INTERNATIONAL AGRICULTURE SERIES 12

The Tunisian Cereals Sector: An Examination of Production, Prices, and Some Alternatives for the Future

JOHN D. HYSLOP

Institute of Agriculture
University of Minnesota

ABSTRACT

Cereals have long been one of the dominant commodity groups in Tunisian agriculture. About 60 percent of Tunisia's cereal production has been in durum, 10 percent in bread wheat, and most of the rest in barley. Yields of all three cereals have been low by world standards and highly variable from year-to-year. Tunisia is currently making significant progress in improving productivity in cereal output by adopting high yielding varieties of bread wheat.

Demand and production projections from base year 1968 to 1972 and 1980 indicate that Tunisia will continue to be a net importer of cereals despite significant productivity gains over the period. Foreign exchange costs of these deficits will vary somewhat depending upon how land area is allocated among durum, bread wheat, and barley.

Internal prices for cereals in Tunisia have, in general, fallen relative to prices for other commodities. However, these prices are still higher than those at which the cereals could be imported. Tunisia will face important price policy decisions as improved productivity begins to close the production-consumption gap. Lower prices for consumers would aid industrial development since cereals are the major wage good in the Tunisian economy. Yet, lower prices may choke off the incentive for higher productivity in cereal production.

Key words: Tunisia, cereals, durum, bread wheat, barley, demand projections, supply projections, prices, price policy, development.

CONTENTS

John D. Hyslop formerly was an assistant professor, Department of Agricultural and Applied Economics, University of Minnesota, and a member of the University of Minnesota staff in Tunisia. He presently is an agricultural economist with the Foreign Economic Development Service, U.S. Department of Agriculture.

This is a collation of three reports prepared by the University of Minnesota staff in Tunisia:

Wheat Production in Tunisia: Trends and Variabilities. J.D. Hyslop and R.P. Dahl. Staff Paper P70-9. Dept. of Agr. and Applied Econ., Univ. of Minn. June 1970.

Wheat Prices and Price Policy in Tunisia. J.D. Hyslop and R.P. Dahl. Staff Paper P70-10. Dept. of Agr. and Applied Econ., Univ. of Minn. June 1970.

An Analysis of Some Alternative Cereals Production Policies in Tunisia. John D. Hyslop. Univ. of Minn. Mkt. Res. Rpt. 3. Oct. 1969. Ditto.

The scope of the first two papers was broadened to encompass barley, which, along with wheat, accounts for essentially all of the cereals produced in Tunisia. Some suggestions from members of the Tunisian Ministry of Agriculture regarding the third report were incorporated into this bulletin.

The author wishes to thank Reynold Dahl for the use of the reports on which he collaborated and for his comments on this bulletin. Vernon Ruttan was instrumental in the initiation of the work on alternative cereal production policies. Mostafa Soliman reviewed the manuscript and made a number of valuable suggestions.

OFFICE OF INTERNATIONAL AGRICULTURAL PROGRAMS
UNIVERSITY OF MINNESOTA

THE TUNISIAN CEREALS SECTOR: AN EXAMINATION OF PRODUCTION, PRICES, AND SOME ALTERNATIVES FOR THE FUTURE

John D. Hyslop

SUMMARY AND POLICY IMPLICATIONS

Cereals are a dominant agricultural commodity in the Tunisian economy. They provide more than half the calories in the average Tunisian diet and account for about a third of total food expenditures. In recent years, about half the country's arable land has been devoted to cereal production. Of this fraction, about 60 percent has been in durum wheat, 10 percent in bread wheat, and 30 percent in barley.

Tunisia once was a net exporter of cereals, particularly of durum. But increased demand, caused by rising population and per capita income and stagnating production, have turned the country into a net importer of grains. At times during the sixties, Tunisia filled about half her cereal needs with imports.

A continuing rise in demand for human consumption coupled with a developing livestock sector will maintain pressure on cereal output. Some relief is anticipated with increasing technological progress in cereal production, particularly in bread wheat.

This report compiles what is known about the Tunisian cereals sector. The analysis is intended to help policymakers recognize alternative policies, and to suggest some of the areas in which important policy choices lie.

The objectives of this report are:

(1) To examine production relationships that have existed among the three cereals in terms of area, production, and yields, and to examine regional differences among them.

(2) To examine price relationships among Tunisian cereals, both internally and compared with international prices, and to examine recorded Tunisian cereal prices and other prices important to the cereals sector.

(3) To examine the outcomes of alternative future production policy decisions in terms of their effect on cereal availability, trade in cereals, value of production, and net foreign balances.

(4) To discuss appropriate price policies for Tunisia's cereals sector.

Production Relationships

Time series data on cereal production in Tunisia showed that cereal yields vary greatly from year to year. Average yields of bread wheat declined between 1946-68, while those of durum and barley showed no discernible trend.

Average yields of all cereals are about 2.5 - 3.0 times greater in northern Tunisia than in the center and south. The yield variability in central and southern Tunisia is two to three times that in the north. In 1 year out of 6, a farmer producing durum and barley in the center and south will at best get back only twice his seed from the crop.

Average bread wheat yields in Tunisia during 1946-68 were two-thirds higher than those of durum and more than twice those of barley. During 1959-68, average bread wheat yields exceeded those of durum and barley in both northern Tunisia and central and southern Tunisia. Nevertheless, more than five times as many land resources have been devoted to durum as to bread wheat. Durum and barley are cultivated farther into the arid south than is bread wheat, and barley is planted even farther south than durum is. Therefore, average yield and variability data mask the production advantages of durum and especially of barley in this region.

The successful introduction of Mexican short-strawed wheats could substantially increase bread wheat production. Tunisia may be able to achieve self-sufficiency in bread wheat with a relatively small shift in hectarage from durum to bread wheat if agronomists' estimates of the yield potentials of these new wheats materialize.

The influence of environmental factors and the resulting production risks should be somewhat lower with the new Mexican varieties since their growing season is shorter. However, the economic risks associated with the new wheats are greater because of higher inputs in the form of land and seedbed preparation, fertilizers, and possibly herbicides. A crop failure could be costly, so proper management is of utmost importance.

Price Comparisons

Analysis of grain prices in Tunisia revealed that current wheat prices are somewhat lower than the internal prices of other countries in North Africa and many other wheat importing countries. While significant increases in cereal prices occurred in Tunisia between 1949-67, these increases were outweighed by larger increases in the general price level. The real price of bread wheat (current price deflated by the index of wholesale prices) declined 14 percent from 1949 to 1967. The real prices of durum and barley declined by 18 and 7 percent, respectively. Such declines would not be significant had they been accompanied by improvements in production technology, but such improvements did not occur.

Increases in grain prices between 1949-67 also lagged behind prices of other important agricultural commodities such as beef, lamb, and edible legumes. This fact undoubtedly reflects attempts by the Tunisian government to hold down increases in the cost of living for low income consumers, for whom wheat is the largest dietary item.

Cereal prices have not increased as rapidly as prices of most industrial products important to farmers. One unit of cereals could have been exchanged for one unit of the bundle of industrial products in 1956, while in 1967 it could have been exchanged for only 0.69 unit. The only price that did not rise relative to cereal prices was that of ammonitrate fertilizer. This is in part a reflection of a subsidy paid by the Tunisian government to encourage its use.

To analyze farmer response to price changes, areas planted to durum and bread wheat during 1945-58 were studied. Large

price increases for both durum and bread wheat occurred during this period, but price increases for durum were larger than those for bread wheat. Both European and Tunisian farmers responded to these price changes by planting more area to wheat and by planting a larger proportion of their wheat area to durum. A positive relationship also existed between the gross returns per hectare (average yield times price) and the area planted to each wheat for both groups of farmers. European farmers were more responsive to changes in the financial returns of the two wheats, probably because many small Tunisian farmers produce mainly for home consumption and, consequently, produce durum, which is preferred for cous-cous, a staple in the Tunisian diet.

Tunisian cereal prices are higher than prices of grains entering European import markets. In addition, the ratio between wheat and barley prices in Tunisia has been maintained above the ratio in international trade. Recent price adjustments have brought the Tunisian price ratio between durum and bread wheat more closely into line with world price ratios.

Alternative Production Policies for 1972 and 1980

Tunisia anticipates significant gains in cereal output. In this analysis, demand projections were matched against production prospects for 1972 and 1980 under three different self-sufficiency models. These models were:

Model O. Production based on the cereal area distribution shown in the 1969-72 plan for agriculture.

Model I. Area distributed to achieve self-sufficiency in bread wheat, at surplus (for human consumption) in barley, and a deficit in durum.

Model II. Area distributed to achieve a deficit in bread wheat, a surplus (for human consumption) in barley, and self-sufficiency in durum.

Complete self-sufficiency in cereals was not considered an alternative. Achieving it would require yield increases and/or area expansions that are not feasible for Tunisia by 1980.

The results of the model specifications were examined and compared considering three criteria: total cereal availability, net foreign balances, and total value of cereal output.

General results of the analysis were:

1. Cereal availability in 1972 was projected to be 800,000 - 830,000 tons, and to increase to the level of 1.2 - 1.3 million tons in 1980.
2. A deficit in cereals was projected to 1980 despite these production increases. The cereal deficit in 1972 would be in the range of 360,000 - 430,000 tons, falling to around 280,000 - 400,000 tons under the medium demand projections in 1980, but increasing to as much as 490,000 tons under the high projections for that year.
   These deficits, plus imports of nitrogen fertilizer, were estimated at a foreign exchange value of 13.2 - 14.6 million dinars in 1972 and 10.6 - 14.3 million dinars in 1980. World prices for cereals were assumed to fall by 10 percent between 1972 and 1980.
3. The total value of cereal output in 1972 was projected to be about 34 million dinars if valued at present internal prices. If Tunisia should alter its internal prices to reflect world market conditions more closely the value of total cereal output in 1972 would be less, about 23-24 million dinars. Even this range represents a significant advance over current levels.

Because current producer prices for cereals in Tunisia are significantly greater than the world prices assumed for 1972, net imports in that year would result in important trading profits for the Office of Cereals. The trading margins of the national cereal monopoly on its import-export operations were examined in light of the projected net import position for 1972. The value of trading profits in 1972 would range from about 3.1 to about 4.2 million dinars, a markup of about one-third on the foreign exchange value of net cereal imports.

The criteria that seemed to be most important in projecting demand and output to 1972 and 1980 were those having to do with Tunisian cereal imports and exports in terms of both quantity and foreign exchange position.

For both sets of demand projections, model O resulted in the smallest quantities of net cereal imports in both 1972 and 1980. This result is reasonable since model O specifies the greatest proportion of land area in bread wheat, and it is for bread wheat that the greatest technological progress is foreseen. Such an outcome has great appeal, since it results in a closer approach to overall cereal self-sufficiency than the other outcomes. Moreover, the projected differences among the models becomes large by 1980, about 50 percent for the medium demand projections and 40 percent for the high demand projections.

When foreign exchange balances were examined, the result became mixed. For 1972, model II, specifying self-sufficiency in durum wheat, was the least costly and model O was the most costly for both sets of demand projections. The difference between them was small, about 5 percent. For 1980, model O was the least costly and model II was the most costly. Here the difference was greater, about 17-20 percent.

Projections of foreign exchange balances are even more tenuous than projections of import and export quantities. The price of durum in world markets is so volatile as to raise many questions concerning the value of such projections. In such a setting and realizing the importance of durum to Tunisian consumers, it might be prudent to establish a policy bias toward greater self-sufficiency in durum and away from bread wheat exports.

Two Important Policy Choices

Continued Emphasis on Cereals. Improved technological progress in bread wheat production raises the question of whether or not development emphasis on bread wheat should be continued. Would the development effort yield better returns if emphasis were transferred to other cereals or even outside the cereal sector?

Emphasizing animal agriculture or tree crops, for example, appears commendable. Both commodity groups present opportunities for increased employment and capital formation that are not tightly constrained by foreign exchange limitations. In addition, technological progress in bread wheat production automatically provides opportunities for increased output of other cereals through resource substitution.

In any region, one cereal is an almost direct substitute for another in its use of production resources. As bread wheat requirements are filled with a lower total utilization of resources, those liberated from bread wheat production can be applied to durum and barley.

So long as some development effort remains within the cereals sector, the choice is among durum, barley, or continued efforts with bread wheat. Economic efficiency requires that the following criteria be considered:

1. Price relationships among the cereals. Obviously, high value cereals should receive more attention than those of lower value.
2. Development costs. Essential considerations are which cereal provides the cheapest productivity gains, where

existing technical knowledge can be most quickly applied, and where the least research effort is required.

Both criteria must be considered in determining the use of development resources. The result may be a shift in emphasis from bread wheat to one of the others, or it may be continued emphasis on bread wheat.

Equity questions also should be taken into account. Further work with bread wheat or a concentration on durum would favor the north, while improved technology in barley production would apply at least equally to the south. Since the south is not as naturally well-endowed as the north, concentration on barley development at the expense of durum or bread wheat may be the wiser course.

Price Policy for Cereals. Cereal prices in Tunisia, particularly those for bread wheat and durum, are currently higher than prices in international markets. Efforts to increase cereal production through improved technology have not yet resulted in significant output gains. In other words, Tunisian agriculture is on the threshold of development.

Tunisia has a significant number of skilled, progressive farmers for whom improved technology is relevant, and for whom cereal prices are important determinants of income position. But the country also has a significant number of farmers who are less skilled and less progressive, or who presently have command over few production resources. For these people, cereal prices (and improved technology in cereals) may have only short-run relevance as either incentives or income determinants.

Since cereals are so important in the Tunisian diet, they are important wage goods in the growing industrial sector. Their availability to the urban consumer will not increase unless prices decline. Lower prices for a wage good contribute to overall economic development by reducing the pressure for higher industrial wages. At the same time, lower prices for food help expand the market for industrial products by reducing the portion of the urban worker's income that is spent on food.

Currently, up to half of Tunisia's cereal requirements are filled with imports. The import tax is identical in kind to the variable levies exacted by the European Economic Community on its cereal imports. It is a highly regressive tax in that it is borne by the low income consumer, who spends a major portion of his income on cereals.

The Tunisian government would be justified in being reluctant to lower cereal prices so long as significant progress in improving production technology has not been achieved and so long as a significant portion of the country's needs are filled with imports. In addition, but less important, is the difficulty the government might have in finding sources of tax revenue as alternatives to the import duty on cereals.

For the long run, these arguments are less impressive. As cereal production and import substitution continue, the Tunisian government must choose between lowering cereal prices, thereby diffusing the benefits of improved technology throughout society, and keeping prices at their present levels, thereby retaining these benefits within the cereals sector.

INTRODUCTION

Cereals have long been one of the dominant commodity groups in Tunisia's agricultural economy. Estimates indicate that cereals account for more than half the calories in the Tunisian diet[1], and that expenditures for cereals make up about a third of total food expenditures in the country.[2]

Cereal production is as important as consumption. In recent years, cereals have been grown on half the country's 3.2-3.4 million arable hectares. Of this area, 60 percent has been used for durum wheat, 10 percent for bread wheat, and the bulk of the remaining 30 percent for barley. Small amounts of oats, corn, and sorghum also are grown.[3]

Tunisia has been a traditional net exporter of cereals, particularly durum. In recent years, however, exports of durum and barley have been intermittent. All during the sixties, Tunisia was a net importer of bread wheat. Since 1960, Tunisia has filled about half its cereal needs with imports.[4]

Increased reliance on imports during the sixties resulted from rising demand due to increasing population and per capita income and from stagnating production due to a lack of resources. The Tunisian government, with the assistance of USAID, presently is engaged in an intensive effort to adopt new, high yielding varieties of bread wheat, along with improved cultural practices in wheat production. This effort is designed to increase Tunisian cereal production by improving yields, and to reduce the country's dependence on cereal imports.

Technological progress has expanded the range of policy choices available to planning authorities. These choices involve the degree to which self-sufficiency in one or more of the cereals is to be achieved. Factors bearing on these choices are:

1. Anticipated growth of productivity in cereal production.
2. Anticipated growth in internal demand for cereals.
3. Anticipated growth in livestock production.
4. Anticipated world prices for cereals and their relationship to internal prices.

The appendixes to this report are not included here because they are not an integral part of the report. They are references for those wishing to pursue a point more fully. To obtain a copy of the appendixes, write to the Office of International Agricultural Programs, 293 Coffey Hall, University of Minnesota, St. Paul, Minnesota 55101.

The appendixes provide a basis for criticizing the analyses and particularly the conclusions drawn. This is especially true of appendixes D and E as they apply to the analysis of alternative policies for cereal production in Tunisia. Appendixes D and E also provide a starting point for alternative assumptions about future prices or production relationships.

[1] Comité Sectorial de la Nutrition et de la Planification Alimentaire. *Rapport et Annexes.* République Tunisienne, Secrétariat d'Etat au Plan et à l'Economie Nationale. Aug. 1968. Table 1, p. 24.

[2] *La Consommation et les Dépenses des Ménages en Tunisie, 1965-1968.* Republique Tunisienne, S.E.P.E.N. Dec. 1968, pp. 208-11.

[3] Area, yield, and production data on cereals in Tunisia were taken from three sources: *Annuaire Statistique de la Tunisie* for data through 1965; Service des Statistiques, Sous-Secrétariat d'Etat à l'Agriculture, S.E.P.E.N. for 1966 data; and Direction du Développement Agricole, S/S.E.A. for 1967 and 1968 data.

[4] These data are from *Statistiques du Commerce Extérieur de la Tunisie*, S.E.P.E.N., annual, and from the Direction du Développement Agricole and the Office of Cereals. Tables showing net trade and supply and distribution of cereals appear in the appendix.

CEREAL PRODUCTION: TRENDS AND VARIABILITIES

The statistical estimates in this section were derived from data obtained from the *Annuaire Statistique de la Tunisie* and from the Office of Cereals. The latter is a state-owned organization that controls cereal marketing in Tunisia. It purchases cereals from farmers at prices established by the government and sells them to commercial users. It also has a monopoly on all cereal imports and exports.

As in many developing countries, the reliability of production statistics in Tunisia is open to question. Reported data may not reflect actual production for two main reasons. First, many small Tunisian farmers have little surplus to market: on-the-farm consumption can be a sizable amount of total production. Estimating the amount of each cereal produced for home consumption is difficult and may result in errors. Second, significant amounts of the cereals farmers sell do not enter the official marketing system as operated by the Office of Cereals. Since farmers must pay a tax of about 10 percent of the official price when they sell to the Office, they often can obtain a nigher price through sales outside official marketing channels. Hence, an alternative market, the marche' tolére, has developed through which sizable quantities of cereals move.

Production data issued by the Office include estimates of cereals produced for home consumption as well as those moving through the marche' tolére, but the accuracy of these estimates is unknown. However, a recent consumption survey[5] conducted throughout Tunisia produced different estimates of total cereal consumption. The discrepancy between official production estimates and those derived from the survey is illustrated in appendix B. The difference between the Office's estimates and those from the survey is so large, particularly for durum wheat, that statistics on the level and trend of grain production in Tunisia obviously must be examined more closely in the future. Because of a lack of other information, the data used in this study are those reported by the Office of Cereals.

National Averages, 1946-68

Area devoted to cereals in Tunisia expanded greatly between the mid-1930's and the end of the 1950's. As shown in table 1, the average area in cereals in 1934-38 was 1,202,000 hectares. This increased to 1,981,000 hectares between 1954-58. In the sixties, however, this area declined. Agricultural development plans have emphasized agricultural diversification and intensification. This emphasis has resulted in the transfer of some poor cereal land into labor-intensive tree crops such as apricots, almonds, and olives, as well as into permanent pasture. Nevertheless, cereals probably will continue to occupy an important place in Tunisian agriculture because there are few alternative crops suited to dryland farming.

Table 1. Average areas devoted to cereals and cereal production, Tunisia, annual averages, 5-year periods, 1934-69

Harvest years	Average area	Production
	-thousand hectares-	-million tons-
1934-38	1,202	552,000
1949-53	1,543	750,000
1954-58	1,981	679,000
1959-63	1,683	607,000
1964-68	1,296	483,000

Sources: *Annuaire Statistique de la Tunisie* and the Office of Cereals.

