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REGIONAL ANALYSIS OF INPUT AND COMMODITY PRICE POLICY UNDER ALTERNATIVE STATES OF RAINFALL, TUNISIA

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TABLE OF CONTENTS

	Page
List of Figures	v
List of Tables	v
Sommaire	vii
Executive Summary	xi
I. INTRODUCTION	1
A. Background	1
B. Purpose and Objectives	2
C. Personnel	2
D. Overview of Report	2
II. DATA	3
A. Aggregate Agricultural Surveys	3
B. Data Bases	4
III. CROP BUDGET MODEL	7
A. Introduction	7
B. Area	7
C. Prices	10
D. Yields	10
E. Agricultural Inputs	10
F. Revenue	11
G. Costs	11
H. Net Revenue per Crop	12
I. Net Revenue per Farm	12
IV. INPUT USE ANALYSIS	13
A. Introduction	13
B. Nitrogen (Ammonitre)	14
C. Triple Super Phosphate (Super45)	15
D. Ordinary Super Phosphate (Super16)	15
E. Herbicides (Désherbant)	15
F. Certified Seed	15
G. Mechanization (Mécanisation)	22
H. Summary and Implications	22

	Page
V. PRICE POLICY ANALYSIS	25
A. Introduction	25
B. Base Case	25
C. Economic Price Calculations	27
D. Commodity Price Policy	30
E. Input Price Policy	33
F. Commodity and Input Price Policy under Alternative Stages of Rainfall	33
VI. SUMMARY AND IMPLICATIONS	39
References	43
Annex A. Chemical Inputs, Seed, Labor, and Mechanized Services per Hectare in the Northwest, Northeast, Central-West, Central-East, and South Regions	45
Annex B. Base Case Crop Budget Model	63
Annex C. Economic Price Calculations	71

Page

LIST OF FIGURES

Figure 1	Crop Budget Model Template and Data Sources	8
Figure 2	Crop Budget Model Template, Prices	9

LIST OF TABLES

Table 1	Extent of Computer Automation of Data from the Agricultural Enquêtes	5
Table 2	Number of Observations in the Reduced Sample Surveys	5
Table 3	Mean Fertilizer Usage and Percent Farms Using Fertilizer	16
Table 4	Mean Herbicide and Certified Seed Use, and Percent of Farms Using Inputs	18
Table 5	Mean Use of Mechanized Services and Percent of Farms Using Mechanization by Type of Activity	20
Table 6	Input Prices Paid by Farmers	26
Table 7	Yield Assumptions by Economic Region, Base Crop Budget Model	28
Table 8	Commodity and Input Price Scenarios	31
Table 9	Rainfall Patterns by Region	34
Table 10	Combined Commodity and Input Price Policy under Various States of Rainfall	37

ANALYSE REGIONALE DE LA POLITIQUE DES PRIX SUR DIFFERENTES CONDITIONS PLUVIOMETRIQUES, TUNISIE

SOMMAIRE

1. Les deux enquêtes agricoles les plus importantes de Tunisie--l'enquête conjoncture et l'enquête de base--sont utilisées pour construire des modèles de budget d'entreprises agricoles. Des modèles sont développés pour chacune des cinq régions économiques de la Tunisie. Ils sont utilisés pour analyser les effets de la politique des prix et de l'élimination des subventions sur les revenus agricoles. Les modèles donnent une base de développement pour les études d'entreprises agricoles à venir et permettent de mieux évaluer les effets de la politique agricole sur la distribution des revenus.

2. L'élimination des subventions sur l'ammonitrate augmentera le prix des engrais azotés. Ceci va influencer les revenus des cultures maraîchères, des céréales et des cultures fourragères, spécialement dans les régions Nord-Ouest, Nord-Est et Centre-Ouest. Ceci va aussi avoir une influence sur les producteurs de cultures maraîchères dans le Centre-Est et le Sud. Parmi les entreprises céréalières, les producteurs de blé tendre seront les plus touchés, tandis que les producteurs d'orge seront les moins touchés. Plus de 70% des producteurs céréaliers du Nord-Ouest et du Nord-Est vont être influencés par l'augmentation du prix des engrais azotés. Les changements du prix de l'ammonitrate n'aura que peu d'effet sur les producteurs de cultures maraîchères et fruitières.

3. Les producteurs de légumes de toutes les régions seront les plus touchés par l'élimination des subventions sur le Super45. L'effet de l'augmentation des prix va aussi influencer les producteurs de cultures céréalières, maraîchères et fourragères dans les régions Nord-Ouest, Nord-Est, Centre-Ouest et Centre-Est. Etant donnés les taux actuels d'utilisation d'engrais, les producteurs fruitiers du Sud ne seront que peu touchés.

4. Les revenus des producteurs de blé tendre seront beaucoup influencés par une augmentation du prix des herbicides. Les agriculteurs du Nord-Ouest seront les plus touchés, alors que les céréaliers du Centre-Est et Sud seront peu influencés. En général, les agriculteurs qui utilisent des engrais seront les plus touchés par la réduction des subventions.

5. Depuis l'étude de Salinger (AIRD 1987) sur les taux de protection des céréales en 1987, deux développements nouveaux ont influencé le marché céréalier. Premièrement, le Dinar a été dévalué de 14%, allant de .84 à .96 en 1989. Ceci a augmenté le prix des céréales importés. Deuxièmement, la grande sécheresse de 1987/88 a beaucoup diminué la production céréalière en Tunisie aussi bien dans les principaux pays exportateurs. Le prix mondial du blé dur en 1989 a augmenté de 51% par rapport à 1986. Le prix mondial de l'orge a augmenté de 45% durant la même période.

6. Trois problèmes reliés à la politique agricole ont été evalué: (1) la mise à jour des prix de base des céréales de 1987 à 1989; (2) le changement des prix des intrants après l'élimination des subventions; et (3) l'évaluation de l'effet combiné de la politique des prix des produits aussi bien que des intrants dans des situations climatiques différentes. Un modèle de budget d'entreprise est utilisé pour prédire l'influence de ces politiques sur les revenus agricoles et les surfaces cultivées.

7. Scénario 1: les prix officiels des céréales augmentent jusqu'au niveau des prix en 1989. Comparé à 1987, l'augmentation relative des revenues nets par hectare est la plus élevée pour l'orge et la moins élevée pour le blé tendre. Scénario 2: les prix des céréales sont les prix d'importation ajustés de tous les impôts et taxes directs et indirects. Dans ce cas, les effets sont même plus dramatiques. Comparé aux prix de 1987, le revenu net par hectare d'orge augmente de 183% dans le Nord-Ouest, de 95% dans le Nord-Est, de 282% dans le Centre-Ouest et de 37% dans le Centre-Est. Le revenu net par hectare de blé tendre augmente de 50% dans le Nord-Ouest, de 38% dans le Nord-Est, de 28% dans le Centre-Ouest, et de 25% dans le Centre-Est. Ces différences sont dues à deux facteurs: (a) l'augmentation des prix est plus importante pour l'orge que pour le blé, et (b) les revenus de base utilisés pour le calcul des changements relatifs sont moins élevés pour l'orge que pour le blé.

8. Ces augmentations de revenu ne sont pas distribués d'une manière uniforme parmi toutes les fermes. Le revenu du blé tendre est en général concentré sur un petit nombre de grandes exploitations. Le revenu du blé dur ou de l'orge est en général distribué d'une manière plus uniforme. Donc, les bénéfices de l'augmentation du prix de l'orge et du blé dur vont être reçus par de nombreuses exploitations de petite et moyenne taille. Les bénéfices concernant l'augmentation du prix du blé tendre vont aller essentiellement aux grandes exploitations.

9. En comparant les prix officiels de 1989 aux prix d'importation, ceci donne une indication de la direction du changement probable des prix officiels. Etant donné que la Tunisie importe du blé dur, les prix officiels en 1989 (21 D/Qx.) sont à peu près au bon niveau puisque le prix d'importation est de 21,7 D/Qx. Le prix officiel du blé tendre est un peu bas (18,6 D/Qx. contre 19,7 D/Qx.). Le prix officiel de l'orge est très bas (14 D/Qx. contre 16,3 D/Qx.), spécialement étant donné que la Tunisie importe de l'orge. A moins que les prix internationaux changent de 1989 à 1990, les prix officiels actuels sont adéquates pour le blé dur. Cependant, le gouvernement Tunisien devrait considérer une petite augmentation du prix officiel du blé tendre et une augmentation substantielle de l'orge.

10. Scénario 3: Les prix des céréales sont les prix officiels de 1989. Comparé à 1987, la plus grande diminution des profits se trouve dans les régions où le taux d'utilisation des intrants est élevée. Pour le blé dur, les revenus par hectare diminuent de 9% dans le Nord-Est, de 6,2% dans le Nord-Ouest, et de 5,3% dans le Centre-Ouest. Dans le Centre-Est et le Sud, où le taux d'utilisation des engrais est faible, la diminution des revenus est négligeable. Etant données les techniques de production actuelles, les producteurs de blé tendre sont les plus touchés par une augmentation du prix des intrants, alors que les producteurs d'orge sont les moins touchés.

11. La sécheresse a une influence importante sur les bénéfices des changements de la politique agricole et sur les risques financiers des agriculteurs. Les données chronologiques sur la pluviométrie de 1973 à 1988 sont utilisées pour définir trois situations climatiques: Scénario 4: faible pluviométrie; Scénario 5: pluviométrie moyenne; et Scénario 6: haute pluviométrie. Ces scénarios sont evalués aux prix d'importations de 1989 en l'absence de subventions.

12. Le scénario 4 donne une idée des effets d'une augmentation des prix des céréales aussi bien que des prix des intrants. Comparé à 1987, les revenus nets augmentent dans toutes les régions et pour toutes les cultures. L'augmentation est substantielle pour l'orge dans le Nord-Ouest et le Nord-Est. Ceci est dû au fait que le prix de l'orge augmente beaucoup et que l'orge utilise relativement peu d'intrants. Les augmentations de revenu sont aussi importantes pour le blé dur et le blé tendre dans le Centre-Est et le Sud où les intrants sont peu utilisés.

13. L'analyse d'un taux d'inflation de 8% par an indique que: (a) a l'exception du Sud, la politique des prix du blé dur et du blé tendre n'a que peu d'effet sur les revenus réels; (b) les revenus réels ont tendance à augmenter dans le Sud pour les trois cultures de céréales; et (c) les revenus réels de l'orge augmentent beaucoup dans toutes les régions.

14. Les scénarios 4 et 5 mesurent l'effet de la pluviométrie sur l'agriculture. Le scénario 4 (faible pluviométrie) est anticipé entre 27% et 40% du temps. Le scénario 5 (forte pluviométrie) est anticipé entre 27% et 33% du temps. Dans chaque cas, l'effet sur les rendements est dramatique. Dans une situation de sécheresse (scénario 4), les revenus diminuent le moins pour le blé tendre dont les rendements sont moins sensibles aux variations climatiques. Ceci est dû au fait que le blé tendre est en général cultivé sur de meilleures terres ayant une bonne rétention en eau. L'orge, qui est en général cultivé sur les terres de moindre qualité, montre la plus forte diminution des rendements et des revenus dans toutes les régions. La diminution est la plus forte dans les régions du Centre et du Sud, où la secheresse est la plus sévère.

15. Les effets sur les revenus sont les opposés dans une situation de forte pluviométrie. Le blé tendre montre la plus petite augmentation, alors que l'orge montre la plus grande augmentation des revenus par hectare. Donc, les revenus peuvent changer beaucoup d'une année sur l'autre en fonction de la pluviométrie. Pour le blé dur, le revenu net par hectare dans la région Nord-Ouest va de 123 D/ha en période de sécheresse à 203 D/ha en année de bonne pluviométrie. Pour le blé dur et l'orge, la gamme des revenus va de 125 à 165 D/ha et de 48 à 102 D/ha.

16. Cette étude a montré les effets de la politique des prix sur les revenus agricoles et leur distribution par culture et par région. Les modèles de budget d'entreprise ont établi un lien entre les enquêtes agricoles et l'analyse de plusieurs problèmes de la politique agricole. Les limitations de données (petits échantillons et le manque de certaines données) ont influencé la portée de cette analyse. Les résultats obtenus indiquent comment les données actuelles peuvent être utilisées dans l'analyse économique de l'agriculture Tunisienne.

REGIONAL ANALYSIS OF INPUT AND COMMODITY PRICE POLICY UNDER ALTERNATIVE STATES OF RAINFALL, TUNISIA

EXECUTIVE SUMMARY

1. Tunisia's two most important agricultural surveys--the Enquête Conjoncture and the Enquête de Base--are used to construct crop budget models for Tunisian agriculture. Models are constructed for the five economic regions of Tunisia, and are used to evaluate the impact of input subsidy removal and commodity price policy on crop income under three states of rainfall. The models lay the foundation for future farm modeling studies and for studying the distributional impacts of policy reform.

2. Removal of subsidies on Ammonitre, resulting in higher nitrogen prices, will largely affect producers of vegetables, cereals, and forage crops in the northwest, northeast, and central-west regions, and producers of mainly commercial vegetables in the central-east and the south. Among cereal producers, bread wheat producers will be hardest hit by the higher nitrogen prices; barley producers will be the least affected. Over 70 percent of the producers of cereals in the northwest and northeast will be affected by higher nitrogen prices. Producers of legumes and tree crops will be only marginally affected by changes in the price of Ammonitre.

3. Removal of subsidies on Super45 will also have the largest impact on producers of commercial vegetables in all regions. The impact of higher prices will also be sharply felt by producers of cereals, legumes, and forage crops in the northwest, northeast, central-west, and central east regions. Producers of tree crops, and producers in the south, will be only marginally affected by higher prices of Super45 at current use rates.

4. Producers of bread wheat will be hardest hit by higher herbicide prices, relative to durum wheat and barley. Producers in the northwest will be most affected, while cereal producers in the central-east and south will experience no effect. Given similar rates of subsidy on fertilizer and herbicides, subsidy reduction will have a greater effect on fertilizer demand and on production and incomes of fertilizer users, since fertilizer use is more widespread in terms of application rates and number of farms using the input.

5. Since the Salinger study (AIRD 1987) computed rates of protection for cereals in 1987, two major structural changes have affected supply, demand, and prices in the cereals market. First, a devaluation of the dinar by 14 percent, from .84 in 1986 to .96 in 1989, has increased the price of cereal imports and import parity prices at the farm level. Second, the worldwide drought of 1987/88 not only sharply reduced area harvested and yields in Tunisia, but also cut yields in the principal exporting countries. World

prices of durum wheat in 1989 are 51 percent higher than in 1986. World barley prices have increased 45 percent over the same period.

6. Three sets of agricultural policies were evaluated in this study: (1) updating base 1987 official prices for cereals with 1989 official prices and with 1989 import parity equivalents; (2) changing base 1987 official input prices to 1991 target levels, after phasing-out input subsidies; and (3) evaluating the combined effect of both input and commodity price policies under alternative states of drought. A crop budgeting model is used to forecast the impacts of these policies on income per hectare and crop area.

7. Under scenario (I), official commodity prices for cereals are raised to 1989 levels. Increases in net revenue per hectare on a percentage basis are highest for barley and lowest for bread wheat. The impact is even more dramatic under scenario (II), which looks at import parity prices, net of all direct and indirect taxes and subsidies. Compared with 1987 base prices, net income per hectare of barley increases 183 percent in the northwest, 95 percent in the northeast, 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 northwest, 38 percent in the northeast, 28 percent in the central-west, and 25 percent in the 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 13.5 percent; bread wheat, 8.8 percent; and barley, 16.7 percent, since 1987), and (2) base case incomes for calculating percentage changes are lowest for barley.

8. 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 northwest and northeast. Income from durum wheat and barley tends to be more evenly distributed across farms. Thus the benefits of higher barley prices, and to a lesser extent durum wheat prices, will largely affect small to medium-size farmers. Increasing returns on bread wheat will primarily benefit medium to large-scale producers.

9. Comparing 1989 official prices with import parity equivalents gives a crude indication of the optimal direction of change in official prices. Given that Tunisia is a net importer of durum wheat, 1989 official prices (21.0 D/Qx) appear to be set at about the right level nationally according to estimated import parity prices (21.7 D/Qx). The official bread wheat price (18.6 D/Qx versus 19.7 D/Qx) appears somewhat low and the official barley price (14.0 D/Qx versus 16.3 D/Qx) appears substantially undervalued, particularly given that Tunisia is a net importer of both cereals. Unless international prices in 1990 diverge substantially from 1989, current official prices are adequate for durum wheat. However, the government of Tunisia should consider marginally raising the official price of bread wheat, and substantially raising the price of barley.

