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ZAMBIA MAIZE POLICY MODEL

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ZAMBIA MAIZE POLICY MODEL

Introduction

The importance of maize to agriculture and the general economic health of Zambia is shown by a number of alternative statistics. In terms of area planted, maize is estimated to have occupied over 70% of the total land under cultivation. In spite of its importance to the overall nutritional level for the country, statistics are somewhat more difficult to obtain. According to the 1970 household consumption survey, however, maize meal made up 62% of total weight of food consumed. Caloric intake levels associated with maize are also quite high, especially in urban households.

Since maize is so important to Zambia's economy, it is not surprising that considerable attention has been devoted to policies to promote its production and, in some instances, subsidize its consumption. In Zambia, maize policy has formed the backbone of agricultural policy for over two decades. Prices were fixed at predetermined levels to provide national self-sufficiency. Jansen (1986) provides a review of historical maize pricing policies.

Maize meal prices received a subsidy of nearly 30% from 1972 to 1982. This subsidy kept meal prices low and therefore allowed wages to remain low. Meal prices are of particular importance to the urban consumer who is unable to produce crops for personal consumption. Attempts to raise meal prices in the recent past have met with considerable urban resistance.

In examining the approach taken for past policy selection, it is apparent that the majority of decisions have been reached without substantial empirical analysis, particularly with respect to the longer term impacts of the policy levers selected. Atherton and Reintsma (1986, pg v) indicate that there are long and short term analyses incorporated in the policy formulation, but that the decision makers are only now "...coming to rely increasingly on an empirically-based process, and to generate some demand for data collection and analysis to underpin decisions".

With respect to the hierarchy of that policy formulation process, Atherton and Reintsma suggest that support be provided to key organizations. Number one on the list is the Planning Division of the Ministry of Agriculture and Water Development, (PD/MAWD).

This report details the development and implementation of a policy analysis tool to be utilized directly by personnel within PD/MAWD. The analysis tool is a set of software for projecting supply and utilization of maize within Zambia, indicating expected levels of production, retention, marketing, import needs, producer revenues and a variety of government cost factors. The modeling system, developed in conjunction

with two key individuals within PD/MAWD, is intended to be a simplified system model which minimizes the "black box" approach to analysis. The policy analyst within PD/MAWD has the opportunity to override the model solutions at several key decision points and to impose a unique insight on current policy actions within Zambia. Further, the modeling system is not intended to provide the "right" answer. It is developed to indicate the consequences of a variety of policy decision. The political process within Zambia should be utilized to determine the appropriate action for Zambia. If the modeling system converts the arguments from the vocal forum into debate with respect to the economic consequences of the various actions, it will have been successful.

To reiterate, this system is designed to be utilized by the analyst. As such there are a limited number of "whistles and bells" attached. The spreadsheet does not make extensive use of macros or the windowing capability of the underlying software. This is done so that the user has complete access to the analysis system.

Data Constraints and Utilization

The difficulty of obtaining consistent cross-sectional and time series data sets for Zambia is well documented. FAO Report No. 4715-ZA, Annex 5, pg 4 states: "The paucity of recent data on nutrition status reflects wide acknowledgement that Zambian agricultural and economic conditions have worsened since 1971." Atherton and Reintsma's (1986 pg 34) report on the ZATPID project indicates "...the available data and analyses were relatively weak and not adequate to meet the greatly increased demand..." As an additional example of data concerns for Zambia, Memorandum #2 in this report series describes three separate supply and utilization tables for maize in Zambia. These three sources are: ERS, FAS, and a composite developed by Fosu (1985).

The paucity and conflicting nature of data made econometric estimation of demand and supply impossible. Further, as PD/MAWD is the destination agency, a methodology was needed to provide PD/MAWD with a system which could quickly accept information on the entire range of policy options as well as new data.

PD/MAWD has reported a consistent series of data reflecting area, yield, production and sales for the major crops. These data are jointly compiled by PD/MAWD, CSO and the FAO-sponsored early warning service. The data reported by PD/MAWD are gaining acceptance as the definitive source of agricultural information. Thus, since their data bases are gaining acceptance and they are the destination agency, a decision was reached to utilize the maize data on area and production held by PD/MAWD exclusively.

Imports and stock holdings are also important in determining final supply and utilization tables. Official import data is relatively easily to obtain. NAMBOARD is the sole importer

of maize for Zambia and has excellent historical records. Some unofficial, quasi-illegal importing of maize and maize meal likely occurs over the northern border. However, data on these small shipments are unavailable.

Until recently, stocks have also been held exclusively by NAMBOARD, with a few days' supply held by millers. However, cooperatives have recently been allowed to hold stocks, implying that stock holding information must now be gathered from two sources. Data on stocks held at the farm level are not available. However, as fixed prices are in place for maize on an annual basis, there is little incentive for the producer to retain quantities in excess of subsistence levels much beyond harvest.

Thus, nearly all categories making up the supply and utilization tables are in hand with some degree of consistency and reliability. These data include area, yield and production from PD/MAWD, NAMBOARD and cooperative stock levels and crop receipts, imports by NAMBOARD and sales of maize to mills by cooperatives and NAMBOARD. As is the case for stocks, both the cooperatives and NAMBOARD are allowed to make sales to mills. Data must be collected on both categories from both organizations. These data sources are combined into a consistent supply and utilization table with data extending back to the 84/85 drop year. As previously mentioned, this time period of observations is too short for reliable econometric estimation of supply and demand responses.

All of the variables described above are either collected by, or are readily available to PD/MAWD. Analysts within PD/MAWD are familiar with the individuals within NAMBOARD who have data concerning mill sales and stocks. Further, there are contacts within the cooperatives for obtaining data on coop purchases and stock holdings. This allows for the analysts to update the supply and utilization tables as new information becomes available.

It is important to note the data series which are considered "hard" as these will be important when the variables to be projected are concerned. Those considered to have the most reliability are area, yields, imports, stocks and sales to mills.

Maize Model Structure

The maize model developed for Zambia incorporates economic factors on both the supply and demand sides. However, the final model development is much more pragmatic than originally designed. As an example of the simplification generated at a request of the PD/MAWD analysts, the demand side now contains one, as opposed to two demand components. The previous model incorporated economic factors affecting meat consumption and feed use per animal. Further, human consumption was projected based on income and price factors. However, as indicated in Memorandum #2, information on consumption alone is subject to considerable question. Splitting the consumption series into

two components implies substantially more information than is available.

For data reasons and usage factors, the model now contains three primary economic relationships, area planted, per capita sales to mills and retentions. The functional relationships have not changed markedly from earlier models. Area remains a function of the producer price of maize and the price of fertilizer. Consumption, proxied by per capita mill sales, is a function of real income and real prices. Each of these and the third relationship will be discussed in turn.

Area Planted

The area planted to maize is considered to respond to two economic terms and a trend growth factor. The economic factors are the producer price of maize and the price of fertilizer. The elasticity of area response to maize price is taken as 0.3 and that for fertilizer price at -0.2. Trend growth raises plantings by 20,000 ha/year. These elasticities and trend term were chosen in such a way as to minimize the sum of errors over the period of time when data is considered reliable.

Per Capita Mill Sales

Per capita mill sales are used as a proxy for demand as opposed to total consumption. A review of historical data on per capita consumption when total supplies are considered indicates substantial variability. Further, it is difficult to identify any economically driven fluctuations since consumption appears to be driven primarily by supply shifts.

For this reason, per capita mill sales are estimated as a response to the real consumer price of maize, real income, and production levels. Price responsiveness is assumed to be very low at -0.1 due to the subsistence nature of maize in Zambia. For this same reason, the income elasticity is placed at 1.0. Finally, sales are estimated to respond to production levels as well. As prices are fixed during the year, the demand curve could be assumed to be perfectly elastic. Thus consumption levels would be more driven by supply. Empirically, the addition of supply greatly aided in reducing errors as well.

Farm Retentions

One concern of agencies within Zambia is that the price differential between the farm and consumer level had widened to such an extent in 1986 that there would be little reason for producers to keep any maize on the farm. This would then require moving large amounts of milled corn back out to the rural communities, causing further transportation problems. Further, as the flow of information section will indicate, imports are determined by the difference between mill sales and

NAMBOARD/Coop purchases coupled with stock changes. Thus, the proportion of maize which is produced and actually sold off the farm is doubly important. This is estimated as a constant percentage, adjusted by the differential between producer and consumer prices of maize. As the differential increases, i.e. producer prices rise without adjustment in consumer prices, then the producer will market a larger portion of his crop.

With subsidized consumer prices, it is to a producer's advantage to market his crop if the differential is high and buy the processed product. If the gap is small, the producer is better off to by-pass the difficulties of transporting and selling his maize by keeping it for personal consumption.

Model Closure

These three factors are taken together with stock identities to close the supply and utilization projection system. Area is determined as mentioned. Yield is taken as exogenous to price and is projected to show trend growth of 0.2 bags/ha/year. These two factors generate production and when beginning stocks are added, total domestic supply is determined. Marketed production is estimated as previously described so that stocks plus marketed production give the level of grain available for sales to mills.

Demand for mill sales is estimated based on the factors already described. Stocks are determined based on the objectives provided in the marketing order for the 1986 crop. The change in stock levels and mill sales are compared to the level of grain available for mill sales. If the demand levels are greater than available supplies then maize is imported to close the system. Should supplies be greater than demand, a portion is added to stocks and a portion is exported.

International Linkage

Imports fill the gap between domestic supplies and corresponding utilization. Linkage to the international markets generates necessary border prices for government cost exposure. Border price is a combination of world maize prices modified for internal rates of exchange for the dollar. Since longer term forecasts of U.S. grain are available on a regular basis, a linear linkage equation was estimated that converts the U.S. price modified by the exchange rate into a boarder price.

This linkage equation with world market prices and macro economic forecasts for exchange rates provides information appropriately conditioned on the general world economic environment.

Government Cost

Government costs are primarily associated with supply side subsidies, consumer subsidies and import costs.

Fertilizer subsidies are driven by the acreage response equation. Future levels of fertilizer use and corresponding subsidies are associated with projected area planted. Area planted is conditioned on fertilizer price and commodity prices. As subsidies are reduced, area planted will also decline.

