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Analysis of Agricultural and Food Price Policy in Haiti: An Adaptive Policy Simulation Model

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Abstract
In early 1986, the government of Haiti began a series of economic reforms in agriculture designed to reduce the degree of government price intervention, to increase efficiencies in the agricultural sector, and to reduce restrictions on the quantities of food imports. The critical extent of hunger and malnutrition in Haiti has underscored concerns by USAID and other donor organizations for the need to consider the impacts of agricultural policies and food aid on the agricultural sector, government finances, and food availability.

The 1987 economic reforms eliminated export taxes (on coffee), broke up government trading monoppolies, and removed most quantity restrictions on agricultural imports. Seven principal food commodities (rice, maize, millet, beans, sugar, chicken parts, and pork meat) remained subject to import licensing and new ad valorem tariffs of 50 percent. There were also concurrent changes in taxing and charges for wheat and wheat flour. Such pricing policy changes have significant impacts on production and consumption of food commodities and on important aggregates such as farm income, the purchasing power of consumers, and the degree of hunger as measured in calorie availability.

A policy model designed to operate on a microcumputer was developed to evaluate these impacts. The model utilizes basic supply and demand behavioral parameters and is designed so the analyst can easily alter these parameters and projection assumptions.

In an extension of the model, a coffee sector was added to evaluate impacts of export tax changes.

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The 1987 economic reforms eliminated export taxes (on coffee), broke up government trading monopolies, and removed most quantity restrictions on agricultural imports. Seven principal food commodities (rice, maize, millet, beans, sugar, chicken parts, and pork meat) remained subject to import licensing and new ad valorem tariffs of 50 percent. There were also concurrent changes in taxing and charges for wheat and wheat flour. Such pricing policy changes have significant impacts on production and consumption of food commodities and on important aggregates such as farm income, the purchasing power of consumers, and the degree of hunger as measured in calorie availability.

A policy model designed to operate on a microcomputer was developed to evaluate these impacts. The model utilizes basic supply and demand behavioral parameters and is designed so the analyst can easily alter these parameters and projection assumptions.

A baseline, established using specific assumptions on population growth, inflation, projected world cereal prices, and parameters related to supply and demand for rice, corn, millet, and wheat provided a way to evaluate the effects of alternative agricultural policy changes. The baseline consumption parameters were derived from the 1986-87 Haiti Household Expenditure and Consumption Survey.

Two policy alternatives that demonstrate the operation of the policy simulation model were chosen: a selective reduction for the tariff on corn (Alt 1), and a more general reduction on rice, corn, and wheat tariffs from 50 to 10 percent (Alt 2). Reducing tariffs on the cereal grains increased overall cereal consumption after the first year, and reduced the level of farm income. Because of strong negative effects on rural incomes, calories available for consumption fell during the year in which the tariffs were reduced. Urban consumers became better off, although changing consumption patterns led to changes in the relative amounts of calories and proteins. The differential effects suggest the importance of limited and targeted food assistance to alleviate initial adjustment costs. There was little change among the cereals consumed when all tariffs were reduced at one time. With only corn tariffs reduced, there were changes in grain consumption. Although corn producers' (and rural) income fell, total calories consumed from cereals increased over the baseline as corn was substituted for other grains. In contrast, with general tariff reductions, falling rural incomes reduced calorie intake, especially in rural areas.

In an extension of the model, a coffee sector was added to evaluate impacts of export tax changes.

PREFACE

This report is part of a series of CARD reports analyzing food consumption and agricultural price policy for Haiti, conducted in cooperation with the Nutrition Economics Group of OICD/USDA during the period 1986-89, with S.R. Johnson as principal investigator. In addition to the authors, Quentin Grafton participated in the early stages of research.

The study of Haiti's food consumption patterns and agricultural price policies was made possible through the cooperation of several organizations and people who helped to plan, organize, and implement the study. They include Director Louis Smith and other staff of the Institut Haitien de Statistique et d'Informatique; Mr. James Walker, Chief of the Office of Economic Analysis; Giovanni Caprio of USAID/Port-au-Prince; Marjorie Dauphin, resident advisor in Haiti for the Bureau for the Census; and Shirley Pryor, Nutrition Economics Group of OICD/USDA. Also, Stephanie Seguino of USAID/Port-au-Prince provided helpful comments on earlier versions of this report.

AN ANALYSIS OF AGRICULTURAL AND FOOD PRICE POLICY IN HAITI: AN ADAPTIVE POLICY SIMULATION MODEL

Widespread hunger and continuing economic and political problems are key determinants of the development of agricultural and food policies in Haiti. In early 1986 Haiti began a series of economic reforms in agriculture, including those designed to reduce the degree of government price intervention, to increase efficiencies in the agricultural sector, to reduce restrictions on quantities of food imports, and to encourage export crops by eliminating export taxes. A series of economic, financial, and political crises in 1987 and 1988 restricted Haiti's ability to benefit from many of these reforms. Yet the critical extent of hunger and malnutrition in the country has underscored concerns by USAID and other donor organizations for the need to consider the impacts of agricultural policies and food aid on the agricultural sector, government finances and food availability (see, for example, Deaton and Siaway 1988).

Agricultural reforms, implemented in FY86-87, eliminated export taxes (phasing out those on coffee), broke up government trading monopolies, and removed all but seven of the quantity restrictions on agricultural imports. These seven (rice, maize, millet, beans, sugar, chicken parts, and pork meat) remained subject to import licensing, new ad valorem tariffs, but not to formal quantity restrictions. The intent was to improve resource allocation in agriculture by lowering food prices and improving efficiency.

Anticipated changes in product prices for Haiti's major cereals production as well as for wheat and flour imports are likely to have significant impacts on production and consumption of food commodities, and on levels of income and nutrition.

Haiti's retail prices for corn, rice, sorghum, and wheat products exceed the retail levels of the United States, its principal grain supplier. Rice, corn, and sorghum are produced in Haiti, but domestic production levels are insufficient to meet food demand, even at higher prices. Wheat is imported and provides a substantial portion of domestic cereal grains supply. Despite large wheat imports, Haiti appears to remain a food deficit country from a dietary viewpoint.

Cereal grains are staples for a vast majority of the poor, so high grain prices may cause decreases in real income and widespread malnutrition and hunger. As a result, food pricing policy, particularly cereal grains import policy, is an important component of Haiti's development strategy since food imports play a crucial role in meeting food demand. Since 1986, large quantities of contraband food appear to have been entering Haiti and some domestic food prices have been declining. Although the fall in prices may benefit consumers, producers are likely to receive lower prices. The government of Haiti (GOH) also may lose potential tax revenues and credibility as far as its ability to enforce the law is concerned. Such a problem further complicates food pricing policy in Haiti.

This study develops a generalizable framework to evaluate the effects of alternative cereal grain policies on domestic cereal grains prices, consumption, and production; dietary intake in urban and rural areas; government receipts; and the level of imports.

A generalized food grains model, which incorporates demand and supply parameters as well as world agricultural commodity prices, can be applied to evaluate price and import policy changes. This model is implemented in a spreadsheet program on a microcomputer, making it generally accessible and useful to the policy analyst.

This paper describes such a policy framework and applies it to evaluate the effects of changes in agricultural and food price policy. The second section describes Haiti's import licensing policy; the third section describes the model's conceptual framework. The remaining sections describe the

structural relationship of the model, the formation of prices in Haiti, the development of a baseline projection, an evaluation of the effects of alternative policies relative to the baseline, and changes to the model with the introduction of coffee.

Grain Import Policy

Historically, the government of Haiti has restricted imports of cereal grains in order to enhance the income of local producers and protect the development of self-sufficiency, especially for rice. Until March 1, 1987 a de facto quota system was in operation. To import grains (rice and corn) into Haiti, an agent had to first register with the Ministry of Commerce as an official seller. Then, if the agent wished to import grain, he made a formal and written application to the Ministry of Commerce. The stated policy was that if there was "need" for additional grain supplies the license would be granted. Once granted, the agent could import grain if he had sufficient foreign exchange.

The need to import was determined in consultation with the Ministry of Agriculture and the Ministry of Commerce. If a shortfall was likely to exist in the market due to insufficient local production, a specified amount of imported grain would be allowed to make up the difference. The only grain excluded from this system was wheat, which was imported exclusively for milling purposes by the government parastatal, the Minoterie d'Haiti. In addition, corn imported jointly by the government and the privately owned feed mill SONUAN did not require an import license. Although the stated policy was to import whenever the Ministry of Agriculture deemed there was a shortfall, margins between domestic grain prices and landed import prices have been high, allowing importers and distributors to use the margins to obtain preferential treatment in the import process.

On March 1, 1987, the government abandoned the requirements to obtain a license for importing grains. Today, the GOH controls grain imports through 50 percent tariffs imposed on major cereal grains. In addition, a 10 percent sales tax (TCA) is also levied on the total value of the import, including duties. Historically, high domestic cereal grain prices have led to relatively high domestic

food prices and distorted production practices of agricultural producers. Such conditions are likely to worsen the standard of living and overall nutritional status in the country. Furthermore, any changes in pricing policies are likely to have impacts on both consumers and producers.

Conceptual Framework for the Adaptive Policy Simulation

Quantitative evaluation of alternative agricultural price policies is a major concern for policymakers. This evaluation provides evidence of possible policy effects on different economic variables and indicators of interest, and assists in choosing among potential policies. The impacts can be measured as changes in production, consumption, exports, imports, government costs, income and its distribution, and availability of nutrients among different segments of the population. Traditional techniques used by policymakers, such as single market studies or general equilibrium models, frequently fail to evaluate the impacts of changing policy alternatives and exogenous assumptions over the broad range of economic variables and performance measures. Single market studies are limited in their ability to evaluate cross-commodity effects.

Recently, more attention has been focused on multimarket and multicommodity models. Multimarket models extend the more simplistic single market models to include distribution and some general equilibrium considerations but stop far short of a fully detailed general equilibrium analysis (Braverman, Hammer, and Ahn 1983). These models, by relating commodity and factor markets, more realistically trace the effects of a price policy change in the agricultural sector than do single market studies.

The essence of multimarket and multicommodity models is a set of consistent equations reflecting the institutional, political, technological, behavioral, and economic characteristics of producers and consumers, and market equilibrium conditions for both commodities and factors. The system can be solved for different values of variables that can be influenced directly by policy. The system of equations can be developed econometrically or noneconometrically.

It is relatively cumbersome to conduct experiments of price policy changes using either the full multimarket or the multicommodity econometric models. Adaptive policy simulation models (APSM) provide an alternative, flexible method by which multicommodity or multimarket interactions may be evaluated. These noneconometric versions developed on spreadsheet programs are used if there are data shortages that make econometric modeling not feasible, or when time and cost constraints prevent the development of an econometric modeling system. Their advantage relative to the econometric systems is convenience and flexibility. Sensitivity testing and impact analysis are facilitated by the ease with which structural parameters can be changed and computations can be completed (Meyers 1988). This report presents a simplified and operational version of an APSM for Haiti as a tool useful for testing the effects of alternative policy scenarios and changing behavioral and technological assumptions. The model is applied to Haiti's agricultural system.

In this study, the APSM model has three basic components that are illustrated in Figure 1. The first component includes the external assumptions defining policies, technology, state of the economy, and behavioral parameters for supply and demand. The model's second component projects supply and disposition for the selected food commodities. It includes a structure for determining supply, consumption, and trade. This component estimates the price influences on production and consumption by commodity and between the urban and rural population. The third component estimates various performance measures derived from the first two parts and may include the growth and distribution of production and consumption, availability of food components and nutrients, farm revenue, and government expenditures/receipts and imports.

The structure of the commodity modules in the second component is illustrated in Figure 2. It is assumed that prices are exogenous and are determined by the government (administered) or by international markets (with added tariff). Area harvested is influenced by economic factors or by government programs, such as those promoting irrigation. Yield is determined by commodity and

fertilizer prices, land quality or erosion, technological improvement over time, or government programs for irrigation and extension. Domestic consumption is determined by prices, income, and population. In many cases, government policies may strongly influence commodity prices. Seed use and waste are proxied based on historic, proportional relationships. Stock levels are assumed to be zero (USDA/ERS 1986).

Important linkages between policies and performance measures are summarized in Figure 3. The major policy to be evaluated is identified in the circle entitled "domestic price policy." Domestic commodity price policy directly influences production and consumption. Commodity prices also influence farm and rural income indirectly through production. Thus, a change in crop prices influences rural consumption in two ways. A higher price reduces consumption through the direct price effect but increases consumption through the income effect for the producer household. For households that are both producers and consumers, the dominating net consumption effect depends on the magnitudes of the income effect and the relative values of the price and income elasticities.

Cross-price effects are also included. Thus, a change in one price can influence the consumption and production levels for the other three commodities. The linkages and interactions among government policies, factors, and commodity markets form the basis for evaluating alternative agricultural pricing policies. Changes in price policy affect both macro and microeconomic performance measures.

Model Structure

The model's structural equations are classified into the supply side and the demand side. In addition, there is one equation that reflects market equilibrium conditions. These relationships are now described in greater detail. The model is applied to four cereal crops: corn, rice, and sorghum (millet), which are domestically produced, and wheat, which is imported only.

Commodity Supply and Demand

The core of the planning model is the commodity sector. The structure of the commodity supply and demand requires a set of own- and cross-price elasticities. The production and consumption relationships in the commodity sector are all based on constant elasticity functions, but the microcomputer program permits the elasticities to be changed across time, as desired.

Supply is determined by both physical (technological) relationships as well as economic factors. The normal area, yield, and irrigation growth affect supply, independently of prices. These shift variables are subject to government influence resulting from greater investment in area expansion, technology research, and irrigation. Area and yield are determined by own- and cross-commodity prices. And, in turn, output prices and fertilizer input prices affect the area and yield estimates themselves. These relationships are described here and the listing of variables is summarized at the end of this section.

Constant Price Area Projection. Equation 1 estimates the area cultivated under each crop in Haiti ($QAC_{i,t}$), where i = 1, 2, 3 crops: corn, rice, and sorghum. The area under each crop is assumed to grow at a constant rate of AR_i, bringing more land under cultivation for crop i each year. Given the baseline value of area harvested of crop i in the previous period ($QAC_{i,t-1}$), the constant price area projection equation ($QAC_{i,t}$) holding prices constant, is:

$$QAC_{i,t} = QAC_{i,t-1} (1 + AR_i). \quad (1)$$

Area Harvested. The area harvested of crop i ($QA_{i,t}$) is determined by the area cultivated, the relative change in farmgate prices of the crop (FPR_i), changes in prices for competing crops (FPRj), and the supply price elasticities (n_{ij} where i,j = crops):

$$QA_{i,t} = QAC_{i,t} \prod_{j=1}^{4} (FPR_{j,t}/FPR_{j,t-1})^{n_{ij}}. \quad (2)$$

Farm households are likely to increase the area harvested of a crop whose price has increased since the last period, at a rate that depends upon the strength of the supply price elasticities (own and cross prices). Thus, the constant price area projection ($QAC_{i,t}$) from Equation (1) is adjusted by price effects to obtain the area harvested.

Constant Price Yield Projection. Like the constant price area projection, the constant price yield projection ($YLDC_{i,t}$) is assumed to grow over time at a growth rate ($YR_{i,t}$) independent of relative crop prices. Thus,

$$YLDC_{i,t} = YLDC_{i,t-1} (1 + YR_{i,t}) \quad (3)$$

where, $YLDC_{i,t-1}$ is the previous year's yield for crop i. Such independent growth could occur due to the use of improved variety seeds or pest control, for example.

Average Yield. To obtain average yield the constant price yield projection (3) is adjusted by effects of relative changes in the prices of the crops ($FPR_{i,t}/FPR_{i,t-1}$), and relative changes in the prices of agricultural inputs (such as irrigation and fertilizer):

$$YLD_{i,t} = YLDC_{i,t-1}(IR_{i,t}/IR_{i,t})^{a_i} (FPR_{i,t}/FPR_{i,t-1})^{b_i} (PF_t/PF_{t-1})^{c_i} \quad (4)$$

where $YLDC_{i,t}$ is the constant price yield of crop i; $IR_{i,t}$ is area under irrigated crop i; a_i is yield elasticity of crop i with respect to irrigation; b_i is yield elasticity of crop i with respect to crop i prices ($FPR_{i,t}$); and c_i is the yield elasticity of crop i with respect to real fertilizer price (PF_t). Thus the average yield of crop i depends on the change in output prices, the change in fertilizer prices, as well as the area irrigated. In this model for Haiti, only the inputs of irrigation and fertilizer influence crop yield, and further, only rice is assumed to be irrigated.[1]

Production. Domestic production of crop i ($QP_{i,t}$) is determined as the area harvested (Equation 2) multiplied by average yield (Equation 4):

$$QP_{i,t} = QAC_{i,t} \bullet YLD_{i,t} \tag{5}$$

Net Production. Net production from domestic sources ($DS_{i,t}$) is the total domestic production less a share set aside for seed and feed and losses due to waste, and to milling:

$$DS_{i,t} = QP_{i,t} (1 - SW_i - MR_i) \tag{6}$$

where SW_i is the percentage of crop i used as seed, feed, and waste; and MR_i is the percentage of crop i lost in milling.

Total Supply from Domestic Sources. Total supply of cereal grain i ($QSD_{i,t}$) is the domestic supply ($DS_{i,t}$) plus beginning stocks ($QBST_{i,t}$):

$$QSD_{i,t} = DS_{i,t} + QBST_{i,t} . \tag{7}$$

For Haiti, stocks were assumed to be zero (ERS 1986). Thus, total supply of crop i is simply equal to domestic supply.

Domestic Per Capita Consumption. Domestic per capita consumption in the urban and rural areas ($QDC^r_{i,t}$, r = 1 for urban, 2 for rural) is assumed to depend on consumption in the last period ($QDC^r_{i,t-1}$), the relative change in retail prices of cereal grains ($PR_{j,t}$ / $PR_{j,t-1}$), change in per capita income (I^r_t / I^r_{t-1}) and the strength of the demand price elasticities ($e^r_{i,j}$), and income elasticities, d^r_i. That is,

$$QDC^r_{i,t} = QDC^r_{i,t-1} (I^r_t/I^r_{t-1})^{d_i^r} \prod_{j=1}^{4} (PR_{j,t}/PR_{j,t-1})^{e^r_{i,j}} . \tag{8}$$

Thus, per capita consumption of each cereal grain (i,j = corn, rice, sorghum, and wheat) is influenced by the relative change in prices ($PR_{j,t}/PR_{j,t-1}$) of all the grains as well as per capita income. The per capita income defined for the two regions is different and explained below.

