except in central Tunis and possibly not in central Sousse), in most of the small towns, and in many of the villages. Most small towns and villages without their own souks are located within about 15 km of another town's souk. Most souks meet on one designated day each week, although some operate throughout the week. The sellers are mainly a combination of professional retailers, distributors who both buy grain from various sources and sell in the souks, and farmers selling their own grain. The number of sellers in each souk varies widely according to the region of the country, the amount of wheat grown in the area, the size of the city or town, and the season of the year. In the summertime in the north, most of the souks seem to have from 10-50 sellers each generally with 2-5 sacks each of grain to sell. Several souks with up to 100 sellers and over 300 sacks of grain were also visited or described. In the central region, there are somewhat fewer souks, but they seem to be almost as large as those in the north - from 10-50 sellers each usually with about 2-4 sacks of grain. There are, however, several particularly large souks in the central region which handle from 500-1,000 sacks of grain at a time in summertime. Even though selling grain in the NCS is not technically legal, the souk sellers are supposed to obtain a selling permit from the government (reportedly at a cost of D3.000-4.000 per year) and pay a selling tax for each sack of grain sold (about D.020 per sack).

Almost all towns and villages have small "boutiques," general stores that sell a variety of goods, such as foods, household items, clothes, and small farm equipment. Many of these boutiques also sell wheat and barley.

Noncontrolled System Prices: Farm Prices, Retail Prices, and Wholesale/Retail Margins

The grain prices in the NCS vary according to the region of the country and the main economic activities within each region. The prices are generally much lower in the north, higher in the center and the highest in the south. Similarly, within each region the prices are lower in the wheat growing areas and are appreciably higher in areas which specialize in other crops or in nonagricultural

activities. The grain prices also vary within each region and economic area according to several other major factors. These include: (1) the season of the year - prices are lowest in the summer after the harvest, and rise significantly in the winter and late spring, as grain stocks are depleted; (2) the size of the crop - prices are lower in the years of large crops and higher when the crops are scanty; (3) the quality of the grain - there is a great sensitivity to quality differences and a wide range of prices offered for the various qualities; (4) the quantity purchased - lower prices are offered for larger quantities (sometimes one quintal, sometimes greater amounts) and higher prices are charged for smaller quantities, such as a wiba (about 33.3 kg), a gelba or themna (about 16.7 kg), and a saa or roboui (about 4.2 kg); and (5) the stringency of government regulation of the NCS - a top Office of Cereals official explained that when Office agents see prices rising "unreasonably" on the NCS, the officials will be more active in controlling and apprehending traders. This sometimes has the undesired effect of pushing the prices up even higher.

In July-August 1974, farmers, distributors, retailers and consumers throughout Tunisia were questioned about current NCS prices for wheat and barley of medium quality in their immediate locale, as well as the prices the previous winter. Data were sought primarily concerning the on-farm prices of grain to private individuals and the retail prices to consumers. These data were judged to be the most relevant for a fortification program, for they can be compared with government retail prices for grain and wheat products and provide information which enables a fuller understanding of consumers' reasons for participating in the controlled or noncontrolled systems and their possible ability or willingness to pay for fortification.

The on-farm sale prices and the retail prices for NCS grain, as well as some prices of OC grain in 83 locales are presented in the Statistical Annex to this report.

Although this survey was very limited it does suggest certain possible issues of importance which should be researched in much greater detail in the future. First, the NCS prices for all grains are indeed lowest in the northern region and highest in the south. Averages of the durum wheat farm and retail sale prices quoted in each region provide one verification of this point. The average summer farm sale price for durum wheat in the north was D5.886/qq, compared to the

central average of D6.525 and the average in the south, D8.145. Similarly, the average summer retail price quoted in the north, D6.342/qq was about 8 percent less than the central average (D6.882/qq) and 17 percent lower than the average in the southern region, D7.595/qq.

Second, in each region the summer farm and retail sale prices for NCS grain seem to be higher than the sale price from the government purchasing centers, as this comparison for average durum wheat prices shows (Table 8.17).

Table 8.17

Comparison of Average Summer Farm Sales Prices, NCS Retail Prices, and Government Prices for Durum Wheat, by Region

(Dinars per quintal)

	Average Summer Farm Sales Price	Average Summer NCS Retail Prices	Average Government Price
North	D5.886	D6.342	D5.922
Center	D6.525	D6.882	D6.420
South	D8.145	D7.595	D7.417

Source: Data from survey results presented in Statistical Annex.

In spite of this apparent price differential, very little grain is sold to individuals from the government centers and most consumers prefer to buy the NCS grain. The reasons for this preference were outlined in the section on the noncontrolled wheat distribution system; the main reasons were that the government grain is considered to be of low quality, the consumers cannot select the grain themselves, and the centers sell only larger quantities than most consumers wish or are able to buy in one purchase.

While government prices seem to be lower than NCS summer prices for durum wheat, for barley the NCS prices seem to be lower. In the central and southern regions, where almost all human consumption of barley occurs, the NCS average summer prices per quintal were D4.185 and D5.332, compared to government prices of D4.200 in the central region and D5.408 in the south.

Fourth, although the survey data for winter prices in the noncontrolled system are very limited, the responses are nevertheless useful, for in all cases they showed a significant increase over the summer prices. In four locations in

the north, winter durum prices in the NCS averaged 16 percent over summer prices, while the NCS barley retail price in three towns in the central region also averaged 16 percent higher than the summer level. In the south, in three locations, the average winter NCS retail price for durum increased 17 percent over the summer average, while the one winter NCS price quoted for barley in the south was 22 percent higher than the summer price.

Finally, the most important price issue is the comparison of the prices of controlled system and noncontrolled system products. Semolina provides the most useful point of comparison, since it is the main product of the small mills and is also a widely consumed controlled system product. In most areas of the country centrally processed semolina costs D8.500 qq. In the noncontrolled system milling fees are generally about D300/qq in the northern and central regions and D.400 in the south. Using the average prices of durum in each region (from Table 8.17) and an estimated extraction rate of 90 percent, the average cost of quintal of NCS semolina can be estimated.* In the northern region the average price of a quintal of NCS semolina in summertime was calculated to be D7.340, about 14 percent less than the price of controlled system semolina. Furthermore, especially in the wheat-growing regions, the wheat prices are generally much lower than the average used in these equations, so the savings from making homemade semolina are much greater. For example, when durum is purchased for D5.500, a frequent price in the northern region, the cost of homemade semolina drops to D6.405/qq, 25 percent less than the price of government semolina. In addition, the consumers usually have the right to retain the offal for animal food or trade them for the milling fee, thus resulting in an even greater savings.

In the central region, using an average summer price for durum of D6.882, the price of a quintal of NCS semolina is estimated to be D7.872, about 7 percent less than the government price for semolina. However, in the south, using the average price quoted of D7.595 and a slightly higher milling fee of D.400/qq, the price of NCS semolina would be D8.830, about 4 percent more expensive than controlled system semolina. Yet when the value of the offal is included in the

*The calculations were based on the following equations: (1) 90 percent x = 1.00 qq; x = 1.11 qq; (2) for the north x = 1.11 (D6.342) + D.300; x - D7.340. The calculations for the south and center were done in a similar manner.

calculation, the NCS price drops somewhat; for example, if the offal could be exchanged for the milling fee, the price for semolina would be D8.430, slightly less than the government price.

In summary, the survey data suggests that during the summer, locally processed semolina is cheaper than government semolina in the northern and central regions. However, in the south the NCS price is generally somewhat higher than the government price, unless the value of the offal is included in the calculations. The limited data concerning wintertime prices in the three regions does not permit this type of analysis. Yet the available data suggest that during the winter, the price of NCS semolina in the north still remains less than the government price, but in the central and southern regions, the NCS price is higher than the price of controlled system semolina.

Wholesale and Retail Margins

Several dealers who only act as wholesalers reported that they usually make from D.200-.500 per quintal of grain transported. For the usual short trips of less than 20 km, the cost of transportation by rented truck ranges from about D.100-.130 per quintal; thus the wholesaler's margin would generally be from D.070-.400 per sack. If longer trips and greater transport charges are involved, the commercants charge higher fees to cover these costs. The distributors' other costs may involve the upkeep of their own trucks, mules or camels; salaries to assistants, and the rental or purchase of sacks to contain the grain.

All of the retailers who were interviewed purchase grain directly from farmers and thus also perform a distribution function. The margins which they reported ranged from about D.200/qq (for large purchases) up to D1.400/qq (when purchased in small lots). The usual wholesale/retail markup seemed to be in the range of D.500-.800 per qq of grain. Retailers reported that they are required to buy a selling permit (at a one-time cost of D3.000-4.000) and pay a selling tax of D.020 per quintal of grain.

These limited data suggest that the commercants, the middlemen of the Tunisian wheat system, are not taking unreasonable profits. In fact, most commercants interviewed had several vocations; most also work as farmers, millers, and retailers, thus suggesting that their activities as middlemen are not particularly lucrative and do not earn them an adequate income.

The Small Mill System for the Processing of Noncontrolled Cereals and Cereals Consumed on the Farm

The distinction between the large mills of Tunisia and the small local mills was precisely defined in the previous sections. In summary, almost all phases of the operations of the 18 large mills are directly controlled by the government, the mills process the controlled system grain, purchased at the official collection centers, and the average capacity of these mills is roughly estimated at 36,800 centers, and the average capacity of these mills is roughly estimated at 36,800 tons/year. In contrast, the small local mills operate without any government controls (except for the granting of initial permits and the collection of taxes), the mills process the grain of the noncontrolled system as well as the grain consumed on the farms,* and the average maximum capacity of these mills is about 876 tons/year, about 2 percent of the capacity of the average large mill.**

The Quantity of Cereals Processed by the Small Mills

In the past, both the Office of Cereals and the BPDA published data concerning the quantity of grain processed by the small mills or other information from which these data could be derived. However, neither the office nor the BPDA, nor any other Tunisian organization, currently publishes or attempts to collect data of this type.

The earliest estimates of the wheat processed by the small mills can be calculated from Office of Cereals estimated of the percentage of production sold to the controlled system from 1962-72. According to these calculations (presented during this period an average of 307,000 tons, 43 percent of all wheat consumed, was processed annually through the small mills; this included an annual average of 260,000 tons of durum, 70 percent of consumption, and 47,000 tons of bread wheat, 15 percent of all bread wheat consumption.

Another estimate of the quantity of grain processed through the small mills is provided by BPDA data for the years 1965-70. These data, estimated that during these years an average of 231,000 tons of durum (59 percent of consumption)

*A small quantity of grain purchased from the government collection center is also processed by the small mills.

**Using the FAO method of calculating, based on 24-hour-a-day operations for 300 days a year.

and 215,000 tons of bread wheat (7 percent of consumption) were processed annually by the small mills. These figures are somewhat lower, but similar in magnitude to the Office of Cereals data for the same years; the OC averages for these years are 286,300 tons of durum (73 percent of consumption) and 39.000 tons of bread wheat (13 percent of consumption). The BPDA also estimates that an average of 46,000 tons of barley (46 percent of consumption) and other grains were processed each year by the small mills during these years. The overall averages for all grains are about 300,000 tons per year, an estimated 38 percent of total grain consumption.

For the year 1973-74 probably the best estimate of the quantity of grain processed by the small mills can be derived from BPDA data on total wheat availability and utilization, combined with Office of Cereals estimates of the quantity of grain in the controlled system. It was calculated that 48 percent of all grains consumed by humans flowed through the controlled system, including 31 percent of durum consumption, 70 percent of bread wheat consumption, 49 percent of both wheats together, and 39 percent of barley and other grains. Although some of the remaining grain may be held in storage at the farm level or ground by hand at home, almost all of the grain not flowing through the controlled system can be assumed to flow through the noncontrolled system and to be processed in the small mills. Thus in 1973-4, about 52 percent of all grain consumed by humans was processed by the small mills including 70 percent of durum consumption, 30 percent of bread wheat, 51 percent of both wheats together, and 61 percent of barley consumption.