10. In scenario (III), 1987 official prices are raised to 1989 official levels. The greatest declines in profitability are experienced in those regions with the highest rate of input utilization. For durum wheat, incomes per hectare decline -9.0 percent in the northeast, -6.2 percent in the northwest, and -5.3 percent in the central-west, relative to base case levels. In

the central-east and south, where the utilization of inputs is more sparse, declines in income are minimal. Under current farming practices, bread wheat farmers are hurt the most by higher input prices, and producers of barley the least.

11. Drought has a very important influence on the net benefits of policy change (e.g., on incomes), on the rate at which these benefits are received, and on the financial risk of cash input utilization. Rainfall time series for the 15-year period, 1973/74 to 1987/88, are used to define three states of drought stress. Impacts of increasing official output prices to 1989 import parity levels and eliminating input subsidies are evaluated under three states of precipitation: (IV) low rainfall, (V) average rainfall, and (VI) high rainfall.

12. Comparing scenario (V) with the base case scenario gives a crude indication of the net effect of both higher commodity prices and higher input prices on the crop sector. Net income improves in all regions and for all crops. Incomes improve substantially for barley in the northwest and northeast, since barley experiences the largest increase in price and is least affected by higher input costs. 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.

13. Income in the base case is in 1987 dinars and the policy scenarios are in 1989 dinars. Multiplying base case figures by 1.26 to show the effect of compounded inflation of 8 percent over 3 years indicates that: (a) with the exception of the south, output and input price policy on durum wheat and bread wheat tend to be nearly equally offsetting, resulting in no real income change; (b) real incomes tend to increase for all cereals in the south; and (c) real incomes for barley increase substantially in all zones.

14. Scenarios (IV) and (VI) indicate the volatile effect that rainfall has on policy impacts. The low rainfall scenario can be expected to occur between 27 and 40 percent of the time, depending on the region. The high rainfall scenario can be expected 27-33 percent of the time. Both states have a profound impact on yields. Under severe drought stress (scenario IV), incomes fall the least on bread wheat since it is generally grown on better quality soils with better water retention. Changes in rainfall thus do not affect yields as much as other cereals. Barley, which is generally grown on poorer soils, experiences the sharpest drop in yields and income in all regions. The drop is most severe in the central regions and the south, where declines in rainfall are most severe.

15. The effect on income is reversed under situations of good rainfall. Bread wheat, which appears to be most resistant to drought, experiences the least gains from higher rainfall. Barley, which appears most susceptible to drought, experiences the highest gains with improvements in rainfall. As a result, the different cereals experience varying degrees of swing in incomes between good and poor rainfall years. For durum wheat, net income per hectare in the northwest ranges from 123 D/ha in poor rainfall years to 203 D/ha in good years. Ranges for bread wheat and barley are 125-169 D/ha and 48-102 D/ha, respectively.

16. This study has shown the effect of alternative price policies on farm incomes and the distributional impacts of those policies by crop and region. The crop budget models have provided an interface between farm-level data collection in the agricultural enquêtes and the analysis of several important policy questions. Certainly data limitations--small sample sizes in the EC87 and weaknesses in the types of data collected in the EB87 and EC87 data bases--have affected the scope of this analysis. However, it should also be recognized that existing data can be usefully applied. This study has demonstrated the potential of one type of analysis--crop budgeting. Work is now being planned to proceed with more sophisticated economic models.

REGIONAL ANALYSIS OF INPUT AND COMMODITY PRICE POLICY UNDER ALTERNATIVE STATES OF RAINFALL, TUNISIA

I. INTRODUCTION

A. Background

Policy analyses to date by the General Directorate for Development Planning and Agricultural Investments (Direction Générale de la Planification du Développement et des Investissements Agricoles, D/GPDIA) have been based on published aggregated data from the agricultural enquêtes or from theoretical "norms" published in agronomic or socioeconomic studies. The Enquête Conjoncture and the Enquête de Base, the two principal survey instruments for agricultural data, offer alternative primary data sources for statistical and economic analysis. Until the 1989 cropping year, the analysis of these enquêtes was undertaken by hand (in the case of the Enquête Conjoncture) or outside the ministry on mainframe computer (in the case of the Enquête de Base). The sole use of data from these enquêtes has been the publication of documents containing uni- or bidimensional tables for public information.

Other economic studies undertaken to present within the context of Tunisia's Agriculture Structural Adjustment Program (ASAP), notably the AIRD study of agricultural profitability, protection, and comparative advantage (based on the Salinger model) and the study on reduction of agricultural input subsidies (Redjeb 1989), have also relied on these aggregated data and theoretical norms. While these studies have made excellent contributions to ASAP, they are lacking in three areas. First, there is uncertainty to what extent the input/output coefficients in the Salinger model, being synthetic norms, accurately represent the realities of Tunisian agriculture. Second, the input/output coefficients in the Salinger model lack an empirical basis for updating parameters in response to structural adjustments over time. Third, the AIRD and subsidy reduction studies are weak in their treatment of regional impacts of ASAP policy reforms.

Crop budgets are useful for evaluating impacts of agricultural policy change on revenue, costs, investment, and producer incentives. If budgets are sufficiently disaggregated by commodity, simple predictions are possible regarding comparative advantage and the direction of adjustments in agriculture. Crop budgets are also useful for forecasting the distributional impacts of policy change, and equity issues are crucial when examining the political and social consequences of reforms. In addition, crop budgets are relatively easy to empirically develop, an aspect that is particularly useful when extensive time series are lacking.

B. Purpose and Objectives

Tunisia's two most important agricultural surveys--the Enquête Conjoncture and the Enquête de Base--are used to construct crop budget models for Tunisian agriculture. Representative crop budget models are constructed for the five economic regions of Tunisia and are used to evaluate the impact of subsidy removal and price policy on crop and farm income under three states of rainfall (degrees of drought stress). The models lay the foundation for future farm modeling studies and for studying the regional impacts of policy change.

C. Personnel

This study was proposed in the concepts paper, "Partial Budgeting Models and the Enquête de Base and Enquête Conjoncture," in December 1988. On a follow-up visit to Tunis by Michael Roth in February 1989, arrangements were made to bring Bel Haj and Mechergui Ayda to Madison in April to assist Wisconsin researchers with data analysis. The Madison trip provided hands-on training in the development of the stylized crop budget model used in this study, statistical analysis of the 1987 Enquêtes de Base and Conjoncture with SYSTAT software, and empirical development of the crop budget model. This work emphasized the construction of crop budgets for five economic regions of Tunisia.

A second visit by Peter Bloch to Tunis in May/June 1989 expanded the work to include construction of crop budget models by farm size. Working with Bel Haj, Mechergui Ayda, and Hamdi Larbi, data were generated by farm size category and subsequently published and distributed in the document, "Coefficients Techniques par Taille, par Secteur et par Région: Données de l'Enquête de Base 1987" (D/GPDIA August 1989). Final work on development of both the regional models and a disaggregated model of the northwest region followed in August through October 1989 at Wisconsin. Only the work of the regional models is covered in this study.

D. Overview of Report

This report is laid out in six chapters. Chapter I contains background information, purpose and objectives, and personnel involved in the study. Chapter II reviews Tunisia's two principal agricultural surveys and the reduced data sets from these surveys that were utilized in this study. Chapter III describes the crop budget model used for policy analysis. Rates of input use, estimated from the Enquêtes de Base and Conjoncture, are presented and analyzed in chapter IV, along with the derivation of input coefficients for the crop budget model. Chapter V explains the derivation of prices and yields, and evaluates the effect on farmers' income of various input and output pricing policies under alternative states of rainfall. Chapter VI is a summary of data-related issues, research findings, and policy implications.

II. DATA

A. Aggregate Agricultural Surveys

Three major agricultural enquêtes are administered annually by the D/GPDIA:[1]

Enquête Conjoncture: Administered at the beginning of the agricultural season (December-January), it is intended to provide information on: (a) planting intentions, (b) input demand projections, and (c) changes in livestock numbers.

Enquête de Base: Administered each year in March-April, it is intended to gather information on: (a) crop area, (b) input utilization (e.g., actual use of mechanization, fertilizer, and herbicides), (c) stock of animals, (d) forecast of cereal yields, and (e) agricultural labor. It also establishes the sampling frame for other specialized studies.

Enquête Céréalière: Administered in three stages: stage one (May-June) identifies the fields to be surveyed and collects data on forecasts of area harvested, yields, and probable harvesting date. During stage two (June-July), yield samples are taken from sample fields at the final stages of crop maturity and are then transported to the Central Direction for threshing, weighing, and moisture tests. Stage three (July-August) collects actual data on harvested area and production.

The Enquête Conjoncture collects information on input utilization and costs for the three principal cereals--durum wheat (blé dur), bread wheat (blé tendre), and barley (orge). But these data are forecasts, not measurements of actual use. The Enquête de Base collects actual input data, but does so only for the crop aggregates--cereals (céréales), legumes (légumineuses), forage crops (fourrages), commercial vegetables (culture maraîchères), and tree crops (arboriculture). Moreover, only input quantities (amount applied per crop) for fertilizers are asked. Data for herbicides and mechanization are in terms of area on which the input is applied, not the amount applied per hectare or per crop. Neither enquête collects actual yield/production data, although the Enquête de Base asks farmers the yields they expect to receive. Both enquêtes are administered at the level of the household within the segment.

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1. From République Tunisienne, Ministère de l'Agriculture, Direction de la Planification, des Statistiques et des Analyses Economiques, Sous-Direction des Statistiques Agricoles, "Méthodologie de Collecte des Statistiques Agricoles," Septembre 1987.

B. Data Bases

Up through the 1988 cropping season, only data for the Enquête de Base were computerized and analyzed using the mainframe computer facilities of the Institut National des Statistiques (Table 1). Because of the drought in 1988, data for the Enquête de Base are very incomplete. Data for the Enquêtes Conjoncture and Céréalière were computed by hand.

For the 1989 season, the D/GPDIA is planning to automate both the Enquête Conjoncture and the Enquête de Base on microcomputers with the assistance of a Food and Agriculture Organization (FAO) project. These data will not be available for policy analysis until 1990.

Two reduced data bases are currently available for policy analysis and are utilized in this study (Table 2):

Reduced 1987 Enquête Conjoncture (EC87): Data from a sub-sample of the original questionnaires administered during the 1987 season were entered into computer under the supervision of M.S. Redjeb from the ISG in the fall of 1988. A random sample of questionnaires was chosen, approximately one out of ten, resulting in a data base of 720 farms.

Reduced Enquête Agricole de Base (EB87): A reduced data set, excluding non-resident farmers, was disaggregated by Gouvenorate using the computing facilities at the University of Wisconsin in 1988 (summer). Questions pertaining to both non-resident and resident farmers on pages 1-3 of the original Enquête de Base have been eliminated, and replaced by a special "Fiche Supplémentaire Réservée à l'Exploitation (FSRE)." The data base contains 5,984 observations for analysis.

Comparison of the regional breakdown between the EB87 and the EC87 indicates that the samples represent different populations of households. The Enquête Conjoncture, because of the pseudo-random process used to sample and computerize data and its smaller sample size, probably exhibits the greatest bias. The EC87 sample appears to exaggerate the number of farms in the northwest region (61.3 percent in EC87 versus 28.6 percent in EB87), and underreport farms in the northeast (3.8 percent in EC87 versus 24.2 percent in EB87) and south (4.2 percent in EC87 versus 10.8 percent in EB87). Farms in the central-west and central-east regions appear to be more or less equally represented in the EB87 and EC87 data sets.

Data in Table 2 also indicate that the number of households/observations for the northwest region (442 observations) in the EC87 data set is quite large relative to other regions. Samples are moderate in size for the central-west and central-east regions, and small (less than 30 observations) in size for the northeast and south regions. While the EC87 data set is suitable for estimating input-output coefficients at the regional level, only the data set for the northwest region has sufficient observations to permit calculation of coefficients by farm-size category.

TABLE 1

Extent of Computer Automation of Data from the Agricultural Enquêtes[a]

YEAR	ENQUETE CONJONCTURE	ENQUETE DE BASE	ENQUETE CEREALIERE
1987	manual	computer	manual
1988	manual	computer	manual
1989 (planned)	computer	computer	manual

a. Manual indicates that data are not computerized and that analyses are conducted by hand. Computer indicates that data were computerized in 1987 and 1988 by the Institut National des Statistiques, and will be computerized in 1989 by the D/GPDIA if current plans hold.

TABLE 2

Number of Observations in the Reduced Sample Surveys

	EC87	EB87
Northwest	442 (61.3)	1,712 (28.6)
Northeast	27 (3.8)	1,450 (24.2)
Central-west	109 (15.1)	893 (14.9)
Central-east	112 (15.6)	1,285 (21.5)
South	30 (4.2)	644 (10.8)
Total households/observations	720 (100)	5,984 (100)

Figures in parentheses are percent of total observations.

III. CROP BUDGET MODEL

A. Introduction

The structure of the crop budget model in this analysis is largely determined by the type of data contained in the Enquêtes de Base and Conjoncture. As illustrated in the Crop Budget Model Template in Figures 1 and 2, durum wheat, bread wheat, and barley are the units of enquiry in the Enquête Conjoncture, while cereals, legumes, forage crops, commercial vegetables, and tree crops are the principal units of enquiry (except for area estimations) in the Enquête de Base.

With the exception of revenue, costs, and net revenue calculations in Figure 1, the rows of the crop budget model are yields and input quantities per hectare.

B. Area

Two measurements of area are included in the model:

- SFM, or mean cultivated area per average farm in the sample (superficie de la ferme moyenne), is total area cultivated divided by the total number of farms in the sample, including those not cultivating the crop;

- SC, or the conditional mean of cultivated area of growers (superficie par culture cultivée), is total area cultivated divided by the number of farms in the sample actually cultivating the crop. It thus excludes those observations where crop area is zero, indicating that the crop is not grown.

The numerator of SFM and SC is the same. Only the denominator is different depending on whether all farms in the sample are considered (as in the case of SFM) or just those farms growing the respective crop (as in SC). As fewer farms cultivate a given crop, SC tends to diverge from SFM, and the standard deviation of the SFM estimate tends to increase (at high values of SC/SFM) due to more zeros in the sample. Conversely, as more farms cultivate a given crop, SC converges to SFM, and the standard deviation of SFM tends to decline. These data are calculated from the EB87 data base to ensure that area calculations are consistent with estimates of total farm size.[2]

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2. Since the EC87 data base includes only cereals data, it is impossible to benchmark crop area estimates with those of other crops as a check for consistency with total area cultivated.

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Figure 1: Crop Budget Model Template and Data Sources.

	Nordouest Ble Dur	Nordouest Ble Tendre	Nordouest Orge	Nordouest Cereales	Nordouest Lagumineuses	Nordouest Fourrages	Nordouest Maraicheres	Nordouest Arboriculture
Superficie de la Ferme Moy. (SFM) (ha)	EB87							
Superficie par Culture Cult. (SC) (ha)								
Revenu et Output:								
'endement (R) (Qx/ha)	Statistiques Agricole							
Revenu par Hectare (R*P)								
Revenu de la Ferme Moyenne (R*P*SFM)								
Revenu par Culture Cult. (R*P*SC)								
Intrants:								
Main d'Oeuvre (jour/ha):	EC87							
Preparation du Sol								
Epandage des Engrais								
Semis								
Desherbage								
Moisson								
Main d'Oeuvre Familale (%)								
Macanisation (heures/ha):								
Preparation du Sol								
Epandage des Engrais								
Semis								
Desherbage								
Moisson								
Ammonitre (kg/ha)	EC87			EB87				
Super 45% (kg/ha)								
Super 16% (kg/ha)								
Semences Totales (kg/ha)								
Semences Certifiees (%)								
Desherbant 2.4.D (litre/ha)								
Desherbant Polyvalent (kg/ha)								
Couts (D/ha):								
Ammonitre								
Super 45%								
Super 16%								
Semences								
Desherbant 2.4.D.								
Desherbant Polyvalent								
Macanisation (Prep a Desher)								
Moisson								
Main d'Ouevre Non-Familiale								
Cout d'Opportunite de la Terre								
Couts par Hectare (D/ha)								
Couts de la Ferme Moyenne (D/ha * SFM)								
Couts par Culture Cultivee (D/ha * SC)								
Revenu Net:								
Revenu Net par Hectare								
Revenu Net de la Ferme Moyenne								
Revenu Net par Culture Cult.								