Consumer subsidies reflect import differential costs (border prices less consumer price) and the domestic subsidies associated with the differential between producer and consumer prices. Other costs reflect NAMBOARD and Union handling charges as well as transportation and storage costs.

Flow Chart and Model Description

Appendix A contains a detailed description of the model. the sequence of tables reflect the logical path necessary in generating longer term consequences of policy options conditional on pertinent economic information, nine logical steps are presented in figure one of appendix A. Each step produces information necessary for continuing to the next level. Accumulated information is passed on automatically such that changes in initial stages are reflected in later estimates and calculations.

The model is designed to be user friendly. As such, data values and equations can be changed at each stage in the logical link. Tables 1 through 9 reflect actual information that will be observed on the computer screen. External information generated by the modeler has been underlined in each Table. Internally generated information is described in detail above each table. In most cases, this involves a structural equation or general assumption regarding growth rates associated with economic and population variables.

REFERENCES

- Fosu, Joseph. "Data Availability in Zambia and Its Applicability for Policy Modelling." Memorandum #2, CEAP Project in Zambia, October, 1985.
- Atherton, Joan and Curt Reintsma. "Impact Assessment and Institutional Analysis." Zambian Agricultural Training, Planning and Institutional Development Project (611-0075) U.S. Agency for International Development, March, 1986.
- Jansen, Doris J. "Zambia: A comparative Study of the Political Economy of Agricultural Pricing Policies." Development Technologies, Inc., 10 Orange Ave., Larkspur, CA 94939, 1986.

APPENDIX A

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SEQUENCE

- . TABLE 1: Cost of production estimates for commercial and small farms to determine recommended price supports
- . TABLE 2: Predetermined information -- inputs, population, exchange rate, etc.
- . TABLE 3: Estimated planted area
- . TABLE 4: Total domestic maize supply
- . TABLE 5: Zambia internal market prices and handling costs
- . TABLE 6: Maize mill delivery equation (consumer demand)
- . TABLE 7: Supply and demand utilization estimates for maize
- . TABLE 8: Total domestic consumption
- . TABLE 9: Government costs

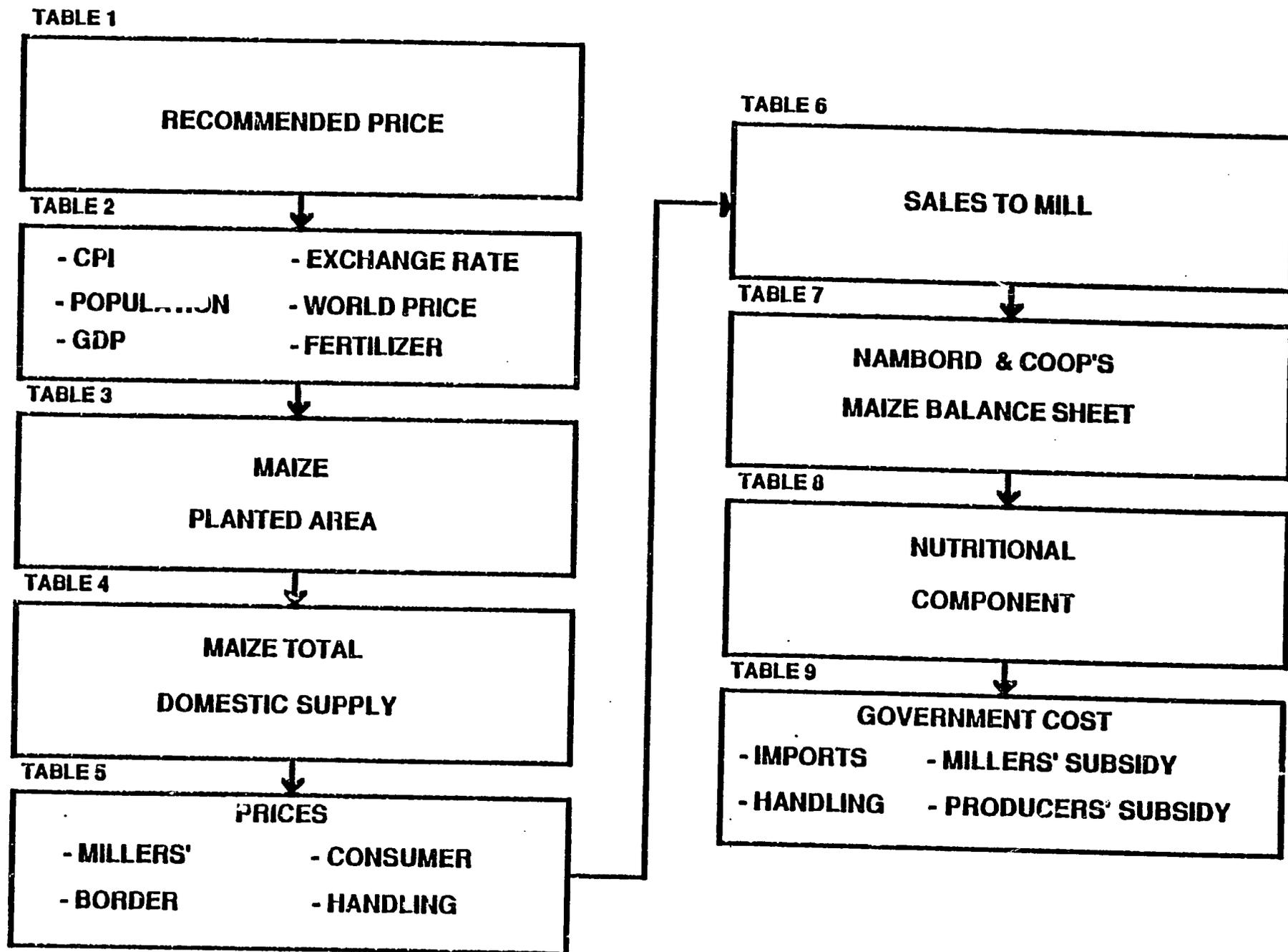


FIGURE 1

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Table 1: Cost Of Commercial Maize Production

Table 1 computes the total cost per bag at the commercial farm level for three yield levels. Using an average cost, a recommended price per bag is determined.

Externally Supplied Values

- . Three Yield Values
- . 1986/87 Value of Capital Used
 - . Cost/Unit
 - . Units/Hectare
- . 1986/87 Variable Costs
 - . Cost/Unit
 - . Units/Hectare
- . Seasonal Interest
 - . Interest Rate
 - . Number of Months
- . Allowed Depreciation

Internally Generated Values

- . The Cost/Unit of each subsequent year is inflated by 20%
$$\text{Cost/Unit}_T = (\text{Cost/Unit}_{T-1}) (1.2)$$
- . Units/Hectare are assumed constant throughout the period
- . Interest Rates, Number of Months and Allowed Depreciation are assumed constant through the period
- . Recommended Price/Bag
$$= [(\text{Total Price/Bag})_1 + (\text{Total Price/Bag})_2 + (\text{Total Price/Bag})_3] / 3$$

and Recommended Price per Bag											
YIELD, 90kg BAGS/HA		65.00	COST/UNIT UNITS/HA COST/HA			COST/UNIT UNITS/HA COST/HA			COST/UNIT UNITS/HA COST/HA		
ITEM:	UNITS	1986/87			1987/88			1988/89			
VALUE OF CAPITAL USED											
(a) VEHICLES	EACH	1166.00	1	1166.00	1399.20	1	1399.20	1679.04	1	1679.04	
(b) EQUIPMENT	EACH	214.00	1	214.00	256.80	1	256.80	308.16	1	308.16	
(c) BUILDINGS, ETC.	EACH	621.00	1	621.00	745.20	1	745.20	894.24	1	894.24	
(d) LAND CLEARING	EACH	1000.00	1	1000.00	1200.00	1	1200.00	1440.00	1	1440.00	
TOTAL REPLACEMENT COST				3001.00			3601.20			4321.44	
AVG. VALUE OF CAPITAL				1500.50			1800.60			2160.72	
****VARIABLE COSTS****											
SEED	KG.	2.26	25	56.50	2.71	25	67.80	3.25	25	81.26	
FERTILISER: D MIXTURE	KG.	0.68	300	204.00	0.82	300	244.80	0.98	300	293.76	
UREA	KG.	0.68	250	170.00	0.82	250	204.00	0.98	250	244.80	
LIME	KG.	0.30	250	75.00	0.36	250	90.00	0.43	250	108.00	
CHEMICALS: PRIMAERAM	LITRES	57.75	4	231.00	69.30	4	277.20	83.16	4	332.64	
THIODAN	LITRES	26.25	2	52.50	31.50	2	63.00	37.80	2	75.60	
LABOUR	DAYSEK/SAY	4.21	45	189.45	5.05	45	227.25	6.06	45	272.81	
FUEL, + 20% OIL & LUB.	L. @ K/L	2.74	130	291.20	2.69	130	349.44	3.23	130	419.33	
VEHICLE & TRACTOR R&M	EACH	222.09	1	222.09	266.51	1	266.51	319.81	1	319.81	
EQUIPMENT REP. MAINT	EACH	120.20	1	120.20	144.24	1	144.24	173.09	1	173.09	
REPAIRS TO BLDGS, RDS	EACH	44.93	1	44.93	53.92	1	53.92	64.70	1	64.70	
INSURANCE	EACH	101.43	1	101.43	121.72	1	121.72	146.06	1	146.06	
CROP TRANSPORT	/BAG YIELD	1.58	65	102.70	1.90	65	122.75	2.28	65	147.89	
PACKING MATL (BAGS)	/BAG YIELD	1.00	65	65.00	1.20	65	78.00	1.44	65	93.60	
OTHER EXPENSES	EACH	28.22	1	28.22	33.86	1	33.86	40.64	1	40.64	
SUB-TOTAL				1954.22			2345.06			2814.08	
SEASONAL INTEREST	MONTHS @ %	25.0%	9	366.42	25.0%	9	439.70	25.0%	9	527.64	
VARIABLE COSTS: Total				2320.64			2784.76			3341.72	
****FIXED COSTS****											
DEPRECIATION											
VEHICLES		1166.00	25.0%	291.50	1399.20	25.0%	349.80	1679.04	25.0%	419.76	
EQUIPMENT		214.00	20.0%	42.80	256.80	20.0%	51.36	308.16	20.0%	61.63	
BUILDINGS, ETC.		621.00	5.0%	31.05	745.20	5.0%	37.26	894.24	5.0%	44.71	
LAND CLEARING		1000.00	2.5%	25.00	1200.00	2.5%	30.00	1440.00	2.5%	36.00	
RETURN ON AVG. CAPITAL				390.35			468.42			562.10	
MANAGEMENT ALLOWANCE		1500.50	25.0%	375.13	1800.60	25.0%	450.15	2160.72	25.0%	540.18	
		3086.11	5.0%	154.31	3703.33	5.0%	185.17	4444.00	5.0%	222.20	
TOTAL FIXED COSTS				919.78			1103.74			1324.18	
TOTAL COST OF PRODUCTION				3240.42			3888.50			4666.20	
COSTS/BAG, BY YIELDS											
		Var'ble/bag	Fixed/bag	Total/bag	Var'ble/bag	Fixed/bag	Total/bag	Var'ble/bag	Fixed/bag	Total/bag	
Bags/ha =	55.00	41.72	16.72	58.45	50.26	20.07	70.33	61.12	24.08	85.20	
Bags/ha =	60.00	38.46	15.33	53.79	45.83	18.40	64.23	55.65	22.07	77.72	
Bags/ha =	65.00	35.70	14.15	49.85	42.12	16.99	59.10	51.07	20.38	71.45	
RECOMMENDED PRICE/BAG (Kw/bag)				54.03			64.55			78.12	
Percent increase (X)							19.18%			21.02%	