Food Consumption. Total cereal grain consumption ($QD_{i,t}$) is equal to

$$QD_{i,t} = \sum_{r}^{2} (POP_t^r \cdot QDC_{i,t}^r) \tag{9}$$

where POP_t^r is the population in region r and the cereals include wheat (i = 4).

Seed, Feed, and Waste. Total seed, feed, and waste is equal to

$$QSFW_{i,t} = SWR_{i,t} \cdot QP_{i,t} . \tag{10}$$

Net Imports. The market clearing conditions are expressed in terms of net imports.

$$QIMP_{i,t} = QD_{i,t} - QSD_{i,t} . \tag{11}$$

A summary of the variables is provided below.

Constant area projection

$$QAC_{i,t} = QAC_{i,t-1} (1 + AR_i) ;$$

Area harvested

$$QA_{i,t} = QAC_{i,t} \prod_{j=1}^{4} (FPR_{j,t}/FPR_{j,t-1})^{n_{ij}} ;$$

Constant price yield projection

$$YLDC_{i,t} = YLDC_{i,t-1} (1 + YR_{i,t}) ;$$

Average yield

$$YLD_{i,t} = YLDC_{i,t} (IR_{i,t}/IR_{i,t-1})^{a_i} (FPR_{i,t}/FPR_{i,t-1})^{b_i} (PF_t/PF_{t-1})^{c_i} ;$$

Production

$$QP_{i,t} = QAC_{i,t} \cdot YLD_{i,t} ;$$

Net production

$$DS_{i,t} = QP_{i,t} (1 - SW_i - MR_i) ;$$

Total supply from domestic sources

$$QSD_{i,t} = DS_{i,t} + QBST_{i,t} ;$$

Domestic per capita consumption

$$QDC^{r}_{i,t} = QDC^{r}_{i,t-1} \, (I^{r}_{t}/I^{r}_{t-1})^{d^{r}_{i}} \prod_{j=1}^{4} (PR_{j,t}/PR_{j,t-1})^{e^{r}_{ij}} ;$$

Food consumption

$$QD_{i,t} = \sum_{r}^{2} (POP^{r}_{t} \bullet QDC^{r}_{i,t}) ;$$

Seed, feed, and waste

$$QSFW_{i,t} = SWR_{i,t} \bullet QP_{i,t} ;$$

Net imports

$$QIMP_{i,t} = QD_{i,t} - QSD_{i,t} .$$

The variables are defined as:

$QAC_{i,t}$ and $QAC_{i,t-1}$	is the area harvested of crop i in period t and the previous period, t−1,
AR_{i}	is the area growth rate of crop i,
$QP_{i,t}$	is the domestic production of crop i in period t,
$FPR_{j,t}$, $FPR_{j,t-1}$	is the farmgate price of crop j in period t, and t−1,
n_{ij}	is the area elasticities with respect to relative farmgate price of crop and competing crops,
$YLDC_{i,t}$, $YLDC_{i,t-1}$	is the yield rate of crop i in current year (t) and previous year (t−1),
$YR_{i,t}$	is the constant yield growth rate of crop i in period t,
$YLD_{i,t}$	is the adjusted yield rate of crop i in period t,
$IR_{i,t}$, $IR_{i,t-1}$	is the area irrigated of crop i in current (t) and previous year (t−1),
a_{i}	is the supply elasticities of crop i with respect to irrigation,
b_{i}	is the yield elasticities of crop i with respect to its farmgate price,
PF_{t}, PF_{t-1}	is the real fertilizer price in current (t) and previous year (t−1),
$QP_{i,t}$	is the domestic production of crop i in period t,
$DS_{i,t}$	is the net domestic supply of crop i in period t,

SW_i is the percentage of domestic production in the form of seed, feed, and other wastes,

MR_i is the percentage of production lost in milling,

QSD_i is the total supply from domestic sources of cereal grain i,

$QBST_{i,t}$ is the beginning stocks,

$QDC^r_{i,t}$, $QDC^r_{i,t-1}$ is the per capita consumption of cereal grain i in the r^{th} region current (t) and previous period, (t−1),

$PR_{j,t}$, $PR_{j,t-1}$ is the retail price of cereal grain j in current (t) and previous period (t−1),

I^r_t, I^r_t is the current (t) and previous year's per capita incomes in region r,

$e^r_{i,j}$ is the own- and cross-price demand elasticities for cereal grain i with respect to price j in region r,

d^r_i is the expenditure elasticity of crop i in region r,

$QD_{i,t}$ is the total cereal grain consumption in period t,

POP^r_t is the population in period t in region r,

$QSFW_{i,t}$ is the seed, feed, and waste in period t,

$SWR_{i,t}$ is the certain percentage of seed, feed, and waste from net production in period t, and

$QIMP_{i,t}$ is the imports less exports for grain i at t.

Price Formation

This section describes the formation of the retail cereal grain prices in Haiti and the manner in which prices of traded cereal grains are linked to international commodity prices. CIF (cost, insurance, and freight) cereal grain prices plus various duties and taxes were used to establish the base prices. Then these were linked to historical data on Port-au-Prince retail prices to estimate marketing margins. Using standard margins, farmgate prices were established from the estimated retail prices.

Rice and Corn Price Formation Equations

The CIF prices for corn and rice (i = 1, 2 for corn and rice) were obtained from the FOB_i Gulf port prices (FOB_i) plus a shipping and insurance charge (SI_i):[2]

$$CIF_i = FOB_i + SI_i \qquad (i = \text{corn and rice}). \tag{12}$$

Prior to 1987 an import duty (ID_i) and a sales tax (ST_i) were imposed on the landed grain. The (unobserved) ex factory (or "portgate") price (PP_i) was defined as:

$$PP_i = (CIF_i + ID_i)(1 + ST_i) \tag{13}$$

where the import duty, ID_i, was applied on a per metric ton basis, and the sales tax ST_i, applied as a percentage of the value from the combined CIF or landed price and import duties paid, for cereal grain i.

In 1987, the import duty was abolished and replaced by a tariff (TF_i), imposed on the CIF value of the landed grain at a 50 percent rate. The ex factory price (PP_i) can then be redefined to include the tariff (TF_i) as well:

$$PP_i = \{(CIF_i +)(1 + TF_i)\}(1 + ST_i)\ . \tag{14}$$

Note that from 1984 to 1986, $TF_i = 0$, and from 1987 to 1990, $ID_i = 0$.

The ex factory prices were linked to the observed retail prices (RP_i) in Port-au-Prince by applying a markup (W_i) to the ex factory price:

$$RP_i = PP_i(1 + W_i). \tag{15}$$

The constant markup W_i was derived from the ratio between the Port-au-Prince retail price to the estimated ex factory price in 1984 (the year of available data), and was assumed to include the wholesale and intermediate markups (husking, polishing, and milling as applicable).[3]

Finally, a farmgate price (FGP_i) was established for each cereal grain:

$$FGP_i = RP_i/(1 + C_i) \tag{16}$$

where C_i was the price spread between retail and farmgate price.

Thus the retail price of rice and corn, when linked to Gulf port prices with the shipping and insurance charges, duties, and taxes and the various markups added, were defined as

$$RP_c = \{(CIF_c + ID_c)(1 + TF_c)\}(1 + ST_c)(1 + W_c) \tag{17}$$

for corn. A similar equation was also defined for rice:

$$RP_r = \{(CIF_r + ID_r)(1 + TF_r)(1 + ST_r)\}(1 + W_r)\,. \tag{18}$$

The retail prices refer to milled rice and corn.

Sorghum Price Formation

Evidence for the sorghum (millet) market is not readily available. Until 1987 Haiti did not import sorghum officially. Domestic prices were determined by domestic market conditions. The observed retail prices in Port-au-Prince, available directly for 1984, 1986, and 1987, were input for 1985 based on the percentage change observed in corn prices between 1984 and 1985. Beyond 1988 the retail price of sorghum changed with the retail price of corn.

Wheat Price Equation

Wheat price formation was somewhat different from that of rice and corn. Wheat has been entirely imported in Haiti for milling purposes by the government parastatal, the Minoterie d'Haiti, or imported directly as flour through the Minoterie. There is a different tax structure for wheat. The CIF value of wheat (CIF_w) is the FOB Gulf port price (FOB_w) plus the shipping and insurance charges (SI_w),

$$CIF_w = FOB_w + SI_w . \tag{19}$$

Although the Minoterie paid no tax on the imported wheat, several taxes were imposed on wheat processed by the Minoterie before it or wheat flour was sold at retail outlets. The Minoterie's flour price (MP_w) was calculated as the CIF_w plus a markup (DM) that includes the cost of processing wheat into flour, bagging the flour, and the Minoterie's profits:

$$MP_w = CIF_w(1 + DM) . \tag{20}$$

Until 1986, a special account tax (SAT_w), port administration tax (PAT_w), and a general administration tax (GAT_w) were imposed on wheat flour. The general administrative tax was assessed on a percentage basis, whereas the other two taxes were at fixed levels. Denoting retail markup as DR, the retail price of wheat flour can be defined as

$$RP_w = \{MP_w(1 + GAT_w) + PAT_w + SAT_w + ET\}(1 + DR) . \tag{21}$$

The ET appearing in Equation 21 is an excise tax that was assessed in 1986 but has now been abandoned (i.e., ET = 0 for all years 1984 to 1990, except 1986).

In 1987, with the introduction of new import policies, the excise duty (ET), the port administration tax (PAT_w), the general administration tax (GAT_w) and the special account tax (SAT_w) were all removed and replaced by a tariff (TF_w) on the CIF value of the landed grain. Also, a sales tax (TCA_w) was added. Thus, the retail price equation for wheat flour from 1987 to 1990 is defined as

$$RP_w = \{CIF_w(1 + TF_w)(1 + DM)\}(1 + TCA_w)(1 + DR) \tag{22}$$

where DR is the retail markup already defined and TCA is a sales tax imposed on wheat flour at an 11 percent rate.

As described above, the duties and taxes applied to imported rice and corn were of a similar nature although the rates vary. In the case of wheat a different tax structure prevailed. A summary of the duties and the various taxes imposed on imported grains is provided in Table 1.

Data Sources for Prices

The price data series used in this study were identified as follows. The crop year for the Gulf port price series refers to U.S. crop year, and varies for each crop. For rice, corn, and wheat the crop years were respectively August/July, October/September, and July/June. For sorghum the retail prices were for calendar years and obtained from Borsdorf, Foster, and Haque (1985) for 1984; and for 1986 and 1987 the retail prices were obtained from USAID/Haiti (Seguino 1987b). The rice, corn, and wheat Gulf port prices (actual and forecast) were obtained from FAPRI/CARD projections (February 1989).

For this study the 1983/84 crop year prices were used directly. For example, the 1983/84 crop year price was taken as the 1984 calendar year price.

The retail prices for all rice, milled corn, and whole sorghum are from Borsdorf and Foster (1985, Table 23). In establishing price ratios to convert ex factory to retail prices, the base year (1984) values were used for all grains as well as for wheat and wheat flour. The retail price of wheat flour and landed price were obtained from the World Bank (1985). The various taxes imposed on wheat flour before retail sales are also from the same source.

Calculating Corn, Rice, and Sorghum Prices

For this study, retail prices in urban areas were established from price levels (actual and projected) in Port-au-Prince.[4] Observed domestic retail prices in Port-au-Prince, reported in Table 2, were linked to Gulf port prices using the procedures described in the previous section and using the duties and taxes summarized in Table 1. Sorghum prices were determined by corn prices. Hence, the

domestic prices in Haiti fluctuate with the Gulf port (or world) prices.[5] Government policies influence domestic prices through the duties and taxes imposed on imported grains. The derivation of prices for corn and rice are detailed in Table 3, and based on Equations 12 through 15. Note that retail prices for each grain were linked to the ex factory prices by multiplying the ex factory price by the estimated "spread" $(1 + W_i)$.

Since data on farmgate prices were unavailable for Haiti, the price spread estimated in earlier studies was used to adjust for differences between retail and farmgate prices. Levitt and Laurent (1986) estimated the price spread to be about 55 percent for the three cereal grains (rice, corn, and sorghum) between the retail Port-au-Prince prices and farmgate prices. This level is higher than those estimated by Borsdorf, Foster, and Haque (1985), which ranged from 22 to 27 percent. Borsdorf, Foster, and Haque's estimates may have been low, however, when husking, polishing, and milling factors are taken into account. The constant percentage price transmission assumes that all changes in Port-au-Prince prices are immediately (within the year) passed to the farm level.

Calculating Wheat Prices

The wholesale price of flour was set equal to the Minoterie price plus all the taxes applied (Eq. 21). The Minoterie price includes all costs for milling, other processing, and profits (see Table 4). The relevant taxes were the special account tax (SAT), port tax (PAT) and the general administration tax (GAT). Starting in 1987, the SAT and PAT taxes were replaced by a tariff. The excise tax only appeared in 1986.

To obtain the retail price of flour, the wholesale price of flour was further multiplied by a markup equal to the historical ratio of the retail price of wheat flour to the wholesale price.

Alternatively, the retail price of wheat flour can be directly linked to the Minoterie price by multiplying it by the retail price to Minoterie price ratio.

Comparison Between Price Series

No uniform price series data are available for Haiti. The prices generated from these methods are worth comparing with prices observed in the most recently available periods (1986 and 1987) for Haiti. The tax structures for imported grains changed in 1987 and have been incorporated in the model. Changes in the import policy have necessitated some changes in the 1987 retail markup for rice only and have been noted in the appropriate places. In addition to these differences, the two price series could differ due to differences in the commodity considered as well as the market in which the prices were collected. Table 5 shows, however, that prices generated from the model and observed prices in Port-au-Prince compare favorably, except for 1987 rice prices.

Assumptions

Many of the parameters required for this study are not currently available. Some are derived from calculations based on the 1986/87 Haiti Household Expenditure and Consumption Survey (HECS), or from other recent studies in Haiti. Others are obtained from studies conducted for similar developing countries. This section describes the parameters as well as the baseline values of the variables presented earlier.

Baseline Parameters

Elasticities. The demand elasticities assumed for the four cereal grains are provided in Table 6 for urban and rural areas, and in Tables A.1 and A.2. The estimates were derived from the HECS data.[6]

Supply response elasticities include those for prices and yield. These crop response elasticities are based on studies for similar countries and patterns observed in descriptive studies of Haiti (e.g., Levitt and Laurent 1986), and are reported in Table A.3. The supply price/area elasticities are relatively small, and assume corn supply response to be larger than that for either rice or sorghum.

The yield elasticities with respect to crop and fertilizer prices show that increases (decreases) in the crop price are likely to increase (decrease) the yield of the crop. Increases in the fertilizer price are likely to decrease fertilizer use and hence crop yields are also expected to decline (Table A.3). Other assumptions about input use are that no fertilizer is used in sorghum production and that rice is the only crop irrigated (i.e., the only one having nonzero yield elasticities with respect to irrigation) as shown in Table A.3.

Agricultural Area and Yield Growth Rates. The Haitian agricultural sector has been characterized by stagnant or negative growth rates for some time (USAID/Haiti 1985). According to USAID/Haiti, the area currently under cultivation in Haiti already exceeds the feasible area, and even marginal lands have been brought under cultivation. Levitt and Laurent (1986) also point out that although cropped area has been increasing, yield rates may have declined because marginal lands have been cultivated.

For the baseline assumptions, more favorable conditions were assumed. Table A.4 summarizes the growth assumptions. Positive area growth rates of 1 percent for rice and .5 percent for corn were assumed, as areas formerly under sugarcane shift to rice and corn. Sorghum area growth rate was assumed to be zero.

A 1 percent growth rate was assumed for irrigated rice area. The irrigation facilities in Haiti are poor and potential exists to bring more area under irrigation (World Bank 1985). Fertilizer use in Haiti was assumed to grow annually at 0.1 percent, from a base level of kilograms per hectare in 1984.

Area and Yields at Constant Prices. During the 1984 base year the area under rice, corn, and sorghum was respectively 97, 219, and 174 thousand hectares (FAO Production Yearbook 1985), as shown in Table A.5. Irrigated rice was assumed to be 75 percent of the total rice area.[7] The base

year yield levels, measured in metric tons per hectare, were obtained from Levitt and Laurent (1986) and are provided in Table 7.

Conversion Factors. Production losses or waste levels of the cereal grains produced in Haiti are believed to be very high. The USAID/Haiti estimated that production losses, including seed and feed losses and losses due to pests, range from 20 to 50 percent. For the baseline, the production losses were set at 26 percent for rice and 30 percent for corn and sorghum. The milling factors (Tuck and Riordan 1985) were: rice, 70 percent; corn and sorghum, each 90 percent; and imported wheat, 75 percent for 1984 to 1986 and thereafter 77 percent.[8] These factors are reported in Table A.6.

Production Costs. Recent estimates of production costs for rice, corn, and sorghum are not available. The World Bank (1985) reports production cost estimates for rice and corn that vary significantly across different regions of the country depending upon the type of cultivation practices adopted (Table 8). These were used as the basis for the cost of production estimates. For example, the cost of production for rice under traditional farming was more than double the cost of production under irrigated farming. The cost estimates varied less for corn. In Table 11, estimates of the costs of production under different farming practices are reported for both rice and corn.

To obtain the cost of production for rice and corn on a per hectare basis, the cost estimates reported as dollars per metric ton with labor costs assumed at 80 percent of market wages (the second row for rice and corn, Table 8) were multiplied by the yield rates (Table 7). These are reported in Table A.6. The cost estimate for the Artibonite Valley was selected for rice since about two-thirds of Haiti's rice production takes place in this valley. For corn, the cost estimates for traditional farming in association with other crops was selected since much of Haiti's corn is cultivated this way. The selected cost estimates have been adjusted to 1984 costs using the cost growth rate assumption of 1 percent.

