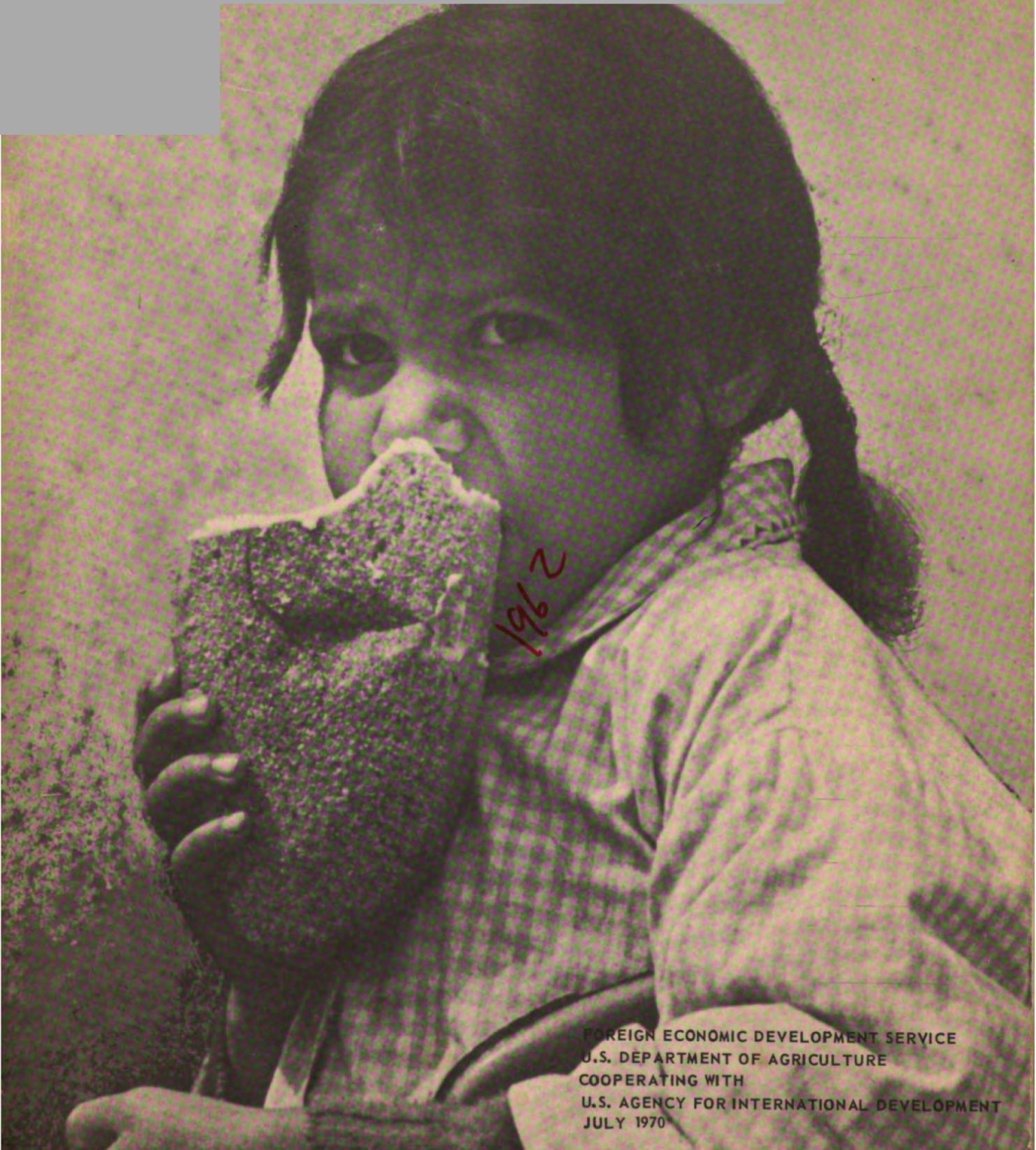


ECONOMIC ASPECTS OF  
NUTRITION IMPROVEMENT IN *Tunisia*



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FOREIGN ECONOMIC DEVELOPMENT SERVICE  
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## PREFACE

This report is an outgrowth of participation in an interdisciplinary advisory team which consulted with the National Institute of Nutrition and Food Technology (Institut National de Nutrition et de Technologie Alimentaire) in Tunis in March and June of 1970. Other members of the team were Dr. Jacques May of the U.S. Public Health Service (team leader), Mrs. Jean Pinder of the Africa Bureau in AID (nutrition education), and Dr. Roy Morse of the Food Science Department at Rutgers University. Each worked with a different unit of the Institute. My primary contact was the Economics Division.

The purpose of the team was to provide advice to the new Institute on objectives, organization, and procedure. While much of the work of the team concerned internal matters, I also attempted to take a broader economic look at the nutritional problem in Tunisia. Hopefully, the result - this report - will be of value to the Economics Division as well as to others concerned with nutrition policy in Tunisia. Since Tunisia's nutrition problems are similar, in varying degree, to those found elsewhere in the developing world, the report may be of wider interest.

For those who are not familiar with the Institute, perhaps a few words of background would be in order. The Institute was formally established by the Government of Tunisia in the fall of 1969. Administratively, it is under the Ministry of Health. Physically, it is currently located in a rented building in Tunis; construction has been started, however, on a new building at the School of Medicine at the University of Tunis. The four major divisions of the Institute are Human Nutrition, Food Science, Education, and Economics.

One of the major initial projects of the Institute is the sponsorship of a fortification study in southern Tunisia in cooperation with AID and the Harvard School of Public Health. This project, one of the first large-scale tests of its kind in the world, will evaluate the fortification of wheat with lysine, vitamins, and minerals. The study was getting underway at the time of our visits. At a later date, it is expected that the Institute will sponsor a nationwide nutrition survey.

The Institute and the fortification project have received active support from AID, which also sponsored the advisory team.

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## SUMMARY

### The Problem

Tunisia, like many developing nations, faces a serious nutrition problem. Diets are deficient in both quantitative and qualitative terms. Quantitatively, undernutrition results from a lack of calories. Qualitatively, malnutrition results from a lack of protein, vitamins, and minerals.

The prevalence of these deficiencies is not uniform. Geographically, they are most severe in the rural areas (and probably among unskilled laborers who live in poverty on the fringes of cities). Elsewhere, undernutrition is less severe. But malnutrition is more pervasive, especially among expectant and nursing mothers, babies, and young children. A shortfall in nutrients for this critical group can have most unfortunate effects for the individuals involved and eventually for society as a whole.

Given very limited resources, how can a relatively poor country like Tunisia most efficiently handle its nutritional problem? Assuming it cannot tackle everything at once, where should it make its move? This report does not provide the answers, but it does seek to provide a framework for analyzing the problem.

### Possible Approaches

Several approaches could be taken to meet Tunisia's nutrition problem. The decision of which route to follow will vary somewhat with the perception of the problem by the person or the group making the analysis.

Still, most approaches should consider two basic economic factors: demand and supply. Demand is of two types: potential and effective. There is a vast potential demand for improved nutrition in Tunisia, but this has to be backed with income and interest to become effective demand. Income improvement, a long and difficult process, may lead to improved nutrition but this process is by no means automatic. Nutrition education can probably help, but only within limits.

Assuming a relatively constant effective demand, supply could be altered in several ways. One would be to deal with existing food products: lower the cost or improve their nutritive qualities through breeding, processing, or fortification. A second would be to introduce or develop new food products, including processed products. Thirdly, both existing and new products could be made available to needy groups at relatively low cost through existing maternal and child feeding programs.

Two programs which utilize a combination of supply and demand are presently in operation and could be expanded. One is food for work, where workers are paid in both food and cash. The other is a more sophisticated concept known as price discrimination, a variation of which is used for vegetable oils.

## Role of Wheat

Wheat is by far the leading food commodity in Tunisia. It is the principal source of calories and protein. Any attempt to improve nutrition must take it into account.

There are two main types of wheat: bread (soft) - blé tendre (close to U.S. hard), and durum - blé dur (equivalent to U.S. durum). Each has its own special uses. Bread wheat is consumed entirely domestically, while the durum wheat has been exported in some years.

Wheat production has fluctuated sharply, largely in response to changes in rainfall. This has led to a dependence on imports in short crop years. A large share of the imports have been concessional in nature: U.S. PL 480 shipments have been the primary source, but concessional wheat is also becoming available from other sources.

In order to reduce the dependence on imported wheat, an Accelerated Wheat Production Program has been inaugurated. The Program involves the use of Mexican bread varieties. These varieties out-yield the leading native variety under similar growing conditions and show a particular advantage where rainfall is higher. They have been comparable to the leading native variety in protein and lysine levels. Whether they will prove comparable in baking quality to the Tunisian consumer remains to be seen.

Similar production advances will next be needed with the harder wheat varieties.

## Policy Questions

At present, economics is more useful in selecting among alternative nutrition programs than in suggesting how much should be spent on nutrition improvement in total. Implementation of nutrition improvement in Tunisia will involve a number of important policy decisions.

One which will arise soon is the matter of how far to push the self-sufficiency program in wheat. Is it more efficient to raise wheat or to import it? At the moment, there is a relative surplus of wheat in the developed nations and they find it convenient to export under concessional terms or to provide donations. This situation, however, may not always exist. At the same time, the pronounced variations in domestic production due to weather add another note of uncertainty.

A second question concerns the selection of an appropriate technique to improve nutritional quality. Three major approaches are open: (1) adjustments in existing crop production patterns, (2) manufacture of new and nutritious food products, or (3) fortification of grains. Each has its limitations. Other crops may be relatively unprofitable to raise, difficult to distribute to needy areas, or too expensive for the low income consumer. New manufactured products may face the same economic problems plus the social problem of

consumer acceptance. Fortification of wheat would not reach farm families who mill part or all of their production for home use (except through the school lunch program).

Determination of the technique adopted will depend in part on whether it is desired to take a selective or mass approach. A new weaning food, for example, might be considered a selective approach in that it would be used by young children. Fortification, on the other hand, is more of a mass approach; fortified wheat would be consumed by all age groups. If the concern is just with a specific group such as young children, a selective approach might seem in order. If the concern is with larger groups, fortification might appear more appropriate.

But it is easy to jump to quick conclusions in this matter. It should be remembered that the cost of fortifying wheat is low and there is no extra distribution cost. Conversely, the cost of producing and distributing a selective product is likely to be much higher; in addition some families may be overlooked. Hence it might be that it would be cheaper in some cases to resort to fortification. Much more economic analysis of this matter is needed. Also, more needs to be known about the effects of fortification.

Actually, a variety of approaches may be needed. Not even a mass technique like fortification will reach each family year-round. Several approaches are possible in Tunisia because of foreign assistance. The United States is already enriching and partially fortifying wheat flour donated under Title II; a protein concentrate might conceivably be added at some point. The World Food Program and other countries are also donating wheat; possibly they might be interested in fortification. UNICEF and FAO are about to provide substantial assistance in the manufacture of a low-cost, high-protein food product. Perhaps domestic or foreign commercial firms may be involved with other food products.

The difficulty will be for the Tunisian Government to decide where to best invest its own limited resources. It may obtain a substantial multiplier effect by encouraging foreign programs, but it is doubtful that exclusive reliance should be placed on these programs. Some attention needs to be given to a program which could be supported in the absence of foreign assistance.

#### Implications for Nutrition Institute

The assessment of alternative ways of improving nutrition in Tunisia provides a worthy and challenging task for the Economics Division of the new Institute. Tunisia is one of the first less developed nations to set up a staff to deal with the economic dimensions of the nutrition problem.

The major potential tasks of the Economics Division fall into three functional categories: (1) food statistics, (2) food economics, and (3) food policy. The division might eventually be structured into three comparable groups. Food statistics would be responsible for the compilation of primary and secondary data related to food and nutrition. Food economics would carry

out economic analyses pertaining to food consumption, new products, fortification and the like. Food policy would be concerned with the role of nutrition in national planning and in international programs.

Since the Economics Division presently has too small a staff to begin to carry out all these functions, it, no less than others, needs to be concerned with careful use of limited resources. One possible way to extend its impact is to concentrate on cooperative projects with other units of the Institute, other government agencies, and international groups. Similarly, the group might have a multiplier effect on nutrition improvement by serving in a staff role to key policy makers - providing them with economic data, analysis, and advice.

Further technical training would be of material assistance in helping the present staff to carry out these functions. One staff member has proposed a program of training in France which appears quite satisfactory. For a second staff member, who received his Ph.D. in economics from Brown, a three to six months post-doctoral tour of selected government agencies and universities in the United States has been suggested which would be financed by AID.<sup>1/</sup>

### Concluding Remarks

Nutrition is in part an economic problem. Yet the field has been almost entirely dominated by the biological sciences.

There are limits, however, as to how much economists will be able to contribute until certain basic physiological relationships are more clearly understood. Perhaps the most important is the nature of the link between nutrition and mental or physical performance. One might assume that this had been well established long ago, but there still appears to be a wide difference of opinion among nutritionists.