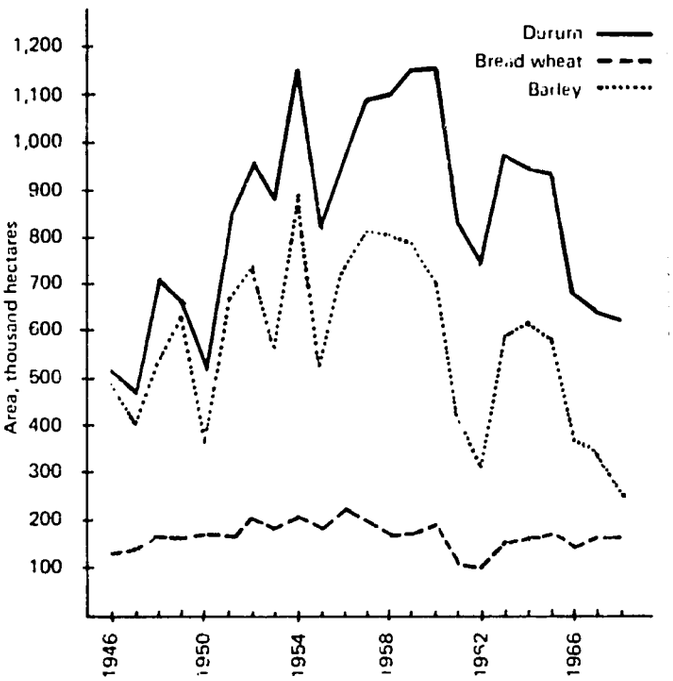


Figure 1. Area of durum, bread wheat, and barley, Tunisia, 1946-68 (source: appendix table A-1).

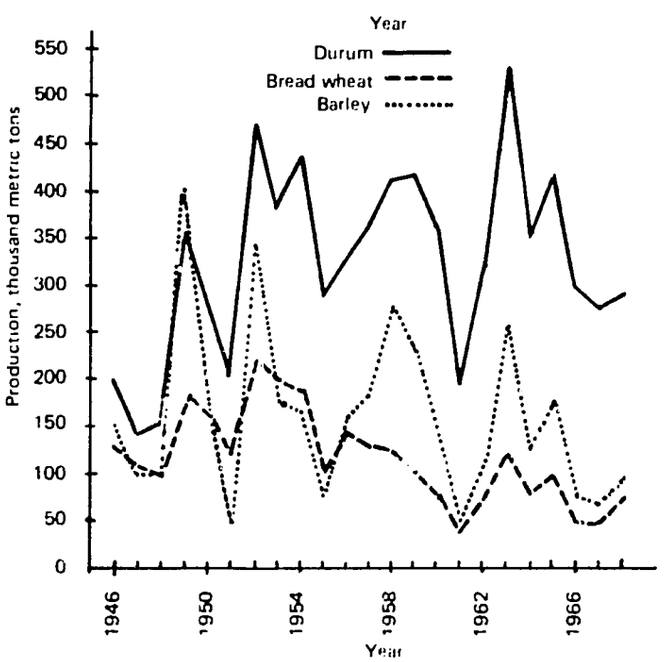


Figure 2. Production of durum, bread wheat, and barley, Tunisia, 1946-68 (source: appendix table A-1).

[5] *La Consommation et les Dépenses des Ménages en Tunisie, 1965-1968.* République Tunisienne, S.E.P.E.N., Direction Générale du Plan. Dec. 1968. Table 54, p. 160.

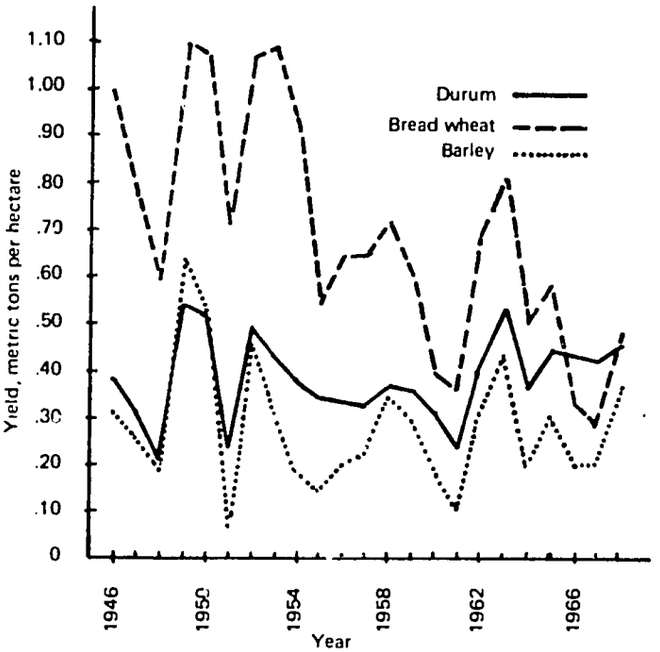


Figure 3. Yields of durum, bread wheat, and barley, Tunisia, 1946-68 (source: appendix table A-1).

The statistics analyzed in this section are plotted in figures 1-3. Figure 1 shows that most of the expansion of the area in cereals from 1946 to 1960 was in the areas devoted to durum and barley, while bread wheat area changed little. The expansion in durum area during the period was due to several factors, among them, the improved market position of durum relative to bread wheat, and improved durum varieties. The expansion of land area in barley from 1946 to the mid-1950's apparently occurred in the central and southern portions of the country. It is here, in the more arid regions, that barley has the advantage over wheat.

The decline in cereal area since 1960 also came out of durum and barley areas. The reduction in durum area is attributable in part to the implementation of the triennial plan, 1962-64, and later to quadrennial plans. These plans have called for increased emphasis on producing high yielding bread wheat and reducing durum production.

Table 2. Annual average areas devoted to each cereal, Tunisia, 1946-68, 1959-68, and 1964-68

	Average area		
	1946-1968	1959-1968	1964-1968
	----------thousand hectares----------		
Durum	844	871	770
Bread wheat	168	155	161
Total wheat	1,012	1,026	931
Barley	573	500	434
Total cereals	1,585	1,526	1,365
Ratio of durum to bread wheat	5.0:1	5.6:1	4.8:1
Ratio of total wheat to barley	1.8:1	2.1:1	2.1:1

Source: appendix table A-5.

The price paid to farmers for barley has been falling relative to the price for wheat since the mid-1950's, which may partially explain the decline in barley area since that time.

Between 1946-68, Tunisian farmers planted an average of 5 hectares of durum to every hectare of bread wheat (table 2). During the last 10 years of this period, 1959-68, the ratio was somewhat higher, at 5.6 to 1. During the last 5 years, 1964-68, however, the ratio was 4.8 to 1.

The wheat to barley area ratio for 1946-68 was 1.8 to 1. It rose slightly to 2.1 to 1 during the last 10 years of the period and remained there during the last 5 years.

Land areas devoted to durum and barley not only are considerably greater than those devoted to bread wheat, but, as shown in figure 1, they also are more variable from year to year. This variation may be due to weather conditions at planting time. Bread wheat production tends to be concentrated in the northern part of the country, where rainfall is higher and more certain. Although most of the durum is produced in the north, significant quantities are grown in the center and south, where rainfall is more sparse and erratic. This factor is even more important in the case of barley.

As shown in figure 2, production of the three cereals varies substantially from year to year. This variation is attributable to changes in the area planted as well as to changes in yields per hectare (table 3). As shown in table 3, yields have been

Table 3. Average yield and variability in yield of cereals, Tunisia 1946-68 and 1959-68

	1946-68			1959-68		
	Average yield	Standard deviation	Coefficient of variation*	Average yield	Standard deviation	Coefficient of variation*
	-metric tons per hectare-		-percent-	-metric tons per hectare-		-percent-
Durum	0.39	0.09	23	0.40	0.08	20
Bread wheat	0.70	0.25†	36†	0.51	0.17	33
Barley	0.29	0.13	45	0.27	0.10	37

*The coefficient of variation is the standard deviation divided by the average. When comparing variabilities in cereal yields, coefficients of variation are more relevant than standard deviations since the averages around which variables are measured are not the same.

†The standard deviation and the coefficient of variation would have been somewhat lower had they been computed after allowance for the secular decline in bread wheat yields.

Source: appendix table A-5.

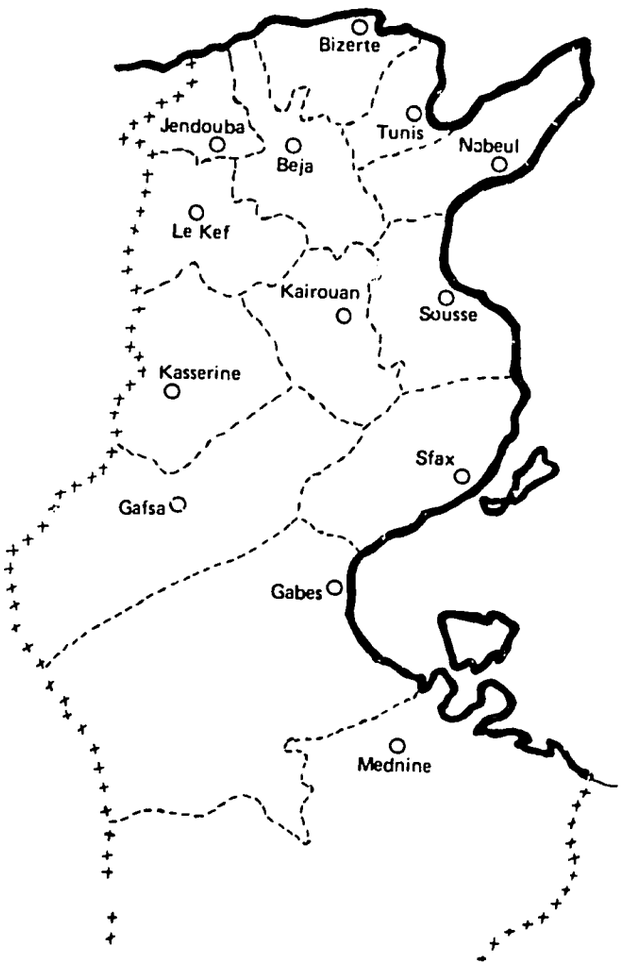


Figure 4. Map of Tunisia showing regional boundaries.

highly variable and those of bread wheat have declined relative to those of both durum and barley since 1946.

The statistics in table 3 measure the extent of the variation in yields. Over 1946-68, yields of durum, bread wheat, and barley averaged 0.39, 0.70, and 0.29 metric ton per hectare, respectively. During the last 10 years of the period, durum and barley yields averaged about the same as for the entire period. Bread wheat yields averaged 0.51 ton per hectare during the last 10 years, or 0.19 ton below the long-term average.

Yield variability is shown by two statistics: standard deviation and coefficient of variation. The latter indicates variation in percentage terms and permits comparison of yield variabilities. The standard deviation shows the range on either side of the mean within which approximately two-thirds of the observations fall. Over the entire period, therefore, two-thirds of the observed durum yields fell within the range 0.30-0.48 ton per hectare. Two-thirds of the bread wheat yields fell within the range 0.45-0.95 ton. The corresponding range for barley was 0.16-0.42 ton per hectare.

In percentage terms, barley yields were the most variable of the three, probably because so much barley is grown in southern Tunisia. However, a decline in barley area in the south beginning in 1959 reduced yield variability to 37 percent in the 1959-68 period.

Durum yield variability was lower than that for bread wheat, illustrating the relative tolerance of the two wheats to North African conditions. Durum yield variability also declined in the 1959-68 period as its area in the south was reduced.

Regional Averages, 1959-68

Because of the great geographic differences, particularly rainfall differences, in Tunisia's agricultural resources, the data were examined on a regional basis. The last 10 years of the period, 1959-68, were chosen for this purpose.

Official data on area and production of cereals are reported on a regional basis. For this purpose, Tunisia was divided into two relatively homogeneous regions: northern Tunisia (Tunis, Béja, Le Kef, Jendouba, Bizerte, Nabeul) and southern-central Tunisia (Gabes, Gafsa, Kasserine, Kairouan, Medinine, Sfax, Sousse). The geographical boundaries of the regions are shown in figure 4.

Area, production, and yield data for the two regions are shown in figures 5 and 6. Again, the figures indicate extreme variability in cereal production and yields.

The area, yield, and production data for durum and barley in southern-central Tunisia are very similar. Possibly these figures were estimated using rule-of-thumb relationships, in which case their reliability must be questioned.

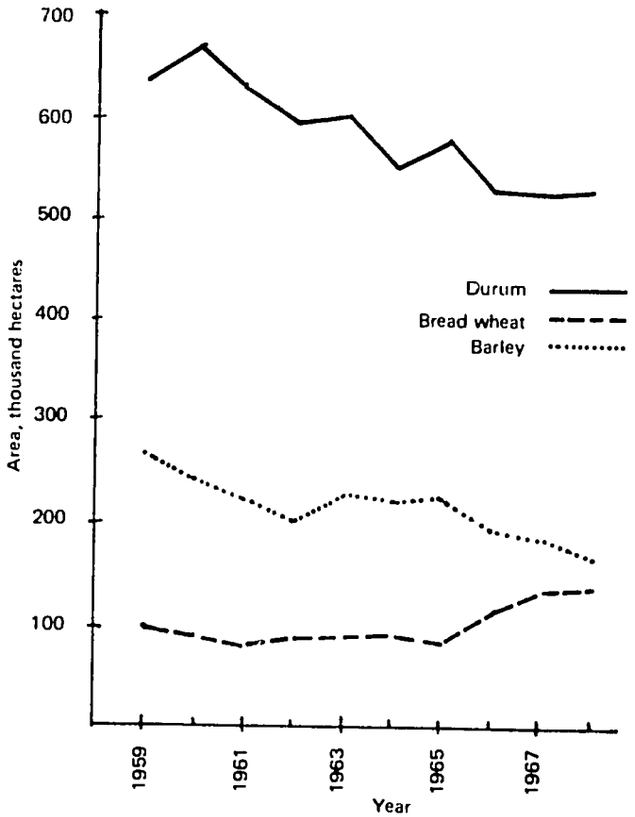
Table 4 shows the average areas devoted to each cereal in both regions during 1959-68. Durum was slightly more important relative to bread wheat in northern than in southern-central Tunisia, although the area devoted to durum has declined over the decade in both regions. The decline has been greater in the southern-central region due to the conversion of poor cereal land into tree crops and pasture. The importance of barley in southern-central Tunisia is again evident.

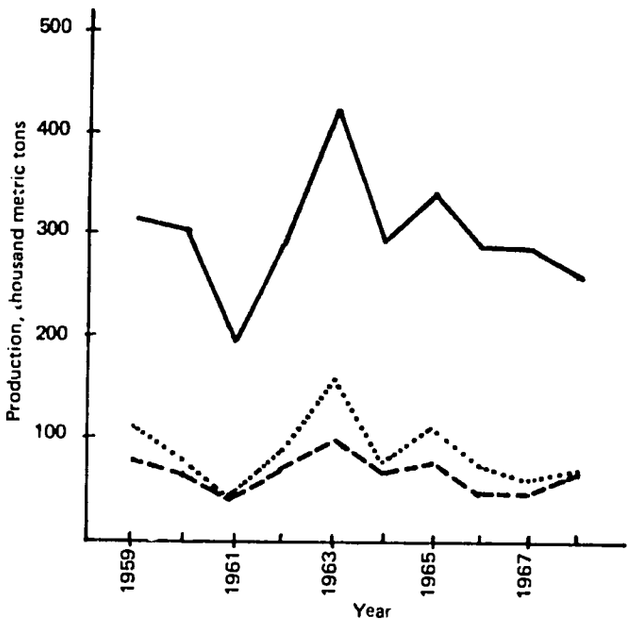
The difference between the productivities of the two regions and the extreme variability in yields are evident from the statistics in table 5. The average yield of durum in the north, 0.50 ton per hectare, was more than three times the 0.16 ton yield in the center and south. For bread wheat and barley, yields in the north were about two and one-half times those in the center and south. The coefficient of variation shows that yield variability increased considerably for each cereal from north to south.

Table 4. Annual average areas devoted to each cereal, northern and southern-central Tunisia, 1959-68

	Average areas	
	Northern Tunisia	Southern-central Tunisia
	----------thousand hectares----------	
Durum	586	285
Bread wheat	99	56
Total wheat	685	341
Barley	216	284
Total cereals	901	625
Ratio of durum to bread wheat	5.9:1	5.1:1
Ratio of total wheat to barley	3.2:1	1.2:1

Source: appendix tables A-6 and A-7.





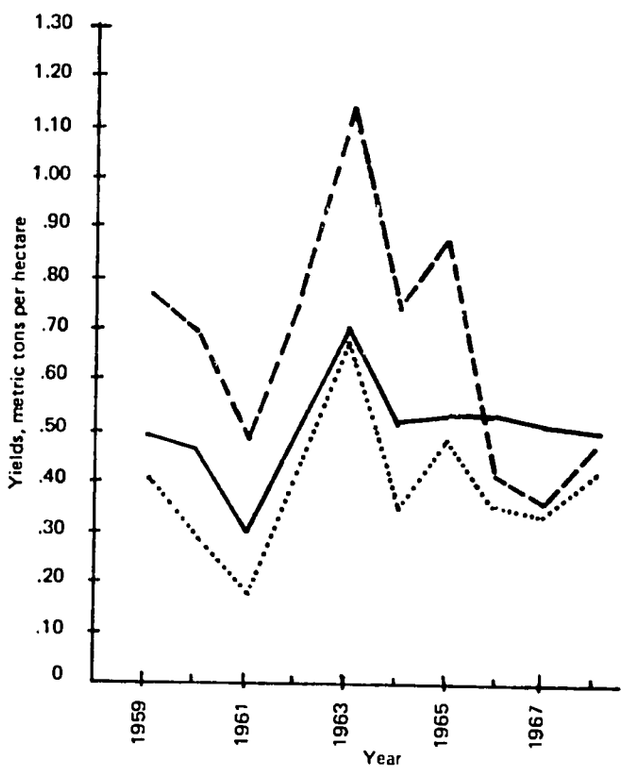


Figure 5. Area, production, and yields of durum, bread wheat, and barley, northern Tunisia, 1959-68 (source: appendix table B-1).

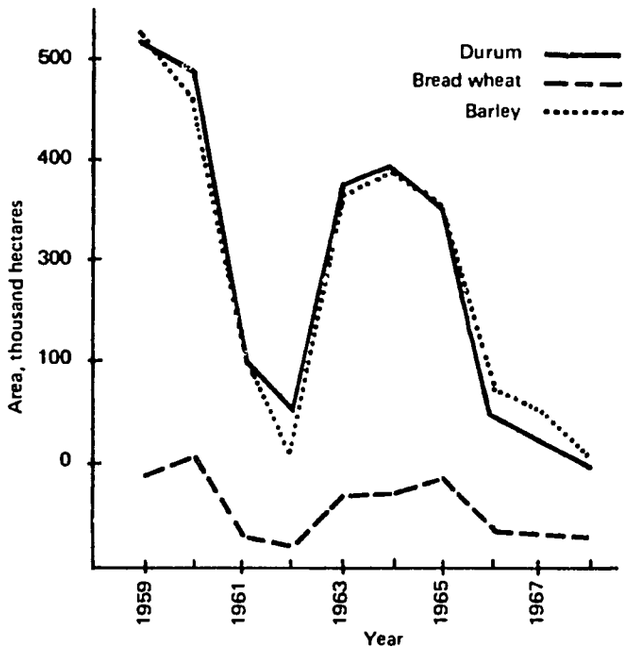
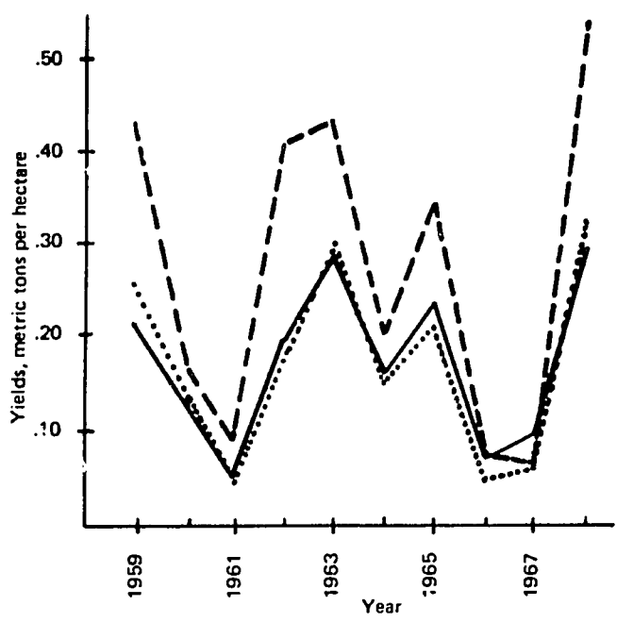


Figure 6. Area, production, and yields of durum, bread wheat, and barley, central and southern Tunisia, 1959-68 (source: appendix table C-1).



