ANALYSIS OF FOOD CROP PRODUCTION AND MARKETING TRENDS IN RWANDA WITH EMPHASIS ON DRY BEANS

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ABSTRACT

ANALYSIS OF FOOD CROP PRODUCTION AND MARKETING TRENDS IN RWANDA WITH EMPHASIS ON DRY BEANS

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This study examines trends in total and per capita food crop production, marketing and prices in Rwanda during the period 1970-1991. It gives special emphasis to dry beans. This study is also concerned with gaining more insights into rural household level dry bean transactions, and gaining a better understanding of the relative importance of rural bean imports through informal cross-border trade with Rwanda's neighboring countries. More specifically, the intent is to provide potential users and Rwandan policy makers with information on household dry bean transaction trends and other key market behavior indicators such as volume of bean sales, purchases, rural consumption and imports.

Empirical analysis, using a national informal imports identity approach and data from the 1990 ENRD, leads to a major conclusion that Rwanda is increasingly a net importer of dry beans. It is also found that a large and growing majority (84%) of rural households are net purchasers of beans. Results of the analysis show also a decline in bean and overall calorie production on both per capita and total basis (from 8 major food crops studied) among households in the net buyer categories.

Analysis undertaken to determine whether for a given household net sales position for one commodity are correlated with the net sales volume of other commodities shows relatively weak relationships at the national level, thus revealing some degree of specialization in sales. When analysis is conducted by selecting only households who are net

sellers of beans, sweet potatoes or bananas and on agroclimatical zones basis, more insights are gained on the degree of specialization in sales at the household level.

Bean production (coupled with overall food crop output) instability has led to year-to-year and monthly bean price fluctuations. This analysis tries to identify some of the factors responsible for such deviations from the typical seasonal pattern.

Government officials and private sector managers involved in the bean subsector are under increasing pressure to adjust their policy decisions under different bean supply scenarios. This study provides potentially useful information about such issues and suggests possible public and private actions to be taken that could better facilitate the process of regional integration of dry bean markets in Rwanda and neighboring countries of Zaire, Uganda and Burundi.

To my Parents, now gone.

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LIST OF ABBREVIATIONS

ae	Adult Equivalent
Avrg.	Average
BNR	The National Bank of Rwanda
CEPGL	Economic Community of the Great Lakes
CIF	Cost, Insurance, and Freight
CPI	Consumer Price Index
DSA	Division of Agricultural Statistics of MINAGRI
ENBC	National Household Budget and Consumption Survey (MINIPLAN)
ENRD	National Household Revenues and Expenditures Survey (MINAGRI)
FAO	Food and Agricultural Organization of the United Nations
FOB	Free On Board
FRW	Rwandan Franc (the national monetary unit)
GOR	Government of Rwanda
H.H	Household
IBRD	International Bank for Reconstruction Development
ISNAR	International Service for National Agricultural Research
MAV	Moving Average
MINAGRI	Ministry of Agriculture, Livestock, and Forests, Republic of Rwanda
MINIPLAN	Ministry of Planning, Republic of Rwanda
OBK	Organization of Kagera Basin
ONAPO	National Office of the Population
OPROVIA	National Office for Development and Marketing of Food and Animal Products
PREF	Prefecture (Administrative Units as listed below)
But	Butare
Byu	Byumba
Cya	Cyangugu
Gik	Gikongoro
Gis	Gisenyi
Git	Gitarama
Kgo	Kibungo
Kbye	Kibuye
Kig	Kigali
Ruh	Ruhengeri
PTA	Preferential Trade Area
SAP	Structural Adjustment Program
Std	Standard Deviation
US$	United States Dollar
Yr	Year

ANALYSIS OF FOOD CROP PRODUCTION AND MARKETING TRENDS IN RWANDA WITH EMPHASIS ON DRY BEANS

CHAPTER I. INTRODUCTION

Two overriding concerns of the Government of Rwanda's (GOR) agricultural production, marketing and trade policy in food crops have been the desire to protect local producers and to save foreign exchange. This option loosely assumes the desirability and feasibility of a high national degree of food self-sufficiency. To this end, imports of food crops such as beans, sorghum, bananas, etc, from neighboring countries have been officially restricted if not banned under normal circumstances. At the same time, unofficial food inflows into Rwanda have been substantial for many years. Increasingly there has been recognition among Rwandan analysts that the self-sufficiency policy has not been fully realized, and that increases in total agricultural output, productivity, and incomes have fallen short of anticipated levels.

It is only in recent years that many public and private sector analysts and donor institutions in Rwanda voiced increased interest in designing and launching a market-oriented food policy based on national self-reliance, rather than strict self-sufficiency. Currently such a strategy is being considered by the GOR as a cornerstone of successful food security and overall economic growth and development. Among other things, it is expected that such an approach will play a potential role in speeding up the transition from subsistence farming to commercial production. However, food security-related trade as one component of this new philosophy of market integration of traditional agriculture must be viewed against the backdrop of socio-economic and agricultural policies in Rwanda as well as in individual neighboring nations. Indeed, some past and even present agricultural marketing and pricing

policies in Rwanda conflict with the expansion of trade (price controls, import licensing, etc).

In Rwanda, dry beans are a key crop that provide both calories and proteins, and have historically received considerable government focus in terms of production, pricing and import policy. Analysis of the historical production and marketing situation for dry beans, undertaken in the context of changes facing other major food crops, can contribute to improved insights into challenges and opportunities facing the current GOR objective of developing a more market-oriented food policy.

1.1 Study Objectives

The general objective of this study is to analyze recent production, marketing and trade relationships for dry beans in the context of production and pricing changes facing other major food crops grown in Rwanda. Five more specific objectives derive from the need for analysis to guide market-oriented food policy concerns discussed above. They are to:

- Analyze national-level agricultural production (both total and per capita) and price trends for dry beans and seven related major food crops grown in Rwanda;
- Analyze household level dry bean market behavior (volume of domestic household level bean transactions);
- Analyze the historical behavior of dry bean imports as potential sources of calories and proteins to make up national short-falls. Also to describe the nature of informal cross-border trade in dry beans and other agro-based and consumer commodities;
- Analyze annual and seasonal dry bean prices and factors associated with price variation;
- Under different domestic and regional dry bean supply scenarios (short-falls or excess bean production in Rwanda and/or neighboring nations), suggest possible public and private sector actions that might improve performance of the bean market for both producers and consumers.

This could include recommendations for further analyses and/or data collection needed to continue assisting the GOR to improve its market-oriented bean policy.

Because of data limitations and the range of issues involved, this paper will provide a preliminary analysis of the important questions raised in this study. Until results of more detailed studies are available, it is hoped that the following review of the subject will be of interest to decision makers and other potential users.

1.2 Research Approach

To accomplish the objectives of this study, an analysis of the existing related studies is carried out. Second, information from various organizations and institutional reports and sector studies is used to describe the nature of official dry bean trade and informal cross-border trade. Data on domestic production of 8 staple food crops, on rural household commodity and labor transactions, and a price data base for dry beans are used in the following analyses.

Prices used are retail market prices collected in Kigali-Center for beans (except for 1972-1974 where monthly bean prices are from Gikongoro). Kigali is the largest commercial center in Rwanda, with very diverse types of food merchants. According to Loveridge and Ngirumwami (1987), Kigali-Center merchants tend to be both retailers and wholesalers. They appear to act as intermediaries between deficit and surplus regions. Hence, it is believed that prices in Kigali-Center market can be used for the purpose of the bean market analysis herein.

Prices in urban areas such as Kigali are also good indicators of prices received and paid by farmers in many rural areas of Rwanda. Loveridge (1988) found relatively high correlations between different market levels (urban retail, farmer sale and farmer purchase prices) especially for Prefectures such as Kigali which is relatively self-sufficient and the flow of beans was normally unidirectional from rural to urban areas). Overall, Loveridge concluded:

"Prices received by farmers are generally lower than urban prices as long as there are rural surpluses. In contrast, prices received by farmers are about the same as urban prices with significant imports".

National crop production estimates are as reported in FAO Production Yearbooks for the last two decades. However, the time series sample period may vary according to the specific topic of focus.

FAO's series are preferred to figures from the Division of Agricultural Statistics (DSA) of the Ministry of Agriculture, Livestock, and Forests (MINAGRI) because they are available for a period back as early as 1961 whereas DSA data cover only the past six years (starting with 1984). Overall, data from the two sources since 1984 shows the same trend. It is noteworthy however, that FAO's figures on banana production seem to be underestimated. The author thinks that FAO mostly reported the banana "plantains" while DSA reports data on both plantains and "bananas for beer." Hence, the FAO production data on bananas has been inflated by 21 percent after comparison with DSA figures on bananas. The interested reader is referred to Appendix A1.1 for this comparison and adjustment of data on bananas.

Because foreign supplies also influence local food availability in Rwanda, national production statistics are not enough to determine the nature of aggregate food shortfalls. Unfortunately, relevant production statistics from neighboring countries are either unavailable or unreliable for this analysis. Hence, the compromise is to rely more on prices in Rwanda as a key indicator of the degree of food scarcity. In fact, it is believed that prices reflect a number of factors, including foreign and domestic supplies, and transport and storage costs. It is worth mentioning, however, that using prices as a proxy for food availability has a drawback--that is, prices are only indicators of availability whereas food security involves both availability and access.

Using volumes of rural dry bean sales and purchases and other transactions, a dry bean imports identity is derived to estimate import

quantities. These transactions are based on a survey of over 1200 households' "Income and Expenditure" conducted by DSA in the 1990 agricultural year. A seasonal price index is also computed for the purposes of assessing typical variations from the general seasonal pattern and predicting bean prices in three years ahead.

1.3 Organization of the Paper

This paper is organized as follows. Chapter I is devoted to introductory remarks, objectives, and the research approach of the study. Chapter II provides an overview of the Rwandan farm sector, food security, agricultural trade, and structural adjustment program. Chapter III discusses historical national dry bean and other food crop production trends in terms of total and per capita output, as well as price trends for these crops. Emphasis is also put on examining changes in the relative importance of individual crops in supplying calories and proteins. A composite calorie price series is also computed.

Chapter IV deals with domestic bean transactions; volumes transacted are estimated at the household and extrapolated to the national level. Chapter V describes the nature of informal cross-border trade and examines the historical behavior of bean imports as an additional source of calories and proteins. Chapter VI analyzes annual and seasonal bean price fluctuations. It also examines domestic and regional factors associated with price fluctuations. In the course of this analysis, a "Price Index of Seasonality" is developed for dry beans, showing both the standard deviations and trends. A "Projected Seasonal Price Index " for 1992-1994 is also shown.

Chapter VII treats dry bean market performance. It suggests some possible public and private sector actions that might improve performance of the bean market under different domestic and regional dry bean supply scenarios. Chapter VIII summarizes the major conclusions, discusses policy implications and notes limitations of the study.

CHAPTER II. BACKGROUND ON AGRICULTURE AND RELATED TOPICS IN RWANDA

2.1 Overview

2.1.1 Human and Physical Resources

Rwanda is a small landlocked country (26,338 square kilometers) located in central eastern Africa. The country is characterized by a series of hills with steep slopes and flat ridges intersected by deep valleys with plains at the bottom. Rwanda is a country of high mountains with altitudes ranging between 1000 and 3000 meters (ISNAR, 1983).

There is moderate rainfall in two rainy seasons with great variation in both intensity and duration. Temperatures are mild however, varying widely depending on relief and altitude. Soil fertility varies causing regional concentrations of major crops and livestock. Delepierre (1974) describes 12 agro-ecological zones in Rwanda based on altitude, rainfall, and soil type criteria: these exhibit differences in crop and livestock specializations and are fairly closely related to variations in farming systems.

Rwanda has limited natural resources, including a shortage of land due to the mostly hilly and mountainous terrain and costly-to-use wetlands. Its level of social and economic development remains among the lowest in the world, despite important strides made since independence in 1962: per capita income reached only US$310 in 1989, life expectancy is 47 years, and adult literacy is only 37 percent (World Bank, 1990).

An extraordinarily high birth rate threatens the longer term stability of the country. Rwanda is the most densely populated of the African continent, with over 250 inhabitants per square kilometer and has one of the highest population growth rates (3.7-4.0 percent) in the

world (Goldmark, 1987). The rural population (most of all involved in agriculture) is estimated to be over 90 percent of the total.

The average farm at the national level contained 0.94 hectares (94 ares) of land (Table 2-1), with considerable variation by Prefecture: largest average farm size appears in Kibungo and Kibuye, with the smallest in Gisenyi and Cyangugu.

Table 2-1: Distribution of Cultivated Land by Quartile of Area Available per Household (in ares); 1990 Season B

	QUARTILE 1		QUARTILE 2		QUARTILE 3		QUARTILE 4		RWANDA	
PREF.	% Of Land	Avrg Area per HH	% Of Land	Avrg Area per HH	% Of Land	Avrg Area per HH	% Of Land	Avrg Area per HH	Avrg Area per HH	Cases in Sample
But	9.3	33.1	17.2	61.9	25.2	91.0	48.4	175.1	90.1	147
Byu	8.4	38.1	16.3	72.6	23.5	105.7	51.8	233.3	112.5	110
Cya	7.8	19.7	13.5	35.8	23.5	59.7	55.3	139.3	64.0	93
Gik	7.0	23.5	13.9	47.6	22.9	80.1	56.2	188.5	85.2	91
Gis	7.9	15.1	15.8	29.5	25.0	47.4	51.2	97.9	47.3	127
Git	7.1	27.3	14.4	56.1	24.3	93.0	54.2	209.5	96.5	155
Kgo	7.3	39.3	15.1	84.4	26.0	143.3	51.7	284.2	137.4	94
Kbye	7.5	37.8	14.8	71.5	24.9	122.9	52.8	264.7	123.8	86
Kig	7.0	29.5	14.5	62.7	28.3	120.3	50.3	220.4	107.5	152
Ruh	8.0	27.0	14.9	49.2	24.2	81.3	52.9	174.1	83.2	123
RWANDA	7.7	29.1	15.1	57.2	25.0	94.4	52.1	197.1	94.4	1178

Source: Computed from DSA raw data, 1990

When taking into account the number of adult equivalents living on each farm (Table 2-2), the average national level farm has about 21 ares per adult equivalent, again with significant variation across Prefectures. Kibungo and Kibuye persist in having the largest farm size per adult equivalent, with Gisenyi and Cyangugu again having the smallest.

The land distribution patterns shown by the data in Tables 2-1 and 2-2 indicate that land is somewhat concentrated in the upper quartile households. On a per farm basis, the upper 25 percent of households hold some 52 percent of land, with average farm sizes (1.97 hectares) more than double the national average (0.94 hectares).

Table 2-2: Distribution of Cultivated Land by Quartile of Area Available per Household Adult-Equivalent (in ares); 1990 Season B

	QUARTILE 1		QUARTILE 2		QUARTILE 3		QUARTILE 4		RWANDA	
PREF.	% Of Land	Avrg Area per ae	% Of Land	Avrg Area per ae	% Of Land	Avrg Area per ae	% Of Land	Avrg Area per ae	Avrg Area per ae	Cases in Sample
But	10.1	8.4	16.7	14.0	24.5	20.1	48.8	41.0	20.8	147
Byu	9.9	9.5	15.7	14.9	24.3	22.8	50.1	49.0	23.9	110
Cya	8.6	4.3	14.9	7.9	25.9	13.1	50.5	25.7	12.8	93
Gik	7.6	6.0	15.4	12.3	23.9	18.4	53.1	42.2	19.7	91
Gis	7.9	4.1	14.9	7.4	23.9	12.4	53.4	27.8	12.9	127
Git	7.4	6.9	15.5	13.8	25.6	23.7	51.4	46.8	22.8	155
Kgo	7.3	9.5	14.0	17.8	27.0	34.1	51.7	68.2	32.2	94
Kbye	6.9	8.2	13.9	16.3	24.0	29.4	55.3	66.7	30.0	86
Kig	7.3	6.4	15.2	13.5	23.2	20.5	54.4	47.0	21.9	152
Ruh	9.4	6.6	15.4	10.7	25.0	17.3	50.2	35.3	17.4	123
RWANDA	8.2	7.0	15.2	12.9	24.7	20.9	51.8	44.3	21.2	1178

Source: Computed from DSA data on Land (1990) and adult equivalent conversion factors from ENBC, MINIPLAN (1988)

On an adult equivalent basis, a very similar pattern is shown, with the upper quartile households holding 51.8 percent of the land and average size farms of 44 ares per adult equivalent.

The lowest quartile households, as a national average, have total farm sizes of less than one third of a hectare, and as a group, this quartile holds only about 8 percent of the land. On an adult equivalent basis, results are similar, with very small amounts of land (seven ares per ae).

In summary, available household level data on land in Rwanda show that farm sizes have already reached alarmingly small levels, especially for households in the smallest farm size quartile. If prevailing land tenure, population growth, and technology patterns persist in the future, small plot sizes per household and per adult equivalent in these households will make it extremely difficult to sustain a typical rural household in Rwanda.