Perhaps one of the basic reasons is that heretofore it has not been possible to do much experimental work directly on humans, especially in less developed nations. The fortification study now getting underway in southern Tunisia is a significant exception. While the circumstances of the test limit the opportunity for performance tests, the matter should be given further consideration.

The economist is concerned with costs and returns. Costs can be relatively easily calculated. But until the nature of the link between improved nutrition and performance can be more clearly demonstrated by others, his role is limited. This would be a shame, for, to paraphrase a familiar expression, nutrition is too important to be left only to the nutritionists.

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<sup>1/</sup> This staff member subsequently resigned because of degree equivalency problems. He now has a good position with OECD in Paris.

## I. THE PROBLEM

Tunisia faces the twin problems of undernourishment and malnutrition. Undernourishment exists in some areas because of a quantitative shortage of food (calories) in the diet. Malnutrition exists because of qualitative deficiencies in proteins, vitamins, and minerals.

### A. Nutrient Levels

Nutritional levels in Tunisia in the mid-1960's, as estimated by a government committee, are presented in Table 1. The average per capita daily intake of calories was 2,340 while that of proteins was 65 gms.<sup>1/</sup>

In terms of minimum desired nutritional levels, there were serious deficiencies in every category except for vitamin B<sub>1</sub>. Overall deficiencies were approximately as follows: calories, 10%; animal protein, 30-35%; vitamin A, 30%; vitamin B<sub>2</sub>, 17%; vitamin C, 11%; and calcium, 20%.<sup>2/</sup> The rural areas fell well behind the urban areas in all categories except vitamin B<sub>1</sub>.

The proportion of the population below even minimum nutrient levels is alarmingly high, ranging from 25 to 61% for the country as a whole. The deficiencies, as would be expected, are considerably greater for the rural than urban areas. The rural figures range from 30% to as high as 70%, the highest figures being for vitamin B<sub>2</sub> (70%) and vitamin A and calcium (50%). The deficiency in animal protein quality - roughly indicated by the proportion of animal protein, is also very high in the rural areas (70%).

### B. Food Consumption

The composition of food in Tunisia is heavily oriented to cereals and cereal products. Cereals account for about 1/3 of the total, whether the measure be weight of product (33.4%) or proportion of expenditures (32.8%). Within the cereal category, nearly all (over 85% on a weight basis) is composed of wheat.

The situation for other products is a bit more mixed and is presented in Table 2. Ranking on the basis of weight shows cereals followed by vegetables, fruits, milk, sugar, meat, root crops, oil and fat, fish, pulses, and eggs. In terms of expenditures, cereals are followed by meat, oil and fat, vege-

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<sup>1/</sup> FAO food supply analysis sheets for the 1964-66 period (prepared for the Indicative World Plan) show lower figures for both calories (2,126) and protein (62.5 gms.). They include estimates for unreported production (285 calories and 10.9 gms. of protein).

<sup>2/</sup> "Comité Sectoriel de la Nutrition et de la Planification Alimentaire," Rapport du S/Comité de l'Economie Alimentaire (T. Jaouadi, rapporteur), August 1968, p. 2.

Table 1. ESTIMATED AVERAGE DAILY NUTRIENT INTAKE  
PER PERSON, TUNISIA, MID-1960's

	<u>Rural</u>	<u>Urban</u>	<u>Total</u>
<b>I. <u>Actual Intake:</u></b>			
Calories	2,250	2,600	2,340
Protein (g.)	63	74	65
(% animal)	(17)	(34)	(22)
Vitamins			
A (UI)	3,080	5,000	3,560
B <sub>1</sub> (mg.)	2.0	1.9	2.0
B <sub>2</sub> (mg.)	1.3	1.7	1.4
C (mg.)	58	95	67
Calcium (mg.)	465	680	520
<b>II. <u>Percent of Population Below:</u></b>			
Calories: 2,000	30	12	25
Protein: 55 g.	30	12	25
(% animal: 20)	(70)	(34)	(61)
Vitamins			
A: 4000 UI	50	27	44
B <sub>2</sub> : 1.4 mg.	70	35	61
C: 55 mg.	30	12	25
Calcium: 400 mg.	50	27	44

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Source: "Comité Sectoriel de la Nutrition et de La Planification Alimentaire," Rapport du S/Comité de l'Economie Alimentaire (T. Jaouadi, rapporteur), August 1968, pp. 3, 5.

Table 2. ESTIMATED PER CAPITA FOOD CONSUMPTION AND EXPENDITURES BY TYPE OF PRODUCT, TUNISIA

<u>Type of Product</u>	<u>Consumption</u> (1968)	<u>Expenditures</u> (1965-68)
Cereals and cereal products	145.0 kg.	32.8%
Vegetables	86.5	9.0
Fruits	65.0	4.3
Milk	62.0	3.5
Sugar	18.3	4.9
Meat	15.8	14.6
Root crops	15.0	2.4
Oil and fat	14.4	10.5
Fish	5.3	2.1
Pulses	4.0	2.2
Eggs	2.4	1.1
Tea and coffee	NA	6.5
Spices	NA	3.2
Other	NA	2.9
<hr/>		
Total	433.7 kg.	100%

Sources:

Consumption. Plan de Développement Economique et Social, 1969-1972, Agriculture et Pêche, Secrétariat d'Etat au Plan et à l'Economie Nationale, Vol. 2 (December 1968), pp. 131-132.

Expenditures. "La Consommation et les Dépenses des Ménages en Tunisie, 1965-1968," Secrétariat d'Etat au Plan et à l'Economie Nationale, December 1968, pp. 208-211.

tables, tea and coffee, sugar, fruits, spices, milk and dairy products, root crops (potatoes), pulses, fish, and eggs. Tea and coffee in themselves have no food value, while spices have little if any; together they account for nearly 10% of total expenditures.

The pattern of expenditures varies geographically. Total expenditures on food in the rural areas are only about 60% of those in large cities. Yet food accounts for 57% of total rural expenditures as opposed to 40% in the urban areas. The distribution between products also varies: the rural areas spend a larger proportion on cereals, oil and fat, tea and coffee, sugar, and fruits; the urban areas spend a larger portion on meat, vegetables, milk and dairy products, spices, root crops (potatoes), pulses, fish, eggs, and other products.<sup>3/</sup>

### C. Relation of Nutrients and Commodities

The importance of individual crops varies according to the individual nutrient.

Cereals, because of their dominant place in the diet, play a correspondingly larger role in nutrient supply than would be the case in more economically advanced nations. In 1968, it is estimated that cereals accounted for 56% of total calorie intake, 67% of proteins, 80% of vitamin B<sub>1</sub>, 52% of vitamin B<sub>2</sub>, and 30% of calcium.

The commodity ranking by individual nutrient was as follows:

- Calories. Cereals (56%), followed by oil (15%), sugar (8%), fruits (5%), and milk (5%).
- Protein. Cereals (67%), followed by milk (10%), meat (9%), vegetables (4%), and pulses (4%).
- Vitamin A. Vegetables (70%), followed by fruits (18%) and milk (7%).
- Vitamin B<sub>2</sub>. Cereals (52%), followed by milk (20%), meat (9%), vegetables (9%), and fruits (5%).
- Vitamin C. Vegetables (69%), followed by fruits (25%), potatoes (4%), and milk (3%).
- Calcium. Milk (41%), followed by cereals (30%), vegetables (18%), fruits (6%), and pulses (2%).

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<sup>3/</sup> "La Consommation et les Dépenses des Ménages en Tunisie, 1965-1968," Secrétariat d'Etat au Plan et à l'Economie Nationale, December 1968, pp. 208-211; and "Comité Sectoriel...", op. cit., pp. 3, 18.

Clearly if nutrition is to be improved, attention needs to be given to existing food consumption patterns.

The Tunisian Government has projected that the per capita domestic demand for food products will expand as follows by 1980:4/

Fish	166	Potatoes	121
Meat	150	Vegetables	117
Eggs	150	Pulses	117
Milk	140	Sugar	117
Fruits	131	Oil	112
		Cereals	103

In addition, exports of certain fruits (especially apricots) and vegetables (tomatoes) are expected to increase.5/

From a nutritional point of view, an expansion in domestic demand, assuming it materializes, could mean an improvement in composition of diet. . The key question, however, centers on distribution: if the demand comes from the wealthier sector of society, as is likely, the impoverished may not be materially better off.

#### D. Special Problems

While low income is perhaps the major cause for poor nutrition in some rural areas, there are others. The climate in many interior areas severely limits the variety of agricultural products that can be raised. The remote and scattered location of individual farms makes transportation difficult and expensive. Storage facilities in the home are limited at best; refrigeration is nonexistent.6/ The nutritional problems may well be particularly severe in the case of the migrant nomads.

Aside from reference to the difference between the nutrient situation in country and city, we have spoken only of national and annual averages. Within these averages, many special needs or problems are hidden. Among the most important of the needs are the special nutritional requirements of expectant

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4/ "Comité Sectoriel...", op. cit., p. 18 (Table 2, chart 1). Since these projections were made, income growth has not increased at the expected rate; the higher figures may be revised downward.

5/ For details on the outlook for fruits and vegetables, see G. Coda-Nunziante "Tunisia," in Horticulture in the Mediterranean Area: Outlook for Production and Trade, FAO Commodity Bulletin Series 42, 1968, pp. 146-165.

6/ T. Jaouadi et al., "Les Aspects de la Nutrition en Tunisie," Third African Conference on Nutrition and Child Feeding, Tunis, Doc. 14, May 25, 1970, 43 pp.

and nursing mothers, babies, and young children. The nutritional problems of rural residents who have migrated to the fringes of cities in a vain search for work are not well known. Also, annual figures do not reveal seasonal deficits; these can be serious in the case of perishables during the hot, dry summers. More research is needed on these special nutritional problems.

## II. CONCEPTUAL APPROACHES

Given a severe nutritional problem, what approaches are conceptually open? The economist might divide them into two main groups, those centering about demand and those centering about supply, or some combination of the two.

### A. Demand

There are two major dimensions to demand. It is necessary to differentiate between (1) potential and (2) effective demand. Potential demand is interest in or desire for a product. When this interest is backed by purchasing power it becomes effective demand. Each one is a necessary but not by itself sufficient condition. Both are needed.

#### 1. Potential Demand

There is undoubtedly a strong potential demand for food in general among most of the Tunisian population. The demand, however, may not be focused so much on improved nutrition as on obtaining increased food to provide a "full" feeling. Knowledge of and interest in a well-rounded diet in nutritional terms appears limited. One way of helping increase this interest is through nutritional education. Another is through commercial advertising and promotion of attractive and nutritious products (though the appeal may have to be other than on a nutrition basis).

#### 2. Effective Demand

Improvement of nutrition usually costs money. In a relatively poor country like Tunisia, this is a matter of major concern. Conceptually, effective demand can be increased by improving incomes or lowering costs to consumers. Either process is easier to outline than to accomplish.

##### a. Improvement of Incomes

If the incomes of the poor are increased, they will initially spend a large proportion of the added income on food. After meeting certain minimum food needs, consumers will spend a decreasing portion of added income on food (Engel's law): still, the absolute amount spent on food will increase. Hopefully these increased expenditures will go not only for calories but will include other needed nutrients. However, there is no guarantee that this will happen. In the United States, for example, surveys have shown that "there is only a loose association between income level and nutritional quality of diets."<sup>1/</sup>

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<sup>1/</sup> Stephen J. Hiemstra, "Food, A Special Issue in Welfare Programs," National Food Situation, February 1970, p. 26. The former Chief of Food

In any case, the process of increasing the incomes of the poor is not easily accomplished in a developing nation. There simply are not the resources available for large-scale income transfers. Rather, income improvement is intertwined with national economic development - a long, difficult and uneven process. The poor, moreover, are often among the last groups to experience any increase in income.

b. Reduction of Costs

Perhaps a more direct and immediate way of increasing consumption of nutritionally superior foods is to lower their cost to consumers, or to minimize price rises. The Tunisian Government has done this to some extent by holding the price of wheat, bread and a few other commodities down - a process which undoubtedly has been aided by the availability of PL 480 wheat. The problem here is that while bread is widely consumed by the poor, it is presently far from being a nutritionally superior food. Moreover, government control or subsidization of prices in the short run is not the same thing as taking steps to increase the efficiency of production and marketing which will make lower prices possible in the long run.

B. Supply

Demand places a severe restraint on what can be accomplished in improving nutrition through supply. What are the possibilities open within these confines?

1. Existing Products

Any program which seeks to improve nutrition must start with existing foods. Nutritionally, there are four general approaches open:

a. Increase Natural Nutrient Levels

Natural nutrient levels can be increased by (1) breeding in improved nutritional factors or (2) by modifying processing. American plant breeders, for example, have developed a new corn variety with twice the normal level of lysine and tryptophan; work is now underway to see if the same can be done for other grains.<sup>2/</sup> Processing techniques can sometimes be adjusted to con-

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<sup>1/</sup> (cont'd.) and Nutrition in AID's India Mission observes that more money for an impoverished family does not automatically lead to a better diet because of (1) an increased expenditure on non-food items and (2) the fact that food expenditures may not go for more nutritious products ("India Faces Massive Nutrition Problem," Front Lines, April 22, 1970, p. 20).