Although there is some variation in these different estimates, it seems clear that a considerable proportion of the wheat and other grains consumed in Tunisia is processed through the small mills. The exact proportion cannot be precisely measured with data which are currently available, but it seems safe to conclude that from about 40-50 percent of the wheat and a somewhat higher proportion of the barley consumed each year in Tunisia is processed through the small mills. Compared to other North African countries, these estimates seem reasonable. The UN/FAO estimates that in the mid-1960s, from 20-40 percent of Algerian Wheat and 60-75 percent of the wheat in Morocco and Egypt was processed by small "village" mills. Comparable data for other developing countries where wheat is a

major item of production and consumption were as follows: Lebanon and Turkey, 20-40 percent, Pakistan, 60-75 percent, and Iran and India, up to 85 percent.*

Under a centrally implemented fortification program, with fortification only in the large government mills, this grain processed in the small mills would not be reached. Thus the diets of the consumers of this grain, mainly the rural population and the inhabitants of villages and small towns throughout Tunisia would not be covered by the fortification program. However, since some or all of these groups would almost certainly be defined as target groups of a fortification program in Tunisia, the grains which they consume should be included in the program. The most effective way of accomplishing this aim would most likely be to implement the fortification at the point-of-milling of these grains, in the small local mills.

The Number of Small Mills and Their Locations

No serious attempt has ever been made to determine the number of small mills in Tunisia and their location. Some observers estimate is that there are about 2,000 small mills, based on the common belief that there are about 2,000 villages in Tunisia and every village has one small mill. Most other less casual estimates place the number much higher. The 1970 International Milling Company report estimates that there are from 3,200-3,500 small mills, but offers no explanation of the source of the data or its method of derivation.** The manager of the large mill at Ebba Ksour, a very knowledgeable man with over 30 years' experience in Tunisian wheat milling, roughly guesses that there are 5,000 small mills throughout the country.

The Office of Cereals does have some data concerning the number of small mills; detailed records dating back to the late 1800's show that as of mid-1974 there were 2,404 small mills registered with the Office of Cereals. A top Office official noted that many small mills are not registered, a situation which does not particularly concern the Office of Cereals or the National Guard police. When questioned about the probable number of unregistered mills, the official guessed 500. However, he then offered two example situations for which he had precise data: in the delegation (county) of Kebili, (one of the areas where the fortification

*From UN/FAO, Economics Survey of Modern Flour Mills, ibid., p.6.
**International Milling Company, Feasibility Study, ibid., p. 74.

project is being implemented), he noted that only 3 of 11 small mills are registered, and in Douz, another delegation where fortification is being conducted, only 5 to 12 mills are registered. If these two cases are in any way representative of other delegations (a hypothesis which is impossible to validate with the limited information available), they suggest that less than half of the small mills in Tunisia are registered. Thus with 2,404 registered mills there may actually be at least 4,808 small mills, or more, in the entire country.

Contrary to popular opinion, the number of small mills does not seem to have been decreasing in recent years. Although there is no hard data (because of the high proportion of unregistered mills), the high Office of Cereals official thinks that the number has been increasing. He related that in 1974 the Office received over 500 requests for permission to register and open new small mills. After evaluating the small mill facilities in each area, as well as the demand for local processing, regional officials granted permission for registration to 193 of the requests. Some mills close due to lack of business or other reasons, but there is little data concerning closing; nor is there any data concerning unregistered openings. However in spite of these data gaps, the available Office of Cereals information suggests that the number of small mills has been slowly increasing in recent years.

A major objective of the survey which was conducted as part of this study was to provide a better estimate of the number and location of small mills than the estimates currently available. This was seen as an essential part of the study, for fortification may have to be implemented through these mills if the target groups are defined to include the mills' users, primarily the rural population throughout Tunisia and the lower income groups in most towns and cities. Due to restricted funds, time, and manpower, the survey of mills was limited, but does provide the first detailed, broadly based data about these mills. From this data no solid conclusions can be made, but estimates can be made which are rough but nevertheless more refined than previous guesses can be drawn.

The basic methodology of the survey was to visit a sampling of population centers of all different sizes in each of four areas of Tunisia. In each location several mill users were questioned about the number of mills in their own locale and grinders in these mills. In addition, in about half of the locations mills were visited and the millers were interrogated in detail about their operations and about the other mills in their locale. From the information obtained, the average

number of mills and grinders in the mills was calculated for each size of population center. Then these averages were multiplied by the total number of population centers of each size in each area, to give an estimate of the total number of mills and grinders in each type of population center and in the whole area. From these area calculations, the total number of mills and grinders in Tunisia was estimated.

The information concerning the grinders was collected because some mills regularly process grain in more than one grinder and this data would thus be necessary to calculate the cost of fortification equipment for all grinders which are regularly used. The data on sifters were gathered so that the feasibility of fortifying the grain as it was being sifted, rather than during the milling, could be evaluated.

The four areas by which the data were divided were the northwest, the main wheat-producing area of Tunisia, the northeast, the central region and the southern region. The population centers were divided into eight initial categories: (1) large cities (population over 100,000); (2) medium cities (population, 50,000-99,000); (3) small cities (population 20,000-49,999); (4) large towns (population 10,000-19,000); (5) medium towns (population 5,000-9,999); (6) small towns (population 2,000-4,999); (7) villages (population, 100-1,999); and (8) small villages (population, 50-99). A second analysis was also done with category seven, villages, further subdivided into villages with a population of 200-1,999 and those with from 100-199 inhabitants.

There are several important limitations with this methodology. First, the population data which were used were from the 1966 census, the only sufficiently detailed population data available at the time of the preparation of this report. Second, one can question whether the data classification should be based on the number of inhabitants of "population centers" (cities, towns and villages), rather than the rural population in the surrounding countryside. While the small mills are, in fact, almost always located in "population centers," the number of mills may be more a reflection of the rural population living nearby. The best approach might have been to use a system of classification based on the populations of the centers and surrounding rural areas, but the limited resources available for this research did not permit this further degree of refinement. Third, while the census gives detailed information about the number of villages of different sizes

in each gouvernorat, the exact population of each village was not available. Therefore, calculated assumptions had to be made about the relationship between village size and number of mills. In fact the two different analyses were made in order to incorporate varying assumptions about these relationships in the four areas of the country; in the two estimates the number of mills and grinders were assumed to be different in villages in each area with populations of 200-1,999, 100-199, and 50-99. Fourth, the accuracy of basing the analyses on inhabitants, estimates of the number of mills in their locale can be questioned. However, most respondents displayed a high degree of assuredness, answered quickly, and could almost always relate the exact location of each mill.* A few respondents admitted that they did not know about all the mills, and the responses of others who displayed hesitancy or uncertainty, or who gave answers highly inconsistent with other responses, were not used in the analyses. Finally, where there were more than a few mills, most respondents did not know the exact number of grinders in each mill; they usually could count the grinders in one or two of the mills. For the mills for which the respondents could not remember the exact number of grinders, the mills were assumed to have one grinder. Therefore, the estimate of the number of grinders can only be interpreted as a minimum number, and there are probably many more grinders in the small mills.

During the survey a total of 136 locations throughout Tunisia were visited. Thirty were in the northwest; 38 in the northeast; 32 in the central region, and in the south, 36 locations were visited.

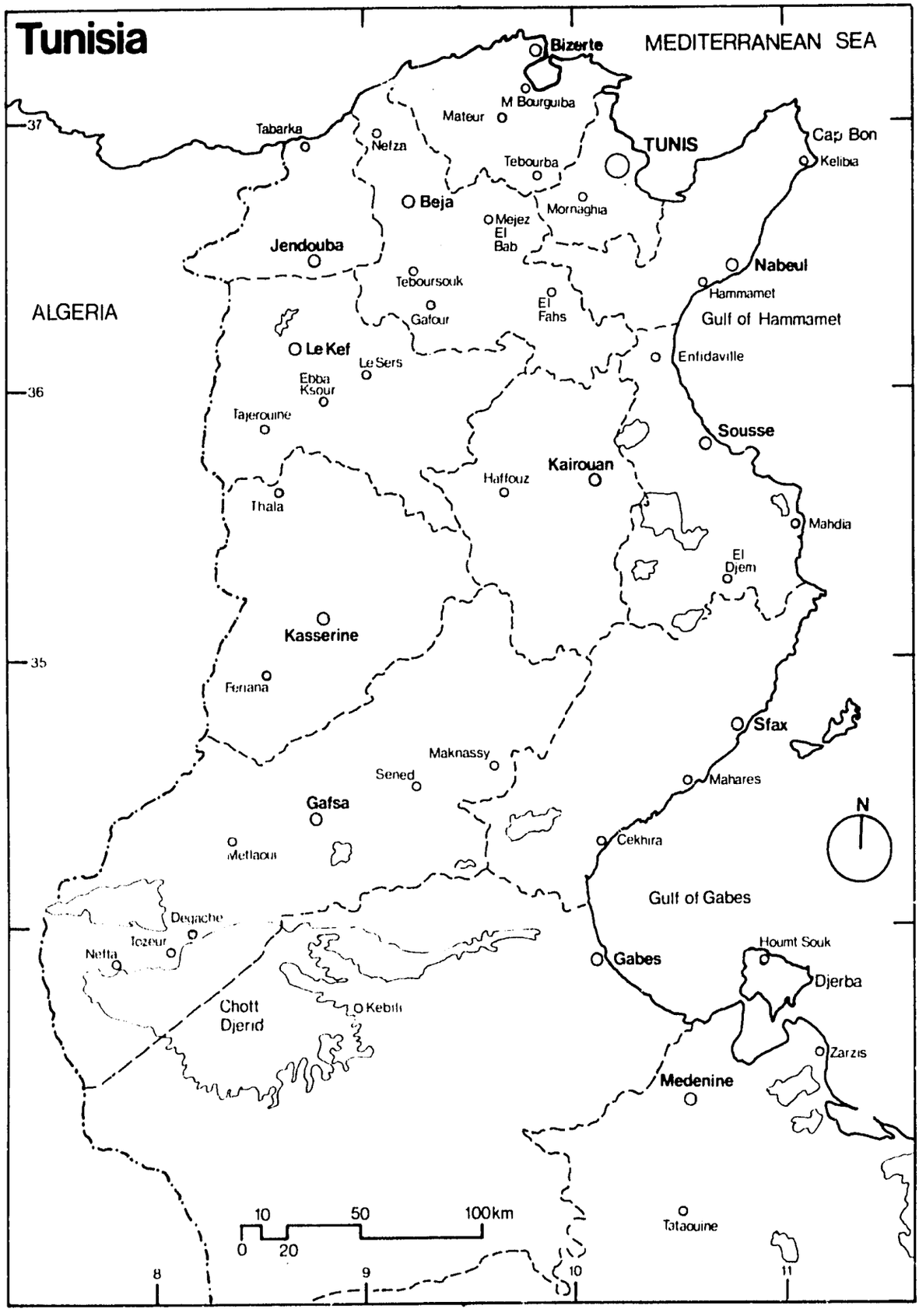
Maps of Tunisia are presented in Figures 8.2 and 8.3.

In the first estimate, all of the villages visited were assumed to have a population of 100-1,999 and the projection of total mills and grinders was based on the findings in the villages visited.** In addition, it was arbitrarily assumed that in the northwest 50 percent of the villages with populations of 50-99 have one mill with one grinder; in the northeast and in three gourvernorats of the central region,

*The one exception was Sfax, where the large size of the city plus the large number of mills made it impossible for inhabitants to estimate accurately the total number of mills. The answers ranged from 40-100, and some of these mills grind no wheat or barley. Therefore, the estimate of 25 used in the analysis should be considered an extremely rough guess.

**However, in fact the limited village population data available showed that a few of the villages visited had populations of less than 100. Some of these smaller villages also had mills.