2.1.2 Economic Indicators

So far, Rwanda's integration into the international exchange economy has been largely based on agriculture, which accounts for 40 percent of the GNP. Exports are almost entirely agricultural,

specifically coffee and, more recently, tea. Coffee alone provides three-quarters of the foreign exchange earnings (Nezehose, 1990 and Braun and al., 1991). Manufacturing is limited by the small domestic market, difficult and costly access to external markets, and the shortage of local skilled labor, as well as marketing and entrepreneurial capabilities (IBRD, 1990).

Since 1980, Rwanda's economic growth has slowed and become more erratic. In contrast to an average GDP growth of 6.6 percent between 1973-80, the 1980-87 growth averaged only 2.6 percent, including a decline of 3.2 percent in 1988, mostly reflecting unfavorable weather conditions and a drastic decline in world market prices for coffee. In 1989, GDP declined further by about 3.2 percent, owing largely to adverse climatic conditions and restrictive import licensing (IBRD, 1990).

2.1.3 Food Security

One of the pressing issues of the population and government of Rwanda is food security. Despite extensive efforts in recent years, food availability in Rwanda is still considered inadequate (IBRD, 1991). Moreover, it is highly probable that the dependence of the country on both regional and world food markets will increase in the decade ahead, assuming foreign exchange is somehow made available to procure such supplies.

A textbook definition of food security is "the ability of a country or a region to assure, on a long-term basis, that its food system provides the total population access to a timely, reliable, and nutritionally adequate supply of food" (Eicher and Staatz, 1986). Reutlinger (1984) reports that food insecurity may be either transitory or chronic. Transitory food insecurity results from short-term phenomena such as food production shortfalls or reduction in income which reduce the ability of vulnerable groups to acquire food in the marketplace.

In Rwanda, crop production is one primary component of a household's ability to assure its own food security. Staple crops provide food for home consumption, with eventual surpluses for some households sold as cash sources to provide income to purchase food and meet other cash expenses. Despite government's restrictive recommendations about crop choices per natural region, farmers grow a diverse mix of crops.

On a daily basis, beans and sweet potatoes/white potatoes constitute the main food for the majority of the population in the rural areas. However, variation in food consumption is noticeable across geographic zones. Beans play a critical role in Rwandan food security because they are more storable sources of calories and the key protein source. Data in Table 2-3 reveals that overall beans are the third most important form of caloric food production, accounting for 16.3 percent of total calorie production. Bananas (27.2 percent) and sweet potatoes (21.3 percent) are also major sources of calories for Rwandans and they store well prior to harvest. Although these products are highly perishable once harvested, they remain important in mitigating the effects of short term production shortfalls at the local level.

Table 2-3: Major Crop Contributions of Lipids, Calories, and Proteins as Percentages of Total Output in Rwanda; 1989

Crop	% of Total Calories	% of Total Proteins	% Total Lipids	% of Total* Area Planted
Beans	16.3	44.0	20.3	19.4-13.0
Sorghum	9.8	9.7	3.9	2.7-14.1
Maize	7.7	8.5	25.4	11.1-4.7
Bananas	27.2	10.5	9.3	26.5-26.2
S.Potatoes	21.3	11.8	9.9	10.0-10.9
W.Potatoes	3.5	3.0	1.2	2.2-2.3
Cassava	8.1	1.7	3.3	8.4- 8.2

Source: DSA, 1991

* Figures in the last column are for season A (October - March) and season B (April - September) respectively.

According to McMartin, Dufner, and Erlandson (1977), beans are consumed in most nations of the world, yet different types are not readily substituted for one another, and per capita consumption varies greatly from one country to another. Beans are a relatively cheap source of protein, so their per capita consumption is relatively high among low-income groups. These findings are especially important for Rwanda.

Table 2-3 also shows, in terms of total production of proteins, that beans are ranked first with 44 percent, followed by sweet potatoes (11.8 percent), and sorghum (9.7 percent). The ENBC study found that animal products constitute only about eight percent by value of the total food consumption among rural households. Thus, beans are clearly the most important source of proteins in rural diets, especially among households that do not own livestock of any type. In terms of lipids as a percentage of total output, the major dominant crops are maize with 25.4 percent, and beans (20.3 percent).

In terms of area planted, bananas are the most important (26.5 percent) followed by beans (19.4 percent), maize (11.1 percent), and sweet potatoes (10.0 percent), to name but a few. Coffee and tea occupy more than 90 percent of area planted for export crops.

Livestock also plays a role in ensuring food security of some rural households. They provide manure for agricultural production, and a store of wealth. As shown in Table 2-4, goats dominate the number of ruminants owned by typical households (53.4 percent of households have goats), followed by cattle (27.1 percent), sheep (24.4 percent), and hogs (13.0 percent of households) (DSA, 1991).

Referring to the rural component of the National Budget and Consumption Survey (ENBC) conducted by Rwandan Ministry of Planning (Miniplan) in 1983, Rwamasirabo (1990) reported that of the total net income per household per year, animal production represented 8 percent. Breaking down the gross value of animal production, he found that cattle contributed 40 percent, goats 30 percent, pigs 13 percent, and sheep 7

percent. He also found that some 27 percent of households have no livestock, with this increasing to almost 50 percent for households with less than 0.5 hectares of land per farm.

Table 2-4: Total Number of Animals, Percentage of Households Owning and Average Number of Livestock Species per Household

Animal Species	Total Number	% Households Owning	Avrg Number/ Household
Cattle	788,588	27.1	2.2
Goats	1,976,366	53.4	3.0
Sheep	725,481	24.4	2.4
Hogs	280,528	13.0	1.7

Source: DSA, 1991

Also using results from ENBC, Schnepf (1992) reports: "The prevalences of chronic malnutrition and underweight children are extremely high in Rwanda, relative to other African countries, and reflect the widespread poverty of the rural and urban population." He also found that: "Nearly 53 percent of rural children younger than six in Rwanda were found to be chronically malnourished, while 5 percent were acutely malnourished, and nearly 30 percent were underweight. These figures are slightly higher than levels of urban malnutrition: 38 percent of urban children younger than five years of age were stunted, over 6 percent were wasted, and 22 percent were underweight."

According to the same author, the rural poor orient the majority of their income toward food acquisition as a 10.0 percent increase in income, which is accompanied by a 9.2 percent increase in food expenditure and a 6.7 percent increase in calories. Higher income rural households seem to have food expenditure and calorie acquisition elasticities very similar to those of lower income urban households. This demonstrates the disparity in nominal wealth levels between rural and urban areas.

The Government of Rwanda's current main objectives in the agricultural and food security sectors are to promote market-induced specialization and improve income growth. According to World Bank (1991), this will most rapidly increase agricultural production and its

derivatives: processing, transport, storage, exports, etc, and thereby best promote food security. One way out of the prevailing impasse (dependence on agricultural production, crop yields at traditional levels, and population pressure) is to concentrate on increasing yields, primarily by developing technical packages based on the use of modern inputs, particularly of mineral fertilizers.

With such a market-induced approach farmers are expected to produce for the market, thereby getting cash to buy inputs to increase yields and output. Another advantage of production for the market is that it permits the producer to use credit to purchase inputs, labor, etc. Through higher-value specialization, it is believed that a market strategy will permit Rwanda to realize its comparative advantage by selling abroad what it produces mostly successfully, and importing what it cannot produce well or at all.

The advantages discussed above are by no means a complete list. However, they are the principal reasons generally used in Rwanda against favoring the old strategy of strict self-sufficiency which may not adequately stimulate market-oriented production and possible regional trade. A key question is to what extent a self-reliance policy can ensure a sustainable economic growth and food security. Yet the prior self-sufficiency option coupled with macroeconomic constraints such as shortages of foreign exchange, budgetary shortfalls, probably the debt crisis in 1980s, etc, has substantially limited the number of actions that the government can undertake to improve rural living standards.

2.1.4 Agricultural Trade

Within Rwanda, initial market assembly and local redistribution of many food crops including dry beans are carried out by numerous small traders and agents acting either on their own account or on behalf of larger merchants. Due to a lack of accurate price and market information outside the merchant network, plus the lack of credit and the low quality of farm and household storage, the producers' bargaining

position has sometimes been reduced. Indeed, some argue that farmers are occasionally forced to sell at lower prices (the case of white potatoes in 1983 is a good illustration). However, recent improvements in nationwide transport, marketing, and information have opened much greater opportunities for both domestic and international trade in a large range of commodities, including food. Trade contributes much to the food security of the households because it increases food supplies and augments employment and income.

Unlike many African countries, the GOR has done little to restrict domestic food crops marketing, which is in contrast to the cross-border food crops marketing policy. Loveridge (1991) reports that movement of commodities from one region of the country to another as well as between rural and urban markets is relatively unregulated. In contrast, export of most food crops and livestock were officially prohibited prior to independence, and at independence this law was not repealed. But in practice, a considerable number of agricultural products still seem to move between Rwanda and neighboring countries.

Trade regulations, however, are observed concerning the determination of the days, hours, and locations of the domestic markets. The majority of the markets in Rwanda take place once a week, twice, three or four times per week for others. The large urban and regional markets can be opened every day of the week. Tardif-Douglin (1991) found that some of these restrictions are related to traditional market regulations and others are based on strategic considerations (reduction in drunkenness, idleness, and lack of labor productivity from experience in the past). Although the majority of these regulations seem to improve the markets behavior, cases exist where their application is very restrictive and reduces the dynamic of the market activity (producers are often forced to leave the marketplace at a determined hour even if they have not yet sold their commodities).

In a world which is becoming increasingly interdependent, Rwanda like other developing countries is reformulating its existing production

and trade policies in an effort to maintain economic stability in the midst of a growing economic crisis.

Rwanda is landlocked in the center of Africa and relies on road transport primarily through Uganda, Burundi, Kenya, and Tanzania for moving its imports and exports. The nearest seaports are Mombasa in Kenya (1250 km) and Dar es Salaam in Tanzania (1950 km). In very recent years, some of these transport routes have become increasingly insecure, thus rendering Rwanda's international transactions extremely vulnerable. The related high transportation costs are almost prohibitive for the integration of bulky commodities into the international exchange economy.

For instance, Braun and al. (1991) reports that transport costs for cereals from Rwanda to Mombasa exceed normal f.o.b world market prices and thus, export and import parity prices of cereals in Rwanda establish a range between negative and more than twice the long-term average of the c.i.f East Africa coast price.

In an attempt to promote their regional economic growth, lessen their growing international dependency and assure their food security, Rwanda and other African countries have organized themselves into different economic associations, with the possibilities that one country can adhere to more than one regional organization.

For the specific case of Rwanda, it is a member of the Economic Community of the Great Lakes (CEPGL) which includes Burundi and Zaire. Rwanda has also joined the Kagera Basin Organization (OBK) which covers a geographical area comprising in addition, Burundi, western Tanzania, southwestern Uganda, and eastern Zaire. Rwanda is also affiliated to Preferential Trade Area (PTA). Although the circumstances and objectives vary, a common goal of these organizations it to increase intra-regional trade as a way to combat factors handicapping each member country's prosperity.

2.1.5 Structural Adjustment Program

The reasons for the economic crisis in the Third World in general and in Rwanda in particular since the last decade, and the regional problems just discussed are the focus of more exhaustive studies. For purposes of the present study, it is important to mention that overall development problems are basically related to historical trade patterns, transport, weather, war, and domestic policies, and must be overcome if greater intra-regional trade is to succeed.

If we particularly consider one aspect of the domestic policies problem, many of the countries within the associations mentioned above have domestic policies which discourage intra-regional transactions. These include the maintenance of overvalued currencies which result in increased imports and decreased exports, and direct consumer subsidies for food and other necessities. In addition, there is a use of tariffs for controlling domestic spending and for tax collection purposes.

Since November 1990, Rwanda has relaxed some of these constraints by initially devaluating its currency by forty percent in response to domestic economic difficulties such as rapidly increasing international debt and balance of payments deficits. More recently (June 1992), another fifteen percent devaluation was adopted.

According to Miniplan (1990), the primary goal of the on-going Structural Adjustment Program (SAP) in Rwanda is to improve the supply response of the economy to changing market conditions. There is also a hope that SAP policy reforms would increase exports, improve the balance of payments account, and increase income growth. A crucial role will be devoted to the encouragement of market forces and price mechanisms in the allocation of resources. Controls through restrictions which handicap the development of both domestic and international trade will be eliminated in the short term.

2.2 Related Research

This section briefly reviews the literature that directly relates to the subsequent understanding of agricultural trade. First, focus is on the general literature on international agricultural trade primarily in the Third World, and finally a review is developed in the context of Rwanda and economic affiliations (CEPGL, OBK, PTA) to which it belongs.

Developing countries are prone to complain about the protectionist policies of the developed countries and about the perceived decline in their external terms of trade. As a general rule, they also tend to be pessimistic about their own potential to compete in international markets.

Schuh (1988) found that the reason for such a situation is that many of the barriers to the developing countries' export performance are self-imposed. Indeed, they over-value their currencies by wide margins, impose explicit export taxes on their primary commodities and embargoes on exports of agricultural goods so as to keep domestic prices of such goods low. To the same end they tend to impose complicated licensing schemes. Empirically, these self-imposed distortions tend to be as important, or more important, as compared to externally imposed barriers to trade.

These policies tend to limit the response on the part of both consumers and producers to changes in conditions in commodity markets, thus not only contributing to the instability in these markets, but also making agricultural sector socially unprofitable.

According to Vidali (1988), developing countries have been virtually ousted from international agricultural markets, because--having only their natural resources--they are financially and technologically uncompetitive in an environment characterized by volatile exchange rates and a high degree of protectionism.

Thus, developing countries have lost an important source of foreign exchange. Because of their high level of indebtedness and a critical lack of resources for financing development, they have

undertaken a justified struggle to open the markets of the developed countries to their agricultural exports.

The same author believes that one of the major factors producing distortions in agricultural trade is the disequilibrium between supply and demand promoted by the subsidies paid to producers in the industrial countries, and the enormous scientific and technological progress that has served to increase their output.

Timmer, Falcon, and Pearson (1983) argue that the tendency to protect a country's food producers and consumers from unstable world markets is quite understandable, especially when there is no use of market systems to generate price signals or to reflect relative scarcity to both producers and consumers. For them, such autarky has its costs, including lower overall levels of consumer welfare, although some countries may achieve a more equal distribution of important commodities through such policies.

Potential for greater trade in food commodities in Rwanda and among its neighboring countries in Central-Eastern Africa is possible through regional organizations but has yet to be fully exploited. One could argue, however, that this potential is sporadic and subject to the vagaries of the weather and potential disruptions of transport routes depending on the socio-political situation in the region.

It is in this context that in the recent years, most Central-Eastern African countries have increasingly voiced an interest in expanded intra-regional trade as one strategy towards increased food security within the geographic area. In fact, some of them are landlocked, transport costs are high, and dependence on trade with external countries is perceived as risky.

Nevertheless, based on the economic theory of integration, Koester (1986) mentions two arguments against regional cooperation. First, regional cooperation could detract from worldwide integration, which is seen as economically more efficient. Second, it implies discrimination against other possible trading partners. However, Koester believes in

the existence of the overall potential for regional cooperation to improve food security.

CHAPTER III. HISTORICAL NATIONAL FOOD CROP PRODUCTION BEHAVIOR

This chapter undertakes an analysis of changes in domestic production and prices for 8 staple food crops since 1970 with special emphasis on dry beans. The analysis is undertaken at the national level, and no attempt is made to disaggregate results to the prefectoral level. Thus, the chapter begins by examining the trends in both total and per capita production. Trends in dry bean and other seven major food crop prices are also examined and a composite calorie price series is computed. The analysis covers the following food commodities: beans, peas, maize, sorghum, sweet potatoes, cassava, white potatoes, and bananas. These eight products provide about 95 percent of total calorie output in Rwanda.

3.1 Trends in Total Food Crop Production

National production estimates of the eight major food crops for the period from 1970-1990 are shown in Table 3-1 and are graphed in Figures 3.1 to 3.3.

Two years (1974 and 1984) were characterized by generally recognized droughts. The 1984 case probably caused more severe effects especially with respect to the strict self-sufficiency policy which, by that time was only 2 years old. Sweet potatoes, and to some extent maize appear to have proved their resistance to the drought in 1974, whereas the weather vagaries in 1984 apparently did not affect output of cassava and white potatoes.

Figures 3.1, 3.2 and 3.3 show a steady increase in production in the 1970s for each individual crop except for peas, which declined fairly steadily until 1989. The same trend is observed in the early 1980s, with more fluctuations around the trend while a general slowdown in the expansion of output occurred in the mid-1980s. One crop, namely maize was not responsive to the normal rainfall in 1985, a year in which the remaining crops of interest showed a significant production recovery.