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Table 2: General Data

Table 2 brings together various data which will be widely used in subsequent tables.

Externally Supplied Values

- . Consumer Price Index, 1982-85
- . Producer Price, 1982-85
- . Fertilizer Price, 1982-88
- . Urban and Rural Population, 1982-90
- . Gross Domestic Product, 1982-87
- . U.S. Corn Price, 1982-90
- . Exchange Rate, 1982-90

Internally Generated Values

- . Consumer Price Index (1986-90): $CPI_T = CPI_{T-1} \times 1.25$
- . Producer Price (1986-90): Table 1
- . Gross Domestic Product (1988-90): $GDP_T = GDP_{T-1} \times 1.2$
- . Per Capita Gross Domestic Product = $GDP \times 1,000,000 / \text{Total Population}$
- . Real Per Capita GDP = Per Capita GDP / CPI

TABLE 2: GENERAL DATA	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
CPI - All Items	258.5	308.6	363.8	479.2	599.0	748.8	935.9	1169.9	1462.4
Producer Price (Kw/bq)	16.00	18.30	24.56	28.32	54.03	64.55	78.12	94.77	115.22
Fert.Price(Kw/bg Urea)	10.95	14.95	24.10	26.75	26.75	48.00	58.00	63.80	70.18
Total Population	6,060,822	6,262,756	6,472,763	6,691,209	6,918,473	7,154,954	7,154,954	7,154,954	7,154,954
Urban	2,690,562	2,825,090	2,966,345	3,114,662	3,270,395	3,433,915	3,433,915	3,433,915	3,433,915
Rural	3,370,260	3,437,666	3,506,419	3,576,547	3,648,078	3,721,040	3,721,040	3,721,040	3,721,040
Gross Domestic Product	3,595	4,181	4,733	5,908	7,377	9,212	11,054	13,265	15,918
PerCap GDP	593.2	667.6	731.3	883.0	1066.2	1287.5	1545.0	1854.0	2224.7
Real Per Cap GDP	2.29	2.16	2.01	1.84	1.78	1.72	1.65	1.58	1.52
U.S. Corn Price					\$2.05	\$1.85	\$1.95	\$2.05	\$2.20
Exchange Rate (K/\$)	0.928	1.251	1.794	3.894	7.150	7.250	7.250	7.250	7.250

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Table 3: Estimate Of Area Planted To Maize

Table 3 uses Producer Price, Fertilizer Price, and the Consumer Price Index to estimate the area planted to maize.

Externally Supplied Values

- . Price and Fertilizer Price Elasticities
- . Trend
- . Calibration
- . 1982 Estimated Area
- . 1981 CPI (C99)

Internally Generated Values

- . Real Price Change Effect

$$= \text{Area}_{T-1} \times \text{Price Elasticity} \times \frac{\text{Producer Price}_{T-1}/\text{CPI}_{T-1} - 1}{\text{Producer Price}_{T-2}/\text{CPI}_{T-2}} + \frac{\text{Producer Price}_T/\text{CPI}_T - 1}{\text{Producer Price}_{T-1}/\text{CPI}_{T-1}}$$

- . Fertilizer Price Change Effect

$$= \text{Area}_{T-1} \times \text{Fertilizer Price Elasticity} \times \frac{\text{Fertilizer Price}_T/\text{CPI}_T - 1}{\text{Fertilizer Price}_{T-1}/\text{CPI}_{T-1}}$$

- . Estimated Area_T

$$= \text{Area}_{T-1} + \text{Price Change Effect}_T + \text{Fertilizer Price Change Effect}_T + \text{Trend} + \text{Calibration}$$

Table 3: Estimate of Area Planted to Maize

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Price Elasticity:									
Fert. Price Elasticity									
Real Price Change Effect ('000 Ha)		1.26	7.61	0.99	34.88	41.34	-6.65	-5.53	-5.37
Fert Price Change Effect ('000 Ha)		-13.1	-39.8	15.8	23.0	-49.8	3.9	14.4	15.1
Trend ('000 Ha)		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Calibration ('000 Ha)		78.5	-28.0	38.0	-82.0	0.0	0.0	0.0	0.0
Estimated Area ('000 Ha)	454.5	541.2	501.0	575.8	571.7	583.3	600.5	629.4	659.1

Table 4: Total Domestic Supply

Table 4 uses Estimated Area, the Consumer Price Index and Producer Price to estimate Production, Marketed Production, and Beginning and Ending Stocks.

Externally Supplied Values

- . Beginning Stocks, 1982-85
- . Production, 1982-85
- . Marketed Production, 1982-85

Internally Generated Values

- . Area: Table 3
- . Yield
 - 1982-85: $\text{Yield} = \text{Production} / \text{Area}$
 - 1986-90: $\text{Yield}_T = \text{Yield}_{T-1} + 0.2$
- . Beginning Stocks
 - 1987-90: $\text{Beginning Stocks}_T = \text{Ending Stocks}_{T-1}$
- . Percent Marketed
 - 1982-85: $\text{Percent Marketed} = \text{Marketed Production} / \text{Production}$
 - 1986-90: $\text{Percent Marketed} = (\text{Producer Price} / \text{CPI} - 0.07) \times 3 + 0.63$
- . Marketed Production (1986-90) = Production x Percent Marketed
- . Retention = Production - Marketed Production
- . Total Domestic Supply = Beginning Stocks + Production
- . Ending Stocks
 - 1982-85: $\text{Ending Stocks}_T = \text{Beginning Stocks}_{T+1}$
 - 1986-90: $\text{Ending Stocks} = \text{Max} [(\text{Marketed Production} \times 0.35), 2750]$

TABLE 4: TOTAL DOMESTIC SUPPLY

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Area ('000 Ha)	454.5	541.2	501.0	575.8	571.7	583.3	600.5	629.4	659.1
Yield (bags)	18.3	19.2	19.3	21.7	21.0	21.2	21.4	21.6	21.8
Beginning Stocks ('000 bags)	1,321	1,652	1,635	1,953	1,454	2,902	2,937	3,015	3,155
Production ('000 bags)	8,336	10,392	9,686	12,471	12,006	12,365	12,851	13,595	14,369
% Marketed	68%	57%	65%	57%	69%	68%	67%	66%	66%
Marketed Production	5,706	5,902	6,268	7,070	8,291	8,392	8,615	9,013	9,431
Retention	2,630	4,490	3,418	5,401	3,715	3,974	4,235	4,581	4,938
Total Domestic Supply ('000 bags)	9,657	12,044	11,321	14,424	13,460	15,267	15,788	16,610	17,523
Ending Stocks ('000 bags)	1,652	1,635	1,953	1,454	2,902	2,937	3,015	3,155	3,301

Table 5: Price Data

Table 5 uses Producer Price, Marketed Production, U.S. Corn Price, and the Exchange Rate to compute the Millers Price and Import Price.

Externally Supplied Values

- . Millers' Price, 1982-85
- . Millers' Subsidy, 1986-90
- . Border Price, 1982-85
- . Consumer Price, 1982-86
- . NAMBOARD Charge, 1982-90
- . Union Charge, 1982-90

Internally Generated Values

- . Producer Price: Table 2
- . Producer Payments = Producer Price x Marketed Production
- . Millers' Price (1986-90) = Producer Price - Millers' Subsidy
- . Total Millers' Subsidy = Millers' Subsidy x Marketed Production
- . Border Price = (U.S. Corn Price x Exchange Rate x 4.5891) + 1.4211
- . Consumer Price = (Miller Price x 50 / 90 / 0.96) + 3.5
- . Total Handling = NAMBOARD Total + Union Total
- . NAMBOARD Total = NAMBOARD Charge x Marketed Production / 2
- . Union Total = Union Charge x Marketed Production / 2

TABLE 5: PRICE DATA	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Producer Price (Kw/bag)	16.00	18.30	24.50	28.32	54.03	64.55	78.12	94.77	115.22
Producer Payments ('000 Kw)	91289.25	108003.38	153557.11	200212.12	447990.62	541712.04	673064.12	854173.47	1086642.15
Millers Price (Kw/bg)	17.00	22.48	26.00	28.32	34.03	54.55	73.12	94.77	115.22
Millers Subsidy (Kw/bg)	0.00	0.00	0.00	0.00	20.00	10.00	5.00	0.00	0.00
Total Millers Subsidy ('000 Kw)	0	0	0	0	165,828	83,916	43,076	0	0
Border Price Alternate Formula	16.73	17.09	23.24	35.34	44.74	41.06	43.20	45.34	48.56
Border Price (Kw/bg)	16.73	17.09	23.24	35.34	68.82	63.09	66.43	69.76	74.76
Consumer Price (50kg Roll)	13.00	16.90	18.77	20.64	20.64	35.07	45.82	58.34	70.18
Handling ('000 Kw)	19,285	21,955	25,635	45,953	99,497	100,699	103,384	108,160	113,173
NAMBOARD Charge (Kw/bag)	3.38	3.72	4.09	4.50	16.00	16.00	16.00	16.00	16.00
Total (Kw)	19,285	21,955	25,635	31,813	66,331	67,133	68,922	72,107	75,448
Union Charge (Kw/bag)	---	---	---	4.00	8.00	8.00	8.00	8.00	8.00
Total (Kw)	---	---	---	14,139	33,166	33,566	34,461	36,053	37,724

02.

