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APIP

Agricultural Policy Implementation Project

General Directorate for Development Planning and Agricultural Investments (DGPDIA)
Ministry of Agriculture, Republic of Tunisia

AGRICULTURAL POLICY ANALYSIS: A SUMMARY REPORT

Final Report 91-5

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AGRICULTURAL POLICY ANALYSIS: A SUMMARY REPORT

I- Introduction

Dependency on mineral wealth for export earnings and the revenues to fund state programs has been a major factor underlying structural adjustment reforms in the Mahgreb countries. In the 1970's, Tunisia has been able to maintain expensive subsidies on agricultural inputs and foodstuffs as oil prices skyrocketed. In contrast, the 1980's have been characterized by lower export revenues and mushrooming budget deficits. For example, public debt had mounted to $5 billion in 1987. Since 1986, Tunisia has devalued its real exchange rate by 25 percent in an attempt to stimulate exports and attract tourism. It has also implemented a program of structural adjustments in Agricultural Policy by lowering subsidies on fertilizer, animal feed, meat and other staples.

These adjustments have been motivated by the poor performance of the Tunisian agricultural sector in the early 1980's as well as by outside pressures from funding organizations such as the World Bank. In the last five years, the Ministry of Agriculture has been conducting studies to improve policy planning with the assistance of the Tunisian Agricultural Policy Implementation Project. This report summarizes the policy analysis jointly conducted over the last four years between the University of Wisconsin and the Tunisian Ministry of Agriculture. It discusses some of the policy implications of a number of economic studies investigating various aspects of Tunisian Agriculture (including both private farms and state farms). The discussion presented here focuses on some of the lessons learned from these studies.

II- The Scope and Limitations of Pricing Policy

Prior to the inception of Tunisia's structural adjustment program in 1988, the government heavily subsidized prices for commercial fertilizers while holding prices of grains below import parity levels. Consumers received implicit food subsidies. Producers were implicitly taxed. Fertilizer subsidies helped compensate producers for low cereal prices. As Tunisia attempts to move toward a market economy, one issue is to anticipate the effects of eliminating agricultural subsidies. In a market economy, changing price levels always influence economic profits and thus welfare. In general, higher (lower) profits can be expected to stimulate (dampen) farm production activities. However, the effects of pricing policy on agriculture may vary from one agricultural sector to another.

A- An Aggregate Analysis of Price Effects

An econometric model of Tunisian agriculture was developed (see Chavas, 1990). The aggregate model consists of five outputs and two inputs. The five outputs are: 1/ cereals; 2/ fruits; 3/ vegetables; 4/ livestock; and 5/ other crops. The two inputs are: 1/ variable inputs (fertilizers, chemicals, etc.) ; 2/ other inputs. The model is based on annual data from 1971 to 1988 obtained from the Ministry of Agriculture and Ministry of Planning of Tunisia. Two versions of the model are specified and estimated. One version is a structural econometric model that incorporates risk and partial adjustments. The other version is a reduced form model of supply and demand functions.

The structural model indicates that the speed of adjustment (as measured by the partial adjustment coefficients) differs across sectors. The coefficients of partial adjustment vary from .01 to .23. The results indicate that the adjustments are very slow for vegetables, livestock and variable inputs. For each of these activities, the partial adjustment coefficient is not significantly different from zero and does not exceed 0.03. This indicate that no more than 3% of "desired adjustments" actually take place from one year to the next. In the context of a partial adjustment model, this would mean that the effect of prices on vegetable supply, livestock supply or variable input demand is not significantly different from zero. In contrast, the partial adjustment coefficients are 0.23 for cereals, 0.17 for fruits, 0.21 for other crops and 0.09 for other inputs. This indicates better possibilities of adjustments to market prices for those sectors.

The reduced form model provides estimates of supply and demand elasticities for each sector. The long run supply elasticity for cereals and fruits is found to be around 1. In other words, a 10% increase in output price would stimulate production by about 10% for those activities. The long run supply elasticity for vegetables and livestock is found to be .37 and .07, respectively. However, these elasticities are not significantly different from zero, which is consistent with the results of the structural model reported above. The elasticity of demand for variable inputs was found to be around –0.20. Again, in agreement with the structural model, this elasticity is not significantly different from zero. These elasticities are in general consistent with elasticities reported recently in the "Subsidy Reduction Study" using different and more disaggregated sub–sector data. Other results that are of interest include the elasticity of cereal supply with respect to the price of variable inputs found to be about – .50. Similarly, the elasticity of fruit supply with respect to the price of variable inputs is –0.49 in the short run and –0.75 in the long run.