Table 3-1: Production of 8 Major Food Crops in Rwanda; 1970-1990 (Thousands of Metric Tons)

Year	Banana	Beans	Cassava	Maize	Sweet Potatoes	White Potatoes	Peas	Sorghum
1970	1998	144	345	64	417	126	65	156
1971	2032	144	372	56	403	148	67	140
1972	2034	131	350	50	418	131	55	144
1973	2138	133	363	55	431	140	56	142
1974	1994	115	360	64	617	110	51	121
1975	2098	153	394	67	681	150	57	144
1976	2202	163	415	71	700	170	57	155
1977	2294	172	444	77	708	177	56	164
1978	2338	170	373	76	778	219	50	183
1979	2448	181	654	83	872	215	39	163
1980	2496	181	542	85	876	217	35	179
1981	2808	192	537	85	964	254	36	193
1982	2877	214	593	92	1033	269	35	214
1983	2859	257	501	110	932	225	27	189
1984	2488	227	524	102	820	263	20	183
1985	2549	314	579	99	988	335	27	228
1986	2541	278	362	135	870	241	20	159
1987	2577	265	390	102	807	181	20	150
1988	2589	250	390	88	808	183	17	177
1989	2571	230	500	94	970	200	20	164
1990	2539	200	500	110	900	190	25	155

Source: FAO Production YearBooks, 1970-1990 (Preliminary for 1990).

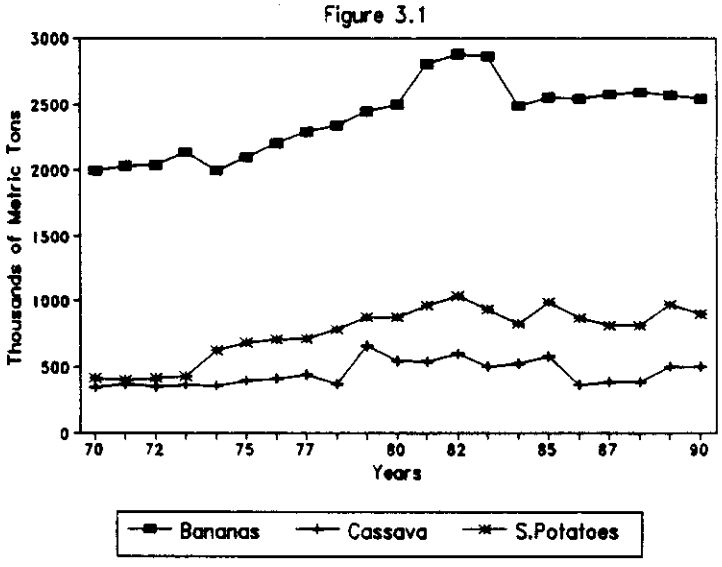

Figure 3.1: National Annual Production (in Metric Tons) for Bananas, Sweet Potatoes, and Cassava; 1970-1990

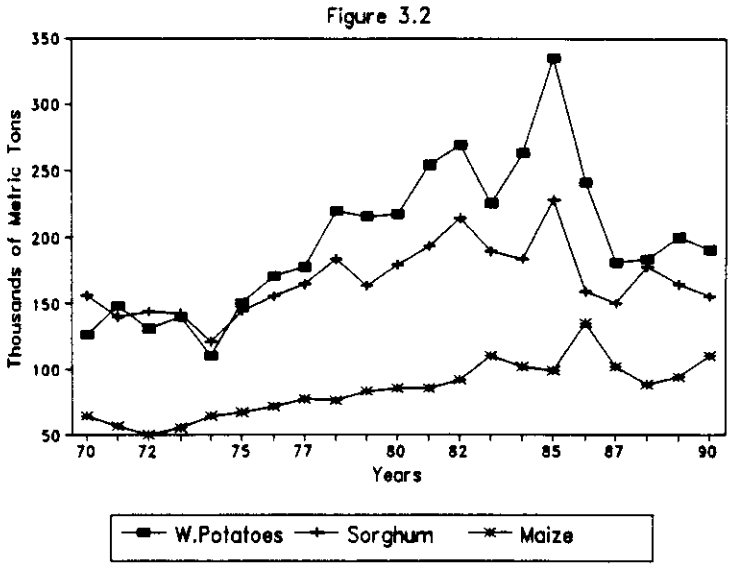

Figure 3.2: National Annual Production (in Metric Tons) for White Potatoes, Sorghum, and Maize; 1970-1990

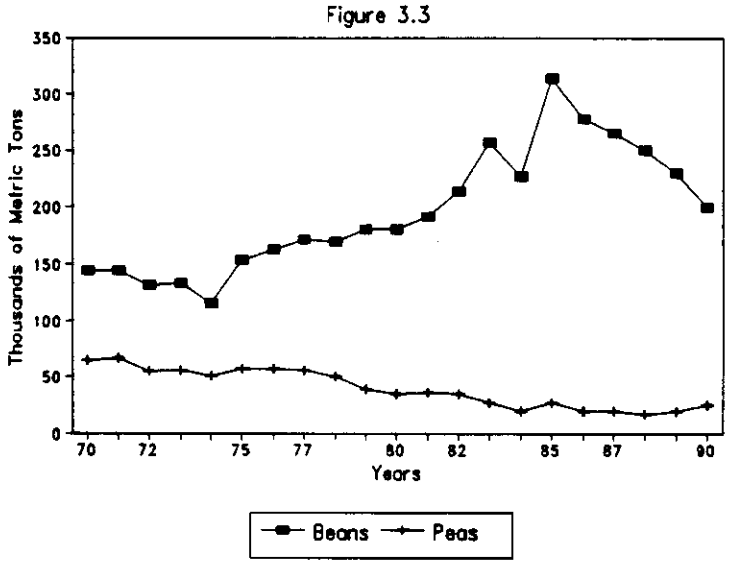

Figure 3.3: National Annual Production (in Metric Tons) for Beans and Peas; 1970-1990

If we particularly consider the last five year period (Figure 3.3), the trend in bean production is substantially downward. Other crops in overall declined but with much fluctuation. These trends

should be treated with some caution; all of this data is from FAO. Their data source for years 1970-1983, and 1985 are based on production estimates produced by MINAGRI without the aid of a systematic sample survey. The remaining years' data are based on data from an agricultural survey unit established with MINAGRI in 1983. According to Loveridge (1989), the rough MINAGRI estimates of prior years were based on field staff observations and information on rural consumption patterns under an assumption of zero food crop imports. While it is believed that the rough order of magnitude of these estimates are most likely correct, they are not thought to be as accurate as estimates since 1985.

A question arising from Figure 3.3 that should be directed to national legume research team is why does the production of peas, another important source of calories and proteins, continue decreasing? Maize appears to be the only crop which has reversed a downward trend in the three most recent years (Figure 3.2).

Total production from the 8 crops measured in metric tons, in calories and in proteins, as well as income per capita (in US$) and total population of Rwanda are presented in Table 3-2. Figure 3.4 shows the trend patterns in total physical production for all crops and this same indicator converted to calories.

The "All Crops" column in Table 3-2 is the sum of the 8 food commodities annual productions expressed in metric tons. The calories column is the sum of the individual crop production (in metric tons) converted to calories by crop specific conversion factors. The same process is used to get the estimate of protein produced. Crop specific conversion factors are shown in Appendix A1.2.

Figure 3.4 reveals that national total food crop production substantially expanded in the 1970s, barely keeping abreast of overall population growth. A record high was reached in 1982, when food output started fluctuating until 1985 (probably due more to varying FAO data sources rather than actual conditions). Since that date, global

Table 3-2: Total Crops Production Measured in Thousands Metric Tons, in Calories (in Milliards Kcal) and Proteins (in Metric Tons), Income per Capita (in US$), and Population (in Millions); 1970-90

Year	All Crops	Calories	Proteins	Income/ Capita	Population
1970	3315	2913808	68714	300	3695
1971	3362	2882957	68287	300	3817
1972	3313	2783704	63463	290	3944
1973	3458	2872867	64627	290	4077
1974	3432	2896846	60392	280	4215
1975	3744	3274625	72624	280	4358
1976	3933	3442167	76336	290	4506
1977	4092	3588413	79195	300	4658
1978	4187	3660901	80205	310	4815
1979	4655	4048075	81800	340	4976
1980	4611	3998933	81783	350	5139
1981	5069	4301386	87849	360	5306
1982	5327	4616580	95144	360	5477
1983	5100	4469003	97642	370	5653
1984	4627	4102978	87637	380	5836
1985	5119	4816892	113071	350	6026
1986	4606	4185886	95722	360	6225
1987	4492	3951866	91151	330	6434
1988	4502	3940481	89595	330	6656
1989	4749	4159907	88402	290	6893
1990	4619	4015720	81700	280	7237

Source: Figures on Production and Population are from FAO and figures on Income per Capita from IBRD World Tables, 1991

production appears to have moved downward slightly until 1990 with however, a relatively small rebound in 1989.

Figure 3.4 may be indicating that the years 1982-1985 (ignoring the effect of the 1984 drought) represent a period when the country reached its peak production possibility frontier for all crops (holding technology and crop mix constant) while total demand continued to climb. It is interesting to note that it is about this period in Rwanda when the land expansion program reached the end of its major growth phase.

Not surprisingly, fluctuation in total calorie production follows physical production instability given that calories (proteins also) are directly computed from physical total output by applying specific conversion factors. Total protein production is declining, especially through the reduction of beans in the output mix, though beans remain the most important source of plant proteins.

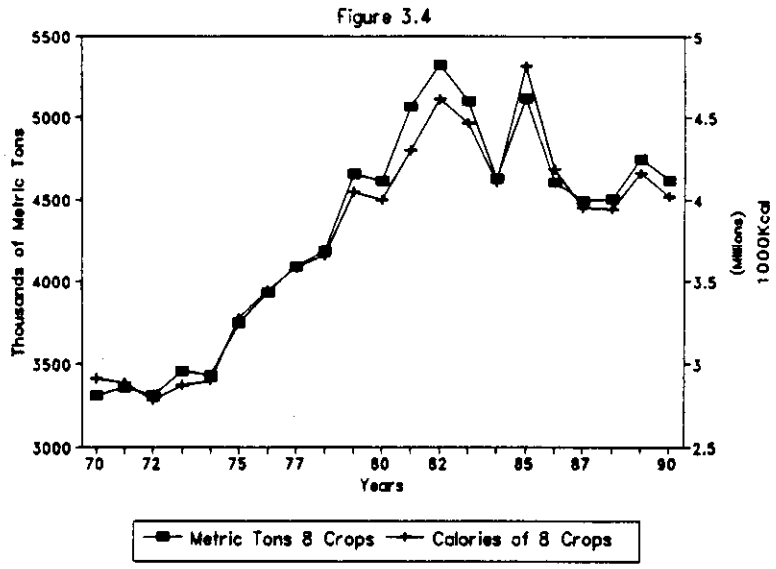

Figure 3.4: Total Production for 8 Major Food Crops Measured in Thousands of Metric Tons and in Calories (in Milliards of Kcal); 1970-1990

A look at the income per capita column in Table 3-2 helps to see that this welfare indicator roughly falls into three phases throughout the sample period. During 1970-1978, income per capita was at a lower level, growth then performed satisfactorily between 1978-1986 before absolute income dropped back to the level of early 1970s. The same table shows a continuous increase in total population. An important question then, is to know the implications of the above findings on the food demand pattern.

Generally, growth in population will increase the demand for staple foods, as will income growth in poor countries such as Rwanda. Thus, the second and third phases described above call for greater attention in terms of food demand. On the one hand, food crop output over the period 1979-1986 may have nearly satisfied the increase in food demand stemming from an improvement in income per capita level. On the other hand, income per capita level has been declining since 1987, going in the same direction as the recent trends in staple food production.

Schnepf (1992) reports a food expenditure elasticity of demand among rural Rwandan consumers of 0.85. Hence the large proportion of additional income in rural areas goes into additional food expenditure. But for rural consumers, income itself is largely a function of agricultural production, and a high food expenditure elasticity of demand simply says that most food output expansion is consumed by those producing the food.

When these households produce less food, they consume less and are immediately affected by the real income drop because their overall level of food consumption is relatively low to begin with. Overall, then, the rapidly declining levels of total and per capita food output in Rwanda are matters for serious concern, as are issues related to population growth. Reduction in income may then have a negative effect on overall food demand, in spite of continuing population increases. It is important to note in passing that there has been efforts to reduce the rate of population growth in Rwanda through ONAPO, but tangible results have still not been attained.

The trends identified in overall food crop production in general, and dry bean output in particular, are believed to be mainly attributed to a complex interaction of crop pest outbreaks, changes in weather patterns, declines in soil fertility, and tremendous population increases, coupled with limited potential for land expansion.

In Rwanda, common practices to improve and maintain soil fertility are repeated application of household wastes, leaf mulch and crop wastes as well as application of animal manure in those households that keep animals. According to DSA (1990), only 10.5 percent of Rwandan farmers use chemical fertilizers. When considering beans, some observers report that a percentage of the area usually used for bean production is increasingly being shifted into higher caloric and drought resistant crop production, namely sweet potatoes, other things being equal (constant current technology).

Overall, the decline in agricultural production is a potential cause of great concern especially because the period reported includes years after the introduction of the so-called high-yielding varieties. It is noteworthy that at the present in Rwanda, incremental crop production is more likely to stem from improvement in land productivity and the share of new high-performance varieties, given that expansion in acreage planted is no longer a feasible means of increasing agricultural output in response to population pressure.

For the economy as a whole, this poor performance can lead to significant food imports and/or use of food aid. Both of these strategies in turn can drain limited foreign exchange earnings at the expense of agricultural sector improvement unless food imports are based on growing export earnings from areas where Rwanda has comparative advantage. This could include barter agreement like the 1989 case.

3.2 Trend in Per Capita Food Crop Production

Nutritional surveillance and food security are vital to Rwanda, an agrarian country still suffering from widespread malnutrition. This section attempts to begin to measure calorie and protein output per capita against theoretical needs--that is 2100 Kcal per capita per day and 59 Grams per capita per day (DSA, 1991). The purpose is to begin a comparison between how the population is fed and how it should be fed. A major limitation of the analysis is that examining only household production data does not give the full view of potential household consumption. Nonetheless, a complete analysis must begin with detailed understanding of domestic production.

Figures 3.5 and 3.6 aid in depicting rapidly decreasing domestic per capita food production in Rwanda. However, these figures (and of course, the following analysis) do not include the amount of diverse nutrients obtained from animal products. Nor do they account for international food movements (especially informal dry bean and other imports) and household-level purchases. One observation that

demonstrates the serious nature of the food problem, is that since 1986, both per capita calorie and protein production appear to have been below levels attained in the 1974 and 1984 drought years.

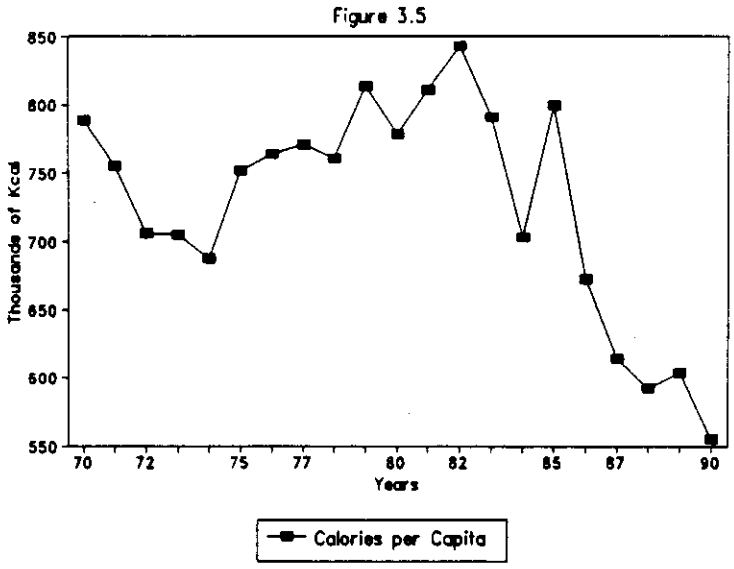

Figure 3.5: Calorie Production per Capita in (Thousands of Kcal) for 8 Major Food Crops; 1970-1990

A second point is the fact that since 1970, the level of per capita plant protein has been far below the suggested minimum annual requirements (21.5 Kg/capita/year) reaching 11.5 Kg/capita/year in 1990. The third point concerns the per capita calorie production level which on average has been above the minimum requirements (766,500 Kcal/capita/year) during the period from 1975-1983 and in 1985 where national food production made a slight recovery because of near normal rainfall throughout the year.

Finally, the same graphs indicate that food consumption per capita is highly sensitive to drought. If then we were to expect a drought in 1994, the impact would probably be more profound for a population already consuming below the nutritional norms. The question then is to know to what extent imports (official, informal, and concessionary) will respond to possible short and long food shortfalls. As the country has

limited capacity to import (foreign exchange shortage), it will be hard to adjust quickly.