Figure 8.2


Tunisia
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Bizerte
M Bourguiba
Mateur
Tabarka
Nefza
TUNIS
Cap Bon
Kelibia
Tebourba
Beja
Mornaghia
Mejez El Bab
Jendouba
Teboursouk
Nabeul
Hammamet
Gulf of Hammamet
ALGERIA
Gafour
El Fahs
Le Kef
Le Sers
Enfidaville
Ebba Ksour
Tajerouine
Sousse
Kairouan
Haffouz
Thala
Mahdia
El Djem
Kasserine
Feriana
Sfax
Maknassy
Sened
Mahares
Gafsa
Cekhira
Metlaoui
Gulf of Gabes
Degache
Tozeur
Nefta
Gabes
Houmt Souk
Djerba
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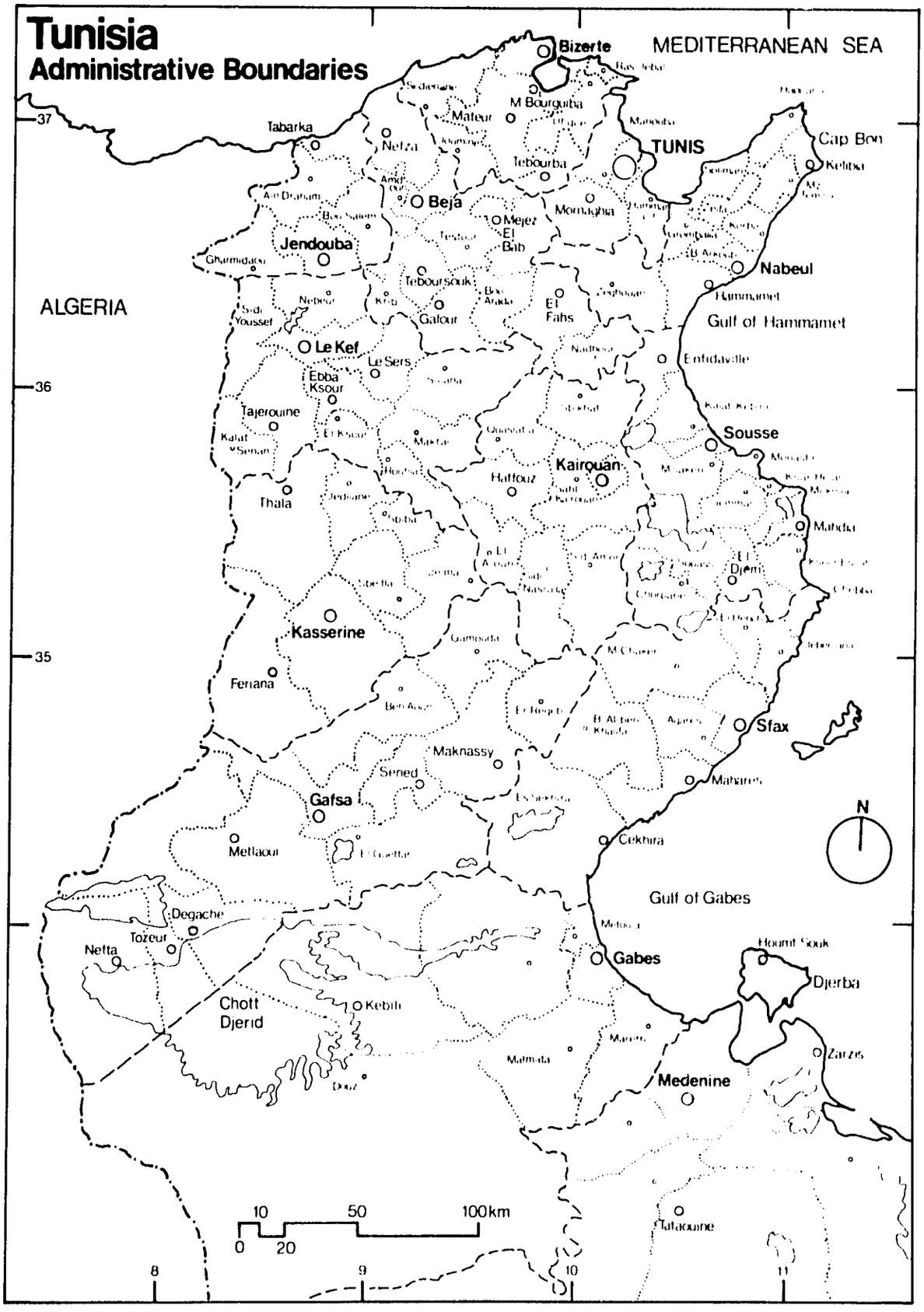
Figure 8.3


Tunisia
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Tebourba
Cap Bon
Kelibia
Beja
Mejez El Bab
Mornagia
Jendouba
Teboursouk
Gafour
El Fahs
Nabeul
Hammamet
Gulf of Hammamet
Enfidaville
Le Kef
Le Sers
Ebba Ksour
Tajerouine
Sousse
Kairouan
Haffouz
Thala
Mahdia
El Djem
Kasserine
Feriana
Sfax
Maknassy
Sened
Gafsa
Mahares
Metlaoui
Cekhira
Gulf of Gabes
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25 percent of these small villages were assumed to have one mill and one grinder; in the fourth central gouvernorat, Kasserine, which lies partly in a mountainous mining area, only 10 percent of the small villages were assumed to have one mill with a grinder. In the south, it was assumed that none of the villages with populations of 50-99 have mills.

Based on these assumptions and the methodology outlined above, the number of mills in each region and in the entire country were calculated. These calculations and the result are included in Appendix V. As the Appendix V shows, for all Tunisia the total number of mills was estimated to be 5,091, with at least 5,358 grinders. The area totals are as follows: (1) northwest, 2,334 mills (46 percent of the country's total) with 2,343 grinders; (2) northeast, 578 mills (11 percent of the total) with 672 grinders; (3) the central region, 1,526 mills (30 percent of the total) with 1,553 grinders; and (4) the southern region, 653 mills (13 percent of the total) with 790 grinders.

In the second estimate the assumptions about the villages were changed in order to give less weight to the smaller villages with populations from 50-99, as well as those with 100-199 inhabitants. The villages visited were assumed to have populations of 200-1,999 (rather than 100-1,999, as in the first projection) and the projection for this category was based on the survey finding from the villages visited. Then all villages throughout the country with populations of 100-199 were assumed to have only one mill with one grinder. Finally, it was assumed that in the northwest, only 25 percent of the villages with populations of 50-99 have a mill with a grinder, and in the northeast, center and south, it was assumed that none of these smaller villages have mills.

Appendix V presents the results of the calculations based on these assumptions. In this analysis, the total number of mills in Tunisia was calculated to be 3,666, with a minimum of 3,876 grinders. For each area, the totals are as follows: (1) the northwest, 1,469 mills (40 percent of the total in Tunisia) and 1,478 grinders; (2) the northeast, 533 mills (15 percent of the total) with 625 grinders; (3) the central region, 1,085 mills (30 percent of the total) with 1,112 grinders; and (4) the southern region, 559 mills (15 percent of the total) with 661 grinders.

Thus, according to these two projections, the number of small mills in Tunisia ranges from 3,666-5,000. These results are indeed consistent with the magnitude of the various different estimates noted in the beginning of this chapter and thus seem to be a reasonable estimate. In order to implement a fortification program through these mills, the exact number and location of each mill would have to be determined through a more comprehensive survey. But these data are sufficiently detailed to provide a basis for the estimation of the cost of the fortification program implemented through the small mills.

The Facilities and Operations of the Small Mills

As part of the survey for this report, the operators of 65 small mills throughout Tunisia were questioned in detail about their equipment and operations. This information was collected because if fortification were implemented through these mills, it would be essential to have a complete understanding of the capabilities and present activities of these mills. For example, any necessary fortification equipment would have to be installed in these mills, probably attached to the grinders. The kind of fortification equipment and the amount of fortificant dispensed would be largely determined by the present milling equipment, its current output and its maximum output capability. Similarly, an analysis of the feasibility of assigning any of the costs of fortification to the millers or customers must include some data on the miller's costs and revenues, and the prices charged to customers.

Detailed interviews were conducted at mill locations and the results of these interviews are presented in a brief summary form. It should be noted that this survey includes only a small sampling of mills, due to limited time, personnel and finances. The intention was not to provide a definitive analysis of the small mill operations, but within these constraints, to gather any possible information which could provide a better understanding of the small mill activities than was currently available. (As of 1974-75, information about these small mills was minimal.)

Most (63%) of the mills interviewed have one grinder (milling machine), although a significant portion (27%) have two grinders and a small number have three or more machines. In the central region, one machine generally processes grain and many of the second machines are reserved for the grinding of spices and peppers for harissa (a staple hot sauce). However, in the north and south, usually only one machine for grains is actually used at any time and any others are kept for use in case of the breakdown of the main machine or for spare parts. Thus, if fortification equipment were to be attached to a grinding machine, except in rare cases, only one piece or set of equipment would be needed per mill, since only one grinder usually handles grain during any given period.

In the mills interviewed, over 30% of the grinders are the Danish Diamont machines depicted. However, the most common brand are the Bamford machines, an English brand found in almost half of the mills interviewed. The Bamfords

seem to be most popular in the northern and central regions, while the Diamont is found most often in the south. Several other brands of Italian, English, Danish and French machines are also used by some Tunisian mills.

Most manufacturers of milling machines make several different models with different dimensions, horsepower, and milling capacities. For example, in Tunisia, Diamont advertises fourteen different models with horsepowers ranging two to twenty-five and capacities from 1 qq (100 kg) to 12 qq (1,200 kg) per hour. Most of the machines currently in use in Tunisia appear to be the smaller models; 55 out of 80 grinders viewed (69%) had a capacity of one quintal per hour, while another ten machines (13%) mill only one-half a quintal per hour (Table 8.18). All of the machines viewed with 0.5/qq per hour capacity are located in the central and southern regions while conversely, all of the machines with capacities of 2.0 qq/hour or more are located in the northern region.

Since most mills contain only one grinder and most of the grinders have a capacity of 1 qq/hour, the total mill capacity of most mills is 1 qq/hour. A total of 60% of the mills visited are in this category, but 36% of the mills had a total capacity for all grinders of 2 qq/hour or more.

Forty mill operators were questioned about the age of their milling machines. Over half of these millers reported that their grinders were less than 19 years old, and almost 25% of the grinders were less than five years old. This information supports the thesis that not only is the number of small mills in Tunisia not decreasing rapidly each year, but that the number is probably increasing, since new mills are being opened and new equipment is being purchased for the existing mills.

The motors of the milling machines can be constructed to operate by means of electricity, gasoline, oil or benzine. Data concerning the exact proportion of each type of grinder operating in the various regions were not collected. However, many of the mills visited had grinders which were not operated with electricity and many of the mills did not use any electricity for lighting.* Therefore, any equipment necessary for a fortification program through the small mills should not require electrical power.

*It is not clear what proportion of the location actually had electricity available, but the millers chose not to use it.

Table 8.18

Hypothetical Monthly Income Statements for Two Small Mills in Summer and Winter

	First Mill[1]				Second Mill[2]			
	Summer		Winter		Summer		Winter	
	Dinars	Dollars[3]	Dinars	Dollars	Dinars	Dollars	Dinars	Dollars
I. Net Revenues	71	$167.56	20	$47.20	153	$361.08	51	$120.36
II. Costs								
1. Rent	-	-	-	-	-	-	-	-
2. Equipment[4]	1.250	2.95	1.250	2.95	3.333	7.87	3.333	7.87
3. Spare parts and repairs	2	4.72	1	2.36	4	9.44		4.72
4. Electricity or gas	12	28.32	6	14.16	25	59.00	12	28.32
5. Other equipment costs	1	2.36	1	2.36	3	7.08	2	4.72
6. Water	-	-	-	-	-	-	-	-
7. Maintenance costs	1	2.36	1	2.36	2	4.72	2	4.72
8. Salaries to workers[5]	-	-	-	-	30	70.0	-	-
9. Insurance	-	-	-	-	-	-	-	-
10. Interest								
Subtotal	17.250	40.71	10.250	24.19	67.333	158.91	21.333	50.34
11. Taxes (5% revenues)	3.550	8.38	1	2.36	7.650	18.05	2.550	6.02
Total costs	20.800	$ 49.09	11.250	$26.55	74.983	$176.96	23.883	$ 56.36
III. Net Income (revenue minus cost)	50.200	$118.47	8.750	$20.65	78.017	$184.12	27.117	$ 64.00

[1] Average summer workload: 7 qq/day of cereals ground; winter workload: 2 qq/day. Based on daily operations, 30 days a month. Grinding price: D 340/qq. (average northern price).

[2] Converted at the 1974 exchange rate of 1 dinar = U.S.$2.36.

[3] Average summer workload: 15 qq/day; average winter workload: 5 qq/day; grinding price: D.340/qq.

[4] Depreciation for equipment, over 10-year period, initial value in smaller mill, 150 dinars, and large mill, 400 dinars (two grinders).

[5] In the second mill, one worker paid 1 dinar/day in summer.