The results indicate that the response to changing market conditions varies across sectors. For cereals and fruits, supply elasticities are relatively high, indicating the importance of prices in influencing production decisions. For those sectors, pricing policy is therefore expected to have important effects on the levels of production.

In contrast, vegetables, livestock and variable inputs have slower adjustment coefficients and are less responsive to changing market conditions. This indicates that, besides prices, other factors (such as access to credit, input availability, etc.) play an important role in guiding production decisions in those sectors. For example, such factors may impose various constraints on farmers and prevent them from responding to price incentives. This suggests that pricing policy focusing on those sectors would influence agricultural income, but would likely have only a small impact on production decisions. For vegetables, livestock and variable inputs, a policy intended to stimulate agricultural production should therefore focus on non–price policy instruments, including agricultural credit, improvement in agricultural marketing, more efficient use of irrigation water, and/or improved research and extension programs.

B– Disaggregate Analyses

A disaggregate analysis provided useful insights on the evolution of Tunisian agriculture and its response to subsidy removals. The approach relies on trend analysis, on yield response estimation, on crop budgeting analysis and on linar programming analysis of the farm sector. Whenever possible (given data availability), the analysis was conducted at a regional level, thus reflecting the important agro–climatic differences existing across Tunisia. In each case, an attempt was made to examine crop income under current prices and under import parity prices.

1. Yield Analysis for Cereals

Yield response functions for cereals were specified and estimated using time series data (see Kristjanson et al., 1990). In yield response analysis, total fertilizer is found to have a strongly significant effect on yields of bread wheat, durum wheat as well as barley. For durum wheat in the North, the estimated elasticity of fertilizer use (nitrogen plus phosphates) is .24, implying that a 2.4 percent increase (decrease) in fertilizer use will bring about a 2.4 percent increase (decrease) in durum wheat yield. Bread wheat shows a slightly higher responsiveness with an elasticity of .27. The responsiveness of barley yields was lower than that of both types of wheat (.14). When each type of fertilizer is analyzed individually, both nitrogen and phosphate fertilizers show a significant influence on yields of all three crops. The yield response to nitrogen fertilizer is slightly higher than to phosphate fertilizer. Bread wheat yields again show the most responsiveness to individual fertilizers.

Rainfall was also found to be a significant factor in explaining cereals yields. The elasticity of yield with respect to rainfall was .32 for bread wheat, .67 for durum wheat, and .82 for barley. These large elasticities indicate that drought can have a swamping effect on cereal yields.

Variability in yields has been increasing for all cereals in recent years, reflecting less predictable rainfall patterns. Because of the possibility of crop failure, rainfall uncertainty provides a negative incentive for using fertilizer. The countervailing effect of drought on input use suggests that the effects of the structural adjustment program will vary across regions depending on climatic conditions.

The relatively high response of bread wheat yields to fertilizer, and its relatively low yield response to rainfall reflect the fact that bread wheat is generally grown on better soils with greater water holding capacity. Such soils generally enable lower risk of fertilizer use and buffer the adverse effects of drought. The availability of high quality land is limited however. This would explain why the area in bread wheat has remained rather stagnant in the last 30 years, the increase in production being due mostly to yield increases associated with improved varieties and a more intensive use of fertilizers. Most of this growth has been experienced in the north west and central west regions.

Production, area and yields of durum wheat have been stagnating nationwide. Only in the south has there been a noticeable upward trend in production, area and yield in recent years. In contrast, barley production has been increasing. This is due mostly to a steady rise in acreage, while yields have a downward trend due the expansion on marginal land and to low levels of fertilizers. The most rapid expansion has been in the central west, north west and south.

Barley has the lowest yield response to fertilizer, the highest yield response to water and the lowest yield per hectare. This reflects the fact that barley is grown primarily on poor soils with the greatest vulnerability to drought. Barley is generally more drought resistant than wheat. Thus, in response to declining and more variable rainfall, a number of farmers have apparently shifted their crop mix toward barley, especially in the central west and south.