It should be pointed out that the rice production cost estimate that was used (Artibonite Valley with labor valued at 80 percent of market wage) is high compared with the estimated farmgate price of rice. The discrepancy would be even greater if costs from traditional farming were used. The high cost of production estimates, along with the relatively low farmgate price estimate, can cause rice income to become negative. More reliable and current cost of production estimates would help verify the current estimates.

No production cost estimates were available for sorghum. It is likely that sorghum production costs are lower than corn production costs, and the production cost estimate for sorghum was assumed to be about 75 percent of that of corn. Finally, the cost of production of each cereal grain was assumed to increase at 1 percent annually, due to increased use of purchased inputs.

Other Projection Assumptions

The required macro assumptions concern population levels, distribution of population, both urban and rural population growth rates, and growth rates of urban and rural per capita incomes. Other information required includes consumption per capita of each cereal grain, the calories per kilogram of cereal grains, and the percentage of each cereal grain consumed in urban compared to rural areas.

Population. Table A.9 provides population estimates for the rural and urban areas and for Haiti's overall population. Total population is assumed to grow at 1.9 percent annually (World Bank 1985). The distribution of Haiti's population is about 75 percent in rural areas and 25 percent in urban areas. The rural population growth is calculated as the weighted difference between total and urban population, with the urban areas growing faster than the rural. Rural population growth rate is lower than the national growth rate because of rural to urban migration. The World Bank (1985) estimates the urban population growth rate at about 2.4 percent.

Income. The growth rate for 1983/84 was set at 1.7 percent, based on estimates by Levitt and Laurent (1986) and reported in Table A.9. This rate declined, due to unfavorable weather conditions,

to -4.7 percent in 1984/85. Beyond 1985 urban income was assumed to continue at the 1.7 percent annual growth rate.

Rural income growth rate is determined by both farm income growth and also exogenous rural income growth, with the two components weighted equally. First, the gross farm income growth rate is determined from changes in the net farmgate value of corn, rice, and sorghum production, assuming no growth in farm income due to improved efficiency. The current level of productivity is so low that farmers appear to be unable to take advantage of any positive supply shock (World Bank 1988).

The exogenous rural income growth rate is based on urban income growth. It was assumed that some of urban growth carries over to the rural sector at a rate of 20 percent; that is, exogenous rural income growth occurs at a rate .20 times the urban income growth.

Overall rural income growth was derived from both sources of income change (farm income and exogenous rural income), and calculated using equal weights to obtain the overall rural income growth rate. Fluctuations in the rural income growth rate would be observed whenever production levels, prices of rice, corn, and sorghum, or urban income fluctuate.

Consumption. Haiti's population is about 75 percent rural and 25 percent urban. Grain consumption distribution was based on evidence from the 1986/87 HECS and is reported in Table A.9: 63 percent of rice was consumed in rural areas and the remaining 37 percent in urban areas; 74 percent of corn was consumed in rural areas and 26 percent in urban areas; and 66 percent of imported wheat was consumed in rural areas, the remaining in urban areas (based on estimated bread consumption). Finally, 89 percent of sorghum was consumed in rural areas. The per capita disappearance of each cereal grain in the base year was obtained by dividing the total supply of each grain in each region by the total population. These estimates were not far from annual estimates of per capita consumption based on the 1986/87 HECS.

Calories. For the four cereal grains consumed, calories per 100 grams (edible portion) were obtained from the food composition tables for Haiti (CARD 1988). The estimated calories per 100 grams were: 360 for milled rice, 363 for milled corn, 364 for wheat flour, and 332 for milled sorghum. These levels were used to calculate per capita annual calories from the food availability data.

Baseline Results

This section reports the model's baseline results between 1984 and 1990. The behavioral equations described earlier, along with the assumptions, were used to estimate production, consumption, and import levels of the various cereal grains in Haiti. As described above, information was observed directly or estimated for 1984; much after that was derived from calculated projection values, and actual world commodity prices through 1988. The baseline results are summarized in Tables 9 through 15 (and reported in Tables A.10 through A.13).

Between 1984 and 1990, the prices of the three crops cultivated in Haiti generally declined. However, the area under each crop remained generally constant despite declining crop prices. In part, this was due to the exogenous area growth rate assumptions (Table A.4). Also, because competing crop prices declined, cross-price effects held the area harvested of all the three crops relatively constant (Table 9).

The combined negative effects of a declining relative rice price and increasing fertilizer price were not sufficiently large to cause rice yields to decline (see Table 10); the positive factors (irrigation and exogenous growth) tended to increase rice yields marginally over the years. This was also true for corn yields, although the only factor likely to increase their yields was exogenous growth. In the case of sorghum, the negative price effects dominated, and yields fell.

In general, the 1985 per capita consumption levels for all the cereal grains were low, and rose throughout the remaining period (Table 11). In rural areas, per capita consumption of all cereal

grains declined in 1985. As cereal prices fell, rural incomes also declined by about 12 percent. The observed decline in rural per capita consumption resulted from strong income effects.

In 1986 per capita consumption of all cereal grains increased. Although prices in this period declined, rural per capita income increased with exogenous growth, thus stimulating consumption.

Rice and sorghum per capita consumption declined in 1987; per capita consumption of corn and wheat increased. The decline in rural incomes offset the effects of declines in all prices. Since corn prices fell by the greatest amount, consumers appeared to substitute corn and wheat for rice and sorghum.

In 1988, the per capita consumption of all grains increased noticeably, due to higher rural incomes offsetting the negative effect of higher prices (i.e., stronger income effect). Beyond 1988, the prices of wheat had increased; other grain prices remained relatively stable. Rural income, in part determined from these prices, also fluctuated less. The result was less consumption of wheat and almost the same consumption of corn, sorghum, and rice.

Note that consumption of rice in urban areas started a gradual recovery in 1986 (Table 11). This increase in urban per capita consumption was due to growth of urban per capita incomes (assumed to grow at 1.7 percent annually from 1986 to 1990).

But in rural areas, per capita incomes changed whenever farm income changed. Hence, the combined effects of relative price changes as well as income influenced per capita consumption in a different manner than for urban areas.

Table 12 summarizes the projected domestic supply of each cereal grain as well as consumption and estimated imports, based on the results generated by the model. In most cases consumption of cereal grains exceeded supply. This is true for rice, corn, and sorghum. Although the quantities of rice imported officially were very small, larger quantities may have entered the country as contraband or illegal imports. These quantities were not included directly in the model; the difference between

consumption and supply is (total) imports; differences between official imports and total imports may be due to unobserved contraband, or other errors in the data. No other restrictions on imports were built into the model. This allows some projected export of sorghum (millet) but this is highly unlikely. The case of wheat was different because all wheat is imported into Haiti. Wheat consumption increased until 1988 due to a fall in world wheat prices. Subsequent wheat price increases caused consumption to decline.[9]

Table 13 shows the farm income growth rate, generated from the model, the exogenous growth rate, and the derived rural income growth ratio. The farm income growth rates sometimes show large fluctuations because of the volatility of farmgate prices, which are linked to U.S. Gulf port prices.

The per capita calorie availability was estimated from per capita consumption of each cereal grain; the results are summarized in Table 14. The calories contributed by the cereal grains were higher in urban than in rural areas. Of course, the calorie levels depend on the assumptions made about cereal grain distribution in each region and any change in this distributional assumption would affect calorie availability. Over time, the per capita calorie availability in both urban and rural regions was projected to have increased relative to 1984.

Wheat imports contributed a significant portion of the calories supplied by the cereal grains in Haiti, as shown in Table 15. The wheat share grew until 1988. Corn followed wheat in the share of calories supplied from cereals.

Analysis of Policy Alternatives

Two policy options were evaluated with the policy model in order to illustrate its use as a planning tool yielding information on the impacts of price changes on supply and use of commodities, calorie distribution, and other performance variables. Other alternatives are possible by changing either the policies or parameter values.

The first policy alternative (Alt 1) was to reduce the tariff on corn imports starting in 1987, moving from 50 to 10 percent of the CIF value. The second policy alternative (Alt 2) was to reduce tariffs on all grain commodities, except sorghum, from 50 to 10 percent of the corresponding CIF values. The results were evaluated in terms of changing consumption, changes in imports, farm income, and calorie consumption and distribution. The results are summarized in Figures 4 through 22.

Alternative 1: Reducing Tariffs on Corn Imports

The tariff reduction on corn imports decreased retail and farmgate prices. As a result of lower corn prices for 1987, the structure of relative prices faced by consumers and producers changed. This had different impacts, related to the structure and underlying assumptions of the model (see Tables A.14 through A.17).

Following the reduction of the corn tariff in 1987, quantities of corn consumed increased and quantities of other commodities consumed decreased (Figures 4 through 7). The relative magnitude of the changes was determined by the degree of product substitutability and implied cross-price elasticities. As expected, the biggest decrease in consumption due to the lower corn prices was for sorghum and the smallest was for wheat.

With lower tariff rates on corn imports, people consumed more corn and less of the other grains than they would have if tariff rates had remained constant. Because of the lower relative farmgate price of corn, the area cultivated and yield (and therefore production) decreased. The area cultivated (and production) of competing rice and sorghum crops increased in proportion to the degree of competitiveness with respect to corn measured by the assumed area price elasticities. All area adjustment occurred in 1987.

Corn imports increased in 1987 because domestic production decreased and demand increased due to lower prices. On the other hand, with more production and lower quantities of rice and

sorghum consumed, the amount of rice and sorghum commodities available for export increased, as shown in Figures 8 through 11. Less wheat was imported because consumed quantities of wheat also decreased. In subsequent years, corn imports increased because of insufficient domestic production to meet demand; exports of rice and sorghum continued, since supply response to falling relative prices was weak.

Net farm income growth began declining in 1987 due to lower farmgate prices and output for corn. There was some improvement in subsequent years. Net farm income declines also dampened the availability of per capita calories in rural areas for 1987. In later years, the tariff reduction increased total per capita calories available in Haiti; the increases came mainly from increased consumption of rice and corn.

Alternative 2: Reducing Tariffs on All Grain Imports

For Alt 2, tariff rates on imports of rice, wheat, and corn were reduced to 10 percent. As a consequence, the 1987 structure of relative prices faced by consumers and producers was altered, reducing the relative retail and farmgate prices of rice, corn, and wheat with respect to sorghum (see Tables A.18 through A.21).

Lower prices for corn and rice generated lower rural income. For rural consumers, the income and price effects worked in opposite directions. For corn and rice, the price effect was stronger than the negative income effect increasing corn and rice consumption, respectively. Consumed quantities of sorghum fell due to negative price and income effects of the change. And finally, the negative income effect also reduced consumed quantities of wheat (see Figures 4 through 7). Lagged consumption effects ("persistence") and the subsequent stability of relative price structure caused these trends to persist for subsequent years.

The change in relative prices for all four grains meant higher consumed quantities of rice and corn, but lower quantities of sorghum and wheat for urban consumers.

Lower farmgate prices of corn and rice meant less area cultivated (and less production) for these crops in 1987. Overall, the increase in urban consumption was greater than the decrease in rural consumption for corn and rice, since urban income was not affected by the fall in grain prices. With higher consumption and lower domestic production, imports increased. Sorghum exports are shown to increase because of higher production and less domestic consumption; wheat imports decreased.[10] These trends also continued in subsequent years (see Figures 8 through 11) .

With lower farmgate prices, net farm income decreased initially (Figures 15 and 16). One important difference between the two alternatives is that calorie consumption fell in the first year (1987) due to the effects of markedly lower rural income (Figures 17 and 18).

Adding Coffee to the Basic Model

The Haitian government has set targets for a tax reduction policy on coffee exports for the study period. The policy model was extended to include coffee in order to evaluate the effects of this tax change. The proposed tax levels are: 26 percent tax rate for 1984-85, 23 percent for 1986, 15 percent for 1987, and 0 percent for 1988-90. These changes are only presented to illustrate the flexibility of the policy simulation model.

Coffee production differs from that of cereal grains in its production cycle. The coffee tree must reach maturity in order to produce beans. This biological process usually takes several years, implying that no production is obtained from newly planted trees until maturity. In contrast, some marginal increases in harvested quantity can be obtained by more intensively picking the existing trees. These facts condition the way the response of domestic coffee supply to changes in own and competitive crop prices was represented.

The supply response was determined as a short-run supply response through the yield equation and not through the area cultivated equation. In other words, when favorable coffee prices existed, the increase in domestic supply was attributed to an increase in yield of the existing coffee trees

(perhaps because of more intensive agricultural practices, research, or extension activities) and not to an increase in area cultivated. Any increase in production due to more area cultivated could only occur after the coffee trees matured. In addition, unstable coffee prices (closely related to world prices) and agricultural policies have limited the long-run substitution possibilities with annual crops.

These features of coffee production were reflected in the model: there are zero or very low cross-price supply elasticities between coffee and other annual crops; and the area cultivated in coffee depends on a constant price "natural" growth rate, but remains independent of prices of potential substitute crops (mainly corn). Both relationships complemented each other so that production of coffee due to an increase in area cultivated was independent of crop prices. Recall that for temporary crops the area cultivated depended on the "natural" rate of growth and on own and other competitive crop prices.

A relatively high yield elasticity for coffee, with respect to own-price compared to that for the correspondent other crops, was assumed. Also a high yield elasticity of coffee over time was assumed, attributed to increased extension services and investments related to more favorable and stable government policies concerning coffee.

As a result of introducing coffee into the general model, the rate of growth in rural income was higher than it was in the original model for the baseline. This was especially true when the export tax rate was low. The lower the export tax, the higher the rate of rural income growth. Even when export tax relief was shared both by the farmer and the middlemen, more income was generated in the rural sector. With more money to spend, rural consumers used larger quantities of rice, corn, sorghum, and wheat. The increase in consumed quantities of these commodities depends on the relative size of different expenditure elasticities. With limited increases in domestic production, imports of the cereal grain commodities increased in order to satisfy increased demand.

Summary and Conclusions

A generalizable adaptive policy simulation model (APSM) was developed for Haiti to allow evaluation of the impacts of alternative agricultural policy changes. The parameters and baseline assumptions of the model were based on available data for Haiti and included the 1986-87 Household Expenditure and Consumption Survey. Where unavailable specifically for Haiti, parameter values were derived from evidence in other developing countries.

Analysis of the two alternative policies showed that cereal grain consumption and production in Haiti are affected by government tariff policies for cereals. And, because rural incomes are closely related to farm income, the consumption effects of reduced cereal grain prices are not always positive.

The two policy alternatives evaluated to demonstrate the operation of the model were a selective reduction for tariffs in corn (Alt 1) and a more general reduction in all tariffs on cereal grains (except sorghum) from 50 to 10 percent (Alt 2). Reducing tariffs on all the cereal grains decreases overall cereal consumption and reduces the level of farm income. Because of strong negative effects on rural incomes, calories available for consumption fell during the year in which tariffs were reduced. Urban consumers were better off, although changing consumption patterns led to changes in the relative amounts of calories and proteins.

When only corn tariffs were reduced, there were changes in consumption among the grains. While corn producers' (and rural) income fell, the share of total calories consumed from corn first fell, then increased over the baseline as corn was substituted for other grains. In contrast, with general tariff reductions, falling rural incomes reduced calorie intake generally, but increased the share of calories coming from rice and corn. The relative share of calories from wheat fell. The projected differential effects suggest the importance of limited and targeted food assistance to alleviate the initial adjustment costs.

ENDNOTES

1. In the case of Haiti, fertilizer use per hectare is very low. Irrigation, however, is confined to mostly rice (World Bank 1985) and hence irrigation is assumed to influence rice yields only. See the Assumptions section, p. 18, for more use details.

2. All time subscripts are removed from the equations.

3. The markups may have also changed after implementation of the new import policy. See Table 1.

4. Rural retail prices faced by rural consumers are also required in the analysis. Since no rural retail prices are available, the rural retail price can be calculated as some percentage of the urban retail prices. Calculating rural retail prices as a fixed percentage of urban retail prices does not change the relative prices and hence the rural retail prices are not calculated. However, any lags in price transmission are not captured by this method.

5. This assumption that the fluctuations in Gulf port prices will be transmitted to domestic prices in Haiti, especially in the case of rice, corn, and sorghum may not be true, given that free trade in these commodities has not existed in Haiti. However, since one major objective of this study is to examine the implications of trade liberalization in cereal grain prices, these price linkage assumptions are necessary. In Haiti, duties and taxes on imported grains are so high that domestic price variations will depend on duties and taxes.

6. In poor countries the demand elasticities are generally higher in rural areas than urban areas given that, especially for staples, rural households spend a relatively larger proportion of their incomes on food. The elasticities reported in Table 6 were derived from estimates using the Haiti 1986-87 data, with some adjustment downward to make the estimates more consistent with other elasticities reported by studies for Central America, Indonesia, and the Philippines.

7. The Artibonite Valley, which is the major rice growing area in Haiti, is mostly irrigated. Some irrigated rice is also cultivated in the northern part of the country. Generally there are two rice harvests in irrigated areas.

8. The milling conversion factors are obtained from Tuck and Riordan (1985) for rice, corn, and sorghum. For wheat the Minoterie's milling rate is expected to increase from its present 75 percent to 77 percent after the modernization effort was completed in 1987.

9. The baseline data were not adjusted to account for curtailment of wheat supplies to Haiti in 1988 with resulting changes to wheat consumption.

10. It is unlikely, however, that any sorghum (millet) would be exported. We have not accounted for additional costs incurred for the export market.