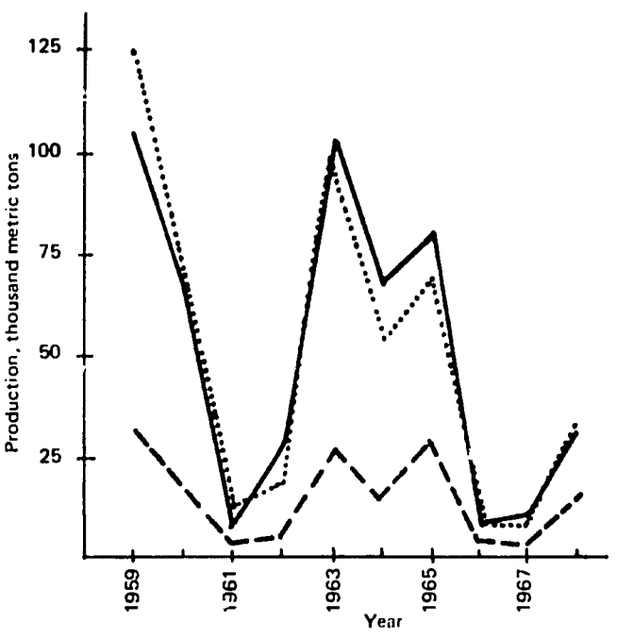


Table 5. Average yields and variability of yields of cereals, northern and southern-central Tunisia, 1959-68

	Northern Tunisia			Southern-central Tunisia		
	Average yield	Standard deviation	Coefficient of variation	Average yield	Standard deviation	Coefficient of variation
	-million tons per hectare-		-percent-	-million tons per hectare-		-percent-
Durum	0.50	0.09	18	0.16	0.08	50
Bread wheat	0.67	0.23	34	0.26	0.16	62
Barley	0.39	0.13	33	0.16	0.09	56

Source: appendix tables A-6 and A-7.

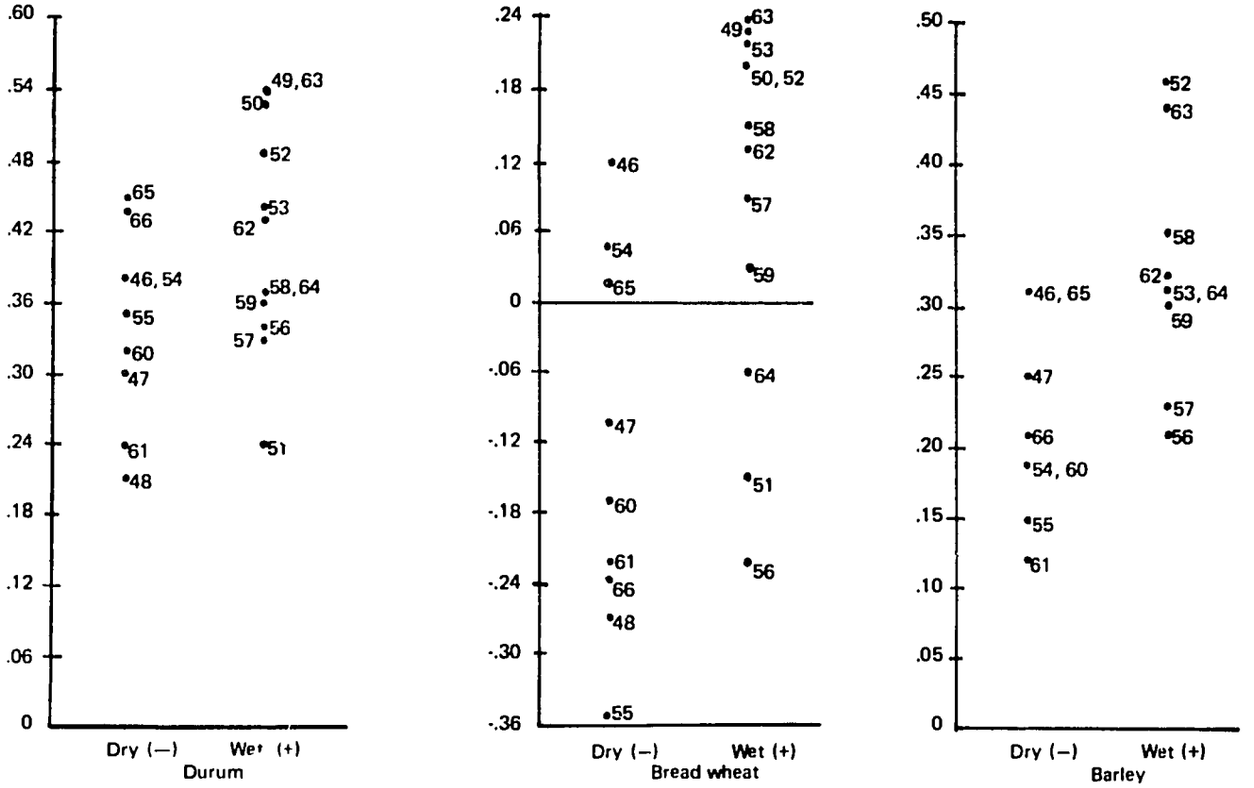


Figure 7. Relation between national average yields of durum, bread wheat, and barley and years of dry (–) and wet (+) weather. Yields of bread wheat are shown as deviations from their mean values in 1946-56 (.87 metric ton per hectare) and in 1957-66 (.57 metric ton per hectare) (source: yield data from appendix table A-1).

The advantages durum has over bread wheat in the arid regions are somewhat masked by the statistics in table 5: They do not show that durum is cultivated farther into the arid south than is bread wheat.

This fact also points up the importance of barley in the center and south. It is cultivated even farther south than durum, yet average yields of the two cereals are equal in this region. Also, the yield variability of barley increases less than that of durum from north to south.

Cereal production in southern Tunisia is a relatively risky operation. The standard deviation of barley and durum yields indicates that two-thirds of the annual yield observations lie in the range 0.08-0.24 ton per hectare for durum and 0.07-0.25 ton for barley. Using the rule-of-thumb 0.05 ton per hectare as seed, farmers on the average get back less than twice their seed in 1 year out of 6. The decline in cereal area in the center and south during the sixties probably is representative of improved resource allocation.

Cereal Production, Further Analysis

There can be no question that cereal yields in Tunisia are highly dependent upon natural conditions, particularly moisture availability (see table 5). In the center and south, cereal yields are lower and more variable than they are in the north, where rainfall is higher.

Some idea of the dependence of yields on rainfall can be obtained by correlating yields with wet and dry periods. Lee Dutcher, former meteorologist for USAID/Tunis, divided the period 1944-62 into shorter weather periods which he distinguished as either wet or dry.[6] The relation between the wet-dry variable and cereal yields is shown in figure 7.

Although the relationship is not perfect, the data in figure 7 suggest that there is a definite positive relationship between rainfall and average yields. In years of dry weather, durum yields were concentrated below their average. A similar and even more definite relationship existed for bread wheat. In this case, yields were measured as deviations above and below the 1946-56 and 1957-66 means. The relationship for barley was particularly pronounced, probably reflecting the high year-to-year variation in yields as a result of so much barley production in the center and south, where rainfall variations are most severe.

The relationships shown are more exact than might be expected considering the nature of the data. The wet-dry index is relatively crude, and the yield data, being nationwide averages, do not allow for geographic variation from an overall weather pattern.

The relationship between wheat yields and total September-April rainfall has been examined graphically for an individual farm in Tunisia.[7] This study showed that the correlation between the two variables was quite close. Important departures from the relationship were associated with highly favorable (or unfavorable) intrayear rainfall distribution and, in one year, a severe frost in April.

---

[6] Russell B. Gregg, *Agricultural Credit in Tunisia*, USAID/Tunis, 1967, p. 9. In this paper, the data were extended up to 1966.

[7] "Pluviométrie et Stabilité de la Production," *Terre de Tunisie*, Bulletin du Secrétariat d'Etat à l'Agriculture, No. 4, Jan. 1958, pp. 59-63.

Table 6. Average areas devoted to durum and bread wheat by Tunisian and European farmers, 1946-58

	Durum	Bread wheat
	---thousand hectares---	
Tunisian farmers	718	63
European farmers	105	120

Sources: *Annuaire Statistique de la Tunisie, Statistique Générale de la Tunisie, Tableaux Statistiques* (Annexes of Report of *Président de la République sur la situation en Tunisie*).

Besides the inhibiting effects of nature, the reduction of production resources associated with the political events of the fifties undoubtedly had an impact on yields. The intense struggle for independence created a climate of uncertainty among the colon (European) farmers. Such uncertainty reduced investments in fertilizers and in production resources such as machinery.

Indirect evidence for this assertion can be drawn from figure 3 and table 6. As shown in the table, the colons produced more bread wheat but less durum than the Tunisians. And a glance at figure 3 shows that bread what yields declined relative to durum yields. It may be no accident that the decline coincided with the years following independence.

Another factor in the long-term decline of bread wheat yields was the change in crop rotations. Prior to World War II, most wheat in Tunisia was grown in a 2-year rotation of wheat and fallow. But rotations in northern Tunisia were subsequently changed to 3-year rotations in which bread wheat followed durum. Since bread wheat did not then benefit from fallow in the previous year, its yield performance declined.

Since 1962 the agricultural plans of the Tunisian government have called for further changes in crop rotations, recommending the inclusion of forages and edible legumes along with wheat and further reduction in fallow wherever moisture is adequate. Bread wheat, however, still follows durum in these rotations and does not receive as much benefit from the forage or legume crop as does durum.

Mexican Wheats in Tunisia

The government of Tunisia, in cooperation with USAID, is now attempting to increase the production of bread wheat by introducing Mexican semi-dwarf varieties. Mexico has increased its wheat production considerably (from an average of 0.65 metric ton per hectare in 1943 to 2.84 metric ton per hectare in 1965) with new varieties developed with the assistance of the Rockefeller Foundation.

New wheat varieties developed in Mexico are relatively insensitive to differences in day length and light intensity and so are adaptable to other countries. India, Pakistan, and Turkey, for example, have purchased substantial quantities of Mexican wheat seed in recent years.

Most of the experience with these new wheat varieties in Mexico, India, and Pakistan has been on irrigated land, but they have produced well under dryland farming in the high rainfall areas of Turkey.

In Tunisia, wheat is produced under dryland farming, and probably will continue to be since the amount of irrigated land is limited. Mexican wheat varieties may have considerable potential here. They have a shorter growing season than native varieties and so can be planted later and harvested earlier. Consequently, their growing season can be more readily geared to the period when the most rain is received.

Currently, Tunisia must use scarce foreign exchange for bread wheat imports to make up for its sizable deficits. This drain on foreign exchange will become more intense unless the trend in declining bread wheat yields can be reversed.

The program for improving cereal production with Mexican wheats was begun in Tunisia in the autumn of 1967, when about 500 hectares of short-strained Mexican types were planted in demonstration plots along with some Tunisian varieties. This program was expanded to about 12,000 hectares in 1968. About 10,000 hectares were planted to Mexican varieties by Tunisian farmers in a program outside the cereal improvement project. The results of the first 2 years with these wheats under natural rainfall conditions are summarized in table 7.[8]

Mexican varieties included in the 1968 and 1969 programs were all grown in the north. For the 1970 harvest, 140,000 hectares were to be planted to Mexican wheats, but apparently only 53,000 hectares were planted.[9] Anticipation for the 1971 harvest is 120,000 hectares.[10] This amount exceeds the 1959-68 average of 99,000 hectares for northern Tunisia and approaches the 155,000 hectare average for the entire country over that period.

Cereal production for the 1970 harvest is estimated at 726,000 metric tons: 150,000 of bread wheat, 369,000 of durum, and 207,000 of barley.[11] Total cereal production for 1970 is thus above the average for the past 10 years (see table 1), and bread wheat production is greater than for any year since 1954.

Of course, it is unlikely that the average yields shown in table 7 could be achieved nationwide or even across the north. But the yield comparisons between Mexican wheats and the traditionally grown variety Florence-Aurore suggest that important gains in cereal output should be forthcoming.

CEREAL PRICES AND PRICE POLICY IN TUNISIA

In his book *Getting Agriculture Moving*, A. T. Mosher delineates five essentials for agricultural development: markets for farm products, constantly changing technology, local availability of supplies and equipment, production incentives for farmers, and transportation. He emphasizes that without any one of these essentials there can be no agricultural development.[12]

While there is substantial evidence that Tunisian cereal production could be increased with new varieties, optimum fertilization, and other improved cultural practices, farmers must have adequate economic incentives. Grain prices should be favorable relative to prices of competing crops and commodities. Adequate fertilizer supplies must not only be available, but fertilizer prices should be low relative to cereal prices to encourage its use. Finally, price policies must reflect market differentials between durum and bread wheat prices.

[8] The report of the Accelerated Cereal Production Project covering the 1968 and 1969 harvests and including detailed output tables is included in appendix C.

[9] Press conference of Abdallah Farhat, Minister of Agriculture, Reported in *L'Action*, August 23-24, 1970. The average yield of Mexican wheat reported in this article was 4.5 tons per hectare, but this is obviously an error, possibly a misprint or a figure applying only to irrigated areas.

[10] Ibid.

[11] Data reported by A. Sahnoun, Bureau du Plan et de Développement Agricole (successor agency to the Direction du Développement Agricole).

[12] A.T. Mosher, *Getting Agriculture Moving*, Frederick A. Praeger, New York, 1966, p. 66.

Table 7. Average yields of cereals under Accelerated Cereals Production Project (demonstration) and of Mexican short-strawed varieties in unsupervised production in Tunisia, natural rainfall, 1968 and 1969

Program	Average yields								
	Bread wheat, short-strawed Mexican varieties					Bread wheat, Tunisian varieties		Durum, new	Barley,
	INIA 66	Tobari 66	Jaral 66	Sonora 63	Siete Cerros	Florence-Aurore	Ariana 66	Tunisian variety	U.S. variety
	metric tons per hectare								
1968 demonstrations, simple average of 27 plots, 500 hectares	2.67	2.39	2.19	2.40	*	1.76	2.14	*	*
1969 demonstrations, simple average of 22 plots, 12,000 hectares	2.00	1.78	1.43	1.59	1.50	1.36	1.62	1.43	1.78†
1969 unsupervised production: Pure seed program, 91 growers, 5,486 hectares	1.71**	1.19**	*	1.24**	*	*	*	*	*
Commercial program, 162 growers, 4,767 hectares	1.28**	1.49**	1.13**	1.43**	*	*	*	*	*

*Variety not included in program.
†Simple average of three plots in low rainfall area.
**Weighted averages: total production of each variety divided by total area in that variety.

Source: Accelerated Cereals Production Project, "Farm Experience with Short-Stemmed Mexican Bread Wheat Varieties during 1968-69." Republic of Tunisia, Secretary of State for Agriculture. Nov. 1969. This report is included in appendix C.

Market Organization and Cereal Prices

Nearly all producing countries have instituted price support systems, and governments play a major role in pricing and marketing. Tunisia is no exception. The government establishes prices for cereal producers and controls all cereal marketing.

There are three principal price guarantees for cereal producers throughout the world: (1) a guaranteed minimum price that sets a floor for domestic prices, (2) a guaranteed price range that permits domestic prices to fluctuate between a floor and ceiling, and (3) a fixed price under which all producers receive the same price. The first type is most widely used and usually involves the least government interference. The second type has been widely used in western Europe. It benefits both producer and consumer by guaranteeing minimum prices and fixing maximum prices. The third type usually involves a governmental agency that buys all cereals at fixed prices.[13] This is the system used in Tunisia.

The Office of Cereals, the agency responsible for cereal marketing in Tunisia, has several principal functions: (1) To organize, control, and improve the production of cereals, cotton, and nutritional legumes, (2) To maintain a balance between supplies and needs of these commodities through purchasing and selling operations, (3) To organize and control the marketing of these commodities, and (4) To organize and control the production and distribution of livestock feed.[14] The overall objective of the Office is to maximize farmer income and improve the quantity and quality of his agricultural production.[15]

The Office purchases cereals directly from farmers or through marketing cooperatives that act as its agents. Producer prices are fixed each year after consultation with a committee of representatives from the Secretary of State for the Plan and National Economy, the Undersecretary of Agriculture, the National Union of Tunisian Farmers, the Flour Millers, the National Agricultural Bank, and the Office of Cereals.[16]

Farm prices are announced in June or July, which is harvest time for the wheat and barley planted the previous fall. Most other countries, including the United States, announce prices at planting time.

Farm prices in Tunisia do not reflect storage costs, so there is no economic incentive for farmers to store cereals for later sale. Instead, this marketing function is performed by the Office of Cereals or marketing cooperatives that act as its agents.

Producer prices for each cereal of a given class and grade are uniform throughout the country. A farmer located a considerable distance from consumption centers receives the same price as a farmer adjacent to such centers.

The Office of Cereals maintains buying stations throughout the producing areas. Farmers can sell their produce directly to these buying stations. While the Office represents the official marketing channel for grain, an unknown (but probably significant) amount is bought and sold through the previously mentioned marche' tolere'.

The Office of Cereals maintains storage and handling facilities throughout the producing regions with a total capacity in modern elevators of 276,000 metric tons. One modern elevator of 20,000 tons capacity in Bizerte has facilities for mechanically loading and unloading ocean-going vessels.

Marketing margins for cereals are fixed by the same process as producer prices. In fact, prices and margins are administratively determined from the farm price of wheat through the retail price of bread (see table 8). The first column of the table

[13] Frank Barlow, Jr., and Susan Libbin, "International Grain Marketing, Pricing and Trade Policies," in *Marketing Grain*, N.C. Reg. Res. Pub. 176, Purdue Univ. Agr. Exp. Sta., Jan. 1968.
[14] Ghazi Duwaji, *Economic Development in Tunisia*, Frederick A. Praeger, New York, 1967, p. 103.
[15] *La Presse*, Jan. 27, 1968.
[16] These were the agencies before the 1970 governmental reorganization.

Table 8. Marketing margins for bread wheat, Tunisia, July 1, 1965-June 30, 1966

	Price per quintal of wheat	Price per quintal of flour
	----------dinars----------	
Farm price of wheat	3.450	4.530
Plus:		
Transportation, storage, and operating cost of Office of Cereals	0.416	0.546*
Price to flour miller	3.866	5.076
Plus milling margin.....	0.525	0.689*
Wholesale price of flour	4.391	5.765†
Plus baker's margin	2.150*	2.821
Retail price of bread.....	6.541	8.586

*Some prices and margins were reported on the basis of a quintal of wheat and some on the basis of a quintal of flour. To maintain consistency within each column, prices were converted on the basis of 76.2 kilograms of flour for each quintal of wheat. The asterisk indicates where each conversion was made.

†The wholesale price of 1 quintal of medium quality flour as sold for home baking. It was assumed that this also is the price at which flour is sold to commercial bakeries.

Source: Jabeur El-Abri, "Analyse des résultats de la compagne de commercialisation des céréales et légumineuses 1965-66." Secrétariat d'Etat au Plan et à l'Economie Nationale, Division du Développement Agricole.

expresses prices and marketing margins in terms of 1 quintal of wheat. Since 1 quintal of wheat yields an average of only 0.76 quintal of flour, margins in terms of 1 quintal of flour are shown in the second column.

Tunisian Cereal Prices and World Prices

Basic Producer Prices for Wheat: National Comparisons

In comparing producer wheat prices among countries, many difficulties arise: (1) trade disequilibrium between hard and soft currency areas so that converting national currency into dollars may not reflect the true comparative purchasing power of wheat prices, (2) wheat quality differences and lack of uniformity in grades and standards among countries, (3) price quotations for different locations, and (4) differences in price support systems and types of government payments to producers.[17] Despite these difficulties, such comparisons do provide some basis for judging the relative magnitude of wheat prices in individual countries.