The products which the small mills process vary in the different regions of the country. The mills in the north handle primarily durum wheat although limited amounts of bread wheat and barley are also processed in these mills. A small proportion of the northern mills also occasionally grind spices, peppers, broad beans, chick peas (mainly to put in coffee and for other liquid and semi-liquid dishes) and sorghum (which is ground into a fine flour for cakes). In the central region grinding durum wheat is often a less important activity than grinding spices, peppers, chick peas, sorghum, and barley, the main product of many of the mills, especially in the Sfax area. In the south most mills grind mainly barley, but also durum, spices, and peppers, as well as small quantities of bread wheat, sorghum, chick peas, and broad beans.

Almost half of the millers interviewed reported that, during the peak summer months (June-September) they process an average of less than ten quintals of durum a day. Furthermore, most of these mills with low workloads are located in the central and southern regions. In contrast, three-fourths of the remaining mills which handled an average of ten or more quintals per day are located in the northern region, and all of the mills with very large workloads (averaging over 50 qq/day) are located in the north. Furthermore, of six mills located with average workloads of over 50 qq/day, five are located in the northwest part of the northern region.

In winter and spring the millers reported that their average workload decreases significantly. Of 52 millers interviewed, ten responded that usually no durum is brought in by customers, and another 34 millers (65% of those interviewed) reported average workloads of less than 10 qq of durum per day. The average output of the larger also decreases significantly in winter. Only five northern mills reported average workloads of 15 or more quintals per day, and the largest "small" mill located, a mill in Le Kef which handles over 100 qq/day in summer, reported that its workload decreases about 50% in winter.

Few of the millers reported processing any bread wheat in summer, and the survey found only one miller whose customers bring bread wheat to be ground in winter. The workload of barley is higher; many of the millers reported handling barley in summer, and most of these millers said that their average workload was two or more quintals per day. The data for barley processing in winter are almost identical; most of the millers which process barley reported handling an average of two or more quintals of barley per day.

Fifteen of the millers interviewed reported handling spices, peppers, broad beans and sorghum. Almost all of their mills were located in the central and southern regions.

The extraction rate which millers obtain when grinding durum varies mainly according to the machines used and the number of times which the wheat is ground. Generally after one grinding, the output is sifted through a course sieve and about two-thirds of the finer output is retained as semolina; this is resifted through finer sieves to produce two or three grades of semolina suitable for couscous and a fine grade for use in tabuna bread or cakes. The remaining one-third of the output from the initial grinding may be used as animal feed, but is usually ground a second time, producing 75% semolina and 25% animal feed after sifting. Again, when this semolina is sifted through finer sieves it produces several different grades and the coarse animal feed output may be ground a third time in order to separate more semolina from the offal. In the small mills it was reported that the coarser output may be ground as many as seven times and as many as eight different grades of semolina may be produced. Apparently in the north most customers have their durum ground at least two or three times, producing about 90-95% semolina (four to six grades) and 5-10% animal feed. Before fortification could be implemented through the small mills, it would be imperative to collect more refined data concerning these grinding and sifting practices and extraction rates in order to ascertain the appropriate rate of addition of the fortificant and to evaluate whether all of the fortificant would be sifted through to the semolina reserved for human consumption or whether a certain portion of the fortificant might remain in the offal to be fed to the animals.

Most customers of the small mills take the ground wheat home and sift the semolina from the offal by hand, with small sifters with sieves of various sizes to separate out the various grades of semolina. However, some of the small mills provide sifting services for the customers by means of "automatic" sifters, large free-standing wooden frames with imported meshes from which as many as eight grades of semolina can be separated. Survey respondents were questioned about the sifting facilities in the mills, because of the possible usefulness which the sifters might have in a fortification program. Fortification feeders might be attached to the sifters' output shutes, thereby assuring that all grades of semolina are equally fortified and that none of the fortificant is retained in the residual animal feed. After millers and customers began being questioned about their

local mills' sifting facilities, it became clear that few have these sifters and most of the sifters are located in mills in the northern region. Only 29 sifters were located in the north (17 in Bizerte, 6 in Tunis, 1 in Nabeul, 4 in Beja, and 1 in Le Kef), one was located in the central region (Kairouan), and more were found in the south. Most of the millers who have sifters reported that less than half of their total output is usually sifted, probably because of the additional charges for sifting. (Grinding with sifting usually costs about 1-1/2 to 2 times as much as grinding alone.) In mills without sifters the millers were asked why they did not have these facilities. Their responses were as follows:

(1) I don't have enough work in my mill to require a sifter (response given mainly in the central and southern regions).

(2) People are used to sifting at home, probably would not want to pay more for the sifting service.

(3) I cannot afford one.

(4) I've never seen one, don't know anything about them. (One miller who had never seen a sifter said that he would obtain one if it would draw more customers to his mill.)

(5) My mill is too crowded; there's not enough room for a sifter. (The sifters used in Tunisia are about 6-8 feet long, about 4 feet wide and about 3 feet high.)

Fifteen millers were also asked if they would buy a sifter if low interest credit were available. Seven millers responded that they probably would buy one under such conditions, but eight said that they still would not want a sifter. (Most of these millers said that they can afford to buy one, but do not need or want one; one miller said that he still could not afford to pay for the electricity.)

Most of the millers interviewed keep their mills open every day of the year, from nine to sixteen hours a day. Some millers maintain these same rigorous hours, but close their mill one day a week, usually on Friday the Moslem Holy Day. Other millers adhere to different schedules: some are open 24 hours a day, every day; one mill is open in the evenings only, which is the only time when electricity is available, and some are open only in summertime.

The prices charged by millers surveyed vary widely, ranging from D.200-.750 ($0.48-$1.79) for the grinding of quintal of durum. The prices charged in

the northwest show the lowest average (D.268/qq; the average for eleven mills) while the average prices charged in the south are the highest (D.446/qq average for eleven mills). The limited data concerning the prices for both grinding and sifting suggest that these prices are about twice the price of just grinding a quintal of durum. The prices for grinding and sifting may be slightly higher in the northeast than the northwest, but grinding prices are also higher in the northeast.

One miller reported that he earns revenue not only from the fees charged for the grinding and sifting services, but also from the sale of grain offal at the mill by customers who own no animals. He reported that in his area (the northern town of Mateur), one quintal of grain offal could be sold for three dinars in the summertime.

Only limited financial data about the cost of operations of the small mills were obtained during the survey. This was due to several interacting factors: the nervousness of many millers about giving such information, the considerable time required to pose all the interview questions, and the higher priority given to other questions. Although the millers seemed surprisingly relaxed with the interviewers and open about discussing the details of their business, they were often hesitant to discuss financial matters in detail, since they feared that the information might somehow be used to require them to pay higher taxes. Thus, the financial questions were placed at the end of the interview, when a certain degree of trust might have been established and when the answers to all of the other questions had been obtained. However, in many cases the millers lacked the time to complete the entire questionnaire, and therefore, the last questions pertaining to financial matters were often not asked.

Most millers reported that they pay no rent, but that they own the mill property and building. Four millers who do not own their mills reported that their monthly rents are four dinars ($9.44), nine dinars ($21.24), twelve dinars ($28.32) and thirty dinars ($70.80) (includes the rental of a grinder as well as the mill property). The main expense of most mill operators is the cost of the grinding equipment. New grinders like the ones used in most small mills are priced from about 176 dinars ($415) to 276 dinars ($651), depending on the capacity of the machines.* The owners of some of the older, larger grinders (possibly

*Prices quoted by the distributor of Diamont grinders. The price ranges for other brands may vary somewhat.

more dependable) estimate much higher present resale values for their machines. One miller placed the current value of his twenty-year old grinder at 2,800 dinars ($6,608) while the owner of a mill in Le Kef (the mill with the largest output of any interviewed throughout Tunisia) estimated that his massive, sixty-year old grinder is presently worth 15,000 dinars ($35,400).

Some of the millers are able to make their own spare parts for the grinders, and a few operators reported that they can obtain spare parts in their own locale or in nearby towns. But, most millers said that they could only obtain parts in Tunis or sometimes Sfax, and they reported extreme difficulty in obtaining parts and long waits. For example, one mill had not been operating for nine days because of unavailable spare parts, and another miller had been waiting for six months for parts delivery. In another mill, 3 of 7 grinders were not operable because of the unavailability of parts. In fact, many millers keep extra grinders in order to provide spare parts when they are needed.

The twenty-one millers who use electricity in their operations reported widely ranging monthly costs. The operators of eight of the smaller mills pay from 10-14 dinars per month ($24-$33) in summertime, while three millers reported paying over 70 dinars ($165) per month. In winter because of the significantly decreased workload, the electricity costs also drop sharply - most millers pay less than 10 dinars ($23) monthly.

Some millers with grinders operating with gas motors were not sure of their exact monthly gasoline costs. Six other millers with gas-operated grinders reported monthly gasoline costs ranging from 9 dinars ($21) to 55 dinars ($130).

Many millers operate their mills by themselves or with the assistance of unpaid family labor. However, a significant portion of the millers interviewed hire additional workers during the peak summer months. Most of these millers hire from one to three full-time workers, although in one mill, seven workers are employed each summer. During the winter, few mills employ workers to assist the millers. The pay for the hired laborers in the north (where most mills with additional employees are located) ranges from D.800-1.200 per day ($1.88-$2.83).

Several millers stated that they are required to pay government taxes amounting to 5% of total revenues, although it was suggested that many millers pay less than this preparation. A few millers reported paying insurance fees of about 10 dinars ($24) annually for the protection of their mills and some millers also have water outlets installed in their mills mainly for human use and maintaining the cleanliness of the mill, but not for any milling function. Average water bills were about 5 dinars ($12) per month.

Based on this limited financial data, a simple income statement for a small Tunisian mill may be roughly estimated. Table 8.18 includes hypothetical statements for two mills with different workloads in both summer and winter. The first mill is a typical mill like those found in villages; the average workload is only 7 qq/day in summer and 2 qq/day in winter. With minimal costs estimated (no rent, water, labor, insurance or interest costs), the monthly net income to the miller, before paying salary to himself or family members, is only $118.47 in summer and $20.65 in winter, totalling about $639.08 annually. In the slightly larger second mill, where the average daily workload is 15 qq in summer and 5 qq in winter the miller is somewhat more prosperous. He earns a monthly average of $184.12 during the summer and $64.00 in winter, totalling $1,248.48 for the entire year. For either miller the addition of any rent expenses, extra labor costs, or other expenses for interest, insurance, extra repairs or new equipment would significantly reduce their already rather meager income.

The millers were also questioned about the occupations of their customers, in order to ascertain the proportion of people who were having home grown grain milled and the proportion of people who were purchasing their grain in the non-controlled system. Many millers were not able to answer these questions with precision and some refused to attempt to make any estimates. When asked what proportion of their customers who are farmers who produce some wheat, 21 of 37 responding millers (58%) said that at least half of their customers grow all or some of their own wheat, Three of the millers in the center and south said that none of their customers produce any wheat. Of 28 millers who could estimate the proportion of their customers who work on wheat-producing farms (and thus, might receive wheat as partial salary payment), over half (12) said that these farm workers constitute from 20-29% of their customers. Four of the southern millers responded that none of their customers are workers on wheat-producing

farms. The millers were also asked to estimate the proportion of their customers who have nonagricultural occupations. Eleven of nineteen responding millers (58%) said that farmers and workers on nonwheat producing farms comprise from 10-39% of their customers, while 17 of 21 responding millers (81%) said that customers with nonagricultural occupations constitute less than 29% of their clients.

The millers were also questioned about the average number of customers whom they service each day in the summer, the frequency of each customer's visit, and the average amount of grain brought by each customer. Of 32 millers responding to the first question, over half said they normally service from 10-29 customers per day. The millers also explained that the frequency of customer visits varied widely; some farmers make only one visit to the local mill annually, bringing the families' full year's supply of grain at one time, while other people have their day's supply of grain ground each day. However, most of the millers said that most of their customers bring grain to the mill from one to three times a week. Finally, the millers reported that at each visit most customers bring in small quantities of grain. Twenty-eight of 33 responding millers (85%) said that their customers normally bring in from 4.2-16.6 kg (1/24 - 1/6 of a quintal or a sack) to be processed at one time.*

Much of this information which was gathered about the small mills and the millers would be extremely useful for the design of a fortification program implemented through these mills. For example, the data concerning the average output of the mills throughout the year, the fees charged, and the typical costs of operating a mill are all necessary in estimating the incomes of the millers, and subsequently, an appropriate fee which might be paid to the millers for their participation in a fortification program. Similarly, the information concerning the small quantities of grain which many poorer people purchase at one time and bring to be milled, as well as the data on the usual milling fees, would be valuable in determining how

*In rural areas of Tunisia the quintal (100 kg) is broken down into several subdivisions: 1 quintal = 3 wiba (1 wiba = 33.3 kg)
= 6 gelba or themna (1 gelba or themna = 16.6 kg)
= 24 saa or roboui (1 saa or roboui = 4.2 kg)

much of the cost of fortification these people might be able or willing to bear. However, one of the most important results of the mill survey was the general impression of the millers which was gained. Most of the millers were extremely cooperative, helpful, and pleased and proud to participate in the mill survey. Some who were told that the results might be used for a nutrition program for lower income groups seemed eager to be of assistance. Thus, if a fortification program were designed which did not severely distrupt the milling activities, and if the millers were fairly compensated for any time and effort necessary for the implementation operations, it seems that they would be willing and trustworthy participants in any program of fortification implemented through their mills.