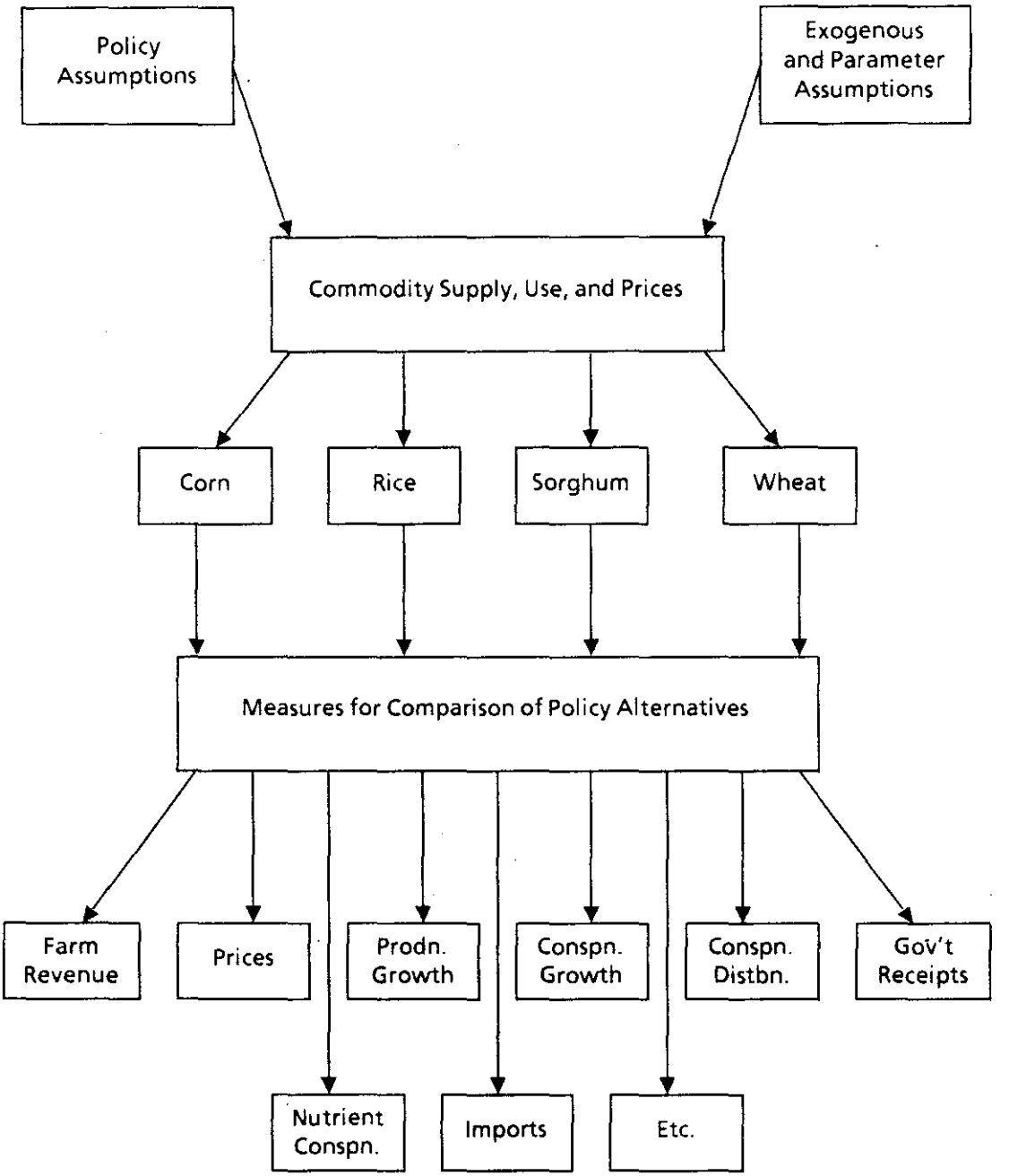

Figure 1. General components of the Food Policy Model

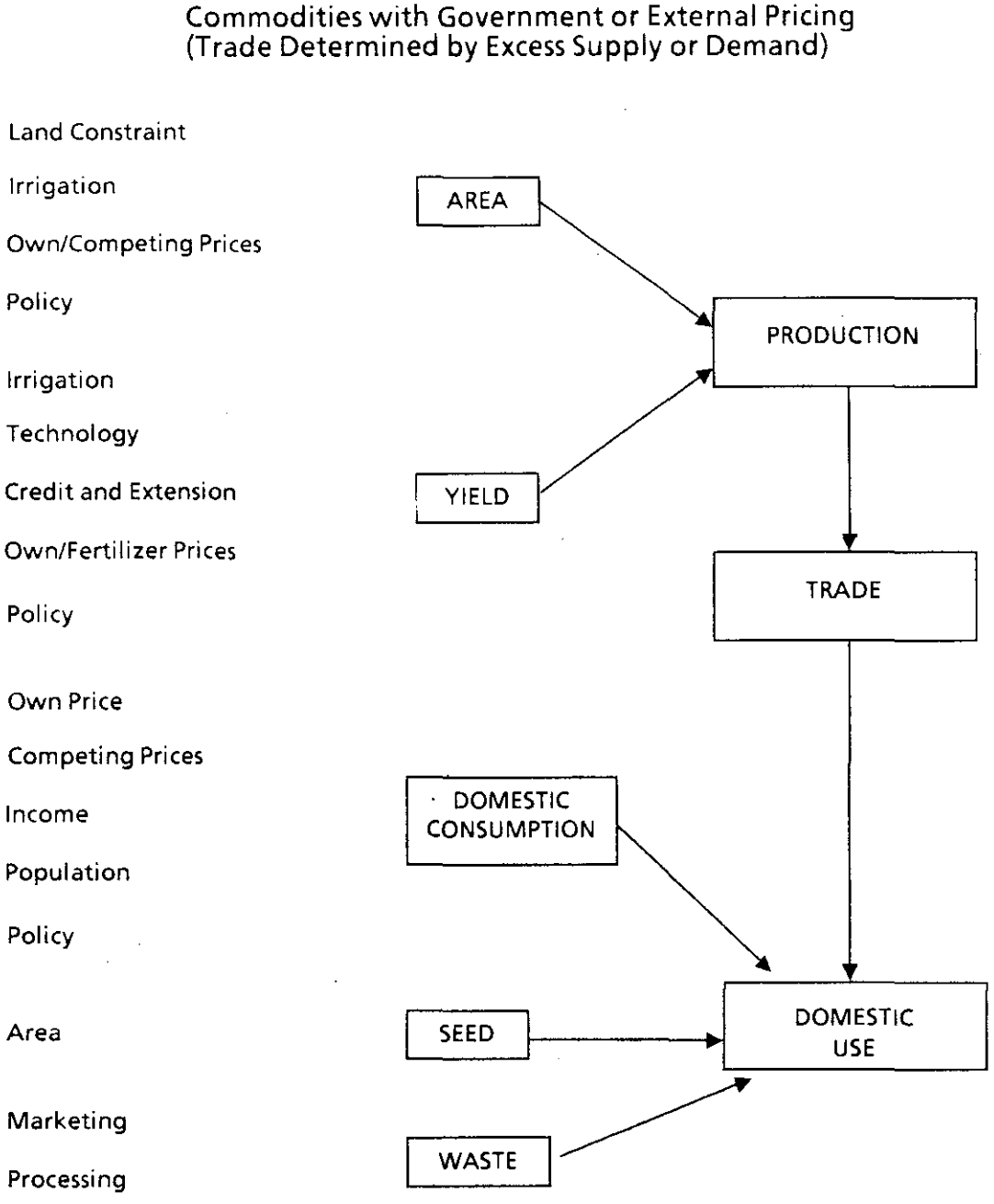

Figure 2. Components of commodity supply and use

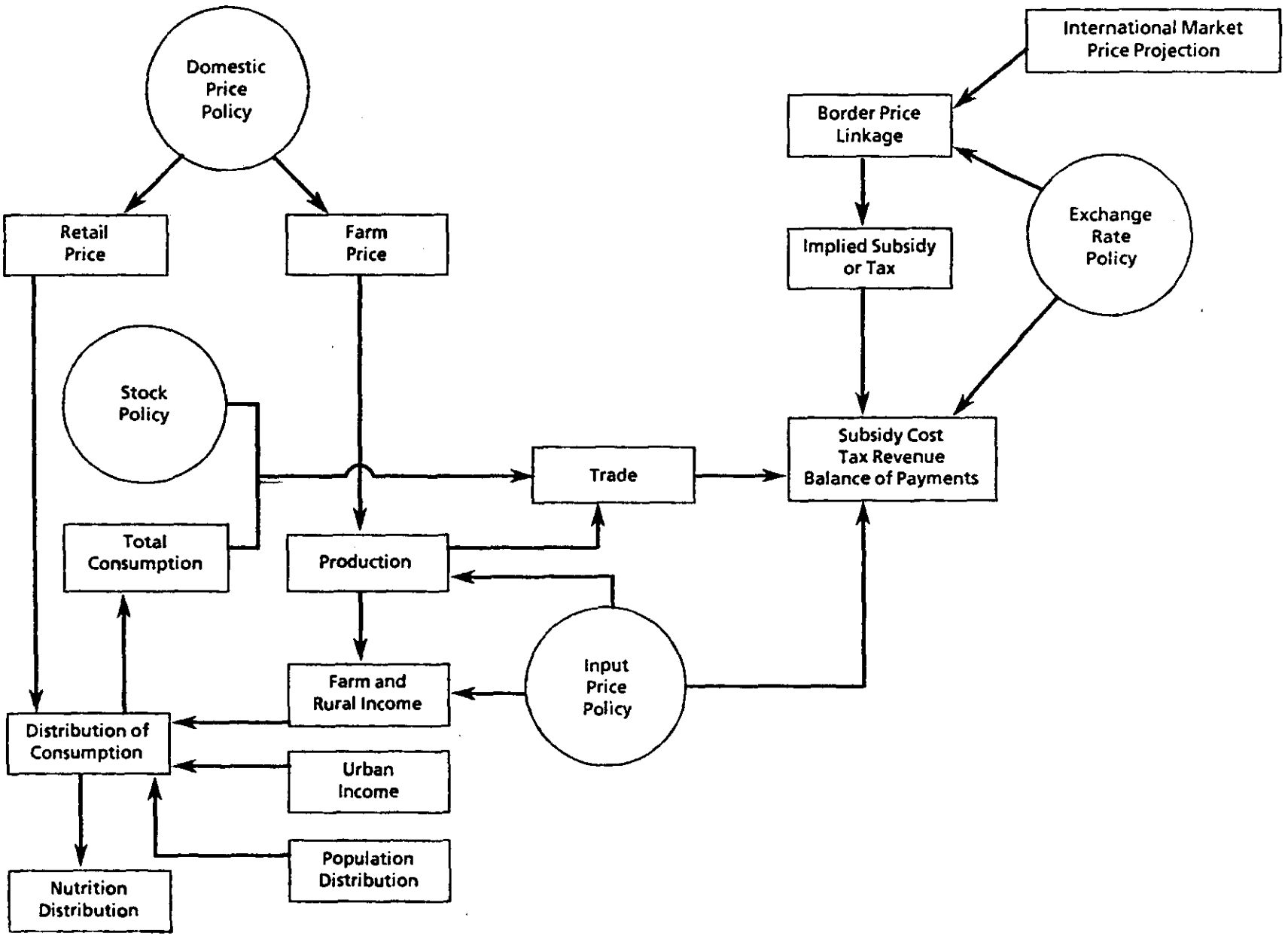

Figure 3. Linkages between policies and performance measures

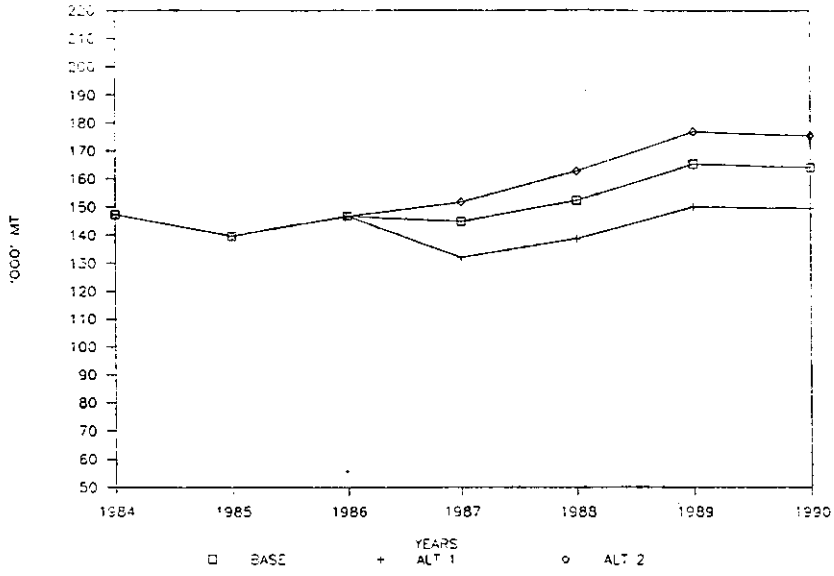

Figure 4. Rice consumption in Haiti: Base projections and tariff reduction policies under two alternatives

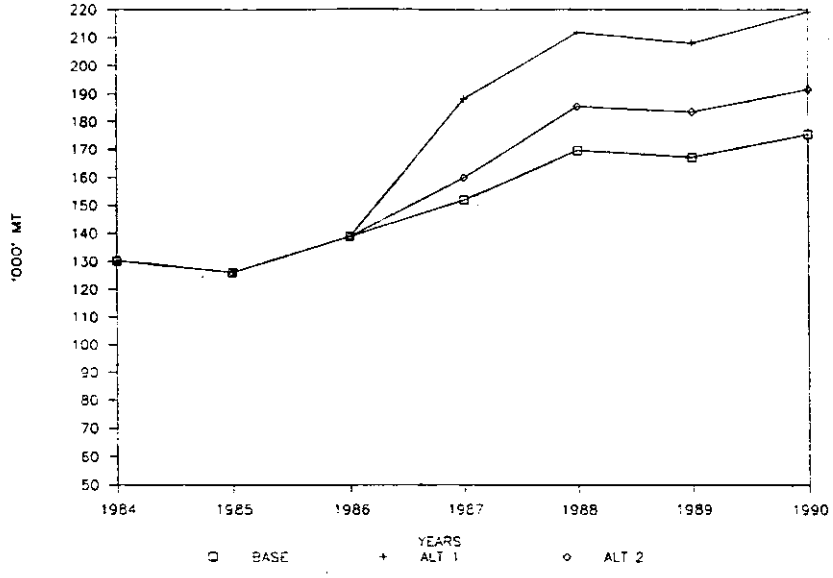

Figure 5. Corn consumption in Haiti: Base projections and tariff reduction policies under two alternatives

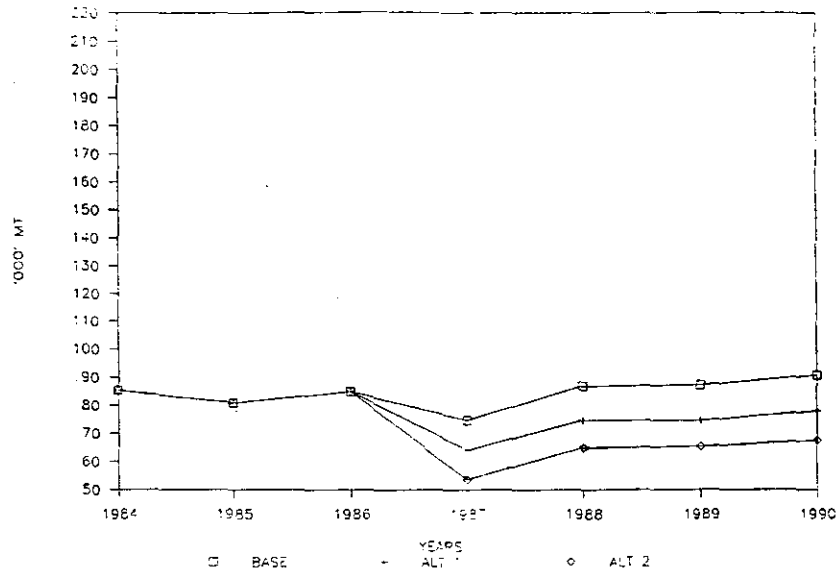

Figure 6. Sorghum consumption in Haiti: Base projections and tariff reduction policies under two alternatives

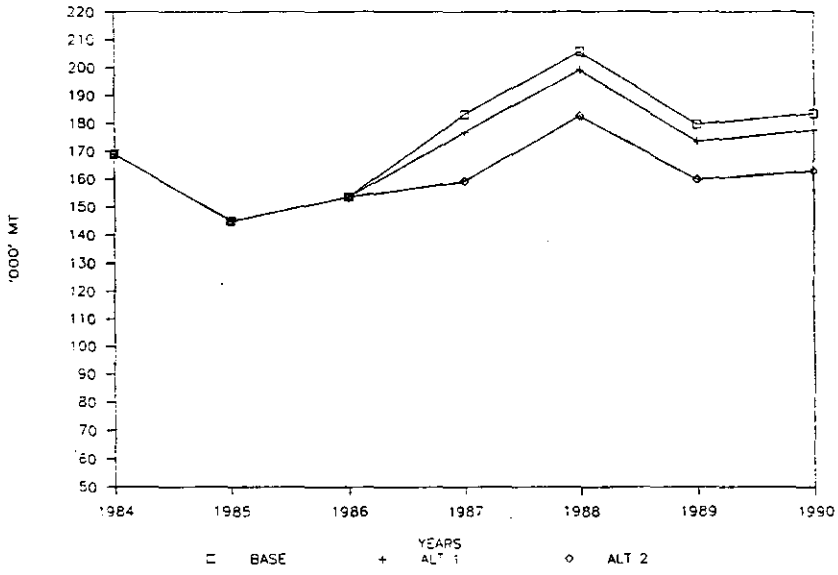

Figure 7. Wheat consumption in Haiti: Base projections and tariff reduction policies under two alternatives