As shown in figure 8, basic producer prices for wheat (used as a basis for government guaranteed prices in 1966-67) ranged from $45.93 per metric ton in the United States to $187.39 per ton in Finland. However, the $45.93 per ton price in the United States represents only the price support loan. Besides this minimum price, participating farmers received marketing certificates (direct income payments) with an average value of about $22.05 per ton of wheat produced by program participants, so their guaranteed minimum wheat price actually was about $67.97 per ton. Figure 8 also shows that producer prices for wheat were considerably lower in principal exporting countries such as the United States, Canada, Australia, and Argentina than in the principal commercial importing countries, notably the developed countries of Western Europe and Japan. France, the only European country that traditionally exports wheat, had the highest producer wheat prices, $90.39 per ton, of any important exporting country.

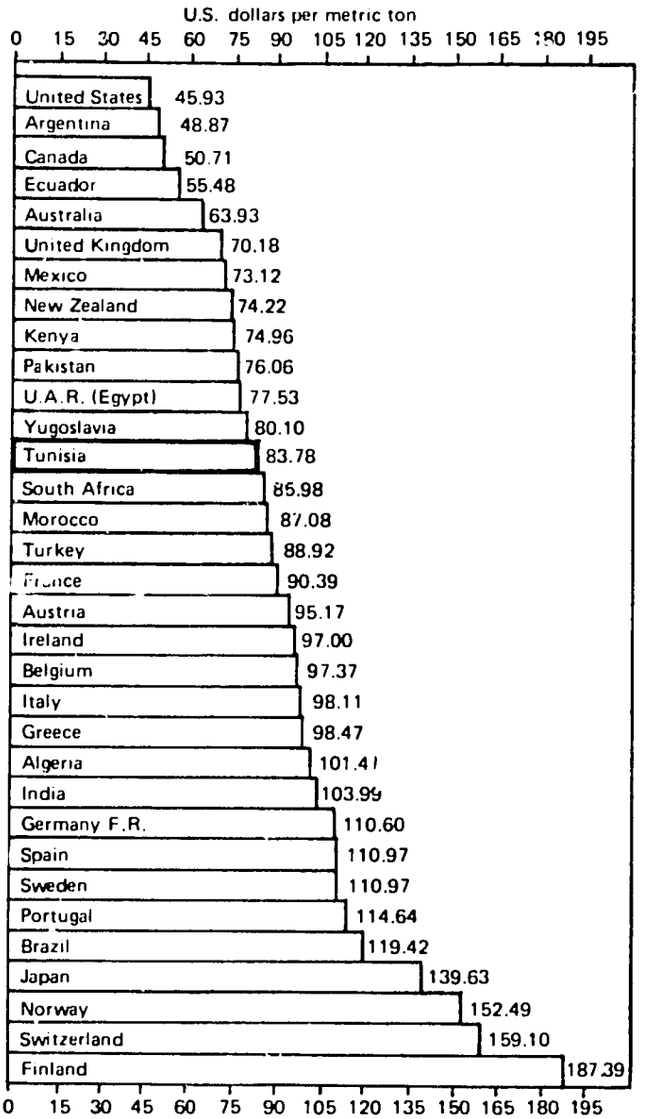


Figure 8. Basic producer prices for wheat, U.S. dollars per metric ton, 1966-67 (source: International Wheat Council, "World Wheat Statistics," 1967).

The North African countries of Algeria, Morocco, and Tunisia have been relatively large noncommercial wheat importers under such government programs as U. S. Food for Peace. These three countries are important producers of durum wheat, and prices shown for them in figure 8 are farm prices for durum. Bread wheat had a lower price in all three countries. Prior to 1964, when the Tunisian dinar was devalued, producer prices for durum were nearly equal in Tunisia and Algeria.

Durum wheat typically commands a premium over other wheats in world markets. The size of this premium varies considerably from year to year, primarily in response to durum supplies. When one considers that the wheat price for Tunisia

[17] Barlow and Libbin, op. cit.

Table 9. Import prices for bread wheat and barley, c.i.f. North Sea ports, and producer prices for bread wheat and barley, Tunisia, 1958-69

Year	European import prices		Tunisian base prices**			
	Wheat, U.S. No. 2 hard red winter*	Barley, U. S. No. 2–3 feed†	Bread wheat	Barley	Bread wheat‡	Barley‡
	dollars per metric ton		dinars per metric ton		dollars per metric ton	
1958	69.85	53.90	35.96	21.58	85.58	51.36
1959	69.37	55.50	34.50	20.00	82.11	47.60
1960	67.90	57.26	34.50	20.00	82.11	47.60
1961	70.13	53.69	34.50	20.00	82.11	47.60
1962	70.69	62.50	34.50	20.00	82.11	47.60
1963	72.46	57.25	34.50	20.00	82.11	47.60
1964	70.19	58.50	34.50	25.00	82.11	59.50
1965	65.21	63.50	34.50	25.00	65.55	47.50
1966	71.48	66.50	34.50	25.00	65.55	47.50
1967	67.99	63.50	43.00	28.00	81.70	53.20
1968	67.24	53.25	43.00	28.00	81.70	53.20
1969	61.36	46.88	43.00	28.00	81.70	53.20

*Year beginning July 1.
†Calendar year.
**Crop year beginning at harvest.
‡Exchange rates: 1 dinar = $2.38 through 1964; 1 dinar = $1.90 from 1965.
Source: appendix table A-8.

in figure 8 represents a higher valued wheat than in most other countries except Algeria and Morocco, it is evident that Tunisian wheat prices are not high relative to those in other wheat importing countries.

Price Trends for Cereals: Internal and International Comparisons

Wheat and Barley. The relationships between her internal cereal prices and prices in international markets are of great importance to Tunisia. As seen in table 9, Tunisian domestic prices for bread wheat, at official exchange rates, have generally been well above international prices. The devaluation of the dinar in late 1964 brought these prices into line for a short period, but the price increase in 1967 widened the gap once more.

Internal prices for barley have generally been lower than international prices, particularly since the devaluation. Again the increase in the official base price in 1967 opposed the downward trend in world cereal prices during the late 1960's.

Relative movements in Tunisian and international prices for bread wheat and barley during the sixties are shown in figures 9 and 10. At constant exchange rates, Tunisian prices moved more or less in step with world prices. The Tunisian increase in

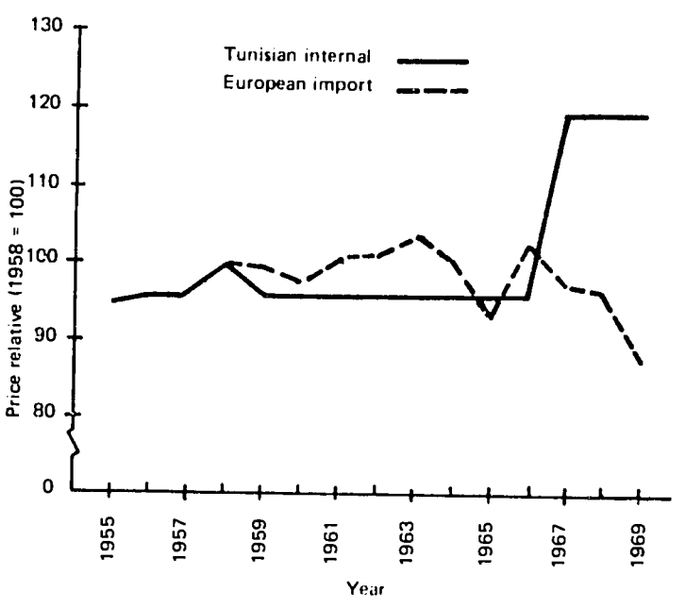


Figure 9. Price relatives for bread wheat: Tunisian internal prices and import prices, c.i.f. North Sea ports, 1958 = 100 (source: appendix table A-8).

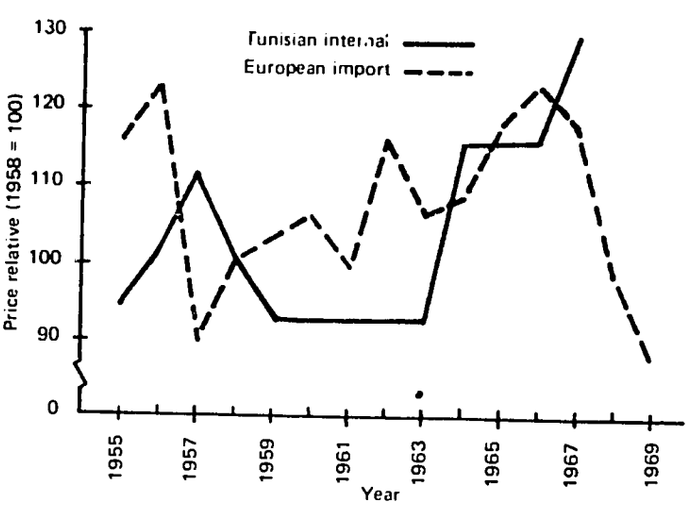


Figure 10. Price relatives for barley: Tunisian internal prices and import prices, c.i.f. North Sea ports, 1958 = 100 (source: appendix table A-8).

Table 10. Price ratios of bread wheat to barley: Tunisian internal price ratios and ratios of European c.i.f. prices, 1958-69

Year	Price ratio: bread wheat to barley	
	Tunisian prices	Import prices
1958	1.67	1.30
1959	1.72	1.25
1960	1.72	1.19
1961	1.72	1.31
1962	1.72	1.13
1963	1.72	1.27
1964	1.38	1.20
1965	1.38	1.03
1966	1.38	1.07
1967	1.53	1.07
1968	1.53	1.26
1969	1.53	1.31

Source: Derived from the data of appendix table A-8.

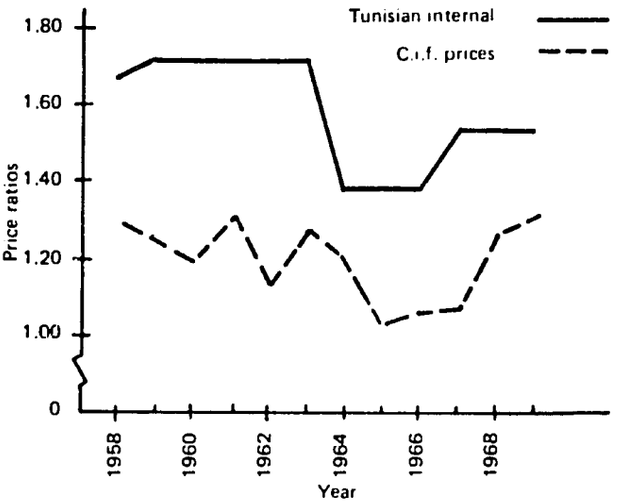


Figure 11. Price ratios of bread wheat to barley: Tunisian internal prices and European c.i.f. prices.

official prices for all cereals occurred just at the time when worldwide surpluses began to force prices down on import markets.

The relationship between wheat and feed grain prices is brought out clearly in table 10 and figure 11. Relative to feed grains, Tunisian wheat prices are much higher than international wheat prices. In the late 1960's, international prices for wheat approached their feed value level. Substantial quantities of wheat are fed to livestock in advanced countries, but no wheat is fed to livestock in Tunisia, and a large portion of barley goes toward human consumption each year.

In the face of declining international prices, the recent price increases for cereals in Tunisia illustrate the policy dilemma faced by the less-developed countries. The question is whether or not they should increase the availability of agricultural products to their citizens by lowering internal prices to the level of imported products. This would aid in industrial development since food commodities, particularly cereals, are an important wage good on the industrial side. On the other hand, doing so might deter the country's agricultural development. The dilemma is most strong in countries like Tunisia, where the Green Revolution is just getting underway.

Bread Wheat and Durum. Durum wheat is used primarily for pasta products, macaroni and spaghetti, and in these products has no good substitute. In Tunisia, it is also the preferred raw material for cous-cous, a staple in the Tunisian diet. In 1960-61, per capita utilization of durum for food in Tunisia was 55.9 kilograms per capita, second only to Algeria, whose per capita utilization was 38.3 kilograms.[18] (The 1966 Consumption Survey estimate of durum wheat consumption in Tunisia was 89 kilograms per capita.)

Durum production is more geographically concentrated than bread wheat production. The main producing areas are the countries in the Mediterranean basin, North America, and particular areas in the USSR and Argentina. Because these regions are semiarid, weather variations often cause world production to vary from year to year. Another factor contributing to production variations is the shift from durum to other wheats following years when durum prices are low. Generally, durum yields are lower than other wheat yields

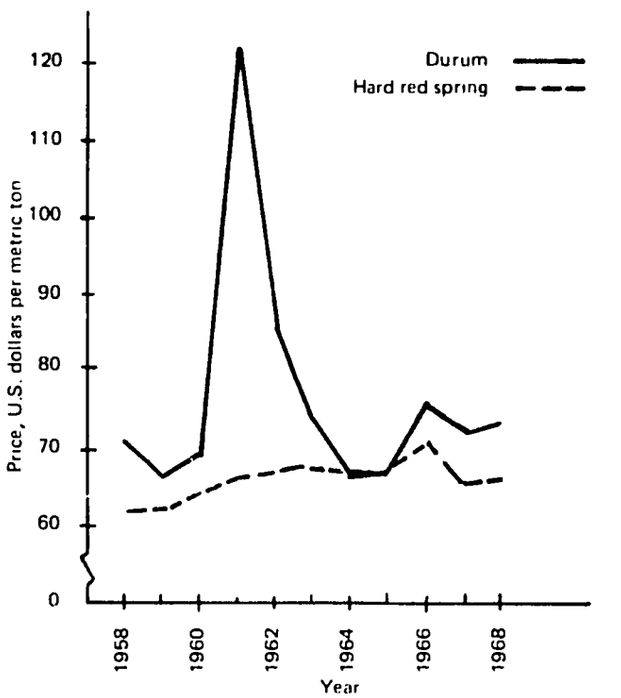


Figure 12. Export prices for Canadian durum and hard red spring wheat (source: appendix table A-9).

in most producing areas because the breeding of high-yielding varieties has been less impressive than with other wheats. The resulting lower profitability of durum (except in periods of scarcity and high prices) causes growers to shift to other wheats when supplies are abundant and prices are low.[19]

The price fluctuations for durum are well illustrated in figure 12, which shows the export price differentials between durum and Canadian spring wheat, a good quality bread

[18] *A World Survey of the Production, Trade, Prices and Consumption of Durum Wheat,* International Wheat Council, 28 Haymarket, London, S.W. 1, Nov. 1963, p. 10.

[19] Ibid., p. 2.

wheat. Canadian price data are presented as close approximations to world wheat prices because no other long-term price series are available currently.

Due to short supplies of durum in 1961, its price rose to $122.18 per metric ton, a premium of $55.50 per ton over northern spring. Durum supplies subsequently increased due to increased plantings, and the differential between prices for the two wheats fell. Since 1962, however, durum supplies have been ample, and its price has remained close to, or even below, the price of northern spring wheat.

An important implication of these year-to-year changes in price and production is the tremendous production flexibility possessed by large countries such as the United States and Canada relative to small countries such as Tunisia. This is illustrated by the situation in North Dakota, from which more than 85 percent of U. S. durum production comes. During 1961-65, total wheat area in that state averaged 2.4 million hectares, of which 720,000 hectares were in durum.[20] During the same period in Tunisia, total wheat area averaged 1.1 million hectares, 931,000 of which were in durum. Although North Dakota's durum production is concentrated in a small area, its entire wheat producing area is available for expansion under profitable market conditions. For example, the state's durum area was expanded from 952,000 hectares in 1967 to 1,219,000 in 1968, a 28 percent increase.[21] Such an increase would be difficult, if not impossible, in Tunisia.

The price of durum in Tunisia has been maintained at a higher level than the price of bread wheat compared with the world market (figure 13). Except for 1961 and 1962, the ratio of the base price for durum to that for bread wheat in Tunisia has been well above that in Canada. The economic rationale behind this situation was the special trading relationship Tunisia enjoyed with France. Tunisia exported durum to France in exchange for French bread wheat. France maintained a sizable premium for durum (in 1964 the internal price of durum at $117.21 per ton in France was 1.17 times the price of bread wheat at $100.31 per ton),[22] and Tunisia was able to trade durum for bread wheat on these terms. This arrangement has since been terminated.

Despite the end of this arrangement, a high price ratio for durum relative to bread wheat has been maintained. Tunisia has imported much soft wheat from the United States under PL 480.

For the 1967 and subsequent harvests, the base price for durum was increased to 48 dinars per ton, while that for bread wheat went to 43 dinars, reducing the durum-bread wheat price ratio from 1.22:1 to 1.12:1. This reduction should have some influence on increasing bread wheat production.

Adjustments in Tunisian wheat prices have been in accord with changes in world market price differentials between durum and bread wheat. Since 1962-63, world production has fluctuated around 14 million tons compared with an average of about 10 million tons in the previous 4 years.[23] As a result, world durum prices have declined relative to bread wheat prices.

Increased world durum production since 1962-63 has been due to fortuitous balancing of good weather conditions in some regions with bad weather in others, increased plantings

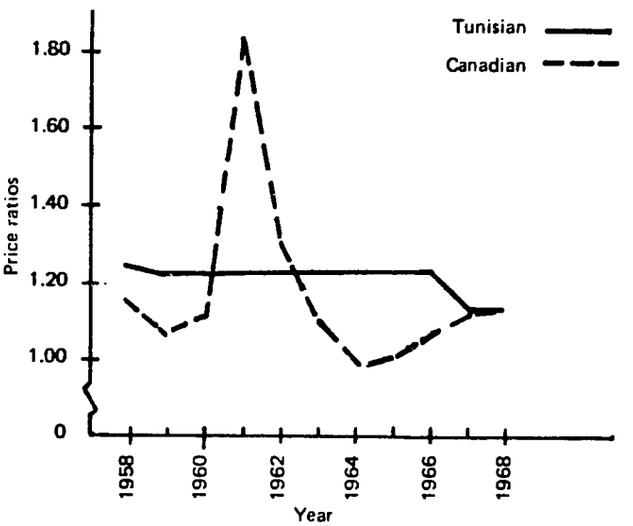


Figure 13. Price ratios of durum to bread wheat: Tunisian internal prices and Canadian export prices (source: appendix table A-9).

of durum by Canadian producers in 1965, and increased durum yields compared with bread wheat yields in the United States. In the early 1950's, durum yields in the United States were about 25 percent below the overall yields of other varieties, but with the introduction of new, disease-resistant varieties, durum yields increased to almost 30 percent above those of other varieties in the sixties.[24]

The International Wheat Council has suggested that an appropriate price relationship between durum and other wheats would be a more or less stable premium for durum wheats above bread wheats at a level that would provide reasonable returns for exporting countries without being high enough to discourage consumption or encourage substitution in importing countries. The corresponding reduction of wide price fluctuations might well lead to an expansion of demand, bringing indirect as well as direct advantages to durum producers.[25]

Durum wheat has been excluded from the maximum price provision of the International Wheat Agreement, mainly because it has normally been sold at a premium over bread wheats. The premium exists partly because of the poor substitutability of other wheats in pasta production and partly because of the lower yields and greater risks inherent in durum production.

Tunisian Cereal Prices: Trends and Comparisons

The "Real" Price of Cereals

A comparison between the prices of cereals and the general price level indicates changes in the quantity of all other goods for which one unit of cereal can be exchanged. So it can be used in judging the overall incentive effect of prices in Tunisia.

The index of wholesale prices in Tunisia in current use is based on commodity prices and weights from 1940. Serious

[20] Economic Research Service, U.S. Department of Agriculture, *Crop Production,* 1967 Annual Summary, Dec. 19, 1967.
[21] U.S. Department of Agriculture, *Agricultural Statistics, 1969.*
[22] Barlow and Libbin, op. cit., p. 17.
[23] *Durum Wheat in 1964-65 and 1965-66,* International Wheat Council, 28 Haymarket, London, S.W. 1, Apr. 1967, p. 20.
[24] Ibid., pp. 17-21.
[25] Ibid., p. 21.