Table 6: Estimated Sales To Mills

Table 6 uses Consumer Price, CPI, and Real Per Capita Gross Domestic Product to estimate sales of maize to mills.

Externally Supplied Values

- . Price Elasticity
- . Income Elasticity
- . Supply Adjustment Factor
- . Baseline Per Capita Sales, 1982-90
- . Calibration, 1982-90
- . 1981 Consumer Price and CPI (B160)
- . 1981 Real Per Capita GDP (B161)

Internally Generated Values

- . Price Adjustment
= Baseline Sales x $(\text{Consumer Price}_T / \text{CPI}_T / \text{Consumer Price}_{T-1} / \text{CPI}_{T-1})$ x Price Elasticity
- . Income Adjustment
= Baseline Sales x $(\text{Real Per Capita GDP}_T / \text{Real Per Capita GDP}_{T-1}^{-1})$ x Income Elasticity
- . Supply Adjustment
= Supply Adjustment Factor x (Per Capita Production - Baseline Sales)
- . Per Capita Sales Estimate
= Baseline Sales + Adjustment Factors + Calibration
- . Total Mill Sales
= Per Capita Mill Sales x Population / 90,000

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Table 6: ESTIMATED SALES TO MILLS

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Price Elasticity:	-0.10								
Income Elasticity:	1.00								
Supply Adjustment Factor:	0.15								
Producer Price (Kw/bag)	16.00	18.30	24.50	28.32	54.03	64.55	78.12	94.77	115.22
Producer Payments ('000 Kw)	91289.25	108003.38	153557.11	200212.12	447990.62	541712.04	673064.12	854173.47	1086642.15
Millers Price (Kw/bg)	17.00	22.48	26.00	28.32	34.03	54.55	73.12	94.77	115.22
Millers Subsidy (Kw/bg)	0.00	0.00	0.00	0.00	20.00	10.00	5.00	0.00	0.00
Total Millers Subsidy ('000 Kw)	0	0	0	0	165,828	83,916	43,076	0	0
Border Price Alternate Formula	16.73	17.09	23.24	35.34	44.74	41.06	43.20	45.34	48.56
Border Price (Kw/bg)	16.73	17.09	23.24	35.34	68.82	63.09	66.43	69.76	74.76
Consumer Price (50kg Roll)	13.00	16.90	18.77	20.64	20.64	35.07	45.82	58.34	70.18
Handling ('000 Kw)	19,285	21,955	25,635	45,953	99,497	100,699	103,384	108,160	113,173
NAMBOARD Charge (Kw/bag)	3.38	3.72	4.09	4.50	16.00	16.00	16.00	16.00	16.00
Total (Kw)	19,285	21,955	25,635	31,813	66,331	67,133	68,922	72,107	75,448
Union Charge (Kw/bag)	---	---	---	4.00	8.00	8.00	8.00	8.00	8.00
Total (Kw)	---	---	---	14,139	33,166	33,566	34,461	36,053	37,724

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Table 7: NAMBOARD And COOP's Maize Balance Sheet

Table 7 uses Marketed Production and Sales to Mills to compute import levels.

Externally Supplied Values

- . Imports, 1982-86

Internally Generated Values

- . Opening Stocks: Table 4
- . Purchases: Marketed Production (Table 4)
- . Imports (1987-90)
= Deliveries to Mills + Ending Stocks - Purchases - Opening Stocks
- . Total Availability
= Imports + Purchases + Opening Stocks
- . Deliveries To Mills
1982-86: Deliveries To Mills = Total Availability - Ending Stocks
1987-90: Estimated Mill Sales (Table 6)
- . Ending Stocks: Table 4

Table 7: NAMBOARD and COOP's Maize Balance Sheet

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Producer Price (Kw/bag)	16.00	18.30	24.50	28.32	54.03	64.55	78.12	94.77	115.22
Producer Payments ('000 Kw)	91289.25	108003.38	153557.11	200212.12	447990.62	541712.04	673064.12	854173.47	1086642.15
Millers Price (Kw/bg)	17.00	22.48	25.00	28.32	34.03	54.55	73.12	94.77	115.22
Millers Subsidy (Kw/bg)	0.00	0.00	0.00	0.00	20.00	10.00	5.00	0.00	0.00
Total Millers Subsidy ('000 Kw)	0	0	0	0	165,828	83,916	43,076	0	0
Border Price Alternate Formula	16.73	17.09	23.24	35.34	44.74	41.06	43.20	45.34	48.56
Border Price (Kw/bg)	16.73	17.09	23.24	35.34	68.82	63.09	66.43	69.76	74.76
Consumer Price (50kg Roll)	13.00	16.90	18.77	20.64	20.64	35.07	45.82	58.34	70.18
Handling ('000 Kw)	19,285	21,955	25,635	45,953	99,497	100,699	103,384	108,160	113,173
NAMBOARD Charge (Kw/bag)	3.38	3.72	4.09	4.50	16.00	16.00	16.00	16.00	16.00
Total (Kw)	19,285	21,955	25,635	31,813	66,331	67,133	68,922	72,107	75,448
Union Charge (Kw/bag)	---	---	---	4.00	8.00	8.00	8.00	8.00	8.00
Total (Kw)	---	---	---	14,139	33,166	33,566	34,461	36,053	37,724

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Table 8: Nutritional Component

Table 8 uses price and domestic supply data to calculate total and per capita consumption and index of real per capita expenditure on meal.

Externally Supplied Values

- . None

Internally Generated Values

- . Consumption = Retained Stocks + Deliveries To Mills
- . Per Capita Consumption = Consumption x 90,000 / Total Population
- . Per Capita Mill Sales = Deliveries To Mills x 90,000 / Total Population
- . Index Of Real Per Capita Expenditure On Meal
= Consumer Price x Per Capita Mill Sales / CPI / 4.396

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Table B: Nutritional Component

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Consumption ('000 bags)	9,245	11,519	10,428	14,050	12,186	12,340	12,887	13,366	13,886
Per Capita Consumption (kg)	137.3	165.5	145.0	189.0	158.5	155.2	162.1	168.1	174.7
Per Capita Mill Sales (kg)	98.22	101.01	97.47	116.33	110.21	105.24	108.82	110.50	112.56
Index of Real Per Capita Expenditure on Meal	1.00	1.12	1.02	1.01	0.77	1.00	1.08	1.12	1.09

Table 9: Government Costs

Table 9 examines the costs incurred by the government in Consumer Subsidies and Handling Charges.

Externally Supplied Values

- . None

Internally Generated Values

- . $\text{Consumer Subsidy} = \text{Import Subsidy} + \text{Domestic Subsidy}$
- . $\text{Import Subsidy} = (\text{Border Price} - \text{Miller Price}) \times \text{Imports}$
- . $\text{Domestic Subsidy} = (\text{Producer Price} - \text{Millers Price}) \times (\text{Deliveries To Mills} - \text{Imports})$
- . Handling Charges: Table 5
- . $\text{Total Government Cost} = \text{Consumer Subsidy} + \text{Handling Charges}$

12.

Table 9: Government Costs

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Consumer Subsidy ('000 Kw)	-5709.38	-30723.05	-11850.25	7581.60	193516.67	83649.03	41919.03	2226.10	13620.77
Import Subsidy ('000 Kw)	-334.80	-5982.90	-2925.60	7581.60	56648.35	83.84	-765.94	2226.10	13620.77
Domestic Subsidy ('000 Kw)	-5374.58	-24740.15	-8924.65	0.00	136868.32	83565.19	42684.97	0.00	0.00
NAMBOARD & Union Handling Charges (Kw/bag)	19284.85	21954.79	25634.64	45952.64	99496.91	100698.93	103383.53	108160.34	113172.61
Total Government Cost	13575.48	-8768.26	13784.39	53534.24	293013.58	184347.96	145302.56	110386.44	126793.38

Table 10: 1989/90 Values for Varying Scenarios

The purpose of Table 10 is to show what would result by changing the original model parameters.

Scene 1: The Millers' Subsidy is maintained at 20 kw/bag from 1986/87 to 1990/91.

Scene 2: The Millers' Subsidy is maintained at 20 kw/bag and the Recommended Price is dropped by 20 kw/bag from 1986/87 to 1990/91.

Table 1A: Cost of Non-Commercial (Oxen Farm) Maize Production

Table 1A computes the Cost of Production for maize at the oxen farm or non-commercial level.

Externally Supplied Values

- . Yield
- . 1986-87: Value Of Capital Used
 - . Cost/Unit
 - . Units/Hectare
- . 1986/87 Variable Costs
 - . Cost/Unit
 - . Units/Hectare
- . Seasonal Interest
 - . Interest Rate
 - . Number of Months
- . 1986/87 Risk Allowance
- . Allowed Depreciation

Internally Generated Values

- . The Cost/Unit for subsequent years is inflated by 20%
$$\text{Cost}_T/\text{Unit} = \text{Cost}_{T-1}/\text{Unit} \times 1.2$$
- . Units/hectare are assumed constant throughout the period.
- . Interest rates, number of months, and allowed depreciation are assumed constant throughout the period.