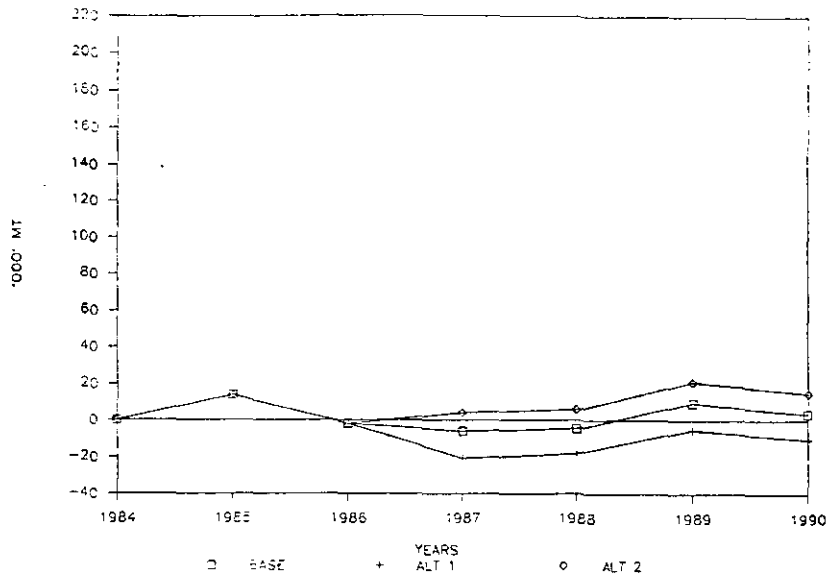

Figure 8. Rice imports in Haiti: Base projections and tariff reduction policies under two alternatives

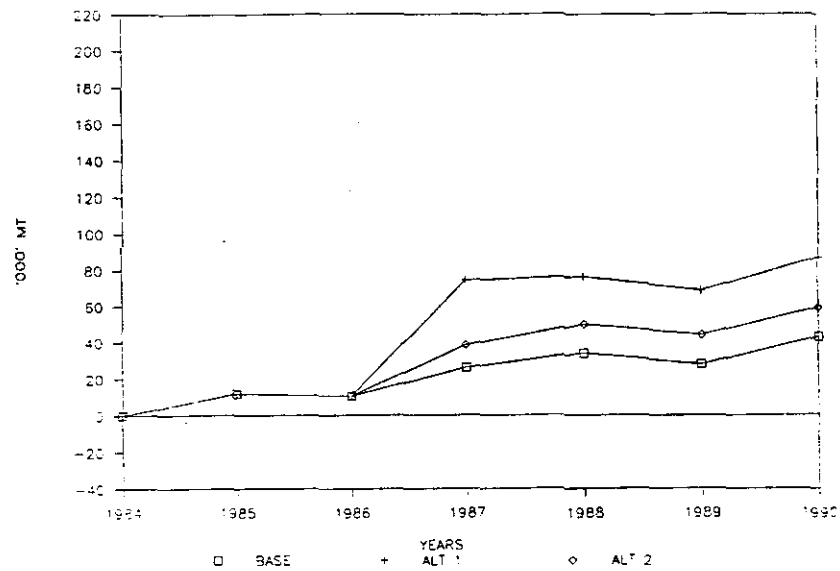

Figure 9. Corn imports in Haiti: Base projections and tariff reduction policies under two alternatives

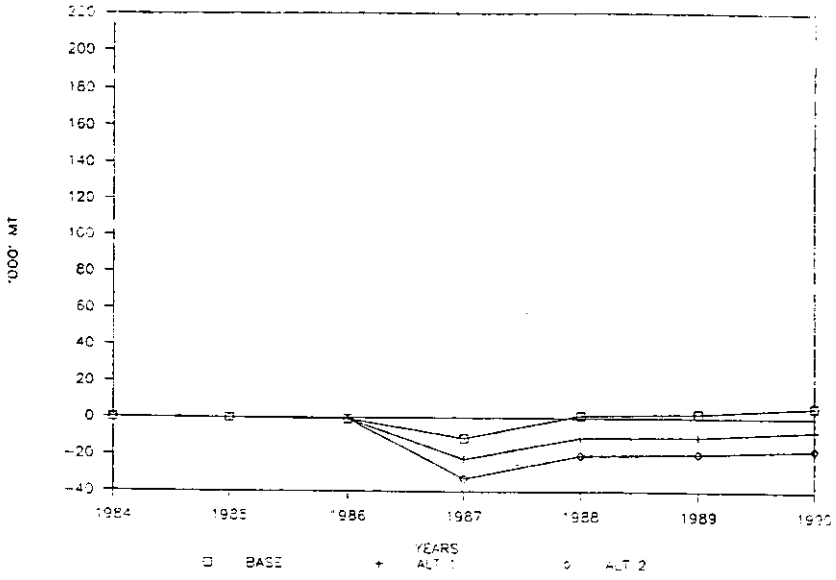

Figure 10. Sorghum imports in Haiti: Base projections and tariff reduction policies under two alternatives

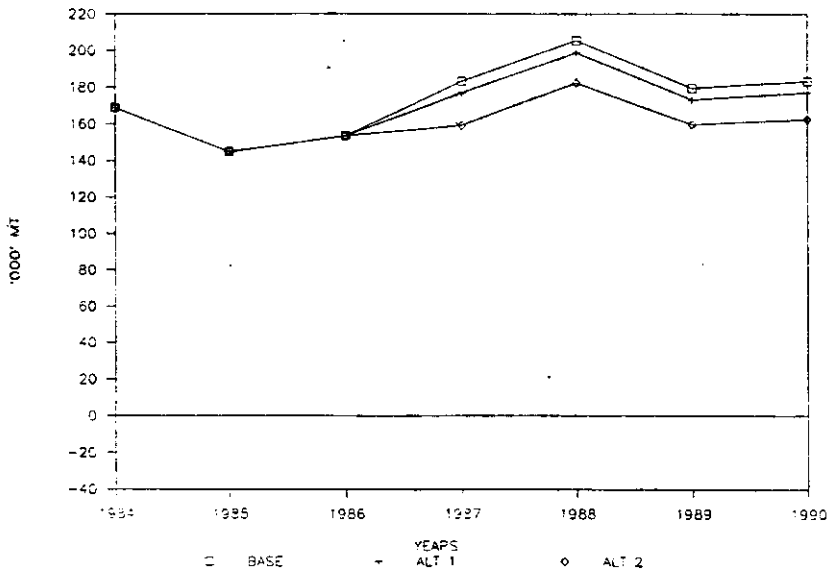

Figure 11. Wheat imports in Haiti: Base projections and tariff reduction policies under two alternatives

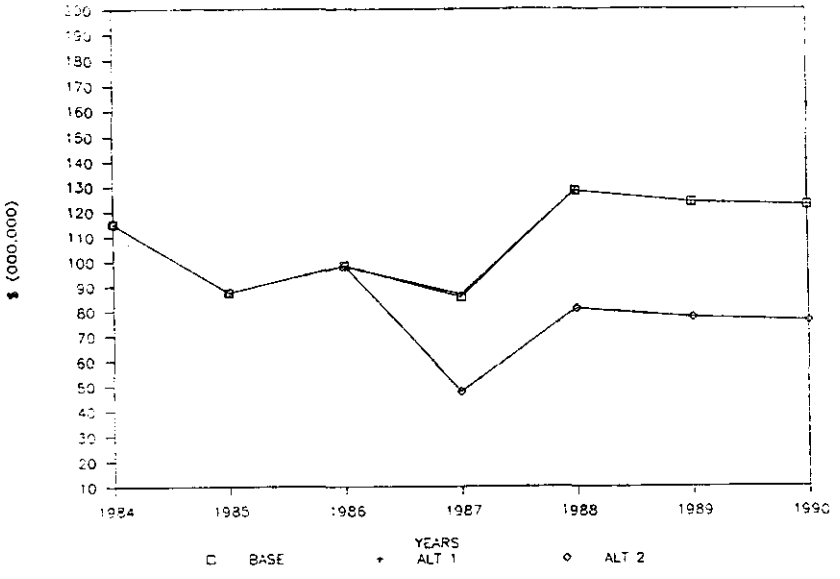

Figure 12. Net rice income in Haiti: Base projections and tariff reduction policies under two alternatives

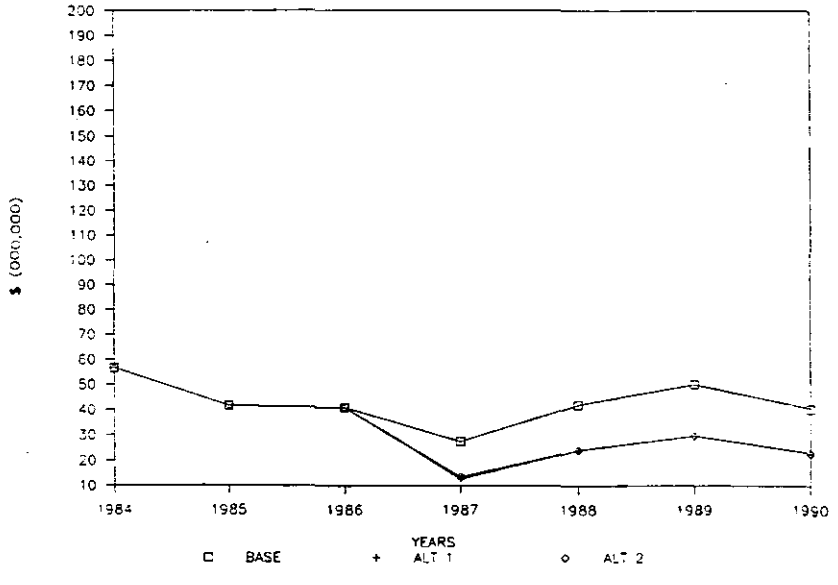

Figure 13. Net corn income in Haiti: Base projections and tariff reduction policies under two alternatives

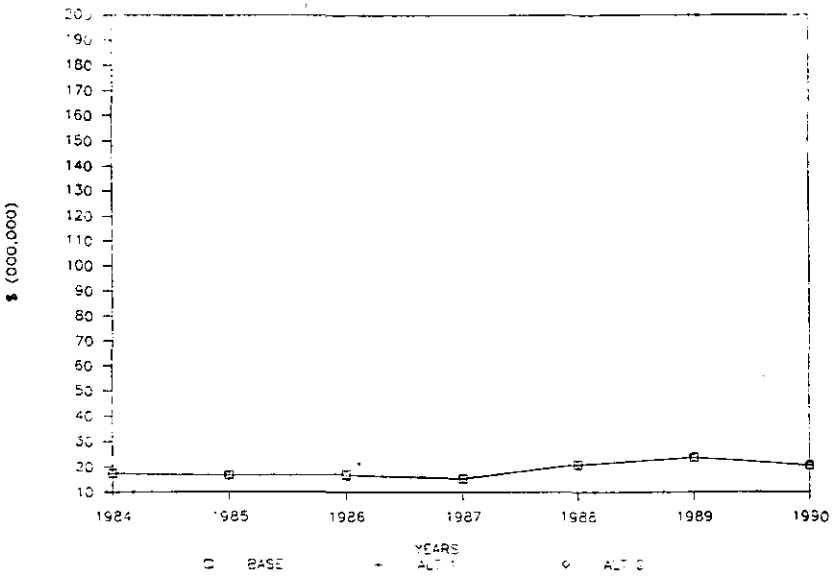

Figure 14. Net sorghum income in Haiti: Base projections and tariff reduction policies under two alternatives

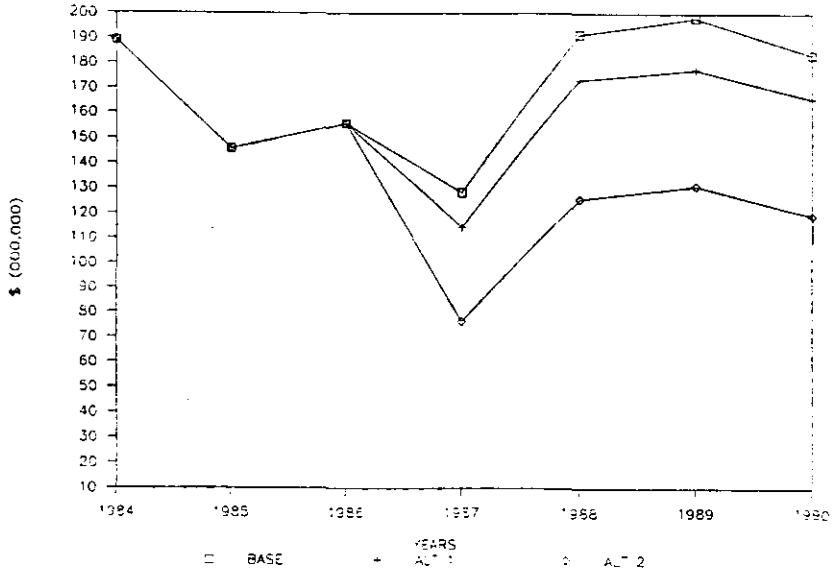

Figure 15. Net farm income in Haiti: Base projections and tariff reduction policies under two alternatives

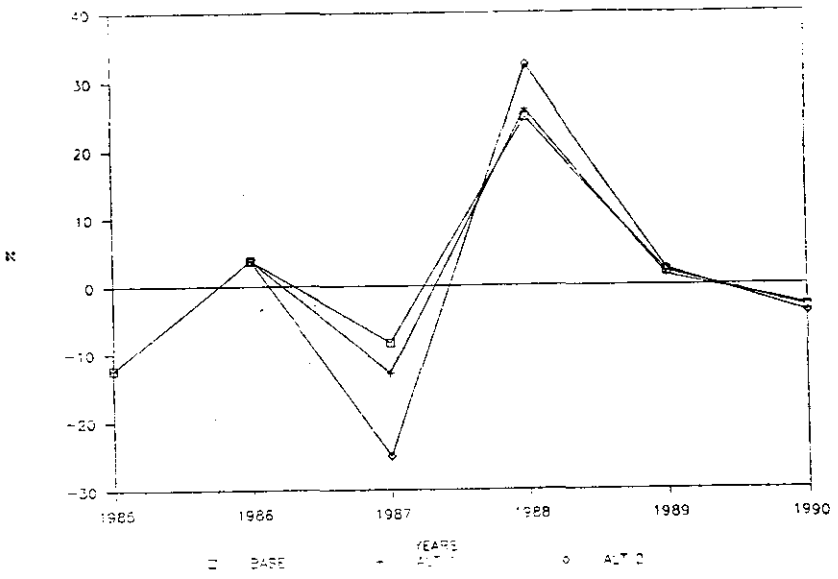

Figure 16. Net farm income growth rate in Haiti: Base projections and tariff reduction policies under two alternatives

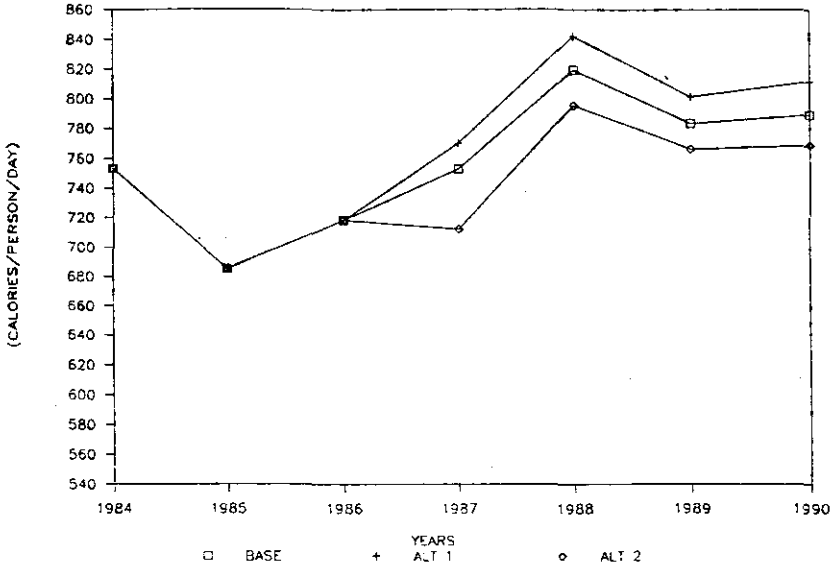

Figure 17. Calorie consumption for all Haiti: Base projection and tariff reduction policies under two alternatives

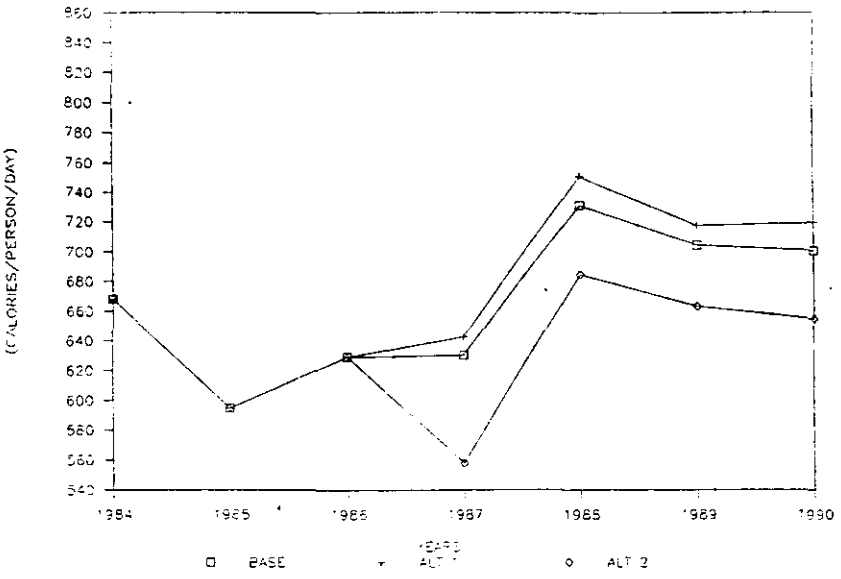

Figure 18. Calorie consumption in rural Haiti: Base projections and tariff reduction policies under two alternatives