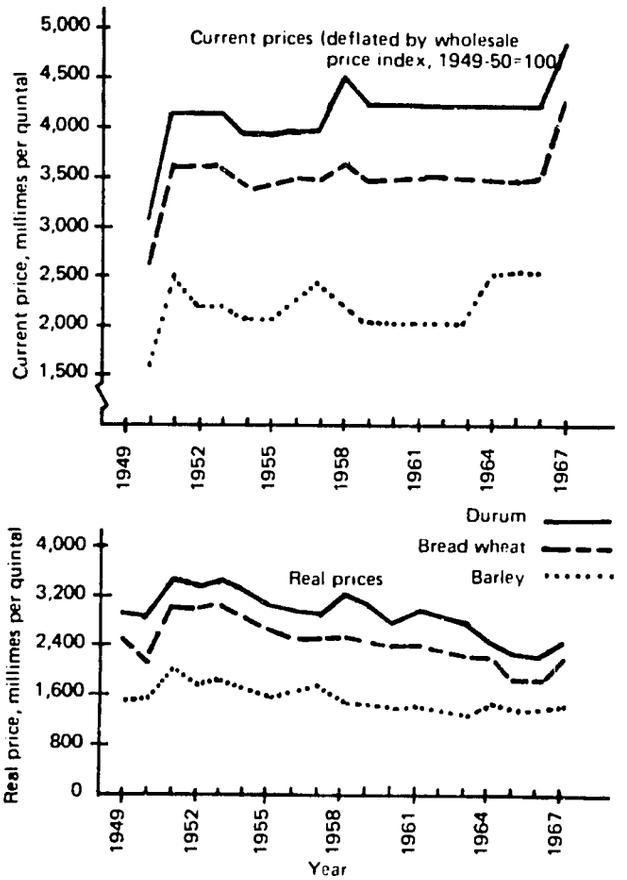


Figure 14. Current and real cereal prices, Tunisia, harvest years 1949-67 (source: appendix table A-11).

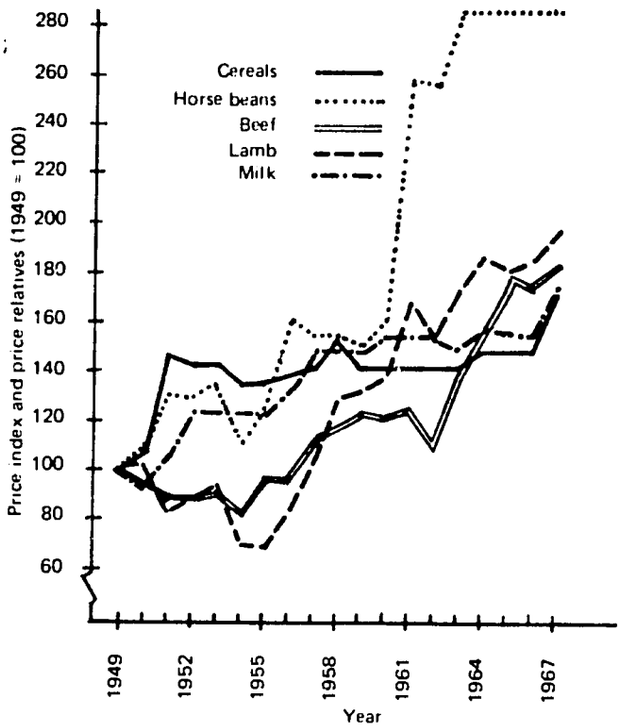


Figure 15. Price index for cereals and price relatives for horse beans, beef, lamb, and milk, 1949-67 (1949 = 100) (source: appendix table A-12).

flaws in this index adversely affect its present relevance and probably overstate the degree of increase in the general wholesale price level since 1940 and between any 2 years subsequent to 1940. However, since it is the only price index covering the time span under discussion, it was used in computing "real" prices for grains.

Figure 14 shows that the significant increases in current prices for each cereal since 1949 have been outweighed by increases in the general price level. Through the harvest of 1966, the price of durum increased from 2,932 millimes per quintal to 4,200 millimes.[26] Most of this increase had been accomplished by 1951, when the durum price was 4,140 millimes per quintal, 41 percent above the 1949 price. However, the wholesale price index rose so high during 1945-66 that the real price of durum fell to 2,207 millimes per quintal, a decline of over 24 percent. The increase to 4,800 millimes for the 1967 harvest still left the real price at 2,401 millimes, more than 18 percent below its 1949 level.

The pattern for bread wheat was almost identical. The price of 3,450 millimes per quintal in 1966 was 38 percent greater than the 2,500 millime price in 1949. All of this increase occurred between 1945 and 1951. From 1951 through 1953, the price of bread wheat was 3,600 millimes per quintal, actually higher than that paid from 1954 through 1966. In contrast, the real price of bread wheat fell to 1,803 millimes in 1966, more than 27 percent below its 1949 level. The increase in price to 4,300 millimes per quintal in 1967 brought the real price of bread wheat up to 2,158 millimes, 14 percent below its 1949 price.

Prices for barley increased by 64 percent, from 1,523 millimes in 1945 to 2,500 millimes in 1966. Again, most of this increase occurred by 1951. This increase was greater than that for either durum or bread wheat. The increase in barley price to 2,800 millimes in 1967 meant a decline of 7 percent in its real price from its 1949 level, much less of a decline than for either durum or bread wheat.

Prices of Cereals and Other Agricultural Commodities

Comparing changes in cereal prices with changes in the prices of specific products important to agriculture also is pertinent. In figure 15 the prices of cereals and some other important agricultural commodities are compared using an index of cereal prices and price relatives for horse beans, beef, lamb, and milk. Horse beans are included because they often are part of the crop rotation with cereals, and they compete with cereals for land.

As shown in the figure, prices of beef, lamb, and horse beans have risen relative to prices for grains and milk since 1949. The increase for horse beans was quite striking, particularly between 1960 and 1963. In that 3-year period the wholesale price rose from 3,375 millimes per quintal to 6,000 millimes, an increase of almost 78 percent. In terms of the price relative, this was from 162 in 1960 to 287 in 1963.

Prices for wholesale meats, beef, and lamb moved together over the 1949-67 period. They declined from 1949 to 1954-55

[26] The millime, one one-thousandth of a dinar, is the direct descendant of the French franc, which was the unit of currency until the Banque Centrale de Tunisie became the currency issuing institution in late 1958.

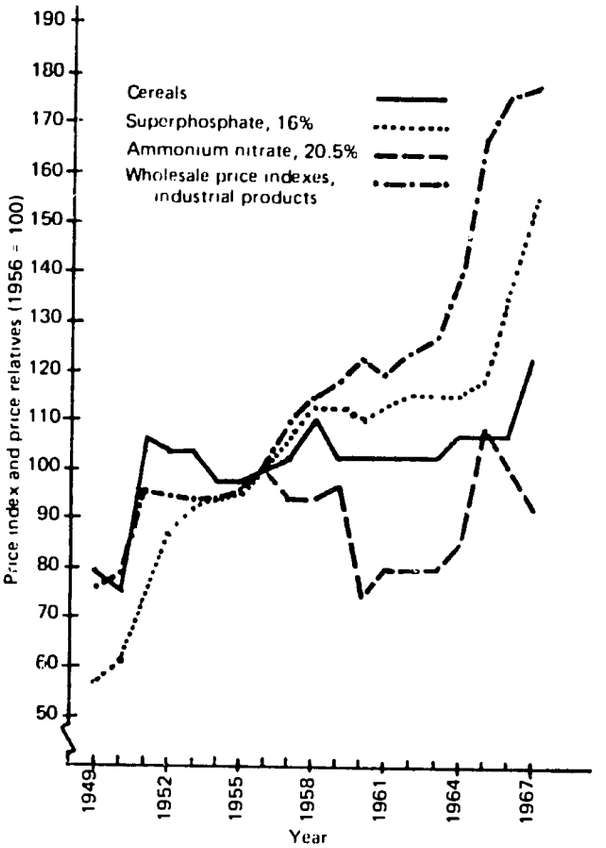


Figure 16. Price index for cereals and price relatives for superphosphate, ammonium nitrate, and the index of wholesale prices for industrial products, 1949-67 (1956 = 100) (source: appendix table A-13).

and then rose quite sharply. Increases over 1949-67 were 84 percent for beef and 98 percent for lamb. From 1954 to 1967, their price relatives increased from 84 to 184 for beef and from 71 to 198 for lamb, or increases of 122 percent and 179 percent for beef and lamb, respectively.

Over 1949-67, prices for cereals and milk generally lagged. The retail price of milk increased by 75 percent, with a period of relative stability from 1957 through 1966. The price index for cereals increased by 70 percent over the period. Most of this increase occurred between 1949 and 1951, with another significant increase for the 1967 harvest. The period 1951-66 was one of remarkable stability in grain prices.

Tunisia's attempts to achieve economic growth have met with considerable success in recent years. It has been estimated that between 1960 and 1965, per capita gross domestic product (GDP) grew, in real terms, at an annual compound rate of 3.3 percent.[27] The route toward development, of course, included emphasis on investment. Over the same period, gross investment in fixed capital averaged 21 percent of GDP.[28] The cost of this investment in terms of foregone goods and services was reflected in price level changes. Thus the cost of living index for the city of Tunis increased by 14.1 percent between 1960 and 1965. On an annual basis, this is a compound rate of increase of 2.7 percent.[29]

There can be no doubt that price stability for wheats and milk is a reflection of the political importance of these commodities, particularly in relation to the significant increases in the overall cost of living. Wheat, of course, is a staple in the Tunisian diet, especially in the diets of the large mass of low income consumers. And milk is a "politically sensitive" food commodity throughout the world because of its association with the health and development of children.

The price changes for horse beans can be viewed in this same general framework. Before the 1962 harvest, prices for horse beans were uncontrolled. In 1962, after the 61 percent increase in price from 1960-61, the trade in horse beans and chick peas was taken over by the Office of Cereals.

Prices for Cereals and Some Nonagricultural Commodities

Two important price series were readily obtainable from published sources: the price series for superphosphate, an important fertilizer that is locally produced, and the index of wholesale prices for industrial commodities. The price series for ammonitrate, another important fertilizer, is not published on any regular basis. The 1956-67 price series for this commodity was drawn together and made available by the Union Naticnale des Agriculteurs. At present, Tunisia imports all its nitrogen fertilizers. The price relatives computed from the data were set to the base year 1956 because this was the earliest year for which data for ammonitrate were available.

As shown in figure 16, the price of ammonitrate was the only price that did not rise relative to the price of wheats. Part of this lack of increase is a reflection of a subsidy paid by the Tunisian government to encourage its use. For nitrogen fertilizers, this subsidy has amounted to 30-40 dinars per ton of plant nutrient in recent years.[30] Another important factor has been the decline in the real costs of producing and distributing nitrogen fertilizers.[31]

The price index for cereals went from 71.9 in 1949 to 122.8 in 1967, an increase of 71 percent. Over that same period the price of superphosphate and the value of the price index for industrial products more than doubled. The price relative for superphosphate increased from 57.6 in 1949 to 154.5 in 1967, an increase of 168 percent. The price relative (1956 = 100) for the index of industrial prices went from 75.9 to 177.3, an increase of 134 percent.

The meaning of these changes in price relatives can be illustrated by the change in the purchasing power of cereals. Since the base year for the price relatives was 1956, a unit of a nonagricultural product is defined here as the quantity for which one unit of cereals could have been exchanged in 1956. Changes in purchasing power of wheat are shown in table 11.

One unit of cereals could have been exchanged for one unit of industrial products in 1956. It could have been exchanged for 0.95 unit in 1949, and for 0.69 unit in 1967. This indicates that the prices of cereals rose slightly relative to the industrial price index between 1949 and 1956 and fell rather sharply thereafter. The other numbers can be similarly interpreted.

Farmers apparently have not received economic incentives through the price mechansim. If Tunisia's agricultural production policy goal is to expand cereal output relative to that of

[27] Computed from data given in *Les Comptes de la Nation*, Tome II, and *Annexes Statistique du Rapport sur le Budget Economique de l'Année 1968*. Both of these works are published by the Secretariat d'Etat au Plan et à l'Economie Nationale.

[28] Ibid.

[29] *Annuaire Statistique de la Tunisie, 1964 et 1965.*

[30] Food and Agriculture Organization of the United Nations, *Annuaire de la Production*, Vol. 20, 1966, p. 604.

[31] Gian S. Sahota, *Fertilizer and Economic Development*, New York, Frederick A. Praeger, Publishers, 1968.

Table 11. Number of units of nonagricultural commodity for which one unit of cereal can be exchanged

Year	Super-phosphate	Ammonitrate	Industrial products
	----------	units ----------	
1949	1.25	------	0.95
1956	1.00	1.00	1.00
1967	0.79	1.32	0.69

Source: appendix table A-13.

Table 12. Producer prices of durum and bread wheat, francs per quintal, harvest years, 1944-57

Harvest year	Durum	Bread wheat
	francs per quintal	
1944	630	550
1945	900	800
1946	1,255	1,103
1947	1,595	1,400
1948	2,645	2,300
1949	2,932	2,500
1950	3,172	2,600
1951	4,140	3,600
1952	4,140	3,600
1953	4,140	3,600
1954	3,910	3,400
1955	3,910	3,400
1956	3,967	3,450
1957	3,967	3,450

Source: *Annuaire Statistique de la Tunisie*, various issues, 1946-59.

the other agricultural commodities, the government might consider increases in grain prices as one means of achieving this goal.

Wheat Price-Quantity Relationships

Examining changes in wheat area over time can provide some insight into the decision making process of Tunisian farmers. Changes in wheat area by types of wheat for both Tunisian and European farmers in Tunisia during 1945-58 are shown in figures 17 and 18.

Over the period, the area devoted to durum by both groups of farmers increased remarkably. The Tunisian area almost doubled, from 576,000 hectares in 1945 (harvest year) to 976,000 in 1958 (harvest year). The European acreage more than doubled, from 63,000 hectares to more than 130,000 over the same period. Bread wheat area also increased, although there was a decline in the European area after 1955. The Tunisian area more than doubled over the period, from 31,000 to 75,000 hectares. The decline in the European bread wheat area after 1955 apparently was not a substitution of durum hectares for those in bread wheat.

As shown in table 12, prices of both commodities increased by more than five times during 1944-57. Diagrams showing the gross correlations between area planted to each wheat and showing wheat prices lagged 1 year[32] indicate the likelihood of a positive relationship between supply and price for both European and Tunisian farmers. However, there are strong trend factors in both the price and area variables. To compensate partially for these trends, as well as to indicate that the relationship between bread wheat and durum is of primary importance, the quantity variable was expressed as the percentage of total wheat area devoted to durum, and the price variable was expressed as the difference between the prices of durum and bread wheat. The simple correlations between these modified variables are shown in figure 19.

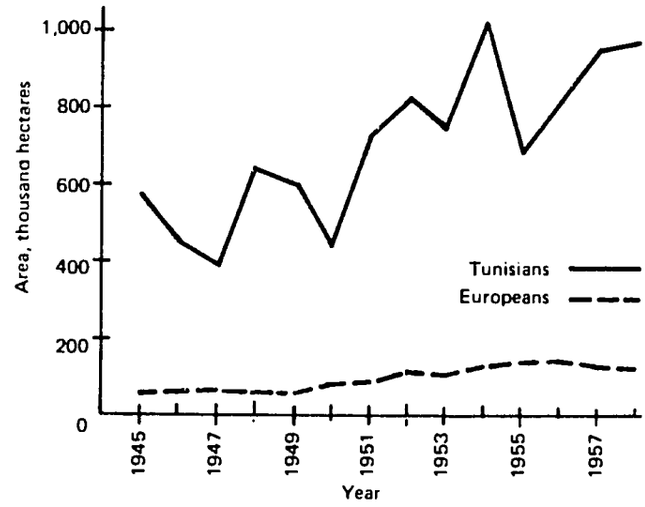


Figure 17. Area planted to durum by Tunisian and European farmers, 1945-58 (source: appendix tables A-14 and A-15).

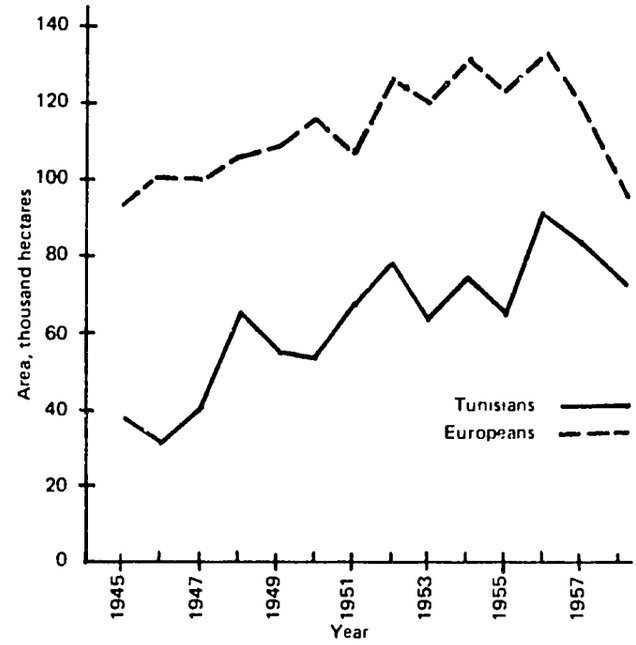


Figure 18. Area planted to bread wheat by Tunisian and European farmers, 1945-58 (source: appendix tables A-14 and A-15).

Although there is still some trend in the data, the positive relationship between price and quantity of durum relative to bread wheat is evident for the European farmers. And, except for the harvest years 1945 and 1946, such a relationship appears to exist for the Tunisian farmers as well.

[32] A price lag of at least 1 year is required. Prices are announced at harvest time, too late to be guides for current crop production.

Table 13. Durum and bread wheat prices, average yields, and gross returns per hectare for Tunisian farmers, harvest years, 1945-58

Harvest year	Prices		Average yields		Gross returns		
	Durum	Bread wheat	Durum	Bread wheat	Durum	Bread wheat	Difference
	--millimes per quintal--		--quintals per hectare--		---------- --dinars per hectare----------		
1945	900	800	1.1	3.4	1.0	2.7	-1.7
1946	1,255	1,103	2.9	7.1	3.6	7.8	-4.2
1947	1,595	1,400	2.1	4.1	3.3	5.8	-2.5
1948	2,645	2,300	1.6	2.8	4.3	6.5	-2.2
1949	2,932	2,500	4.8	9.1	14.2	22.7	-8.5
1950	3,172	2,600	4.2	6.0	13.3	15.7	-2.4
1951	4,140	3,600	1.5	3.7	6.2	13.4	-7.2
1952	4,140	3,600	3.9	6.4	16.0	23.1	-7.1
1953	4,140	3,600	3.2	7.0	13.3	25.0	-11.7
1954	3,910	3,400	2.9	4.5	11.4	15.2	-3.8
1955	3,910	3,400	2.7	3.1	10.8	10.6	0.2
1956	3,967	3,450	2.7	3.7	10.7	12.9	-2.2
1957	3,967	3,450	2.7	3.7	10.6	12.7	-2.1
1958	4,468	3,956	3.1	4.5	13.7	16.3	-2.6

Source: appendix table A-16.

Table 14. Durum and bread wheat prices, average yields, and gross returns per hectare for European farmers, harvest years, 1945-58

Harvest year	Prices		Average yields		Gross returns		
	Durum	Bread wheat	Durum	Bread wheat	Durum	Bread wheat	Difference
	--millimes per quintal--		--quintals per hectare--		----------dinars per hectare----------		
1945	900	800	7.5	7.4	6.7	6.0	0.7
1946	1,255	1,103	10.5	10.8	13.2	11.9	1.3
1947	1,595	1,400	8.6	9.4	13.8	13.1	0.7
1948	2,645	2,300	6.8	7.9	18.0	18.3	-0.3
1949	2,932	2,500	10.6	12.0	31.2	30.1	1.1
1950	3,172	2,600	11.2	12.9	35.5	33.5	2.0
1951	4,140	3,600	9.0	8.9	37.3	32.0	5.3
1952	4,140	3,600	12.0	13.5	49.9	48.6	1.3
1953	4,140	3,600	11.7	13.0	48.5	46.7	1.8
1954	3,910	3,400	10.5	11.9	41.0	40.6	0.4
1955	3,910	3,400	7.1	6.8	27.6	23.1	4.5
1956	3,967	3,450	7.6	8.4	30.1	28.9	1.2
1957	3,967	3,450	8.3	8.5	32.8	29.4	3.4
1958	4,468	3,956	8.6	9.2	38.5	32.9	5.6

Source: appendix table A-16.

To show that the choice between durum and bread wheat also is affected by yields, gross returns per hectare; i.e., average yield times price, were calculated for each wheat for both groups of farmers (tables 13 and 14).

The positive relationship between financial returns and quantity supplied is again apparent in figure 20. It is more apparent for Tunisian farmers than it was in the previous diagram, although European farmers still appear to be more responsive to changes in their financial returns. This may be partially attributable to the fact that many small Tunisian farmers produce mainly for home consumption and, hence, produce durum.