Figure 2: Crop Budget Model Template, Prices.

	Nordouest	Nordest	Centouest	Centest	Sud
Ble Dur					
Ble Tendre					
Orge					

	Nordouest	Nordest	Centouest	Centest	Sud
Ammonitre (D/Qx)					
Super 45% (D/Qx)					
Super 16% (D/Qx)					
Desher. 2.4.D (D/litre)					
Desher. Polyvalent (D/kg)					
Mecanisation (D/heure)					
Moissonneuse-Batteuse (D/heure)					
Salaire d'un Oeuvrier (D/jour)					
Semences Certifiees B.D. (D/Qx)					
Semences Ordinaires B.D. (D/Qx)					
Semences Certifiees B.T. (D/Qx)					
Semences Ordinaires B.T. (D/Qx)					
Semences Certifiees Orge (D/Qx)					
Semences Ordinaires Orge (D/Qx)					

C. Prices

Commodity and input prices are exogenous policy variables in the model. The impact of alternative prices on farm income is forecast by manipulating price variables in Figure 2. Prices are defined as:

- Commodity Price (Pk). The price of the k-th commodity, either official prices or economic border equivalent prices (net of all government taxes and subsidies).

- Input Price (w_j, w_l, w_m). The price of the j-th labor input, l-th mechanized activity, or m-th chemical input, either official prices, financial prices (prices farmers actually pay), or economic border equivalent prices.

D. Yields

The crop yield is also a policy variable. The joint impacts of price policy under alternative good rainfall years (higher yields) and drought years (poor yields) are contingent on yield assumptions in the model. Yields are defined as:

- Yield (Yk). Yields in the base model are 3-year (1985-87) averages of the k-th commodity taken from aggregate yields published in official statistical bulletins and compiled in the data base prepared by the University of Wisconsin and the D/GPDIA. For the drought scenarios, yield levels are estimated from time-series data on rainfall and estimates of the rainfall elasticity of production (Kristjanson and Roth 1990).

E. Agricultural Inputs

Input demand in the model is the quantity of input used per hectare for respective crop activities. In practice, some farms use inputs; others do not. Coefficients in the model represent an average technology based on mean input levels for an average farm, including cases where zero inputs are used. The EB87 and EC87 data sets enable the derivation of input coefficients for the following inputs:

- Labor (Lj). Days worked per hectare on the j-th activity, including land preparation (préparation du sol), application of fertilizer (epandage des engrais), planting (semis), weeding (désherbage), and harvesting (moisson). Days worked by salaried workers are calculated by multiplying total labor by percent salaried labor (main d'ouevre familiale).

- Mechanization (M_l). Hours of mechanized services per hectare on the l-th activity, including land preparation, application of fertilizer, planting, weeding, and harvesting.

- **Chemical Inputs** (Z_m). Amount of the m-th input applied per hectare. Inputs include Ammonitre (kgs), Super45 (kgs), Super16 (kgs), 2.4.D. (liters), and Polyvalent (kgs).

- Seed (S_k). Amount of total seed (kgs) applied per hectare. The amount of uncertified seed per hectare is calculated as Sk * (1-semences certifiées) and certified seed as Sk * (semences certifiées).

F. Revenue

Three estimates of crop revenue are defined in the crop budget model in Figure 1:

(1) Revenue per hectare of the k-th crop (revenu par hectare), R_k.

$$R_k = P_k * Y_k$$

(2) Revenue of the k-th crop for an average farm (revenu de la ferme moyenne), RFM_k, based on mean area cultivated.

$$RIM_k = P_k * Y_k * SFM_k$$

(3) Revenue of the k-th crop actually cultivated (revenu par culture cultivée), RSC_k, based on conditional mean area cultivated.

$$RSC_k = P_k * Y_k * SC_k$$

G. Costs

Three estimates of costs are defined and computed in the crop budget model:

(4) Total cost of the k-th crop per hectare (coûts par hectare), C_k.

$$C_k = w_j * L_j + w_l * M_l + w_m * Z_m$$

summed over all j, l, and m inputs.

(5) Total cost of the k-th crop for an average farm (coûts de la ferme moyenne), CFM_k.

$$CFM_k = (w_j * L_j + w_l * M_l + w_m * Z_m) * SFM_k$$

(6) Total cost of the k-th crop actually cultivated (coûts par culture cultivée), CSC_k.

$$CSC_k = (w_j * L_j + w_l * M_l + w_m * Z_m) * SC_k$$

H. Net Revenue per Crop

Based on costs and revenues, three estimates of net revenue are calculated in the crop budget model:

(7) Net revenue per hectare of the k-th crop (revenu net par hectare), NR_k.

$$NR_k = R_k - C_k$$

(8) Net revenue of the k-th crop for an average farm (revenu net de la ferme moyenne), $NRFM_k$.

$$NRFM_k = RFM_k - CFM_k$$

(9) Net revenue of the k-th crop actually cultivated (revenu net par culture cultivée), $NRSC_k$.

$$NRSC_k = RSC_k - CSC_k$$

It is worth noting that net revenue calculations in equations (7), (8), and (9) are the returns to land, family labor, and management, since prices have not been assigned to these non-tradable inputs. Determining how this income is allocated among these inputs would require more sophisticated statistical analysis than time or data permit for this study.

I. Net Revenue per Farm

The measure of crop income, $NRFM_k$, in equation (8), summed across the five crop categories--céréales, légumineuses, fourrages, cultures maraîchères, arboriculture--is the appropriate measure of average total farm income in the g-th region. The income measure in equation (9) overestimates average farm income in the sector, since crop areas exceed arable land endowments. By changing input prices (w_j, w_l, or w_m) or output prices (P_k), impacts of price policy can be evaluated either on crop income (equations 7, 8, 9) or on farm income (crop income summed across all commodities).

IV. INPUT USE ANALYSIS

A. Introduction

Input-output coefficients for the regional crop budget models were estimated from the EC87 and EB87 data sets, or inferred from coefficients calculated for other regions. Mean input levels and standard deviations for fertilizer (Ammonitre, Super45, and Super16), herbicides (2.4.D., Polyvalent), seed, family and non-family labor, and mechanization are presented in Annex A for eight crop categories (durum wheat, bread wheat, barley, total cereals, legumes, forage crops, commercial vegetables, and tree crops) and for five economic regions (northwest, northeast, central-west, central-east, and south). Estimates for durum wheat, bread wheat, and barley are calculated from EC87; means and standard deviations for the other crop categories are calculated from EB87.

The standard deviation provides a measure of variability in input use from farm to farm within a region, and thus is an indication of the reliability of input-output coefficients in the model. Given any region, high standard deviations relative to the mean imply high inter-farm variability within the region concerning input use, and/or wide disparities in the number of farms using the input. Both possibilities have implications for changes in income resulting from policy change. Some policies (e.g., output and input price policy) may have greater impact on input use per unit of land, while other programs (credit enhancement, extension, market liberalization) may be aimed at increasing farmers' access to inputs and increasing input distribution and use over a wider area. Variations in input use will always exist due to differences in resource endowments among farms and to differences in technology. However, this variation should decline as technology becomes more widely disseminated among farms.

The coefficient of variation (standard deviation/mean) is a conventional measure of relative variability. A number of points stand out from the comparison of means and standard deviations in Annex A:

- Coefficients of Variation (C.V.) for nitrogen and phosphate fertilizers are generally lowest for bread wheat and highest for barley. For bread wheat in the northwest region, the C.V. is .45 for Ammonitre, .65 for Super45, and 1.8 for Super16. For barley, the C.V. for Ammonitre is .83, .72 for Super45, and 6.2 for Super16.

- The variation in input use tends to increase from north to south, e.g., the C.V. for Ammonitre is .71 in the northwest, 1.2 in the northeast, 3.5 in the central-west, and 2.7 in the central-east. The C.V. in the south drops to 0.0 because no inputs are used.

- Seed shows the lowest level of inter-farm variation, since all planted area requires seed. In contrast, herbicides show the highest level of variation. For durum wheat in the northwest region, the C.V. for seed use is 0.26; Super45, .60; Ammonitre, .71; 2.4.D., 1.2; Polyvalent, 1.9; and Super16, 3.7.

- Days of total human labor worked on the farm showed surprisingly high variation. Again for durum wheat in the northwest region, the C.V. for human labor is 2.8 for land preparation, 4.9 for weeding, and 2.9 for harvesting. For the same activities with mechanization, the C.V. is .55 for land preparation, 4.1 for weeding, and 3.0 for harvesting. The high variation is in part due to the substitution between human labor and mechanization.

By disaggregating crop budgets into specific technologies, the relative variability in input use of individual inputs should decline. Specific technologies might include durum wheat with and without fertilizer, or bread wheat with and without mechanization. Since the purpose of this paper is to calculate the effect of price policy on aggregate regional income, the current budgets are appropriate. More detailed budgets, however, will be required for policy studies examining the profitability of alternative technologies and crop substitution.

There is also considerable variation in rates of input utilization across regions. Mean input levels of Ammonitre, Super45, and Super16 are reported in Table 3; mean input levels of 2.4.D., Polyvalent, and certified seed in Table 4; and mean hours of mechanized labor on land preparation, planting, weeding, and harvesting in Table 5. The number of observations in Table 3 is the number of farms in the data sets, EC87 or EB87, respectively, that cultivate the crop. Figures in parentheses are the percentage of farms applying the respective input on the crop. For example, 74.7 percent of the farms in the northwest (330/442) cultivated durum wheat. Of this total, 88.2 percent used some level of nitrogen fertilizer; 83.3 percent, Super45; 7.6 percent, Super16; 46.7 percent, 2.4.D.; 36.7 percent, certified seed; 88.2 percent, mechanization for land preparation; and 75.8 percent, mechanization for harvesting.

A number of salient points stand out from the comparison of input use across crops and regions in Tables 3, 4, and 5:

B. Nitrogen (Ammonitre)

The rate of nitrogen utilization is generally highest on vegetables followed by cereals and forage crops. In the northwest region, for example, the average application rate on commercial vegetables is 150 kg/ha with 81 percent of farms applying nitrogen to commercial vegetables, 102 kg/ha and 82 percent of farms for cereals, and 67 kg/ha and 53 percent of farms for forage crops. Among cereals, the highest rate of utilization is on bread wheat (207 kg/ha, 100 percent of farms) and lowest on barley (83 kg/ha, 78 percent of farms). Ammonitre use on barley is lower than on bread wheat in part because of lower actual application rates and in part because fewer farms apply fertilizer to barley. Nitrogen levels also tend to decline from north to south. On cereals, for example, average application rates are 102 kg/ha in the northwest (82 percent of farms), 97 kg/ha in the northeast (78 percent of farms), 7.9 kg/ha in the central-west (0.1 percent), 1.5 kg/ha in the central-east (2.5 percent), and 0.0 kg/ha in the south (0 percent). Other than the central-west for vegetables and the northeast for tree crops, vegetables and tree crops receive relatively small applications of nitrogen compared with other crops.

C. Triple Super Phosphate (Super45)

The rate of utilization is again highest on commercial vegetables (northwest, 111 kg/ha; northeast, 126 kg/ha; central-west, 80 kg/ha; central-east, 111 kg/ha; and south, 77 kg/ha). Application rates on cereals, legumes, and forage crops are also considerable and nearly even across regions. In the northwest, for example, 81 kg/ha are applied on cereals, 86 kg/ha on legumes, and 65 kg/ha on forage crops. Similarly, in the northeast, average application rates are 78 kg/ha on cereals, 77 kg/ha on legumes, and 74 kg/ha on forage crops. Only in the central-west region, where most of the Super45 is applied to legumes and to commercial vegetables, does this trend diverge significantly. Farms also tend to apply phosphate uniformly on all cereals, although application rates are slightly higher on bread wheat. Little phosphate is applied to tree crops.

D. Ordinary Super Phosphate (Super16)

In comparison with triple super phosphate, utilization of ordinary super phosphate is relatively minor. Fairly sizable amounts are used on commercial vegetables in the northwest (40 kg/ha, 9 percent of farms), northeast (40 kg/ha, 25 percent of farms), central-east (40 kg/ha, 6 percent of farms), and south (17 kg/ha, 18 percent of farms). An appreciable amount is also applied to bread wheat in the northwest region (43 kg/ha, 28 percent of farms) and to legumes in the northeast region (44 kg/ha, 20 percent of farms). In general, use of ordinary super phosphate tends to be concentrated in the northwest and northeast regions, with only minor utilization in other zones.

Unlike fertilizer, data in the EB87 data set do not permit the calculation of rates of input use per hectare for the inputs 2.4.D., Polyvalent, certified seed, or mechanization. Rates of utilization for the following inputs are possible only for cereals in the EC87 data base.

E. Herbicides (Désherbant)

The greatest utilization of 2.4.D. and Polyvalent is in the northwest and northeast regions. In the northwest region, application rates are highest on bread wheat (1.1 l/ha of 2.4.D. and 2.4. kg/ha of Polyvalent) and lower for durum wheat (0.6 l/ha and 0.8 kg/ha) and barley (0.3 l/ha and 0.4 kg/ha). Application rates tend to decline from north to south. For bread wheat, for example, rates in the northwest are 1.1 l/ha of 2.4.D. (84 percent of farms) and 2.4 kg/ha Polyvalent (71 percent of farms), northeast (1.3 l/ha 2.4.D., 0.0 kg/ha Polyvalent), central-west (0.2 l/ha 2.4.D., 0.4 kg/ha Polyvalent), and none in the central-east and south.

F. Certified Seed

Certified seed is closely linked with fertilizer use and herbicides. Rates of utilization are highest on bread wheat and durum wheat in the northwest and northeast regions. Low rates of utilization are found in the central-east, central-west, and south.

TABLE 3

Mean Fertilizer Usage and Percent Farms Using Fertilizer

		BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
		EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Northwest	No. Obs.	330	95	275	1,379	749	469	226	552
	Ammonitre	125.0 (88.2)	207.0 (100.)	83.0 (77.5)	102.4 (82.4)	1.3 (1.5)	67.2 (52.9)	150.0 (81.0)	9.6 (10.7)
	Super45	81.4 (83.3)	97.8 (81.1)	66.5 (73.1)	81.0 (80.2)	85.5 (58.5)	65.3 (51.8)	111.0 (75.7)	2.8 (2.2)
	Super16	11.3 (7.6)	43.4 (28.4)	2.6 (2.5)	0.02 (0.1)	2.7 (1.1)	1.0 (0.4)	40.1 (8.8)	0.4 (0.2)
Northeast	No. Obs.	5	2	6	863	504	669	434	956
	Ammonitre	100.0 (-)	150.0 (-)	66.7 (-)	97.1 (78.0)	3.2 (5.0)	86.4 (70.0)	141.6 (80.4)	28.3 (26.8)
	Super45	108.0 (-)	50.0 (-)	53.3 (-)	78.2 (63.2)	76.9 (48.6)	74.0 (55.5)	126.2 (61.8)	21.2 (20.0)
	Super16	0.0 (-)	0.0 (-)	0.0 (-)	2.9 (4.9)	44.3 (19.8)	9.5 (8.4)	37.9 (24.9)	3.8 (1.9)
Central-West	No. Obs.	26	6	15	729	27	295	90	742
	Ammonitre	23.1 (7.7)	50.0 (-)	20.0 (13.3)	7.9 (0.1)	52.6 (25.9)	4.6 (3.4)	91.2 (54.4)	2.4 (3.0)
	Super45	25.0 (19.2)	25.0 (-)	33.3 (33.3)	5.2 (4.7)	100.1 (37.0)	2.6 (3.1)	80.2 (44.4)	2.5 (3.5)
	Super16	0.0 (0.0)	0.0 (-)	0.0 (0.0)	0.1 (0.1)	0.0 (0.0)	0.2 (0.3)	1.9 (3.3)	0.1 (0.1)

(continued)

(Table 3, continued)

		BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
		EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Central-East	No. Obs.	7	5	30	786	31.4	73	397	1,232
	Ammonitre	21.4 (-)	30.0 (-)	10.0 (10.0)	1.5 (2.5)	1.7 (1.6)	18.6 (15.1)	183.2 (47.9)	1.9 (3.4)
	Super45	81.4 (-)	97.8 (-)	66.5 (6.7)	81.0 (3.7)	95.5 (9.6)	65.3 (11.0)	111.0 (36.0)	2.8 (1.3)
	Super16	11.3 (-)	43.4 (-)	2.6 (3.3)	0.02 (0.1)	2.7 (0.3)	0.0 (0.0)	40.1 (6.3)	0.4 (0.1)
South	No. Obs.	5	0	9	264	61	63	103	585
	Ammonitre	0.0 (-)	0.0 (-)	0.0 (-)	0.0 (0.0)	1.0 (1.6)	25.9 ( )	70.3 ( )	3.4 (14.5)
	Super45	0.0 (-)	0.0 (-)	0.0 (-)	0.0 (0.0)	1.0 (1.6)	14.9 (47.6)	76.7 (95.1)	3.9 (10.3)
	Super16	0.0 (-)	0.0 (-)	0.0 (-)	0.0 (0.0)	0.0 (0.0)	0.4 (6.3)	17.2 (18.4)	0.03 (0.3)

a. See Annex A for complete information on means and standard deviations. Means are calculated based only on those farms growing the respective crop in the sample.

b. Figures in parentheses are percent farms using the input on the crop activity.

c. A '-' implies that the sample size is too small (<10) to permit meaningful percentage calculations.