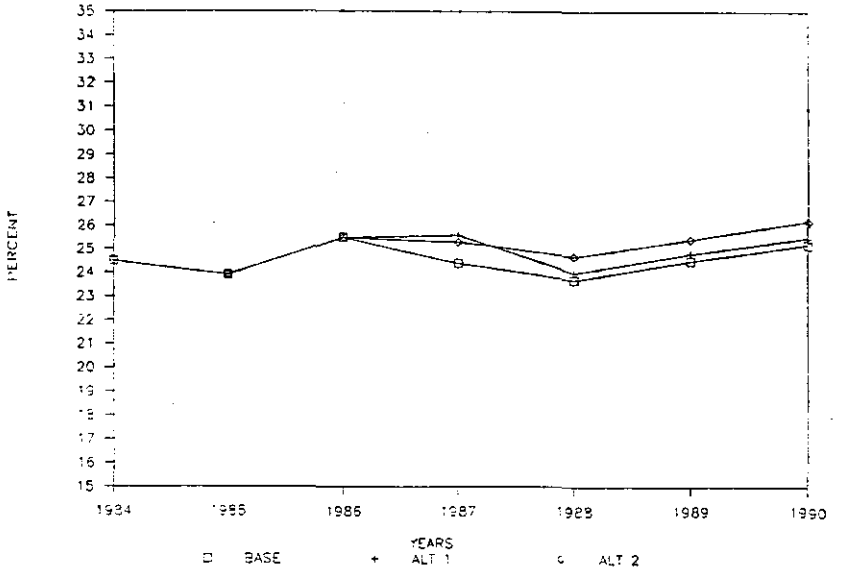

Figure 19. Percentage of cereal calories from rice in Haiti: Base projections and tariff reduction policies under two alternatives

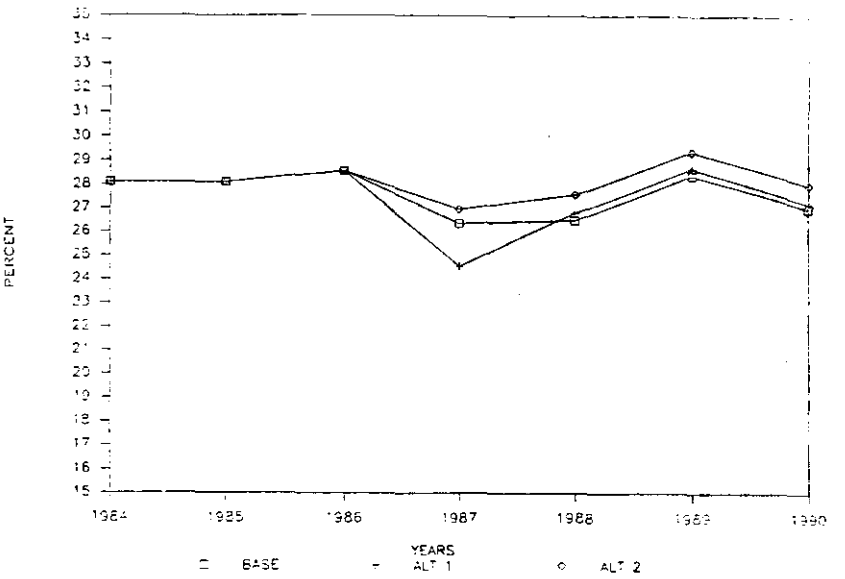

Figure 20. Percentage of cereal calories from corn in Haiti: Base projections and tariff reduction policies under two alternatives

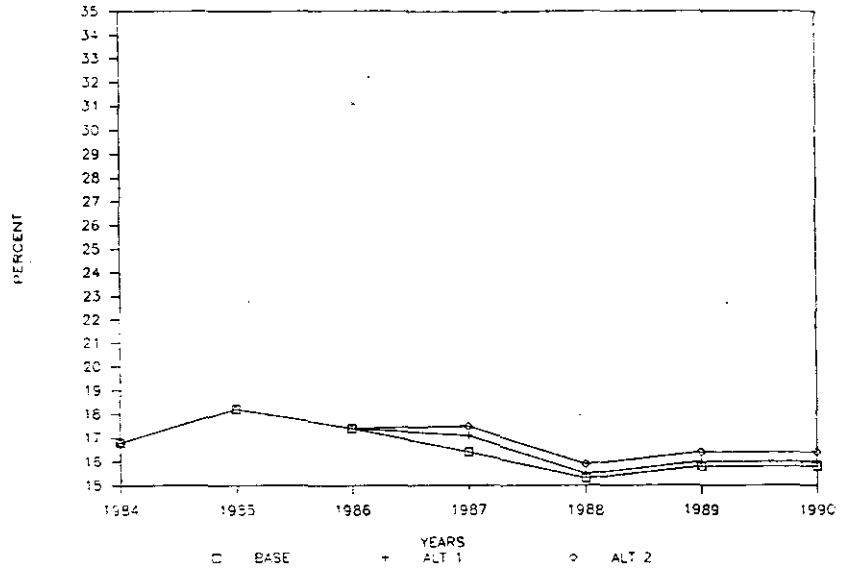

Figure 21. Percentage of cereal calories from sorghum in Haiti: Base projections and tariff reduction policies under two alternatives

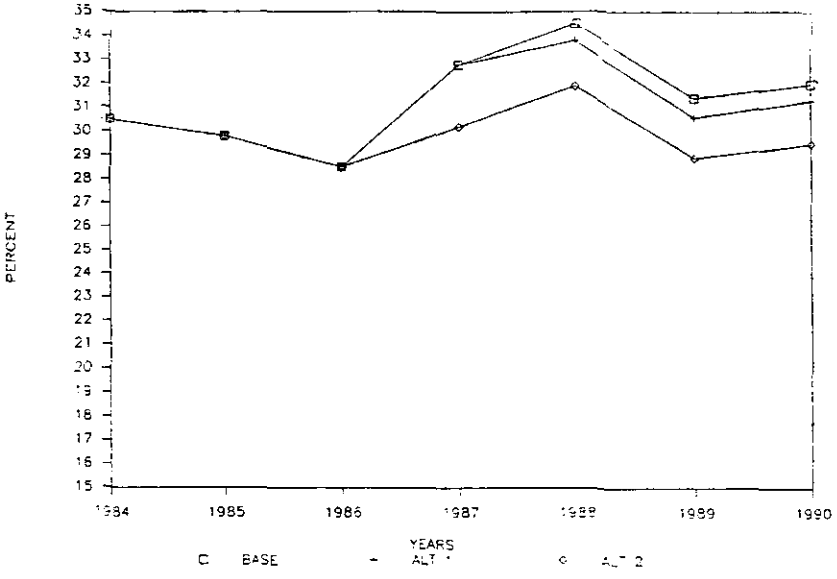

Figure 22. Percentage of cereal calories from wheat in Haiti: Base projections and tariff reduction policies under two alternatives

Table 1. Duties and taxes imposed on grain imports, 1984-90

	Type of Duty or Tax	Applicable Period
Rice		
Import duty	fixed-value (@ $170/mt)	1984 to 1986
Tariff	50% CIF value	1987 to 1990
Sales tax	1) 11% on (CIF + import duty)	1984 to 1986
	2) 11% on (CIF + tariff)	1987 to 1990
Corn		
Import duty	fixed-value (@ $70/mt)	1984 to 1986
Tariff	50% CIF value	1987 to 1990
Sales tax	1) 11% (CIF + import duty)	1984 to 1986
	2) 11% (CIF + tariff)	1987 to 1990
Wheat		
Special account[a]	fixed-value (@ $20.46/mt)	1984 to 1986
Port ad valorem tax[a]	fixed-value (@ $1.10/mt)	1984 to 1986
Excise duty[a]	fixed-value (@ $0.88/mt)	1986
General ad valorem tax[a]	11% Minoterie flour price	1984 to 1986
Sales tax(TCA)[a]	11% (CIF + tariff)	1987 to 1990
Tariff[b]	40% CIF value	1987 to 1990

SOURCE: Personal communication with USAID/Haiti staff.

[a]Applied to wheat flour.
[b]Applied to whole wheat.

Table 2. Retail cereal grain prices in Haiti (monthly averages for 1983 and 1984)

Commodity	1983	1984
Ordinary Milled Rice		
Jean Denis		
$/mt	812.00	649.00
Gourdes/marmite	11.30	9.04
Port-au-Prince		
$/mt	1042.00	1070.00
Gourdes/marmite	14.51	14.90
Milled Corn		
Jean Denis		
$/mt	549.00	437.00
Gourdes/marmite	6.70	5.34
Port-au-Prince		
$/mt	582.00	572.00
Gourdes/marmite	7.11	6.99
Milled Wheat		
Jean Denis		
$/mt	233.67	310.81
Gourdes/marmite	3.12	4.15
Port-au-Prince		
$/mt	308.56	368.48
Gourdes/marmite	4.12	4.92

SOURCES: Borsdorf and Foster (1985, Tables 22, 23, and 64) and Borsdorf, Foster, and Haque (1985, Table 25).

Notes: The marmite is a volume measure. The conversion factor of marmite into kilograms varies for each grain. The conversion factors reported by Borsdorf and Foster (1985) were used to convert the marmite into metric tons. The conversion factors from marmite to pounds are: rice (milled): 6.0-6.25 lb; whole millet: 5.75-6.00 lb; milled corn: 5.25-5.50 lb. Pounds are converted to metric tons by dividing pounds by 2200. The Gourde has been pegged at 5 Gourdes to one U.S. dollar since 1919.

Table 3. Cereal grain price formation in Haiti: Port-au-Prince, 1984 and 1987

	Rice		Corn	
	1984	1987	1984	1987
	($/mt)			
Average Gulf port price (FOB_i)	$278.00	$220.90	$146.00	$ 70.00
Estimated shipping & insurance charges (SI_i)	45.00	45.00	45.00	45.00
Estimated landed price (CIF_i)	323.00	265.90	191.00	115.00
Import duty (ID_i)	170.00	0.00	70.00	0.00
Tariff (TF_i)	0.00	132.95	0.00	57.50
Sales tax (ST_i)	54.23	43.87	28.71	18.98
Ex factory price (PP_i)	547.23	442.72	289.71	191.48
Observed retail price (RP_i)	1262.62	1021.50	573.19	378.83
Farmgate price (FP_i)	814.60	1007.90	369.80	244.41

SOURCES: Continental Grain for FOB prices and shipping costs. L'Administration Generale des Douanes for import duties. Borsdorf, et al. (1985), for prices. The FOB Gulf port prices are from FAPRI/CARD 1989. Also see Table 5 for the types of duties and taxes applicable on the landed grain.

Notes: The price spread between retail and farmgate (i.e., 55%) has been estimated for Haiti by Levitt and Laurent (1986). The freight rates for grains are in bagged form. Rice and corn imported in Haiti are in bagged form. Bulk rates are lower for grains.

Price ratios:

Rice

Ex factory to retail price ratio = 1262.62/547.23 = 2.3073 (i.e., $1 + W_r = 2.31$) for 1984 and for 1987 the price ratio is 1021.50/442.72 = 2.3073 (i.e., $1 + W_r = 2.31$). The estimated price spread between farmgate and retail price is 55 percent of the farmgate price.

Corn

Ex factory to retail price ratio = 573.19/289.71 = 1.9784 (i.e., $1 + W_c = 1.9785$).

The estimated price spread between farmgate and retail price is 55 percent of the farmgate price.

Table 4. Wheat flour price formation in Haiti

	1984	1987
	($/mt)	
Whole Wheat #2 Gulf port price (FOB_w)	$165.00	$109.00
Shipping and Insurance	9.00	9.00
CIF price	174.00	118.00
Tariff	0	59.00
Minoterie price	498.52	351.18
Special Account Tax (SAT)	20.46	0
Port Administration Tax (PAT)	1.10	0
General Administration Tax (GAT)	54.84	34.12
Wholesale Price	574.92	396.12
Retail Price (RP_w)	$594.01	$455.27

Notes: For 1984-86 Minoterie to CIF price ratio in all periods is equal to the mark-up (1 + DM). This markup captures the Minoterie's costs as well as profits. To arrive at the retail price, the wholesale price was multiplied by another markup (1 + DR). These mark-ups were specific for every year.

After 1987 constant markups for all years were applied (equal to the historical means).

Table 5. Comparison of retail price series

Commodity	1984	1985	1986	1987
			($/mt)	
Rice				
Estimated	$1263	$1165	$1127	$1022
Rice Miami	NA	NA	1045	618
Rice Mme. Ggsse			1135	NA
USAID/Haiti[a]	NA	NA	1090	NA
Milled Corn				
Estimated	573	510	470	379
USAID/Haiti	NA	NA	527	468
Wheat Flour				
Estimated[b]	589	559	476	437
USAID/Haiti[c]	NA	NA	484	472
Whole Sorghum				
Estimated	368	328	318	300
USAID/Haiti	NA	NA	346	300

SOURCE: The "estimated" values are from the model except for 1984. The USAID/Haiti prices are directly from a memorandum dated May 12, 1987, and refer to Port-au-Prince prices made available from IHSI.

[a]The average monthly price observed in Port-au-Prince for Mme Ggsse and Miami rice (weighted equally).
[b]Retail price.
[c]Wholesale price.

Note: NA = Not applicable. For 1984 all prices are observed retail prices. For whole sorghum 1986 and 1987 retail prices are observed prices. The USAID/Haiti prices for 1986 is the average price based on the average of the 12 months and for 1987 the average price is based on five months, average (January to May).

Table 6. Demand elasticities

Commodity	Rice Price	Corn Price	Sorghum Price	Wheat Price	Expenditure
Urban Areas					
Rice	-0.65	0.10	0.04	0.02	0.85
Corn	0.15	-0.56	0.15	0.03	0.83
Sorghum	0.06	0.07	-0.86	0.06	0.95
Wheat	0.20	0.04	0.10	-0.60	0.84
Rural Areas					
Rice	-0.74	0.30	0.09	0.01	0.97
Corn	0.20	-0.89	0.30	0.03	0.96
Sorghum	0.15	0.40	-0.94	0.10	1.10
Wheat	0.10	0.04	0.06	-0.75	0.97

Table 7. Area and yield levels: Haiti 1984

Commodity	Area	Yield
	(000 ha)	(mt/ha)
Rice	97.0	2.052
Corn	219.0	0.850
Sorghum	174.0	0.700

SOURCE: Levitt and Laurent 1986.

Table 8. Production cost estimates for rice and corn

Crop and Practice	$/mt	$/mt with labor at 80% of mkt. wage
Rice		
Traditional Farming		
Swamp	754	654
Rainfed	794	691
Irrigated Cultivation		
North 1983	473	263
Artibonite Valley	419	236
Corn		
Traditional Farming		
Monoculture	205	171
Associations	162	130
All	173	140
Improved Farming		
Monoculture	146	130

SOURCE: Calculated from World Bank 1985.

Table 9. Area harvested of rice, corn, and sorghum: Haiti 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				(thousand hectares)			
Rice	97.00	83.06	97.31	98.52	99.16	99.19	101.26
Corn	219.00	193.25	216.10	212.25	222.34	228.69	218.64
Sorghum	174.00	165.94	175.04	175.59	173.34	172.81	174.08

SOURCE: Table A.5.

Table 10. Rice, corn, and sorghum yield: Haiti 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				(kilograms per hectares)			
Rice	2052	2049	2068	2078	2143	2129	2149
Corn	850	846	851	849	872	871	866
Sorghum	700	698	699	699	705	702	698

SOURCE: Table A.5.

Table 11. Per capita consumption of cereal grains: Haiti 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				kilograms per capita			
Rice							
Rural	22.48	20.06	20.75	19.04	21.54	23.20	22.00
Urban	39.61	39.48	40.52	42.51	38.07	39.83	40.54
Corn							
Rural	23.36	21.77	23.84	25.32	28.97	27.96	28.59
Urban	24.63	24.60	25.83	28.59	27.55	26.96	28.38
Sorghum							
Rural	18.39	16.89	17.39	14.60	17.35	17.22	17.41
Urban	6.82	7.15	7.39	7.58	6.61	6.30	6.93
Wheat							
Rural	20.47	16.46	17.39	19.90	23.64	19.89	19.58
Urban	61.42	54.00	55.23	65.73	67.19	58.68	59.74

SOURCE: Tables A.10 and A.11.

Table 12. Domestic supply and consumption of cereal grains: Haiti 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				(thousand metric tons)			
Rice							
Supply	147	126	149	151	157	156	161
Consumption	147	140	147	145	152	166	165
Imports	0	14	-2	-6	-5	10	4
Corn							
Supply	130	114	129	126	136	139	133
Consumption	130	126	139	152	170	167	176
Imports	0	12	10	26	34	28	43
Sorghum							
Supply	85	81	86	86	86	85	85
Consumption	85	81	85	75	87	87	91
Imports	0	0	-1	-11	1	2	6
Wheat							
Supply	0	0	0	0	0	0	0
Consumption	169	145	154	183	206	180	184
Imports	169	145	154	183	206	180	184

SOURCE: Tables A.10 and A.11.

Note: Rice is paddy rice, corn is whole corn, sorghum is whole sorghum, and wheat is whole wheat. Numbers may not add correctly due to rounding.

Table 13. Rural income growth rates: Haiti 1985-90

	1985	1986	1987	1988	1989	1990
			(percent)			
Gross Farm Income	-22.90	6.98	-17.56	49.00	3.40	-7.35
Efficiency Growth Rate	0.00	0.0	0.00	0.00	0.00	0.00
Farm Income Growth Rate	-11.45	3.49	-8.78	24.50	1.70	-3.67
Exogenous Growth Rate	-0.94	0.34	0.34	0.34	0.34	0.34
Rural Income Growth Rate	-12.39	3.83	-8.44	24.84	2.04	-3.33

SOURCE: Table A.12.

Table 14. Per capita calorie availability by regions for rice, corn, sorghum, and wheat: Haiti 1984-90

Region	1984	1985	1986	1987	1988	1989	1990
Rural	668	595	629	631	732	704	701
Urban	1009	955	984	1116	1080	1018	1049
All Haiti	753	685	718	753	820	784	789

SOURCE: Table A.13.

Table 15. Percentage distribution of calories from cereal grains: Haiti 1984-90

Cereal Grain	1984	1985	1986	1987	1988	1989	1990
Rice	25	24	25	24	24	25	25
Corn	28	28	29	26	27	28	27
Sorghum	17	18	17	17	15	16	16
Wheat	30	30	29	33	34	31	32

SOURCE: Table A.13.

Note: Numbers may not add to 100 due to rounding errors.