The Home Grinding of Wheat

Some Tunisian families who grow their own cereals or purchase whole grain wheat or barley do not take these cereals to the small local mills to be processed, but grind the grains at home. Typical home grinding equipment consists of two large, round flat stones or clay discs placed on top of each other. The grain is placed between the two discs and the top disc is rotated, usually by means of a stick lodged in a notch or hole in the disc. The grain is crushed by the rotating action of the stones. After the grinding, several sifters with different mesh sizes are used to separate out the offals and the coarser and finer grades of semolina.

There is no data available about the number of Tunisian families which grind their cereals at home. It is widely agreed to be a very small proportion of the population; most experts and officials roughly estimate the exact proportion to be between 1-3 percent. These families are generally thought to be among the lowest income groups in Tunisia.

As part of the survey conducted for this report, an attempt was made to provide more information about the numbers and location of the people who grind their wheat at home and why they process their wheat in this manner. The survey respondants in each locale were asked two questions: (1) who does their grinding at home in this area, and (2) why do these people prefer home grinding. Although the answers to these questions do not enable a more precise measurement of the number or proportion of families who grind at home, the responses do provide useful new information.

In both the northwest and northeast, most respondants said that very few people, almost no one, or no one at all, grinds at home anymore. However, some people contradicted this by saying that many people in isolated rural or mountain areas, some of the poorest people in rural areas, villages, and urban fringes, as well as a few wealthier city people, still practice home grinding. In the central region the answers were very similar to those in the north, although the home grinders also include the nomads, shepherds, and bedouins.* According to the survey respondents, the greatest proportion of families who grind at home seems to be in the south. As in the central region, these families include the nomads, bedouins and shepherds, as well as some people of all income levels outside the towns and villages, and some urban people.

In all three regions the respondents gave very similar answers when questioned about the reasons that people grind at home. These reasons were explained as follows:

(1) Many poor people grind at home in order to save money, both the milling fees and transportation costs to the small mills.

(2) Some people prefer home grinding because it is more convenient and less time consuming than taking the grain to the mill. This explanation was given most frequently in the central and southern regions, where there are fewer mills than in the north. Some families who live only a few kilometers from a mill consider this distance too far to travel for grain millings. Many families prefer grain which is milled daily or every few days, and some families can only afford to trade or buy one or two days' grain supply at one time. Thus, many of these people, who might typically travel into "town" (including village centers) only once a week (often on "souk" day), grind their grain at home every day, just before making their cous-cous, tabuna, or other dishes. The nomads and shepherds, who rarely come into "town" and the bedouins, who reportedly come to town infrequently, also do their own grinding because they are rarely near a small mill.

*The bedouins are a particular group of people who typically live in isolated groups in the central and especially the southern region. Some bedouins are also nomads.

(3) Many people of all income levels grind their own grain only for certain special dishes, such as zomita (a breakfast drink or porridge made with semolina or ground barley), and malthouth (barley cous-cous).

The individuals who grind their grain at home would obviously not be reached by a fortification program through either the large government mills or the small local mills. This is particularly notable since most of these people are part of the probable target population groups of any nutrition program. However, since the people who home grind constitute such an extremely small percentage of the population, the overall effectiveness of a fortification program would not be significantly reduced. Nevertheless, by well publicizing the benefits of fortification, it might be possible to encourage some of these people to have at least some of their grain, perhaps the grain designated for the children, milled in the local mills where the fortificants were being added.

Barriers to the Implementation of a Fortification Program in Tunisia: Centralized Program

Because of the dichotomous structure of the Tunisian wheat processing system, the barriers which would be encountered in a centrally implemented program and in a decentralized program have been evaluated separately. However, these two types of programs are not mutually exclusive. In fact a fortification program which could reach the two most likely target-groups, the urban poor throughout the country and the lower income inhabitants of the southern region, would require a two pronged implementation scheme, with the fortificants being dispensed in both the large controlled mills and the small local mills.

Barrier I: Nutritional Need

Tunisia is a developing country in Africa that exists on a cereal-based diet. A nutrition survey (Institut National de la Statistique, 1968) carried out between 1965 and 1968, showed an average per capita caloric intake of 2,360 calories and 65g of protein; of this total, cereal supplied 68 percent of the calories. However, countrywide averages are deceptive and often mask regional differences in consumption. Table 8.19 shows the nutrition survey data stratified according to

Table 8.19

Foods (g/person/day) in Typical Tunisian Diets

	FAO 1964-66[1]	Nutrition Survey 1965-68[2]					Southern Villages Antar 1971-72[3]
	All Tunisia	All Tunisia	Big Cities	All Rural	Villages	Scat. Dwel.	
Cereals	392	403	353	422	364	458	310
Potatoes	30	42	55	38	46	36	17
Sugars and sweets	43	49	55	47	47	47	32
Pulses	16	10	15	8	10	8	10
Vegetables	202	240	303	205	250	191	93
Fruits	139	164	340	102	104	100	51
Meat	33	36	59	30	35	28	13
Eggs	6	2	4	2	2	2	0
Fish	7	13	27	7	12	6	1
Milk	106	68	96	59	49	63	20
Fats and oils	37	42	56	39	40	39	31
Calories	2190	2360	2550	2310	2230	2470	1640
Total Protein	66	65	68	64	60	67	40

[1] FAO, 1969

[2] Institut National de la Statistique, 1968

[3] Tesi, et al., unpublished observations

city/rural/village areas of Tunisia and contrasted with the countrywide statistics. It is apparent that cities fair better than the rural areas with 14 percent more calories and 15 percent more protein than the villages.

The mean intake of 65g of protein would appear adequate except for the fact that only 14 percent of the total amount of the protein in the diet is from animal sources (Table 8.20). The Comite-sectariel (1968) in Tunisia recommended that 30 percent to 40 percent of the protein intake should be of animal origin; the protein problem appears to be one of quality rather than quantity.

Southern Tunisia borders on the Sahara desert and because of the limited rainfall is adequate only for cultivation of dates as a commercial resource (Tesi, et al., 1975). Results from the national nutrition surveys (Bourtourline, et al., 1972) have shown that nutritional deficiencies are present to a greater degree than in the rest of Tunisia and anthropometric studies have shown that preschool children of the southern villages demonstrate maturational delay when compared to other areas (Bourtourline, 1972). Deficits of food energy are more common in the south (Antar) than the rest of rural Tunisia.

Four surveys on food consumption of families were carried out in the southern Tunisian villages between 1971 and 1972 (El Lozy, et al., 1975). Each survey involved between 150 and 300 families. Table 8.19 shows that the Antar villages get only about 75 percent of the calories (1,640 as opposed to 2,230) and 70 percent of the protein (40g as opposed to 58g) that the average Tunisian village gets. In addition, in the Antar villages, cereal products are the principal foods and of these 97 percent were represented by wheat products (Table 8.21). The most traditional food in Southern Tunisia is cous-cous (Tesi, et al., 1975). This is a coarse semolina steamed and eaten with a sauce composed of water, oil, tomato paste, a few vegetables and occasionally a little meat. Main meals generally consist of a single dish, cous-cous.

Since the Tunisian diet relies heavily on wheat and is limited in variety, it is not surprising that micro-nutrient deficiencies have been identified (Republicque Tunisierre, 1968). According to the comitesectorial de la planification alimentaine (1968), low intakes of calcium, vitamin A, riboflavin, vitamin C, iodine and fluoride have been identified in the population. Rickets have been observed in 20 percent to 30 percent of individuals under 20 years of age. The deficiencies in micro-nutrient intake are much more severe in rural than in urban areas, as can be seen from Table 8.22.

Table 8.20

Protein Intake in Grams per Day per Person, by Degree of Urbanization

Protein Intake	Large Cities	Other Communes	Scattered Population	Total Rural	Total for Tunisia
Total Protein	67.7	59.8	67.3	63.7	64.8
Provided by cereals	41.4	43.4	53.5	49.3	47.1
Of animal origin	15.0	8.3	7.0	7.4	9.3
Animal protein as percentage of total protein	22.0	14.0	10.0	12.0	14.0

Table 8.21

Daily per Capita Consumption of Commonly Consumed Tunisian Foods

Food	Per Capita Consumption in Grams
Cereals	310
Legumes	10
Fresh Vegetables	93
Potatoes	16
Fresh Fruit	17
Dates	34
Meat	13
Fish	1
Oil	31
Sugar	32
Milk	20
Leghmi[1]	8
Tomato concentrate and hari ssa[b]	12

a) A sweet juice from date palm

b) A paste made of oil and red pepper

Table 8.22

Percentage of the Population for Whom the per Capita Daily Nutrient Intake Falls Below Specified Levels

--Percentage of the Population for Whom the per Capita Daily Nutrient Intake Falls Below Specified Levels.

Nutrient	Level Specified	Rural	Urban	Tunisia as a Whole
Calories	2,000	30	12	25
Protein				
Total (g)	55	30	12	25
Ratio of animal to total protein (percent)	20	70	34	61
Vitamins				
A (I.U.)	4,000	50	27	44
B_2 (mg)	1.4	70	35	61
C (mg)	55	30	12	25
Calcium (mg)	400	50	27	44

To summarize, the Tunisian diet as a whole is characterized by heavy consumption of cereals and a very low consumption of animal products such as meats, eggs, and milk (Table 8.19). Cereal consumption is heaviest in the rural areas particularly in the South (Table 8.23).

Taking the country as a whole, 85.6 percent of the protein consumed is of vegetable origin (Table 8.24).

Wheat is the major source of calories and protein in Tunisia. It is important to realize, since calories and protein are derived primarily from a single grain source, a dietary deficit in total protein is also likely to indicate a deficit in calories.

Barrier II: Commodity System Structure

One major issue in this category is the ability of a centralized program to reach specific target groups. For those groups which are already consuming large mill products, it would be relatively easy to fortify only the limited quantities of wheat products which would be delivered to these groups. The mills already keep detailed records of the geographical destination of their output; for 1973-1974 these records illustrate the relative simplicity with which targeting could be accomplished. Of course, the groups which consume mostly locally milled products would not be effectively reached by a centralized fortification program, and the barley portion of Tunisian diets would also not be covered by a program in which only wheat is fortified. Thus, if these groups, the rural and small town people who consume mainly locally milled products and the major barley consumers, the lower income people in the central and southern regions are defined as target groups, implementation of the program through the small mills and the fortification of barley must both be seriously considered.

The second major issue relating to the commodity system structure is the necessity of gaining and maintaining the support of the directors of the large mills in order to assure that a fortification program be properly implemented. Since the mills are already controlled by the government and the millers must comply with government instructions, there would probably be no resistance to the imposition of the additional requirements which would be necessary for a fortification program. In addition, because the government already collects extremely detailed

Table 8.23

Annual per Capita Consumption Levels
(in Kilograms, Weights as Purchased)

Product Group	Large Cities	Rural Areas			Tunisia as a Whole
		Villages	Scattered Households	Total Rural	
Cereals	129.0	133.0	167.0	154.0	147.0
Vegetables	110.6	91.3	69.6	75.0	87.7
Fruits	124.2	38.7	36.6	37.4	60.0
Eggs	60[a]	30[a]	30[a]	30[a]	38[a]
Meats	21.6	12.8	10.1	11.0	13.0
Milk	35.0	18.0	23.0	21.5	25.0
Fish	9.8	4.2	2.1	2.7	4.6
Fats and Oils	20.4	14.5	14.2	14.2	15.5
Sugar	20.0	17.0	17.0	17.0	18.0

[a]Number of eggs, not weight.