<sup>2/</sup> Paul J. Mattern, "New Approaches to Amino Acid and Vitamin Improvement of Cereal Products: Protein Improvement by Breeding," Protein-Enriched Cereal Foods for World Needs (ed. by Max Milner), American Association of Cereal Chemists, St. Paul, 1969, pp. 234-244; The Protein Gap, AID's Role in Reducing Malnutrition in Developing Countries, Agency for International

serve a higher proportion of the natural nutrients: in wheat milling, a higher extraction rate will provide a more nutritious product (but one at the same time which may have lower consumer acceptance). Or other natural products of high nutrient level might be blended in.

b. Produce More Nutritious Products

Clearly, not all agricultural products are of equal nutritional value. In terms of Tunisian needs, increased production of pulses (beans) could be of great benefit: they are not only high in biologically utilizable protein, but can be fairly widely raised and easily stored in dried form. Unfortunately, however, the demand for pulses in Tunisia is not strong.<sup>3/</sup> Peanuts might have better demand prospects, but they - like soybeans - may require too much water to raise. Still, there may be some opportunity for the substitution of pulses for less nutritious crops, and it should probably be explored.

At present, practically all commercial vegetable production is concentrated in the north. If there are possibilities for increased home production of vegetables throughout the country, a significant contribution could be made to nutrition. Carrots, for instance, are an important potential source of vitamin A, while tomatoes contain large quantities of vitamin C. And, as we have noted, pulses are a good source of protein. A basic problem with home production of vegetables would be their seasonal nature; they could probably be grown only during the wet season in some of the areas of greatest need.

Increased production of animals and animal products would of course make a significant contribution to protein supply. But there are severe limitations on both supply and demand in Tunisia. Dairy and poultry products would perhaps be in the strongest position, but even they might be too expensive to be accessible on a regular basis to anyone but the high income consumer.

c. Processing

Increased processing could make additional supplies of food available during the dry season. There are two problems with this approach in terms of commercial processing. One is the lack of effective demand for the more expensive processed product. The other is the wide variations in production, due to the vagaries of weather.

Still, several possibilities are open. One might be increased drying. Such products are relatively easy to prepare, package, distribute, and store. They could help get around the problem of seasonality of supply. Prospective

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<sup>2/</sup> (cont'd.) Development, Bureau for Technical Assistance, 1970, pp. 21-22; Howard S. Sprague, "The World Protein Problem," War on Hunger, April 1970, pp. 3, 14, 15.

<sup>3/</sup> Jacques May, The Ecology of Malnutrition in Northern Africa, Hafner Publishing Co., New York, Studies in Medical Geography, Vol. 7, 1967, pp. 82, 84.

products include fish, milk, and certain vegetables and fruits (though it might be cheaper to import certain products such as PL 480 milk). An alternative to commercial processing could be provided by home or community canning.

#### d. Fortification

One of the most promising ways of quickly improving the nutrition of low income groups is to fortify the wheat or wheat products they consume with protein additives,<sup>4/</sup> vitamins, and minerals. A large-scale test of such a program utilizing lysine as the protein additive is presently getting underway in southern Tunisia. The Institute also plans to evaluate the use of wheat-soy blend (WSB) and fish protein concentrate (FPC). All U.S. wheat flour provided under PL 480 Title II programs is enriched with vitamins B<sub>1</sub>, B<sub>2</sub>, niacin, and iron, and is fortified with vitamin A and calcium (see Appendix B).<sup>5/</sup>

One of the big factors conditioning the future course of such activities will be cost: can it be kept low enough for the low income consumer to pay, or can the process be financed or subsidized by the Tunisian Government or by foreign nations and/or international bodies? Conceivably, products other than wheat - such as soft drinks - could be fortified, but even if technical difficulties could be solved the problem would be to see that they get into the hands of those who need them most. Even fortified wheat would not reach everyone: farmers who consume only their own wheat production would have to be approached in some other way.

#### 2. New Foods

There is a vast potential array of nutritious new products available and no attempt will be made to summarize them here.<sup>6/</sup> They are mainly of pro-

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<sup>4/</sup> Protein additives may take the form of (1) protein concentrates such as soybean flour, dry skim milk, or fish protein concentrate, or (2) amino acids such as lysine, threonine, tryptophan, or methionine. Specification of the most appropriate amino acid depends on identification of the one which is limiting in specific commodities and individual diets. Lysine is the limiting amino acid in wheat. Some nutritionists think that in the absence of near-adequate calorie levels, supplemented protein may be metabolized largely as calories; hopefully the fortification project will shed some light on this matter.

<sup>5/</sup> As used here, enrichment means the restoration of nutrients lost in milling (a 65 to 75% extraction rate is required), while fortification involves raising the nutrient levels well above those found in the natural state.

<sup>6/</sup> These have been extensively reviewed by Aaron M. Altschul. See, for example, "Food: Proteins for Humans," Chemical and Engineering News, November 24, 1969, pp. 73-81.

cessed form, though conceivably some new high-protein crop, for instance, could be introduced for cultivation in Tunisia. Of the many processed foods, only a few have been tried in Tunisia.

The International Milling Company, under contract with AID, recently carried out consumer tests on four foods fortified with high-protein wheat fractions: couscous (entirely wheat), chorba langues d'oiseaux (a pasta product), chocolate beverage mix, and breakfast cereal. The four were first tried at a trade fair; all were well received except the breakfast cereal. The couscous and chorba items were then placed in stores. They did not sell well, partly - it is thought - because the product was too dark and because of brand loyalty to existing products.<sup>7/</sup>

A new high-protein product which was developed in Algeria as a cooperative project of UNICEF, FAO, and WHO will likely be introduced in Tunisia soon.<sup>8/</sup> Known as "Superamine" it is basically composed of wheat flour, chick-pea flour, lentil flour, skim milk powder, and is enriched with vitamins and minerals. It can be used as a weaning food or for the manufacture of pasta products. Acceptability studies have been conducted by the Institutes of Nutrition and Statistics; the product appears to be well received. It will be manufactured in a plant operated by the government on a non-profit basis. The retail price is expected to be much lower than comparable products.

The basic problem with new food is to develop a product which can be produced and distributed cheaply and which will be accepted and purchased by low income groups. The IMC products and others have not yet met this test. "Superamine" has not yet been sold directly to consumers in either Algeria or Tunisia (sales in Algeria have been to the government for institutional use). If there is continuing difficulty in moving such products through commercial channels, they might be fitted into institutional feeding programs.

### 3. Feeding Programs

Three feeding programs are conducted in Tunisia which are directed to groups with special nutritional needs. One reaches expectant and nursing mothers; the other two reach young children.<sup>9/</sup> They are directly supported

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<sup>7/</sup> "Feasibility Study for Locally Produced Wheat Based Protein Food Products in Tunisia," International Milling Company, January 1970. The IMC ~~couscous~~ was quite different in appearance from the local product. The dark color was evidently brought on by drying at high temperatures.

<sup>8/</sup> The background of this product is described by G. D. Kapsiatis in "History and Status of Specific Protein-Rich Foods: FAO/WHO/UNICEF Protein Food Program and Products," in Milner, op. cit., pp. 258-262. The same agencies will help sponsor the product in Tunisia. SIDA, the Swedish AID agency, will also be involved.

<sup>9/</sup> A review of the latter two programs as of 1966 is provided in Gene S. White and Jean B. Cutter, "A Report on the Child Feeding Program in Tunisia" (AID, Bureau for Technical Assistance, Office of Nutrition).

by the United States through PL 480 Title II donations, though administration is shared with other groups and the Tunisian Government.

The United States provides dry milk to UNICEF which in turn distributes it to maternal child care centers. It is by far the smallest program, reaching only 18,500 persons in FY 1970, but could be expanded.

Preschool children are reached through a feeding program in municipal centers. In FY 1970, an estimated 170,000 children received food in 320 centers. The primary U.S. commodities involved are wheat flour, dry milk, and soybean oil. This program is to undergo special study in the coming year in order to improve the efficiency of operation.

Primary school children (ages 6-12) are provided food through a school lunch program. This is the largest of the three programs: in FY 1970, U.S. food reached nearly 430,000 needy children, perhaps half of the total enrolled in Tunisia. The United States principally provides wheat flour, dry milk, and soybean oil. Three voluntary agencies supervise distribution: CARE (north), Catholic Relief Services (central) and American Joint Distribution Committee (south). In addition to primary schools, small quantities - less than 10% of the total - are distributed to other grades and other institutions (hospitals old age homes, etc.).<sup>10/</sup>

The three programs provide an excellent channel for reaching groups which most need improved nutrition.<sup>11/</sup> One obvious limitation of school feeding is that schools are only in operation seven months a year. Possibly the preschool feeding program, which operates year-round, could be enlarged the other five months.

### C. Combination Supply and Demand

Most nutritional programs will have both a supply and demand interrelationship. Particularly good examples are provided by food for work and price discrimination.

#### 1. Food for Work Programs

Two food for work programs are conducted in Tunisia. They aid nutrition through both supply and demand. The programs offer the unemployed both a cash wage (which is paid for by the Tunisian Government) and a basic food allowance. The latter is provided by PL 480 Title II or the World Food Program. The cash wage may, of course, be used to buy further food.

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<sup>10/</sup> Current details on the school feeding programs may be found in Department of State Airgram A-475 from Tunis, September 8, 1969, 15 pp. (PROP-Title II).

<sup>11/</sup> Other institutional feeding programs cover only another 35,000 individuals. They are outlined in Jaouadi, op. cit., pp. 23-24a.

SCHOOL FEEDING PROGRAM



Sack used for PL 480 Title II wheat flour shipped to Tunisia. Most of this flour is used in the primary school feeding program. Note that it is enriched and partially fortified.

School lunch in a regional town. Hot meal. Milk prepared from dry skim milk powder is usually served in the morning rather than at lunch. (Photo courtesy of US/AID Tunis.)



School lunch in a rural town. Cold meal. (Photo courtesy of CARE-MEDICO, Tunis.)

Typical rural school in northwestern Tunisia. Canteen facilities in schools such as this are very limited.

Regional warehouse and distribution center for PL 480 Title II food, Le Kef. Operated by the Comité National de Solidarité under the supervision of CARE. The truck was provided by CARE.

Vocational training in agriculture, oasis area of Cheninni-Gabes. Basic diet of participants in such programs is supplemented by the World Food Program. (Photo courtesy of USIS, Tunis.)

The PL 480 food for work program in Tunisia, known as "Lutte Contre le Sous-Development" (LCSD), was the first of its type in the world. It originated in the drought year of 1958 and has been renewed annually since. America provides wheat which is locally milled; through FY 1970, some 872,000 tons of wheat valued at \$121 million (CCC value and freight) has been provided. It is estimated that the food distributed through this program reaches at least 450,000 people (workers and dependents), approximately 10% of the population, and 30 to 40% of the unemployed male labor force. The program probably reaches those with the greatest nutritional need since LCSD employment is accepted only as a last resort.<sup>12/</sup>

The World Food Program has sponsored somewhat similar activities since 1965. There are, however, two differences. First, the WFP establishes specific projects of two to five years, generally relating to rural areas or vocational training (in the latter case the WFP supplements the basic diet). Secondly, the WFP provides a wider range of commodities: recent agreements, for instance, have included corn, wheat, wheat flour, edible oil, sugar, pulses, dried skim milk, and cheese. The United States is a principal supplier of many of these items. Since 1965, nine projects valued at \$42 million have been approved.

A recent AID report indicated that attempts to interest the Government of Tunisia in accepting foodstuffs other than wheat under the PL 480 Title II program have "generally met with a negative response, due primarily to the problems connected with the distribution of other commodities and the non-acceptance of Tunisians of certain other foods." It adds that the WFP is encountering problems along this line due to non-acceptance of cheese.<sup>13/</sup> If, however, the U.S. wheat could be fortified with protein supplements, vitamins, and minerals, a broad range of nutritional needs could be better met. We shall say more about fortification later.

## 2. Price Discrimination

Nutrition might conceivably be improved by making further use of an economic concept known as price discrimination (sometimes referred to as a two price system or selective pricing). A variation of this procedure is currently being used for vegetable oils.

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<sup>12/</sup> Department of State Airgram TOAID A-476 from Tunis, September 8, 1969. Details are provided in the "Task Force Report on the PL 480, Title II, Food for Work (LCSD) Program in Tunisia, 1966-1969," October 1, 1969, 60 pp. (attachment to TOAID, October 31, 1969).

<sup>13/</sup> "Task Force Report...", op. cit., p. 38. Discussions with the WFP officer in Tunis confirmed that there had been some difficulties with cheese and that egg powder required educational efforts (conversation with Joaquin P. Ramirez Lopez, March 18, 1970).

a. The Concept

Price discrimination is not a new idea.<sup>14/</sup> Nor is the thought of applying it to food for the benefit of low income groups.<sup>15/</sup> In fact, it was the basic theory behind the establishment of the Food Stamp Plan in the United States. But it has been less consciously applied - if at all - to improve nutrition in less developed nations.