Much of the durum produced by Tunisian farmers was produced in central and southern Tunisia, while most bread wheat was grown in the north. This is reflected by the data in table 13, which show that, for Tunisian farmers, gross returns per hectare for durum were almost invariably lower than those from bread wheat. Rainfall in the center and south is much less plentiful and agricultural resources are limited, so there is a higher proportion of subsistence farmers who practice traditional farming methods. European farmers, on the other hand, were concentrated on large farms on the most productive land in northern Tunisia. Gross returns obtained by the Europeans from the two wheats were quite close, with returns from durum slightly higher during most of this period (table 14). This in no way implies that the Tunisians were less interested in the market and prices than the Europeans. It may suggest that their natural environment was a strong influence in masking such interest.

With the departure of the colon farmers in the late 1950's and early 1960's and the assumption of their holdings by the state and by cooperative farms, much of this differentiating influence was removed. Price levels and price relationships among wheats and other crops may now be equally as important as other policy instruments in controlling wheat production.

The primary influence of prices may be that of affecting the profitability of farming, and, in turn, the ability of agriculture to bid resources away from other sectors of the economy. Consequently, price policy does have a role to play in Tunisia's agricultural development.

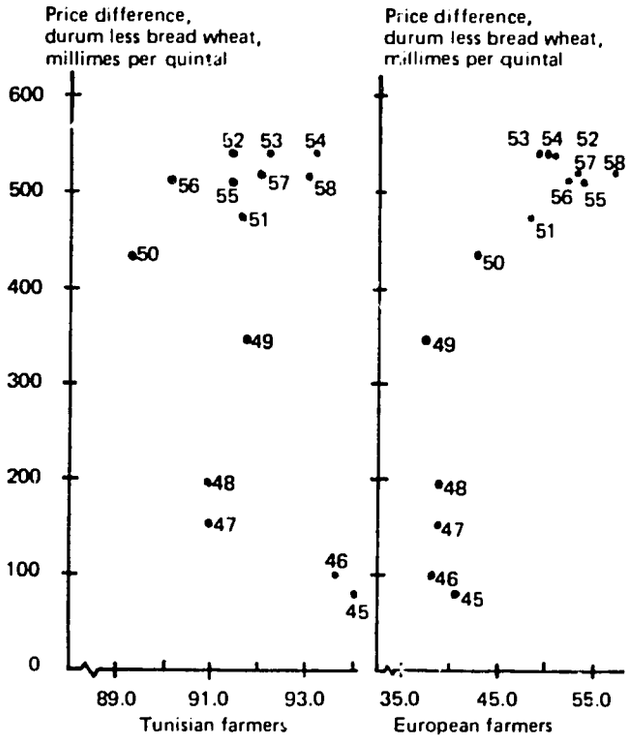


Figure 19. Simple correlation: percentage of wheat area planted to durum by Tunisians and Europeans and difference between prices of durum and bread wheat, price difference lagged 1 year, harvest years 1945-58 (source: appendix table A-16).

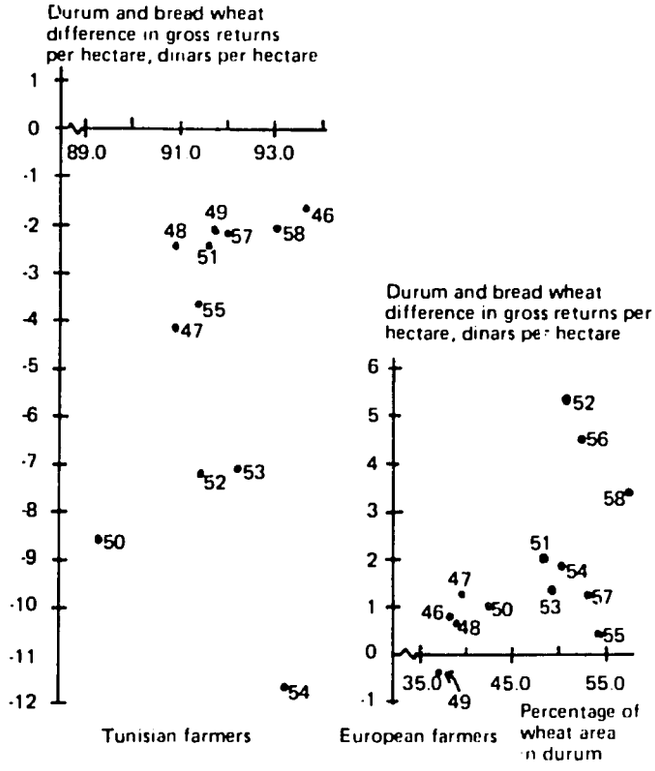


Figure 20. Simple correlation: percentage of wheat area planted to durum by Tunisians and Europeans and difference between gross returns per hectare from durum and bread wheat (durum less bread wheat) lagged 1 year, harvest years 1946-58 (source: appendix table A-16).

ALTERNATIVE POLICIES FOR CEREAL PRODUCTION IN TUNISIA

In this section, some alternative policies for cereal production in Tunisia are examined by matching demand projections for cereals with production projections under three different supply hypotheses or models. Surpluses and deficits were assumed to be exported and imported and were valued at a set of "world" prices assumed to prevail in the future. Production was valued both at assumed world prices and at present internal prices, permitting a partial examination of how producer income would be affected by altering internal Tunisian cereal prices to conform more closely with world market conditions.

Benchmark years selected for this analysis were 1972 and 1980. The first of these is convenient in that it coincides with the end of Tunisia's current 4-year plan.[33] The second year was arbitrarily selected to indicate the magnitude of the production task Tunisia must set for itself over a somewhat longer time span.

Production Target Under 1969-72 Plan for Agriculture

The 1972 targets for cereals de-emphasize their production relative to products for which the export potential seems greater (fruits) or for which the rate of internal demand growth is expected to be high (livestock products).

"Average year 1968" was used as the base year in formulating the 1972 production targets for all commodities under the 1969-72 agricultural plan. Production in average year 1968 is what would have been produced under normal climatic conditions. In many cases, real production was adjusted upward to arrive at average year production. For example, real cereal production from the 1968 harvest was estimated at 466,000 metric tons. Production in average year 1968 was 766,000 tons divided as follows: durum, 450,000; bread wheat, 110,000; others (mostly barley), 206,000. Projected production for 1972 is shown in table 15.

Note that about 80 percent of 1972 total cereal production will be concentrated in the investment projects. Yields of project cereals are forecast at about 1.1 metric tons per hectare, with those of bread wheat at 1.2 tons and those for durum and other cereals (largely barley) at just under 1 ton.

The data in table 15 suggest some diminution of total area in cereals by 1972. A rough guess at total 1972 area may be obtained by assuming that nonproject cereals will yield an average of 0.4 ton per hectare, implying a total nonproject cereals area of 406,000 hectares. The total area in project cereals is forecast at 758,000 hectares. The nation's total area in cereals would therefore be 1,164,000 hectares, a 20-percent decline from the 1960-68 average of 1,462,000. An average yield of 0.25 ton per hectare for nonproject cereals may be more reasonable. This is closer to the yields received during the recent past in central and southern Tunisia, and would place total area in cereals at 1,407,000 hectares, close to the long-run average.

[33] République Tunisienne, Secrétariat d'Etat du Plan et à l'Economie Nationale. *Plan de Développement Economique et Social, 1969-72.* Volume 2 of this work has the subtitle *Agriculture et Pêche (Agriculture and Fisheries)*. References to this document in this section will be to the 1969-72 agricultural plan or to the 1969-72 plan for agriculture. Reference to other sections of the plan, those dealing with its nonagricultural aspects, will be to the 1969-72 plan or to the plan.

Table 15. Planned cereal production in Tunisia, 1972: area, yield, and production, project and nonproject

Commodity and item	Production category: Projects: Irrigation	Projects: Coopératives du Nord*	Projects: Total projects	Nonproject	Total
Bread wheat					
Area, hectares	5,576	425,000	430,576	-	-
Production, tons	24,140	480,300	504,440†	51,500	555,940†
Yield, tons/hectare	4.33	1.13	1.17	-	-
Durum					
Area, hectares	-	178,000	178,000	-	-
Production, tons	-	176,400	176,400†	49,000	225,400†
Yield, tons/hectare	-	0.99	0.99	-	-
Other cereals					
Area, hectares	950	147,000	147,950	-	-
Production, tons	2,850	135,500	138,350†	61,750	200,100†
Yield, tons/hectare	3.00	0.92	0.94	-	-
Total cereals					
Area, hectares	6,526	750,000	757,526	-	-
Production, tons	26,990	792,200	819,190†	162,250	981,440†
Yield, tons/hectare	4.14	1.06	1.08	-	-

*The project category Coopératives du Nord was that adopted in preparing the agricultural plan. It refers to the cooperative farms which, until the dramatic political events of the fall of 1969, dominated the agricultural lands in northern Tunisia. Since that time the area in cooperative farms has been reduced to about 200,000 hectares. The category was retained in this section for taxonomic convenience.

†These totals differ from those given in the summary table of the 1969-72 agricultural plan for 1972. In that table, project-produced bread wheat is forecast at 518,500 tons, and total cereals are forecast at 995,000 tons. The other differences probably are due to rounding.

Source: S.E.P.E.N., *Plan de Développement Economique et Social, 1969-72, Agriculture et Pêche*, Part IV, tables showing 1972 area and production for each project, and part V, nonproject production of cereals.

Perhaps an even more significant shift in emphasis is that displayed by the projected areas devoted to durum and bread wheat. Within the cereal production sector defined by the projects, bread wheat area is projected at 431,000 hectares, while that for durum will be 178,000. Bread wheat and durum will be planted in the ratio of 2.4 to 1.0. The 1960-68 average ratio of bread wheat to durum was 0.2 to 1.0.

The production strategy here is an attempt to close the increasing production-consumption gap for total cereals by substituting high-yielding bread wheat for durum. The total area in cereals may be reduced, reflecting an increased emphasis on higher valued crops and forages. The proportion devoted to feed grains (other cereals category) is increased over that of 1960-68 to reflect the increasing need for livestock feed concentrates.

Given the total area in cereals and the distribution of cereals within this area, the 1972 target does not seem too conservative. Anticipated yields for 1972 represent significant progress from present levels. The yields of project-produced durum and barley in 1972 are about 2 to 2.5 times their 1959-68 average in northern Tunisia, and those for bread wheat are about 1.7 times their average over that period.

The greater the difference in yields among cereals, the more important will be the distribution of land area among them. Early experience with Mexican wheats led some experts to anticipate average yields of 1.5 tons per hectare in the north within a few years.[34] This implies a 1972 yield differential of about 0.5 ton per hectare between bread wheat and the other cereals. With a fixed total area in cereals, total cereals production would increase by 500 tons for every 1,000 hectares transferred to bread wheat from durum or barley. With a narrower differential, the gain in total cereals would be less.

Demand Projections for Cereals in Tunisia

The Tunisian government attempts to measure the consumption objectives of its citizens and then plan future production to meet these objectives. In some cases, notably with olive oil and luxury goods, conflicts between this principle and other development objectives have resulted in limitations on the kinds and qualities of consumption goods available. National monopolies in cereals and oil, for example, are instrumental in controlling the quality characteristics of oil and flour. Government-controlled prices for many basic commodities also play an important role in influencing consumption patterns.

In the 1969-72 plan for agriculture, considerable attention was given to demand projections for major commodity groups. One of these groups was cereals. No attempt, however, was made to project the demands for individual cereals. Without some idea about future demand, production policy for cereals is likely to go wide of the mark in matching production with demand.

For this analysis, demand projections for individual cereals through 1986 were made. These projections differed from those in the 1969-72 agricultural plan in some of the basic data used. In general, these differences were such as to increase future demands for cereals over those of the earlier projections.

Aggregate quantities of each cereal demanded were projected as functions of per capita total consumption expenditure and population alone. The assumption was that relative prices for cereals and other related commodities will remain unchanged. An alternative assumption was that the

[34] Release of press conference given by Habib Aounallah, Adjoint au Directeur du Développement Agricole. Mimeo, undated. See also page 12 above.

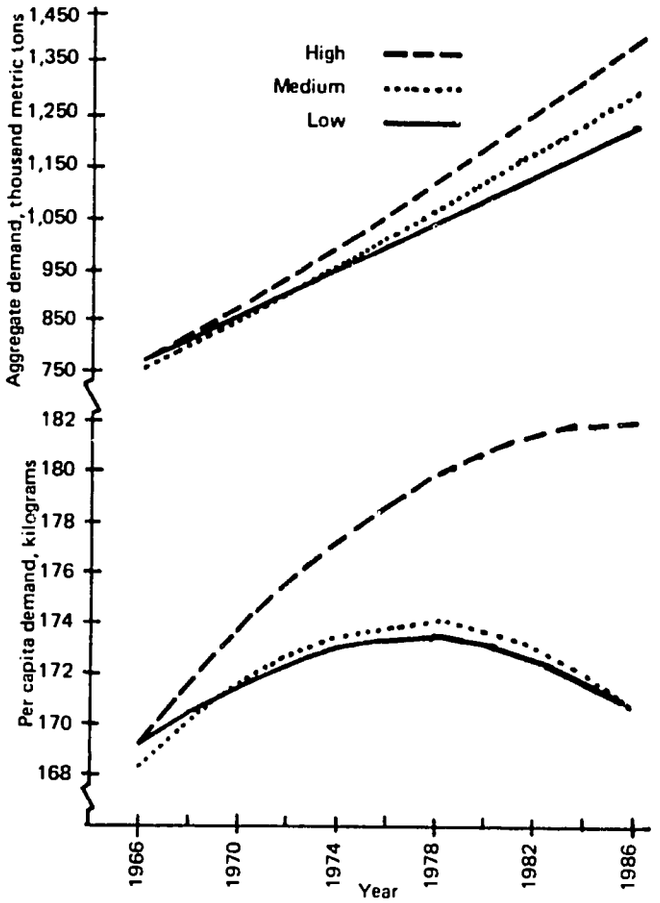


Figure 21. Per capita and aggregate demand projections for total cereals for human consumption, Tunisia, low, medium, and high assumptions, 1966-86.

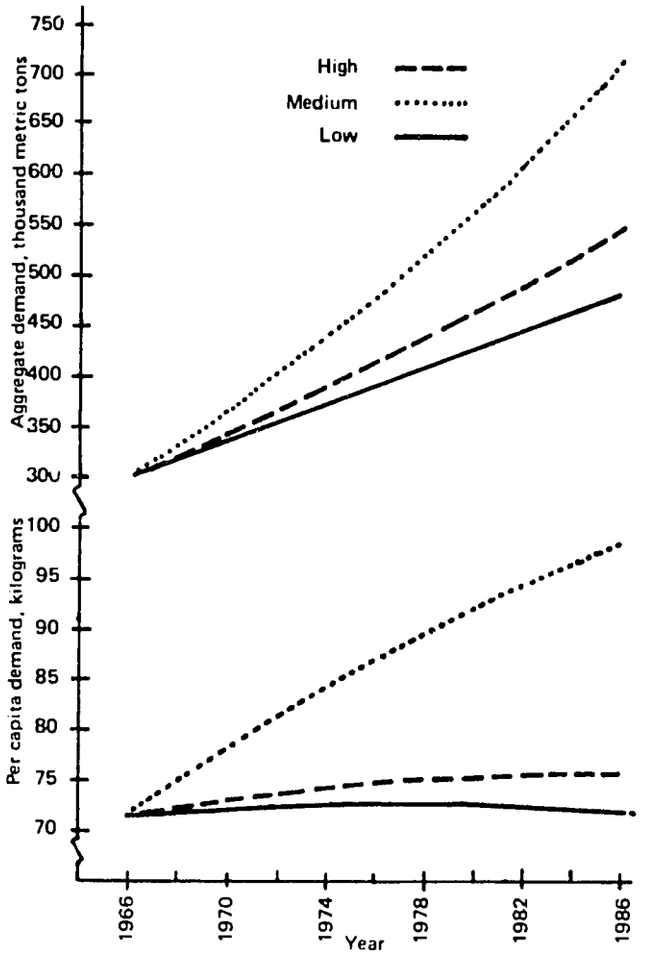


Figure 22. Per capita and aggregate demand projections for bread wheat, Tunisia, low, medium, and high assumptions, 1966-86.

demand for each cereal is perfectly inelastic with respect to relative prices.

Three sets of projections were made. The low projections used the growth rates for population and consumption expenditure used for the agricultural plan. Also, the expenditure elasticities used for individual cereals were made consistent with the expenditure elasticity used for total cereals.[35] The high projections used a higher rate of population growth and about the same rate of growth as the low projections for consumption expenditure. The expenditure elasticities of demand for individual cereals were made consistent with a higher expenditure elasticity for total cereals.

The medium demand projections were cast in a different framework. The Tunisian population was divided into three categories: large cities, small cities, and villages (including strictly rural residents). The demand for total cereals was projected for each urbanization category. The result was a demand projection lying between the high and low projections for total cereals.

The demands for individual cereals were projected by computing the consumption of each cereal as a percentage of total cereals in 1966 in each urbanization category. Similar percentage distributions were estimated at the income levels predicted for 1986 in each category. The percentages were computed for each intervening year by interpolating between the 1966 and 1986 expenditure levels.

A more thorough discussion of the procedures used in the projections is given in appendix D. The projected quantities demanded through 1986 are shown there and in appendix tables A-17 through A-20. They are shown graphically in figures 21 through 24.

Note the dominance of the effect of increasing population over that of increasing per capita income. In figure 21, aggregate demand continues to rise, although per capita demand peaks out in 1978-80. The medium per capita projection for total cereals is quite close to the low projection. However, the aggregate medium projection falls almost midway between the low and high because the rate of population growth assumed is close to that of the high projection.

The difference between the high and low aggregate projections for total cereals is small, about 3 percent in 1972. By 1980, however, it increases to almost 10 percent.

For total cereals, the medium projections lie between the low and high projections. For individual cereals, however, they lie outside the low and high projections. In general, the

[35] Consistency in this case required that the weighted sum of the income elasticities for individual cereals be equal to the income elasticity for total cereals. The weight in each case was the proportion of total expenditure for cereals spent on each cereal. (See appendix D for further explanation using the actual elasticities.)

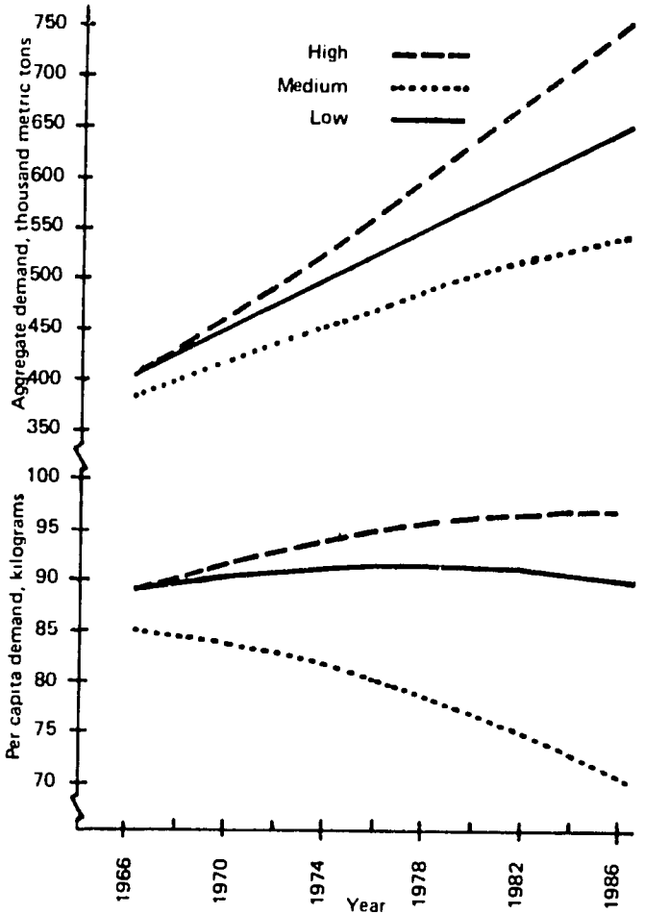


Figure 23. Per capita and aggregate demand projections for durum for human consumption, Tunisia, low, medium, and high assumptions, 1966-86.