Table 8.24

Major Sources of the Protein Consumed (Percentages)

Product Group	Large Cities	Rural Areas			Tunisia as a Whole
		Villages	Scattered Households	Total Rural	
Cereals	61.2	72.7	79.5	77.4	72.7
Animal Products	22.0	15.8	10.4	11.6	14.4
Fresh Vegetables	6.5	6.0	4.3	4.7	5.5
Dry Legumes	4.9	3.7	2.7	3.0	3.4
Other	5.4	1.8	3.1	3.3	4.0
Total	100.0	100.0	100.0	100.0	100.0

records concerning all phases of the operations of these mills, there would probably be no miller resistance to providing the various types of data which would be necessary for the implementation of a program.

Barrier III: Technology

The technological aspects of fortification through the large controlled mills in Tunisia present no serious barriers. The actual process of the fortification is, in fact, an extremely simple procedure. In the Tunisia pilot project a small feeder was installed in each of the participating mills; the feeder added the fortificant powder to the stream of processed flour in the final step in the operations, as the flour was released into the sacks. One supervisor was required to monitor the operations and perform periodic quality control checks on the fortified products.

If an expanded fortification program were to be implemented in the same manner as the pilot project, which seems the logical procedure, feeders would be installed in each of the participating large mills and supervisors would have

to be trained to oversee the fortification activities in each participating mill. In addition, the blending operations would have to be set up for the mixing of the lysine, vitamins, and minerals, which are produced by different companies and would be shipped separately to Tunisia. For this operation a large tank-type blending machine and some other small equipment would be required and several supervisors to direct the blending activities would have to be trained.

The only technological barrier which would be encountered in a centralized fortification program is the variation in the milling extraction rates in the different mills, and thus, the variation in the nutritional content of the wheat products milled at different times in each mill. The mills could all be required to use one uniform set of extraction rates, but this requirement would probably arouse the opposition of the millers as well as consumers who have a sensitive appreciation of the different products produced at the various mills and a wide range of preferences for these products. A more feasible alternative might be to allow each mill to determine its own extraction rates, but to require that the same rates be used throughout the year within the mill. The best solution might be to allow the mills some flexibility and permit the use of several different rates with different premixes blended to suit each rate. This, of course, would complicate the blending and distribution of the premix, but could technically be accomplished without great difficulty. Regardless of the exact solution, it is important that the quantity of fortificants to be added be determined as precisely as possible. Adding an insufficient quantity of premix would reduce the nutritional effectiveness of the fortification, and while adding slightly more premix than is needed would not cause any biological or medical problems, it would result in unnecessary additional costs, since the fortificants represent most of the cost of the fortification program.

Barrier IV: Consumer Acceptability

One of the main barriers to a fortification program in Tunisia would be the resistance of Tunisian consumers towards certain alterations in the characteristics of their wheat products and their mistrust of government intentions in allowing these alterations. Although it is widely believed that consumers in developing countries might oppose the addition of any foreign substance to their cereal products; this did not seem to be true in Tunisia or in Thailand. In Tunisia,

in fact some consumers seemed to be enthusiastic about the possible beneficial effects of the fortificants. However, the survey also showed that Tunisian consumers are highly sensitive to the color of their wheat products and that they generally favor lighter colored products and reject darker colored varieties. In the pilot project region, the semilina which was fortified with lysine a white powder, was actually favored over the non-fortified semolina from other towns.

The color of the lysine evidently lightened the overall color of the semolina, according to the Tunisian consumers. Conversely, several years ago when an American company attempted to introduce a highly nutritious new brand of cous-cous, the product was rejected and the project failed mainly because the product had a slightly darker color than the familiar cous-cous, and consequently, became widely known as "black cous-cous." The Tunisian consumers also seem to be wary of the intentions of the government in allowing additives in wheat products. Some consumers in the pilot project area expressed a fear that the fortificants were actually a birth control device. Similarly, survey respondents throughout the country believed that the government always, or often, allows the addition of ground corn or broad beans to wheat products in order to dilute the products, and thus lower producer costs. Although this practice was permitted during several periods of inadequate wheat harvests in the past, it has not been allowed recently, nevertheless many consumers believe that the practice still persists and complain that these additives change the flavor of wheat products; give them a darker, more yellow color, and reduce the nutritional content of their semolina or flour. The danger for a fortification program is that some consumers might avoid any fortified products due to their fear that the fortificants might actually be corn or broad beans; in the pilot project area some respondents were certain that not only vitamins, but also corn was being added to the semolina. Some of these people said that they eat the fortified products anyway, but others said that they try to avoid the government semolina and buy whole wheat to grind locally whenever possible. Thus, if fortification were being implemented only in the large mills, some of the previous market for government products might be diverted to the noncontrolled system, where consumers could retain control over the milling of their wheat. However, since the consumer sensitivity to color is so pronounced in Tunisia, this problem might be avoided if it could be assured that the addition

of the lysine and vitamin premix would, according to a Tunisian consumer, lighten the color of the semolina or flour. Alternatively, the fears concerning the possible fortification with corn or beans could be alleyed by a comprehensive public education program before the lysine and vitamin fortification is initiated.

The fortificant premix used in Tunisia has no perceptable taste or odor, and the addition of the premix to wheat flour does not affect the texture or cooking characteristic of the flour. Thus, there would probably be no problems of consumer resistance due to these fortificant characteristics.

Barrier V: Intervention Economics

An estimate of the cost of the feeders and blending equipment, as well as the other initial capital costs required for a fortification program implemented through all of the 18 large mills is presented in Table 8.25. In addition, the Table also includes an estimate of the annual operating costs of a fortification program, as well as an explanation of the derivation of the cost calculations for the major items in the estimates.

These calculations are based on the assumption that all of the wheat products produced by all of the 18 mills are fortified. However, if it were decided that only certain target groups were to receive the fortified products, then only part of the total output would be fortified and many of these costs would be significantly reduced. Similarly, after the specification of particular target groups, it might be decided that fortification of the products for these groups could be performed in a few of the large mills and their overall costs would be further decreased.

In these calculations it was also assumed that the vitamins and minerals, as well as the lysine would be manufactured in Europe; shipping costs from France are used in the shipping estimates. In early 1974, officials of the Ajinomoto Company, the major manufacturers of lysine, said that they were considering opening a plant in France. They also explained that they would seriously consider opening a plant in the region of any country where lysine fortification were to be undertaken on a large scale basis.

As the data in Table 8.25 show, the total estimated capital cost for a program of fortification implemented through the large mills would be $288,949, which includes $100,500 (35 percent) in equipment costs and $94,599 (33 percent)

Table 8.25

Estimate of Cost of Fortification Implemented
Through 18 Large Mills
(U.S. $)

I. Capital Costs

A. Fortification Equipment	
1. Fortificant blender	$27,000
2. Scales	2,500
3. Ladders	1,000
4. Feeders and spare parts	40,000
5. Laboratory equipment	30,000
B. Shipping of Fortification Equipment	
1. Shipping of blender from point of manufacture (U.S.) to Tunisia	$16,000
2. Shipping of feeders and spare parts from point of manufacture (U.S.) to Tunisia	18,000
C. Landing Fees, Equipment Handling and Transport	
1. Cargo lending fees and unloading of blender and feeders	$ 250
2. Handling and transport of blender to central warehouse	100
3. Transport of feeders to 18 mills	300
D. Warehousing	
1. Central warehouse (Tunis) - land and construction	$81,409
2. Regional warehouses - land and construction:	
a. Sousse	4,374
b. Sfax	1,908
c. Ebba Ksour	1,908
3. Warehouse equipment	5,000
E. Administration	
1. Equipment for central and regional offices (at warehouses)	$ 2,500
F. Training	
1. Training of blender and feeder operators and supervisors	$ 2,500

Table 8.25 (Continued)

G.	Program Start-Up Costs: Planning and Initial Implementation	
	1. Personnel	$13,200
	2. Office expenses	3,000
	3. Domestic and overseas travel	8,000
	4. Education and publicity	30,000
	Total Capital Costs	$288,949

II. Annual Operating Costs

A.	Fortificants	
	1. Lysine and vitamins	$6,970,510
B.	Containers for Blended Premix	
	1. Additional drums	$148,500
	2. Liners for all drums	18,658
C.	Transport and Handling of Fortificants	
	1. Transport and handling within France	$9,971
D.	Shipping of Fortificants	
	1. Shipping of fortificants from point of manufacture (France) to Tunisia, including containers	$71,050
	2. Shipping of drum liners from point of manufacture (France) to Tunisia	123
E.	Landing Fees, Handling and Transport of Fortificants and Liners	
	1. Cargo landing fees	$6,136
	2. Handling, from ship, at dock, at central warehouse	4,914
	3. Transport from dock to central warehouse	2,061
F.	Blending and Fortification Operations	
	1. Labor costs	
	a. Blending supervisors at central blending point	$6,000
	b. Supervisors of feeders, fortification, and quality control in each mill	64,800
	2. Electricity	
	a. For blender	5,292
	b. For feeders	7,300

Table 8.25 (Continued)

G. Warehousing (central (Tunis) and three regional warehouses)	
1. Laborers	$10,500
2. Telephone, utilities, maintenance	6,840
3. Supplies	2,500
H. Premix Distribution	
1. Handling	$3,062
2. Transport to 13 other Tunis mills	3,145
3. Transport to Sousse, Sfax, Ebba Ksour mills	2,517
I. Program Administration	
1. Personnel	$25,800
2. Supplies, utilities	2,400
3. International and domestic travel	4,200
Total Annual Operating Costs	$7,376,279

Explanation of Major Items in Cost Estimate for Large Mill Fortification System

I. Capital Costs

A. Fortification Equipment

1. Blender: one 5000 lb. capacity blender to mix lysine and vitamins. Capacity requirements based on blending of four batches per day, with generous surplus time provided for breakdowns and other problems. To be located at central warehouse/blending point (STIM mill, in Tunis suburbs). Manufactured in the U.S.

2. Scales: for the weighing of the lysine and vitamins before blending.

3. Ladders: two @ $500 each for access to the top of the blender where fortificants are poured in for mixing.

4. Feeders: 20 @ $2000. Eighteen feeders intended for ongoing use in mills, with two feeders to be used as backup replacements. Manufactured in the U.S.

C. Landing Fees, Equipment Handling and Transport

These costs, as well as many other domestic costs calculated in this section, are derived from basic rates outlined in Industrial Investment in Tunisia, Economic and Social Environment (Investment Promotion Agency, Government of Tunisia, Tunis, 1973).

Table 8.25 (Continued)

D. Warehousing

One large central warehouse in Tunis which receives all fortificant shipments and dispatches blended premix shipments to the three regional warehouses, which service four mills outside Tunis. Plan monthly shipments of fortificants to Tunisia and monthly dispatches of premix to regional warehouses. Capacity of each warehouse is for two months' inventory of fortificants or premix. Costs based on land costs of D1.5 per square meter and construction costs of D25 per square meter.

F. Training

Three days of training for three blender operators and 36 feeder operator/supervisors (2 for each mill).

G. Program Start-Up Costs

Personnel and office expenses for six-month planning period. Personnel staff includes program administrator and assistant administrator, one accountant, one scientist, and one secretary. Travel expenses provide for trips within Tunisia, and to Japan and France, for discussions with lysine and vitamin manufacturers.

II. Annual Operating Costs

A. Fortificants

Estimated cost of lysine and vitamin premix, $3,130/ton; based on December 1975 prices for vitamins, iron and niacin and projected 1980 price of lysine, estimated by Ajinomoto Company officials in January 1974. Added at a rate of 0.5% per weight of flour and semolina, rate of addition in pilot project for Tunisian wheat fortification. Output from 18 large mills based on Office of Cereals records for the 1973-74 output from each mill, presented in Annex 14. Total estimated flour and semolina output, 445,340 tons; total quantity of premix to be added, 2,227 tons.

B. Containers

Drums - The lysine drums to be reused for the distribution of the blended premix; since lysine constitutes about 60% of the premix weight, containers needed for about 40% of the premix. Drums contain 30 Kg; thus 29,700 drums needed, at $5 per drum. Liners at $.25 each needed for all drums.

D. Shipping of Fortificants

From France to Tunisia, at $29/ton (125% of 1974 rate).

Table 8.25 (Continued)

F. Blending and Fortification Operations

Two blending supervisors, $250 each per month. Eighteen supervisors of fortification (feeder operations and quality control); one in each mill, with a second person in each mill trained as a substitute. Eighteen at $300/month.