TABLE 4

Mean Herbicide and Certified Seed Use, as a Prcent of Farms Using Inputs

		BLE DUR	BLE TENDRE	ORGE
		EB87	EB87	EB87
Northwest	No. Observations	330	95	275
	Désherbant 2.4.D.	0.6 (46.7)	1.1 (84.2)	0.3 (26.9)
	Désherbant Polyvalent	0.8 (22.7)	2.4 (70.5)	0.4 (11.6)
	Semence Certifiées	34.7 (36.7)	70.2 (81.1)	3.4 (5.1)
Northeast	No. Observations	5	2	6
	Désherbant 2.4.D.	0.5 (-)	1.3 (-)	0.4 (-)
	Désherbant Polyvalent	0.2 (-)	0.0 (-)	0.0 (-)
	Semence Certifiées	90.0 (-)	70.0 (-)	16.7 (-)
Central-West	No. Observations	26	6	15
	Désherbant 2.4.D.	0.04 (3.8)	0.2 (-)	0.0 (0.0)
	Désherbant Polyvalent	0.1 (3.8)	0.4 (-)	0.0 (0.0)
	Semence Certifiées	3.9 (3.8)	4.2 (-)	6.7 (6.7)

(continued)

(Table 4, continued)

		BLE DUR	BLE TENDRE	ORGE
		EB87	EB87	EB87
Central-East	No. Observations	7	5	30
	Désherbant 2.4.D.	0.0 (-)	0.0 (-)	0.0 (0.0)
	Désherbant Polyvalent	0.0 (-)	0.0 (-)	0.0 (0.0)
	Semence Certifiées	0.0 (-)	0.0 (-)	0.0 (0.0)
South	No. Observations	5	0	9
	Désherbant 2.4.D.	0.0 (-)	0.0 (-)	0.0 (-)
	Désherbant Polyvalent	0.0 (-)	0.0 (-)	0.0 (-)
	Semence Certifiées	20.0 (-)	0.0 (-)	0.0 (-)

a. See Annex A for complete information on means and standard deviations. Means are calculated based only on those farms growing the respective crop in the sample.

b. Figures in parentheses are percent farms using the input on the crop activity.

c. A '-' implies that the sample size is too small (<10) to permit meaningful percentage calculations.

TABLE 5

Mean Use of Mechanized Services and Percent of Farms Using Mechanization by Type of Activity

		BLE DUR	BLE TENDRE	ORGE
Northwest	No. Observations	330	95	275
	Préparation du Sol	0.6 (88.2)	1.1 (98.9)	0.3 (81.5)
	Semi	1.3 (47.3)	2.6 (87.4)	1.3 (44.4)
	Désherbage	1.5 (29.1)	2.2 (78.9)	1.3 (24.0)
	Moisson	1.2 (75.8)	1.7 (97.9)	1.2 (67.6)
Northeast	No. Observations	5	2	6
	Préparation du Sol	2.3 (-)	2.5 (-)	2.2 (-)
	Semi	6.4 (-)	15.5 (-)	5.2 (-)
	Désherbage	6.2 (-)	15.5 (-)	5.0 (-)
	Moisson	15.7 (-)	37.5 (-)	13.2 (-)
Central-West	No. Observations	26	6	15
	Préparation du Sol	3.3 (61.5)	3.3 (-)	3.1 (26.7)
	Semi	0.04 (100.)	0.1 (-)	0.1 (100.)
	Désherbage	0.02 (3.8)	0.1 (-)	0.0 (0.0)
	Moisson	0.5 (100.)	0.3 (-)	0.9 (100.)

(continued)

(Table 5, continued)

		BLE DUR	BLE TENDRE	ORGE
Central-East	No. Observations	7	5	30
	Préparation du Sol	2.0 (-)	1.8 (-)	2.0 (96.7)
	Semi	0.3 (-)	0.3 (-)	0.2 (13.3)
	Désherbage	0.0 (-)	0.0 (-)	0.0 (0.0)
	Moisson	0.0 (-)	0.0 (-)	0.0 (0.0)
South	No. Observations	5	0	9
	Préparation du Sol	3.7 (-)	0.0 (-)	4.2 (-)
	Semi	0.0 (-)	0.0 (-)	0.0 (-)
	Désherbage	0.0 (-)	0.0 (-)	0.0 (-)
	Moisson	0.0 (-)	0.0 (-)	0.0 (-)

a. See Annex A for complete information on means and standard deviations. Means are calculated based only on those farms growing the respective crop in the sample.

b. Figures in parentheses are percent farms using the input on the crop activity.

c. A '-' implies that the sample size is too small (<10) to permit meaningful perecentage calculations.

G. Mechanization (Mécanisation)

The highest rates of mechanization are observed on bread wheat, followed by durum wheat, then barley. On bread wheat in the northwest region, for example, over 80 percent of the farms used mechanization for land preparation, planting, weeding, and harvesting. In contrast, for durum wheat and barley, mechanization was used on only 82-88 percent of the farms for land preparation; 44-47 percent for planting, 24-29 percent for weeding, and 68-76 percent for harvesting, respectively. The amount of time spent per hectare per activity tends to increase from north to south, although the small number of observations in the northeast, central-east, and south regions make comparisons difficult. In the northwest, for example, mechanized land preparation on barley (the only crop found widespread across regions) required 1.1 hours/ha; northeast, 2.5 hours/ha; central-west, 3.3 hours/ha; central-east, 2.0 hours/ha; and south, 4.2 hours/ha. While all activities tend to be mechanized in the northwest, northeast, and central-west regions, only land preparation tends to be mechanized in the central-east (also planting) and south.

H. Summary and Implications

A number of important policy implications are worth noting from this analysis:

- Ammonitre. Removal of subsidies on Ammonitre, resulting in higher nitrogen prices, will largely affect producers of vegetable crops, cereals, and forages in the northwest, northeast, and central-west regions, and producers of mainly commercial vegetables in the central-east and south. Among cereal producers, bread wheat producers will be hardest hit by higher fertilizer prices, and barley producers will be the least affected. Over 70 percent of the producers of these crops in the northwest and northeast will be affected by higher nitrogen prices. Producers of legumes and tree crops will be only marginally affected by changes in Ammonitre prices.

- Super45. Removal of subsidies on Super45 will have the largest impact on producers of commercial vegetables in all regions. The impact of higher prices will also be sharply felt by producers of cereals, legumes, and forage crops in the northwest, northeast, central-west, and central-east regions. Producers of tree crops, and producers in the south, will be only marginally affected by higher prices of Super45 at current use rates.

- Super16. Commercial vegetable producers will be somewhat hurt by higher prices of Super16. However, given the same proportional increases in prices of Super45 and Super16, producers using Super45 stand to lose the most given its more widespread use across regions. Most of the effect will be felt by producers in the northwest region. Higher prices of Super16 will have little or no effect on aggregate production or incomes in other regions.

- **Désherbant.** Bread wheat will experience the largest net decline in income from higher herbicide prices. Producers in the northwest will be hardest hit, while cereal producers in the central-east and south will experience no change in income. However, given similar rates of subsidy on fertilizer and herbicides, subsidy reduction will have a greater effect on fertilizer demand and on production and income of fertilizer users, since fertilizer use is more widespread in terms of both application rates and number of farms involved.

V. PRICE POLICY ANALYSIS

A. Introduction

Three sets of agricultural policies are evaluated in the remainder of this section: (1) updating base 1987 official prices for cereals with 1989 official prices and with 1989 import parity levels; (2) changing base 1987 official input prices to 1991 target levels after phasing-out input subsidies; and (3) evaluating the combined effect of the input and commodity price policies under alternative states of drought. The crop budgeting model described in section III is used to forecast the impacts of these policies on income per hectare and crop area actually cultivated (SC). Implicit in the crop budgeting model is a number of key assumptions:

- Input quantities per hectare remain fixed at base case levels, despite changes in prices.

- Crop area is assumed to remain constant, although changes in net income provide a crude indication of the direction of crop substitution following policy change.

- Yields remain constant, despite changes in input and commodity prices that should affect investment and input utilization.

In spite of these limitations, crop budgets are easy to implement, offer a broad overview of the structure of input use and output in the agricultural sector, and provide a simple but powerful framework for evaluating policy impacts on farm income. They are also the fundamental building blocks for more sophisticated economic analyses (domestic resource cost calculations, and farm modeling and sector modeling using operations research techniques). Nevertheless, the above assumptions should be carefully considered in interpreting results of the policy simulations.

B. Base Case

The base case scenario incorporates input and output prices, area, yields, and inputs per hectare for the 1987 cropping season. It is the basis for comparing income changes resulting from price policy adjustments and drought in subsequent scenarios. Annex B shows the complete base crop budget model incorporating the following assumptions:

- **Commodity Prices.** 1987 Official Prices--18.5 D/Qx for durum wheat, 17.0 D/Qx for bread wheat, and 12.0 D/Qx for barley.

- **Input Prices.** Average real prices paid by farmers in 1987 (Table 6) adjusted for data voids and inconsistencies due to small sample sizes in certain regions.

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TABLE 6

Input Prices Paid by Farmers

	NORTH-WEST	NORTH-EAST	CENTRAL-WEST	CENTRAL-EAST	SOUTH
Number of observations	442	27	109	112	30
Ammonitre (D/Qx)	11.84 (.75)	9.57[b] (2.7)	10.80[b] (.70)	10.43[b] (.15)	-
Super45 (D/Qx)	11.02 (1.1)	9.68 (2.3)	6.92 (.78)	-	-
Super16 (D/Qx)	11.43 (.33)	-	-	7.95[b] (.10)	-
Désherbant 2.4.D. (D/Qx)	3.15 (.54)	7.50[b] (0.0)	3.90[b] (0.0)	-	-
Désh. Polyvalent (D/Qx)	6.91 (1.5)	7.00[b] (0.0)	7.75[b] (0.0)	-	-
Mécanisation (D/Heure)	6.56 (3.3)	4.50[b] (.71)	5.22 (0.73)	4.83 (.67)	4.79 (.43)
Méc.-Batteuse (D/Heure)	21.24 (3.9)	24.00 (2.8)	22.62 (3.24)	-	-
Salaire d'un Ouvrier	3.16 (1.5)	2.90[b] (0.0)	3.70 (.64)	3.46 (.47)	7.83 (10.86)
Semence Cert. (D/Qx):					
Blé Dur	24.81 (3.8)	26.20 (.84)	31.00[b] (0.0)	-	-
Blé Tendre	22.41 (2.8)	22.50[b] (3.5)	19.60[b] (0.0)	-	-
Orge	12.59 (1.6)	13.00[b] (0.0)	22.00[b] (0.0)	-	-

a. Means calculated only if the respective input is actually used.

b. Less than 5 farms in the sample used the input.

c. A '-' implies that no farms in the sample used the input.

- **Yields.** 1985-87 simple averages of yields reported in official statistics (Table 7).

- Inputs. Average quantity of input applied per hectare in 1987, calculated from the EC87 and EB87 data sets. In cases where no crop is grown or inconsistencies arise due to small sample sizes, inferences are made based on input levels in other regions.

Because of lack of data on inputs in the EB87 data set, coefficients for yields and inputs per hectare are left empty for the aggregate crops--cereals, legumes, forage crops, commercial vegetables, and tree crops--in Annex B. A review of the literature did not provide enough information on input coefficients to justify further development of the budgets. However, the budgets are left intact to demonstrate that the analytical framework can easily be extended to other commodities, and to set the stage for further crop budgeting work once the improved 1989 Enquêtes de Base and Conjoncture are entered onto computer in 1990.

C. Economic Price Calculations

Since the AIRD study computed rates of protection for cereals in 1987, two major structural changes have affected supply, demand, and prices in the cereals market. First, a devaluation of the dinar by 14 percent, from .84 in 1986 to .96 in 1989, has increased the price of cereal imports and border price equivalents at the farm level. Second, the worldwide drought of 1987/88 not only sharply reduced area harvested and yields in Tunisia, but also cut yields in the principal exporting countries. World prices of durum wheat in 1989 were 51 percent higher than in 1986. World barley prices increased 45 percent over the same period (Annex C).

The price and cost information used by AIRD to calculate financial and economic prices is contained in Annex C. As the study points out, it is very important that price comparisons be made at the same point in the marketing chain. Like the Salinger model, prices in this study are compared at purchasing points of the Office des Céréales, corresponding to farm-gate prices. The economic price or the border equivalent price of the k-th commodity at the farm level in 1989, exclusive of direct and indirect taxes and subsidies, is calculated as:

$$(10) \quad P_k^e = (P_k^b * e) + p_k^e + t_k^e + s_k^e$$

where, P_k^e = economic price of the k-th commodity in dinars per ton at the farm level in 1989.

P_k^b = CIF border price Tunisia in dollars per ton.

e = exchange rate in dinars per U.S. dollar.

p_k^e = port taxes exclusive of direct and indirect taxes in specific tax equivalents, calculated as 1986 dinars (from AIRD) adjusted for inflation (Annex C).

TABLE 7

Yield Assumptions by Economic Region, Base Crop Budget Model
(Qx/Ha)

	NORTH-WEST	NORTH-EAST	CENTRAL-WEST	CENTRAL-EAST	SOUTH
Blé Dur	14.46	14.79	5.82	-	3.51
Blé Tendre	19.38	18.78	10.89	-	2.42
Orge	11.36	12.75	5.69	-	2.14
Céréales	14.30	14.81	5.90	-	2.61
Légumineuses	-	-	-	-	-
Fourrages	-	-	-	-	-
Maraîchères	-	-	-	-	-
Arboriculture	-	-	-	-	-

a. Means are simple 3-year averages, 1985-87.

b. A '-' implies regional data not yet assembled at the time of this study.

t_k^e = transport costs per ton from Tunis port to regional markets, calculated as 1986 dinars (from AIRD) adjusted for inflation.

s_k^e = transport costs per ton from regional markets to Office des Céréales purchase points, calculated as 1986 dinars (from AIRD) adjusted for inflation.

Border prices (P_k^b) in 1989 were calculated as the 1986 price in the AIRD study times the ratio of 1989 to 1986 U.S. prices (U.S. Gulf prices for wheat and the Minneapolis price for barley). In the case of U.S. wheat, this ratio was 1.51, indicating that U.S. wheat prices increased 51 percent over the period 1986 to 1989 (see Annex C for calculations). In the case of barley, the ratio was 1.45. Calculating border prices in this manner precluded the need to estimate ocean freight and insurance charges (from the U.S. to Tunis), and also enabled price estimates in the Salinger model to be used as a reference point for sake of consistency and comparison. Port charges (p_k^e) and transport costs (t_k^e plus s_k^e) from Tunis to the farm level for 1989 were calculated by multiplying the estimates in the Salinger model by an inflation factor of 8 percent compounded for 3 years. Again this approach permitted reasonably accurate estimation of transfer costs without making overly stringent demands for new data collection.