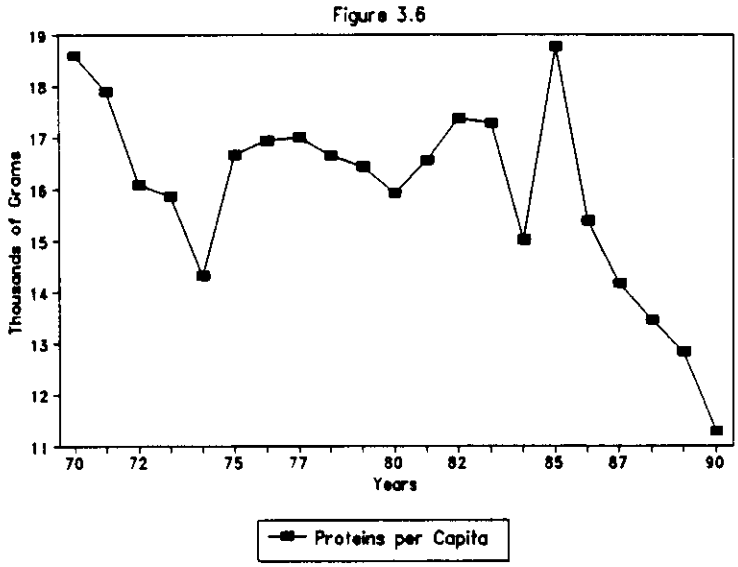

Figure 3.6: Plant Protein Production per Capita (in Thousands of Grams) for 8 major Food Crops; 1970-1990

Turning our attention to beans, it is important to recall that they are a potential source of both calories and proteins. Beans show a pattern similar to the other staple food commodities with, however, a sharp drop in calorie and protein production per capita.

3.3 Relative Importance of Crop Share

3.3.1 Potential Calorie Contributors

Nearly three-quarters of the calories produced by the 8 major food commodities are derived from bananas, sweet potatoes, beans and sorghum. For proteins, these crops plus maize provide 90 percent, with bean being the major contributor (nearly 50 percent). Figures 3.7 and 3.8 show the individual crop share in both calorie and protein production for specific big contributors.

As expected, a decrease in total dietary energy supply is associated with a decline in the bean food calorie share. In most recent years, the percentage rate in food energy share has been nearly

constant for sorghum and slightly increasing for bananas, sweet potatoes (notice also the big shift in 1973), and cassava.

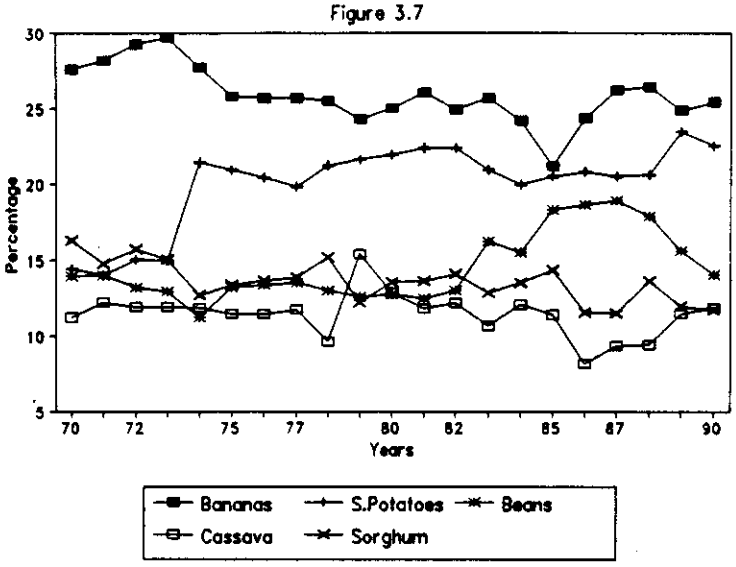

Figure 3.7: Calorie Production Share (%) for Selected Major Food Crops; 1970-1990

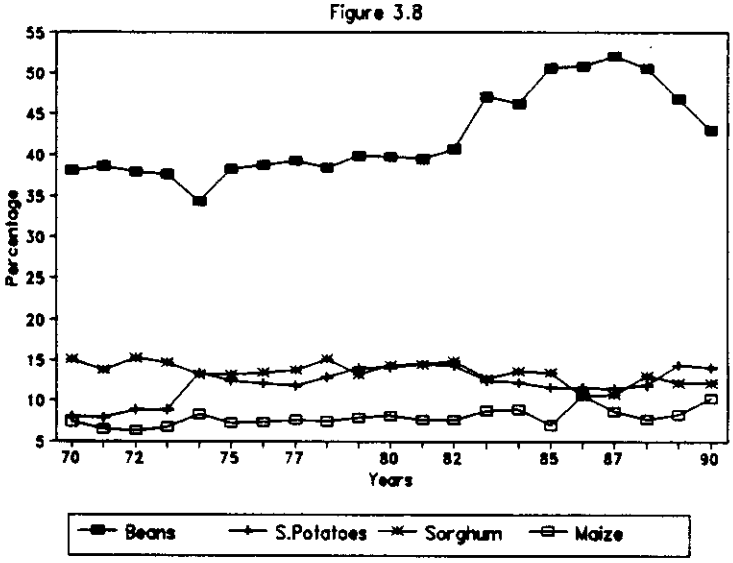

Figure 3.8: Protein Production Share (%) for Selected Major Food Crops; 1970-1990

3.3.2 Potential Protein Contributors

Similarly, the decrease in total protein production is associated with a decline in bean protein share. The percentage trend in food protein share has been constant for sorghum and slightly increasing for sweet potatoes and maize. The above findings lend some support to the hypothesis that farmers are shifting some bean area to sweet potatoes and bananas.

3.4 Trends in Real Annual Consumer Prices

Table 3-3 shows annual real prices for 8 major staple food crops for the period 1970-1990. Figures 3.9 through 3.11 depict annual real price trends for the same set of crops. The purpose of this section is to examine individual crop market price behavior.

Table 3-3: Annual Real Prices (in Frw/Kg) for 8 Major Food Crops; 1970-1990

Year	Beans	Maize	Sweet Potatoes	Peas	White Potatoes	Sorghum	Banana	Cassava
1970	78	60	30	78	54	78	24	42
1971	71	83	30	77	60	89	24	42
1972	81	35	35	87	52	81	23	40
1973	58	53	26	69	42	85	32	37
1974	89	48	28	101	44	73	28	28
1975	87	62	28	124	46	56	31	28
1976	69	40	26	75	38	69	26	26
1977	66	41	25	74	33	41	25	18
1978	50	33	19	58	29	41	21	17
1979	61	40	27	76	40	61	27	20
1980	60	40	27	76	29	45	29	22
1981	39	34	22	66	24	46	27	19
1982	45	38	23	62	21	41	20	15
1983	43	40	20	52	20	35	20	16
1984	66	78	23	73	22	43	27	20
1985	56	49	24	90	20	41	28	32
1986	37	83	19	57	16	39	20	13
1987	54	37	21	76	19	36	22	14
1988	47	34	19	60	21	30	24	19
1989	57	42	17	85	21	37	20	20
1990	49	41	19	78	19	38	20	19

Source: The nominal prices are from MINIPLAN

Figure 3.9

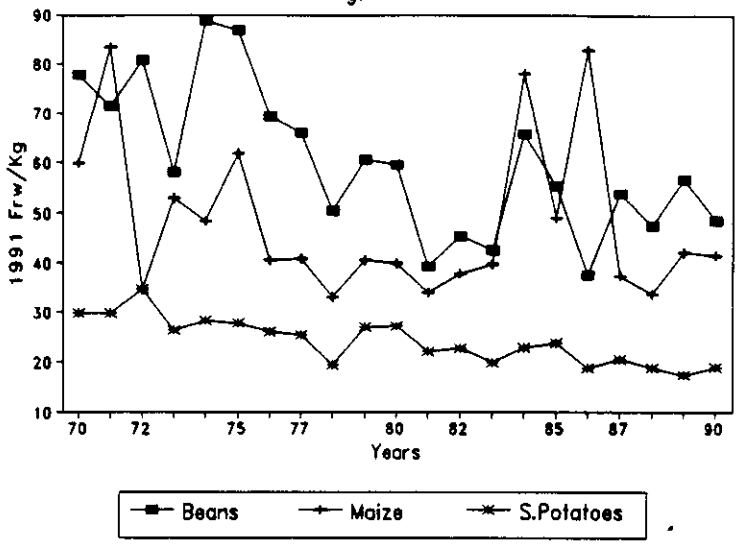

Figure 3.9: Trend in Annual Real Prices (Frw/Kg) for Beans, Maize and Sweet Potatoes; 1970-1990

Figure 3.10

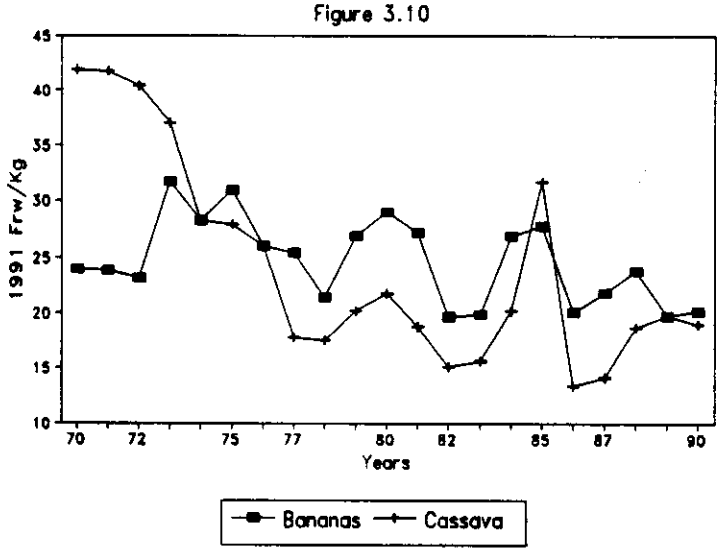

Figure 3.10: Trend in Annual Real Prices (Frw/Kg) for Bananas and Cassava; 1970-1990

A. Dry Beans

Dry bean real prices fluctuated sharply throughout the sample period. Prices show a downward trend during the period from 1970 to

Figure 3.11

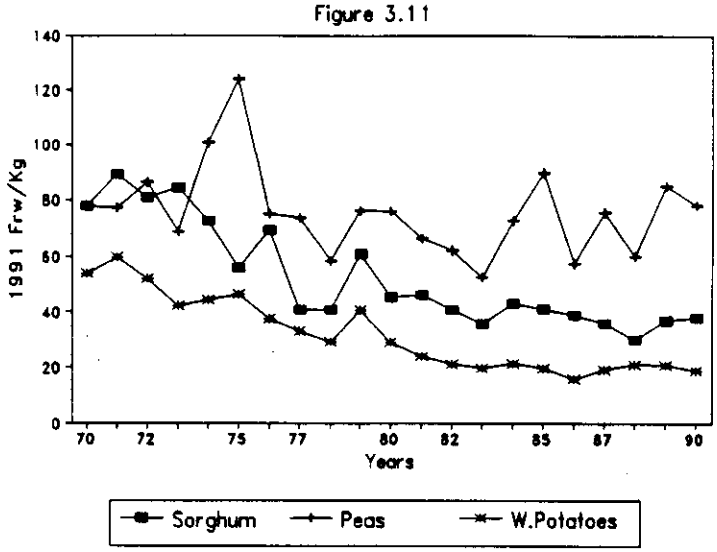

Figure 3.11: Trend in Annual Real Prices (Frw/Kg) for Sorghum, Peas, and White Potatoes; 1970-1990

1985 and thereafter a slight upward trend. Three peaks are clearly observed in 1974, 1979/80, and 1984, the highest level being reached in 1974 (90 Frw/Kg). Recall that 1974 and 1984 were generally recognized as drought years.

B. Sweet Potatoes

This crop, to some extent, is more drought resistant, hence it is considered a famine food crop. The general trend in sweet potato prices is slightly downward with moderate fluctuations. Prices went up in 1984 (the main problem being caterpiller infestations reducing output and not really drought) when production dropped by 12 percent as compared to the 1974 drought when production surprisingly increased by 30 percent and prices also went up. This difference in responsiveness could be associated with a shortage in other food commodities in 1974, thus boosting demand for sweet potatoes and thereby pushing up the market price. Since the mid 1980s, sweet potatoe prices have been lower; this may be associated with a slight increase in sweet potatoes supply.

C. Maize

Maize real prices behavior is characterized by many sharp fluctuations. Three noticeable peaks were reached in 1971, 1984, and 1986.

D. Bananas

The annual real prices for cooking bananas fluctuated sharply and widely showing however, a near horizontal general trend. The prices rose to peaks in 1973, 1975, 1980 and 1985. Prices were not responsive to the 1974 drought. They dropped by 4 Frw/Kg in 1974 while they rose by 7 Frw/Kg in 1984, with the highest price level being attained in 1973 (32 Frw/Kg).

E. Cassava

For cassava there was a wide fluctuation in annual real prices since mid 1970s. Prices were higher in early 1970s and thereafter gradually came down until 1985 where they peaked sharply reaching 32 Frw/Kg level. This sharp increase was most likely associated with a 37 percent drop in cassava production.

F. White Potatoes

Potatoes real prices are showing a modest downward trend with very little to almost no fluctuation since 1986. Prices were higher in 1970s and reached the peak in 1971 (60 Frw/Kg) compared with the prices in the 1980s which are relatively lower, with the lowest level reached in 1986 (16 Frw/Kg). White potatoes being particularly a regional food crop, the decline in price is more likely associated with a combination of both varietal improvement (through a special National Program for white potatoes improvement) and reduction in transport costs (rural feeder roads in the North). This last factor may also hold for other crops in general.

G. Sorghum

Sorghum prices show a downward trend with sharp fluctuations in the 1970s. They did not respond to the 1974 drought although production dropped by 15 percent compared with 1984 where the price increased by 7 Frw/Kg. In the most recent years, sorghum price is slightly increasing, because not only is there a decline in its production, but probably also because the demand has been boosted by the use of sorghum in industrial brewing as a substitute for barley. But there is a lack of information on volumes of sorghum transacted with BRALIRWA in order to make better inferences.

H. Peas

Real prices for peas were consistently the highest of all the food crops included in this study. As mentioned previously, pea supply has been declining since 1970s, reaching 20,000 metric tons in 1990, which corresponds to 69 percent drop as compared to the 1970 production level. Pea prices fluctuated frequently and sharply over the sample period.

In looking at the price trends for the staple foods described above, one can conclude that there have been few acute food price crises except for two years, namely 1974 and 1984, which were characterized by wide spread drought. The higher annual real prices in most recent years is most likely primarily attributed to declining food crop output. If these trends continue then there should be much concern for food supply status in Rwanda in years to come.

3.5 Trends in Weighted-Calorie Prices

To further examine the overall cost of food, analysis in this section attempts to build a weighted-calorie price series, utilizing production and price data on the principal food crops over the sample period of 1970-1990. First, an annual price per calorie of each crop is developed. Second, this price per calorie per product is multiplied by total calories produced from each individual crop. Suming over the

eight crops gives the grand total value of calories. Third, a weighted price per composite calorie series is determined (referred to as "Calorie Composite" in Table 3-4). This is computed as a ratio between the grand total value of calories and total calorie production.

Table 3-4: Real Calorie Prices for 8 Major Crops and for a Composite Calorie Price Series (in Frw/1000Kcal); 1970-90

Year	Beans	Maize	Sweet Potatoes	Peas	White Potatoes	Sorghum	Banana	Cassava	Calorie Composite
1970	25.64	18.55	27.68	24.92	93.73	25.60	66.55	40.93	39.02
1971	23.56	25.85	27.56	24.80	103.68	29.41	66.26	40.75	40.71
1972	26.65	10.74	32.06	27.74	90.45	26.61	64.23	39.50	39.92
1973	19.18	16.40	24.47	22.03	73.65	27.85	88.25	36.18	43.55
1974	29.24	15.00	26.11	32.28	77.19	23.88	78.48	27.58	40.01
1975	28.58	19.20	25.79	39.68	80.85	18.35	86.11	27.24	41.03
1976	22.89	12.56	24.09	24.10	65.47	22.85	72.41	25.45	35.44
1977	21.79	12.61	23.53	23.62	57.54	13.39	70.71	17.39	32.15
1978	16.64	10.23	17.97	18.66	50.69	13.42	59.39	17.08	27.14
1979	19.98	12.53	24.93	24.45	70.34	19.95	74.91	19.74	34.21
1980	19.70	12.35	25.14	24.37	50.44	14.90	80.59	21.24	34.80
1981	12.90	10.55	20.47	21.26	41.47	15.12	75.72	18.29	31.51
1982	14.94	11.71	20.97	19.85	36.82	13.43	54.63	14.77	25.70
1983	14.01	12.30	18.36	16.80	34.54	11.66	55.18	15.23	24.81
1984	21.73	24.18	21.16	23.27	37.46	14.17	74.81	19.72	32.69
1985	18.31	15.17	22.02	28.80	34.52	13.49	77.22	31.01	31.83
1986	12.34	25.70	17.32	18.42	27.93	12.76	55.77	13.07	25.04
1987	17.77	11.54	19.01	24.26	33.52	11.83	60.69	13.80	27.02
1988	15.63	10.44	17.31	19.18	36.91	9.85	65.91	18.29	27.60
1989	18.72	13.01	15.99	27.29	36.53	12.19	54.93	19.30	25.58
1990	16.01	12.85	17.54	25.05	33.00	12.48	56.01	18.53	25.74

Source: The raw data are from FAO, MINIPLAN, and DSA

Yearly real calorie price trends shown in Table 3-4 are basically following the trends in annual real price for each particular food crop.