Table 1A: Costs of Non-Commercial (Oxen Farm) Maize Production

YIELD, 90kg BAGS/HA	35.00	COST/UNIT	UNITS/HA	COST/HA	COST/UNIT	UNITS/HA	COST/HA	COST/UNIT	UNITS/HA	COST/HA
ITEM:	UNITS	1986/87	1986/87	1986/87	1987/88	1987/88	1987/88	1988/89	1988/89	1988/89
VALUE OF CAPITAL USED										
FIXED IMPROVEMENTS /HA.		375.00	1	375.00	450.00	1	450.00	540.00	1	540.00
AVERAGE VALUE OF CAPITAL				187.50			225.00			270.00
****VARIABLE COSTS****	K£.									
SEED	K£(10/BAG)	2.94	25	73.50	3.53	25	88.20	4.23	25	105.84
FERTILISER: D MIXTURE	K£.	0.96	200	192.00	1.15	200	230.40	1.38	200	276.48
AMM/NITR	K£.	0.96	200	192.00	1.15	200	230.40	1.38	200	276.48
CHEMICALS: DDT	K£	17.01	2	34.02	20.41	2	40.82	24.49	2	48.99
LABOUR	DAYS@K/DAY	4.21	90	378.90	5.05	90	454.68	6.06	90	545.62
OXEN COSTS: PLOUGH	/HA	45.00	1	45.00	54.00	1	54.00	64.80	1	64.80
HARROW	/HA	29.00	1	29.00	34.80	1	34.80	41.76	1	41.76
RIDGE	/HA	29.25	1	29.25	35.10	1	35.10	42.12	1	42.12
CULTIVATE	/HA	50.40	1	50.40	60.48	1	60.48	72.58	1	72.58
CROP TRANSPORT	/BAG YIELD	1.80	35	63.00	2.16	35	75.60	2.59	35	90.72
PACKING MATERIAL (BAGS)	/BAG YIELD	2.50	35	87.50	3.00	35	105.00	3.60	35	126.00
SUB-TOTAL				1174.57			1409.48			1691.38
SEASONAL INTEREST	MONTHS @ %	25.0%	12	293.64	25.0%	12	352.37	25.0%	12	422.85
TOTAL VARIABLE COSTS				1468.21			1761.86			2114.23
****FIXED COSTS****		Base Cost	% Allowed	Total	Base Cost	% Allowed	Total	Base Cost	% Allowed	Total
DEP'N: FIXED IMPROVEMENTS		375.00	5.0%	18.75	450.00	5.0%	22.50	540.00	5.0%	27.00
RETURN ON CAPITAL (K)		187.50	25.0%	46.88	225.00	25.0%	56.25	270.00	25.0%	67.50
RISK ALLOWANCE		1204.00	5.0%	60.20	1444.80	5.0%	72.24	1733.76	5.0%	86.69
MANAGEMENT ALLOWANCE		1575.29	5.0%	78.76	1890.35	5.0%	94.52	2268.41	5.0%	113.42
TOTAL FIXED COSTS				204.59			245.51			294.61
TOTAL COST OF PRODUCTION				1672.80			2007.36			2408.83
COST/BAG				47.79			57.35			68.82
PERCENT INCREASE							9.6%			11.5%

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Table 8A: Estimate Of Total Maize Consumption

Table 8A uses Consumer Price, CPI and Real Per Capita Gross Domestic Product to estimate total maize consumption.

Externally Supplied Values

- . Price Elasticity
- . Income Elasticity
- . 1982/83 Baseline Consumption
- . 1981/82 CPI and Consumer Price (M199)
- . 1981/82 Real Per Capita Gross Domestic Product (M200)
- . Calibration (1982-90)

Internally Generated Values

- . Baseline Consumption is assumed constant through the period
- . Price Adjustment_T
= Price Elasticity x (Consumer Price_T/CPI_T/Consumer Price_{T-1}/CPI_{T-1}-1) x Baseline Consumption
- . Income Adjustment_T
= Income Elasticity_T x $\frac{\text{Real Per Capita GDP}_T}{\text{Real Per Capita GDP}_{T-1}} - 1$ x Baseline Consumption
- . Supply Adjustment = Production x 90,000 / Total Population - Baseline Consumption
- . Per Capita consumption = Baseline Consumption + Adjustments
- . Total Consumption Estimate
= Per Capita Consumption x Population / 90,000 + Calibration

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Table BA: Estimate of Total Maize Consumption

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Price Elasticity	-0.3								
Income Elasticity	0.5								
Baseline Consumption (kg)	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0
Price Adjustment (kg)	-4.3	-3.6	2.3	6.7	8.1	-14.6	-1.8	-0.8	1.5
Income Adjustment (kg)	-4.1	-3.9	-4.8	-5.6	-2.3	-2.3	-2.7	-2.7	-2.7
Supply Adjustment (kg)	-11.2	14.3	-0.3	32.7	21.2	20.5	26.6	36.0	45.7
Per Capita Consumption (kg)	115.3	141.9	132.2	168.8	162.0	138.7	157.1	167.5	179.6
Calibration ('000 bags)	1200	1200	500	1299	1299	1909	1909	1909	1909
Total Consumption Estimate ('000 bags)	8,968	11,072	10,010	13,849	13,751	12,935	14,400	15,229	16,184

APPENDIX B

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SUMMARY OF REVISIONS

TABLE 1:

- . The error in calculating Fixed Costs/Bag has been corrected.
- . Recommended Price/Bag has been renamed Average Cost/Bag.
- . A new field called Imposed Price/Bag has been added.

TABLE 2:

- . Producer Price is set equal to the Imposed Price/Bag in Table 1.
- . Urban and Rural Populations are internally generated from 1987 to 1990.
- . Fertilizer price is broken down into two components, urea (40%) and compound (60%)

Table 3:

- . No changes.

Table 4:

- . Yield calculated as Production / Area until 1987.
- . Production values externally supplied until 1987.
- . Percent Marketed calculated as Marketed Production / Production until 1987.
- . Marketed Production externally supplied until 1987.

Table 5:

- . Millers' Price renamed Millers' Maize Price.
- . Millers' Subsidy renamed Namboard Price Subsidy.

- . Consumer Price renamed Millers' Input Cost.
- . New Consumer Price which allows for a profit margin is introduced.

Table 6:

- . No changes.

Table 7:

- . No changes.

Table 8:

- . No changes.

Table 9:

- . The fields Consumer Subsidy, Import Subsidy and Domestic Subsidy have been removed.
- . Net Import Costs, Direct Import Costs, Import Revenues, Namboard Price Subsidy, Fertilizer Subsidy and Storage Costs have been introduced.
- . Total Government Cost has been redefined.

SEQUENCE

- . TABLE 1: Cost of production estimates for commercial and small farms to determine recommended price supports
- . TABLE 2: Predetermined information -- inputs, population, exchange rate, etc.
- . TABLE 3: Estimated planted area
- . TABLE 4: Total domestic maize supply
- . TABLE 5: Zambia internal market prices and handling costs
- . TABLE 6: Maize mill delivery equation (consumer demand)
- . TABLE 7: Supply and demand utilization estimates for maize
- . TABLE 8: Total domestic consumption
- . TABLE 9: Government costs

FLOW CHART

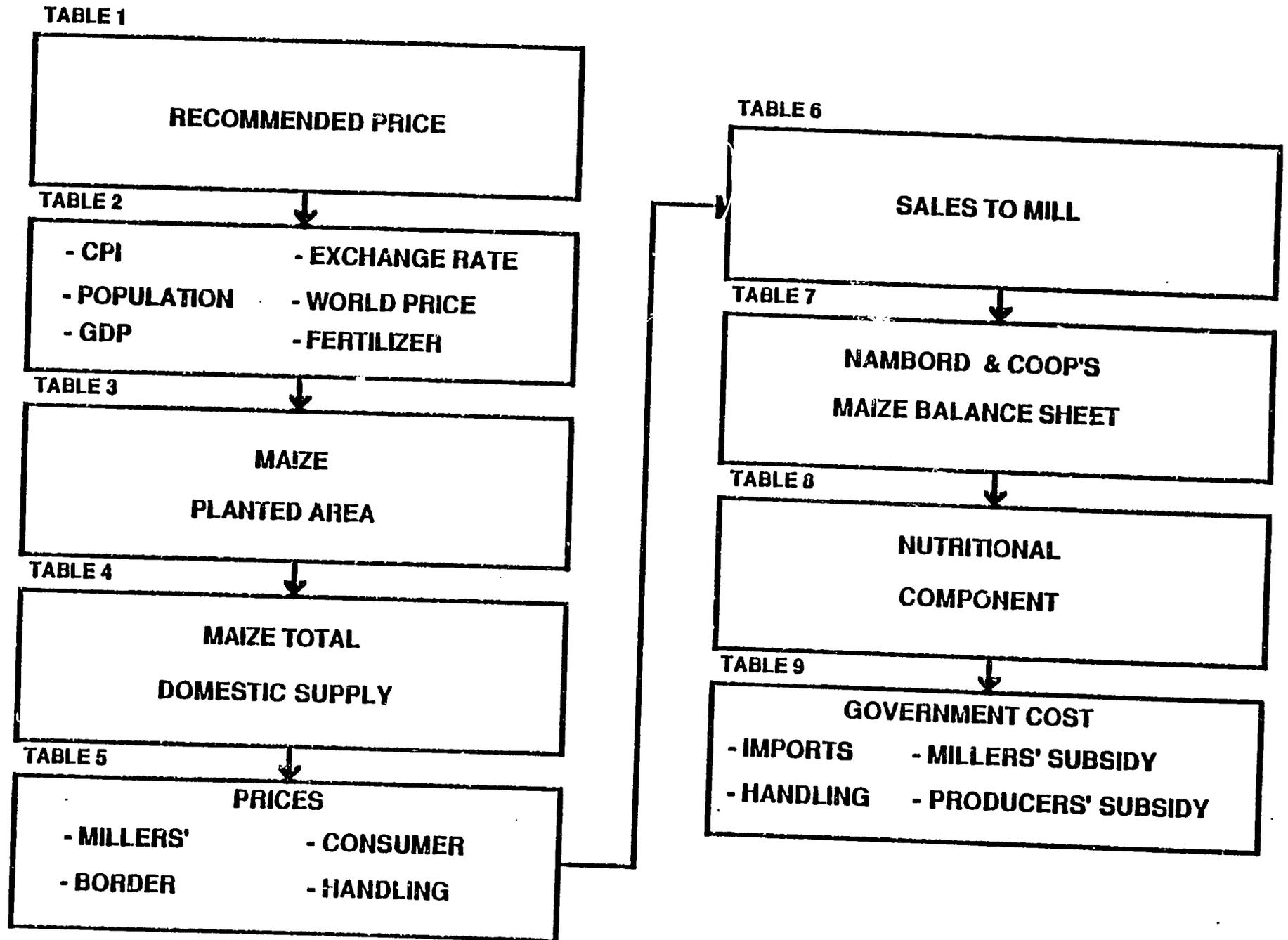


FIGURE 1

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Table 1: Cost Of Commercial Maize Production

Table 1 computes the total cost per bag at the commercial farm level for three yield levels. Using an average cost, a recommended price per bag is determined.