The economic price (P_k^e) is the border equivalent price, including all transport and transfer costs to the farm level, but excluding all direct and indirect taxes and subsidies. Since Tunisia is a net importer of cereals, the economic price is calculated on an import parity basis, i.e., border prices plus transfer costs. Economic prices could also be calculated on an export parity basis, i.e., border prices less transfer costs. The export parity price is the price farmers must receive at the farm level to cover costs of production plus marketing costs to the export market. For durum wheat in 1989, the import parity price at the farm level is 21.75 D/Qx (i.e., border price of 203.12 D/t plus 4.88 D/t for port charges plus 5.96 D/t for transport to rural markets plus 3.50 D/t for transport to the farm level, free of all taxes and subsidies) (Annex C). The export parity price is 18.88 D/Qx assuming that transfer costs for imports and exports are the same. The difference between the import parity and the export parity price is the 'transportation wedge' in trade theory. Export parity prices are not used in this analysis, since cereal exports are unlikely at current exchange rates and levels of technology.

The import parity price has important implications for food imports versus domestic production. If the parity price of a given crop exceeds its cost of production in terms of domestic resources, then it would be cheaper for the government to purchase the commodity abroad (ignoring possible problems of scarce foreign exchange) and to encourage labor to be shifted from that crop to other crops or sectors of the economy where Tunisia holds a comparative advantage. Alternatively, if the import parity price is higher than domestic

production costs, it would be cheaper for Tunisia to produce the crop domestically and to redeploy its resources from other sectors into production of that crop.

One other point deserves emphasizing. AIRD calculates domestic costs of production directly by charging labor costs at a fixed wage and land at a zero price except for the north region. These estimates of cost of production are then compared with border equivalent prices to calculate rates of protection and to determine comparative advantage. In this analysis, net income calculations are the returns to land, family labor, and management. Setting a fixed wage rate for labor imposes unrealistic rigidities, because agricultural wages can be expected to decline as rural incomes fall (as a result of price change). This decline in wages is due to less than perfect mobility of labor between farm and non-farm employment and limited non-farm employment opportunities in rural areas, particularly in the central and southern regions.

D. Commodity Price Policy

This section evaluates the combined effect of changes in world grain prices and exchange rates on crop income and on the appropriateness of 1989 official prices for cereals. Two alternative output price policies are evaluated: (I) the impact of 1989 official prices administered by the Office des Céréales, and (II) the impact of setting prices to 1989 import parity equivalents (border prices net of all direct and indirect taxes and subsidies). Impacts of these alternative prices are simulated by changing prices in the base model in Annex B as follows:

(I) **Raise Official Commodity Prices to 1989 Levels**--21.0 D/Qx for durum wheat, 18.5 D/Qx for bread wheat, and 14.0 D/Qx for barley.

(II) **Raise Official Commodity Prices to 1989 Import Parity Equivalents**--21.7 D/Qx for durum wheat, 19.7 D/Qx for bread wheat, and 16.3 D/Qx for barley.

In both scenarios, input prices, yields, and inputs/hectare remain the same as in the base case scenario.

The impact of 1989 official prices on net income per hectare and on net income per area of crop cultivated (SC) is reported in Table 8. Between 1987 and 1989, official prices of durum wheat have increased 13.5 percent; bread wheat, 8.8 percent; and barley, 16.7 percent. Net income per hectare and per area of crop cultivated is positive in all regions except for barley in the south. Income for all three cereals is highest in the northeast, followed by the northwest, central-east, central-west, and south.

Increases in net revenue per hectare are highest for barley and lowest for bread wheat. In the case of barley, for example, net income (D/ha) increases 85 percent in the northwest, 44 percent in the northeast, 131 percent in the central-west, and 21 percent in the central-east (net income in the south is negative). In the case of bread wheat, net income (D/ha) increases 28 percent

TABLE 8

Commodity and Input Price Scenarios

		1986 BASE PRICES	1989 OFFICIAL COMMODITY PRICES (I)	1989 ECONOMIC PARITY PRICES (II)	1989 OFFICIAL INPUT PRICES (III)
		Net Income per Hectare (D/ha)			
Northwest	Durum Wheat	123.1	159.3	169.4	115.5
	Bread Wheat	104.4	133.5	156.8	92.2
	Barley	26.7	49.5	75.6	23.0
Northeast	Durum Wheat	143.6	180.6	191.0	131.0
	Bread Wheat	132.7	160.9	183.4	117.8
	Barley	58.0	83.5	112.8	51.5
Central-West	Durum Wheat	47.6	62.1	66.2	45.1
	Bread Wheat	105.8	122.2	135.2	102.5
	Barley	8.7	20.1	33.2	5.4
Central-East	Durum Wheat	55.1	69.7	73.8	53.1
	Bread Wheat	120.0	136.3	149.4	117.2
	Barley	41.3	49.8	56.6	40.6
South	Durum Wheat	20.0	28.7	31.2	19.7
	Bread Wheat	1.6	5.2	8.1	1.6
	Barley	-9.6	-5.3	-0.4	-9.6
		Income per Crop Area Cultivated (D/ha * SC)			
Northwest	Durum Wheat	6,336.8	8,197.4	8,718.4	5,947.1
	Bread Wheat	8,500.1	10,866.1	12,758.9	7,505.2
	Barley	733.7	1,357.1	2,074.1	630.6
Northeast	Durum Wheat	7,952.4	9,999.7	10,573.0	7,253.1
	Bread Wheat	15,980.8	19,373.6	22,087.8	14,186.4
	Barley	1,996.5	2,874.7	3,884.6	1,772.0
Central-West	Durum Wheat	2,298.3	3,001.0	3,197.7	2,175.8
	Bread Wheat	2,023.1	2,335.5	2,585.3	1,959.4
	Barley	333.1	767.2	1,266.3	207.2
Central-East	Durum Wheat	1,894.7	2,394.6	2,534.6	1,825.5
	Bread Wheat	2,318.5	2,634.1	2,886.5	2,264.0
	Barley	361.2	681.9	1,050.7	341.4
South	Durum Wheat	363.4	523.1	567.9	357.6
	Bread Wheat	30.4	101.0	157.4	30.4
	Barley	-281.3	-155.4	-10.6	-281.3

in the northwest, 21 percent in the northeast, 16 percent in the central-west, and 14 percent in the central-east. These differences among crops are caused by two factors: (1) price increases are highest for barley and lowest for bread wheat, and (2) base case incomes for calculating percentage changes are lowest for barley.

The impact of 1989 import parity prices on income is even more dramatic. Compared with 1987 base prices, net income per hectare of barley increases 183 percent in the northwest, 95 percent in the northeast, 282 percent in the central-west, and 37 percent in the central-east. By way of contrast, net income per hectare of bread wheat increases by 50 percent in the northwest, 38 percent in the northeast, 28 percent in the central-west, and 25 percent in the central-east.

These increases in income are not spread evenly among farms in a given region. As noted earlier, in section III.A, the ratio of crop area when cultivated (SC) to crop area for an average farm (SFM) is a reasonably good indicator of crop concentration. In the northwest region, the average area of land cultivated when the crop is grown (r = SC/SFM, in parentheses) is 51.5 ha (r = 1.44 = 51.5/35.8) for durum wheat; bread wheat, 81.4 ha (r = 12.5); and barley, 27.4 ha (r = 1.65). The degree of specialization and concentration is slightly higher in the northeast: durum wheat, 55.4 ha (r = 2.23); bread wheat, 120.4 ha (r = 14.2); and barley, 34.4 ha (r = 2.57). Bread wheat tends to be concentrated on fewer farms, as indicated by ratios (SC/SFM) of 9-72 in the central and southern regions. Barley tends to be more widely cultivated, with ratios of 1.2-2.5 across these same zones.

The implications of these farm-size patterns are evident in Table 8. Income from bread wheat tends to be concentrated on fewer farms in all regions, and on very large farms in the northwest and northeast. Income from durum wheat and barley tends to be more evenly distributed among farms, although the price and yield advantage of durum wheat gives it higher income. Thus, the benefits of higher barley prices will largely affect small to medium-size farmers. Increasing returns on bread wheat will primarily affect medium to large-scale producers.

Comparing 1989 official prices with their import parity equivalents gives a crude indication of the optimal direction of change in official prices. Given that Tunisia is a net importer of durum wheat (243,574 tons in 1985-87), for example, 1989 official prices (21.0 D/Qx) appear to be set at about the right level nationally according to estimated import parity prices (21.7 D/Qx). However, the official price of bread wheat (18.6 D/Qx versus 19.7 D/Qx) appears somewhat low, and the official barley price (14.0 D/Qx versus 16.3 D/Qx) appears substantially undervalued, particularly given that Tunisia is a net importer of both cereals (553,435 tons of bread wheat and 46,236 tons of barley in 1985-87). Unless international prices in 1990 diverge substantially from 1989, and as long as inflationary pressures remain moderate, current official prices are adequate for durum wheat. However, the government of Tunisia should consider marginally raising the official price of bread wheat and substantially raising the price of barley.

E. Input Price Policy

This section evaluates the impact of official prices of fertilizer, herbicides, and certified seed on income per hectare, after subsidy levels are phased out in 1991. Official prices are taken from the Subsidy Reduction Study (Redjeb 1989). Impacts of alternative input pricing policies are simulated by changing prices in the base model in Annex B. The following price assumptions are made:

> (III) Raise Input Prices to 1989 Official Levels. The price of Ammonitre is raised to 12.8 D/Qx, Super45 to 14.1 D/Qx, 2.4.D. to 4.8 D/Qx, certified durum wheat seed to 31.8 D/Qx, certified bread wheat seed to 29.2 D/Qx, and certified barley seed to 22.8 D/Qx in all regions relative to the base case.

Commodity prices, yields, and input use per hectare remain the same as in the base case scenario. Results of these higher input prices on income per hectare and by area of crop cultivated are presented in the last column of Table 8.

The greatest declines in profitability are experienced in those regions with the highest rate of input utilization. For durum wheat, incomes per hectare decline 9.0 percent in the northeast, -6.2 percent in the northwest, and -5.3 percent in the central-west relative to 1987 base case levels. In the central-east (-3.6 percent) and south (-1.5 percent), where the utilization of inputs is more sparse, declines in income are less severe.

Under current farming practices, bread wheat farmers are hurt the most by higher input prices, and producers of barley, the least. In the northwest region, for example, net income per hectare of bread wheat declines -12.2 D/ha; durum wheat, -7.6 D/ha; and barley, -3.7 D/ha. As rates of input utilization are higher on bread wheat compared with durum wheat and barley, removal of subsidies hits bread wheat producers the hardest. In contrast, income remains virtually unchanged in the central-west, central-east, and south, where input use is minimal.

F. Commodity and Input Price Policy under Alternative States of Rainfall

In arid and semi-arid climates, drought has a very important influence on the net benefits of policy change (e.g., on incomes), on the rate at which these benefits are received, and on the financial risk of cash input utilization. The three scenarios in this section examine the impacts of changes in rainfall on commodity and input price policy. Specifically, impacts of increasing official output prices to 1989 import parity levels and eliminating input subsidies are evaluated under three states of drought stress: (IV) low rainfall; (V) average rainfall; and (VI) high rainfall.

Rainfall time series for the 15-year period, 1973/74 to 1987/88, are presented for five economic regions in Table 9, ranked from lowest to highest levels of precipitation. Figures in parentheses are the respective years in which the rainfall is received. Each rainfall series is subdivided into three

TABLE 9

Rainfall Patterns by Region

	NORTHWEST	NORTHEAST	CENTRAL-WEST	CENTRAL-EAST	SOUTH
			(precipitation)		
Rainfall (mm)[1]	445 (73)	298 (87)	215 (87)	129 (87)	92 (76)
	449 (87)	391 (85)	255 (81)	141 (80)	103 (81)
	470 (78)	421 (77)	255 (83)	143 (81)	105 (87)
	472 (82)	448 (80)	279 (85)	203 (73)	105 (80)
	478 (83)			223 (77)	108 (85)
		458 (73)	299 (80)		119 (83)
	504 (81)	469 (78)	300 (78)	233 (76)	
	519 (85)	478 (81)	303 (76)	234 (85)	131 (79)
	521 (77)	536 (82)	307 (82)	267 (83)	143 (77)
	603 (79)	550 (74)	337 (84)	307 (79)	145 (86)
	604 (80)	553 (83)	343 (86)	317 (78)	161 (82)
			387 (87)	319 (84)	171 (73)
	613 (76)	587 (75)			
	623 (74)	600 (79)	392 (79)	329 (86)	196 (74)
	647 (84)	603 (76)	409 (74)	390 (75)	207 (78)
	693 (75)	659 (86)	521 (73)	431 (74)	219 (84)
	719 (86)	675 (84)	577 (75)	435 (82)	370 (75)
Low Rainfall:					
range (mm)	445-478	298-448	215-279	129-223	92-119
mean (mm)	462.8	389.5	251.0	167.8	105.3
probability[2]	.33	.27	.27	.33	.40
Average Rainfall:					
range (mm)	504-604	458-553	299-387	233-319	131-171
mean (mm)	550.2	507.3	325.1	279.5	150.2
probability[2]	.33	.40	.46	.40	.33
High Rainfall:					
range (mm)	613-719	587-675	392-577	329-435	196-370
mean (mm)	659.0	624.8	474.8	396.3	248.0
probability[2]	.33	.33	.27	.27	.27

1. Figures in parentheses are the year in which the wet season begins (e.g., 87 refers to 1987/88 cropping season).

2. Probability is the chance of rainfall falling within the specified range.

groups defining states of nature in rainfall patterns. Summary statistics corresponding to each of the three rainfall states are shown at the bottom of Table 9. Under the low state of rainfall in the northwest region, for example, the average rainfall is 462.8 mm, the range is 445-478 mm, and the probability that rainfall in any year will fall within this range is 33 percent based on the 15-year time series.

The data in Table 9 generally indicate that the volatility of rainfall increases from north to south. Relative to the average rainfall state, precipitation under the low rainfall scenario declines from 15.9 percent in the northwest to 40.0 percent in the central-east. Under the high rainfall state, precipitation on average is in the range of 20 percent higher in the northwest to 65.1 percent higher in the south. Compared with farmers in the north, producers in the central-east and south are hit relatively harder in drought years, but benefit relatively more in good rainfall years. Further, there does not appear to be a strong correlation between the timing of rainfall (years) and the levels of rainfall (mm) across regions.

Mean rainfall levels associated with the three states of nature are used to estimate crop yields under various degrees of drought stress. Calculating yields based on the same ranking procedure as employed in Table 9 for rainfall would be inappropriate since other factors of production (i.e., fertilizer) are changing over time. Instead, yields are calculated from rainfall elasticities of production, estimated in Kristjanson and Roth (1990), which controlled for changing levels of fertilizer use. Yields are calculated according to the equation:

$$(11) \quad Y_{kg} = Y^{*}_{kg} * (1 + r_{kg}) * R_{kg}$$

where, Y_{kg} = yield of the k-th commodity in region g.

Y^{*}_{kg} = yield of the k-th commodity (1985-87 average) in the base case.

r_{kg} = rainfall elasticity of production, i.e., 0.67 for durum wheat, 0.32 for bread wheat, and 0.82 for barley, taken from Kristjanson and Roth (1990).

R_{kg} = percentage change in rainfall from Table 9.

The rainfall elasticity of production is the change in yield resulting from some percentage change in rainfall. If, for instance, rainfall in any region increases (decreases) 10 percent, then yields of durum wheat would increase (decrease) 6.7 percent; bread wheat, 3.2 percent; and barley, 8.2 percent. These elasticities were found to remain constant between northern and southern regions, enabling the use of one set of elasticity estimates across zones.

Impacts of the combined commodity and input pricing policies, under alternative states of rainfall, are simulated by changing prices and yields in the base model in Annex B. The following yield assumptions are made:

(IV) Low Rainfall Scenario. Yields (Qx of grain per ha) are calculated from equation 11:

	Northwest	Northeast	Central-West	Central-East	South
Durum Wheat	12.92	12.49	4.93	4.26	2.81
Bread Wheat	18.40	17.39	10.10	9.50	2.19
Barley	9.88	10.32	4.63	3.83	1.62

(V) Average Rainfall. Yields are the same as in base case.

(VI) High Rainfall.

	Northwest	Northeast	Central-West	Central-East	South
Durum Wheat	16.38	17.09	7.62	7.45	5.04
Bread Wheat	20.61	20.17	12.50	12.35	2.92
Barley	13.20	15.17	7.84	7.64	3.28

In all three scenarios, the following changes in prices are made to the base case model:

Raise Official Commodity Prices to 1989 Import Parity Levels--21.7 D/Qx for durum wheat, 19.7 D/Qx for bread wheat, and 16.3 D/Qx for barley.