Traditionally, price discrimination is used by a monopolist to maximize revenue. It may be practiced when the monopolist is faced with two distinctly different demand schedules for a product, one of which is more elastic than the other. Product prices and/or quantities are then adjusted in each market until marginal revenues are equalized. At this point, prices are raised and quantity lowered in one market and prices lowered and quantity increased in the other.

In terms of nutrition, the process might be utilized to: (a) raise food prices to high income consumers and reduce them to low income groups, or (b) raise prices on less nutritious foods and lower them on more nutritious products, or (c) some combination of the two.

b. Application to Tunisia

Could these practices be carried out in Tunisia? It appears that they might. Although we will look at only two possibilities, it should be recognized that other variants are possible, especially if the goal of profit maximization is relaxed.

In the case of price discrimination between high and low income consumers, it is essential that the markets be separated. This might be done through the introduction of a grading system (at present formal grades are not used in Tunisia).<sup>16/</sup> Higher prices would then be charged for the fancy grades and

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<sup>14/</sup> Jules Dupuit seems to have captured the idea in 1844 in an article in the Annales de Ponts et Chaussées. (Frederick V. Waugh noted and translated this paper in the 1930's; for a recent assessment of Dupuit's contributions, see Robert B. Ekelund, "Price Discrimination and Product Differentiation in Economic Theory: An Early Analysis," Quarterly Journal of Economics, May 1970, pp. 268-278.)

<sup>15/</sup> See Frederick V. Waugh: (with F.L. Burtis and A.F. Wolf) "The Controlled Distribution of a Crop Among Independent Markets," Quarterly Journal of Economics, November 1936, pp. 31-37; "Market Prorates and Social Welfare," Journal of Farm Economics, May 1938, pp. 403-416. The general differential effects were noted by Joan Robinson in The Economics of Imperfect Competition, Macmillan, London, 1933, chp. 16.

<sup>16/</sup> This idea, cast in terms of meat, was suggested by Dr. R. P. Dahl. Another variation, far removed from the situation in Tunisia, is

lower prices for the ordinary grades. Grades are not customarily related to nutritional qualities so no one would lose in this sense. The lower price for one grade would mean that the poor could increase their purchases or maintain the same quantity and use what is in effect added income to buy other - and hopefully nutritious - products.<sup>17/</sup>

Price discrimination between products of varying nutritional levels might be more difficult in some ways. It would require that the government have monopoly market control over the crops involved, that the nutritious products have a more elastic demand, and that the adjusted price of the desired product be in a price range acceptable to low income consumers.<sup>18/</sup> Just what products fall into these categories in Tunisia, however, is uncertain and would require further investigation. (If there are no prime candidates, then the government might consider moving from pure discrimination into subsidization of certain products.)

There are many reasons why price discrimination might not work in Tunisia - not the least of which are the administrative problems and the lack of a sufficiently large and evenly distributed wealthy class. But the process has as noted, essentially been used for edible oil (see Chapter IV/A/2) and might be expanded to other products.

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<sup>16/</sup> (cont'd.) reported by Waugh. During the early years of the New Deal in America when pigs were being slaughtered to reduce supplies, a meat packer suggested that surplus pork be ground into sausage and sold for a low price to anyone who wanted it. The idea was not adopted. (Frederick V. Waugh, Managing Farm Surpluses, National Planning Association, Pamphlet No. 117, April 1962, p. 66.)

<sup>17/</sup> Another variation was recently provided in India. The Agricultural Prices Commission has recommended lower prices for red than for the preferred white indigenous wheat varieties. "This will enable the authorities to satisfy the requirements of the low income consumer at cheaper rates." ("Report on Price Policy for Rabi Foodgrains for the 1970-71 Season," Agricultural Prices Commission, March 1970, p. 15.)

<sup>18/</sup> It is also assumed that the government has purchased the food from farmers at sufficiently high prices to insure continued production and that losses on one product are offset by gains on another.

### III. THE CASE OF WHEAT

Any effort to improve nutrition in Tunisia must take wheat - by far the major food - into consideration. Here we shall review the major economic aspects of this commodity and discuss some current changes which may relate to nutrition.

#### A. Major Types and Uses of Wheat

There are two major types of wheat raised and used in Tunisia: durum and bread.

Durum wheat (Triticum durum - blé dur) is similar to the durum wheat raised in the Northern Great Plains states in the United States. It is ground to produce semolina flour. Semolina is generally of two types, fine and coarse. The fine flour is used for the manufacture of pasta products, macaroni and spaghetti, and for home bread. The coarse flour is used for couscous, a staple product of the Tunisian diet; couscous may be produced commercially, but in some areas is made at home. Per capita utilization of durum wheat for food in Tunisia is the second largest of any country in the world.<sup>1/</sup>

Bread or soft wheat (Triticum vulgare - blé tendre) is similar to hard wheat raised in the United States for baking purposes. It is commonly milled into a flour known as farina. This is used by commercial bakeries to produce the French or Italian loaf. Farina is also sold for home baking.

Bread and durum wheat may be substituted for each other in production but generally are not substituted in consumption. If there is consumption substitution it is one way: the use of small amounts of farina in blends with semolina to produce pastas and couscous. There is one significant exception: American bread wheat utilized in the food for work program is ground into a semolina-like product which is given to the workers.

#### B. Supply of Wheat

Statistical data on the supply of wheat in Tunisia are not readily available. Here we shall summarize some of the available statistics, primarily with respect to supply.

##### 1. Production

Wheat production fluctuates sharply, largely in response to weather which influences both planted area and yield. Data on annual production

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<sup>1/</sup> R. P. Dahl and J. D. Hyslop, "Wheat Prices and Price Policy in Tunisia," University of Minnesota in Tunisia, Marketing Report No. 2, October 1968, p. 14.

estimates for bread and durum wheat since 1960 are summarized in Table 3. From 1966 to 1969, wheat production was held back by a series of dry years. In the last half of 1969, the country suffered from severe floods and a sharp change in agricultural organization; <sup>2/</sup> still, 1969/70 production is expected to be the highest since 1962/63.

Over the 10-year period from 1960 to 1969, durum wheat represented 82% of total production, and bread wheat 18%. While nearly all wheat production is concentrated in the higher rainfall zone in the north, some durum production extends into the central and southern zones. Yields of both types, which are almost entirely grown under non-irrigated conditions, are among the lowest in the world - generally below 0.5 metric ton per hectare.

## 2. Trade

Tunisia has been a net wheat importer since 1960. Durum wheat was exported through 1966 (except for 1961), but was more than offset by imports of bread wheat. Net annual imports varied from 16,000 to 334,000 tons from 1960 to 1968, according to official statistics.<sup>3/</sup>

An attempt has been made to sort out imports for the last three seasons by type of program. The results are presented in Table 4. The role of commercial imports dropped sharply during this period and that of concessional imports increased correspondingly. The U.S. PL 480 program accounted for a large share of total imports.<sup>4/</sup> Imports under other food programs increased sharply in 1969-70: they included the World Food Program (for which America is the supplier of wheat in the case of Tunisia), the European Economic Community, individual members of the Community, and Canada. The Title II and other wheat was provided as a grant; thus gifts accounted for 37% of wheat imports in 1968/69 and 64% in the disaster year of 1969/70 (the good 1969/70 crop was not harvested until June 1970).

Commercial and Title I imports are expected to drop off to zero in 1970/71; concessional imports will also decrease.

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<sup>2/</sup> Both are discussed by Henry Giniger in the New York Times, February 6, 1970, p. 6. On the change in organization, also see: Benno Sternberg-Sarel, "It's Not Enough to Want It," Ceres, March-April 1970, pp. 30-34; and John L. Simmons, "Land Reform in Tunisia," Agency for International Development, Spring Review, June 1970, 108 pp.

<sup>3/</sup> Annual issues of Statistiques du Commerce Extérieur de la Tunisie, Secrétariat d'Etat au Plan et Aux Finances. The data are on a calendar year basis.

<sup>4/</sup> PL 480 commitments in dollar terms are reported in detail in Appendix A.

Table 3. ESTIMATED PRODUCTION OF DURUM AND BREAD WHEAT IN TUNISIA

<u>Crop Year</u>	<u>Durum</u>	<u>Bread</u>	<u>Total</u> <u>1/</u>
	- thousand metric tons -		
1959/60	365	79	444
1960/61	200	42	242
1961/62	321	72	393
1962/63	529	113	642
1963/64	350	81	431
1964/65	421	100	521
1965/66	300	49	349
1966/67	280	50	330
1967/68	310	73	383
1968/69	220	80	300 <u>2/</u>
1969/70	400	180	580

1/ Total production is under-reported by an estimated 20%.

2/ Earlier estimates placed the crop at 350.

3/ Preliminary.

Sources:

1960-1967. John D. Hyslop, "An Analysis of Some Alternative Cereals Production Policies in Tunisia," University of Minnesota In Tunisia, Marketing Report No. 3, October 1969, p. 5.

1968. Foreign Agricultural Service Report No. TN9007 from Rabat, December 10, 1969 (source of earlier estimate for 1969 cited in footnote 2).

1969-1970. Food for Peace Office, US/AID, Tunis, June 2, 1970.

### 3. Total Supply and Consumption

The total annual supply picture for wheat over the past three seasons is presented in Table 5. Domestic production accounted for less than half of the total supply. Imports represented over half the total supply in two of the three seasons. The increase in supplies in 1969/70 was largely due to the expansion in concessional imports. The supply situation in 1970/71 is expected to improve slightly, largely because of increased domestic production.

Annual consumption of wheat in Tunisia in the late 1960's averaged about 133 kg. per person (flour equivalent). The figure was lower in villages (120 kg.) and in cities (128 kg.), but higher in the rural areas (144 kg.). Nationally, durum wheat consumption (89 kg.) exceeded that of bread wheat (44 kg.). While durum was more important in the countryside and villages, the situation was reversed in the cities where bread wheat consumption was over three times that of durum.<sup>5/</sup>

#### C. Introduction of Mexican Varieties

An Accelerated Cereals Production Program is underway in Tunisia.<sup>6/</sup> Emphasis is being placed on the use of improved wheat varieties and production techniques. Mexican varieties are being introduced initially and will be used for breeding with local varieties. The program promises to have considerable influence on Tunisian production.

##### 1. Quantitative Factors: Area and Yield <sup>7/</sup>

Mexican varieties were first planted during the 1967-68 crop year. Their estimated area has expanded from 1,125 acres (450 hectares) in that season to about 30,000 acres (12,000 hectares) in 1968/69 and an estimated 131,000 acres (53,000 hectares) in 1969/70.

Yields are higher due to (a) the genetic qualities of the varieties themselves, and (b) the fact that they are grown in more favorable areas with improved cultural practices. The average yield of the total Tunisian wheat crop in the 1968/69 crop year (a dry season) was less than 5.0 quintals per hectare. By comparison, yields in production demonstrations averaged 13.6 for a leading Tunisian variety (Florence-Aurore) and 17.0 for four Mexican varieties.<sup>8/</sup>

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<sup>5/</sup> "La Consommation...", op. cit., p. 160.

<sup>6/</sup> The Program is jointly sponsored by AID, CIMMYT (International Maize and Wheat Improvement Center), and the Tunisian Government.

<sup>7/</sup> The data in this and the following section have been computed from information provided by Dr. S. C. Litzenberger, Food and Agriculture Officer, US/AID, Tunis.

<sup>8/</sup> The individual varieties ranked as follows: Inia 66, 20.0; Jaral 66, 14.3; Sonora 63, 15.9; and Tobari 66, 17.8.

Table 4. ESTIMATED WHEAT IMPORTS BY TYPE OF PROGRAM, TUNISIA

<u>Program</u>	<u>1967/68</u>	<u>1968/69</u>	<u>1969/70</u>	<u>1970/71</u> (anticipated)
	- thousand metric tons -			
Commercial	243	66	77	-
Concessional	171	225	458	253
PL 480 <u>1/</u>	171	206	201	106
Title I	152	120	115	-
Title II	19	86	86	106
Other	-	19	257	147
World Food Program <u>1/</u>	-	-	69	25
EEC & EEC countries, Canada	-	19	163	122
Flood relief	-	-	25	-
<b>Total</b>	<b>414</b>	<b>291</b>	<b>535</b>	<b>253</b>

1/ Including wheat equivalent of flour.

Source: Food for Peace Office, US/AID, Tunis, March & June 1970.

Table 5. ESTIMATED TOTAL WHEAT SUPPLIES, TUNISIA

	<u>1967/68</u>	<u>1968/69</u>	<u>1969/70</u>	<u>1970/71</u> (anticipated)
	- thousand metric tons -			
Beginning stocks	34	100	60	33
Production <u>1/</u>	333	383	300	580
Imports	414	291	535	253
<b>Total</b>	<b>781</b>	<b>774</b>	<b>895 <u>2/</u></b>	<b>866</b>

1/ Production of previous season, harvest of which is completed just before or early in fiscal year.

2/ Of this total, about 60 was lost because of the floods.

Source: Combination of data from Tables 3 and 4 and Food for Peace Office, US/AID, Tunis.