Externally Supplied Values

- . Three Yield Values
- . 1986/87 Value of Capital Used
 - . Cost/Unit
 - . Units/Hectare
- . 1986/87 Variable Costs
 - . Cost/Unit
 - . Units/Hectare
- . Seasonal Interest
 - . Interest Rate
 - . Number of Months
- . Allowed Depreciation
- . Imposed Price/Bag (86/87 - 91/92)

Internally Generated Values

- . The Cost/Unit of each subsequent year is inflated by 20%
$$\text{Cost/Unit}_T = (\text{Cost/Unit}_{T-1}) (1.2)$$
- . Units/Hectare are assumed constant throughout the period
- . Interest Rates, Number of Months and Allowed Depreciation are assumed constant through the period
- . Average Cost/Bag = $[(\text{Total Price/Bag})_1 + (\text{Total Price/Bag})_2 + (\text{Total Price/Bag})_3] / 3$

Table 1: Costs of Commercial Maize Production
and Recommended Price per Bag

YIELD, 90kg BAGS/HA		65.00	COST/UNIT UNITS/HA COST/HA			COST/UNIT UNITS/HA COST/HA			COST/UNIT UNITS/HA COST/HA		
ITEM:	UNITS		1986/87			1987/88			1988/89		
VALUE OF CAPITAL USED											
(a) VEHICLES	EACH	1166.00	1	1166.00	1399.20	1	1399.20	1679.04	1	1679.04	
(b) EQUIPMENT	EACH	214.00	1	214.00	256.80	1	256.80	308.16	1	308.16	
(c) BUILDINGS, ETC.	EACH	621.00	1	621.00	745.20	1	745.20	894.24	1	894.24	
(d) LAND CLEARING	EACH	1000.00	1	1000.00	1200.00	1	1200.00	1440.00	1	1440.00	
TOTAL REPLACEMENT COST				3001.00			3601.20			4321.44	
AVG. VALUE OF CAPITAL				1500.50			1800.60			2160.72	
**** VARIABLE COSTS ****											
SEED	KG.	2.25	25	56.50	2.71	25	67.80	3.25	25	81.36	
FERTILISER: D MIXTURE	KG.	0.68	300	204.00	0.82	300	244.80	0.98	300	293.76	
* UREA	KG.	0.68	250	170.00	0.82	250	204.00	0.98	250	244.80	
* LIME	KG.	0.30	250	75.00	0.36	250	90.00	0.43	250	108.00	
CHEMICALS: PRIMAGRAM	LITRES	57.75	4	231.00	69.30	4	277.20	93.16	4	332.64	
* THIODAN	LITRES	26.25	2	52.50	31.50	2	63.00	37.80	2	75.60	
LABOUR	DAYSEK/DAY	4.21	45	189.45	5.05	45	227.25	6.06	45	272.85	
FUEL, + 20% OIL & LUB.	L. @ K/L	2.24	130	291.20	2.69	130	349.44	3.23	130	419.33	
VEHICLE & TRACTOR R&M	EACH	222.09	1	222.09	266.51	1	266.51	319.81	1	319.81	
EQUIPMENT REP. & MAINT.	EACH	120.20	1	120.20	144.24	1	144.24	173.09	1	173.09	
REPAIRS TO BLDGS, RDS	EACH	44.93	1	44.93	53.92	1	53.92	64.70	1	64.70	
INSURANCE	EACH	101.43	1	101.43	121.72	1	121.72	146.06	1	146.06	
CROP TRANSPORT	/BAG YIELD	1.58	65	102.70	1.90	65	123.24	2.28	65	147.89	
PACKING MATL (BAGS)	/BAG YIELD	1.00	65	65.00	1.20	65	78.00	1.44	65	93.60	
OTHER EXPENSES	EACH	28.22	1	28.22	33.86	1	33.86	40.64	1	40.64	
SUB-TOTAL				1954.22			2345.06			2814.08	
SEASONAL INTEREST	MONTHS @ %	25.0%	9	366.42	25.0%	9	439.70	25.0%	9	527.64	
TOTAL VARIABLE COSTS				2320.64			2784.76			3341.72	
**** FIXED COSTS ****											
DEPRECIATION			Base Cost	% Allowed	COST/HA	Base Cost	% Allowed	COST/HA	Base Cost	% Allowed	COST/HA
VEHICLES			1166.00	25.0%	291.50	1399.20	25.0%	349.80	1679.04	25.0%	419.76
EQUIPMENT			214.00	20.0%	42.80	256.80	20.0%	51.36	308.16	20.0%	61.63
BUILDINGS, ETC.			621.00	5.0%	31.05	745.20	5.0%	37.26	894.24	5.0%	44.71
LAND CLEARING			1000.00	2.5%	25.00	1200.00	2.5%	30.00	1440.00	2.5%	36.00
					390.35			468.42			562.10
RETURN ON AVG. CAPITAL			1500.50	25.0%	375.13	1800.60	25.0%	450.15	2160.72	25.0%	540.18
MANAGEMENT ALLOWANCE			3086.11	5.0%	154.31	3703.33	5.0%	185.17	4444.00	5.0%	222.20
TOTAL FIXED COSTS				919.78			1103.74			1324.48	
TOTAL COST OF PRODUCTION				3240.42			3888.50			4666.20	
COSTS/BAG, BY YIELDS											
Bags/ha =	55.00	41.72	16.72	58.45	50.26	20.07	70.33	61.12	24.09	85.20	
Bags/ha =	60.00	38.46	15.33	53.79	45.83	18.40	64.23	55.55	22.07	77.72	
Bags/ha =	65.00	35.70	14.15	49.85	42.12	16.98	59.10	51.07	20.38	71.45	
AVERAGE COST/BAG (K/bag)				54.03			64.55			78.12	
IMPOSED PRICE/BAG (K)				55.00			78.00			70.00	

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Table 2: General Data

Table 2 brings together various data which will be widely used in subsequent tables.

Externally Supplied Values

- . Consumer Price Index, 1982-85
- . Producer Price, 1982-85
- . Fertilizer Price, 1982-88
- . Urban and Rural Population, 1982-86
- . Gross Domestic Product, 1982-86
- . U.S. Corn Price, 1982-90
- . Exchange Rate, 1982-90

Internally Generated Values

- . Consumer Price Index (1986-90): $CPI_T = CPI_{T-1} \times 1.25$
- . Producer Price (1986-90) = Imposed Price/Bag (Table 1)
- . Fertilizer Price (1989-90): $FP_T = FP_{T-1} \times 1.2$
 - . Urea Price (1982-90) = Fertilizer Price $\times 0.4$
 - . Compound Price (1982-90) = Fertilizer Price $\times 0.6$
- . Total Population (1982-90) = Urban Population + Total Population
 - . Urban Population (1987-90): $UP_T = UP_{T-1} \times 1.037$
 - . Rural Population (1987-90): $RP_T = RP_{T-1} \times 1.037$
- . Gross Domestic Product (1988-90): $GDP_T = GDP_{T-1} \times 1.2$
- . Per Capita Gross Domestic Product = $GDP \times 1,000,000 / \text{Total Population}$
- . Real Per Capita GDP = Per Capita GDP / CPI

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TABLE 2: GENERAL DATA	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Consumer Price Index	258.5	308.6	363.8	479.2	599.0	748.8	935.9	1169.9	1462.4
Producer Price (K/bag)	16.00	18.30	24.50	28.32	55.00	78.00	100.00	120.00	144.00
Fertilizer Price (K/unit)	10.95	14.95	24.10	26.75	26.75	72.50	87.00	104.40	125.28
Urea Price (K/unit)	4.38	5.98	9.64	10.70	10.70	29.00	34.80	41.76	50.11
Compound Price (K/unit)	6.57	8.97	14.46	16.05	16.05	43.50	52.20	62.64	75.17
Total Population	6,060,822	6,262,756	6,472,763	6,691,209	6,918,473	7,174,457	7,439,911	7,715,188	8,000,650
Urban	2,690,562	2,825,090	2,966,345	3,114,662	3,270,395	3,391,399	3,516,881	3,647,006	3,781,945
Rural	3,370,260	3,437,666	3,506,419	3,576,547	3,648,078	3,783,057	3,923,030	4,068,182	4,218,705
Gross Domestic Product	3,595	4,181	4,733	5,908	7,377	9,212	11,054	13,265	15,918
PerCap GDP	593.2	667.6	731.3	883.0	1066.2	1284.0	1485.8	1719.3	1789.6
Real Per Cap GDP	2.29	2.16	2.01	1.84	1.78	1.71	1.59	1.47	1.36
U.S. Corn Price					\$1.65	\$1.66	\$1.69	\$1.97	\$1.71
Exchange Rate (K/\$)	0.928	1.251	1.794	3.894	12.000	15.000	17.500	20.000	20.000

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Table 3: Estimate Of Area Planted To Maize

Table 3 uses Producer Price, Fertilizer Price, and the Consumer Price Index to estimate the area planted to maize.