Raise Input Prices to 1989 Official Levels--Ammonitre 12.8 D/Qx; Super45, 14.1 D/Qx; 2.4.D., 4.8 D/Qx; certified durum wheat seed, 31.8 D/Qx; certified bread wheat seed, 29.2 D/Qx; and certified barley seed, 22.8 D/Qx, in all regions.

Input use per hectare is assumed to remain the same as in the base case scenario.

Scenario (V) under average rainfall simulates the combined effect of higher commodity prices in scenario (II) with higher input prices in scenario (III). Comparing scenario (V) with the base case scenario in Table 10 gives a crude indication of the net effect of both higher commodity prices and higher input prices on the crop sector. Model results indicate that net income improves in all regions and for all crops. Incomes improve substantially for barley in the northwest and northeast regions, since it experiences the largest increase in price and is least affected by higher input costs due to lower average input utilization compared with other cereals.

It should be recalled that the base case is in 1986 dinars and the policy scenarios are in 1989 dinars. After multiplying base case figures by 1.26 to show compounded inflation of 8 percent over 3 years, results indicate that: (a) output and input price policy on durum wheat and bread wheat tend to nearly equally offset each other in the northwest, northeast, central-west, and central-east, resulting in no real income change; (b) real incomes tend to

TABLE 10

Combined Commodity and Input Price Policy under Various States of Rainfall

		1986 BASE PRICES	OUTPUT AND INPUT PRICE POLICY: LOW RAINFALL (IV)	OUTPUT AND INPUT PRICE POLICY: AVG RAINFALL (V)	OUTPUT AND INPUT PRICE POLICY: HIGH RAINFALL (VI)
		Net Income per Hectare (D/ha)			
Northwest	Durum Wheat	123.1	128.4	161.8	203.4
	Bread Wheat	104.4	125.2	144.5	168.8
	Barley	26.7	47.7	71.8	101.8
Northeast	Durum Wheat	143.6	128.4	178.3	228.2
	Bread Wheat	132.7	141.1	168.5	195.9
	Barley	58.0	66.7	106.3	145.7
Central-West	Durum Wheat	47.6	44.4	63.7	102.7
	Bread Wheat	105.8	116.3	131.9	163.6
	Barley	8.7	12.6	29.9	64.9
Central-East	Durum Wheat	55.1	37.9	71.8	107.1
	Bread Wheat	120.0	119.2	146.6	175.4
	Barley	41.3	19.3	55.9	94.3
South	Durum Wheat	20.0	15.7	30.9	64.1
	Bread Wheat	1.6	25.5	32.3	47.2
	Barley	-9.6	-8.8	-0.4	18.2
		Income per Crop Area Cultivated (D/ha * SC)			
Northwest	Durum Wheat	6,336.8	6,608.7	8,328.7	10,473.1
	Bread Wheat	8,500.1	10,192.7	11,764.0	13,736.2
	Barley	733.7	1,309.0	1,971.0	2,793.9
Northeast	Durum Wheat	7,952.4	7,110.2	9,873.7	12,637.2
	Bread Wheat	15,980.8	16,595.4	20,293.4	23,591.5
	Barley	1,996.5	2,296.1	3,660.2	5,018.7
Central-West	Durum Wheat	2,298.3	2,142.5	3,075.1	4,961.4
	Bread Wheat	2,023.1	2,224.0	2,521.6	3,128.0
	Barley	333.1	481.4	1,140.4	2,477.0
Central-East	Durum Wheat	1,894.7	1,302.2	2,465.4	3,680.8
	Bread Wheat	2,318.5	2,303.0	2,832.1	3,387.7
	Barley	361.2	176.5	1,030.8	1,926.5
South	Durum Wheat	363.4	285.7	562.3	1,166.9
	Bread Wheat	30.4	495.1	627.9	916.6
	Barley	-281.3	-260.0	-10.6	536.1

increase for all cereals in the south; and (c) real incomes for barley increase substantially in all zones.

Scenarios (IV) and (VI) indicate the volatile effect that rainfall can have on policy impacts. The low rainfall scenario can be expected to occur between 27 percent and 40 percent of the time, depending on the region (Table 9). The high rainfall scenario can be expected 27-33 percent of the time. Both states have a profound impact on yields.

Under severe drought stress (scenario IV), incomes fall the least on bread wheat since, as Kristjanson and Roth (1990) point out, it appears to be grown on better quality soils with better water-holding capacity. Changes in rainfall thus do not affect yields as much as other cereals, reflected in the low rainfall elasticity of production (.32). Net income per hectare, for the northwest, for example, falls only -13 percent, while rainfall declines 15.9 percent (from an average of 550 mm to 463 mm, Table 9). Net income in the northeast falls -16.3 percent; central-west, 11.8 percent; central-east, -18.7 percent; and south, -18.0 percent. Barley, which Kristjanson and Roth conclude is grown on poor soils (.82 elasticity), experiences the sharpest drop in yields and income in all regions. The drop in income per hectare of barley is most severe in the central-east (-65.5 percent), central-west (-57.9 percent), and south, where the decline in rainfall is most severe.

The effect on income is reversed under situations of good rainfall. Bread wheat, which proved to be most resistant to drought, experiences the least gains from higher precipitation. Barley, which proved most susceptible to drought, experiences the highest gains to improvements in rainfall. As a result, the different cereals experience variable rates of swing in incomes among good and poor rainfall years. For durum wheat in the northwest, for example, net income per hectare ranges from 123 D/ha in poor rainfall years to 203 D/ha in good years. Ranges for bread wheat and barley are 125-169 D/ha and 48 102 D/ha, respectively. In the south, which experiences the greatest fluctuations in rainfall, the range in income is 16-64 D/ha for durum wheat, 26-47 D/ha for bread wheat, and -9 to 18 D/ha for barley.

VI. SUMMARY AND IMPLICATIONS

Tunisia's two most important agricultural surveys--the Enquête Conjoncture and the Enquête de Base--are used to construct crop budget models for Tunisian agriculture. The models, constructed for the five economic regions of Tunisia, are used to evaluate the impact of input subsidy removal and commodity price policy on crop income under three states of rainfall. These models lay the foundation for future farm and sector modeling studies and for evaluating the distributional impacts of policy reform according to regions of the country. A number of important research findings and policy conclusions were obtained from the analysis of the data bases and from the empirical development and application of the crop budget model.

Removal of subsidies on Ammonitre will largely affect producers of vegetables, cereals, and forage crops in the northwest, northeast, and central-west regions, and mainly affect producers of commercial vegetables in the central-east and the south. Among cereal producers, those producing bread wheat will be hardest hit by the higher nitrogen prices; barley producers will be affected the least. Over 70 percent of the producers of these crops in the northwest and northeast will be affected. Producers of legumes and tree crops will be only marginally affected by changes in Ammonitre prices.

Removal of subsidies on Super45 will also have the largest impact on producers of commercial vegetables in all regions. The impact of higher prices will also be sharply felt by producers of cereals, legumes, and forage crops in the northwest, northeast, central-west, and central-east regions. Producers of tree crops, and producers in the south, will be only marginally affected by higher prices of Super45 at current use rates.

Commercial vegetable producers will be somewhat hurt by higher prices of Super16. However, given the same proportional increases in prices of Super45 and Super16, the latter will have the least effect on farm incomes because it is less widely used. Most of the effect will be felt by producers in the northwest region. Higher prices of Super16 will have little or no effect on aggregate production or incomes elsewhere.

Relative to producers of durum wheat and barley, producers of bread wheat will be hardest hit by higher herbicide prices. Producers in the northwest will be most affected, while cereal producers in the central-east and south will experience negligible effect. Given similar rates of subsidy on fertilizer and herbicides, subsidy reduction will have a greater impact on fertilizer demand and on production and incomes of fertilizer users, since fertilizer use is more widespread in terms of application rates and number of farms using the input.

Since the AIRD study computed rates of protection for cereals in 1987, two major structural changes have affected supply, demand, and prices in the cereals market. First, a devaluation of the dinar by 14 percent, from .84 in 1986 to .96 in 1989, has increased the price of cereal imports and import parity equivalents at the farm level. Second, the worldwide drought of 1987/88

not only sharply reduced area harvested and yields in Tunisia, but also cut yields in the principal exporting countries. World prices of durum wheat in 1989 were 51 percent higher than in 1986. World barley prices increased 45 percent over the same period.

Three sets of agricultural policies were evaluated in this study: (1) updating base 1987 official prices for cereals with 1989 official prices and with 1989 import parity equivalents; (2) changing base 1987 official input prices to 1991 target levels, after phasing-out input subsidies; and (3) evaluating the combined effect of both input and commodity price policies under alternative states of drought.

Under scenario (I), which raises official commodity prices, increases in net revenue per hectare are highest for barley and lowest for bread wheat. In the case of barley, net income (D/ha) increases 85 percent in the northwest, 44 percent in the northeast, 131 percent in the central-west, and 21 percent in the central-east (net income in the south is negative). However, in the case of bread wheat, net income (D/ha) increases only 28 percent in the northwest, 21 percent in the northeast, 16 percent in the central-west, and 14 percent in the central-east. These differences among crops can be attributed largely to two factors: (1) price increases are highest for barley and lowest for bread wheat (since 1987, official prices of durum wheat have increased 13.5 percent; bread wheat, 8.8 percent; and barley, 16.7 percent); and (2) base case incomes for calculating percentage changes are lowest for barley.

The impact of higher output prices is even more dramatic under scenario (II), which looks at import parity prices (i.e., border prices, net of all direct and indirect taxes and subsidies). Compared with 1987 base prices, net income per hectare of barley increases 183 percent in the northwest, 95 percent in the northeast, 282 percent in the central-west, and 37 percent in the central-east. By way of contrast, net income per hectare of bread wheat increases only 50 percent in the northwest, 38 percent in the northeast, 28 percent in the central-west, and 25 percent in the central-east.

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 northwest and northeast. Income from durum wheat and barley tends to be more evenly distributed across farms. Thus the benefits of higher barley prices--and, to a lesser extent, durum wheat prices--will largely affect small to medium-size farmers. Increasing returns on bread wheat will primarily benefit medium to large-scale producers.

Comparing 1989 official prices with import parity equivalents gives a crude indication of the optimal direction of change in official prices. Given that Tunisia is a net importer of durum wheat, 1989 official prices (21.0 D/Qx) appear to be set at about the right level nationally according to estimated import parity prices (21.7 D/Qx). However, the official bread wheat price (18.6 D/Qx versus 19.7 D/Qx) appears somewhat low, and the official barley price (14.0 D/Qx versus 16.3 D/Qx) appears substantially undervalued, particularly given that Tunisia is a net importer of both cereals. Unless international prices in 1990 diverge substantially from 1989, and as long as inflation pressures remain moderate, current official prices are adequate for durum

wheat. However, the government of Tunisia should consider marginally raising the official price of bread wheat, and substantially raising the price of barley.

In scenario (III), 1987 official input prices are raised to 1989 official levels in all regions. The greatest declines in profitability are experienced in those regions with the highest rate of input utilization. For durum wheat, incomes per hectare decline -9.0 percent in the northeast, -6.2 percent in the northwest, and -5.3 percent in the central-west regions relative to base case levels. In the central-east and south, where the utilization of inputs is more sparse, declines in income are less severe. Under current farming practices, bread wheat farmers are hurt the most by higher input prices, and producers of barley, the least. In the northwest region, for example, net income per hectare of bread wheat declines -12.2 D/ha; durum wheat, -7.6 D/ha; and barley, -3.7 D/ha. In contrast, income remains virtually unchanged in the central-west, central-east, and south, where input use is minimal.

Drought has a very important influence on the net benefits of policy change (e.g., on incomes), on the rate at which these benefits are received, and on the financial risk of cash input utilization. Rainfall time series for the 15-year period, 1973/74 to 1987/88, is used to define three states of drought stress. Impacts of increasing official output prices to 1989 import parity levels and of eliminating input subsidies are evaluated under three states of drought: (IV) low rainfall; (V) average rainfall; and (VI) high rainfall.

Scenario (V) gives a crude indication of the net effect of both higher commodity prices and higher input prices on the crop sector. Net income, relative to the base case, improves in all regions and for all crops. Incomes improve substantially for barley in the northwest and northeast regions, because barley experiences the largest increase in price and is least affected by higher input costs due to lower average input utilization compared with other cereals. Increases in income also tend to be large for durum wheat and bread wheat in the central-east and south, because yields are superior, resulting in higher revenues, and impacts of higher input prices are dampened by low input utilization on all crops.

Income in the the base case is in 1986 dinars, and the policy scenarios are in 1989 dinars. Multiplying base case figures by 1.26 to show the effect of compounded inflation of 8 percent over 3 years indicates that: (a) output and input price policy on durum wheat and bread wheat tend to nearly equally offset each other in the northwest, northeast, central-west, and central-east, resulting in no real income change; (b) real incomes tend to increase for all cereals in the south; and (c) real incomes for barley increase substantially in all zones.

Scenarios (IV) and (VI) indicate the volatile effect that rainfall has on policy impacts. The low rainfall scenario can be expected to occur between 27 percent and 40 percent of the time, depending on the region. The high rainfall scenario can be expected 27-33 percent of the time.

Under severe drought stress (scenario IV), incomes fall the least on bread wheat since it is generally grown on better quality soils with better

water-holding capacity. Changes in rainfall thus do not affect yields as much as other cereals, reflected in the low rainfall elasticity of demand (.32). Barley, which is generally grown on poorer soils (.82 elasticity), experiences the sharpest drop in yields and income in all regions. The drop is most precipitous in the central-east, central-west, and south, where declines in rainfall are most severe.

The effect on income is completely reversed under situations of good rainfall. Bread wheat, which appears to be most resistant to drought, experiences the least gains from higher rainfall. Barley, which appears most susceptible to drought, experiences the highest gains to improvements in rainfall. As a result, the different cereals experience varying magnitudes of swing in incomes between good rainfall and poor rainfall years. For durum wheat, for example, net income per hectare in the northwest ranges from 123 D/ha in poor rainfall years to 203 D/ha in good years. Ranges for bread wheat and barley are 125-169 D/ha and 48-102 D/ha, respectively.

This study has shown the effect of alternative price policies on farm incomes, and the distributional impacts of those policies by type of crop and by region. The crop budget models have provided an interface between farm-level data collection in the agricultural enquêtes and analysis of several important policy questions. Certainly data limitations--small sample sizes in the EC87 and weaknesses in the types of data collected in the EC87 and EB87--have affected the scope of this analysis. Some of these problems will be corrected with the availability of the 1989 enquêtes; the crop budget analysis should be extended to cover more crops utilizing these new data. However, it should also be recognized that existing data can be usefully applied. This study has demonstrated the potential of one type of analysis--crop budgeting. Work is now being planned to proceed with more sophisticated farm planning models.