Overall, beans, maize, sweet potatoes, sorghum, and cassava seem to be the least costly crops in terms of calories while peas, white potatoes and bananas seem to be the most expensive.

Turning our attention to the composite calorie price series (Figure 3.12) we observe a general negative trend in the real composite calorie prices over the sample period. Fluctuations are wide and sharp, the composite having been the highest in 1970s reaching a peak in 1973 (44 Frw/1000Kcal). The overall price of calories from bananas is high and will tend to pull up the composite, given the relative importance of bananas in consumption. In the more recent years, prices are no longer

dropping and appear to be moving up. Hence, one alternative to reverse these trends is to pull area out of more expensive calorie food crops (bananas for instance) and put it into less costly calorie food crops like sweet potatoes. More in-depth analysis is needed to address the question of whether the general negative trend in the composite price series is associated with an increase in food crop imports. More analysis is also needed to better understand alternative approaches to achieving continued reductions in the composite calorie price series.

Figure 3.12

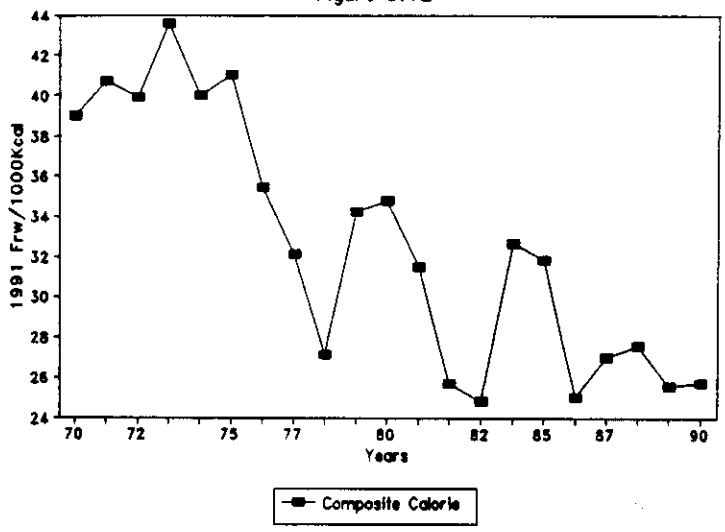

Figure 3.12: Composite Calorie Price Series (Frw/1000Kcal) for 8 Major Food Crops; 1970-1990

3.6 Conclusion

This analysis concentrates on national trends in food crop production and prices. It also looks briefly at two determinants of demand expansion; population growth and changes in income. Table 3-2 shows continuous increase in population and fluctuation in income per capita, with however a downward trend in income per capita since 1984.

This chapter also documented the major trends in total staple food production, and examined calorie and protein production per capita. The

highly unsatisfactory state of food and agriculture in recent years is indicative of the upheavals which can occur causing serious nutritional difficulties. Indeed, total production seems to have reached an upper limit and perhaps turned down. Per capita production of calories and proteins appear to be going down drastically. In addition, prices in general have stopped coming down in most recent years, and may be starting to climb. If appropriate measures are not initiated to reverse the trend and upgrade diets, the widening gap between food supply and population growth will increasingly create hardships for many people in Rwanda. Hunger and malnutrition will spread rapidly as the average calorie and protein intake drop below the minimum requirements.

The above analysis also calls for a greater attention to understanding the nature of malnutrition instead of relying primarily on aggregate calorie and protein output levels as the sole indicator of the household nutritional well-being. Furthermore, more in-depth analysis is needed to address the issue of distribution of food among different groups in the population and within prefectures.

Previous chapters have demonstrated the importance of beans. Indeed, beans play a critical role in food security for a large majority of the Rwandan population. Beans have always been the largest and cheapest source of plant proteins. Table 2-3 showed that beans are ranked third (16 percent in 1989 agricultural year) in terms of calorie production. In the remaining chapters, focus primarily is on the bean subsector, with a particular emphasis on rural household bean transactions and market behavior, bean price patterns and strategies that might improve market performance.

CHAPTER IV. DRY BEAN MARKET BEHAVIOR: VOLUMES TRANSACTED

This chapter studies basic household level production and marketing features of the bean subsector in Rwanda. Adding new analysis with data from 1990, it builds on prior work of Scott Loveridge (1988) who used data from the 1986 agricultural year. It has already been established that beans are an important commodity in terms of sources of plant proteins and calories, and are central to food policy concerns in Rwanda. The focus in this Chapter is on the identification of the producers, sellers, and consumers of beans. Data presented in the following sections show that rural households increasingly relate to the bean market, that Rwanda is increasingly importing beans, and that rural households are increasingly buying rather than selling beans.

4.1 Domestic Bean Production and Marketing

4.1.1 Monthly Bean Production

Using data from the on-going nationally representative DSA household sample, Figure 4.1 reports monthly dry bean production at the national level for the 1986 and 1990 agricultural years. General patterns are quite similar for the two years: small amounts of beans are produced every month, with two peak harvest seasons in January and June. The first harvest is substantially larger than the second. The seasonality of bean production may influence the decision of many farmers to carry bean stocks for two to three months, thus contributing to less price fluctuation. Some harvest during every month should also help reduce price fluctuation.

4.1.2 Monthly Bean Transactions

Figure 4.2, using data from the same sources, shows monthly national quantities of beans purchased and sold in the rural areas during the same two agricultural years. In 1986, estimated national

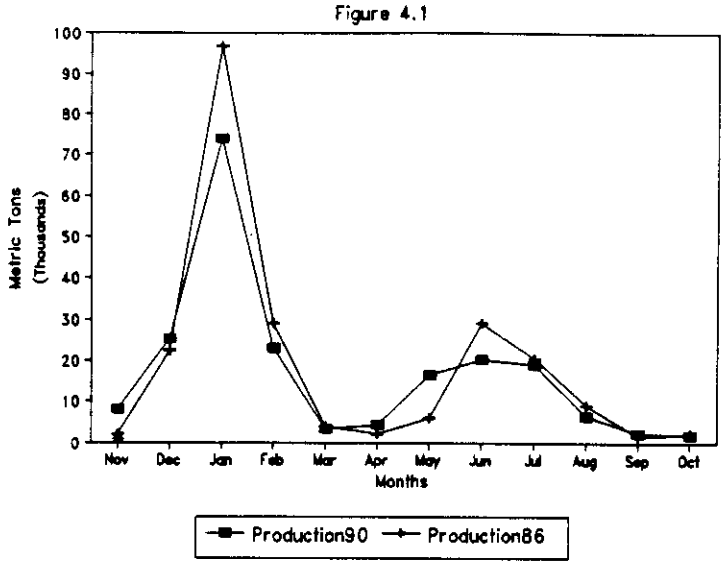

Figure 4.1: Monthly Bean Production (in Metric Tons) in Rwanda; 1986 and 1990 Agricultural Years

monthly rural purchases exceeded national rural sales in every month except January and February, the peak harvest months. Thereafter, total rural monthly sales decreased for the remaining period of 1986. There was a slight rebound during the second harvest peak months, although overall, total household sales were still far below the total monthly purchases.

Although the two years show a similar trend in monthly production, sales and purchases, Figure 4.2 indicates a major change in 1990, as compared to 1986. Total rural purchases exceeded sales in every month in 1990. Overall, purchases in 1990 also exceed those of 1986, while sales in 1990 are below that of 1986 in every month, except for July and October.

In both years, purchases trend upward from January through October with a significant increase in April-May and a more pronounced increase in August-September. Seed needs for the first bean season may contribute to the later peak purchases. Sales after January and February trend downward, with much fluctuation.

Figure 4.2

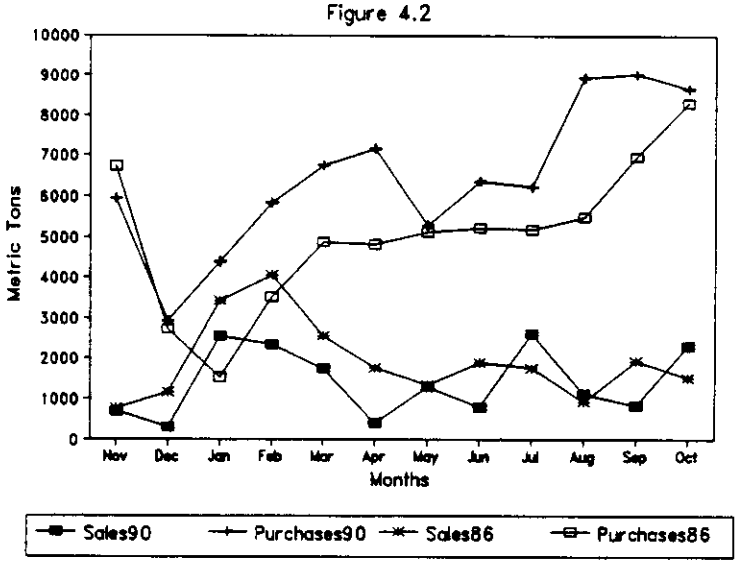

Figure 4.2: National Monthly Rural Bean Purchases and Sales in Rwanda; 1986 and 1990 Agricultural Years

Figure 4.3 indicates that bean sales follow closely the months of bean production. Bean purchases appear to decrease when production increases in the months of November and December. An interesting question for future analysis is to ask who is buying at the bean production peaks. In more concrete terms, what are the characteristics of households who purchase in December, January, and February? These may be households who produce very little, but have access to effective demand to purchase beans when the supply becomes readily available.

For those who are selling during this same period, one plausible explanation could be that many farmers are selling old beans in order to make more storage room for the fresh product. Overall, since both 1986 and 1990 are considered normal agricultural years, these data indicate a significant change in production, sales and purchases in just 4 years. The direction of this change (greater rural purchases) is consistent with other evidence that farmer are shifting away from bean production.

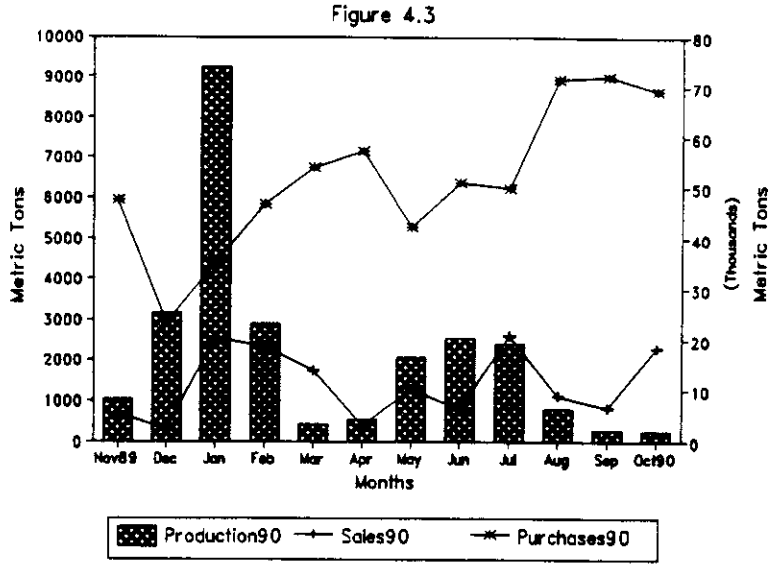

Figure 4.3: National Monthly Rural Bean Purchases, Sales and Production in Rwanda; 1990 Agricultural Years

4.2 Key Dry Bean Market Transaction Indicators

Table 4-1 gives basic national bean statistics on production, sales, gifts given, purchases, and gifts received during three different agricultural years.

Utilization of information in Table 4-1 permits the calculation of some key ratios and other bean market indicators for the 1990 agricultural year which help to understand more about the dry bean subsector. The interested reader should refer to Loveridge (1988) and Minot (1992) for detailed results of similar exercises for the 1986 and 1983 agricultural years, respectively.

The percentage of bean output sold by all farmers in 1990 (sales divided by production) is estimated at 6 percent. This compares with 10 and 7 percent in 1986 and 1983 respectively. Total bean sales in 1990 were valued at 4183 Frw per household which constitutes a 14 percent share in the value of the 8 major food crops. This compares with a 20 percent share in 1983 (the 1986 transaction study did not estimate this because it covered only beans and sorghum).

Table 4-1: Basic Statistics on Dry Beans (in Metric Tons) in Rural Rwanda (1983, 1986, and 1990 Agricultural Years)

Transaction Type	Total* 1983	Total** 1986	Total*** 1990
Production	319,431	224,516	205,908
Sales	21,788	23,023	12,993
Gifts given	NA	9,069	4,388
Purchases	61,213	60,492	73,545
Gifts received	NA	7,764	4,374

* Adjusted from ENBC figures, (Minot 1992)
** From Loveridge (1988)
*** Calculations from ENRD data (1990)
NA = Not Available

Rural bean consumption (production minus gifts given minus sales plus purchases plus gifts received) was 279,439 metric tons, or about 39 kilos per capita in 1990. This compares with estimates of 45 kilos in 1986 and roughly 64 kilos in 1983, respectively.

4.3 Characteristics of Rural Households by Category of Net Bean Sales

Analysis results shown in Tables 4-2 help describe relevant characteristics of net buyer and net seller households per net bean transaction category. For example, in 1990, 84 percent of net dry bean sales come from only 5 percent of smallholders. In contrast 36 percent

Table 4-2: Net Sales of Dry Beans by Household Net Transaction Category; 1990

Household Net Transaction Category	Number of H.H	% of H.H	Net Tons Sold by Class	% of Sales	Average Farm Size (Ha)	Average Revenue (Frw/ae)	Average Revenue (Frw/H.H)
>60 Kg Sold	61217	4.8	12464	84.2	1.8	21763	108815
30-59 Kg Sold	31344	2.5	1360	9.2	1.6	12655	75927
<30 Kg Sold	89798	7.1	976	6.6	1.0	10010	50051
Zero Net Trans.	26040	2.0			1.1	9684	48420
<30 Kg Bought	311112	24.5	-4974	-6.6	0.8	8184	32734
30-59 Kg Bought	292722	23.0	-12972	-17.2	0.8	8610	34439
>60 Kg Bought	459655	36.1	-57391	-76.2	1.0	9054	54324
Total/Average	1271898	100.0			0.98	9440	47199

Source: Calculated from data available from ENRD, DSA 1990
Note: Negative numbers indicate purchases. Revenue (net) is calculated as follows: value of own consumption from production plus net sales plus net value of gifts received minus purchases of inputs plus the value of labor sold. (See footnote to Table 4-11 for more detail on household revenue).

sholds make 76 of the dry beans purchases. As expected, average ze is larger for households with important volumes of net bean Farms with no net transactions have slightly larger average land s than farms that are net buyers of beans.

able 4-3 shows per adult-equivalent bean availability, total Kcal/ae/day produced, and total Kcal/ae/day available from the 8 crops according to household net transaction position. A major finding from this analysis is that the three categories of households that are net buyers of beans have less dietary energy production than the remaining categories. Overall, 84 percent of rural smallholders are net purchasers of beans, against 14 percent who are net sellers. Households falling in the category that buy more than sixty kilos of dry beans per

Table 4-3: Availability of Beans per Adult-Equivalent by Household Net Sale Position, 1990*

Household Net Transaction Category	% of H.H	Beans Produced (Kg/ae)	Beans Transferred (Kg/ae)	Beans Available (Kg/ae)	Total Kcal/ae/day Produced	Total Kcal/ae/day Available
>60 Kg Sold	4.8	137	41	96	4596	3814
30-59 Kg Sold	2.5	76	7	69	2860	2612
<30 Kg Sold	7.1	49	2	47	2479	2381
Zero Net Transact.	2.0	70	0	70	2668	2630
<30 Kg Bought	24.5	35	-4	39	1727	1793
30-59 Kg Bought	23.0	26	-11	37	1424	1618
>60 Kg Bought	36.1	23	-21	44	1551	1796
Total	100.0	37	-10	47	1849	1952**

Source: Calculated from data available from ENRD, DSA 1990

* Transfers are net sales. Availability includes seed and storage losses. Total per adult-equivalent Kcal produced and available is based on the 8 staple food crops. Adult-equivalent (ae) reflects the calories requirements of the household, based on the age and sex of its members as reported in Miniplan ENBC.