Externally Supplied Values

- . Price and Fertilizer Price Elasticities
- . Trend, 1983-90
- . Calibration, 1983-90
- . 1982 Estimated Area
- . 1981 CPI (B99)

Internally Generated Values

- . Price Change Effect

$$\text{Area}_{T-1} \times \text{Price Elasticity} \times \frac{\text{Producer Price}_{T-1}/\text{CPI}_{T-1}^{-1}}{\text{Producer Price}_{T-2}/\text{CPI}_{T-2}} + \frac{\text{Producer Price}_T/\text{CPI}_T^{-1}}{\text{Producer Price}_{T-1}/\text{CPI}_{T-1}^{-1}}$$

- . Fertilizer Price Change Effect

$$= \text{Area}_{T-1} \times \text{Fertilizer Price Elasticity} \times \frac{\text{Fertilizer Price}_T/\text{CPI}_T^{-1}}{\text{Fertilizer Price}_{T-1}/\text{CPI}_{T-1}^{-1}} - 1$$

- . Estimated Area_T

$$= \text{Area}_{T-1} + \text{Price Change Effect}_T + \text{Fertilizer Price Change Effect}_T + \text{Trend} + \text{Calibration}$$

Table 3: Estimate of Area Planted to Maize

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Price Elasticity:	0.3								
Fert. Price Elasticity	-0.2								
Real Price Change Effect ('000 Ha)		1.26	7.61	19.99	37.25	59.26	12.48	-1.20	-6.95
Fert Price Change Effect ('000 Ha)		-13.1	-39.8	15.8	23.0	-134.1	4.2	4.4	4.6
Trend ('000 Ha)		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Calibration ('000 Ha)		78.5	-28.0	38.0	-82.0	0.0	0.0	0.0	0.0
Estimated Area ('000 Ha)	454.5	541.2	501.0	575.8	574.1	519.2	555.8	579.1	596.8

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Table 4: Total Domestic Supply

Table 4 uses Estimated Area, the Consumer Price Index and Producer Price to estimate Production, Marketed Production, and Beginning and Ending Stocks.

Externally Supplied Values

- . Beginning Stocks, 1982-86
- . Production, 1982-87
- . Marketed Production, 1982-87

Internally Generated Values

- . Area = Estimated Area (Table 3)
- . Yield
 - 1982-87: $\text{Yield} = \text{Production} / \text{Area}$
 - 1988-90: $\text{Yield}_T = \text{Yield}_{T-1} + 0.2$
- . Beginning Stocks (1987-90): $\text{Beginning Stocks}_T = \text{Ending Stocks}_{T-1}$
- . Production (1988-90) = Area X Yield
- . Percent Marketed
 - 1982-87: $\text{Percent Marketed} = \text{Marketed Production} / \text{Production}$
 - 1988-90: $\text{Percent Marketed} = (\text{Producer Price} / \text{CPI} - 0.07) \times 3 + 0.63$
- . Marketed Production (1988-90) = Production x Percent Marketed
- . Retention (1982-90) = Production - Marketed Production
- . Total Domestic Supply (1982-90) = Beginning Stocks + Production
- . Ending Stocks
 - 1982-85: $\text{Ending Stocks}_T = \text{Beginning Stocks}_{T+1}$
 - 1986-90: $\text{Ending Stocks} = \text{Max} [(\text{Marketed Production} \times 0.35), 2750]$

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TABLE 4: TOTAL DOMESTIC SUPPLY

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Area ('000 Ha)	454.5	541.2	501.0	575.8	574.1	519.2	555.8	579.1	596.8
Yield (bags)	18.3	19.2	19.3	21.7	21.0	15.0	15.2	15.4	15.6
Beginning Stocks ('000 bags)	1,321	1,652	1,635	1,953	1,454	3,586	2,750	2,750	2,750
Production ('000 bags)	8,336	10,392	9,686	12,471	12,056	7,788	8,449	8,918	9,309
% Marketed	68%	57%	65%	57%	85%	85%	74%	73%	72%
Marketed Production	5,706	5,902	6,268	7,070	10,247	6,620	6,256	6,490	6,660
Retention	2,630	4,490	3,418	5,401	1,809	1,168	2,192	2,428	2,649
Total Domestic Supply ('000 bags)	9,657	12,044	11,321	14,424	13,510	11,374	11,199	11,668	12,059
Ending Stocks ('000 bags)	1,652	1,635	1,953	1,454	3,586	2,750	2,750	2,750	2,750

Table 5: Price Data

Table 5 uses Producer Price, Marketed Production, U.S. Corn Price, and the Exchange Rate to compute the Millers Price and Import Price.

Externally Supplied Values

- . Millers' Price, 1982-85
- . Millers' Subsidy, 1986-90
- . Border Price, 1982-85
- . Consumer Price, 1982-86
- . Namboard Charge, 1982-90
- . Union Charge, 1982-90

Internally Generated Values

- . Producer Price = Producer Price (Table 2)
- . Producer Payments = Producer Price x Marketed Production
- . Millers' Maize Price (1986-90) = Producer Price - Namboard Price Subsidy
- . Namboard Price Subsidy (1982-85) = Max[(Producer Price - Millers' Maize Price), 0]
- . Total Millers' Subsidy = Namboard Price Subsidy x Marketed Production
- . Border Price (1986-90) = (U.S. Corn Price x Exchange Rate x 4.5891) + 1.4211
- . Millers' Input Cost = (Millers' Maize Price x 50 / 90 / 0.96) + 3.5
- . Consumer Price (1987-90) = Millers' Input Cost + 4
- . Total Handling = Namboard Total + Union Total
- . Namboard Total = Namboard Charge x Marketed Production / 2
- . Union Total = Union Charge x Marketed Production / 2

TABLE 5: PRICE DATA	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Producer Price (K/bag)	16.00	18.30	24.50	28.32	55.00	78.00	100.00	120.00	144.00
Producer Payments ('000 K)	91289	108003	153557	200212	563585	516360	625647	778752	959045
Millers' Maize Price (K/bg)	17.00	22.48	26.00	28.32	35.00	38.00	85.00	120.00	144.00
Namboard Price Subsidy (K/bg)	0.00	0.00	0.00	0.00	20.00	40.00	15.00	0.00	0.00
Total Namboard Price Subsidy (0	0	0	0	0	204,940	264,800	93,847	0	0
Border Price (K/bg)	16.73	17.09	23.24	35.34	92.46	115.91	137.41	182.59	158.68
Millers' Input Cost (50kg Roll)	13.00	16.90	18.77	20.64	20.64	25.49	52.69	72.94	86.83
Consumer Price (50kg Roll)	10.00	14.50	18.75	24.00	28.77	28.77	56.69	76.94	90.83
Handling ('000 K)	19,285	21,955	25,635	45,953	122,964	211,840	200,207	207,667	213,121
Namboard Charge (K/bag)	3.38	3.72	4.09	4.50	16.00	50.00	50.00	50.00	50.00
Namboard Total (K)	19,285	21,955	25,635	31,813	81,976	165,500	156,412	162,240	166,501
Union Charge (K/bag)				4.00	8.00	14.00	14.00	14.00	14.00
Union Total (K)				14,139	40,988	46,340	43,795	45,427	46,620

Table 6: Estimated Sales To Mills

Table 6 uses Consumer Price, CPI, and Real Per Capita Gross Domestic Product to estimate sales of maize to mills.

Externally Supplied Values

- . Price Elasticity
- . Income Elasticity
- . Supply Adjustment Factor
- . Baseline Per Capita Sales, 1982-90
- . Calibration, 1982-90
- . 1981 Consumer Price and CPI (B160)
- . 1981 Real Per Capita GDP (B161)

Internally Generated Values

- . Price Adjustment
= Baseline Sales x $(\text{Consumer Price}_T / \text{CPI}_T / \text{Consumer Price}_{T-1} / \text{CPI}_{T-1})$ x Price Elasticity
- . Income Adjustment
= Baseline Sales x $(\text{Real Per Capita GDP}_T / \text{Real Per Capita GDP}_{T-1} - 1)$ x Income Elasticity
- . Supply Adjustment
= Supply Adjustment Factor x (Per Capita Production - Baseline Sales)
- . Per Capita Sales Estimate
= Baseline Sales + Adjustment Factors + Calibration
- . Total Mill Sales
= Per Capita Mill Sales x Population / 90,000

dp

Table 6: ESTIMATED SALES TO MILLS

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Price Elasticity:	-0.10								
Income Elasticity:	1.00								
Supply Adjustment Factor:	0.15								
Baseline PerCap Sales to Mills (Kg)	105.0	105.0	105.0	105.0	105.0	105.0	105.0	105.0	105.0
Price Adjustment (kg)	4.7	-6.8	-3.1	0.9	1.3	6.3	-18.2	-2.7	1.8
Income Adjustment (kg)	-6.4	-6.0	-7.4	-8.7	-3.6	-3.8	-7.8	-7.8	-7.8
Supply Adjustment (kg)	2.8	6.7	4.5	9.4	7.8	-1.1	-0.4	-0.1	0.0
Calibration (kg)	0.0	0.0	0.0	0.0	-1.0	3.0	0.0	0.0	0.0
PerCap Sales Estimate (kg)	106.1	98.9	99.0	106.6	109.5	109.4	78.6	94.4	98.9
Total Mill Sales Estimate ('000 90 kg bags)	7,146	6,881	7,117	7,922	8,417	8,718	6,500	8,088	8,793

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Table 7: NAMBOARD And COOP's Maize Balance Sheet

Table 7 uses Marketed Production and Sales to Mills to compute import levels.

Externally Supplied Values

- . Imports, 1982-85

Internally Generated Values

- . Opening Stocks = Opening Stocks (Table 4)
- . Purchases: Marketed Production (Table 4)
- . Imports (1986-90)
= Deliveries to Mills + Ending Stocks - Purchases - Opening Stocks
- . Total Availability = Imports + Purchases + Opening Stocks
- . Deliveries To Mills
1982-86: Deliveries To Mills = Total Availability - Ending Stocks
1987-90: Estimated Mill Sales (Table 6)
- . Ending Stocks = Ending Stocks (Table 4)

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Table 7: NAMBOARD and COOP's Maize Balance Sheet

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
NAMBOARD & COOP Opening Stocks ('000 bags)	1,321	1,652	1,635	1,953	1,454	3,586	2,750	2,750	2,750
NAMBOARD & COOP Purchases ('000 bags)	5,706	5,902	6,268	7,070	10,247	6,620	6,256	6,490	6,660
Imports ('000 bags)	1,240	1,110	1,060	1,080	303	1,261	243	1,599	2,133
Total Availability ('000 bags)	8,267	8,664	8,963	10,103	12,004	11,468	9,250	10,838	11,543
Deliveries to Mills/Losses ('000 bags)	6,615	7,029	7,010	8,649	8,417	8,718	6,500	8,088	8,793
Ending Stocks ('000 bags)	1,652	1,635	1,953	1,454	3,586	2,750	2,750	2,750	2,750

Table 8: Nutritional Component

Table 8 uses price and domestic supply data to calculate total and per capita consumption and index of real per capita expenditure on meal.