Thus, yields in the demonstration plots were 2.7 times as high as the national average for the Tunisian variety and 3.4 times as high for the Mexican varieties. Or to look at it differently, yields for the four Mexican varieties averaged 26% higher than the Tunisian variety under similar growing conditions; yields for the highest-yielding variety (Inia 66) were 47% higher.

The relative performance of the Mexican varieties in 1968/69 varied considerably with the amount of rainfall. They averaged only 3% higher than the Tunisian variety where there was less than 270 mm of rainfall a year, 34% higher where there was 270 to 350 mm, and 48% higher where there was more than 350 mm.

Yields of both Mexican and the Tunisian varieties would be expected to drop off with a shift from demonstration to commercial farm production conditions. And they do. During the 1968/69 season, yields of Mexican varieties on about 12,400 acres (5,000 hectares) averaged 14.8 quintals per hectare as compared to 17.0 on the demonstration plots. When second generation seed (seed multiplied from the previous year's Tunisian crop) was used on another 11,800 acres (4,770 hectares) the average dropped to 13.3. Still, even this figure was 2.7 times as high as the average for the total Tunisian crop.

Thus, the improved practices and the Mexican varieties hold promise of markedly increasing bread wheat production in Tunisia. The amount of increase will depend on many factors including the amount of appropriate land, the annual rainfall, farmer adherence to improved practices, availability of inputs, and profitability of production. The major variety breakthroughs have been with bread wheat; a similar breakthrough is needed with durum wheat.

## 2. Qualitative Factors: Protein and Lysine

If wheat output seems destined to increase in Tunisia, what is likely to happen to nutritional quality - more specifically biologically utilizable protein? There has been some concern that the Mexican varieties may not rate as high as local varieties in some portions of the world. Is this true in Tunisia? We shall consider protein and lysine percentages.

Protein percentages have been calculated for grain from the production demonstration plots included in the 1967-68 Accelerated Cereals Program in Tunisia.<sup>9/</sup> For three Mexican varieties grown on non-irrigated plots, the average protein percentage was 14.5.<sup>10/</sup> By comparison, the average for the Tunisian variety (Florence-Aurore) grown under the same conditions was 14.9. The difference was probably not significant. Both figures are well above an average of 13.5% for 4,100 lines from the World Wheat Collection grown at the University of Nebraska.<sup>11/</sup>

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<sup>9/</sup> The percentages refer to proportion of dry matter. The analyses were done by the Cereals Technology Laboratory of INRAT in Tunis.

<sup>10/</sup> Individual averages were: Inia, 14.1; Tobarí, 14.5; and Jaral, 14.8.

<sup>11/</sup> Mattern, op. cit., p. 238.

Lysine levels have been determined for samples from the 1967-68 Tunisian production demonstrations.<sup>12/</sup> Results for 32 plots, expressed as percent of protein, were as follows: four Mexican varieties, 2.99; Tunisian variety (Florence-Aurore), 2.89.<sup>13/</sup> The average level for the 4,100 samples in the World Wheat Collection appears to have been about 3.00.<sup>14/</sup> Thus the Mexican varieties were slightly above the local variety in lysine and just about average in terms of the World Wheat Collection.

It will be noted that there appears to have been a reciprocal relationship between protein and lysine. If a variety is higher than another in protein, it is lower in lysine. The reverse is also true. This relationship is normal and was found in the World Wheat Collection.

Just what the most appropriate balance should be between protein and lysine in Tunisia is difficult to say; it would depend in part on the nature of the local diet.<sup>15/</sup> Certainly, though, it would be desirable to have more of both if possible. One of the Mexican varieties, Jaral 66, rated higher than the other three on both counts; whether this is a significant difference is not certain.

A final point that might be mentioned is the relative protein and lysine level of durum wheat. Durum definitely has a higher protein level than the bread wheats grown in Tunisia. In the case of the 26 plot samples noted above, a Tunisian durum variety (Mahmoudi) had a protein level of 16.3 compared to 14.9 for the Tunisian bread variety and 14.5 for the three Mexican varieties. Analysis of durum samples from 19 plots revealed an average protein level of 17.7 and a lysine level of 2.75; by comparison the highest ranking Mexican variety (Jaral 66) had an average protein level of 14.9 and a lysine level of 2.98. Hence the higher protein levels in durum seem to be offset by lower lysine levels.

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<sup>12/</sup> Those analyses were conducted by the University of Nebraska.

<sup>13/</sup> The range for the Mexican varieties was from 2.97 for Inia and Tobari to 3.01 for Sonora and Jaral. The protein percentages for the 32 plots were: four Mexican wheats, 14.2; Tunisian variety, 15.1.

<sup>14/</sup> Mattern, op. cit. Also see Edwin T. Mertz "Genetic Alterations of Agricultural Crops," Proceedings, Western Hemisphere Nutrition Congress II, American Medical Association, 1969. p. 48 (the average for 3,500 lines is given as 3.01).

<sup>15/</sup> While a high protein level is the starting point for improved nutrition, it is by itself not a sufficient condition. To become biologically useful, certain amino acids such as lysine must be present in adequate amounts. But the quantity of lysine available is not only a function of the amount in wheat: it may also be provided by other components in the individual diet. How much lysine is available from these other sources in Tunisia is uncertain. More light will be cast on this subject by the lysine fortification project.

All told then, data for 1967-68 (a dry season) suggest that the Mexican bread varieties were quite comparable to the leading Tunisia variety and averages obtained in the World Wheat Collection in Nebraska in terms of protein and lysine. If they were slightly less in protein than the leading Tunisian variety, they were comparably higher in lysine. Compared to the World Wheat Collection, they were above average in protein and average in lysine. Whether similar relationships hold for subsequent seasons is not yet known.

### 3. Consumer Acceptance

Little data is available on trade and consumer acceptance of the Mexican wheat. Laboratory tests conducted in Tunisia on non-nutrient qualities suggest that the Mexican wheats were comparable in some respects and slightly lower in others. If bread produced from the Tunisian variety (Florence-Aurore) could be ranked excellent, bread from the Mexican varieties would rank at least good. Consumer acceptance and the influence of price become more evident as increasing quantities find their way to market.

### D. Marketing, Milling, and Baking

The Tunisian Government essentially has monopoly control over wheat marketing. All wheat marketed by the farmer - about half of total production during the past three seasons - must be sold to the Office of Cereals at prices fixed by the government. Similarly, this group arranges for all imports. The Office of Cereals in turn principally sells wheat to the 18 mills (16 of which are privately owned) who then sell flour at fixed prices to bakeries or wholesalers. A small quantity of wheat is sold directly to consumers through regional and local units of the Office of Cereals. The amount of wheat sold to mills during the 1967/68 season was about 400,000 tons; only some 28,000 tons were sold directly to consumers (who did their own milling)<sup>16/</sup>

The consumer can acquire wheat through purchase or home production. The purchased forms are grain, flour, pasta, or bread (or other baked goods). On a national basis during the 1965-68 period, about 83% of the wheat equivalent was purchased while only 17% was home grown. When the data for the rural areas are sorted out, the quantity purchased is smaller (77%) and home production correspondingly higher (23%)<sup>17/</sup>.

In the previous chapter it was suggested that a higher rate of extraction in the milling process would result in a more nutritious product, but one which is less desired by consumers because of its color and coarseness. Where the wheat is to be distributed through a food for work program, these

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<sup>16/</sup> The 1967/68 data were kindly provided by Belhawsen Khiari, Chief of the Bakery Section of the Office of Cereals, Tunis, June 4, 1970.

<sup>17/</sup> "La Consommation...", op. cit., p. 159.

qualities are advantageous in that they limit resale. The extraction rate on U.S. wheat milled for the LCSD program is several percent higher than is common for imported wheat in Tunisia.

A possible counterpart to this would be the manufacture of brown as well as white bread. Brown bread used to be commercially produced in Tunisia but evidently has disappeared from the market because of lack of consumer acceptance. Some brown bread, as well as a brown couscous, is still made at home in rural areas. Whether such products could be brought back into popularity seems to be considered unlikely, but could be worthy of further attention.

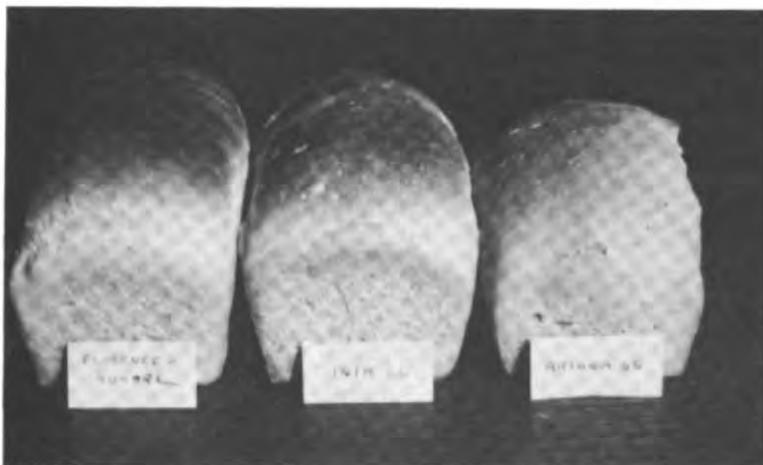
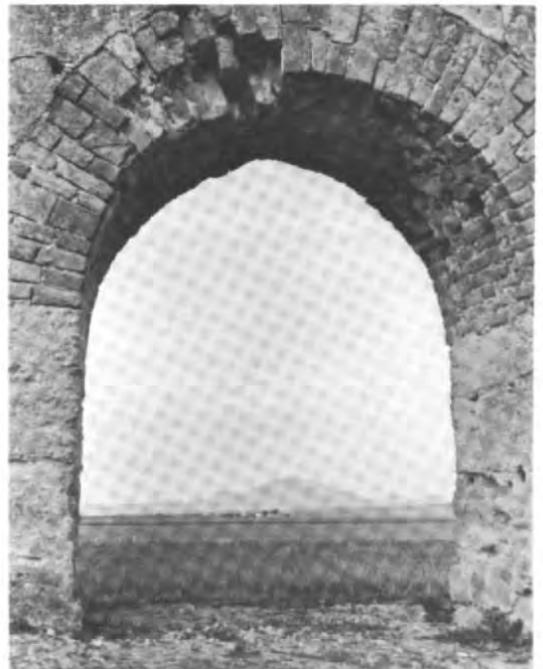
Another possibility would be to fortify commercially produced bread. Such a product is on the market in India and is gaining in popularity. The only limitation from a Tunisian point of view would be that distribution would probably initially be confined to the urban areas, whereas the greatest nutritional needs are in the rural sectors.

WHEAT PRODUCTION AND BREAD



Technician and farmer examine Mexican wheat growing in Tunisia. (Photo courtesy of USIS, Tunis)

Wheat growing area south of Tunis as seen through arch of old Roman aqueduct.



Loaves of bread prepared from improved local variety of wheat (left) and two Mexican varieties (center and right). (Photo courtesy of S. C. Litzenberger)

OFFICE OF CEREALS



Regional warehouse of the Office of Cereals, Le Kef, Regional offices such as this also distribute the semolina flour used in the food for work programs.

Participant in the LCSD program who has just received partial payment for his work in semolina flour, Le Kef.



THE NUTRITION INSTITUTE

Mr. Tahar Jaouadi, chief of the Economics Division.

Architect's drawing of the new \$1.4 million home for the Institute. It is to be financed by AID and the Tunisian Government.



#### IV. POLICY ISSUES

Nutritional deficiencies provide a relatively poor nation like Tunisia with a number of difficult economic policy questions. Resources are extremely limited. How much financial support should be given to nutrition improvement as opposed to many other demands? And within the nutrition area, what is the best way to allocate resources?

The question of how much should be spent on nutrition improvement is extremely difficult to answer. While the budget costs could in part be calculated, it would not be easy to put a price tag on the benefits. Some may be purely medical; others may be social or economic in character. Some are quick and obvious; others - say the reduction of mental retardation in children or the improvement of general health - provide a more subtle long term payoff. The nature and extent of the measurable benefits from improved nutrition are, furthermore, a subject of some disagreement among scientists. A theoretical framework for considering the possible macro-economic aspects of nutrition improvement is presented in Figure 1. 1/

Economics is perhaps of more empirical use in helping to decide among alternative ways of improved nutrition. Some of these have been suggested in the previous portions; some more general issues will be discussed here.

##### A. Self-Sufficiency or Agricultural Trade?

Many less developed nations are currently striving for self-sufficiency in major food crops. Tunisia is presently engaged in such a project for bread wheat. Do such programs represent the most efficient use of resources? Not always. While it is often logical to reduce dependency on imports to reduce foreign exchange costs, whether it is wise to strive for complete self-sufficiency is less certain. Some trade may make sense, especially if the product is more efficiently produced elsewhere. Domestic production resources then can be used for the production of crops with the greatest comparative advantage.

##### 1. Wheat

Tunisia's heavy reliance on imported wheat in recent years has led to strong interest in increasing domestic production. But with foreign wheat lower in cost than Tunisian production, and available under concessional terms, the need for an all-out program is lessened. This is particularly true since a certain portion of the foreign wheat represents donations (which were exceptionally high in FY 1970). Concessional sources, however, cannot always be counted on with the same degree of reliability.