** This total is computed from calorie production from the 8 major food crops. For the specific case of converting bananas to calories, we used a conversion factor for total bananas of 359.53 Kcal/Kg. This assumes that beer bananas, which make up nearly 70 percent of the total production of bananas are in fact converted into beer.When assuming no transformation of beer bananas into beer (see Loveridge, 1992), and thereby gaining more calories available (from 196 to 801 Kcal/Kg), the total become 2568 Kcal/ae/day (or 2616 when adding peanuts and soybeans to the 8 crops). This higher total quoted in Loveridge (1992) represents a potential food availability, rather than an estimate of actual household behavior.

year depend on their own production for some fifty percent of their supply per adult-equivalent. The last column in Table 4-3 shows that in terms of daily calories availability per adult-equivalent from these 8 crops, the big net buyers of beans are significantly improving their dietary energy level through market purchases. The national caloric average level improves (1952 Kcal/ae/day) when taking into account calories available instead of just those produced (1849 Kcal/ae/day). Still, on average the vast majority of calories consumed are produced, not purchased.

To gain further insights from results of analysis of 1986 and 1990 DSA data, Table 4-4 compares bean and overall calorie availability and other characteristics across various household net transaction categories (Note that these tables are completed on a per capita basis, since this was the approach used in 1986).

With the overall reduction in dry bean production between 1986 and 1990, an additional 10 percent of rural households have moved into the

Table 4-4: Availability of Beans per Capita by Household Net Sale Position; 1986 and 1990

Household Net Transaction Category	% of H.H.		Beans Produced (Kg/Cap)		Beans Transferred (Kg/Capita)		Beans Available (Kg/Capit)		Total Kcal/Ca/day Produced		Total Kcal/Ca/day Available	
	1986	1990	1986	1990	1986	1990	1986	1990	1986	1990	1986	1990
>60 Kg Sold	7	5	136	122	48	34	88	88	4658	4117	NA	3946
30-59 Kg Sold	4	3	83	68	13	7	70	61	3442	2551	NA	2612
<30 Kg Sold	11	7	73	45	5	2	68	43	3072	2230	NA	2381
Zero Net Transact.	5	2	49	63	0	0	49	63	2600	2352	NA	2630
<30 Kg Bought	24	24	34	31	-5	-3	39	34	1966	1555	NA	1781
30-59 Kg Bought	18	23	30	23	-11	-9	40	32	1773	1274	NA	1581
>60 Kg Bought	31	36	24	21	-24	-21	48	42	1781	1389	NA	1796
Total	100	100	NA	33	NA	-10	NA	43	NA	1657	NA	1952

Source: Calculated from data available from ENRD, DSA 1990, and Loveridge,1988.
NA = Not available

larger net purchaser categories, where some one third to one half of total availability of beans comes from market purchases. Perhaps most alarming, these households in 1990 are producing some 3-7 kg per person fewer beans, and after purchasing from the market are still 6-8 kg per person below bean availability levels attained in 1986. Likewise, total calorie production from the 8 key crops among households in these same net buyer categories is some 400-500 calories per person lower in 1990, as compared to 1986. This is most likely another example of the effect of rapid population growth and rather static ability to increase agricultural production.

Since the 1986 study did not estimate total calories available, a comparison of this dimension between the two periods is not feasible. Yet from the 1990 data on total calorie availability, it is clear that neither own production nor income generation/market purchase strategies are working well enough to provide adequate calorie availability for large numbers of rural households.

4.4 Implications for Changes in Dry Bean Prices

Loveridge (1989) found that in 1986, 73 percent of rural smallholders were net buyers of dry beans and that only 7 percent of the households accounted for 82 percent of sales. Present results based on 1990 data support these findings, and are also in line with the estimates based on the extrapolation of 1983 ENBC figures to the national level which show that 70% of rural households are bean purchasers against one quarter of them who are bean net sellers (see Minot 1992). With this background from three separate studies, it is very clear that any effort to expand bean output by mandating an increase in the price of beans will likely hurt a large majority of rural farm families (84 percent in 1990), and benefit only a small fraction of them (14 percent). A decision to somehow raise prices would clearly worsen the consumption status of the net purchasers of dry beans through real income reduction. This same group of households appears to

already be consuming below the minimum recommended dietary energy requirements. Other implications for the likely impact of price changes on rural households are implicitly considered in the next two sections.

4.5 Distribution of Households by Net Sales Position of 8 Crops

In this section, we explore the distribution of rural households with respect to their net sales position in all 8 major crops, not just beans. Table 4-5 shows the percentage of households according to their type of participation in markets for the 8 principal food commodities.

The proportion of rural smallholders involved in the market, that is households either purchasing or selling a commodity, is over 60 percent for most food crops, with 98 percent participation for the particular case of beans. Notice also the striking percentage of households that are only buyers of beans (52 percent compared with 54 percent and 49 percent in 1983 and 1986 respectively) against a relatively small number of households that are only bean sellers (5 percent compared with 14 percent and 10 percent in 1983 and 1986 respectively).

Table 4-5: Percentage of Rural Households by Market Participation Status, 1990

Crops	Purchases only	Sales only	Purchases and Sales	No Transactions
	----------Percentage of Household in the Sample----------			
Beans	51.6	5.2	41.3	1.9
Bananas	16.7	30.8	17.3	35.2
S.Potatoes	37.8	27.7	22.0	12.5
W.Potatoes	60.5	4.0	9.1	26.4
Cassava	41.8	14.6	14.1	29.5
Sorghum	50.1	13.3	19.7	16.8
Peas	25.5	4.3	3.1	67.1
Maize	28.5	11.4	12.6	47.6

Source: Calculated from data available from ENRD, DSA 1990

The proportion of households involved in both purchases and sales is more important for beans than for other staple food crops, and for beans has been increasing (22% in 1983, 37% in 1986, and 41% in 1990). Peas and maize are the least frequently exchanged, with almost all households either buying or selling beans and sweet potatoes.

With the exception of beans, relatively few households both sell and buy products, and this finding contradicts the common belief that many households are forced to sell products at low prices during the harvest period, and buy similar products back at high prices during later periods of shortfall.

For beans, the tendency to sell and buy may be increasing, although the 1990 data also support the finding by Loveridge (1989) and Minot (1992) that few households sell beans and buy the same quantities back at later periods. Table 4-6 shows for 1990 the relative quantities of beans bought by net sellers and sold by net buyers. Purchases by net seller households who buy and sell were 28 percent of their gross sales (2,443 tons/8,712 tons) compared with 22% in 1986. Sales by net buyer households were only 17 percent of their gross purchases (5,866 tons/35,329 tons) compared with 19% in 1986. Hence, most households who both sell and buy are on balance major buyers.

Table 4-6: Gross Non-commercial Bean Transactions (in Metric Tons) by Household Net Transaction Category; 1990

Household Net Transaction Category	H.H That Bought and Sold Beans: Quantity Bought	H.H That Bought and Sold Beans: Quantity Sold
Net Bean Sellers	2443	8712
No Net Transact.	14	14
Net Bean Buyers	35329	5866
RWANDA	37785	14592

Source: Calculated from data available from ENRD, DSA 1990

Figures 4.4 and 4.5 provide more insights on net sales in 1990 for dry beans and all the 8 food crops respectively. For Figure 4.5, net sales are summed across these crops in each household and are expressed in calories per adult-equivalent. Figure 4.4 on net sales of beans alone show graphically the results discussed in previous sections. Comparing areas above and under the curve, it is clear that total net purchases substantially exceeds the volume of sales, indicating informal rural bean imports. Finally, among the net sellers of beans, a small

proportion of households account for a large portion of total sales volume.

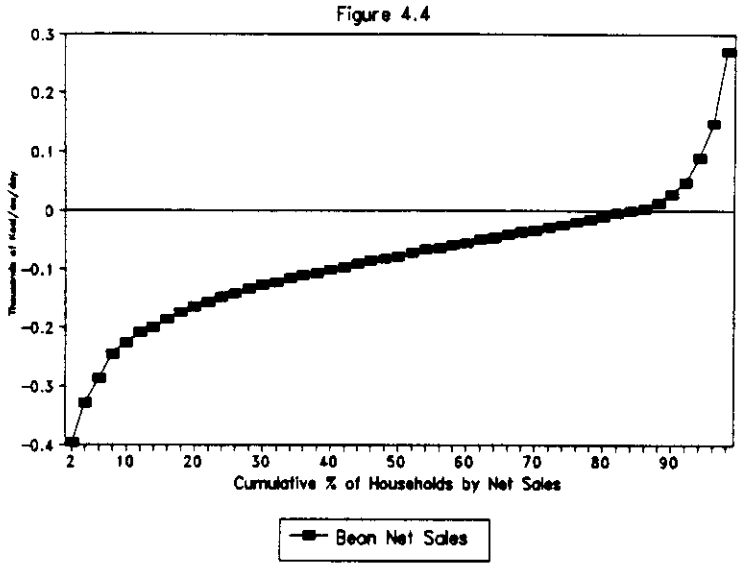

Figure 4.4: Distribution of Households by Net Sales of Beans Expressed in Caloric Terms per Adult Equivalent; 1990

Considering a more complete picture for the 8 major crops, a somewhat similar pattern to that of beans emerges. Figure 4.5 reveals that some 75 percent of the rural households are net buyers of calories from these 8 commodities. Overall, net purchases are widespread and not concentrated among a small number of households. According to the same graph, only about 10 percent (compared with 5% in 1983 found by Minot) of the households buy more than 500 Kcal/ae/day from the 8 food crops. Overall, with the exception of beans, this indicates that relatively small quantities of the eight staple crops are purchased. However, these data include purchases of sorghum and bananas used for beer brewing thus slightly overestimating purchased food consumption. According to Minot (1992), the amounts used by the grower in the manufacture of traditional beer are estimated at 1075 Kg for bananas and 75 Kg for sorghum per household per year. However, Minot also found that sorghum and banana beer making was concentrated among relatively few rural households.

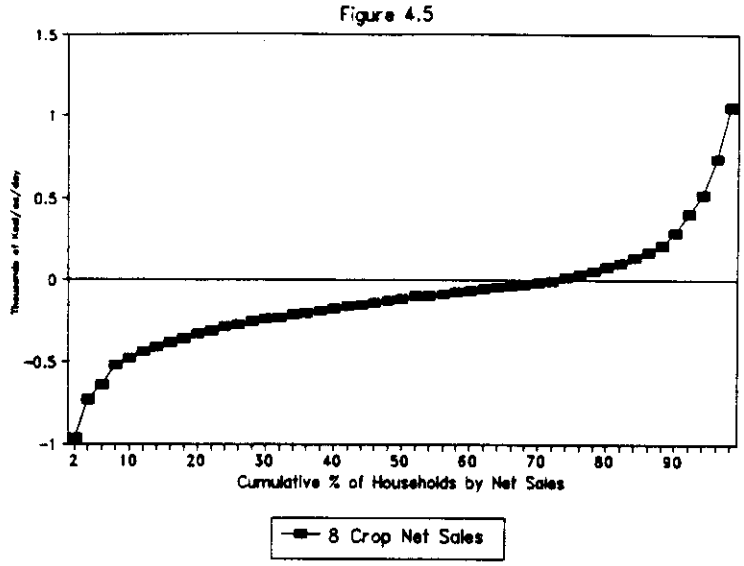

Figure 4.5: Distribution of Households by Net Sales of 8 Major Food Crops Expressed in Caloric Terms per Adult Equivalent; 1990

4.6 Correlation of Net Sales across 8 Major Food Crops

Analysis in this section helps determine whether for a given household the net sales position for one food crop is correlated with the net sales volume of other staple food commodities. To address this question, a series of correlation coefficients are computed between net sellers. A statistically significant and high correlation in absolute terms of net sales across products indicates that rural households are not specializing in production and marketing of one or more commodities. Relatively low correlations indicate specialization in sales of given commodities which may be an indicator of relative specialization in production. Given that the analysis is conducted on net sales, a significantly negative relationship indicates that sales of a given product are related to purchases of another. Analysis of the degree of specialization in sales of these commodities is necessary to better understand production and marketing problems of various types of rural households.

Table 4-7: Correlation of Net Sales Across All of Eight Different Food Commodities; 1990 (Number of cases=1208)

	Beans	Bananas	S.Potatoes	W.Potatoes	Cassava	Sorghum	Peas	Maize
Beans	1.000							
Bananas	.067*	1.000						
S.Potatoes	.033	-.022	1.000					
W.Potatoes	-.101**	-.013	-.062	1.000				
Cassava	.153**	.078*	.158**	-.035	1.000			
Sorghum	.205**	.102**	-.029	-.105**	.078*	1.000		
Peas	.118**	.039	.028	-.118**	.004	.108**	1.000	
Maize	.285**	.031	.098**	-.089**	.090**	.201**	.117*	1.000

* = .01 level of significance
** = .001 level of significance
Source: Calculated from data available from ENRD, DSA 1990

Overall results at this level (Table 4-7) suggest that correlation of net sales across crops is relatively weak. Only four of the commodities pairs have net sales correlations that are statistically significant and greater than 0.15, with the largest relationship between net sales of beans and maize (0.28) followed by sorghum (0.20).

Based on this analysis alone, there appear to be little specialization in sales. But this analysis is conducted across all households in the sample, many of whom do not participate in the market as sellers nor buyers. The analysis also groups together households operating in various agroclimatical zones, where selected crops may indeed respond well together to favorable growing conditions.[1] To further examine this issue, additional analysis is required, selecting only households who are net sellers of each commodity, and taking into account the five major agroclimatic zones of Rwanda. Since this is a detailed undertaking, only the three most important crops that provide calorie sources, beans, sweet potatoes and bananas are included.

Results for beans (Table 4-8) show two clear patterns. Households that are net sellers of selected crops are highly correlated in the Eastern agroclimatic zone. Notice also that some 34 percent of farms in this zone are net sellers of beans. Across all other zones, in

[1] See Appendix A1.20 for a map of the 5 agroclimatic zones of Rwanda.

Table 4-8: Correlation of Household Level Net Sales of Dry Beans With Seven Other Food Commodities By Agroclimatic Zones of Rwanda; 1990

Commodity	Agroclimatic Zone					National Average (n=180)
	North West (n=16)	South West (n=12)	North Central (n=18)	South Central (n=18)	East (n=112)	
Beans	1.00	1.00	1.00	1.00	1.00	1.00
Peas	-.07	.10	-.16	-.15	.07	.07
Sorghum	.67*	-.22	.02	.24	.31*	.35**
Maize	.55	.55	-.17	.39	.60**	.54**
Cassava	-.46	.33	-.61**	.36	.05	.07
W. Potatoes	-.06	.46**	-.75**	.21	-.40**	-.09
S. Potatoes	.19	.18	-.25	-.13	-.03	-.06
Bananas	.16	-.13	-.30	-.09	.06	.10
% of Bean Net Seller Households	7%	6%	8%	8%	34%	14%

* = .01 level of significance
** = .001 level of significance
Source: Calculated from data available from ENRD, DSA 1990

contrast, net seller households vary between 6 and 8 percent. Most importantly, in the Eastern zone there is significant and strongly positive correlation of bean and maize sales, and somewhat strong correlation with sorghum. There is also significant negative correlation with white potatoes. These results are consistent with the relatively larger farms and good growing conditions for beans, sorghum and maize in the Eastern zone. In other zones, there are few statistically significant correlations. Absolute levels of correlation between beans and maize, and beans and sorghum are generally higher (compared to results in Table 4-7) but since there are few degrees of freedom, it is difficult to obtain statistical significant. Overall, the results suggest that among households who are net sellers, especially in Eastern zone, there is a fairly strong relationship among beans, maize and sorghum. Production technology and market improvement research in the East should further investigate these inter-relationships.

Results for sweet potatoes (Table 4-9) reveal first of all that there is little zonal specialization of net sales, with the proportion

Table 4-9: Correlation of Household Level Net Sales of Sweet Potatoes With Seven Other Food Commodities By Agroclimatic Zones of Rwanda; 1990

Commodity	Agroclimatic Zone					National Average (n=460)
	North West n=39)	South West (n=72)	North Central (n=106)	South Central (n=112)	East (n=131)	
S.Potatoes	1.00	1.00	1.00	1.00	1.00	1.00
Beans	.14	-.42*	-.36**	-.04	-.05	-.16*
Peas	-.11	-.05	-.39**	.01	.018*	-.15
Sorghum	-.13	-.46**	-.22	-.09	-.01	-.14
Maize	.01	.10	.12	.04	-.06	.05
Cassava	.15	.13	.01	.00	.04	.00
W. Potatoes	-.54*	.42**	-.24*	-.12	.22*	-.26**
Bananas	-.08	-.12	.13	.13	-.04	-.02
% of Sweet Potato Net Seller Households	22%	38%	39%	44%	41%	38%

* = .01 level of significance
** = .001 level of significance
Source: Calculated from data available from ENRD, DSA 1990

of net seller households in 4 of the 5 zones falling very close to the national average of 38 percent. Within each zone, there is only one case of relatively high and significantly positive correlation of sweet potato and other crop net sales (with white potatoes in the Southwest zone). More common are reasonably strong and significant negative relationships, especially with beans, peas and white potatoes. These findings suggest that throughout most zones, for households who are net sellers of sweet potatoes there is considerable specialization in selling this crop and buying other calorie and protein sources.