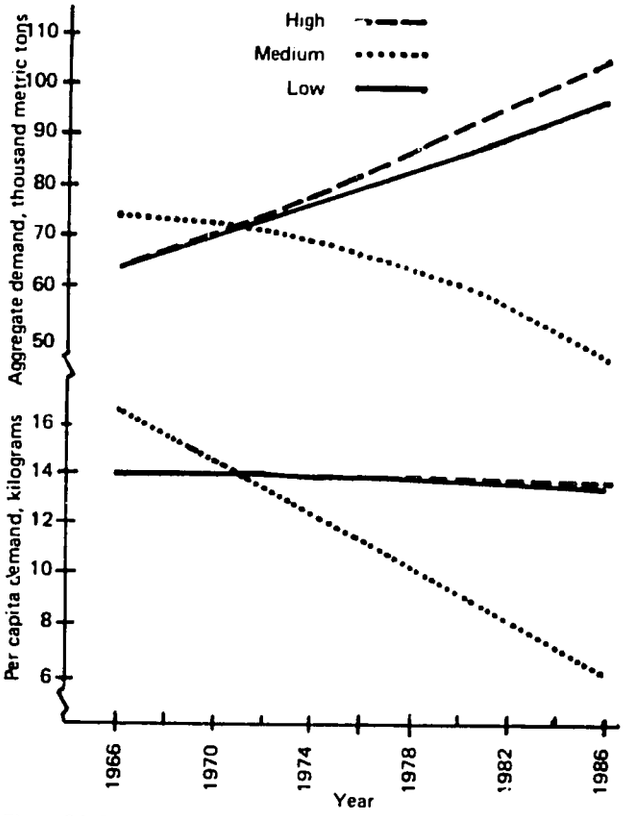


Figure 24. Per capita and aggregate demand projections for barley for human consumption, Tunisia, low, medium, and high assumptions, 1966-86.

medium projections are greater than the high projections for bread wheat and lower than the low projections for durum and barley. This was built into the medium projections for two reasons: (1) Income growth and the trend toward urbanization were believed likely to increase the demand for bread wheat at the expense of durum and, particularly, barley. (2) The substitution of bread wheat flour for some percentage of the semolina in pasta products is common practice whenever bread wheat prices are lower than durum prices.

The assumptions behind the high and low projections explicitly ruled out the first reason and ignored the second. Since the existence of the second phenomenon is certain, the projected low and high demands for durum and bread wheat in 1972 and 1980 were adjusted to recognize some substitution of bread wheat in durum products. Acceptable pastas and cous-cous can be prepared commercially with large amounts (more than 25 percent) of bread wheat flour in the semolina. With hand methods, cous-cous can be prepared with 100 percent bread wheat or almost any other cereal.

On an aggregate basis, it is unlikely that the substitution would be carried to the extent that is technically possible. So long as a large share of cous-cous is prepared in the home, much of it will continue to be made from pure durum semolina. For this analysis, it was assumed that the durum consumption projected for 1972 and 1980 under the high and low assumptions would be reduced by 10 percent, which would be replaced by bread wheat. The resulting quantities are shown in table 16.

Based on growth rates for the livestock sector and indications in the 1969-72 agricultural plan, cereals required for livestock feed are estimated to be 286,000 tons in 1972 and 447,000 in 1986.[36] Both estimates are in terms of barley. In terms of wheat, which substitutes for barley at the rate of 1 ton for about 1.1 tons of barley, the estimated livestock requirements are 260,000 tons and 406,000 tons for 1972 and 1980, respectively. Total cereal requirements for 1972 and 1980, including human and animal consumption needs, are shown in table 17. These requirements would be reduced somewhat if bread wheat were substituted for barley in livestock feeds. However, the difference is small. Under the low demand projections, for example, the full substitution of bread wheat for barley would reduce total cereal requirements in 1972 by about 2.2 percent. Under the low projections for 1980, the reduction would be about 2.7 percent. Since the absolute differences are equal for each demand projection, the percentage differences are somewhat lower for the medium and high projections.

Only two of the demand projections, medium and high, were retained in the analyses of alternative production policies for 1972 and 1980.[37] The medium projection was retained

[36] See appendix E.

[37] The analyses were performed for all three projections, see appendix A.

Table 16. Reduction of 1972 and 1980 projected durum consumption by 10 percent to reflect its replacement by bread wheat, low and high projections

Year	Projected durum consumption	Durum consumption reduced by 10 percent	Projected bread wheat consumption	Bread wheat consumption augmented to replace durum
	thousand tons			
1972				
Low projection.....	481.8	433.6	355.9	404.1
High projection	498.6	448.7	366.5	416.4
1980				
Low projection.....	582.8	524.5	428.7	487.0
High projection	642.8	578.5	467.3	531.6

Source: Low and high demand projections, appendix D.

Table 17. Total Tunisian cereal requirements, 1972 and 1980, three demand projections with livestock requirement expressed in terms of barley and bread wheat

Year and demand projection	Total cereal demanded for human consumption	Livestock requirement for cereals		Total cereal requirement	
		Barley	Bread wheat	Barley	Bread wheat
	thousand metric tons				
1972					
Low.....	911.7	286.0	260.0	1,197.7	1,171.7
Medium.....	912.3	286.0	260.0	1,198.3	1,172.3
High.....	940.0	286.0	260.0	1,226.0	1,200.0
1980					
Low.....	1,098.4	447.0	406.0	1,545.4	1,504.4
Medium.....	1,134.4	447.0	406.0	1,581.4	1,540.4
High.....	1,201.8	447.0	406.0	1,648.8	1,607.8

because it presented a significant alternative to the low and high projections for individual cereals. The low and high projections were based on considerations that resulted in a rising durum demand relative to that for bread wheat. The medium projections had the opposite result. Since the choice between bread wheat and durum is of utmost importance to Tunisia, an analysis emphasizing this choice is extremely valuable.

The high projection was selected over the low because it was based on population projections that were believed to be more tenable. In the high projections the estimated growth rate of 2.8 percent continues to 1976, drops to 2.7 percent for 1976-81, and drops to 2.6 percent thereafter. The low projections assumed much greater progress with family planning programs.

Alternative Supply Models and Necessary Assumptions

Alternative Models. Given the yield and area assumptions and the indicated growth rate of the livestock sector, there is little prospect that Tunisia will attain self-sufficiency in cereals by 1980. This fact was recognized in each model:

Model O. Production of each cereal was based upon the area distribution indicated in the 1969-72 agricultural plan (table 15).

Model I. Area was distributed to achieve self-sufficiency in bread wheat, a surplus (for human consumption) in barley, and a deficit in durum.

Model II. Area was distributed to achieve a deficit in bread wheat, a surplus (for human consumption) in barley, and self-sufficiency in durum.

Due to the medium and high demand projections and the advance specifications of self-sufficiency, cereal production in models I and II depends upon the demand projections. Surpluses and deficits in *all* models depend upon the demand projections.

The area distribution of cereals for models 72-0 and 80-0 is set by the 1969-72 plan for agriculture (table 15). The specifications for the other models are met by redistributing the areas in each of the production categories shown in table 15. Obviously, there are an infinite number of ways in which these areas can be redistributed to achieve the specifications of each model. So the area distributions used in this analysis are essentially arbitrary. They are, however, based on factors that probably will become more important as Tunisian agriculture becomes more oriented to commercial markets.

For models I and II, land in barley in the north was reduced by one-half and given to bread wheat [38] In the future, less barley will be produced for home consumption and the land will be devoted to higher-yielding bread wheat. Irrigated barley land also was given over to higher-yielding bread wheat in the models.

[38] Only the total project area in each cereal is considered below. Detailed project area breakdowns are shown in the tables of appendix A.

Table 18. Assumed prices for 1972 and 1980 and present base farm prices for cereals, Tunisia

Item	1972 price	1980 price	Present internal price
	dinars per ton		
Bread wheat	28.875	25.988	43.000
Durum	30.030	27.027	48.000
Barley	26.250	23.625	28.000
Nitrogen fertilizer	32.977	32.977	

All bread wheat production in the center and south was given over to barley. Cultivation of the higher-yielding Mexican varieties will become centered in the high rainfall areas of the north, leaving the dryer center and south to better-adapted barley and durum.

Differences between models I and II and between the high and medium versions of each model lie solely in the cereal's position in the crop rotation (first crop following a fallow or leguminous forage). If the model's specification calls for more bread wheat, then more area is devoted to it. If the specifications require more durum, more land is given to durum. All land areas in the other production categories remain unchanged between and within models I and II.

Necessary Assumptions. To analyze production alternatives, a number of assumptions concerning areas, yields, fertilizer requirements, and prices had to be made. (See appendix E for a more thorough discussion of these assumptions.) In general, the areas, yields, and fertilizer requirements were based on material presented in the 1969-72 plan for agriculture and upon production norms disseminated to the production cooperatives. A 15-percent allowance for seeds and losses was assumed. Net production was assumed to be available for human and animal consumption.

Price assumptions were based upon continued downward pressure on world cereal prices. Specifically, it was assumed that world feed grain prices for 1972 would remain unchanged from present levels of about $50 per ton, and that bread wheat prices would fall to reflect their feed value of about 110 percent the price of barley (weight basis). World durum prices also would fall, but their recent price relationship to bread wheat would be maintained. The price of durum would thus be at 104 percent the price of bread wheat.[39] For 1980, it was assumed that the price of each cereal in world markets would decline by 10 percent from 1972 levels.

It was assumed that Tunisia would continue to import nitrogen fertilizer materials in 1972 and 1980 at the current average, about 33 dinars per ton (c.i.f. Tunisian frontier).

The specific set of prices used is shown in table 18.

Analysis of Alternative Production Models

The summary tables presented below compare the outcomes of each of the three models judged against total cereal availability, foreign exchange balances, and gross receipts from cereals.[40]

Production of each cereal for 1972 under each model was based upon crop yields derived from the agricultural plan. Projections of nitrogen fertilizer imports were derived from production norms disseminated to production cooperatives. Total area in cereals in northern Tunisia was assumed to remain constant at the level indicated in the agricultural plan.

The outcomes of each of the models differ widely in terms of individual cereals when measured in both quantity terms and value terms. However, *in terms of total cereals,* the outcomes are remarkably similar, both as total quantities and as total dinar values.

Land Area Distributions and Total Cereal Availability

The distribution of land area in northern Tunisia among the three cereals for each model is shown in table 19. Land area in the center and south is not specified, although this portion of the country was projected to provide about 17 percent of total cereal production in 1972 and about 11 percent in 1980.

Distributions differ widely among the three models. In 1972 model O, the land area distribution of the 1969-72 plan for agriculture calls for heavy emphasis on bread wheat. Model I, the bread wheat self-sufficiency model, requires a reduction in land area for bread wheat since, under model O, a surplus of this cereal is produced. Model II requires a further drastic reduction in bread wheat area so that durum production can be expanded to self-sufficiency.

Yield increases between 1972 and 1980 reduce the necessity of shifting land area from one cereal to another to meet the alternative self-sufficiency specifications.

The quantities of cereals available for meeting human and animal consumption needs are shown in table 20. The divergence among the models in the production of individual cereals is evident from the table. In 1972, for example, bread wheat net production falls from 472.5 thousand tons under model O to 206.9 thousand tons under model II (medium projections), or to 196.1 thousand under the high projections of model II. These are declines of more than 50 percent. In 1980, the declines in bread wheat production from model O to model II are less drastic but still quite large. The increases in durum production from model O to model II are of comparable magnitude.

In terms of total cereals, there is not much difference among the models. In both 1972 and 1980, production patterns given by model O result in the greatest output of total cereals. Yet in 1972 the smallest output, achieved under model II, is only 4.6 percent less than that under model O. In 1980 the difference is greater. The smallest output, 1,156.9 thousand tons under model II (high projections), is 10.7 percent less than the 1,295.1 thousand tons produced under model O. In both 1972 and 1980, these reductions are due to the reduced production of bread wheat whose yields are greater than those of the durum that replaced it.

Net External Balances

Quantities Imported and Exported. When projected consumption is matched against projected net production, the result is the quantity of cereal that must be imported to fill the gaps or the quantities available for export. These quantities, plus necessary imports of nitrogen fertilizers, are shown in table 21. Surpluses and deficits in all three models differ, depending on the medium or high demand projection with which production is matched.

Differences among the models are quite large. Total cereal imports increase in both years and for both sets of demand projections from model O through model I to model II. In 1972 the difference between cereal imports under model O and model II is 9.4 percent (percentage of model O imports) for the medium projections and 9.1 percent for the high pro-

[39] The basis for this price assumption is discussed more fully in appendix E.

[40] Tables showing these results in more detail are presented in appendix A.

Table 20. Cereals available from domestic production for meeting human and animal consumption needs, Tunisia, 1972 and 1980

Item	Model O	Medium demand projections		High demand projections	
		Model I	Model II	Model I	Model II
	net cereal production, thousand tons*				
			1972†		
Bread wheat	472.5	401.7	206.9	416.4	196.1
Durum	191.6	268.5	439.2	255.7	448.7
Barley	170.1	153.7	153.7	153.7	153.7
Total cereals	834.2	823.0	799.8	825.8	798.5
			1980†		
Bread wheat	786.8	567.9	485.2	531.6	382.2
Durum	253.5	448.5	96.4	473.9	578.5
Barley	254.8	196.2	196.2	196.2	196.2
Total cereals	1,295.1	1,212.6	1,187.8	1,201.7	1,156.9

*A seed and losses allowance of 15 percent was deducted from gross production to arrive at net production available for consumption.
†See footnotes, table 19.

Table 19 Distribution of land area in northern Tunisia among cereals under the three models, 1972 and 1980

Item	Model O	Medium demand projections		High demand projections	
		Model I	Model II	Model I	Model II
	land area, thousand hectares				
			1972†		
Bread wheat	430.6	413.4	210.6	428.7	199.3
Durum	178.0	269.6	427.4	254.3	483.7
Barley	148.0	73.5	73.5	73.5	73.5
Total area*	756.6	756.5	756.5	756.5	756.5
			1980**		
Bread wheat	430.6	341.2	292.5	319.8	231.9
Durum	178.0	341.9	390.5	363.2	451.1
Barley	148.0	73.5	73.5	73.5	73.5
Total area*	756.6	756.5	756.5	756.5	756.5

*Totals are not equal due to rounding.
†See appendix tables A-21, A-24, A-24c, A-26b, A-26c.
**See appendix tables A-28, A-31b, A-31c, A-33b, A-33c.

jections. In 1980, these differences, as percentages of model O imports, increase to 37.5 percent for the medium projections and 28.2 percent for the high projections.

The most significant relationship brought out by the data in table 21 is that, despite improvements in cereal production, Tunisia is projected to remain a net importer of cereals through 1980. Under the high demand projections, the cereals deficit in two of the three models increases between 1972 and 1980.

Between 1972 and 1980, the total cereals deficit declines under the medium demand projections in each model. These declines range from 77.8 thousand tons in model O to 5.6 thousand in model I and 4.9 thousand in model II. In percentage terms, total import needs under the medium projections also fall, from 30-33 percent in 1972 to 18-25 percent in 1980.

Under the high demand projections, the 1972 to 1980 change in the cereals deficit varies from a decline of 38.1 thousand tons in model O to a 64.4 thousand ton increase in model II. The portion of domestic requirements to be filled by imports falls from 32-35 percent in 1972 to 21-30 percent in 1980.

The difference between the 1980 deficits under the medium and high projections illustrates the importance of population control measures in holding down domestic demand.

Another significant factor in this production-consumption gap is the success of efforts to increase livestock output. In 1972, barley imports account for about half of total cereal imports in each model. By 1980, they are projected to account for well over half. Failure of the livestock sector to develop as intended would make a significant contribution to closing the cereal production-consumption gap. Of course, this occurrence could not be cited as an example of successful agricultural development.

Table 21. Surpluses (+) and deficits (-) of cereals and imports (-) of 33 percent nitrogen fertilizer material, Tunisia, 1972 and 1980

Item	Medium demand projections			High demand projections		
	Model O	Model I	Model II	Model O	Model I	Model II
	thousand tons					
			1972*			
Bread wheat	+ 70.8	0	-194.8	+ 56.1	0	-220.3
Durum	-247.6	-170.7	0	-257.1	-193.0	0
Barley	-187.3	-203.7	-203.7	-190.8	-207.2	-207.2
Total cereals	-364.1	-374.4	-398.5	-391.8	-400.2	-427.5
Nitrogen fertilizer	-106.6	- 96.7	- 66.3	-106.6	- 98.5	- 64.6
			1980†			
Bread wheat	+218.9	0	- 82.7	+255.2	0	-149.4
Durum	-252.9	- 57.9	0	-325.0	-104.6	0
Barley	-252.3	-310.9	-310.9	-283.9	-342.5	-342.5
Total cereals	-286.3	-368.8	-393.6	-353.7	-447.1	-491.9
Nitrogen fertilizer	-106.6	- 85.9	- 78.6	-106.6	- 82.7	- 69.5

*See appendix tables A-22a, A-22b, A-25a, A-25b, A-27a, A-27b.
†See appendix tables A-29a, A-29b, A-32a, A-32b, A-34a, A-34b.

An alternative to exporting the bread wheat surpluses arising under model O is to use them as livestock feed.[41] If this were done, total cereals imported under model O would be:[42]

1972
Medium demand projections... -357.0 thousand tons
High demand projections..... -386.2 thousand tons
1980
Medium demand projections... -282.5 thousand tons
High demand projections..... -328.2 thousand tons

All other total cereal imports and nitrogen fertilizer imports in table 21 would remain the same. Note that the feeding of bread wheat to livestock under model O reduces total imports slightly in both 1972 and 1980.

Import and Export Values. More significant than the comparison of export balances in quantity terms is their comparison in terms of the foreign exchange expended. The dinar equivalents of the foreign exchange costs for each model are shown in table 22.

Here it is assumed that the bread wheat surplus of model O is exported. The price assumption for 1972 and 1980 was that in world markets bread wheat would be priced at its feed equivalent value. Thus the feeding of livestock with bread wheat under model O would not affect the foreign exchange result of that model. The value of the bread wheat used as feed is just offset by the value of the barley replaced.

Present internal price relationships in Tunisia, however, impede bread wheat from being used as livestock feed. Only if the domestic price of bread wheat fell from its present level of 43 dinars per ton to 30.08 dinars per ton (the price of barley remaining at 28 dinars per ton) could bread wheat compete with barley in the livestock ration.

The foreign exchange costs of cereal imports are quite similar under the three models. In *1972,* under the medium demand projections, they range from about 10.3 million dinars for model O to 11.0 million for model II, a difference of about 7 percent. Under the high demand projections, the range is from 11.1 million dinars to 11.8 (model O to model II), about a 6 percent difference.

When the effect of fertilizer imports is included, the order of increasing costs among the models for 1972 is reversed. Model O, at about 13.8 million dinars (medium demand projections) is the most costly, while model II, at about 13.2 million (medium projections), is the least costly. Lower imports of fertilizers under model II more than offset the effect of higher cereal imports. The difference is still small, 4-5 percent. Under the high demand projections, fertilizer imports again more than make up for the difference in cereal imports. Model II becomes the least costly in terms of foreign exchange, and model O becomes the most costly. Again, the difference, about 5 percent, is not large.

These data suggest that, for 1972, a policy of self-sufficiency in durum wheat, with imports of bread wheat and feed grains, would result in some foreign exchange savings compared with a policy of bread wheat self-sufficiency or with a production policy based on the 1969-72 plan for agriculture. However, the savings would be small, and could be outweighed by other factors influencing production policies.

In *1980,* differences in the foreign exchange costs are greater. Under the medium projections, model II, at a cost for cereals of 9.5 million dinars, is about 34 percent more costly than model O at 7.1 million. Adding imports of fertilizer to imports of cereals reduces the difference but does not offset it. Model II remains the most costly at 12.1 million dinars, almost 14 percent more than the foreign exchange cost of model O.

The 1980 foreign exchange costs of the three models under the high demand projections are greater than under the medium projections, but the ranking remains the same. Model II is about 15 percent more costly than model O when fertilizer imports are included.

Implications. The data in table 22 imply that as a program of increased cereal output begins to bear fruit, Tunisian policymakers must become more cognizant of differences in techno-

[41] Bread wheat substitutes for barley in livestock rations at the rate of about 1.1 kilograms of barley for every kilogram of bread wheat.

[42] See appendix tables A-23a, A-23b, A-30a, A-30b.