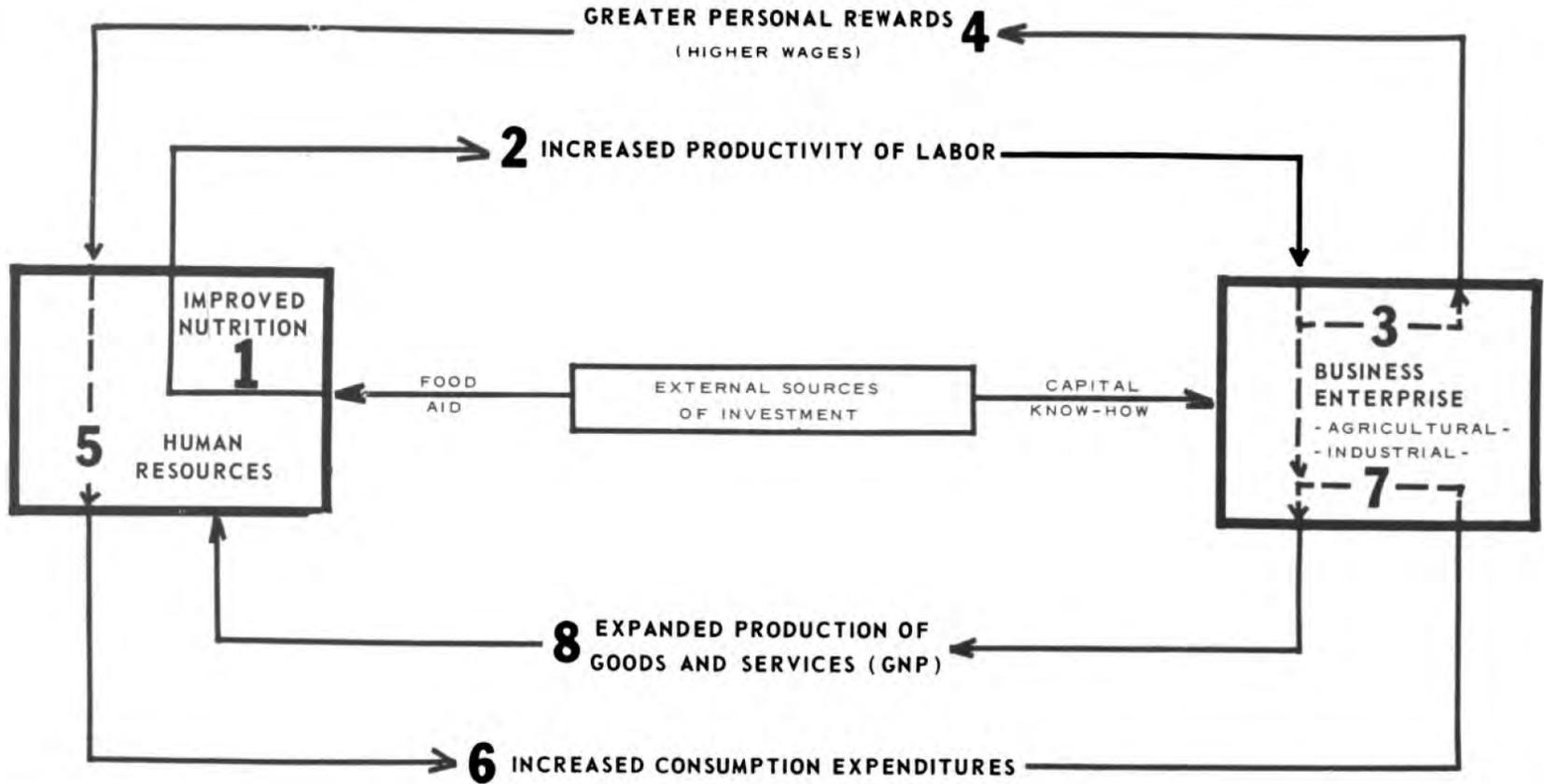
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1/ Figure 1 was developed in cooperation with James Iwan and was previously published in Aaron Altschul, "Combating Malnutrition: New Strategies Through Food Science," USDA, May 21, 1968.

Figure 1.

# THE IMPACT OF IMPROVED NUTRITION ON AN ECONOMY

(A SIMPLIFIED VERSION)



Another question concerns the balance between bread and durum wheat. Bread wheat currently has very limited export prospects; in fact the world market is glutted. Durum wheat has traditionally been exported from Tunisia, but not within the last few years. During that period, the market for durum has weakened. Still, Dahl feels that prospects are stronger than for bread wheat. Hence it would not be wise to stimulate bread production for export at the expense of durum.<sup>2/</sup>

And then there is the question of competition with other potential export crops. Resources placed into wheat production conceivably may be subtracted from production of other products. Whether this has actually happened in Tunisia is not clear. Over the longer run it is hoped that the increased wheat yields will free land for the production of other crops.

Thus, the question of what direction and how far to push wheat production is not easily answered.

## 2. Olive Oil<sup>3/</sup>

Oil is the second most important source of calories in the Tunisian diet. It is also a leading source of fat. Consumption of oils increased about 44% from 1962 to 1968. What were the reasons for this expansion?

Through the early 1960's, olive oil accounted for essentially all of edible oil consumption in Tunisia. In 1962, it was recognized that Tunisian olive oil production was not adequate to meet both domestic needs and an increasing export demand. Since Tunisia has a comparative (and, evidently, an absolute) advantage in olive oil production, and as oil accounts for up to 20% of total export earnings, continued exports were vital. To meet domestic needs, consideration was given to importing cheaper oils for blending.

Such a policy was made possible by the availability of soybean oil, at about half the international price of olive oil, from America under PL 480.

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<sup>2/</sup> See the following reports by the University of Minnesota in Tunisia; John D. Hyslop, "An Analysis of Some Alternative Cereals Production Policies in Tunisia," Marketing Report No. 3, October 1969, 110 pp.; Reynold P. Dahl, "International Trade and Price Prospects for Cereals and Their Implications to Tunisia," Marketing Report No. 5, January 1970, 21 pp. Also see James P. Rudbeck, "U.S. Exports of Durum - A Unique Wheat in World Trade," Foreign Agriculture, March 30, 1970, pp. 2-6.

<sup>3/</sup> This section is based on Osama A. Al-Zand, "Olive Oil Price Policy in Tunisia," University of Minnesota in Tunisia, Marketing Report No. 4, November 1969, 25 pp. Further detail is provided in Al-Zand's Ph.D. dissertation, "Olive Oil Trade and Trade Policies in the Mediterranean Region," University of Minnesota, 1969.

Heavy imports started in 1962/63. The soybean oil was blended with smaller quantities of olive oil in order to preserve the olive oil flavor (soybean oil has not been offered for sale in unblended form in Tunisia). The price of the blended product was set at half the price of pure olive oil; the prices were designed to separate the two markets. The blended oil has found a strong demand. Only about 2% of the total edible oils sold at retail are now pure olive oil (a higher proportion is sold through other channels).

As a result of these policies, the low income consumer has benefited from the availability of lower priced oil and hence has been able to expand his consumption.

The major problem with the program from the Tunisian point of view is that it has been dependent on the availability of PL 480 oil. This may not always be the case. Still, it should be possible to buy soybean (or possibly sunflower) oil from the commercial market at a price below olive oil.

## B. Selection of Nutrition Technique

As we have seen, there are several potential ways to improve nutrition from a supply point of view: (1) adjustments in the type and quantity of agricultural production, (2) fortification of traditional products, (3) manufactured production of more nutritious food products or blends, and (4) distribution of products made available by foreign nations and international organizations. Various combinations of the above and other alternatives are possible. How is a country to allocate scarce resources among them? This question is not easily answered. Some of the major cost and benefit factors which need to be considered are outlined in the following sections.

### 1. Adjustments in Production

Since the Tunisian Government controls farm prices, it can encourage production of products it favors by adjusting farm prices. Which might it favor in economic terms? One preliminary indication could be provided by calculations of the relative cost of nutrients to consumers. Abbott has estimated the world-wide relative cost of protein from various types of products (Table 6). Pulses and wheat were easily the lowest. Skim milk powder was cheaper than might be expected. Dried fish was about eight times more expensive than wheat flour, but still considerably less than other forms of meat. If comparable price and nutrient relationships hold for Tunisia, pulses, wheat, and flour provide the base for comparing costs of alternative crops and products.

Another side of the coin is relative profitability of production. There is little sense in considering production of a commodity if farmers do not find it profitable to raise. There is little information on costs and returns of various crops in Tunisia. One preliminary set of budget figures for crops raised on irrigated land in the north of the country suggests that returns were highest for bread wheat, about equal for durum wheat and sugar beets, less for green peas and forage, and least by far for edible legumes. Thus, wheat continues to rate high but pulses largely drop out of the picture. It

Table 6. RELATIVE COST OF PROTEIN, 1966<sup>1/</sup>

<u>Commodity</u>	<u>¢/lb.</u>	<u>Commodity</u>	<u>¢/lb.</u>
Chick peas	6	Chicken	123
Wheat Flour	11	Beef	164
Dry beans	24	Pork	197
Skim milk powder	31	Eggs	204
Dried fish	89	Lamb	228
Cheese	111		

<sup>1/</sup> Representative prices from around the world. An adjustment was made for the value of calories in the individual items.

Source: John C. Abbott, "Economic Factors Affecting the Distribution of World Food Protein Resources," Protein-Enriched Cereal Foods for World Needs (ed. Max Milner), American Association of Cereal Chemists, St. Paul, 1969, p. 14.

would be useful to have comparable data for non-irrigated areas where most of the agricultural production takes place.

Yet another consideration would be the cost of infrastructure. Should a shift in cropping patterns entail a massive public and/or private capital investment - in irrigation, transportation, storage facilities, communication, etc. - the cost of the shift would obviously be sharply increased.

## 2. Fortification of Grain

Grain can be fortified, as we have noted, with protein additives, vitamins, and minerals. Protein additives may take the form of protein concentrates or amino acids. What are their relative and absolute costs? What else needs to be considered?

The fortification project will provide answers for some of these questions under Tunisian conditions. But this will take several years. What guides are available now? Mr. U. Kracht has adapted some data prepared in the Netherlands which provide some clues.<sup>4/</sup> Taking wheat flour (60 to 70% extraction rate) as a base, the relative costs of adding lysine, soybean flour, and skim milk powder are presented. If these data are normalized on

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<sup>4/</sup> U. Kracht, "Economic Aspects of the Supplementation of Cereals with Lysine," Ad Hoc Group on Amino-Acid Fortification, FAO, May 1969, pp. 8-16.

the basis of product combinations providing 2,000 calories per day, the costs per gram of utilizable protein are very similar. Compared to lysine, soybean flour was 1% less and skim milk powder was 5% more.5/

These figures are subject to several qualifications. On one hand, both soybean flour and skim milk powder contain other amino acids, vitamins, and minerals; lysine does not. On the other hand, the actual amount of lysine added (0.2%) is considerably less than the amount of soybean flour (6%) required to attain the same nutrient level. The difference in amounts has two significant effects. (1) The small amount of lysine does not have any influence on the product in terms of flavor or other qualities while the larger amount of soybean flour may have some detectable effect. (2) The amount of soybean flour to be transported and stored would be 30 times as great as that of lysine; since both would have to be imported, this could be an important consideration in Tunisia.6/

Assuming that lysine is selected for fortification, what would the cost be? In the context of a product combination providing 2,000 calories per day, 1.09 grams of lysine would be added to 542 grams of wheat flour, producing 24.5 grams of utilizable protein. The cost of this amount of lysine, according to the figures reported by Kracht, would be 0.273¢ per person per day or 99.6¢ per year. The costs of the enrichment operation would bring the annual figure up by another cent or so. Thus, the total cost of lysine enrichment on the basis of these data would be a little over \$1.00 per person per year. On a weight basis, the cost of lysine and the enrichment process is estimated at a little over \$5.00 per ton of wheat flour (in East Pakistan, the cost of lysine for a similar level of fortification was recently estimated to be \$4.40 per ton of flour).7/

Whether these general figures would be realized in actual practice in Tunisia is not at all certain. They do not include administrative overhead and probably other costs. Still, if they are at all representative, they certainly suggest that the cost of lysine fortification is not great. The cost of adding vitamins and minerals is much lower; in Tunisia it is estimated to be

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5/ These percentages were developed in part from a total cost figure tabulated from Kracht's paper by David L. Call in "Some Notes on Evaluation of Amino Acid Fortification."

6/ In a new Indian wheat fortification program, local groundnut (peanut) flour, which contains 45-50% protein, is being added. The product has been consumer tested and found satisfactory. See Appendix C for details.

7/ Daniel Rosenfield, Lyle Schertz, and Stanley Gershoff, Possibilities for Cereal Fortification; East Pakistan, U. S. Department of Agriculture, Foreign Economic Development Service (in cooperation with AID), March 1970, p. 14.

a little less than 10% of the cost of lysine.<sup>8/</sup> But any additional cost represents a real burden in a poor country like Tunisia.<sup>9/</sup>

### 3. Manufactured Products

It is probable that new and more nutritious food items will be developed which can be manufactured from Tunisian agricultural products. To the extent that these items can be commercially sold on their own merits, the government need not get directly involved except to provide a favorable investment climate.