Findings on bananas (Table 4-10) suggest even more specialization, but spread across most of the agroclimatic zones. The proportion of banana net seller households is close to the national average (39%) in 4 of the 5 zones. There are no statistically significant positive nor negative correlations at the zone level between sweet potatoes and the other food crops, and most absolute correlations are quite small. This indicates strong degrees of specialization in bananas for net banana sellers. Since there are few strongly negative correlations, it also

ɔle 4-10: Correlation of Household Level Net Sales of Bananas With ven Other Food Commodities By Agroclimatic Zones of Rwanda; 1990

ɔmmodity	Agroclimatic Zone					National Average (n=465)
	North West (n=30)	South West (n=73)	North Central (n=91)	South Central (n=103)	East (n=168)	
ɔnanas	1.00	1.00	1.00	1.00	1.00	1.00
eans	-.27	-.09	-.01	-.01	.10	.14
Peas	.08	.17	.09	.04	-.01	.02
Sorghum	.06	.09	-.20	.03	.15	.17*
Maize	-.10	.05	.01	.05	.03	.07
Cassava	.01	.03	-.06	-.11	.10	.10
W. Potatoes	-.18	-.01	-.18	-.05	.06	-.04
S. Potatoes	-.29	.08	.23	.21	-.02	.01
% of Banana Net Seller Households	16%	42%	35%	40%	53%	39%

* = .01 level of significance
** = .001 level of significance
Source: Calculated from data available from ENRD, DSA 1990

appears that net sellers of bananas are not having to buy other major food crops. This suggests that net banana sellers throughout the zones may have relatively larger farm sizes, wherein they are producing most of their own food, and selling bananas to obtain cash income for non-food requirements. From Table 4-5 we also know that relatively few (17%) households only purchase bananas, and these may be mostly producing banana beer. Future analysis should explore in more detail household behavior surrounding banana production, sales and purchases.

4.7 Sources of Household Revenue By Category of Net Bean Sales

Given the understanding of the distribution of households by net bean and other crop transaction positions, it is important to consider how household income or revenue varies accordingly. It is especially important to understand how households obtain income to purchase varying portions of their bean and other food crop supply. Table 4-11 shows household average revenue and sources of revenue (including an estimate of the value of own production which is consumed) by net bean transaction category. Table 4-12 shows the same data in percentage terms.

Table 4-10: Correlation of Household Level Net Sales of Bananas With Seven Other Food Commodities By Agroclimatic Zones of Rwanda; 1990

Commodity	Agroclimatic Zone					National Average (n=465)
	North West (n=30)	South West (n=73)	North Central (n=91)	South Central (n=103)	East (n=168)	
Bananas	1.00	1.00	1.00	1.00	1.00	1.00
Beans	-.27	-.09	-.01	-.01	.10	.14
Peas	.08	.17	.09	.04	-.01	.02
Sorghum	.06	.09	-.20	.03	.15	.17*
Maize	-.10	.05	.01	.05	.03	.07
Cassava	.01	.03	-.06	-.11	.10	.10
W. Potatoes	-.18	-.01	-.18	-.05	.06	-.04
S. Potatoes	-.29	.08	.23	.21	-.02	.01
% of Net Banana Seller Households	16%	42%	35%	40%	53%	39%

* = .01 level of significance
** = .001 level of significance
Source: Calculated from data available from ENRD, DSA 1990

appears that net sellers of bananas are not having to buy other major food crops. This suggests that net banana sellers throughout the zones may have relatively larger farm sizes, wherein they are producing most of their own food, and selling bananas to obtain cash income for non-food requirements. From Table 4-5 we also know that relatively few (17%) households only purchase bananas, and these may be mostly producing banana beer. Future analysis should explore in more detail household behavior surrounding banana production, sales and purchases.

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Table 4-11: Sources of Rural Household Revenue by Net Bean Transaction Category; Rwanda 1990 (in FRW)

Net Bean Transaction Category	Avrg. Revenue per HH	Own Consum-ption	Net Sales	Net Gifts	Ag. Inputs	Labor Sales			
						Agric.	Unskilled	Skilled	Total
> 60 Kg Sold	108815	45214	40524	2564	-13375	206	336	33345	33887
30-59 Kg Sold	75927	37828	23336	800	-5843	633	1750	17424	19806
<30 Kg Sold	50051	25534	15237	1603	-3685	735	1207	9421	11362
Zero Net Trans.	48420	31273	13084	533	-2457	953	985	4049	5987
< 30 Kg Bought	32734	18715	9608	828	-778	1230	718	2413	4361
30-59 Kg Bought	34439	16284	11272	1037	-1507	1738	1183	4432	7353
> 60 Kg Bought	54324	22050	18005	1564	-2653	2461	1678	11220	15359
RWANDA	47199	21846	15321	1273	-2594	1687	1219	8447	11353

Source: Computed from data available from ENRD, DSA 1990

Note: Value of own consumption, net sales, and net gifts refer to all food and cash crops, livestock products, and banana/sorghum beer produced by sample households. Negative numbers indicate inputs purchases. Revenue (net) is calculated as follows: Own consumption from production plus net sales plus net value of gifts received minus purchases of inputs plus the value of labor sold. Skilled labor include basically small enterprise such as carpenting, furniture making, brick making, trading, mechanics, civil servants, tailoring, pottery, weaving, etc.

Table 4-12: Percent of Rural Household Revenue From Various Sources by Net Bean Transaction Category; Rwanda 1990

Net Bean Transaction Category	Avrg. Revenue per HH	Own Consump-tion	Net Sales on Farm Products	Net Gifts on Farm Products	Labor Sales			
					Agricult.	Unskilled	Skilled	Total
> 60 Kg Sold	100	35.1	31.4	2.4	0.2	0.3	30.6	31.1
30-59 Kg Sold	100	45.1	27.8	1.1	0.8	2.3	22.9	26.1
<30 Kg Sold	100	46.4	27.7	3.2	1.5	2.4	18.8	22.7
Zero Net Transac.	100	61.0	25.5	1.1	2.0	2.1	8.3	12.4
< 30 Kg Bought	100	55.6	28.5	2.5	3.8	2.2	7.4	13.3
30-59 Kg Bought	100	44.7	30.9	3.0	5.0	3.4	12.9	21.3
> 60 Kg Bought	100	37.9	30.9	2.9	4.5	3.1	20.7	28.3
RWANDA	100	43.1	30.2	2.7	3.6	2.6	17.9	24.1

Source: Computed from data available from ENRD, DSA 1990

Note: The value of inputs has been proportionately allocated to own consumption and net sales. See also the note on Table 4-11.

Four major points are shown with these results. First, 1990 yearly average household income was some FRW 47,199. Compared to the average, significantly lower incomes are observed among households with relatively few bean purchases. Recall from Table 4-2 that these households have the smallest farm sizes. The vast majority of dry beans

are sold by households achieving average revenue from all sources that is about three times the national rural average. Recall also that farm size of these households is about twice the national average. The group of households making the largest purchases of beans (those buying about one half of household availability) have slightly higher than average revenue, with skilled labor sales especially helping to provide more income. Notice also that over 75 percent of the purchases at the national level are made by this group. Hence for these households the additional income source from farm sales and skilled labor appear to be major factors allowing higher availability of beans and overall calories per adult equivalent. More analysis is needed to explore how this group, as well as others, might be assisted to raise more revenue from skilled and other labor sales.

Second, the imputed value of own farm production that is retained for consumption is the single largest source of revenue, especially for households in the zero and smallest net bean buyer categories. Net sales of farm produced goods (both food and cash crops) is on average the next largest source of revenue. Labor sales of all sorts are also significant sources of revenue. Interestingly, net bean sellers, and households falling in the transaction category purchasing more than 60 kilos of beans derive relatively significant revenue from selling skilled labor and related products/services. Both groups have higher than average own consumption, as well as relatively high value of net sales of agricultural products, including banana/sorghum beer. Hence there may be a significant positive interaction between agricultural output and revenue from skilled labor. More analysis is needed to better understand this potential relationship.

Third, agricultural and unskilled labor contribute relatively little to overall household revenue. And agricultural labor and unskilled labor are more important for purchasers than for sellers. This suggests that net bean sellers have acquired more labor skills to sell than net purchasers, and are thus more likely to be able to gain

income from non farm sources. Yet net bean sellers are also households with relatively larger farm sizes, thus putting less pressure on them to sell labor off the farm. One can hypothesize that those with skilled jobs are better able to hire labor from small farmers who are willing to work for relatively low wages. Future analysis is needed to understand more about expanding agricultural and unskilled non-farm labor earning opportunities.

Forth, observe in Table 4-12 how the value of net sales from cash and food crops is consistently in the range of 25 to 31 percent of household revenue, although in absolute terms (Table 4-11) net sellers of beans earn from net sales of all agricultural products as much as 2 to 4 times those farm families buying few beans. The fact that households across all of the bean transaction categories appear to have net agricultural sales suggests there are few landless or near landless households. Yet the analysis of farm size in Chapter II showed some farms have as little as .10 hectare/ae. It is very difficult to see how farms of this size could generate net sales from agriculture that are equal to 25 to 30 percent of household revenue. Since many of those same households may be earning very little in absolute terms from labor sales, they may be forced to sell food crops to gain cash for essential non-food needs. Clearly, more analysis is needed to understand the various survival strategies of farm households with relatively low labor sales, low farm size, low bean purchases, and low food availability but who are still able to generate net sales of agricultural products to contribute to household revenues.

4.8 Conclusion

Data presented in this chapter indicate that Rwanda is increasingly a net importer of beans. Farm level bean transaction analysis shows that an increasingly small number of households account for a large amount of beans sold and that a high proportion of smallholders are net purchasers of beans. This group of bean net

buyers, especially those purchasing about 50% of household availability have slightly higher than average revenue, with additional income stemming from farm and skilled labor sales. Households that are net sellers of beans appear to have larger total and adult equivalent farm size. They also tend to have higher income on average. Indeed, both average revenue from all sources and farm size of these households are two to three times the corresponding national averages. Overall, the imputed value of own consumption remains the most important source of revenue, followed by net sales of both food and cash crops. Aggregate labor sales also contribute substantially to household revenue.

Comparison of 1986 and 1990 data shows a relative reduction in bean and overall calorie production (and presumably availability) per capita across household net transaction categories. These results call for improved income strategies aimed at providing and ensuring adequate calorie availability for a large proportion of Rwandan rural households. The development of such strategies will require research and case studies on how to expand output of potentially high calorie food crops such as sweet potatoes and cooking bananas, in the short run at least.

Overall results from correlation of net sales across all of 8 different food commodities at the national level show relatively weak relationships, hence suggesting considerable specialization in sales. If however, analysis is conducted by selecting only households who are net sellers of beans, sweet potatoes or bananas and on agroclimatic zones of Rwanda, more insights are gained on the degree of specialization in sales. Indeed, net sellers of beans appear to also be significant net sellers of maize, and somewhat of sorghum. They also tend to be strongly correlated with net purchases of white potatoes in the East zone. Overall, these findings reflect a strong positive relationship among net beans, maize and sorghum seller households, especially in the East zone.

On the sweet potatoes side, more common among net sellers are significant negative correlations, especially with beans, peas and white

potatoes. The analysis indicates noticeable specialization in sweet potatoes throughout most zones, and significant household strategies to procure other nutrient sources.

Turning attention to bananas, the analysis shows no significant positive nor negative relationships among net sellers at the zone level. However, a relatively significant positive correlation is shown at the national level between banana and sorghum net sales. Interestingly, results on banana net sales indicate strong degrees of specialization and suggest that net sellers of bananas appear to grow most of their own food (given their relatively larger farm sizes), and sell bananas to get cash to buy other goods and services.

CHAPTER V. HISTORICAL BEHAVIOR OF DRY BEAN IMPORTS AS POTENTIAL SOURCES OF CALORIES AND PROTEINS

5.1 Official and Informal Bean Imports Estimates

5.1.1 Official Statistics

FAO uses national sources of data to provide information about a wide variety of socio-economic indicators. These include official statistics on food crop imports, including dry beans. Furthermore as illustrated by data from FAO, it appears that such statistics are not collected in Rwanda on a regular and continuous basis. Indeed, it has been impossible to find a complete description of how, when, and where published estimates on imports and exports were gathered, and how they were processed.

Official data available on bean imports and exports for the last thirty years or so (1961-1988) appear suspect, such that valid analysis is limited, particularly for a meaningful trend assessment. Four years (from 1985 to 1988) show yearly imports ranging from 1,000 metric tons to 5,000 metric tons. Other years show zero imports. Bean exports are reported in the period between 1980-1982 (1,000 metric tons each year).

The intent here is not to say that the FAO series are wrong, and of course, statistics reported are mostly those provided by GOR agencies--it is only to illustrate the importance of the difficulties analysts encounter when undertaking a study of this type.

5.1.2 Trend in Informal Dry Bean Imports

Utilizing data presented in Table 4-1 the net informal imports identity (NII) specified below and initially utilized by Loveridge (1988) allows an estimate of informal bean imports for a given year. This identity assumes no net changes in stock positions (NSR=0) from one year to the next.

$$P - S - GG + GR - NSR = NII$$

Where: P = National Rural Purchases
S = National Rural Sales
GG = National Rural Gifts Given
GR = National Rural Gifts Received
NSR = National Rural Net Stock Reductions
NII = National Rural Net Informal Imports

Thus rural net informal imports (NII) of beans (rural purchases minus sales minus gifts given plus gifts received) are estimated to have been 60,598 tons in 1990. Rural imports divided by rural utilization (consumption) gives the percentage of rural consumption (21.7 percent) which is imported. And about 82.4 percent of what the rural population buys in the bean markets (rural imports/rural purchases) comes from neighboring countries. Comparative results from Loveridge and Minot for 1986 and 1983 are 60 and 64 percent, respectively.

Based on this available household level empirical evidence, it may be concluded that informal bean imports are increasing rapidly. Indeed, results suggest that informal bean imports expanded substantially (from 36,164 to 60,598 metric tons) within a period of only three agricultural years (1986-1990), using results of the net informal imports approach.

According to Minot (1992), figures based on the extrapolation of ENBC data to the national level indicate that bean imports represented 10 percent of rural consumption in 1983 agricultural year. From this information, it is possible to estimate that there were 40,670 metric tons of informal bean imports in 1983.

The factors contributing to the recent sharp increase in beans imports are most likely associated with the growth in rural demand as illustrated by the increase from 1986 to 1990 in the number of households buying beans (73.0%-83.6%) and the volume of beans purchased (54,521-75,337 metric tons). National production also decreased during this period (from 271,000 metric tons in 86/87 to 215,000 metric tons in 89/90).

The reader should be aware that the methodology used by Minot in ENBC is a bit different from that used by Loveridge in the bean and sorghum transaction survey of 1986, especially in terms of production

estimates. Present calculations using data from ENRD of DSA (1990), use Loveridge's approach, wherein production is physically measured. In the case of the ENBC study, production was estimated from measured consumption, sales, and purchases. For a full description of both methodologies, the interested reader is referred to Miniplan (1988) and Loveridge (1988.).

It is worth noting in passing that these findings have crucial implications for establishing a sustainable and sound agricultural policy including price policy, research priorities, and trade policy as well. Because of the strategic importance of bean inflows into Rwanda, in particular for food security, how these quantities get to consumers and the associated trade environment are the issues addressed in the following section.

5.2 The Nature of Informal Cross-Border Trade

5.2.1 Scope of the Study

Until recently there has been little recognition in Rwanda of the reality of informal imports of dry beans, although Rwanda's borders with Uganda, Zaire, Burundi, and Tanzania have often been mentioned as being particularly porous. In an earlier exploratory study of unofficial cross-border trade (Ngirumwami 1989), information was gleaned from interviews with government officials, researchers and agricultural commodity dealers at 25 marketplaces along the border and other among individuals familiar with the informal markets. The aim of the survey was to go to traders and elicit their views on the nature of informal cross-border trade. Salient results of the interviews can be summarized as follows.

5.2.2 Summary of Salient Findings

There is substantial evidence that a wide range of food crops and other consumer goods flow informally between adjacent countries through parallel markets. Sizeable amounts of food products including beans are

believed to flow into Rwanda, especially from Uganda and Zaire. Table 5-1 identifies general survey responses about these flows.

Quantities traded are not known, but the widespread availability of some of these goods in border towns indicates that some of these commodities movements are quite large. Resource constraints unfortunately precluded a further step in the study to determine the size of quantities involved.

In another study, Scott (1988) found that Rwanda normally exports about 2000 tons of white potatoes (a third potentially tradeable food crop) a year, which is less than one percent of total annual production. The same author concluded that Rwanda does not import white potatoes but Ngirumwami (1989) found that small amounts appear to be imported from southern Uganda and eastern Zaire.

According to several of the respondents, traded commodities are primarily used for domestic consumption and no cases of re-export or speculation were mentioned. Thus results suggested that Rwanda imports beans, most likely from eastern Zaire (Kivu region) and southwestern Uganda.