Table 22. Value of cereal imports (-) and exports (+) and of nitrogen fertilizer material (33 percent nitrogen) imports (-), Tunisia, 1972 and 1980, and assumed world market prices, 1972 and 1980

Item	Medium demand projections			High demand projections		
	Model O	Model I	Model II	Model O	Model I	Model II
	thousand dinars					
1972*						
Bread wheat	+ 2,044	0	- 5,625	+ 1,620	0	- 6,361
Durum	- 7,435	- 5,126	0	- 7,721	- 5,796	0
Barley	- 4,917	- 5,347	- 5,347	- 5,008	- 5,439	- 5,439
Total cereals	-10,308	-10,473	-10,972	-11,109	-11,235	-11,800
Nitrogen fertilizer	- 3,516	- 3,189	- 2,188	- 3,516	- 3,248	- 2,130
Net balance	-13,824	-13,662	-13,160	-14,625	-14,483	-13,930
1980*						
Bread wheat	+ 5,689	0	- 2,149	+ 6,632	0	- 3,883
Durum	- 6,835	- 1,565	0	- 8,784	- 2,827	0
Barley	- 5,961	- 7,345	- 7,345	- 6,707	- 8,092	- 8,092
Total cereals	- 7,107	- 8,910	- 9,494	- 8,859	-10,919	-11,975
Nitrogen fertilizer	- 3,516	- 2,833	- 2,592	- 3,516	- 2,727	- 2,292
Net balance	-10,623	-11,743	-12,086	-12,375	-13,646	-14,267

Assumed world market prices (1 dinar = $1.90), 1972 and 1980, dinars per ton

	1972	1980
Bread wheat	28.875	25.988
Durum	30.030	27.027
Barley	26.250	23.625
Nitrogen fertilizer	32.977	32.977

*See footnotes, table 21.

logical and market developments. And Tunisian producers must be made aware of them through proper use of incentives and educational programs.

A second implication is that the foreign balances shown in table 22 could be considered estimates of the minimum costs of achieving full self-sufficiency in cereals in 1972 and 1980. This argument is based upon the consideration that the foreign exchange value of products given up in achieving self-sufficiency is at least equal to the foreign exchange value of the additional cereals produced.

The foreign exchange value of these alternative crops probably is greater than shown in table 22, which implies that it would be uneconomical for Tunisia to move too rapidly toward full cereal self-sufficiency. Such a program should be approached cautiously, with careful attention to the world market values of commodities replaced by cereals. Caution is especially necessary when internal prices for cereals, particularly bread wheat and durum, are well above world market prices.

The large share that barley holds in total cereal imports may be taken as a guide to allocating development resources. Of course, the development of the livestock sector depends on the availability of feedstuffs. This analysis obviously assumes this availability and assumes that a large share of livestock feed is provided by imports.

An equally important guide to allocating resources in cereal production is the cost of increased resource productivity. One cereal competes with another for available production resources. Increased resource productivity in durum, for example, allows additional resources to be transferred from durum to barley, thereby permitting increased output in both cereals.

These issues raise important questions about the equity between the north and the less well-endowed south. But any development effort must take into account which cereal can be produced most cheaply, where existing technical knowledge can be most quickly applied, and where the necessary research can be accomplished with the least effort.

Gross Value of Cereal Production[43]

Gross Values at Present Internal Prices. The gross value of cereal production valued at present internal prices is shown in table 23. In model O, net production and value of production are the same under both the medium and high demand projections.

In *1972,* the differences among the models are small. Under the medium demand projections, model I gives the highest total value, while model O gives the smallest. The difference is less than 1 percent. Under the high demand projections, model I again gives the highest total value, while model II gives the lowest. Here the difference is greater, but still is less than 1 percent.

In *1980,* model O gives the highest total value, 53.1 million dinars, while model II gives the lowest, 50.7 million under the medium demand projections and 49.7 under the high projections. The differences are again small, but much greater than those for 1972, about 5 percent for the medium projections and about 7 percent for the high projections.

[43] Gross value of *net* cereal production. The 15 percent of production allotted for seeds and losses is not available for sale outside the cereal sector.

Table 23. Value of net cereal production, three models, Tunisia, 1972 and 1980, current internal farm prices*

Item	Medium demand projections			High demand projections	
	Model O	Model I	Model II	Model I	Model II
	thousand dinars				
			1972		
Bread wheat	20,318	17,273	8,827	17,905	8,432
Durum	9,197	12,888	21,082	12,274	21,538
Barley	4,763	4,304	4,304	4,304	4,304
Total value	34,278	34,465	34,283	34,483	34,274
			1980		
Bread wheat	33,832	24,420	20,864	22,869	16,435
Durum	12,168	21,528	24,307	22,747	27,768
Barley	7,134	5,494	5,494	5,494	5,494
Total value	53,134	51,442	50,665	51,100	49,697

Internal present prices at farm level, dinars per ton

Bread wheat	43.000
Durum	48.000
Barley	28.000

*The values shown in this table are the products of these prices and the net productions shown in table 20.

Table 24. Value of net cereal production under three models at assumed world prices for cereals, Tunisia, 1972 and 1980*

Item	Low demand projections			High demand projections	
	Model O	Model I	Model II	Model I	Model II
	thousand dinars				
			1972		
Bread wheat	13,643	11,599	5,974	12,024	5,662
Durum	5,754	8,063	13,189	7,679	13,474
Barley	4,465	4,035	4,035	4,035	4,035
Total value	23,862	23,697	23,198	23,738	23,171
			1980		
Bread wheat	20,447	14,759	12,609	13,815	9,933
Durum	6,851	12,122	13,686	12,808	15,635
Barley	6,020	4,635	4,635	4,635	4,635
Total value	33,318	31,516	30,930	31,258	30,203

*Prices are shown in table 22. The values shown in this table are the products of these prices and the net productions shown in table 20.

Gross Values at Assumed World Prices. The gross value of cereal production valued at assumed prices for 1972 and 1980 is shown in table 24.

When net cereal production is valued at the world prices assumed to prevail in 1972 and 1980, the production under model O results in the highest total value. As in earlier comparisons, the difference is not great, ranging from less than 3 percent (1972 medium projections) to about 10 percent (1980 high projections). Again, differences among the models increase from 1972 to 1980 along with the increasing value of production.

The increase in value of total production from 1972 to 1980 is not as great as the production increase figures in table 20 suggest. This is true because world prices for all cereals were assumed to decline by 10 percent between 1972 and 1980. Table 24 shows that this decline is more than offset by increased cereal production.

Comparisons Based on Prices. A comparison of table 24 with table 23 indicates the effect on gross production value of a possible change in price policy for cereals. If the Tunisian government should reduce internal cereal prices for 1972 to reflect assumed world market conditions more accurately, the differences in the values of cereal output would be startling. For example, under model O, valuing cereals at world prices results in a total value of 23.9 million dinars, while using present domestic prices gives a total value of 34.3 million, 44 percent greater. In 1980 the difference is even greater: The 53.1 million dinars at which model O production is valued using present prices is 59 percent greater than the 33.3 million dinars at which the same quantity of cereals is valued at world prices.

Perhaps an equally valid comparison would be that between 1972 and 1980 net production valued at world prices and net production in recent years valued at present domestic prices.

Table 25. 1966-68 average net production and value of net production of cereals, Tunisia, current domestic prices

Cereal	Production	Seed allowance	Net production	Value of net production*
	thousand tons			thousand dinars
Bread wheat	57.3	13.7	43.6	1,874.8
Durum	420.0	60.0	360.0	17,280.0
Barley	151.7	22.7	129.0	3,612.0
				22,766.8

*Prices, dinars per ton: Bread wheat 43.000; Durum 48.000; Barley 28.000

Source: A. Sahnoun. *Comptes Ressources Emplois, 1964-69.* Rapport d'Economie Agricole No. 6, Mar. 1971. These data are revised estimates of cereal production and differ from the earlier estimates presented in appendix A.

An estimate of the average value of net production in Tunisia over a recent 3-year period is shown in table 25.

Compared with the 22.8 million dinar estimate of table 25, the value of model O production in 1972 at the lower assumed world prices is only about 5 percent higher. The value of model O production in 1980 at world prices is 46 percent higher than the production shown in table 25. Thus, the impact on gross income of reducing Tunisia's internal prices to reflect world market conditions more accurately would be severe, even with the projected output gains to 1972. Not until 1980 would net production, valued at world prices, be significantly greater than current production valued at current prices.

Import and Export Margins of the National Cereal Monopoly

All cereals exported from and imported into Tunisia are handled by the Office of Cereals. Since Tunisian internal cereal prices are higher than present day world prices (and higher than the world prices assumed for this analysis), exports from Tunisia result in losses to the agency, while imports result in profits.[44] The magnitude of these trading margins is of interest because the margins result partly from events in world cereal markets. They are independent of the Office's operating efficiencies.

Trading margins for 1972 can be estimated from the quantities of cereals projected to be imported and exported during that year, the prices assumed to prevail in world markets, and present internal prices that are assumed to remain unchanged to 1972. Although the Office sells cereals internally at prices above those at which it acquires them from Tunisian farmers, the latter prices were used as the internal selling prices for measuring import-export trading margins. These margins are shown in table 26.

[44] To the extent that these margins are not retained by the Office of Cereals, but are paid into the national treasury, they are an import duty. This duty is identical in kind to the variable levies exacted by the European Economic Community on its cereal imports. It is a regressive tax in that it is borne by the low income consumer, for whom cereals are the major food expenditure.

Table 26. Trading profits and losses of the national cereal monopoly on import-export operations, Tunisia, 1972*

Item	Margin per ton†	Medium demand projections** Quantity imported or exported	Medium demand projections** Net profit or loss	High demand projections** Quantity imported or exported	High demand projections** Net profit or loss
	dinars	thousand tons	thousand dinars	thousand tons	thousand dinars
			MODEL O		
Bread wheat	14.125	-70.8	-1,000	-56.1	792
Durum	17.970	+247.6	+4,449	+257.1	+4,620
Barley	1.750	+187.3	+ 328	+190.8	+ 334
Net total margin			+3,777		+4,162
			MODEL I		
Bread wheat	14.125	0	0	0	0
Durum	17.970	+170.7	+3,067	+193.0	+3,468
Barley	1.750	+203.7	+356	+207.2	+363
Net total margin			+3,423		+3,831
			MODEL II		
Bread wheat	14.125	+194.8	+2,752	+220.3	+3,112
Durum	17.970	0	0	0	0
Barley	1.750	+203.7	+361	+207.2	+363
Net total margin			+3,108		+3,475

*Imports and the profits on imported cereals are indicated by a plus (+) sign. Exports and the losses on exported cereals are indicated by a minus (-) sign. (Since present internal prices are higher than assumed world prices, exports result in losses for the monopoly, while imports result in gains.)

**See table 21.

†Margins per ton, dinars:

	Present internal price	Assumed world price	Difference
Bread wheat	43.000	28.875	14.125
Durum	48.000	30.030	17.970
Barley	28.000	26.250	1.750

As shown in the table, the national cereal monopoly would gain between 3.1 million and 4.2 million dinars from its import-export operations if the presumed production, demand, and price conditions for 1972 were fulfilled. Comparing this result with the data of table 22 shows that this gain represents a markup of about one-third on the foreign exchange value of net cereal imports for 1972. These gains exist so long as Tunisian internal prices are above world market levels. They would be largely, if not completely, eliminated if Tunisia altered its internal cereal prices to reflect conditions in the international cereal market more closely.

CONCLUSIONS AND IMPLICATIONS: PRICE POLICY FOR A THRESHOLD AGRICULTURE

The Policy Dilemma

A central theme in this report has been the advisability of increasing the amount of cereals available by lowering internal prices to the level of import prices. Industrial development would be aided since food commodities, particularly cereals, are an important wage good in less-developed countries such as Tunisia. An important consideration is whether such an action might not significantly inhibit agricultural development.

A policy prescription of equal internal and external prices is of unquestioned benefit only in a setting of full employment and high resource mobility among alternative employment opportunities. Human resources are of primary importance here, but the argument applies to all resources. In the less-developed countries, where unemployment is typically high, and where resource mobility is typically low, the income and equity consequences of such a prescription may be dangerous.

Falcon points out that this dilemma has become explicit in Pakistan, where some success with new wheat varieties and new technologies has already been achieved.[45] The government of Pakistan has persisted in maintaining internal wheat prices at levels well above world prices. It has done so despite being forced to spend more than $100 million in 1968 in acquiring wheat surpluses. At the same time, these high internal prices and new technologies in wheat resulted in a reduction in the area planted to cotton, Pakistan's major export commodity.

Lower wheat prices would have reduced the effect on cotton planting and would have encouraged industrial development by making wheat, a major wage good, more available to urban workers.

It was argued, however, that doing so would have reduced wheat production because of its disincentive effects. Falcon asserts that the real reason was the effect of lower prices on agricultural incomes.[46] He goes on to argue that: "The fundamental point -- that incentive is a composite of yield and price (i.e., profitability) and not just price -- was overlooked, as were the broader needs of the economy. That somehow agriculture might or should share the results of the cost-reducing effects of the new technology [i.e., share the benefits through lower prices] had been disregarded."[47]

Tunisia has not yet achieved important output gains that can be attributed to new technology, and heavy dependence on imports is projected at least through the seventies. Pressure on Tunisian grain prices is almost exclusively external; i.e., pressure comes from declining world prices for cereals, partially as a result of dumping activities by developed countries.

The income consequences of reduced cereal prices would not strike all Tunisian farmers equally. They would be less severe in the north, where the opportunities to adjust by adopting new technologies are greatest. Within regions, they would be felt most strongly by farmers whose skills and financial status prohibit them from adopting new production techniques.

Yet, in the long run, these inequalities will have to be dealt with even if cereal prices remain unchanged, As Falcon points out, new technologies are not neutral to scale. All producers do not compete on equal terms for agricultural resources. Those who are less wealthy and less skilled are excluded from these markets. And the higher profits from new varieties and fertilization increase the demand for land and labor-replacing machinery.[48] One conclusion is that regional and personal equity problems will have to find their long-run solution outside the price system for cereals.

These equity questions are extremely important to the political stability and overall development of Tunisia. It may well be that the Tunisian government has given these questions less attention than they deserve. In this respect, a relative shift in emphasis from bread wheat toward barley, so important to southern Tunisia, should be given careful consideration.

Any development effort, agricultural or industrial, must give increasing weight to employment creation. Investment projects and crop and livestock enterprises that call for a high labor input can be important in relieving the inequities of increased cereal production. They also can provide increased capital formation opportunities that are not heavily dependent on the availability of foreign exchange.

Policy Issues: Short Run and Long Run

Cereal prices in Tunisia have fallen relative to other prices in the country, and production did not increase through the sixties. Graphic supply analysis suggests the positive role that prices could play in increasing Tunisia's cereal output. The drastic effects of reducing cereal prices to world prices on the sales value of cereal production in 1972 and 1980 has been pointed out.

Tunisian cereal prices were increased by more than 10 percent for the 1967 harvest. Despite this increase, some rationalization of internal and external price relationships was achieved. The price of bread wheat was raised relative to that of durum, bringing them closer to the relationship existing in world markets. New high yielding varieties of bread wheat were just being introduced in Tunisia, and this change in the durum-bread wheat price ratio was consistent with the efforts being made to secure their adoption.

The Tunisian government would be understandably reluctant to lower cereals prices so long as significant progress in improving production technology has not been achieved and so long as a significant portion of the country's needs are filled by imports. Although some import substitution is possible following the encouraging results of the 1970 harvest, Tunisia

---

[45] Walter P. Falcon, "The Green Revolution: Generations of Problems." Seminar paper presented at the annual meeting of the American Agricultural Economics Association, Columbia, Mo., Aug. 10, 1970.

[46] Ibid.

[47] Ibid.

[48] Ibid.

still anticipated importing at least 250,000 tons of wheat[49] during the 1970-71 crop year.

Maintaining internal prices above import levels may have some rationality from the government's fiscal point of view. Trading margins on imported cereals represent monopoly profits to the Office of Cereals. But to the extent that these are then paid into the national treasury, they represent an import duty, identical in kind to the levies exacted by the European Economic Community on its cereals imports. These funds are available to help finance whatever projects the government feels are most appropriate.

Such an import duty represents a highly regressive tax in that it is borne by the low income consumer, for whom cereals represent a major portion of total expenditures. Expenditures on food are estimated at 50.3 percent of all consumption expenditures in Tunisia.[50] And cereals and cereal products are estimated to account for 32.8 percent of all food expenditures.[51] In other words, cereals account for more than 16 percent of all consumption expenditures in Tunisia, and the percentage is higher for consumers with low incomes.

These statistics indicate that cereals are the major wage good in the Tunisian economy. Lowering internal cereal prices to import levels would contribute to overall development by reducing the pressure for higher industrial wages. At the same time, lower cereal prices would help expand the market for industrial products by reducing the portion of the urban worker's income that is spent for food.

This consideration becomes more important as domestic cereal production increases through improved technology. The maximum benefit of increased resource productivity can only be realized by the whole society if cereal availability increases. Cereals will not be more available and the benefits of technological improvement will not be diffused throughout society unless cereal prices fall.

The issue the Tunisian government must decide is whether or not the income and disincentive effects outweigh the benefits of lower cereal prices. The question can be deferred so long as price pressure remains external; that is, so long as Tunisia remains a net importer of cereals, particularly so long as a major portion of Tunisia's imports are received under bilateral or multilateral aid programs.

If Tunisia attains self-sufficiency in cereals, trading profits as a source of government revenue will disappear. And, if Tunisia attempts to become a net exporter of cereals, trading profits will become losses. These losses would grow if recent downward trends continue to widen the difference between Tunisia's internal prices and world prices for cereals.

As economic development proceeds in Tunisia, alternative tax sources can be found to replace the regressive duty on imported cereals. And, as these sources are found, pricing schemes that permit the margins on imported cereals to be passed on to consumers can be developed.

Under such schemes, cereals could be sold domestically at prices that are weighted averages of import and domestic producer prices. The weights used would be the proportions of total domestic requirements provided by domestic production and imports. To the extent that the administration's budgetary needs permit, such pricing schemes would allow the price of the wage good to fall without putting immediate pressure on prices paid to producers. As import substitution proceeds through technological progress, producer prices would have to decline to prevent consumer prices from rising.

The factors discussed above argue against the immediate lowering of Tunisian prices for cereals. In the long run, however, they carry less weight. In this report, cereal production in 1972 was estimated at more than 800,000 tons, almost double the 450,000 tons estimated for 1970. Even if 1972 is an optimistic horizon for projecting gains of this magnitude, Tunisia can look forward with confidence to important progress in cereal production.

The long-run choice for Tunisian authorities is whether these gains are to be retained within agriculture or diffused throughout the economy. If prices are maintained at their present levels, the former will occur. The benefits from improved resource productivity in cereals will accrue to the whole economy only if cereal prices are permitted to fall.

Technological progress in Tunisian cereal production is concentrated in bread wheat. Through resource substitution, the output of other cereals can be expected to increase also. Because of the geographical distribution of production, durum will be particularly affected and barley less so.

The long-run coordination of internal prices with external prices will affect wheat prices more than the price of barley, since the internal price of barley is much closer to the world price than is the price for wheat. This coordination encourages the production of barley at the expense of durum and bread wheat.

Barley production is more concentrated in the central and southern portions of Tunisia than in the north. Equalizing agricultural incomes between northern Tunisia and the center and south could be important to overall social and economic development in the country.

The pressure of events--internal technological progress and worldwide surpluses of cereals--will eventually force the Tunisian government to rationalize its internal prices with those existing in world markets. Whatever course the government chooses, these are the issues upon which its decision must rest.

The appendixes to this report are not included here because they are not an integral part of the report. They are references for those wishing to pursue a point more fully. To obtain a copy of the appendixes, write to the Office of International Agricultural Programs, 293 Coffey Hall, University of Minnesota, St. Paul, Minnesota 55101.

The appendixes provide a basis for criticizing the analyses and particularly the conclusions drawn. This is especially true of appendixes D and E as they apply to the analysis of alternative policies for cereal production in Tunisia. Appendixes D and E also provide a starting point for alternative assumptions about future prices or production relationships.

---

[49] Dana C. Dalrymple, "Economic Aspects of Nutrition Improvement in Tunisia," Foreign Economic Development Service, U.S. Department of Agriculture in cooperation with the U.S. Agency for International Development. July 1970. Dalrymple reports anticipated wheat imports of 253,000 metric tons during 1970-71. This figure was based on an early wheat production estimate of 580,000 tons for 1970. The later estimate was 519,000 tons.

[50] *La Consommation et les Dépenses des Ménages en Tunisie, 1965-1968.* op. cit., p. 297.

[51] Ibid., p. 211.