For each cereal, the value of the marginal product of fertilizer was estimated from the yield response functions. The marginal value product was found to exceed greatly the nominal fertilizer price, indicating less than optimal level of fertilizer use in all regions. This suggests that farmers in general are not responding to price incentives in their fertilizer decisions. This would imply that the removal of fertilizer subsidies will probably have only minimal effect on fertilizer use and cereal production. In this context, the main effect of higher fertilizer prices would be to increase production cost and to reduce the profitability of crop production. Additional evidence supporting the claim of a lack of price responsiveness is obtained from the estimation of fertilizer demand functions: it shows that relative prices do not have a statistically significant effect on fertilizer demand. Possible explanations for this finding include: a/ a tendency of farmers to discount the yield response to modern inputs; b/ fertilizer rationing due poor marketing and distribution channels; or c/ cash flow constraints and credit market imperfections that restrict fertilizer purchase by farmers. This suggests the following policy objectives: a/ the development of extension programs that would speed up the adoption of new technologies; b/ improvements in the marketing system for farm inputs; and c/ improvements in the farm credit system. In other words, it would stress the importance of non-price instruments in agricultural policy.

2. Crop Budgeting Analysis

Crop budget models were developed based on the agricultural surveys conducted annually by the Tunisian Ministry of Agriculture (see Roth, Bloch et al., 1990). Models were constructed for the five economic regions of Tunisia. They were then used to evaluate the impact of input subsidy removal and commodity price policy on crop income. This provided useful information on the distributional impacts of policy reform.

Several scenarios of agricultural policies were evaluated: I- the effects of raising official output prices from their 1987 levels to their 1989 levels; II- the influence of changing output prices to their import parity levels; III- the effects of removing input subsidies; and IV- the combined effects of subsidy removal on both inputs and outputs.

Under scenario I or II, increases per hectare net income are highest for barley and lowest for bread wheat. Comparing import parity prices with 1987 prices, net income per hectare of barley increases 183 percent in the north west, 95 percent in the north east, 282 percent in the central west and 37 percent in the central east. Net income per hectare of bread wheat increases only 50 percent in the north west, 38 percent in the north east, 28 percent in the central west, 25 percent in central east. These differences are caused by two factors: 1/ price increases are highest for barley and lowest for bread wheat (official prices of durum wheat have increased 13 percent, bread wheat 8.8 percent and barley 16.7 percent since 1987); and 2/ incomes used to calculate percentage changes are lowest for barley.

These increases in income are not spread evenly among farms. Income from bread wheat tends to be concentrated on fewer farms in all regions, and on very large farms in the north west and north east. Income from durum wheat and barley tends to be evenly distributed across farms. Thus the benefits of higher barley prices, and to a less extent wheat prices, will largely affect small to medium size farms. Increasing returns on bread wheat will primarily benefit medium to large scale producers.

In scenario III, input prices are raised through the elimination of the subsidies. The greatest decline in profitability is experienced in those regions with the highest rate of input utilization. For durum wheat, income per hectare declines 9 percent in the north east, 6.2 percent in the north west, and 5.3 percent in central west. In the central east and south where the utilization of inputs is more sparse, declines in income are minimal. Under current farm practices, bread wheat farmers are hurt the most by higher input prices, and barley producers the least.

When combining the effects of subsidy removal on both output prices and input prices (scenario IV), nominal income improves in all regions and for all crops under normal weather conditions. Income improves substantially for barley in the north west and north east, since it experiences the largest increase in price and is least affected by higher input cost. Increases in income also tend to be large for durum wheat and bread wheat in the central east and south where impacts of higher input prices are dampened by low input utilization. Taking inflation into consideration, it is found that under normal weather conditions, with the exception of the south, output and input price policies on durum wheat and bread wheat tend to offset each other, resulting in no real income change. In the south, real income is found to increase for all cereals. Finally, real income increases substantially for barley in all zones.