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ANNEX A

CHEMICAL INPUTS, SEED, LABOR, AND MECHANIZED SERVICES PER HECTARE IN THE NORTHWEST, NORTHEAST, CENTRAL-WEST, CENTRAL-EAST, AND SOUTH REGIONS

Previous Page Blank

TABLE 1

Average Fertilizer and Herbicide Application, Northwest Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Total Observations[a]	330	95	275	1,379	749	469	226	552
Ammonitre (kg/ha)	125.03 (88.11)	207.02 (94.01)	82.97 (68.56)	102.44	1.25	67.23	150.01	9.56
Super45 (kg/ha)	81.44 (49.04)	97.83 (63.58)	66.45 (47.67)	81.01	85.48	65.33	111.01	2.78
Super16 (kg/ha)	11.26 (41.53)	43.41 (76.88)	2.55 (15.78)	0.02	2.74	1.00	40.12	0.41
Désherbant 2.4.D. (kg/ha)	0.61 (0.70)	1.05 (0.51)	0.33 (0.56)					
Désherbant Polyvalent (kg/ha)	0.75 (1.46)	2.38 (1.73)	0.38 (1.10)					
Semences Totals (kg/ha)	117.49 (30.51)	126.14 (27.74)	103.55 (24.79)					
Semences Certifiées (%)	34.67 (46.92)	70.24 (41.32)	3.38 (16.32)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 2

Average Time Worked by Type of Activity, Northwest Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Total Observations[a]	330	95	275	1,379	749	469	226	552
Préparation du Sol (dys/ha)	1.24 (3.43)	0.88 (1.19)	1.17 (2.07)					
Epandage des Engrais (dys/ha)	0.24 (0.19)	0.26 (0.15)	0.19 (0.19)					
Semis (dys/ha)	0.30 (1.65)	0.52 (3.06)	0.33 (1.81)					
Désherbage (dys/ha)	0.34 (1.68)	0.52 (3.06)	0.28 (1.83)					
Moisson (dys/ha)	1.46 (4.28)	0.75 (1.61)	1.59 (2.25)					
Main d'Oeuvre Familale (%)	53.56 (43.34)	14.42 (30.91)	54.56 (43.06)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 3

Average Time Spent on Mechanized Activities, Northwest Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Total Observations[a]	330	95	275	1,379	749	469	226	552
Préparation du Sol (hrs/ha)	5.04 (2.76)	7.16 (2.12)	3.54 (2.54)					
Epandage des Engrais (hrs/ha)	0.95 (5.19)	2.23 (7.01)	0.89 (5.01)					
Semis (hrs/ha)	1.32 (5.21)	2.63 (7.17)	1.34 (5.39)					
Désherbage (hrs/ha)	1.49 (6.03)	2.24 (6.60)	1.26 (5.61)					
Moisson (hrs/ha)	1.17 (3.48)	1.69 (4.51)	1.15 (3.85)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 4

Average Fertilizer and Herbicide Application per Farm, Northeast Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Total Observations[a]	5	2	6	863	504	669	434	956
Ammonitre (kg/ha)	100.00 (122.47)	150.00 (212.13)	66.67 (121.11)	97.09	2.25	86.42	141.56	28.33
Super45 (kg/ha)	108.00 (22.80)	50.00 (70.71)	53.33 (61.54)	78.25	76.95	73.98	126.21	21.21
Super16 (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.86	44.31	9.47	37.86	3.78
Désherbant 2.4.D. (kg/ha)	0.50 (1.12)	1.25 (1.77)	0.42 (1.02)					
Désherbant Polyvalent (kg/ha)	0.20 (0.45)	0.00 (0.00)	0.00 (0.00)					
Semences Totals (kg/ha)	112.00 (8.37)	115.00 (7.07)	115.00 (8.37)					
Semences Certifiées (%)	90.00 (22.36)	70.00 (42.43)	16.67 (40.82)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 5

Average Time Worked by Type of Activity, Northeast Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Total Observations[a]	5	2	6	863	504	669	434	956
Préparation du Sol (dys/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Epandage des Engrais (dys/ha)	0.40 (0.55)	0.00 (0.00)	0.17 (0.41)					
Semis (dys/ha)	0.40 (0.55)	0.00 (0.00)	0.67 (0.52)					
Désherbage (dys/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Moisson (dys/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Main d'Oeuvre Familale (%)	40.00 (54.77)	0.00 (0.00)	66.67 (51.64)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 6

Average Time Spent on Mechanized Activities, Northeast Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Total Observations[a]	5	2	6	863	504	669	434	956
Préparation du Sol (hrs/ha)	2.26 (1.24)	2.50 (2.12)	2.22 (1.11)					
Epandage des Engrais (hrs/ha)	6.40 (13.20)	15.50 (20.51)	5.17 (12.17)					
Semis (hrs/ha)	6.40 (13.20)	15.50 (20.51)	5.17 (12.17)					
Désherbage (hrs/ha)	6.20 (13.31)	15.50 (21.21)	5.00 (12.25)					
Moisson (hrs/ha)	15.66 (20.63)	37.50 (10.61)	13.19 (19.42)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 7

Average Fertilizer and Herbicide Application per Farm, Central-West Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations[a]	26	6	15	729	27	295	90	742
Ammonitre (kg/ha)	23.08 (81.52)	50.00 (122.47)	20.00 (56.06)	7.87	52.50	4.50	91.15	2.28
Super45 (kg/ha)	25.00 (55.23)	25.00 (61.24)	33.33 (48.80)	5.15	100.00	2.51	80.14	2.39
Super16 (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.05	0.00	.17	1.89	.05
Désherbant 2.4.D. (kg/ha)	0.04 (0.20)	0.17 (0.41)	0.00 (0.00)					
Désherbant Polyvalent (kg/ha)	0.10 (0.49)	0.42 (1.02)	0.00 (0.00)					
Semences Totals (kg/ha)	85.00 (13.27)	63.33 (54.28)	76.67 (12.91)					
Semences Certifiées (%)	3.85 (19.61)	4.17 (10.21)	6.67 (25.82)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 8

Average Time Worked by Type of Activity, Central-West Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations[a]	26	6	15	729	27	295	90	742
Préparation du Sol (dys/ha)	0.77 (1.69)	0.17 (0.26)	0.13 (0.28)					
Epandage des Engrais (dys/ha)	0.06 (0.14)	0.05 (0.12)	0.12 (0.17)					
Semis (dys/ha)	0.13 (0.08)	0.27 (0.39)	0.16 (0.09)					
Désherbage (dys/ha)	0.004 (0.02)	0.02 (0.04)	0.00 (0.00)					
Moisson (dys/ha)	5.91 (6.10)	5.10 (5.37)	2.56 (3.59)					
Main d'Oeuvre Familale (%)	59.62 (44.76)	46.67 (51.64)	28.00 (37.65)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 9

Average Time Spent on Mechanized Activities, Central-West Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations[a]	26	6	15	729	27	295	90	742
Préparation du Sol (hrs/ha)	3.27 (1.43)	3.27 (2.54)	3.07 (1.78)					
Epandage des Engrais (hrs/ha)	0.04 (0.14)	0.08 (0.20)	0.10 (0.28)					
Semis (hrs/ha)	0.04 (0.17)	0.05 (0.12)	0.09 (0.24)					
Désherbage (hrs/ha)	0.02 (0.08)	0.07 (0.16)	0.00 (0.00)					
Moisson (hrs/ha)	0.53 (0.65)	0.30 (0.73)	0.88 (0.56)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 10

Average Fertilizer and Herbicide Application per Farm, Central-East Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations	7	5	30	786	314	73	397	1,232
Ammonitre (kg/ha)	21.43 (56.69)	30.00 (67.08)	10.00 (30.51)	1.52	1.73	18.57	183.21	1.91
Super 45% (kg/ha)	21.43 (56.69)	30.00 (67.08)	6.67 (25.37)	2.42	24.50	14.59	103.04	0.75
Super 16% (kg/ha)	0.00 (0.00)	0.00 (0.00)	3.33 (18.26)	0.03	.14	0.00	15.30	.01
Désherbant 2.4.D. (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Désherbant Polyvalent (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Semences Totals (kg/ha)	34.71 (15.34)	46.00 (15.17)	34.33 (6.14)					
Semences Certifiées (%)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respectivc crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 11

Average Time Worked by Type of Activity, Central-East Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations	7	5	30	786	314	73	397	1,232
Préparation du Sol (dys/ha)	0.87 (1.83)	1.02 (1.68)	0.45 (1.25)					
Epandage des Engrais (dys/ha)	0.07 (0.19)	0.00 (0.00)	0.04 (0.13)					
Semis (dys/ha)	0.21 (0.16)	0.28 (0.15)	0.21 (0.13)					
Désherbage (dys/ha)	0.40 (0.93)	1.00 (0.94)	0.77 (1.18)					
Moisson (dys/ha)	8.29 (1.25)	9.60 (1.67)	8.80 (2.31)					
Main d'Oeuvre Familale (%)	46.43 (44.41)	66.00 (46.69)	49.67 (42.02)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 12

Average Time Spent on Mechanized Activities, Central-East Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations	7	5	30	796	314	73	397	1,232
Préparation du Sol (hrs/ha)	1.96 (1.13)	1.78 (1.16)	1.99 (1.10)					
Epandage des Engrais (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Semis (hrs/ha)	0.29 (0.76)	0.26 (0.58)	0.18 (0.48)					
Désherbage (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Moisson (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 13

Average Fertilizer and Herbicide Application per Farm, South Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations	5	0	9	264	61	63	103	585
Ammonitre (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.99	25.94	70.29	3.36
Super 45% (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.99	14.92	76.67	3.91
Super 16% (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.35	17.16	0.03
Désherbant 2.4.D. (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Désherbant Polyvalent (kg/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Semences Totals (kg/ha)	29.00 (10.25)	0.00 (0.00)	35.44 (5.32)					
Semences Certifiées (%)	20.00 (44.72)	0.00 (0.00)	0.00 (0.00)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 14

Average Time Worked by Type of Activity, South Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations	5	0	9	264	61	63	103	585
Préparation du Sol (dys/ha)	0.98 (2.19)	0.00 (0.00)	0.00 (0.00)					
Epandage des Engrais (dys/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Semis(dys/ha)	2.10 (0.45)	0.00 (0.00)	1.90 (0.00)					
Désherbage (dys/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Moisson (dys/ha)	8.60 (2.51)	0.00 (0.00)	9.11 (0.93)					
Main d'Oeuvre Familiale (%)	74.00 (43.36)	0.00 (0.00)	93.33 (13.23)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

TABLE 15

Average Time Spent on Mechanized Activities, South Region

	BLE DUR	BLE TENDRE	ORGE	CEREALES	LEGUMI-NEUSES	FOURRAGES	CULTURES MARAICHE-RES	ARBORI-CULTURE
	EC87	EC87	EC87	EB87	EB87	EB87	EB87	EB87
Number of Observations	5	0	9	264	61	63	103	585
Préparation du Sol (hrs/ha)	3.72 (1.36)	0.00 (0.00)	4.18 (1.15)					
Epandage des Engrais (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Semis (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Désherbage (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					
Moisson (hrs/ha)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)					

a. Number of farms growing the respective crop.

b. Means are calculated based only on those farms growing the respective crop.

c. Figures in parentheses are standard deviations.

d. Blanks indicate that comparable data do not exist in the questionnaire.

e. EC87 refers to the 1987 Enquête Conjoncture and EB87 refers to the 1987 Enquête de Base data bases.

ANNEX B

BASE CASE CROP BUDGET MODEL

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Prix d'Output (D/Qx)

	Nordouest	Nordest	Centouest	Centest	Sud
Ble Dur	18.5	18.5	18.5	18.5	18.5
Ble Tendre	17	17	17	17	17
Orge	12	12	12	12	12

Prix d'Intrant

	Nordouest	Nordest	Centouest	Centest	Sud
Ammonitre (D/Qx)	11.80	10.50	10.50	10.50	10.50
Super 45% (D/Qx)	11.00	9.50	7.00	7.00	7.00
Super 16% (D/Qx)	11.40	10.00	7.50	7.50	7.50
Desherbant 2.4.D. (D/litre)	3.25	3.25	3.25	3.25	3.25
Desherbant Polyvalent (D/kg)	7.00	7.00	7.00	7.00	7.00
Mecanisation (D/heure)	5.60	5.00	5.00	5.00	5.00
Moissonneuse-Batteuse (D/heure)	21.25	24.00	22.60	22.60	22.60
Salaire d'un Ouvrier (D/jour)	3.20	3.20	3.50	3.50	3.50
Semences Certifiees B.D. (D/Qx)	24.80	26.20	26.50	26.50	26.50
Semences Ordinaires B.D. (D/Qx)	18.00	18.00	18.00	18.00	18.00
Semences Certifiees B.T. (D/Qx)	23.00	23.00	23.50	23.50	23.50
Semences Ordinaires B.T. (D/Qx)	17.00	17.00	17.00	17.00	17.00
Semences Certifiees Orge (D/Qx)	12.60	13.00	13.50	13.50	13.50
Semences Ordinaires Orge (D/Qx)	12.00	12.00	12.00	12.00	12.00

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	Nordouest Ble Dur	Nordouest Ble Tendre	Nordouest Orge	Nordouest Cereales	Nordouest Legumineuses	Nordouest Fourrages	Nordouest Maraicheres	Nordouest Arboriculture
Superficie de la Ferme Moy. (SFM) (ha)	35.84	6.51	16.68	59.64	7.68	8.14	2.91	7.15
Superficie par Culture Cult. (SC) (ha)	51.47	81.39	27.44	74.05	17.56	29.72	22.06	22.18
Revenu et Output:								
Rendement (R) (Qx/ha)	14.46	19.38	11.36	14.30				
Revenu par Hectare (R*P)	267.51	229.46	136.32					
Revenu de la Ferme Moyenne (R*P*SFM)	9586.65	2144.78	2273.82					
Revenu par Culture Cult. (R*P*SC)	13768.74	26814.75	3740.62					
Intrants:								
Main d'Oeuvre (jour/ha):								
Preparation du Sol	1.24	0.88	1.17					
Epandage des Engrais	0.24	0.26	0.19					
Semis	0.30	0.52	0.33					
Desherbage	0.34	0.52	0.28					
Moisson	1.46	0.75	1.59					
Main d'Oeuvre Familale (%)	53.56	14.42	54.56					
Mecanisation (heures/ha):								
Preparation du Sol	5.04	7.16	3.54					
Epandage des Engrais	0.95	2.23	0.89					
Semis	1.32	2.63	1.34					
Desherbage	1.49	2.24	1.26					
Moisson	1.17	1.69	1.15					
Ammonitre (kg/ha)	125.03	207.02	82.97	102.44	1.25	67.24	149.98	9.56
Super 45% (kg/ha)	81.44	97.83	66.45	81.00	85.52	65.34	110.99	2.78
Super 16% (kg/ha)	11.26	43.41	2.55	0.02	2.74	1.00	40.12	0.41
Semences Totales (kg/ha)	117.49	126.14	103.55					
Semences Certifiees (%)	34.67	70.24	3.38					
Desherbant 2.4.D (litre/ha)	0.61	1.05	0.33					
Desherbant Polyvalent (kg/ha)	0.75	2.38	0.38					
Couts (D/ha):								
Ammonitre	14.75	24.43	9.79					
Super 45%	8.96	10.76	7.31					
Super 16%	1.28	4.95	0.29					
Semences	23.92	26.76	12.45					
Desherbant 2.4.D.	1.98	3.41	1.07					
Desherbant Polyvalent	5.25	16.66	2.66					
Mecanisation (Prep a Desher)	58.07	94.12	46.40					
Moisson	24.86	35.91	24.44					
Main d'Oeuvre Non-Familiale	5.32	8.02	5.18					
Cout d'Opportunite de la Terre	0.00	0.00	0.00					
Couts par Hectare (D/ha)	144.39	225.02	109.58					
Couts de la Ferme Moyenne (D/ha * SFM)	5174.59	1464.90	1827.83					
Couts par Culture Cultivee (D/ha * SC)	7431.96	18314.64	3006.94					
Revenu Net:								
Revenu Net par Hectare	123.12	104.44	26.74					
Revenu Net de la Ferme Moyenne	4412.06	679.88	445.99					
Revenu Net par Culture Cult.	6336.78	8500.11	733.69					

	Nordest Ble Dur	Nordest Ble Tendre	Nordest Orge	Nordest Cereales	Nordest Leguminouses	Nordest Fourrages	Nordest Maraicheres	Nordest Arboriculture
Superficie de la Ferme Moy. (SFM) (ha)	24.82	8.47	13.42	47.49	7.42	18.57	5.93	23.02
Superficie par Culture Cult. (SC) (ha)	55.37	120.44	34.44	79.80	21.36	40.25	19.81	34.92
Revenu et Output:								
Rendement (R) (Qx/ha)	14.79	18.78	12.75	14.81				
Revenu par Hectare (R*P)	273.62	319.26	153.00					
Revenu de la Ferme Moyenne (R*P*SFM)	6791.12	2704.13	2053.26					
Revenu par Culture Cult. (R*P*SC)	15150.06	38451.67	5269.32					
Intrants:								
Main d'Oeuvre (jour/ha):								
Preparation du Sol	1.25	0.90	1.20					
Epandage des Engrais	0.20	0.25	0.17					
Semis	0.30	0.50	0.30					
Desherbage	0.30	0.50	0.30					
Moisson	1.50	0.75	1.60					
Main d'Oeuvre Familale (%)	40.00	14.00	66.67					
Mecanisation (heures/ha):								
Preparation du Sol	5.00	7.15	3.50					
Epanuage des Engrais	0.80	1.50	0.75					
Semis	1.30	2.60	1.30					
Desherbage	1.45	2.20	1.20					
Moisson	1.15	1.70	1.15					
Ammonitre (kg/ha)	100.00	160.00	66.67	97.09	3.17	86.41	141.55	28.33
Super 45% (kg/ha)	85.00	100.00	53.33	78.24	76.94	73.99	126.21	21.21
Super 16% (kg/ha)	0.00	0.00	0.00	2.86	44.30	9.47	37.86	3.78
Semences Totales (kg/ha)	112.00	115.00	115.00					
Semences Certifiees (%)	90.00	70.00	16.67					
Desherbant 2.4.D (litre/ha)	0.50	1.05	0.42					
Desherbant Polyvalent (kg/ha)	0.60	2.35	0.35					
Couts (D/ha):								
Ammonitre	10.50	16.80	7.00					
Super 45%	8.07	9.50	5.07					
Super 16%	0.00	0.00	0.00					
Semences	28.43	24.38	13.99					
Desherbant 2.4.D.	1.63	3.41	1.36					
Desherbant Polyvalent	4.20	16.45	2.45					
Mecanisation (Prep a Desher)	42.75	67.25	33.75					
Moisson	27.60	40.80	27.60					
Main d'Ouevre Non-Familiale	6.82	7.98	3.81					
Cout d'Opportunite de la Terre	0.00	0.00	0.00					
Couts par Hectare (D/ha)	129.99	186.57	95.03					
Couts de la Ferme Moyenne (D/ha * SFM)	3226.39	1580.28	1275.32					
Couts par Culture Cultivee (D/ha * SC)	7197.63	22470.89	3272.87					
Revenu Net:								
Revenu Net par Hectare	143.62	132.69	57.97					
Revenu Net de la Ferme Moyenne	3564.73	1123.86	777.94					
Revenu Net par Culture Cult.	7952.43	15980.79	1996.45					