It is questionable, however, how far a commercial product is likely to reach into the ranks of the poor who may need it most without some sort of public assistance. Even if the product could be manufactured at a low cost, considerable promotional expense would probably be involved in getting it adopted by a tradition-bound society.

Thus it might be desirable to turn first to some sort of institutional feeding program such as food for work, school lunch, pre-school feeding, etc. The products, in this case, should be designed or presented in such a way that they are not likely to be resold (this is admirably accomplished with the food for work semolina).

The Tunisian variant of "Superamine" may avoid some of these difficulties. It will be low in cost, and its introduction will be assisted by international agencies and the Tunisian Government.

### 4. Foreign Donations

Aside from "Superamine" and the child feeding program, foreign donations are largely tied to food for work type projects. These projects are far from costless to the Tunisian Government because it pays the wage that accompanies the food distributed to workers. Such programs, however, must be judged on the basis of more than their effect on nutrition: they are designed in part to reduce the very extensive unemployment. Other programs such as child feeding operate differently, but still not without some involvement by the Tunisian Government.

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<sup>8/</sup> Estimate provided by Dr. Feissel Ard, Chief of Party for the lysine fortification study, June 3, 1970.

<sup>9/</sup> If this cost is wholly passed on to the consumer, there is a possibility that the poor may reduce the quantity of wheat purchased, worsening their calorie situation. More needs to be known about the demand for wheat and other products to determine the extent to which this might occur. In India, it is expected that the additional cost - about 4% of the retail price - will be transferred to the consumer after the trial period.

It is possible that these programs could be modified so that more nutritious foods are provided at no additional cost to Tunisia. There are, as intimated earlier, some difficulties with this approach when it entails providing a wider range of products. It is difficult enough to handle a staple like wheat, let alone other products which may require special handling or consumer education. Still, more attention might be given to this area.

Fortification of wheat could avoid many of these complications. We have noted that all the wheat flour provided by America including donations through the World Food Program, is enriched and partially fortified; possibly arrangements could be made to also include protein additives.<sup>10/</sup> Similarly, it might be possible to find some foreign group which would be willing to partially cover the costs of fortifying other foreign wheat which is milled in Tunisia.

The problem with relying on foreign assistance as a low cost way of improving nutrition is its fickle nature. It may be here today and gone tomorrow; or, perhaps, it would be more accurate to say that the amount available from various sources may vary considerably from year to year. Some attention needs to be given to developing at least a minimal program which the Tunisian Government would be able to carry on by itself on a regular basis.

### C. Mass or Selective Approach?

In Tunisia, as well as elsewhere, there are certain groups most in need of improved nutrition. The critical group in terms of nutrient quality is generally thought to be expectant and nursing mothers, and newborn and young children. Much of the rest of society could use improved nutrition, but their needs may be more quantitative (caloric) in nature and are often considered less crucial.

In terms of resource allocation, would it be better to (a) try to meet the needs of the critical group first, through products such as weaning foods, and then move to the rest of society, or (b) establish a broad-scale program, such as fortification, first and then subsequently concentrate on any further special requirements of the critical group?<sup>11/</sup> The former approach is tra-

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<sup>10/</sup> In India, the cost of the fortification program during the first five months in each of three key cities is being subsidized by PL 480 funds (Section 104h). In February and April of 1970, 4,500 tons of lysine-fortified bulgur were sent by America to Nigeria to be distributed through international programs (Peggy Sheehan, Food for Peace Office, AID, June 29, 1970).

<sup>11/</sup> Call and Levinson suggest that the improvement of nutrition in the critical group may be considered an investment, while the improvement of adult nutrition (other than expectant and nursing mothers) is more in the nature of a consumption expenditure. (F. James Levinson and David L. Call, "Nutrition Intervention in Low Income Countries: Its Economic Role and Alternative Strategies," FAO/WHO/UNICEF Protein Advisory Group, PAG Document 1.13/1, May 1970, pp. 6-7.)

ditionally used, though some question might be raised as to whether the process ever goes beyond the critical group. Selection of the most appropriate policy would depend on a number of factors.

One of the most important is time. Fortification of wheat could be done quickly and with a minimum disruption of consumption patterns. Similarly, highly nutritious existing products such as nonfat dry milk could also be readily provided though distribution and consumption patterns. The other approaches, such as shifts in production patterns or the development and adoption of new products, would generally take longer. And improvement in nutrition through increased incomes made possible by economic development is, at best, a long term prospect.

A related question concerns cost. A mass program is not necessarily more expensive than a selective one. In India, the AID Mission has concluded that:

In the case of certain nutrients and certain carriers, fortification of the entire supply of a staple is less expensive, frequently far less expensive, than any program designed to reach the target group alone.<sup>12/</sup>

The main reason centers about the differing costs of the delivery system. It is no more expensive to deliver fortified wheat than regular wheat. On the other hand, the cost of moving a specialized product to a certain group may be considerably higher because of handling or distribution requirements.

Clearly, many considerations have to be taken into account in making policy decisions on the type of approach. This matter should - and probably will be - subject to much further study and discussion.

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<sup>12/</sup> "Country Field Submission, FY 1971, India," Annex O (Nutrition), AID, September 1969, p. 16.

## V. IMPLICATIONS FOR NUTRITION INSTITUTE

The Division of Food Economics at the Nutrition Institute will find no shortage of problems to work on. The present professional staff of the Division are well aware of the major nutritional difficulties and are now in the process of studying possible approaches. Since the Institute has been in existence for only a few months, the work of the Division is still in the formative stage.

The Division is, it should be recognized, unique. I know of no other publicly-supported nutrition groups, except FAO, with a professional staff of economists. In the United States, Dr. David Call of Cornell University is the only economist to be associated with a school of nutrition. There are few ready-made examples or lessons in the area of economics that can be transferred to the Tunisia group. It will in large part have to find its own way.

This is especially true in Tunisia because the fields of agricultural and food economics have just begun to be developed. There are currently few if any economists with graduate training at work with any of the government agencies except for the Ministry of Planning. There is no department of agricultural economics at the University of Tunis: only one person in the College of Agriculture offers some training in the area.

This situation led to the establishment of an economic project between AID and the University of Minnesota.<sup>1/</sup> The University has established a team of agricultural economists in Tunis who are working with the Agricultural Development Division in the Ministry of Agriculture to establish an economic unit. Some students have been sent to America for M.S. training and others have been selected. To date, the research efforts of the Minnesota team have been aimed at the wheat and olive policy studies cited in the earlier chapters of this report. Other analytical work has been done on agricultural project investment, the rural labor force, and the livestock industry. Contact between the Economics Division of the Institute and the Minnesota team to date has been very limited. Greater communication between the two definitely should be encouraged.

### A. Economics Division Functions

The members of the Economics Division have a good awareness of the functions they might perform - both in terms of national needs and operations within the Institute. Here I shall outline a few of the major functions which it seems to me should be served.

First, the Economics Division clearly needs to work closely with the other three divisions of the Nutrition Institute as well as other agencies of the Tunisian Government (including the Ministry of Agriculture and the

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<sup>1/</sup> One phase of the program deals with the Faculty of Economics at the University of Tunis and will not be discussed here.

Ministry of Planning), the University of Minnesota team, foreign governments, and international organizations. The division should not only exchange information and ideas but engage in cooperative projects.

One of the first efforts should be to build up a body of statistical information pertaining to nutrition and food economics. This would include the compilation of secondary data from other sources and the development of primary data from nutritional and consumption surveys. These and other data should be used to project future nutritional and food needs.

Another function would be the study of the economics of improving nutrition. This would involve review of the contribution of individual commodities to nutrition and the cost of nutrients obtained from each. It will also analyze the costs and returns of new products and techniques. Special attention should be given to the fortification program now being carried out in southern Tunisia. Where new products have been developed, the Division should be prepared to cooperate in the conduct of consumer acceptance and retail sale studies. It should develop improved methods of analysis and projections under Tunisian conditions.

In a broader context, the Division should be concerned with the role of nutrition in the national economy. That is, it should consider present and proposed government policies in terms of their impact on nutrition. Conversely it should study the national economic implications of improved nutrition. It should maintain liaison with the food programs of foreign nations and international organizations. The Division's role would be of a catalytic and advisory nature: as a catalyst it would try to encourage greater interest in nutrition improvement at the policy-making level; as an advisory group it would provide appropriate data and analyses to policy makers.

## B. Economics Division Organization

With a small staff, the precise organization of the Economics Division is not of urgent importance. It is more important that the essential functions be recognized, priorities set, and the appropriate person assigned to the task at hand.

However, from an administrative viewpoint, it may be desirable to have a more detailed delineation in mind. Accordingly, one has been prepared. It closely follows the functions listed in the previous section.

### 1. Food Statistics

This group will be responsible for the compilation of primary and secondary data related to food and nutrition. It will (a) assemble relevant secondary economic statistics from national and international sources, (b) be responsible for the statistical aspects of the proposed nutrition survey (including sample design, assistance in question construction, coding, data tabulation, and quantitative analysis), and (c) where appropriate, and when resources permit, conduct consumption and other surveys. The personnel in this division will be trained in all relevant phases of statistical analysis.

## 2. Food Economics

This group will be responsible for economic analyses pertaining to food consumption and nutrition. It will (a) interpret and analyze primary and secondary data pertaining to food consumption, (b) assess the costs and possible returns of alternative methods of improving nutrition, including economic evaluation of fortification and new products developed by the Institute, and (c) cooperate in the conduct of tests of consumer acceptance and/or purchases of new and/or improved products. The group will also cooperate with the statistics unit in the preparation of food balance sheets, and projections of future food needs, and the development of better methods of specifying demand functions to be used in making such projections. The members of this section will be trained in consumption economics, production economics (industrial engineering), and in marketing research.

## 3. Food Policy

This group will be concerned with the role of nutrition in the national economy. It will (1) examine present and proposed government policies relating to nutrition, and (2) review food programs sponsored by foreign nations and international organizations. In each case, it will seek to assess the nutritional effect of these programs. Where appropriate, it will suggest ways in which they might make a greater contribution to nutrition improvement. The group will seek to stimulate greater interest in nutritional considerations in the formulation of policy. It will have primary responsibility for liaison with the policy units in other Ministries in the Tunisian Government, foreign food programs (such as Food for Peace), and international food programs (such as the World Food Program).<sup>2/</sup> The personnel in this unit will be broadly trained in economics and policy.

## C. Present Personnel and Proposed Training

The Economics Division at present is small but exceptionally able. It is composed of Mr. Tahar Jaouadi (chief), Dr. Abdessatar Grissa<sup>3/</sup>, and Miss F. Harmel. Each has a different background and different training. But in each case, further training is desirable. It would vary for each individual.

### 1. Mr. Jaouadi

Mr. Jaouadi holds a License (B.S.) in agriculture from the University of Tunisia and has completed a year's further study in nutrition under an FAO

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<sup>2/</sup> Some useful suggestions for such work are provided in the recently published Manual on Food and Nutrition Policy (prepared with the assistance of B.F. Johnston and J.P. Greaves), FAO Nutritional Studies No. 22, 1969, Chp. 6, pp. 66-74.

<sup>3/</sup> Dr. Grissa, as mentioned on p. 4 (fn. 1), subsequently resigned.

Tunisia and has completed a year's further study in nutrition under an FAO program. He served with the Nutrition Section of the Ministry of Agriculture for four years and helped introduce the concept of nutrition into the agricultural portion of the national economic plan.

He is considerably above the level - in terms of formal training, experience, and intelligence - of the average student enrolling for a M.S. degree in agricultural economics in the United States. Yet, the probably does not have sufficient course work in economics to enroll for a Ph.D. A problem with American graduate degrees in terms of Mr. Jaouadi's professional position is that there is presently a degree equivalency problem in the government grade and pay scales (see p. 4, fn. 1).

The French degree of Troisième Cycle appears to fall between an American M.S. and a Ph.D. The recipient is entitled to be called "Dr." The degree is normally obtained in two or three years, the first being spent on course work and the remainder on a dissertation. The course work could be completed in nine months and the remainder of the work done in Tunisia. By contrast, an American M.S. would take at least a year and a Ph.D. several years. At this point in the development of the Institute, it is important that Mr. Jaouadi not be gone from Tunisia any longer than possible.

Should Mr. Jaouadi pursue a Troisième Cycle, it would be at the Institut d'Etudes de Développement Economique et Social at the University of Paris or a comparable institute at the University of Dijon. He has been admitted to the University of Paris program. The two most appropriate course options are:

- Santé, Nutrition, Production Alimentaire.
- Développement Agricole et Planification.

Review of the courses offered under each suggests that a combination of the two options might be most desirable. But since Mr. Jaouadi would be examined and prepare a dissertation in one area, the selection would have to be done with care. Because of his background and training, Mr. Jaouadi thinks that it might be better to enroll in the first (Santé...) and take some courses in the second (Développement,..).