However, these results can be affected by rainfall patterns, which have a direct influence on yields and not income. For example, a drought tends to affect bread wheat the least because it is generally grown on better quality soils with better water retention. In contrast, barley, which is generally grown on poorer soils, experiences the largest drop in yields under low rainfall. This suggests that rainfall can have significant effects on the impact of pricing policy, both over time and across regions. Three groups appear most vulnerable to higher fertilizer and food prices: 1/ producers in drought prone zones of central and south Tunisia; 2/ barley producers on the most marginal soils; and 3/ low income consumers in urban areas. This suggests a need to consider proposals to provide income support programs and food relief to the poor (assuming that they can be identified).

Thus, the removal of price subsidies on food consumption as well as on farm input (e.g. fertilizer) is expected to influence the economic welfare of Tunisian households. Its effects can vary widely across farmers depending on the crops produced as well as on the intensity of input use.

3. Linear Programming Analysis of the Farm Sector

Agricultural policy decisions require detailed analysis of the economic performance of the farm sector. For that purpose, two linear programming models of a representative farm were developed for the north west region: one for the private sector, and one for the public sector (see

Roth, Chavas et al., 1991a, 1991b). State farms are typically large, highly mechanized and centrally managed. In contrast, private farms are relatively small and subject to decentralized management. This analysis was done in an attempt to better evaluate the effects of alternative pricing policies and institutional reforms proposed within the framework of the Tunisian structural adjustment program. Impacts of these policies on net income, cropping patterns, output response, input use and opportunity cost of owned resources are simulated with a linear programming model developed from primary and secondary data sources.

For the private as well as the public sector model, a base solution provided the gauge for measuring the model's ability to approximate actual public sector operations. The base solution includes outputs, land use patterns, input use, and the opportunity cost of fixed resources (land, water, permanent labor, animal units) generated by the model. Model results compared well with data reported in official statistics, indicating that the models provide a good representation of crop and input management decisions in the north west sector.

Several policy scenarios were simulated with the model. First, the effect of removing fertilizer subsidies was investigated. Increasing the price of Ammonitre from 118 D/ton to 128 D/ton, and the price of super 45 from D 110/ton to D 141/ton has only a marginal effect on the base solution. Net farm income declines slightly. Cropping patterns are unaffected, indicating that changes in profitability are not sufficient to shift cropping patterns to less fertilizer intensive activities. Fertilizer use also remains the same, a result similar to earlier APIP findings of no significant relationship between fertilizer use and fertilizer prices in the northern region over the period 1975–87. Shadow prices of land resources decline marginally due to higher costs of field crop production. The economic value of livestock units decline slightly due to higher costs of feed grain production and of feedstuffs in animal rations.

Second, the effect of subsidy removal on water price was analyzed. As water prices are increased from D 25,000 tc D 60,000 per million m^3, farm sector income decreases sharply, but output, cropping patterns or input use are not affected. Increasing water prices while simultaneously augmenting water availability has a profound effect on production and income. Compared with the water subsidies scenario alone, net farm income increases 19 percent in the public sector while irrigated area expands. The shadow price of irrigable land nearly doubles as irrigable land not water becomes the binding constraint. Enhanced profitability of relatively water intensive crops results in the substitution of forage for cereals on irrigated land. Opportunity costs of livestock increase substantially due to lower feed costs.

Results of simulations of the public sector model indicate that state farms could improve their profitability in several ways : 1/ by increasing the production of vegetables; 2/ by reducing the production of sugar beets; 3/ by expanding irrigation; and 4/ by providing more flexible labor contracts. Even with higher costs of fertilizer, due to losses of input subsidies, net income with these changes would rise 47 percent. Sugar beets, given current technology, prices and yields, do not appear to represent an optimal use of resources. Further investment in yield increasing or cost–reducing technology will be necessary if the sugar beet industry is to remain competitive with imported sugar. Although proposals to reduce sugar beet production run counter to government objectives of sugar self–sufficiency, increasing vegetable acreage at the expense of sugar beet would increase the profitability of state farms. Also, the centralized management style of state farms can have some undesirable effects. Although centralization does have some advantages (e.g. access to credit), it can be rigid and lack the flexibility that would facilitate quick adjustments to changing economic conditions. For example, the analysis suggests some gains associated with more flexible labor contracts.