Externally Supplied Values

- . None

Internally Generated Values

- . Consumption = Retained Stocks + Deliveries To Mills
- . Per Capita Consumption = Consumption x 90,000 / Total Population
- . Per Capita Mill Sales = Deliveries To Mills x 90,000 / Total Population
- . Index Of Real Per Capita Expenditure On Meal
= Consumer Price x Per Capita Mill Sales / CPI / 4.396

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Table B: Nutritional Component

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Consumption ('000 bags)	9,245	11,519	10,428	14,050	10,226	9,886	8,692	10,517	11,442
Per Capita Consumption (kg)	137.3	165.5	145.0	189.0	133.0	124.0	105.1	122.7	128.7
Per Capita Mill Sales (kg)	98.22	101.01	97.47	116.33	109.50	109.36	78.63	94.35	98.91
Index of Real Per Capita Expenditure on Meal	1.00	1.12	1.02	1.01	0.76	0.75	0.90	1.19	1.19

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Table 9: Government Costs

Table 9 examines the costs incurred by the government in Consumer Subsidies and Handling Charges.

Externally Supplied Values

- . None

Internally Generated Values

- . Net Import Costs = Direct Import Costs - Import Revenues
- . Direct Import Costs = Border Price X Imports
- . Import Revenues
= Max [(Deliveries to Mills - Namboard Purchases) X Millers' Maize Price, 0]
- . Namboard Price Subsidy
= (Producer Price - Millers' Maize Price) X Namboard Purchases
- . Handling Charges: Handling Charges (Table 5)
- . Fertilizer Subsidy: This section has been left blank. The general formula is
Fertilizer Subsidy = Area Planted * Units of Fertilizer/Ha * Subsidy per Unit.
Area Planted is in Table 3. Units of Fertilizer/Ha are in Table 1. The subsidy per Unit must be inserted in this formula or added in a separate category.
- . Storage Costs: This section has been left blank. The general formula is
Storage Costs = (Opening Stocks + Ending Stocks) / 2 X Storage Fee.
Opening and Ending Stock values are in Table 7. The Storage Fee must be inserted in this formula or added in a separate category.
- . Total Government Cost
= Net Import Costs + Namboard Price Subsidy + Handling Charges
+ Fertilizer Subsidy + Storage Costs

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Table 9: Government Costs	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Net Import Costs ('000 K)	5292.20	-6362.16	5339.05	-6550.08	27983.56	66480.87	12756.63	100065.76	31303.58
Direct Import Costs ('000 K)	20745.20	18969.90	24634.40	38167.20	27983.56	146192.11	33445.73	291927.27	338449.90
Import Revenues ('000 K)	15453.00	25332.06	19295.35	44717.28	0.00	79711.24	20689.10	191861.51	307146.32
Namboard Price Subsidy ('000 K)	-5705.58	-24669.62	-9401.46	0.00	204940.00	264800.00	93847.10	0.00	0.00
Handling Charges ('000 K)	19284.85	21954.79	25634.64	45952.64	122964.00	211840.00	200207.16	207667.07	213121.22
Fertilizer Subsidy ('000 K)	-----	-----	-----	-----	-----	-----	-----	-----	-----
Storage Cost	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Government Cost	18871.48	-9077.00	21572.23	39402.56	355887.56	543120.87	306810.89	307732.82	244424.80

Table 8A: Estimate Of Total Maize Consumption

Table 8A uses Consumer Price, CPI and Real Per Capita Gross Domestic Product to estimate total maize consumption.

Externally Supplied Values

- . Price Elasticity
- . Income Elasticity
- . 1982/83 Baseline Consumption
- . 1981/82 CPI and Consumer Price (M199)
- . 1981/82 Real Per Capita Gross Domestic Product (M200)
- . Calibration (1982-90)

Internally Generated Values

- . Baseline Consumption is assumed constant through the period
- . Price Adjustment_T
= Price Elasticity x (Consumer Price_T/CPI_T/Consumer Price_{T-1}/CPI_{T-1}-1) x Baseline Consumption
- . Income Adjustment_T
= Income Elasticity_T x $\frac{\text{Real Per Capita GDP}_T}{\text{Real Per Capita GDP}_{T-1}} - 1$ x Baseline Consumption
- . Supply Adjustment = Production x 90,000 / Total Population - Baseline Consumption
- . Per Capita consumption = Baseline Consumption + Adjustments
- . Total Consumption Estimate
= Per Capita Consumption x Population / 90,000 + Calibration

Table 8A: Estimate of Total Maize Consumption

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Price Elasticity	-0.3								
Income Elasticity	0.5								
Baseline Consumption (kg)	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0
Price Adjustment (kg)	6.0	-8.7	-3.9	1.1	1.7	8.1	-23.3	-3.5	2.3
Income Adjustment (kg)	-4.1	-3.9	-4.8	-5.6	-2.3	-2.5	-5.0	-5.0	-5.0
Supply Adjustment (kg)	-11.2	14.3	-0.3	32.7	21.8	-37.3	-32.8	-31.0	-30.3
Per Capita Consumption (kg)	125.7	136.8	126.0	163.3	156.2	103.3	73.8	95.5	102.0
Calibration ('000 bags)	1200	1200	500	1299	1299	1909	1909	1909	1909
Total Consumption Estimate ('000 bags)	9,664	10,718	9,560	13,437	13,306	10,146	8,014	10,099	10,973

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Table 1A: Cost of Non-Commercial (Oxen Farm) Maize Production

Table 1A computes the Cost of Production for maize at the oxen farm or non-commercial level.

Externally Supplied Values

- . Yield
- . 1986-87; Value Of Capital Used
 - . Cost/Unit
 - . Units/Hectare
- . 1986/87 Variable Costs
 - . Cost/Unit
 - . Units/Hectare
- . Seasonal Interest
 - . Interest Rate
 - . Number of Months
- . 1986/87 Risk Allowance
- . Allowed Depreciation

Internally Generated Values

- . The Cost/Unit for subsequent years is inflated by 20%
$$\text{Cost}_T/\text{Unit} = \text{Cost}_{T-1}/\text{Unit} \times 1.2$$
- . Units/hectare are assumed constant throughout the period.
- . Interest rates, number of months, and allowed depreciation are assumed constant throughout the period.

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Table 1A: Costs of Non-Commercial (Oxen Farm) Maize Production

YIELD, 90kg BAGS/HA		35.00	COST/UNIT UNITS/HA COST/HA			COST/UNIT UNITS/HA COST/HA			COST/UNIT UNITS/HA COST/HA		
ITEM:	UNITS	1986/87	1986/87	1986/87	1987/88	1987/88	1987/88	1988/89	1988/89	1988/89	
VALUE OF CAPITAL USED											
FIXED IMPROVEMENTS	/HA.	375.00	1	375.00	450.00	1	450.00	540.00	1	540.00	
AVERAGE VALUE OF CAPITAL				187.50			225.00			270.00	
****VARIABLE COSTS****											
SEED	KG(10/BAG)	2.94	25	73.50	3.53	25	88.20	4.23	25	105.84	
FERTILISER: D MIXTURE	KG.	0.96	200	192.00	1.15	200	230.40	1.38	200	276.48	
AMM/NITR	KG.	0.96	200	192.00	1.15	200	230.40	1.38	200	276.48	
CHEMICALS: DDT	KG	17.01	2	34.02	20.41	2	40.82	24.49	2	48.99	
LABOUR	DAYSEK/DAY	4.21	90	378.90	5.05	90	454.60	6.06	90	545.62	
OXEN COSTS: PLOUGH	/HA	45.00	1	45.00	54.00	1	54.00	64.80	1	64.80	
HARROW	/HA	29.00	1	29.00	34.80	1	34.80	41.76	1	41.76	
RIDGE	/HA	29.25	1	29.25	35.10	1	35.10	42.12	1	42.12	
CULTIVATE	/HA	50.40	1	50.40	60.48	1	60.48	72.58	1	72.58	
CROP TRANSPORT	/BAG YIELD	1.80	35	63.00	2.16	35	75.60	2.59	35	90.72	
PACKING MATERIAL (BAGS)	/BAG YIELD	2.50	35	87.50	3.00	35	105.00	3.60	35	126.00	
SUB-TOTAL				1174.57			1409.48			1691.38	
SEASONAL INTEREST	MONTHS @ %	25.0%	12	293.64	25.0%	12	352.37	25.0%	12	422.85	
TOTAL VARIABLE COSTS				1468.21			1761.86			2114.23	
****FIXED COSTS****											
		Base Cost	% Allowed	Total	Base Cost	% Allowed	Total	Base Cost	% Allowed	Total	
DEP'N: FIXED IMPROVEMENTS		375.00	5.0%	18.75	450.00	5.0%	22.50	540.00	5.0%	27.00	
RETURN ON CAPITAL (K)		187.50	25.0%	46.88	225.00	25.0%	56.25	270.00	25.0%	67.50	
RISK ALLOWANCE		1204.00	5.0%	60.20	1444.80	5.0%	72.24	1733.76	5.0%	86.69	
MANAGEMENT ALLOWANCE		1575.29	5.0%	78.76	1890.35	5.0%	94.52	2268.41	5.0%	113.42	
TOTAL FIXED COSTS				204.59			245.51			294.61	
TOTAL COST OF PRODUCTION				1672.80			2007.36			2408.83	
COST/BAG				47.79			57.35			68.82	
PERCENT INCREASE							9.6%			11.5%	

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