A major further question is financing, since AID could not support training in France. Three possibilities are open and are presently being explored: (1) FAO/UNICEF, (2) the French Government, and (3) the Tunisian Government.

Should these not materialize, then AID funds for training in the United States would provide an alternative. Any one of several schools might be selected. Because of the presence of the University of Minnesota team in Tunis, it might seem an appropriate choice; a limitation is that work in the consumption area at Minnesota was largely headed by Dr. Margaret Burke, and she has recently moved to Washington. Dr. David Call at Cornell works on food

economics in the Nutrition School and this might offer an alternative. Another possibility would be the Food Research Institute at Stanford.

2. Dr. Grissa<sup>4/</sup>

Dr. Grissa holds a B.A. in economics from Nottingham University in England and a Ph.D. in economics from Brown University. He has taught foreign trade in the Economics Department at the University of Connecticut and the University of Tunis. Clearly, his training requirements are of a different nature than Mr. Jaouadi's.

Since Dr. Grissa's background is in general economics, focus should be given to further exposure to agricultural and food economics. Since he has the major skills, he needs only to "brush up" on current work being done in these areas. For this reason a visit of at least several weeks duration with the economics and nutrition divisions of FAO in Rome and a three to six month tour of appropriate U. S. Government agencies and Universities are recommended. The following stops might be included in the U. S. itinerary:

U. S. Department of Agriculture (Washington, D. C.)

Agricultural Research Service (Consumer and Food Economics Research Division)

Dr. Margaret Burke (Food Consumption Branch)

Dr. Daniel Swope (Food Consumption Branch)

Economic Research Service

Dr. Rex Daly (Economic and Statistical Analysis Division)

Dr. W. E. Manley (Marketing Economics Division)

Food and Nutrition Service (Office of the Administrator)

Dr. Stephen Heimstra

Foreign Agricultural Service (Commodity Programs)

Dr. Turner Oyløe

Foreign Economic Development Service (Nutrition and Agribusiness Group)

Mr. Byron Berntson

Dr. Dan Rosenfield

Statistical Reporting Service (Office of the Administrator)

Mr. Emerson Brooks

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<sup>4/</sup> As mentioned on p. 4 (fn. 1) Dr. Grissa subsequently left the Institute. This proposed program is therefore, included only as an example of a possible post-doctoral training program.

Cornell University

School of Nutrition/Dept. of Agricultural Economics  
Dr. David Call (food economics)  
Mr. James Levinson (nutrition economics)

Michigan State University

Department of Agricultural Economics  
Dr. Harold Riley (food marketing in LDC's)  
Dr. Smith Greig or Henry Larzelere (market research)

Department of Food Technology  
Dr. George Borgstrom (world nutrition)

St. Paul, Minnesota

University of Minnesota (Department of Agricultural Economics)  
Dr. John Hyslop (grain policy)  
Dr. Reynold Dahl (policy and marketing)

Commercial grain firms (food processing and market research sections)  
Pillsbury  
General Mills  
International Milling

Stanford University

Food Research Institute  
Dr. Bruce Johnston

U. S. Department of Agriculture (Albany, California)

Western Utilization Research and Development Division  
Dr. Robert Enochian (marketing economist)  
Dr. Clyde Rasmussen (industrial liaison)

Only the initial contact has been listed: other individuals might be added at each stop.

Just how much time should be spent at each place is uncertain. The U. S. Department of Agriculture in Washington would be the major stop and might take from one to two months. The other stops might range from a few days to several weeks.<sup>5/</sup> Perhaps the best thing would be to try to leave the timing open.

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<sup>5/</sup> Up to a month might be profitably spent in California, at Stanford and the USDA laboratory. Brief stops should also be made at the Berkeley and Davis campuses of the University of California.

### 3. Miss Harmel

Miss Harmel is a recent graduate of the University of Tunis and holds a License (B.S.) in agricultural engineering. She has had additional training in statistics. It is expected that Miss Harmel will work on data pertaining to consumption and the nutritional value of food.

Further training in economics, statistics, and nutrition would be in order. Just what form this should take is unclear. Miss Harmel knows very little English and it is questionable whether it would be advisable to send her abroad for an extended period at this time, especially if Mr. Jaouadi continues his studies in France.

If FAO or some other international agency offers a short term training program in French in one of the above subject matter areas, it would probably be the most desirable initial step. Subsequently, further attention might be given to a more extended program.

## VI. CONCLUDING REMARKS

Economics is concerned with man's well-being. It encompasses the social relationships or social organization involved in allocation of scarce resources among alternative human wants and in using those resources toward the end of satisfying wants as fully as possible. The key elements of economic activity are (1) human wants, (2) resources, and (3) techniques of production.

- Richard H. Leftwich 1/

Nutrition improvement is often viewed as a biological problem. In reality it presents almost a classic economic problem: it involves human wants, resources, and techniques of production. The main differentiating feature is that nutritional needs and human wants may not always be the same thing.

Since nutrition improvement presents an economic challenge, it would seem appropriate to develop an economic strategy to deal with it. But few if any countries have done so. Developed nations have taken domestic nutrition pretty much for granted. The situation, however, is beginning to change, as is illustrated by the United States.

Less developed nations, virtually by definition, have at best considerably fewer resources than the developed nations to devote to nutrition improvement. Concurrently, their nutritional problems are much greater. Thus an economic solution to the nutrition problem is especially needed in the developing world. Tunisia is certainly no exception.

Tunisia has, however, taken a large step ahead (and possibly one that is unique among developing nations) by recognizing the economic side of the nutrition problem and setting up a group to help work on it. While the current staff of three is small, considering the magnitude of the work to be done, it could provide the catalyst necessary to organize and mobilize more widespread activity for nutrition improvement.

One area where the Economics Division could make a major contribution is to compute the costs of the fortification of the wheat used in the fortification study now underway. There is, as noted earlier, little information on this subject, especially on a large-scale basis. And since the fortification process will involve lysine, vitamins, and minerals, a relatively wide range of nutrients will be covered.

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1/ The Price System and Resource Allocation, Rinehart and Co., New York, May 1958, p. 2.

While the costs of fortification are measurable, the economic benefits are more intractable. The medical effects of fortification on **pre-school** children will be measured in some detail, but no arrangements have yet been made to try to measure the effect on productivity or performance of school children or adults. Without the establishment of a link between fortification and performance, it will be difficult, if not impossible, for the economist to try to measure the benefits of the process.

The inclusion of measures of performance has been discussed on several occasions. There is, it appears, a considerable professional difference of opinion on the validity of the various testing procedures currently available.<sup>2/</sup> Moreover, there could be severe difficulties in conducting such tests in the remote and very poor villages which have been selected for fortification. Still, it seems that some attempt should be made to test more than medical effects on pre-school children during the course of the project.

Nutrition is an economic as well as a biological problem. The sooner this is more widely recognized by both economists and biologists, the closer the problem will be to solution.

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<sup>2/</sup> It is understood, however, that an attempt is being made to develop some such measures in a concurrent fortification project in Thailand.

VII. APPENDIX

Appendix A

U. S. PL 480 COMMITMENTS TO TUNISIA

	Fiscal Year						
	Thru 1964	1965	1966	1967	1968	1969	1970
	- in millions of dollars -						
Title I							
Local Currencies	37.2	14.6	-	22.6	9.8	7.4	-
Convertible Local Currency	-	-	-	-	-	-	8.0
Dollar Credits	-	-	-	3.2	10.8	11.2	7.9
Sub total	37.2	14.6	-	25.8	20.6	18.6	15.9
Title II							
Govt. to Govt.	133.8	6.4	8.3	5.3	3.4	7.1	7.4
World Food Prog.	-	-	1.4	0.1	1.3	0.5	8.6
Vol. Agencies	5.5	1.5	0.9	1.9	4.0	2.1	2.9
UNICEF	1.0	0.4	0.4	0.3	0.2	0.1	0.1
Sub total	140.3	8.3	11.0	7.6	8.9	9.8	19.0
Total PL 480	386.4	22.9	11.0	33.4	29.5	28.4	34.9

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Source: Food for Peace and Program Offices, US/AID, Tunis, June 1970.

Appendix B

ENRICHMENT AND FORTIFICATION REQUIREMENTS FOR  
WHEAT FLOUR PURCHASED FOR PL 480 TITLE II

<u>Ingredient</u>	<u>Unit</u>	<u>Minimum</u>	<u>Maximum</u>
- per pound -			
Vitamins			
A <sup>1/</sup>	IU	4000	6000
B <sub>1</sub> (Thiamine) <sup>3/</sup>	mg.	2.0	2.5
B <sub>2</sub> (Riboflavin) <sup>3/</sup>	mg.	1.2	1.5
Niacin <sup>3/</sup>	mg.	16.0	20.0
Minerals			
Calcium <sup>2/</sup>	mg.	500	625
Iron <sup>3/</sup>	mg.	13.0	16.5

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1/ Vitamin A Palmitate added in encapsulated or beadlet form.

2/ No calcium fortification for whole wheat flour.

3/ Enrichment.

Source: "Announcement WF-1, Revised, Purchase of Wheat Flour for Use in Export Programs, Terms and Conditions," U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Minneapolis, August 15, 1969.

WHEAT FLOUR FORTIFICATION IN INDIA

A program to fortify atta - a wheat flour used extensively in Indian homes for the preparation of chapatti - was initiated in Bombay in February 1970. Atta flour ground in commercial mills is being fortified with protein concentrates, vitamins, and minerals. The program is to be extended to Calcutta and New Delhi later.

Although most of the wheat consumed in India is ground in small hand-operated domestic units, about 1/6 is processed by roller flour mills. Of this amount, about 1/4 is atta. Atta is the cheapest of all commercial wheat products and is mostly consumed by the poorer portions of the population.

Altogether, eight ingredients representing seven nutrients are being added to atta. The amounts per ton are as follows:

Protein	
Groundnut flour (45-50% protein)	50.0 kgs.
Vitamins	
A	9.2 gms.
B <sub>1</sub> (Thiamine)	1.5 gms.
B <sub>2</sub> (Riboflavin)	1.38 gms.
Niacin	7.60 gms.
Minerals	
Calcium Diphosphate	800.0 gms.
Calcium Carbonate	800.0 gms.
Iron (as Ferrous Sulphate)	96.0 gms.

The product has been consumer tested and found entirely satisfactory. The groundnut flour supply is obtained in India.

The cost of fortification represents a little over 4% of the retail price. To start with, the program is to be wholly subsidized for up to five months in each city by a rupee grant from PL 480 funds (Sec. 104/h). After the trial period, the program is to be financed by increasing the mill price of wheat.

The project is under the direction of the Food Corporation of India and the state food departments. It may eventually be extended nationwide. A fortified bread, known as "Modern Bread," has been produced in government-owned bakeries in India for several years. The atta project, however, could reach further into the poorer classes who are most in need of nutrition improvement.

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1/ Based on: Department of State Airgram TOAID A 353 from New Delhi, April 8, 1970, 5 pp.; and letter from Ashok Kapur, US/AID, New Delhi, May 1, 1970.

## VIII. SUGGESTED READING

The general literature on the economics of nutrition improvement in the less developed nations is not extensive. Those who wish to read further in the field may find the following recent references of particular value.

Aaron M. Altschul: "Food: Proteins for Humans," Chemical and Engineering News, November 24, 1969, pp. 68-81; "Strategies to Combat Malnutrition," U.S. Department of Agriculture, Office of Secretary, April 27, 1970, 10 pp.

Alan D. Berg: "Malnutrition and National Development," Foreign Affairs, October 1967, pp. 126-136; "India Fortifies Its Children," The Washington Post, July 12, 1970, p. C5 (reprinted in Congressional Record, July 14, 1970, pp. S11262-11264).

B. F. Johnston and J. P. Greaves, Manual on Food and Nutrition Policy, Food and Agriculture Organization, FAO Nutritional Studies No. 22, 1969, 95 pp. (\$2.00; available in French and Spanish).

F. James Levinson and David L. Call, "Nutrition Intervention in Low Income Countries: Its Economic Role and Alternative Strategies," PAG Document 1.13/1, May 1970, 26 pp.

Max Milner (ed.), Protein-Enriched Cereal Foods for World Needs, American Association of Cereal Chemists, St. Paul, 1969, 343 pp.

Daniel Rosenfield, Lyle Schertz, and Stanley Gershoff, Possibilities for Cereal Fortification: East Pakistan, U. S. Department of Agriculture, Foreign Economic Development Service (in cooperation with AID), March 1970, 34 pp.

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Nutrition Newsletter, Food and Agriculture Organization, Nutrition Division, quarterly.

"Strategy for New Protein Supplies," International Agricultural Development, U. S. Department of Agriculture, International Agricultural Development Service (now Foreign Economic Development Service), No. 31, May 1967, 16 pp. (Special issue with articles by Aaron Altschul, Alan Berg, Martin Forman, and F.R. Senti.)

The Protein Gap: AID'S Role in Reducing Malnutrition in Developing Countries, Agency for International Development, Bureau for Technical Assistance, 1970, 24 pp.