APPENDIX

Table A.1. Demand and expenditure elasticities for urban areas used in the policy model for Haiti

	1984	1985	1986	1987	1988	1989	1990
				(own-price)			
Demand Elasticities							
Rice	-0.65	-0.65	-0.65	-0.65	-0.65	-0.65	-0.65
Corn	-0.56	-0.56	-0.56	-0.56	-0.56	-0.56	-0.56
Sorghum	-0.86	-0.86	-0.86	-0.86	-0.86	-0.86	-0.86
Wheat	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
				(cross-price)			
Rice-corn	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Rice-sorghum	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Rice-wheat	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Corn-rice	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Corn-sorghum	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Corn-wheat	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sorghum-rice	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Sorghum-corn	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Sorghum-wheat	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Wheat-rice	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Wheat-corn	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Wheat-sorghum	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Expenditure Elasticities							
Rice	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Corn	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Sorghum	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Wheat	0.84	0.84	0.84	0.84	0.84	0.84	0.84

Table A.2. Demand and expenditure elasticities for rural areas used in the policy model for Haiti

	1984	1985	1986	1987	1988	1989	1990
				(own-price)			
Demand Elasticities							
Rice	-0.74	-0.74	-0.74	-0.74	-0.74	-0.74	-0.74
Corn	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89
Sorghum	-0.94	-0.94	-0.94	-0.94	-0.94	-0.94	-0.94
Wheat	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75
				(cross-price)			
Rice-corn	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Rice-sorghum	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Rice-wheat	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Corn-rice	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Corn-sorghum	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Corn-wheat	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sorghum-rice	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Sorghum-corn	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Sorghum-wheat	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wheat-rice	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wheat-corn	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Wheat-sorghum	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Expenditure Elasticities							
Rice	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Corn	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Sorghum	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Wheat	0.97	0.97	0.97	0.97	0.97	0.97	0.97

Table A.3. Area and yield elasticities used in the policy model for Haiti

Elasticity	1984	1985	1986	1987	1988	1989	1990
Area Elasticities with Respect to Grain Prices							
Rice-rice price	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Rice-corn price	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Rice-sorghum price	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice-wheat price		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Corn-rice price	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22
Corn-corn price	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Corn-sorghum price	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Corn-wheat price	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Sorghum-rice price	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Sorghum-corn price	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Sorghum-sorghum price	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sorghum-wheat price	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
Yield Elasticities with Respect to Grain Prices							
Rice	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Corn	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Sorghum	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Yield Elasticities with Respect to Fertilizer Prices							
Rice	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Corn	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Sorghum	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.4. Annual growth rates assumptions at constant prices for cereal grains production

	1984	1985	1986	1987	1988	1989	1990
				(percent)			
Area Growth Rates at Constant Price							
Rice	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corn	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Sorghum	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yield Growth Rates at Constant Price							
Rice	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corn	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Sorghum	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation Growth Rates at Constant Price							
Rice	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corn	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sorghum	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer Use at Constant Prices							
Growth rate in							
Fertilizer use for rice	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Fertilizer use				(kilograms per hectare)			
Rice	36.00	36.04	36.07	36.11	36.14	36.18	36.22
CIF Fertilizer price				(dollars per metric ton)			
Urea	249.12	230.66	235.50	245.87	255.21	271.54	288.92

Table A.5. Area and yield levels at constant prices for cereal grains production

	1984	1985	1986	1987	1988	1989	1990
				(thousand hectares)			
Area Levels at Constant Prices							
Rice	97.00	83.00	97.00	97.97	98.95	99.94	100.94
Corn	219.00	196.00	219.00	220.10	221.20	222.30	223.41
Sorghum	174.00	166.00	174.00	174.00	174.00	174.00	174.00
Rice irrigated area	72.75	73.48	74.21	74.95	75.70	76.46	77.23
Rice Yield Elasticity with Respect to Irrigation				(elasticity)			
Rice irrigation elasticity	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Yield Levels at Constant Prices				(kilograms per hectare)			
Rice	2052.00	2072.52	2093.25	2114.18	2135.32	2156.67	2178.24
Corn	850.00	854.25	858.52	862.81	867.13	871.46	875.82
Sorghum	700.00	700.00	700.00	700.00	700.00	700.00	700.00

Table A.6. Assumptions on conversion factors and production costs

	1984	1985	1986	1987	1988	1989	1990
				(percent)			
Seed, Feed, and Other Wastes							
Rice	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Corn	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Sorghum	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Milling Rates							
Rice	70.00	70.00	70.00	70.00	70.00	70.00	70.00
Corn	90.00	90.00	90.00	90.00	90.00	90.00	90.00
Sorghum	90.00	90.00	90.00	90.00	90.00	90.00	90.00
Wheat	75.00	75.00	75.00	77.00	77.00	77.00	77.00
Production Cost Assumptions				(dollars per metric ton)			
Rice	485.00	489.85	494.75	499.70	504.69	509.74	514.84
Corn	111.00	112.11	113.23	114.36	115.51	116.66	117.83
Sorghum	66.60	67.27	67.94	68.62	69.30	70.00	70.70
				(percent)			
Cost growth rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table A.7. Price formation equations for wheat and rice, 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				(dollars per metric ton)			
Wheat							
Gulf port FOB price	165.00	156.00	130.00	109.00	124.00	164.73	157.82
Freight & insurance	9.00	9.00	9.00	9.00	9.00	9.00	9.00
CIF price	174.00	165.00	139.00	118.00	133.00	173.73	166.82
Tariff (TF) @ 50% of CIF value	0.00	0.00	0.00	11.80	13.30	17.37	16.68
Minoterie Price ($/mt)	498.53	498.53	422.82	351.18	395.82	517.04	496.47
General administration tax (GAT) @ 11 % of Minoterie price	54.84	54.84	46.51	39.93	45.00	58.79	56.45
Port administartion tax (PAT) @ $1.10/ mt	1.10	1.10	1.10	0.00	0.00	0.00	0.00
Special account tax (SAT) @ $20.46/mt	20.46	20.46	20.46	0.00	0.00	0.00	0.00
Excise duty (ED) @ $0.88/mt effective in 1986 only	0.00	0.00	0.88	0.00	0.00	0.00	0.00
Retail price of flour RP	594.01	651.85	629.18	455.27	513.14	670.29	643.63
Rice							
Gulf port (FOB) price	278.00	240.00	225.09	220.90	294.00	288.18	278.63
Shipping and insurance (SI @ $45.00/mt)	45.00	45.00	45.00	45.00	45.00	45.00	45.00
CIF Price (CIF= FOB price + SI)	323.00	285.00	270.09	265.90	339.00	333.18	323.63
Import duty (ID) @ $170/mt	170.00	170.00	170.00	0.00	0.00	0.00	0.00
Tariff on rice effective from March 1987 @ 10 % of CIF value	0.00	0.00	0.00	26.59	33.90	33.32	32.36
Sales tax (ST) @ 11% on the sum of CIF + import duty or tariff	54.23	50.05	48.41	32.17	41.02	40.31	39.16
Portgate price (PP=(CIF+ID)(1+ST)	547.23	505.05	488.50	324.66	413.92	406.81	395.15
Retail price (RP=PP* (1+Wr))	1262.62	1165.30	1127.12	1021.50	1302.32	1279.96	1243.27
Farmgate price (FGP= RP/1.55)	814.60	751.81	727.17	659.03	840.21	825.78	802.11

Table A.8. Price formation equations for corn and sorghum, 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				(dollars per metric ton)			
Corn							
Gulf port (FOB) price	146.00	117.00	99.00	70.00	98.50	113.71	97.86
Shipping and insurance charges (SI @ $45.00/mt)	45.00	45.00	45.00	45.00	45.00	45.00	45.00
CIF price (CIF=FOB price + SI)	191.00	162.00	144.00	115.00	143.50	158.71	142.86
Import duty (ID) on corn @ $70/mt	70.00	70.00	70.00	0.00	0.00	0.00	0.00
Tariff on corn effective March 1987 @ 10% of CIF value	0.00	0.00	0.00	11.50	14.35	15.87	14.29
Sales tax (ST) @ 11% of CIF+import duty or tariff	28.71	25.52	23.54	13.92	17.36	19.20	17.29
Portgate price (PP=CIF+ID+SI)	289.71	257.52	237.54	140.42	175.21	193.78	174.43
Retail price (RP= (PP*(1+Wc))	573.19	509.50	469.97	277.81	346.66	383.40	345.11
Farmgate price (FGP= RP/1.55)	369.80	328.71	303.21	179.23	223.65	247.36	222.65
Sorghum							
Retail price*	368.48	327.54	317.67	299.57	373.81	413.43	372.14
Farmgate price (FGP=RP/1.55)	237.73	211.31	204.95	193.27	241.17	266.73	240.09

*Retail price: 1984, 1986 and 1987 are actual prices. For other years sorghum price is linked to corn price; see text for details.

Table A.9. Assumptions on population, consumption distribution, and income

Crop	1984	1985	1986	1987	1988	1989	1990
Population Growth Rates				(percent)			
Rural	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Total	1.90	1.90	1.90	1.90	1.90	1.90	1.90
Population				(thousands)			
Total	5503.00	5607.56	5714.10	5822.67	5933.30	6046.03	6160.91
Rural	4127.25	4201.54	4277.17	4354.16	4432.53	4512.32	4593.54
Urban	1375.75	1406.02	1436.93	1468.51	1500.77	1533.71	1567.37
Consumption Distribution				(percent)			
Rural							
Rice	63.00	63.00	63.00	63.00	63.00	63.00	63.00
Corn	74.00	74.00	74.00	74.00	74.00	74.00	74.00
Sorghum	89.00	89.00	89.00	89.00	89.00	89.00	89.00
Wheat	66.00	66.00	66.00	66.00	66.00	66.00	66.00
Constant Income (GDP) Growth Rate Assumptions							
Urban per capita	1.70	-4.70	1.70	1.70	1.70	1.70	1.70
Income				(dollars per capita)			
Urban	495.10	471.83	479.85	488.01	496.31	504.74	513.32

Table A.10. Baseline solution of rice and corn supply and utilization, 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
Rice							
Rice area ('000' ha)	97.00	83.06	97.31	98.52	99.16	99.19	101.26
Rice yield (kg/ha)	2052.00	2049.47	2067.69	2078.37	2143.08	2128.88	2148.65
Rice production ('000' mt)	199.04	170.22	201.21	204.75	212.50	211.15	217.57
Retail price ($/mt)	1262.62	1165.30	1127.12	1021.50	1302.32	1279.96	1243.27
Farmgate price ($/mt)	814.60	751.81	727.17	659.03	840.21	825.78	802.11
Rice prod cost ($/ha)	485.00	489.85	494.75	499.70	504.69	509.74	514.84
Production less loss	147.29	125.97	148.90	151.52	157.25	156.25	161.00
Production less milling	103.10	88.18	104.23	106.06	110.08	109.38	112.70
Consumption per capita (paddy rice kg)							
Rural	22.48	20.06	20.75	19.04	21.54	23.20	22.00
Urban	39.61	39.48	40.52	42.51	38.07	39.83	40.54
Domestic supply ('000' mt)							
Paddy rice	147.29	125.97	148.90	151.52	157.25	156.25	161.00
Rice consumption ('000'mt)							
Paddy rice	147.29	139.80	146.97	145.33	152.59	165.76	164.61
Consumption less Supply = Import ('000' mt)							
Paddy Import	0.00	13.83	-1.92	-6.18	-4.66	9.50	3.61
Total prod cost ('000' $)	47045.00	40686.05	48144.98	49228.17	50043.76	50558.96	52131.44
Gross receipts ('0000' $)	16214.04	12797.64	14631.51	13493.87	17854.50	17436.74	17451.38
Net rice income ('000' $)	115095.44	87290.35	98170.15	85710.50	128501.26	123808.43	122382.39
Corn							
Corn area ('000' ha)	219.00	193.25	216.10	212.25	222.34	228.69	218.64
Corn yield (kg/ha)		850.00	845.66	850.63	848.95	872.09	870.97
Corn production ('000' mt)	186.15	163.42	183.82	180.19	193.90	199.18	189.42
Retail price ($/mt)	573.19	509.50	469.97	378.83	472.72	522.82	470.61
Farmgate price ($/mt)	369.80	328.71	303.21	244.41	304.98	337.31	303.62
Corn prod cost ($/ha)	111.00	112.11	113.23	114.36	115.51	116.66	117.83
Production less loss	130.31	114.39	128.67	126.14	135.73	139.43	132.59
Production less milling	117.27	102.95	115.81	113.52	122.16	125.48	119.33
Consumption per capita (kg)							
Rural	23.36	21.77	23.84	25.32	28.97	27.96	28.59
Urban	24.63	24.60	25.83	28.59	27.55	26.96	28.38
Domestic supply ('000' mt)							
Whole corn	130.31	114.39	128.67	126.14	135.73	139.43	132.59
Corn consumption ('000' mt)							
Whole corn	130.31	126.05	139.09	152.24	169.76	167.50	175.84
Consumption less supply = import ('000' mt)							
Whole corn import	0.00	11.65	10.41	26.10	34.03	28.07	43.24
Total prod cost ('000' $)	24309.00	21664.72	24469.25	24274.17	25681.52	26679.62	25761.86
Gross receipts ('000' $)	80986.37	63521.98	65523.34	51876.87	67808.28	77138.76	66382.75
Net corn income ('000' $)	56677.37	41857.26	41054.09	27602.70	42126.76	50459.14	40620.89

Table A.11. Baseline solution of sorghum and wheat supply and utilization, 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
Sorghum							
Sorghum area ('000' ha)	174.00	165.94	175.04	175.59	173.34	172.81	174.08
Sorghum yield (kg/ha)	700.00	697.53	699.36	698.77	704.66	702.12	697.79
Sorghum prod ('000'mt)	121.80	115.75	122.42	122.70	122.15	121.34	121.47
Retail price ($/mt)	368.48	327.54	327.54	299.57	373.81	413.43	372.14
Farmgate price ($/mt)	237.73	211.31	204.95	193.27	241.17	266.73	240.09
Sorghum prod cost ($/mt)	66.60	67.27	67.94	68.62	69.30	70.00	70.70
Production less loss	85.26	81.02	85.69	85.89	85.50	84.94	85.03
Milling loss	76.73	72.92	77.12	77.30	76.95	76.44	76.53
Consumption per capita (kg)							
Rural	18.39	16.89	17.39	14.60	17.35	17.22	17.41
Urban	6.82	7.15	7.39	7.58	6.61	6.30	6.93
Domestic supply ('000' mt)							
Whole sorghum	85.26	81.02	85.69	85.89	85.50	84.94	85.03
Sorghum consumption ('000' mt)							
Whole sorghum	85.26	81.03	85.02	74.71	86.85	87.34	90.82
Consumption less Supply = Import ('000' mt)							
Whole sorghum import	0.00	0.01	-0.68	-11.18	1.35	2.40	5.79
Total prod cost ('000' $)	11588.40	7785.81	8316.86	8419.29	8465.24	8493.23	8587.70
Gross receipts ('000' $)	28955.40	24458.96	25089.20	23713.95	29457.79	32364.21	29164.47
Net sorghum income ('000'$)	17367.00	16673.15	16772.34	15294.66	20992.55	23870.97	20576.76
Wheat							
Wheat supply ('000' mt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Consumption per capita (kg)							
Rural	20.47	16.46	17.39	19.90	23.64	19.89	19.58
Urban	61.42	54.00	55.23	65.73	67.19	58.68	59.74
Total wheat consumption ('000' mt)							
Whole wheat	168.98	145.10	153.73	183.19	205.60	179.75	183.57
Consumption less supply ('000' mt)							
Whole wheat	168.98	145.10	153.73	183.19	205.60	179.75	183.57
Wheat consumption less milling	126.74	108.82	115.30	141.06	158.31	138.41	141.35

Table A.12. Baseline solution of costs and farm revenues, 1984-90

Crop	1984	1985	1986	1987	1988	1989	1990
				(hundred thousand dollars)			
Production Costs							
Rice	47045.00	40686.05	48144.98	49228.17	50043.76	50558.96	52131.44
Corn	24309.00	21664.72	24469.25	24274.17	25681.52	26679.62	25761.86
Sorghum	11588.40	7785.81	8316.86	8419.29	8465.24	8493.23	8587.70
Total	82942.40	70136.68	80931.09	81921.63	84190.52	85731.81	86481.00
Farm Income							
Rice	16214.04	12797.64	14631.51	13493.87	17854.50	17436.74	17451.38
Corn	80986.37	63521.98	65523.34	51876.87	67808.28	77138.76	66382.75
Sorghum	28955.40	24458.96	25089.20	23713.95	29457.79	32364.21	29164.47
Total	126155.81	100778.58	105244.05	89084.69	115120.57	126939.71	112998.60
Net Farm Income							
Rice	115095.44	87290.35	98170.15	85710.50	128501.26	123808.43	122382.39
Corn	56677.37	41857.26	41054.09	27602.70	42126.76	50459.14	40620.89
Sorghum	17367.00	16673.15	16772.34	15294.66	20992.55	23870.97	20576.76
Total	189139.81	145820.86	155996.58	128607.86	191620.57	198138.54	183580.05
				(percent)			
Income Growth Rates							
Gross farm income		-22.90	6.98	-17.56	49.00	3.40	-7.35
Efficiency growth rate		0.00	0.00	0.00	0.00	0.00	0.00
Farm income growth rate		-11.45	3.49	-8.78	24.50	1.70	-3.67
Exogenous growth rate		-0.94	0.34	0.34	0.34	0.34	0.34
Rural Income Growth Rate		-12.39	3.83	-8.44	24.84	2.04	-3.33
Urban Income Growth Rate		-4.70	1.70	1.70	1.70	1.70	1.70

Table A.13. Baseline solution of calorie consumption and distribution, 1984-90

	1984	1985	1986	1987	1988	1989	1990
			(calories per person per day)				
Consumption							
Rural	667.96	594.77	629.11	630.48	731.53	704.08	700.70
Urban	1009.11	955.24	984.48	1116.16	1079.55	1018.38	1049.35
All Haiti	753.25	685.15	718.48	752.97	819.56	783.81	789.40
Percentage Distribution of Calories, All Haiti							
Rice	24.53	23.88	25.50	24.41	23.71	24.50	25.24
Corn	28.14	28.11	28.57	26.35	26.53	28.35	26.95
Sorghum	16.84	18.21	17.40	16.41	15.29	15.79	15.81
Wheat	30.49	29.80	28.52	32.83	34.48	31.35	32.01
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table A.14. Impacts of a decrease in the tariff on corn imports from 50 to 10 percent on rice and corn supply and utilization