G. Warehousing

Labor - Two laborers at central warehouse and one at each of three regional warehouses. Five at $175/month.

H. Premix Distribution

Transport charges based on estimated trucking costs of D.035/tons/Km. Within Tunis, D.020/tons/Km. to Sousse and Ebba Ksour, and D.018/tons/Km. to Sfax.

I. Administration

Personnel - One administrator at $500/month, one assistant administrator at $450/month; one scientist/quality control supervisor and one accountant at $450/month each, and one secretary at $300/month.

for the construction of warehouses for the storage of the fortificants. The annual operating costs of the program would be about $7,376,279, of which over 94 percent is represented by the cost of the fortificants. If only micro-level fortification programs were done, this $7.3 million would decrease considerably.

As the data in Table 8.25 suggests, the most serious barrier to a fortification program implemented in the large mills would be the magnitude of the program costs. Based on the estimate of the annual operating costs, the cost to fortify a ton of semolina or flour would be $16.56 and the cost per kilo would be 1.66 cents. This is the equivalent of D.007, or about 8 percent of the present cost of coarse semolina and 9 percent of the present cost of bread wheat flour. Although this is a small quantity of money, it is questionable whether the Tunisian government would allow all of these costs to be paid by the consumers; the retail price of wheat products is considered an important political issue and the government keeps these prices as low and as stable as possible. In fact, in the twelve year period from 1963-74, the retail price of coarse semolina was increased only 18 percent (from D.072 to D.085/kg) and the retail price of bread wheat flour was raised 15 percent (from D.065 to D.075/kg). Thus, an 8-9 percent increase in these prices in one year or in a several year period would probably be perceived as intolerable by the government and the consumers. It has also been suggested that part of the cost of fortification might be covered by a reduction in the 'grinding margins' allowed to the large mills. However, since these were recently raised for the first time since 1948 and are still considered inadequate, it is improbable that a reduction in these margins would be allowed by the government. Furthermore, the miller's margins could cover only a small part of program costs, since until recently, the margins were only D.525/qq or D.005/kg, less than the estimated annual program costs of D.007/kg. Data on the current margins is not available, but it is unlikely that they have been increased to a level which would permit them to cover more than a small fraction of total program costs, even if this were considered to be a feasible alternative politically.

Another important economic issue is the price of the fortificants which can probably be expected to increase in the late 1970s. Although some economics of scale might be achieved with expanded production of the main fortificant, lysine, steadily rising energy, oil, and commodity prices would result in inevitable price increases in the lysine and vitamins. Since these fortificant costs represent over

94 percent of total annual program costs, the program would be particularly sensitive to any increases in the prices for fortificants and total program costs would increase almost directly with any changes in fortificant costs.

Because of these various economic factors, it is improbable that a fortification program could be implemented in Tunisia without significant financial support from the Tunisian government, bilateral and multilateral assistance agencies, or from foreign or international health organizations.

In summary, although there are several obstacles to a centrally implemented fortification program, none of these obstacles is insurmountable and most could be overcome with fairly simple and relatively low cost solutions. Therefore, it can safely be concluded that the implementation of a fortification program through the large Tunisian mills would certainly be feasible and would not be particularly difficult to accomplish, although the overall cost would be considerable. One should note, however, that the protein fortification should not be undertaken unless the calorie gap is also simultaneously addressed.

Barriers to a Decentralized Fortification Program

It is commonly thought that it would not be feasible to implement a fortification program through a decentralized, local milling system in a developing country. Some observers think that it would not be possible to develop fortification equipment which would function reliably and effectively under local milling conditions. Other analysts believe that it would be impossible to elicit the support of the local millers and that the millers would not be willing or could not be trusted to implement the program properly. Most of these people also think that the cost of a locally implemented fortification program is simply prohibitive.

However, the pilot fortification project in Thailand and the research on the local mills in Tunisia both suggest that these and other doubts about the feasibility of a decentralized program should be seriously reconsidered and much more carefully analyzed. For the Thai experience and the Tunisia information, as well as the opinions of various experts on different issues which would be involved in the design and implementation of a decentralized fortification program, indicate that it would certainly be feasible to develop such a program in Thailand or Tunisia, and probably in other developing countries as well.

Unlike the Tunisian experience, in Thailand it was clearly recognized that a large proportion of the rice consumed is processed in the small local mills, rather than the much less numerous larger rice mills. In order to reach users of the small mills, mainly rural and village inhabitants, the project planners realized that the fortification would have to be implemented through the small mills. Local and foreign experts designed and constructed small feeders which could be attached to the grinders in the mills; the feeders were built with local materials at a cost of $50.00 each, and operated successfully throughout the several year duration of the pilot project. Although some millers who were initially contacted about the proposed project were reluctant to participate, most millers were cooperative and proved to be effective managers of the fortification operations. On the basis of this experience, it seems clearly reasonable to conclude that it is possible to design an implementation system for a fortification program which technically can be successfully operated in the small local mills of a developing country. There would, however, be several barriers to such a program; these barriers are outlined in the following sections.

Barrier I: Nutritional Need

The existence of nutritional need was documented in the discussion of barriers in a centralized fortification system for Tunisia. The one difference in analyzing a decentralized system of fortification is that the fortificant can potentially be designed to address the nutrient deficiencies on a village by village basis unlike a centralized system where one fortificant formula is used. The decentralized system approach, by tailoring the fortificant to specific nutrient needs in an area, decreases the likelihood of nutrient overcoverage.

Barrier II: Commodity System Structure

One of the most challenging barriers which would be encountered in the small mill program would be the task of eliciting the support and cooperation of the small millers. Most of the millers interviewed in Tunisia were extremely helpful and enthusiastic about participating in a study of the local milling system. Many also seemed to have a high degree of social consciousness and to be concerned about the status of the lowest income groups; this might increase their willingness

to participate in a program to assist these groups. The millers are also accustomed to government controls on various aspects of their business and on most other aspects of their lives. If the millers were required to make significant modifications of their operations or assume additional costs, there would probably be strong opposition to a decentralized program. However, if the program had the support of top national leaders who are popular in the rural areas, and if the millers could see their role as one which contributed to national development and assisted the low income groups, the millers would probably be willing to participate. This willingness would most likely be assured if the millers were paid for their time and effort and could view their participation as an important source of income. In the cost estimates of the proposed small mill fortification system, the millers of the larger mills (about one-third of the total) were scheduled to receive fees of 16 dinars per month in the summer and fall months, about 20 percent of their estimated average monthly income during these months, and eight dinars per month in winter and spring, about 38 percent of their average monthly income during this period of the year. The fees for the operators of the small mills were lower, 12 dinars monthly during the six busier months (25 percent of their average monthly income) and six dinars per month during the remaining six months, about 69 percent of their monthly income. These fees certainly seem high enough to provide an adequate incentive to the millers, nevertheless the fees do not constitute an unreasonable burden on the program since they total less than 11 percent of total annual operating costs of the proposed program. In fact, the fees could probably be set at a lower level without jeopardizing the commitment of the mill operators.

In spite of the probable willingness of the millers to participate in a fortification program, resistance would most likely be stimulated if millers thought that any program information might be used by the government to evaluate their tax position. This potential problem could probably be overcome by the behavior and even the professions of the program administrators. In Thailand the administrators were trusted partly because they were doctors or were perceived by villagers as being medical personnel. In Tunisia, the millers were extremely open with the author and her Tunisian assistant, probably due in part to the fact that they were perceived as scholars or as students and because they behaved in a friendly, informal manner. (When a more brusque, formal government official accompanied the author on one mill interview, the miller who had been interviewed

previously, became more reticent and closed.) Thus, the behavior of project personnel with the millers could be extremely important; furthermore, if the personnel could be presented as health workers or as some other trusted profession, this would probably reduce the suspicion of the millers.

Another important issue, the targeting of specified population groups, does not constitute a serious barrier. Fortification could easily be implemented only in the small mills in certain regions of the country, in specific sections of different regions, or even for particular customers of a given mill. However, as with the centralized program, the barley portion of the grain diet as well as the wheat which is ground at home would not be reached by a program of wheat fortification in the small mills.

Barrier III: Technology

A program in the small Tunisian mills could be designed like the Thai project with certain modifications. Simple feeders which could be attached to the existing grinders could probably be developed for a relatively low cost. Wheat milling experts who worked on the Tunisia pilot project think that the most effective, inexpensive feeders for the small mills would be feeders which dispense the fortificants in a tablet form, rather than a powder. Thus, while the fortificants to be delivered through the large mills would be blended in Tunisia and dispensed in powder form, the fortificants intended for the small mill program would probably be blended and tableted abroad and then shipped to Tunisia in tablet form. As the Thai experience has shown, the millers could easily be trained to operate and repair these machines, and regular visits to the mills by quality control teams could assure that the fortificants were being dispensed properly.

This last issue, the need for effective quality control, is one of the most important problems to be addressed in a decentralized fortification program. Although limited fortificant overdoseage would not cause toxic effects, it would result in expensive wasteage of the fortificants; under doseage would simply mean that the program's effectiveness would be unnecessarily restricted. While a trustworthy feeder for dispensing fortificant tablets could most likely be developed and the millers could be trained to make simple control test and repairs of the equipment, periodic evaluation by specialists would definitely be essential. In the program described elsewhere, each mill would be visisted once every

two weeks by a quality control advisor who would deliver the supply of fortificants needed and conduct quality control checks on the output. In addition, in each region quality control specialists with vehicles would be available to assist any millers with emergency problems.

Another technical barrier which would require further research, is the determination of the exact rates of extraction used in each small mill. Millers might have to be requested to use one extraction rate consistently or, if possible, the feeders might be designed so that they could be adjusted by the millers to fit several different rates of extraction.

Barrier IV: Consumer Acceptability

The issue of consumer resistance to fortification would probably not be as much of a barrier to a small mill program as to a centralized program in Tunisia, for both the Tunisian and their interview respondents indicated little reluctance to having their foods fortified with "medicine" or "vitamins," especially if recommended by the local doctors and if the fortificants did not significantly alter the color, taste, smell, or cooking characteristics of the foods. The main consumer reaction issue in Tunisia seems to be the opposition to having ground corn or broad beans added to reduce the product costs; however, in the small mills the customers could see the fortificants before they are added and be assured that the fortificants are not corn or broad beans. The success of the overall program would certainly depend on a relatively extensive public education and publicity program, but these could be provided at a reasonable cost as the cost estimates indicate.

Barrier V: Intervention Economics

An estimate of the cost of a fortification program implemented through the small mills in Tunisia is provided in Table 8.26. The capital costs for this program, estimated to be almost $2.3 million, are much higher than for the centralized program, for which the capital costs are less than $300,000. There are four main reasons for this difference. First, the program start-up costs for the small mill program are much higher; they total $719,600 or 31 percent of overall capital costs. Much of these funds are designated for the support of twelve regional staffs which are initially responsible for locating the mills,

explaining the program to the millers and eliciting their support. Most of the remaining start-up funds are intended for a one month education and publicity program conducted by local representatives in the area where each small mill is located. The second major category of costs is for distribution and quality control equipment. This category includes $636,000, 28 percent of total capital costs; these funds are intended mainly for the purchase of vehicles necessary for the delivery of fortificants and the transportation of quality control inspectors to the individual mills. The third reason for the higher capital costs for the decentralized program is the need for training programs for the much greater number of personnel participating at the regional and local level, including regional administrators, quality control supervisors, local representatives to conduct the initial education program, and the small millers. These training costs total $388,980, almost 17 percent of total capital costs. And finally, about 16 percent of these costs, a total of $366,600, are designated for the construction of fortificant feeders for each of 3666 small mills.

An estimate of the annual operating costs for a small mill program is also presented in Table 8.26. These costs total $10,860,249, of which over 77 percent, almost $8.4 million, is designated for the fortificants and the tableting of these materials. In addition, about $1.16 million, 11 percent of the total, is allocated for the payments to the millers and another $605,734, 6 percent of total operating costs, are designated for the salaries and costs of the distribution and quality control personnel. If only micro-level fortification were undertaken, the annual cost would be significantly less.