	Centouest Ble Dur	Centouest Ble Tendre	Centouest Orge	Centouest Cereales	Centouest Legumineuses	Centouest Fourrages	Centouest Maraicheres	Centouest Arboriculture
Superficie de la Ferme Moy. (SFM) (ha)	30.82	1.33	25.54	57.90	0.13	6.28	1.66	49.28
Superficie par Culture Cult. (SC) (ha)	48.29	19.12	38.14	70.92	4.44	19.01	16.44	59.31
Revenu et Output:								
Rendement (R) (Qx/ha)	5.82	10.89	5.69	5.90				
Revenu par Hectare (R*P)	107.67	185.13	68.28					
Revenu de la Ferme Moyenne (R*P*SFM)	3318.76	245.76	1743.91					
Revenu par Culture Cult. (R*P*SC)	5199.38	3539.69	2604.20					
Intrants:								
Main d'Oeuvre (jour/ha):								
Preparation du Sol	0.77	0.50	0.50					
Epandage des Engrais	0.06	0.05	0.12					
Semis	0.13	0.27	0.16					
Desherbage	0.40	0.50	0.50					
Moisson	5.91	5.10	2.56					
Main d'Oeuvre Familale (%)	59.62	46.67	28.00					
Mecanisation (heures/ha):								
Preparation du Sol	3.27	3.27	3.07					
Epandage des Engrais	0.12	0.15	0.10					
Semis	0.04	0.05	0.09					
Desherbage	0.02	0.07	0.00					
Moisson	0.53	1.25	0.88					
Ammonitre (kg/ha)	23.08	50.00	20.00	7.87	52.55	4.60	91.17	2.35
Super 45% (kg/ha)	25.00	25.00	33.33	5.15	100.10	2.57	80.16	2.47
Super 16% (kg/ha)	0.00	0.00	0.00	0.05	0.00	0.18	1.89	0.06
Semences Totales (kg/ha)	85.00	63.33	76.67					
Semences Certifiees (%)	3.85	4.17	6.67					
Desherbant 2.4.D (litre/ha)	0.04	0.17	0.00					
Desherbant Polyvalent (kg/ha)	0.10	0.42	0.00					
Couts (D/ha):								
Ammonitre	2.42	5.25	2.10					
Super 45%	1.75	1.75	2.33					
Super 16%	0.00	0.00	0.00					
Semences	15.58	10.94	9.28					
Desherbant 2.4.D.	0.12	0.54	0.00					
Desherbant Polyvalent	0.67	2.92	0.00					
Mecanisation (Prep a Desher)	17.27	17.68	16.27					
Moisson	11.98	28.25	19.89					
Main d'Oeuvre Non-Familiale	10.28	11.98	9.68					
Cout d'Opportunite de la Terre	0.00	0.00	0.00					
Couts par Hectare (D/ha)	60.08	73.32	59.55					
Couts de la Ferme Moyenne (D/ha * SFM)	1851.73	105.29	1520.82					
Couts par Culture Cultivee (D/ha * SC)	2901.04	1516.56	2271.05					
Revenu Net:								
Revenu Net par Hectare	47.59	105.81	8.73					
Revenu Net de la Ferme Moyenne	1467.03	140.46	223.09					
Revenu Net par Culture Cult.	2298.34	2023.12	333.14					

	Cantest Ble Dur	Cantest Ble Tendre	Cantest Orge	Cantest Cereales	Cantest Legumineuses	Cantest Fourrages	Cantest Maraicheres	Cantest Arboriculture
Superficie de la Ferme Moy. (SFM) (ha)	11.66	1.16	15.83	29.38	2.70	0.59	3.56	57.53
Superficie par Culture Cult. (SC) (ha)	34.36	19.32	28.18	48.04	11.05	10.33	11.51	60.00
Revenu et Output:								
Rendement (R) (Qx/ha)	5.82	10.89	5.59	5.90				
Revenu par Hectare (R*P)	107.67	185.13	96.73					
Revenu de la Ferme Moyenne (R*P*SFM)	1255.25	214.32	1081.11					
Revenu par Culture Cult. (R*P*SC)	3699.54	3576.71	1924.13					
Intrants:								
Main d'Oeuvre (jour/ha):								
Preparation du Sol	0.87	0.50	0.45					
Epandage des Engrais	0.07	0.05	0.04					
Semis	0.21	0.28	0.21					
Desherbaye	0.40	0.50	0.77					
Moisson	9.29	9.60	8.80					
Main d'Oeuvre Familale (%)	46.43	66.00	49.67					
Mecanisation (heures/ha):								
Preparation du Sol	1.96	1.78	1.99					
Epandage des Engrais	0.08	0.12	0.06					
Semis	0.29	0.26	0.18					
Desherbage	0.00	0.00	0.00					
Moisson	0.55	1.25	0.90					
Ammonitre (kg/ha)	21.43	30.00	10.00	1.52	1.73	18.57	183.20	1.91
Super 45% (kg/ha)	21.43	30.00	6.67	2.42	24.49	14.59	103.02	0.75
Super 16% (kg/ha)	0.00	0.00	3.33	0.03	0.14	0.00	0.00	0.01
Semences Totales (kg/ha)	34.71	46.00	34.33					
Semences Certifiees (%)	0.00	0.00	0.00					
Desherbant 2.4.D (litre/ha)	0.00	0.00	0.00					
Desherbant Polyvalent (kg/ha)	0.00	0.00	0.00					
Couts (D/ha):								
Ammonitre	2.25	3.15	1.05					
Super 45%	1.50	2.10	0.47					
Super 16%	0.00	0.00	0.25					
Semences	6.25	7.82	4.12					
Desherbant 2.4.D.	0.00	0.00	0.00					
Desherbant Polyvalent	0.00	0.00	0.00					
Mecanisation (Prep a Desher)	11.65	10.80	11.15					
Moisson	12.43	28.25	20.34					
Main d'Ouevre Non-Familiale	18.45	13.01	18.09					
Cout d'Opportunite de la Terre	0.00	0.00	0.00					
Couts par Hectare (D/ha)	52.53	65.13	55.46					
Couts de la Ferme Moyenne (D/ha * SFM)	612.38	75.40	878.17					
Couts par Culture Cultivee (D/ha * SC)	1804.85	1258.25	1562.95					
Revenu Net:								
Revenu Net par Hectare	55.14	120.00	41.27					
Revenu Net de la Ferme Moyenne	642.87	138.93	202.93					
Revenu Net par Culture Cult.	1894.59	2318.46	361.18					

	Sud Ble Dur	Sud Ble Tendre	Sud Orge	Sud Cereales	Sud Legumineuses	Sud Fourrages	Sud Maraicheres	Sud Arboriculture
Superficie de la Ferme Moy. (SFM) (ha)	2.77	0.27	11.74	14.78	0.78	10.27	3.65	57.56
Superficie par Culture Cult. (SC) (ha)	18.21	19.44	29.42	36.06	8.26	105.00	22.81	63.37
Revenu et Output:								
Rendement (R) (Qx/ha)	3.51	2.42	2.14	2.61				
Revenu par Hectare (R*P)	64.94	41.14	25.68					
Revenu de la Ferme Moyenne (R*P*SFM)	179.94	11.18	301.50					
Revenu par Culture Cult. (R*P*SC)	1182.47	799.76	755.51					
Intrants:								
Main d'Oeuvre (jour/ha):								
Preparation du Sol	0.98	0.50	0.00					
Epandage des Engrais	0.00	0.00	0.00					
Semis	2.10	2.10	1.90					
Desherbage	0.00	0.00	0.00					
Moisson	8.60	8.75	9.11					
Main d'Oeuvre Familale (%)	74.00	80.00	93.33					
Mecanisation (heures/ha):								
Preparation du Sol	3.72	3.75	4.18					
Epandage des Engrais	0.00	0.00	0.00					
Semis	0.20	0.20	0.15					
Desherbage	0.00	0.00	0.00					
Moisson	0.40	0.30	0.30					
Ammonitre (kg/ha)	0.00	0.00	0.00	0.00	0.99	25.94	70.27	3.36
Super 45% (kg/ha)	0.00	0.00	0.00	0.00	0.99	14.92	76.67	3.91
Super 16% (kg/ha)	0.00	0.00	0.00	0.00	0.00	0.35	17.15	0.03
Semences Totales (kg/ha)	29.00	30.00	35.44					
Semences Certifiees (%)	20.00	0.00	0.00					
Desherbant 2.4.D (litre/ha)	0.00	0.00	0.00					
Desherbant Polyvalent (kg/ha)	0.00	0.00	0.00					
Couts (D/ha):								
Ammonitre	0.00	0.00	0.00					
Super 45%	0.00	0.00	0.00					
Super 16%	0.00	0.00	0.00					
Semences	5.71	5.10	4.25					
Desherbant 2.4.D.	0.00	0.00	0.00					
Desherbant Polyvalent	0.00	0.00	0.00					
Mecanisation (Prep a Desher)	19.60	19.75	21.64					
Moisson	9.04	6.78	6.78					
Main d'Oeuvre Non-Familiale	10.63	7.94	2.57					
Cout d'Opportunite de la Terre	0.00	0.00	0.00					
Couts par Hectare (D/ha)	44.98	39.58	35.24					
Couts de la Ferme Moyenne (D/ha * SFM)	124.65	10.75	413.77					
Couts par Culture Cultivee (D/ha * SC)	819.12	769.34	1036.84					
Revenu Net:								
Revenu Net par Hectare	19.95	1.56	-9.56					
Revenu Net de la Ferme Moyenne	55.29	0.43	-112.27					
Revenu Net par Culture Cult.	363.35	30.42	-281.33					

ANNEX C

ECONOMIC PRICE CALCULATIONS

TABLE 1

Financial and Economic Prices, Durum Wheat, 1986 and 1989

	1986[a] FINANCIAL PRICE	1986[a] ECONOMIC PRICE	1989[bc] FINANCIAL PRICE	1989[bc] ECONOMIC PRICE
Border Price FOB ($/t)	$ 127.50	$ 127.50	$ 192.68	$ 192.68
Freight and Insurance ($/t)[c]	15.00	15.00	18.90	18.90
Border Price CIF ($/t)	142.50	142.50	211.58	211.58
Exchange Rate ($1.0 = Dinars)	.84	.84	.96	.96
Border Price in D/t	119.70	119.70	203.12	203.12
Charges Portuares:				
Frais bancaires	.42	.69		
Débarquement	.42	.37		
Peage	.19	.17		
Douane	11.80	.00		
Frais à quai	.30	.27		
Assurance	.08	.08		
Surestaries	.00	.00		
Stationnement	.00	.00		
Cadence	.32	.29		
Subvention des dockeurs	.12	-.12		
Marge de l'Office des Céréales	2.12	2.12		
	15.77	3.87	19.87	4.88
Charges de Livraison (Tunis-Marche Rurale)	5.95	4.73	7.50	5.96
Charges de Livraison (Marche Rurale-Ferme)	3.50	2.78	4.41	3.50

a. Data for 1986 are taken from Salinger for 1986. Economic prices are net of all taxes (+) and subsidies (-).

b. Exchange rates are June-July averages 1989. FOB price calculated as 1986 Salinger price times the ratio of U.S. Gulf port prices in the I and II quarters 1989 ($4.73) to the price in 1986 ($3.13/bu). Source: IMF Financial Statistics, 1989.

c. Freight, insurance, port, and transport charges are 1986 costs times compounded inflation of 8 percent for 3 years.

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TABLE 2

Financial and Economic Prices, Bread Wheat, 1986 and 1989

	1986[a] FINANCIAL PRICE	1986[a] ECONOMIC PRICE	1989[bc] FINANCIAL PRICE	1989[bc] ECONOMIC PRICE
Border Price FOB ($/t)	$ 112.50	$ 112.50	$ 170.01	$ 170.01
Freight and Insurance ($/t)[c]	15.00	15.00	18.90	18.90
Border Price CIF ($/t)	127.50	127.50	188.91	188.91
Exchange Rate ($ 1.0 in Dinars)	.84	.84	.96	.96
Border Price in D/t	107.10	107.10	181.35	181.35
Charges Portuares:				
Frais bancaires	.36	.59		
Débarquement	.91	.81		
Peage	.19	.17		
Douane	10.18	.00		
Frais à quai	.37	.33		
Assurance	.12	.12		
Surestaries	.00	.00		
Stationnement	.00	.00		
Cadence	.58	.51		
Subvention des dockeurs	.07	-.07		
Marge de l'Office des Céréales	2.11	2.11		
	14.89	4.57	18.76	5.76
Charges de Livraison (Tunis-Marche Rurale)	5.95	4.73	7.50	6.15
Charges de Livraison (Marche Rurale-Ferme)	3.50	2.78	4.41	3.50

a. Data for 1986 are taken from Salinger for 1986. Economic prices are net of all taxes (+) and subsidies (-).

b. Exchange rates are June-July averages 1989. FOB price calculated as 1986 Salinger price times the ratio of U.S. Gulf port prices in the I and II quarters 1989 ($4.73) to the price in 1986 ($3.13/bu). Source: IMF Financial Statistics, 1989.

c. Freight, insurance, port, and transport charges are 1986 costs times compounded inflation of 8 percent for 3 years.

TABLE 3

Financial and Economic Prices, Barley, 1986 and 1989

	1986[a] FINANCIAL PRICE	1986[a] ECONOMIC PRICE	1989[bc] FINANCIAL PRICE	1989[bc] ECONOMIC PRICE
Border Price FOB ($/t)	$ 85.00	$ 85.00	$ 123.33	$ 123.33
Freight and Insurance ($/t)[c]	15.00	15.00	18.90	18.90
Border Price CIF ($/t)	100.00	100.00	142.23	142.23
Exchange Rate ($ 1.0 in Dinars)	.84	.84	.96	.96
Border Price in D/t	84.00	84.00	136.54	136.54
Charges Portuares:				
Frais bancaires	.38	.62		
Débarquement	7.51	6.69		
Peage	.19	.17		
Douane	8.53	.00		
Frais à quai	1.66	1.47		
Assurance	.10	.10		
Surestaries	.00	.00		
Stationnement	1.04	1.04		
Cadence	1.41	1.24		
Subvention des dockeurs	.12	-.12		
Marge de l'Office des Céréales	1.99	1.99		
	22.93	13.20	28.89	16.63
Charges de Livraison (Tunis-Marche Rurale)	5.95	4.73	7.50	6.15
Charges de Livraison (Marche Rurale-Ferme)	3.50	2.78	4.41	3.50

a. Data for 1986 are taken from Salinger for 1986. Economic prices are net of all taxes (+) and subsidies (-).

b. Exchange rates are June-July averages 1989. FOB price calculated as 1986 Salinger price times the ratio of the Minneapolis price in November 1989 ($3.25) to the price in 1985/86 ($2.24/bu). Source: 1989 CRB Commodity Year Book and Wall Street Journal.

c. Freight, insurance, port, and transport charges are 1986 costs times compounded inflation of 8 percent for 3 years.