Crop	1984	1985	1986	1987	1988	1989	1990
Rice							
Rice area ('000' ha)	97.00	83.06	97.31	99.75	99.16	99.19	101.26
Rice yield (kg/ha)	2052.00	2049.47	2067.69	2078.37	2143.08	2128.88	2148.65
Rice production ('000' mt)	199.04	170.22	201.21	207.31	212.50	211.15	217.57
Retail price ($/mt)	1262.62	1165.30	1127.12	1021.50	1302.32	1279.96	1243.27
Farmgate price ($/mt)	814.60	751.81	727.17	659.03	840.21	825.78	802.11
Rice prod cost ($/ha)	485.00	489.85	494.75	499.70	504.69	509.74	514.84
Production less loss	147.29	125.97	148.90	153.41	157.25	156.25	161.00
Production less milling	103.10	88.18	104.23	107.39	110.08	109.38	112.70
Consumption per capita (paddy rice kg)							
Rural	22.48	20.06	20.75	16.54	18.86	20.21	19.24
Urban	39.61	39.48	40.52	41.21	36.91	38.61	39.30
Domestic supply ('000' mt)							
Paddy rice	147.29	125.97	148.90	153.41	157.25	156.25	161.00
Rice consumption ('000'mt)							
Paddy rice	147.29	139.80	146.97	132.52	138.99	150.41	150.00
Consumption less Supply = Import ('000' mt)							
Paddy Import	0.00	13.83	-1.92	-20.89	-18.27	-5.84	-11.00
Total prod cost ('000' $)	47045.00	40686.05	48144.98	49842.71	50043.76	50558.96	52131.44
Gross receipts ('0000' $)	16214.04	12797.64	14631.51	13662.32	17854.50	17436.74	17451.38
Net rice income ('000' $)	115095.44	87290.35	98170.15	86780.47	128501.26	123808.43	122382.39
Corn							
Corn area ('000' ha)	219.00	193.25	216.10	194.60	222.34	228.69	218.64
Corn yield (kg/ha)	850.00	845.66	850.63	835.89	872.09	870.97	866.35
Corn production ('000' mt)	186.15	163.42	183.82	162.66	193.90	199.18	189.42
Retail price ($/mt)	573.19	509.50	469.97	277.81	346.66	383.40	345.11
Farmgate price ($/mt)	369.80	328.71	303.21	179.23	223.65	247.36	222.65
Corn prod cost ($/ha)	111.00	112.11	113.23	114.36	115.51	116.66	117.83
Production less loss	130.31	114.39	128.67	113.86	135.73	139.43	132.59
Production less milling	117.27	102.95	115.81	102.48	122.16	125.48	119.33
Consumption per capita							
Rural	23.36	21.77	23.84	31.82	36.71	35.25	36.19
Urban	24.63	24.60	25.83	34.01	32.78	32.07	33.77
Domestic supply ('000' mt)							
Whole corn	130.31	114.39	128.67	113.86	135.73	139.43	132.59
Corn consumption ('000' mt)							
Whole corn	130.31	126.05	139.09	188.50	211.91	208.24	219.15
Consumption less supply = import ('000' mt)							
Whole corn import	0.00	11.65	10.41	74.63	76.18	68.81	86.56
Total prod cost ('000' $)	24309.00	21664.72	24469.25	22255.07	25681.52	26679.62	25761.86
Gross receipts ('000' $)	80986.37	63521.98	65523.34	34878.65	49726.07	56568.43	48680.68
Net corn income ('000' $)	56677.37	41857.26	41054.09	12623.58	24044.55	29888.81	22918.82

Table A.15. Impacts of a decrease in the tariff on corn imports from 50 to 10 percent on sorghum and wheat supply and utilization

Crop	1984	1985	1986	1987	1988	1989	1990
Sorghum							
Sorghum area ('000' ha)	174.00	165.94	175.04	176.68	173.34	172.81	174.08
Sorghum yield (kg/ha)	700.00	697.53	699.36	698.77	704.66	702.12	697.79
Sorghum prod ('000'mt)	121.80	115.75	122.42	123.46	122.15	121.34	121.47
Retail price ($/mt)	368.48	327.54	327.54	299.57	373.81	413.43	372.14
Farmgate price ($/mt)	237.73	211.31	204.95	193.27	241.17	266.73	240.09
Sorghum prod cost ($/mt)	66.60	67.27	67.94	68.62	69.30	70.00	70.70
Production less loss	85.26	81.02	85.69	86.42	85.50	84.94	85.03
Milling loss	76.73	72.92	77.12	77.78	76.95	76.44	76.53
Consumption per capita (kg)							
Rural	18.39	16.89	17.39	12.21	14.66	14.45	14.68
Urban	6.82	7.15	7.39	7.42	6.47	6.16	6.78
Domestic supply ('000' mt)							
Whole sorghum	85.26	81.02	85.69	86.42	85.50	84.94	85.03
Sorghum consumption ('000' mt)							
Whole sorghum	85.26	81.03	85.02	64.07	74.67	74.67	78.05
Consumption less Supply = Import ('000' mt)							
Whole sorghum import	0.00	0.01	-0.68	-22.35	-10.83	-10.26	-6.98
Total prod cost ('000' $)	11588.40	7785.81	8316.86	8471.68	8465.24	8493.23	8587.70
Gross receipts ('000' $)	28955.40	24458.96	25089.20	23861.51	29457.79	32364.21	29164.47
Net sorghum income ('000'$)	17367.00	16673.15	16772.34	15389.83	20992.55	23870.97	20576.76
Wheat							
Wheat supply ('000' mt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Consumption per capita (kg)							
Rural	20.47	16.46	17.39	18.74	22.44	18.79	18.56
Urban	61.42	54.00	55.23	64.92	66.36	57.95	59.00
Total wheat consumption ('000' mt)							
Whole wheat	168.98	145.10	153.73	176.91	199.04	173.65	177.74
Consumption less supply ('000' mt)							
Whole wheat	168.98	145.10	153.73	176.91	199.04	173.65	177.74
Wheat consumption less milling	126.74	108.82	115.30	136.22	153.26	133.71	136.86

Table A.16. Impacts of a decrease in the tariff on corn imports from 50 to 10 percent on costs and farm revenues

	1984	1985	1986	1987	1988	1989	1990
				(hundred thousand dollars)			
Production Costs							
Rice	47045.00	40686.05	48144.98	49842.71	50043.76	50558.96	52131.44
Corn	24309.00	21664.72	24469.25	22255.07	25681.52	26679.62	25761.86
Sorghum	11588.40	7785.81	8316.86	8471.68	8465.24	8493.23	8587.70
Total	82942.40	70136.68	80931.09	81921.63	84190.52	85731.81	86481.00
Farm Income							
Rice	16214.04	12797.64	14631.51	13662.32	17854.50	17436.74	17451.38
Corn	80986.37	63521.98	65523.34	34878.65	49726.07	56568.43	48680.68
Sorghum	28955.40	24458.96	25089.20	23861.51	29457.79	32364.21	29164.47
Total	126155.81	100778.58	105244.05	89084.69	115120.57	126939.71	112998.60
Net Farm Income							
Rice	115095.44	87290.35	98170.15	86780.47	128501.26	123808.43	122382.39
Corn	56677.37	41857.26	41054.09	12623.58	24044.55	29888.81	22918.82
Sorghum	17367.00	16673.15	16772.34	15389.83	20992.55	23870.97	20576.76
Total	189139.81	145820.86	155996.58	128607.86	191620.57	198138.54	183580.05
				(percent)			
Income Growth Rates							
Gross farm income		-22.90	6.98	-26.41	51.17	2.32	-6.58
Efficiency growth rate		0.00	0.00	0.00	0.00	0.00	0.00
Farm income growth rate		-11.45	3.49	-13.21	25.59	1.16	-3.29
Exogenous growth rate		-0.94	0.34	0.34	0.34	0.34	0.34
Rural income growth rate		-12.39	3.83	-12.87	25.93	1.50	-2.95
Urban income growth rate		-4.70	1.70	1.70	1.70	1.70	1.70

Table A.17. Impacts of a decrease in the tariff on corn imports from 50 to 10 percent on calorie consumption and distribution

	1984	1985	1986	1987	1988	1989	1990
				(calories per person per day)			
Calorie Consumption							
Rural	667.96	594.77	629.11	642.83	751.03	717.61	719.45
Urban	1009.11	955.24	984.48	1148.18	1110.78	1049.08	1082.12
All Haiti	753.25	685.15	718.48	770.28	842.03	801.70	811.72
				(percent)			
Distribution of Calories							
Rice	24.53	23.88	25.50	25.56	23.97	24.77	25.50
Corn	28.14	28.11	28.57	24.59	26.82	28.65	27.22
Sorghum	16.84	18.21	17.40	17.07	15.46	15.96	15.97
Wheat	30.49	29.80	28.52	32.78	33.75	30.62	31.31
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table A.18. Impacts of a decrease in the tariff on corn, rice, and wheat imports from 50 to 10 percent on rice and corn supply and utilization

Crop	1984	1985	1986	1987	1988	1989	1990
Rice							
Rice area ('000' ha)	97.00	83.06	97.31	98.21	99.16	99.19	101.26
Rice yield (kg/ha)	2052.00	2049.47	2067.69	2040.05	2143.08	2128.88	2148.65
Rice production ('000' mt)	199.04	170.22	201.21	200.36	212.50	211.15	217.57
Retail price ($/mt)	1262.62	1165.30	1127.12	749.10	955.04	938.64	911.73
Farmgate price ($/mt)	814.60	751.81	727.17	483.29	616.15	605.57	588.22
Rice prod cost ($/ha)	485.00	489.85	494.75	499.70	504.69	509.74	514.84
Production less loss	147.29	125.97	148.90	148.26	157.25	156.25	161.00
Production less milling	103.10	88.18	104.23	103.78	110.08	109.38	112.70
Consumption per capita (paddy rice kg)							
Rural	22.48	20.06	20.75	17.97	21.51	23.25	21.88
Urban	39.61	39.48	40.52	50.40	45.14	47.22	48.06
Domestic supply ('000' mt)							
Paddy rice	147.29	125.97	148.90	148.26	157.25	156.25	161.00
Rice consumption ('000'mt)							
Paddy rice	147.29	139.80	146.97	152.24	163.11	177.34	175.83
Consumption less Supply = Import ('000' mt)							
Paddy Import	0.00	13.83	-1.92	3.98	5.86	21.09	14.83
Total prod cost ('000' $)	47045.00	40686.05	48144.98	49075.72	50043.76	50558.96	52131.44
Gross receipts ('0000' $)	16214.04	12797.64	14631.51	9682.98	13093.30	12786.94	12797.68
Net rice income ('000' $)	115095.44	87290.35	98170.15	47754.06	80889.25	77310.46	75845.37
Corn							
Corn area ('000' ha)	219.00	193.25	216.10	208.34	222.34	228.69	218.64
Corn yield (kg/ha)	850.00	845.66	850.63	835.89	872.09	870.97	866.35
Corn production ('000' mt)	186.15	163.42	183.82	174.15	193.90	199.18	189.42
Retail price ($/mt)	573.19	509.50	469.97	277.81	346.66	383.40	345.11
Farmgate price ($/mt)	369.80	328.71	303.21	179.23	223.65	247.36	222.65
Corn prod cost ($/ha)	111.00	112.11	113.23	114.36	115.51	116.66	117.83
Production less loss	130.31	114.39	128.67	121.90	135.73	139.43	132.59
Production less milling	117.27	102.95	115.81	109.71	122.16	125.48	119.33
Consumption per capita (kg)							
Rural	23.36	21.77	23.84	25.86	31.31	30.32	30.76
Urban	24.63	24.60	25.83	32.45	31.28	30.60	32.22
Domestic supply ('000' mt)							
Whole corn	130.31	114.39	128.67	121.90	135.73	139.43	132.59
Corn consumption ('000' mt)							
Whole corn	130.31	126.05	139.09	160.26	185.73	183.73	191.79
Consumption less supply = import ('000' mt)							
Whole corn import	0.00	11.65	10.41	38.36	50.00	44.30	59.20
Total prod cost ('000' $)	24309.00	21664.72	24469.25	23826.63	25681.52	26679.62	25761.86
Gross receipts ('000' $)	80986.37	63521.98	65523.34	37341.63	49726.07	56568.43	48680.685
Net corn income ('000' $)	56677.37	41857.26	41054.09	13515.01	24044.55	29888.81	22918.82

Table A.19. Impacts of a decrease in the tariff on corn, rice, and wheat imports from 50 to 10 percent on sorghum and wheat supply and utilization

Crop	1984	1985	1986	1987	1988	1989	1990
Sorghum							
Sorghum area ('000' ha)	174.00	165.94	175.04	177.23	173.34	172.81	174.08
Sorghum yield (kg/ha)	700.00	697.53	699.36	698.77	704.66	702.12	697.79
Sorghum prod ('000'mt)	121.80	115.75	122.42	123.84	122.15	121.34	121.47
Retail price ($/mt)	368.48	327.54	327.54	299.57	373.81	413.43	372.14
Farmgate price ($/mt)	237.73	211.31	204.95	193.27	241.17	266.73	240.09
Sorghum prod cost ($/mt)	66.60	67.27	67.94	68.62	69.30	70.00	70.70
Production less loss	85.26	81.02	85.69	86.69	85.50	84.94	85.03
Milling loss	6.73	72.92	77.12	78.02	76.95	76.44	76.53
Consumption per capita (kg)							
Rural	18.39	16.89	17.39	9.86	12.51	12.45	12.48
Urban	6.82	7.15	7.39	7.28	6.35	6.05	6.65
Domestic supply ('000' mt)							
Whole sorghum	85.26	81.02	85.69	86.69	85.50	84.94	85.03
Sorghum consumption ('000' mt)							
Whole sorghum	85.26	81.03	85.02	53.62	64.96	65.46	67.73
Consumption less Supply = Import ('000' mt):							
Whole sorghum import	0.00	0.01	-0.68	-33.07	-20.54	-19.48	-17.30
Total prod cost ('000' $)	11588.40	7785.81	8316.86	8498.00	8465.24	8493.23	8587.70
Gross receipts ('000' $)	28955.40	24458.96	25089.20	23935.63	29457.79	32364.21	29164.47
Net sorghum income ('000'$)	17367.00	16673.15	16772.34	15437.63	20992.55	23870.97	20576.76
Wheat							
Wheat supply ('000' mt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Consumption per capita (kg)							
Rural	20.47	16.46	17.39	15.85	19.92	16.82	16.43
Urban	61.42	54.00	55.23	61.50	62.86	54.90	55.89
Total wheat consumption ('000' mt)							
Whole wheat	168.98	145.10	153.73	159.31	182.66	160.11	163.06
Consumption less supply ('000' mt)							
Whole wheat	168.98	145.10	153.73	159.31	182.66	160.11	163.06
Wheat cons less milling	126.74	108.82	115.30	122.67	140.65	123.29	125.55

Table A.20. Impacts of a decrease in the tariff on corn, rice, and wheat imports from 50 to 10 percent on costs and farm revenues

	1984	1985	1986	1987	1988	1989	1990
				(hundred thousand dollars)			
Production Costs							
Rice	47045.00	40686.05	48144.98	49075.72	50043.76	50558.96	52131.44
Corn	24309.00	21664.72	24469.25	23826.63	25681.52	26679.62	25761.86
Sorghum	11588.40	7785.81	8316.86	8498.00	8465.24	8493.23	8587.70
Total	82942.40	70136.68	80931.09	81921.63	84190.52	85731.81	86481.00
Farm Income							
Rice	16214.04	12797.64	14631.51	9682.98	13093.30	12786.94	12797.68
Corn	80986.37	63521.98	65523.34	37341.63	49726.07	56568.43	48680.68
Sorghum	28955.40	24458.96	25089.20	23935.63	29457.79	32364.21	29164.47
Total	126155.81	100778.58	105244.05	89084.69	115120.57	126939.71	112998.60
Net Farm Income							
Rice	115095.44	87290.35	98170.15	47754.06	80889.25	77310.46	75845.37
Corn	56677.37	41857.26	41054.09	13515.01	24044.55	29888.81	22918.82
Sorghum	17367.00	16673.15	16772.34	15437.63	20992.55	23870.97	20576.76
Total	189139.81	145820.86	155996.58	128607.86	191620.57	198138.54	183580.05
				(percent)			
Income Growth Rates							
Gross farm income		-22.90	6.98	-50.83	64.17	4.08	-8.95
Efficiency growth rate		0.00	0.00	0.00	0.00	0.00	0.00
Farm income growth rate		-11.45	3.49	-25.41	32.08	2.04	-4.47
Exogenous growth rate		-0.94	0.34	0.34	0.34	0.34	0.34
Rural income growth rate		-12.39	3.83	-25.07	32.42	2.38	-4.13
Urban income growth rate		-4.70	1.70	1.70	1.70	1.70	1.70

Table A.21. Impacts of a decrease in the tariff on corn, rice, and wheat imports from 50 to 10 percent on calorie consumption and distribution

	1984	1985	1986	1987	1988	1989	1990
				(calories per person per day)			
Consumption							
Rural	667.96	594.77	629.11	557.93	684.17	663.00	654.62
Urban	1009.11	955.24	984.48	1170.25	1126.31	1070.97	1103.85
All Haiti	753.25	685.15	718.48	712.36	796.01	766.49	768.91
				(percent)			
Distribution of Calories all Haiti							
Rice	24.53	23.88	25.50	25.29	24.66	25.37	26.18
Corn	28.14	28.11	28.57	26.96	27.59	29.35	27.95
Sorghum	16.84	18.21	17.40	17.53	15.90	16.35	16.39
Wheat	30.49	29.80	28.52	30.22	31.86	28.92	29.49
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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