As was true with the centralized fortification program, with the decentralized scheme, the intervention costs do constitute a serious barrier to the possible realization of the program. As noted above, the estimated annual operating costs would be about $10.9 million, which represent an estimated cost per ton of wheat processed of $22.85 or D.981/quintal. This would mean that the average estimated summer price of a quintal of durum semolina, including processing charges, would be raised about 12 percent in the northern region (from D7.340 to D8.321/qq), about 12 percent in the central section of the country (from D7.872 to D8.853/qq) and about 11 percent in the south (from D8.830 to D9.811/qq). However, for the farm families or workers who do not buy grain, but simply take their own supply to be processed in the small mills, the impact of the cost of fortification would

Table 8.26

Estimate of Cost of Fortification Implemented Through Small Local Mills
(U.S. $)

I. Capital Costs

A.	Fortification Equipment	
	1. Feeders of fortificant tablets	$366,600
B.	Warehousing	
	1. Central warehouse (Tunis) - land and construction	$73,267
	2. Twelve regional warehouses - land and construction	89,131
	3. Warehouse equipment	15,000
C.	Distribution and Quality Control Equipment	
	1. Quality control equipment	$13,000
	2. Small vans for delivery of tablets and use by quality control teams	455,000
	3. Jeeps for delivery of tablets, and use by quality control teams and on-call advisors	168,000
D.	Administration	
	1. Equipment for central and regional offices (at warehouses)	$8,000
E.	Training	
	1. First training program for regional administrators	
	a. Facilities, supplies and miscellaneous	$4,000
	b. Transportation for participants to conference site	1,020
	c. Per diem for participants	4,080
	2. Second training program for regional administrators	
	a. Facilities, supplies, and miscellaneous	2,500
	b. Transportation for participants	900
	c. Per diem for participants	2,250
	3. Training program for quality control supervisors	
	a. Facilities, supplies, and miscellaneous	5,000
	b. Transportation for participants	5,300
	c. Per diem for participants	3,180
	4. Training program for local representatives in each gouvernorat	
	a. Facilties, supplies, and miscellaneous	10,400
	b. Transportation for participants	21,600
	c. Per diem for participants	34,560

Table 8.26 (Continued)

5. Training program for local millers	
a. Facilities, supplies, and miscellaneous	$39,000
b. Transportation for participants	98,150
c. Per diem for participants	157,040
F. Program Start-Up Costs: Planning and Initial Implementation	
1. Central staff (Tunis)	
a. Personnel	$ 24,600
b. Office expenses	8,000
c. Domestic and overseas travel	20,000
2. Regional staffs	
a. Personnel	184,800
b. Office expenses	31,200
c. Domestic travel	26,000
3. Education and Publicity	
a. Personnel - local representatives	146,800
b. Supplies	109,980
c. Regional travel	66,060
d. Media and billboards	65,500
e. Posters in mills	36,660
Total Capital Costs	$2,296,578

II. Annual Operating Costs

A. Fortificants	
1. Lysine and vitamins	$7,812,480
2. Tableting of blended fortificants	559,104
B. Containers for Tableted Premix	
1. Additional drums	$166,400
2. Liners for all drums	20,800
C. Transport and Handling of Fortificants	
1. Transport of fortificants from point of manufacture to point of tableting (within France)	$4,119
2. Handling of fortificants	4,595
D. Shipping of Tablets	
1. Handling and transport of tablets (in France)	$ 6,910
2. Shipping from France to Tunisia	79,750

Table 8.26 (Continued)

E. Landing Fees, Handling, and Transport of Tablets	
1. Cargo landing fees	$ 6,864
2. Handling of tablets (transfer to central warehouse)	3,063
3. Transport to central warehouse	2,315
F. Feeder Operations	
1. Fuel	$73,320
2. Replacement parts	18,330
G. Warehousing (central and twelve regional warehouses)	
1. Personnel	$27,900
2. Telephone, utilities, maintenance	18,000
3. Supplies	14,400
H. Distribution and Quality Control	
1. Handling and transport of tablets from central warehouse to regional warehouses	$27,967
2. Operation of vans and jeeps	
a. Fuel	37,167
b. Maintenance and spare parts	33,000
3. Distribution/quality control teams	
a. Salaries for drivers/laborers	117,000
b. Salaries for quality control inspectors	273,000
4. On-call quality control personnel	
a. Salaries	117,600
I. Administration	
1. Program administration (Tunis)	
a. Personnel	$29,400
b. Facilities, supplies, utilities	7,200
c. Domestic and international travel	6,800
2. Central warehouse/distribution administration	
a. Personnel	18,000
b. Supplies, utilities	4,800
c. Travel	4,800
3. Regional warehouse/distribution administration	
a. Personnel	115,200
b. Supplies, utilities	43,200

Table 8.26 (Continued)

J. Publicity	$47,450
K. Payments to Millers	
1. Fees to owners of smaller mills	$636,595
2. Fees to owners of larger mills	522,720
Total Annual Operating Cost	$10,860,249

Explanation of Major Items in Cost Estimate for Small Local Mill Fortification System

I. Capital Costs

A. Fortification Equipment

Locally made feeders to be installed in each small mill; 3666 @ $100 each.

B. Warehousing

Large central warehouse in Tunis for the receipt and storage of tablets from Europe and distribution of tablets to 12 other gouvernorats. (Central warehouse handles tablets for the gouvernorat of Tunis.) Plan monthly shipments of tablets and monthly dispatches of tablets to regional warehouses. Capacity of each warehouse is for two months' inventory of tablets. Costs based on land costs of D1.5 per square meter and construction costs of D25 per square meter. These costs, as well as many other domestic costs calculated in this section, are derived from basic rates outlined in Industrial Investment in Tunisia, Economic and Social Environment (Investment Promotion Agency, Government of Tunisia, Tunis, 1973).

C. Distribution and Quality Control Equipment

Sixty-five small vans and 28 jeeps to be used by delivery/quality control teams and on-call quality control advisors assist with fortification/quality control problems.

E. Training

1. First training program for 13 regional administrators: eight-day program in Tunis. Topics to include nutritional need for fortification, general program design and management, the technology of fortification, analysis of methodology for locating small mills in each gouvernorat, and methods of gaining the support and commitment from the millers and the community.

Table 8.26 (Continued)

2. Second training program for 13 regional administrators: five-day program in Tunis, 2-3 months after the first training program. Focus primarily on general program management, the operation of the distribution system, quality control supervision, and problems in miller and community relations.

3. Training program for quality control supervisors and advisors: ten-day program in Tunis for 56 quality control supervisors and 28 on-call quality control advisors. Topics to cover nutrition, technology of fortification, milling operations, lab tests, the distribution of the tablets, and miller and community relations.

4. Training program for local program representatives in each gouvernorat: two-day program in each gouvernorat capital for community inhabitants who would be hired for one month during the initiation of the program to explain the program to the community and answer any questions. Representatives would most likely be vacationing school teachers or older students, or health workers loaned from various organizations.

5. Training program for local millers: two-day program in each gouvernorat capital to explain nutritional need for fortification, the design of the overall program, fortification technology, the repair of feeders, the distribution system, and community relations.

F. Program Start-Up Costs

1. Central staff in Tunis to operate for eight months before the initiation of the fortification operations. Personnel to include one program administrator @ $500/month, two assistant administrators @ $450/month, one assistant @ $300/month, one accountant and one scientist @ $450/month each, and two secretaries @ $300/month each. Travel funds to provide for domestic travel and trips to Japan and Europe for discussion with fortificant manufacturers and tableters.

2. Regional core staffs to operate for four months before the initiation of the fortification operations. Personnel to include the 13 regional administrators @ $450/month each and the 93 quality control supervisors and advisors, @ $350/month each. The quality control personnel would be involved mainly in locating the mills and establishing relations with the millers.

Table 8.26 (Continued)

3. Education and publicity:

   a. Salaries for local community representatives: one representative for five mills, thus 734 representatives @ $200/month for one month.

   b. Supplies for representatives - $30 for each mill (for publicity or educational materials for the mills' customers).

   c. Travel @ $3/day for one month for each representative.

   d. Media - Radio and TV advertisements for 120 days; 50 billboards in each gouvernorat @ $50 each.

   e. Educational/promotional posters in each mill; 3666 posters @ $10 each.

II. Annual Operating Costs

A. Estimated cost of lysine and vitamin premix, $3,130/ton, based on December 1975, prices for vitamins, iron, and niacin and projected 1980 price of lysine, estimated by Ajinomoto Company officials in January 1974. Quantity of fortificants based on estimated output of small mills, 391,682 tons of durum and 153,556 tons of bread wheat (from Table 19.04); extraction rates estimated to be 90% for durum and 80% for bread wheat. Quantity of fortificants needed inflated by 5% to provide for wastage and losses in distribution, storage, or in the feeding operations; total quantity of fortificants needed estimated at 2,496 tons. Fortificants to be made into 2.5 gram tablets, to be added at a rate of 2 per kilogram of wheat. Tableting cost estimated @ $.45/1000 tablets; additional charge for mixing of lysine and vitamins estimated at 25% of tableting charge. Thus total tableting cost, $.56/1000. Tableting to be done in Europe in the country of manufacture of the fortificants (probably France).

B. Containers

The lysine drums to be reused for the shipping and distribution of the tablets; since lysine constitutes about 60% of the premix weight, containers needed for 40% of the tablets. Drums contain 30 Kg; thus 33,280 drums needed @ $5 per drum. Liners, @ $.25 each, needed for all drums.

D. Shipping of Tablets - from France to Tunisia @ $29/ton (125% of 1974 rate).

F. Feeder Operations

Fuel @ $20/mill per year and replacement parts @ $5/mill per year.

Table 8.26 (Continued)

G. Warehousing

Three laborers at central warehouse @ $175/month each; one laborer at each of 12 regional warehouses @ $150/month each.

H. Distribution and Quality Control

1. Transportation charges based on the following rates: less than 50 Km, D.035/ton-Km.; 50-99 Km, D.022/ton-Km; 100-199 Km, D.020/ton-Km; and over 200 Km, D.018/ton-Km.

2. Fuel costs based on estimated price of D.160/liter. Maintenance and spare parts estimated at $400 per year for each of 65 vans and $250 per year for each of 28 jeeps.

3. Salaries for 65 driver/laborers at $150/month. Salaries for 65 quality control inspectors at $350/month.

4. Salaries for 28 on-call quality control personnel at $350/month.

I. Administration

1. Central program administration personnel - one program administrator @ $500/month; one assistant administrator @ $450/month; two accountants @ $450/month and two secretaries @ $300/month. Travel funds for domestic travel and trips to Europe and Japan, if necessary.

2. Central warehouse/distribution personnel - one administrator @ $450/month; one assistant @ $300 month, one accountant @ $450/month; and one secretary @ $300/month. Travel funds for trips to each gouvernorat, for the establishment and maintenance of the distribution system.

3. Regional warehouse/distribution administration - one administrator @ $450/month and one accountant/secretary @ $350/month for each of 12 gouvernorats.

K. Payments to Millers

To two-thirds of the millers (2,456 millers), fees of 12 D/month during six months (summer-fall) and 6 D/month during the remaining six months (winter-spring). To one-third of the millers (1,210 millers) payments of 16 D/month during six months (summer-fall) and 8 D/month during the remaining six months (winter-spring).

be much greater. For if these customers bore the full cost of the program, their normal milling fees of about D.300/qq in the north and center or D. 400/qq in the south would be increased to D1.281 or D1. 381 -- cost increases of over 300 percent in the northern and central regions and over 200 percent in the south. Clearly, these customers would be unwilling and perhaps unable to assume these additional costs.

In conclusion, none of these various barriers to the implementation of a fortification program through the small local mills in Tunisia appears to be insurmountable. The high cost of the program appears to be the most serious problem and the most difficult to resolve. In order to implement the program, it would probably be necessary to obtain funds from bilateral and multi-lateral donors, as well as from the Tunisian government. These funds would most likely have to cover the initial capital costs of the program, and commitments would also have to be made to cover a major portion of the annual operating costs over an extended period of time. Furthermore, the dramatic recent price increases in the price of the fortificants, mainly lysine, and the lack of control over the setting of these prices suggest that program costs might be much higher than estimated; since fortificants constitute such a major portion of operating costs, the program is extremely sensitive to these possible price increases. Thus, program planners would have to be prepared to obtain additional funds for the program or have the participants bear these increased costs. The price impact would not be so serious if only micro-nutrient fortification is undertaken. However, if these financial problems could be solved and if funds could be obtained for present program costs and future cost increases, it is reasonable to conclude that it would be possible to design and implement an effective program of fortification through the small local mills in Tunisia.

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