The stability of the linear programming solution also provides useful insights on the possibilities for structural adjustments. On non–irrigated land, for example, the north–west region has a comparative advantage in cereal production under a wide range of market prices. This reflects the relative rigidity of the food production system in face of agro–climatic constraints

Economic conditions that lower the profitability of cereals will directly affect net farm income, with only minor substitutions to other cropping enterprises. Efforts at crop diversification to raise income, will require higher levels of technology, prices and irrigation than are now possible.

Total cereal supply or input demands tend to be very inelastic, as market prices have only a small impact on production decisions. In the public sector, the elasticity of total cereal supply with respect to a proportional change in the prices of all cereals is found to be 0.26. However, the possibilities of substitutions among cereals cultivated on dry land (hard wheat, bread wheat and barley) are quite important. The elasticities of supply are 1.01 for bread wheat, 4.92 for durum wheat, and 1.43 for barley. These large elasticities are generated mostly by substitutions among cereals. Changing relative prices of cereals can thus generate large adjustments in their respective productions. Yet, the aggregate grain supply response will be minor due to fixed land constraints in the sector. Pricing policy is thus likely to be less effective than policies aimed at stimulating investment in land–substituting technologies that increase wheat and barley production in the long–run.

In the absence of institutional constraints, the possibilities of substitution among irrigated crops (cereals, vegetables, sugar beet and forage) are found to be more important. Irrigated crops are highly profitable and can be sensitive to changing market conditions. Increasing the supply of irrigable land would increase the flexibility of the farming system to respond to prices and climatic risk. Further investments in irrigation infrastructure could represent an efficient use of resources.

The policy study of the northwest public sector model focused on direct government interventions in the public sector, specifically the budgetary impacts associated with reducing public sector employment, impacts on eliminating land use or production quotas on vegetables and sugar beets, and irrigation water rationing in the irrigated perimeters. These issues are not pertinent to the private sector, because of less government control and regulation. More important are issues of market access, and income effects associated with input availability and pricing policy. Two other key differences distinguish the private from the public sector model. First, the private sector model explicitly treats family labor as a fixed resource (the public sector hired all labor); Second, yield response funtions to fertilizer were estimated with data from the 1989 Enquéte Agricle de Base, and estimates were used to incorporate fertilizer response functions in the model. Whereas fertilizer demand in the public sector is based on constant technology (one fertilizer level per crop activity), fertilizer demand in the private sector includes options for high, medium and low levels of fertilizer use depending on prices.

Model results indicate that fertilizer demand is much more sensitive to output and fertilizer prices than was indicated by the public sector model, and price policy has a greater impact on input use and production than were shown for the public sector. The effects of three policy scenarios were examined: (A) eliminating fertilizer subsidies; (B) simulating the effect of marketing constraints on fertilizer access; and (C) imposing a 25% reduction on access to institutional credit.

Increasing fertilizer prices from D 118 to 128/tone of Ammonitre, and from D110 to D141/tonne of Super 45 decreases use of Ammonitre by 8% and super 45 by 7%. Output of Ble dur, the most fertilizer sensitive crop to changing prices, also falls by 6%. Analysis of fertilizer use by farms in the private sector revealed that between 35% to 45% of farms regardless of farm size use no fertilizer. Use rates are higher for wheat and lower for barley. Fertilizer use in the model was constrained to equal 1987 levels to examine the impact of fertilizer rationing on agriculture. Production of ble dur declined 8% and fertilizer use on Ble dur declines from around 110 kg/ha to around 55 kg/ha.

Credit in the sector is constrained to 75% of base model levels to examine the effect of credit rationing on agriculture. Income declines from 198.1 to 195.9 million dinars and Ble dur production declines from 443,302 to 338,016 ha. Forage area declines from 45,973 to 31,095 ha due to cash constraints affecting the ability to hire labor. Cropping patterns shift to less labor

intensive activities. Seasonal labor falls from 2442 to 1700 thousand days, thus having important impacts on labor employment. Conversely, economic rents to fixed family members are increased, as the credit constraint forces greater reliance on family-owned labor.

III- Institution-Building

By African standards, Tunisia's educational system is excellent. As a result, Tunisia has some good human capital available to design and implement its public policy. However, there are some areas where the Tunisian Ministry of Agriculture could become more effective in its policy making process.

There is some room for improving the quality of human capital in the Ministry of Agriculture. The Ministry should strive to attract and keep the best economists and policy analysts in Tunisia. This indicates that the salary structure and reward system within the Ministry should be competitive with the other Ministries. This also suggests working conditions that would appear attractive to top rated economists in Tunisia. These objectives could be reached in several ways: 1/ by a hiring policy that would attract some of the best minds in Tunisia; 2/ by regular training of the current staff at the Ministry in terms of both economic and policy analysis; 3/ by improving the data base used in policy analysis; 4/ by strengthening the linkages between the statistical unit and the policy analysis unit within the planning division of the Ministry of Agriculture; and 5/ by identifying more precise long run objectives for policy planning within the Ministry of Agriculture.

The work leading up to this report had four objectives: (1) to assist the Ministry of Agriculture (MOA) in evaluating the economic performance and impacts of alternative price and institutional policies in the farm sector; (2) to illustrate the usefulness of economic models for policy analysis; (3) to strengthen the skills of DGPDIA/MOA staff in econometric modeling and linear programming techniques; and (4) to help focus data needs and strengthen linkages between the statistics unit and the planning unit in the Ministry. The work discussed here was carried out as a collaborative effort by staff of the DGPDIA/MOA, the Department of Agricultural Economics in the National Institute of Agriculture, and the International Agricultural Programs of the University of Wisconsin. The econometric analysis was conducted following a short course taught at the Ministry on econometric modelling. It provided some practical training for the staff of the Ministry of Agriculture on the specification, estimation and use of econometric models in economic and policy analysis. Similarly, the programming models of representative farms were developed following a short-course taught at the Ministry on applications of operations research methods. They provide an illustration of the use of linear programming in economic analysis and policy planning. With the assistance of APIP, the Ministry now has the computers, the software and the skills to develop models for economic analysis, update them, and use them for further policy planning.

The work helped focus attention on farm policy issues and data requirements. Throughout the analysis, data were obtained from all available sources. It involved previous studies, field visits to private and public farms, as well as discussions with agronomists, livestock specialists and economists of the National Institute of Agriculture. It also relied heavily on official bulletins. With that respect, the annual agricultural surveys (in particular the Enquête de Base et Enquête Conjoncture) provided important sources of information (see Kristjanson et al., 1989). In general, the information collected in those surveys is of good statistical quality. This is to the credit of the statistical unit at the DGPDIA. However, the modeling exercises reported here made it clear that the information available is not always well suited for policy analysis. For example, little information is collected on farm capital. Also, public funding for on-farm research is quite scarce. The information collected by the MOA tends to be oriented toward obtaining aggregate area and production estimates. This is appropriate for aggregate analysis. However, the current paucity of on-farm data cannot support a very detailed or reliable analysis of household level issues.

The work leading to this report contributed to strengthen linkages between the staff in statistics and planning, and to improve skills in economic and policy analysis. However, there is still a need for a better coordination between the department of statistics and the department of planning at the Ministry of Agriculture. This would help in several ways: 1/ by assuring a timely availability and use of statistics at the Ministry of Agriculture; 2/ by providing better guidelines on data needs for economic and policy analysis; and 3/ by improving the quality of the information collected with the purpose of strengthening economic and policy analysis at the Ministry of Agriculture.

Finally, there is a tendency at the Ministry of Agriculture to focus on short term needs at the expense of longer run planning. To be sure, the realities of budgetary decisions and various political considerations will always play a role in the decision making process at the Ministry. Yet, the emphasis toward short term studies and consultancies by donors is having some undesirable effects on the Ministry's agenda. It may be desirable to pay relatively less attention to short run management of the Ministry and more to proactive management aimed at achieving longer term policy objectives.

IV.- Conclusion

This report is a summary of the accomplishments of several years of collaboration between the Ministry of Agriculture of Tunisia and the University of Wisconsin. Its has illustrated the usefulness of economic tools in the analysis of various farm policy issues. More importantly, it has contributed to improving the analytical skills of the staff at the Ministry. As such, some of the payoff from this work will likely be in the longer term, through the improved ability of the Ministry of Agriculture to evaluate and design farm policy. In this context, all of the work presented here cannot be considered as definitive. It is hoped that it will provide templates for future research extending the present analysis to exploit new and better sources of information and to address new economic problems and emerging policy issues.

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