Results also indicated that Rwanda exports potatoes, bananas, small ruminants and manufactured goods such as reconditioned clothes, soap, etc, which appear to offer significant advantages over food products. Cash on delivery is the most commonly used method of payments for all transactions. Farmers appear to be the principal actors involved in this informal market, using head or back to transport their products. They are followed by small assemblers and a few truckers.

Overall, interviews showed that informal trading networks are considered to be beneficial in serving remote prefectoral markets more effectively than through official channels, thus improving food availability for the population in areas that generally are distant from large urban centers.

Results also indicated that flows may also vary over time. On the import side, a serious control of commodity movements from neighboring

Table 5-1: Survey Results Showing Selected Items Flowing Informally Between Rwanda and Neighboring Countries

From / To	Rwanda	Uganda	Zaire	Burundi	Tanzania
Rwanda		Beans	Beans	Beans	Beans
		Sorghum	Sorghum	Sorghum	Cattle
		Maize	Maize	Maize	Cigarettes
		Cattle	Bananas	Bananas	Small ruminants
		Small ruminants	Sugar	Sugar	
		Potatoes	Salt	Palm oil	
			Palm oil		
			Potatoes		
Uganda	Maize				
	Clothes				
	Soaps				
Zaire	Potatoes				
	Cattle				
	Clothes				
	Soaps				
	Small ruminants				
Burundi	Beans		Beans		Beans
	Sorghum		Sugar		Sorghum
	Bananas				Maize
	Clothes				
	Small ruminants				
Tanzania	Soaps			Beans	
	Clothes			Beer	
	Beer			Sorghum	

Source: Ngirumwami, 1989 and personal communications

nations is noticeable. Some eighty-one percent of the survey respondents declared that border crossings were more restricted abroad. The same proportion believed that the removal or lowering of this barrier would considerably expand the potential market and effective demand. However, information on respondent perceptions about the potential for greater cross-border trade in specific items was beyond the scope of the survey.

The majority of respondents also reported a tendency to reduce exports on the Rwanda side, due presumably to the overvalued exchange

rate of its currency (the survey was conducted in 1989 whereas devaluation occurred in November 1990). This helps to confirm that overvalued currencies can inhibit trade, especially when the magnitude of overvaluation differs significantly among currencies within the region.

5.3 Conclusion

Whether to increase or restrain the informal bean import stream is of considerable policy importance. There is growing rural demand for beans (assuming also a similar trend on the urban demand side). Investments have already been made in increasing domestic bean production, yet it appears that these have not yet shown adequate results. However and until more recently, some officials in the Rwandan administration believed deeply in a policy of bean self-sufficiency within the country, thus overlooking the need to invest in conducting research on bean inflows.

Though the analytical efforts to understand informal imports have been on a relatively limited scale and are more of an exploratory nature, the results are significant. Indeed, they help to improve understanding of the underlying structure of informal cross-border trade in Rwanda. Such knowledge can hopefully precede appropriate policy changes and new program initiatives.

The fact of informal imports is encouraging, given the vital role they play as potential contributors rather than hindrances to household food security. One final notable result is the need for greater recognition that food strategies in Rwanda should not be implemented in isolation of broader macroeconomic policies and the trade policies of neighboring countries.

CHAPTER VI. ANNUAL AND SEASONAL DRY BEAN PRICE BEHAVIOR AND FACTORS ASSOCIATED WITH VARIATION

6.1 Annual Dry Bean Price Behavior

The prices of dry beans, like that of any other commodity at a given time and in a given market, are determined by the interaction of forces of supply and demand, and the expectations of market actors concerning future supply and demand. There are two main types of temporal variations in commodity prices: intra-year variation and inter-year variation. High prices are a sign that a commodity is scarce. Holding consumers' purchasing power constant, low prices are a sign that a commodity is abundant. This section examines price fluctuations in Rwandan dry bean markets throughout the years. This analysis can indicate the periods of short term food availability (shortage or abundance) within Rwanda and possibly in neighboring nations. The analysis covers the last two decades (period from 1971 to 1990).

Fluctuation can be measured in a number of ways. One is the measure of nominal fluctuation--that is, a price change in a given year relative to the price of the preceding year. Such a tool, however, fails to distinguish between trend and random elements of fluctuation. To separate trend elements from random components, a three-year moving average technique as well as log-linear regression techniques are used.

Table 6-1 and Figures 6.1 and 6.2 show bean price movements measured through these two procedures (A simple linear regression of annual prices on time gives a poor fit on the trend line, and hence wide fluctuation in the residuals. Thus this technique is not used).

Year-to-year fluctuations of nominal prices reached a peak in 1974 when bean prices rose by fifty percent. This was a known bad year in overall food crop production and particularly in bean output (14 percent drop). Another sharp increase in price (39 percent) was recorded in

Table 6-1: Fluctuation in Annual Retail Prices of Dry Beans; 1971-1990

Year	Nominal Price	Change from Previous Year	Three-Year Moving Average	Deviation of Nominal from 3-Year Moving Average	Deviation of Nominal from Log-Linear	Real Price 1991 Base	Deviation of Actual from 5-Year Moving Average	5-Year Moving Average Real Price
	Frw/Kg	%	Frw/Kg	%	%		%	Frw/Kg
1971	12				22	71		
1972	14	14	12	17	15	81		
1973	11	-27	16	-21	37	58	-25	77
1974	22	50	20	10	-19	89	16	77
1975	28	21	25	17	-42	87	17	74
1976	24	-17	26	-8	-15	69	-4	72
1977	26	8	25	4	-17	66	-1	67
1978	26	0	26	0	-10	50	-18	61
1979	27	4	29	-7	-8	61	10	55
1980	33	18	28	18	-24	60	17	51
1981	23	-43	29	-21	19	39	-21	49
1982	30	23	28	7	0	45	-10	51
1983	30	0	36	-17	6	43	-14	50
1984	49	39	40	23	-44	66	34	49
1985	42	-17	40	5	-16	56	9	51
1986	28	-50	37	-24	27	37	-28	52
1987	42	33	36	17	-3	54	7	50
1988	38	-11	42	-10	12	47	-4	49
1989	46	17	42	10	0	57		
1990	41	-12			16	49		

Source: Nominal prices are from MINIPLAN

1984, which is known also as a drought year in Rwanda (12 percent drop in total bean output). During 1971-1980, fluctuations ranged from 4 to 45 percent compared with a range of 17 to 39 percent during 1981-1990. Nominal fluctuations greater than 10 percent occurred in 4 out of 10 years in both decades.

Among the two techniques used to examine underlying price fluctuations, the moving average method seems to provide a better fit. Deviations of the nominal price from the moving average price indicate that the range of fluctuation in prices was between 4 and 18 percent during 1971-1980 compared with 5 and 23 percent during 1981-1990. Using

Figure 6.1

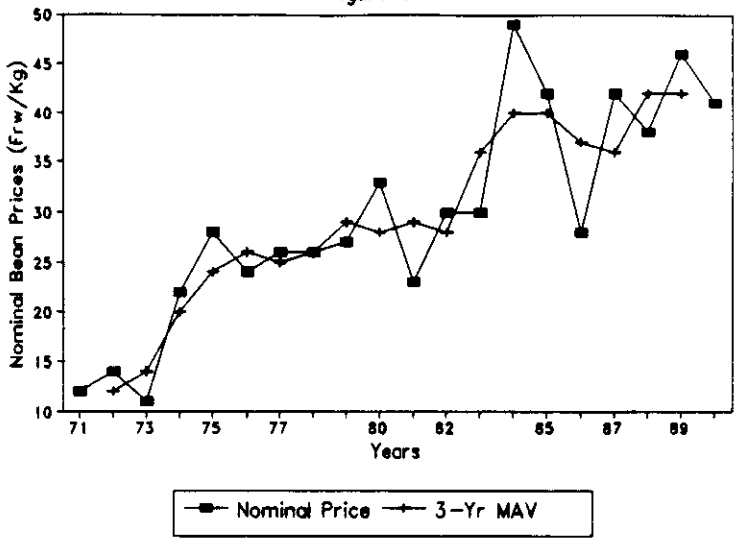


Figure 6.1: Nominal Annual Dry Bean Prices Compared with Three-Year Moving Average; 1971-1990

Figure 6.2

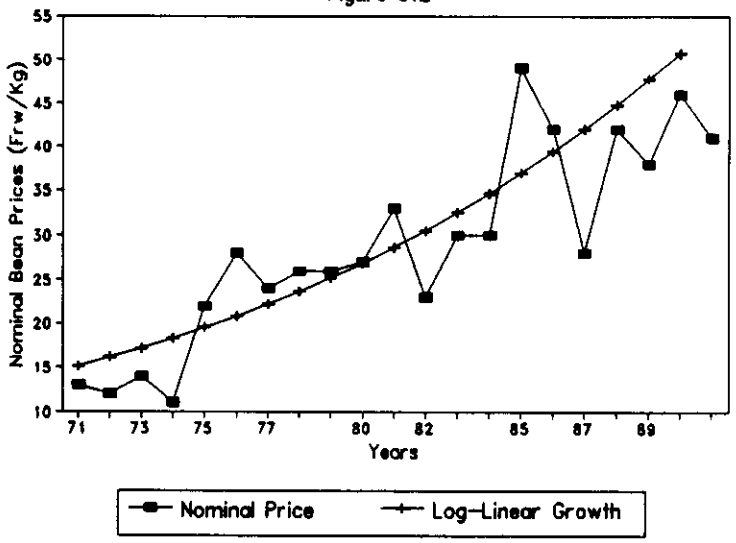


Figure 6.2: Nominal Annual Dry Bean Prices Compared with Log-Linear Annual Growth; 1971-1990

3-year moving average approach shows that nominal fluctuations above 10 percent occurred in 3 out 10 years in the former period, compared with 2 out of 10 years in the latter. Therefore, by this measure, the 1981-

1990 decade had slightly more price stability than the 1971-1980 period. These results most likely reflect a reduction in marketing costs, importing costs, etc. They may also reflect a positive impact of government efforts to stabilize prices which were relatively more intensive in the late 1980s than in 1970s.

Using real prices and a 5-year moving average approach to identify underlying trends shows relative real price stability in the second decade when we consider that only one case of actual fluctuation above 10 percent occurred, compared with 3 cases in the first decade.

Figure 6.3 shows the trend in real bean prices, when using the CPI of 1991 to deflate the nominal series. It also shows a 5-year moving average of real prices. Overall there appears to have been a significant real price decrease over the period of the 1970s. During the 1980s the 5-year moving average shows relatively constant real bean prices. As with the nominal case, real prices jumped substantially in response to the 1974 and 1984 droughts. Overall real price instability around the 5-year moving average is significant.

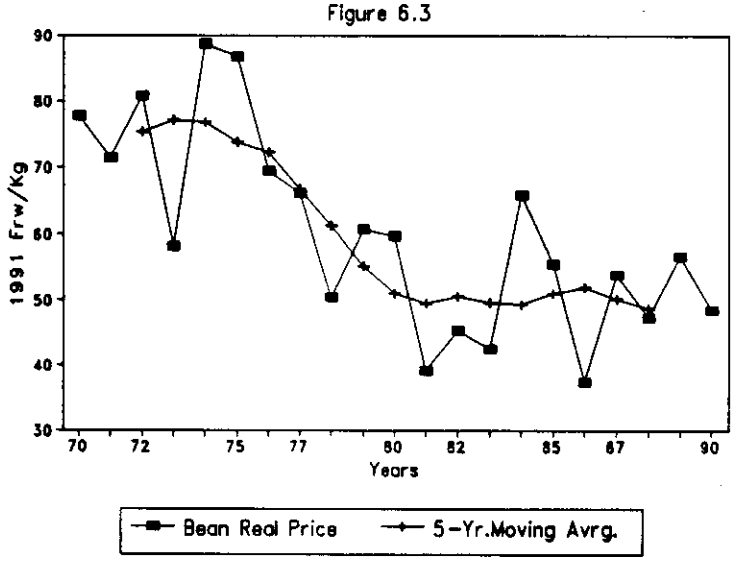


Figure 6.3: Real Annual Dry Bean Prices Compared with Five-Year Moving Average; 1971-1990

Perhaps the most important questions raised by this analysis are: what are the potential sources of the price fluctuations, what are the reasons for the significant real price downtrend in 1970s, and why are real prices no longer decreasing?

Three particular aspects of Rwanda's recent history may, to some extent, help to explain such fluctuations. The first should be related to the ongoing transition, although very slow, from a predominantly subsistence economy to a moderately commercialized one, and the implications of this transition for variability in prices. As Rwanda depends increasingly on informal imports, factors outside the country will also influence prices in Rwanda. The second relates to the frequent changes in GOR pricing schemes. Prior to 1986, a "reference price" system was in place for dry beans. This pricing policy was changed in January 1986 when the GOR moved to a fixed farm level floor sales price before it switched back to the indicative pricing policy in 1988. Another important factor in the pricing system is that official prices used to be pan-territorial and pan-seasonal, while recently they are allowed to vary by region and season.

A third concern is related to the recent political and socio-economic disruptions in Rwanda and among its neighbors which, surprisingly, appear to have had a positive impact on informal dry bean imports, thus playing an important role in helping to stabilize prices in Rwanda. Other factors could include changes in regional trade costs, changes in domestic marketing costs and changes in weather cycles.

6.2 Seasonal Dry Bean Price Index

6.2.1 Introduction

Understanding past price movements is one key way to developing market improvement strategies. Knowing the historical patterns of trends, cycles, and seasonal changes can also provide a base for forecasting. Trends refer to consistent price movements over a period of years. Cycles are fairly regular up and down changes each of which

cover a period of years. Seasonals refer to regular patterns within a year.

As expected in a competitive market, the normal seasonal pattern of crop prices would have relatively low price at the peak of harvest, followed by increases to relatively high price just prior to the subsequent harvest. In theory, prices should rise at a rate that would just cover the full cost of storage, including various risk premiums for private agents (farmers and traders) who carry bean and other crop inventories.

6.2.2 Seasonal Price Patterns on Dry Beans

The following analysis uses monthly cash dry bean prices, mostly quoted in Kigali-Center market. As already stated, the general pattern of prices in Rwanda does follow this market rather closely. The period covered is January 1972 through December 1991.

A computed seasonal index is shown in Table 6-2. The index is the average for each month over the years analyzed with 100 as the base for the annual average of the index. Simply put, the month index value indicates by how many percentage points each month's value lies above or below the annual average. The Standard Deviation (Std) is an indicator of the reliability of the index. The lower the standard deviation, the more confidence one can place in a given monthly value of the index.

Table 6-2: Index of Seasonality for Dry Bean Prices: 1972-1991

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Index	86.0	83.8	84.0	88.2	90.5	95.6	103.2	107.1	110.5	114.5	120.5	110.1
Std	12.9	7.8	5.3	7.7	15.5	13.4	9.3	8.9	7.4	10.9	17.1	15.6
Trend	-0.6	-0.2	-0.3	-0.2	0.3	1.2	0.6	0.0	-0.1	0.5	-0.5	-0.8

Source: Monthly nominal dry bean prices from Miniplan

The trend indicates whether the index value for a given month has shifted over time. A positive (and statistical significant) trend means that the index for that month has increased over time and a negative

trend means that the index for that month has been decreasing. The value of the trend is the annual change in the index.

As an example, under "Index of Seasonality" in Table 6-2, the index indicates that prices averaged lowest in February at 83.8 percent of the annual average and highest in November at 120.5 percent of the annual average. The standard deviation on February of 7.8 percentage points means that one could expect the index to be 83.8 ± 7.8 or a range of 76.0-91.6 in 2 out of every 3 years.

If past trends continue into 1992-1994, the projected seasonal index would be as shown in Table 6-3.

Table 6-3: Projected Seasonal Price Index; 1992-1994

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1992	77.6	81.8	80.0	85.8	94.6	111.6	113.4	109.6	110.2	120.7	114.1	99.1
1993	76.9	81.6	79.7	85.6	94.9	112.8	114.2	109.8	110.2	121.2	113.7	98.2
1994	76.3	81.4	79.4	85.4	95.2	114.0	115.0	110.0	110.1	121.7	113.2	97.4

Source: Monthly nominal dry bean prices from Miniplan

The projected seasonal index indicates that bean prices are expected to be much higher in June of the years ahead as compared to the price in June 1991. The analysis shows a significant t-statistic value (2.49) for the trend in June. This may indicate that the second harvest in Rwanda is putting less downward pressure on bean prices over time. Indeed, Figure 4.1 showed that the magnitude of the June peak harvest may be decreasing. However, it is also in June that Zaire and Burundi are harvesting a large proportion of their annual bean production.

Based on the information presented above, two different strategies can be suggested for different type of market-oriented producers: selling, and/or purchasing or storing. Indeed, it appears that net sellers should hold their beans longer, and net buyers should buy more when prices are low. However, all will depend on various factors facing individual farmers such as storage facilities (already in place or new), and smallholders' ability and willingness to handle risk. Net buyer

households could significantly cut the cost of beans procured, if they have the ability to store, and the capital to purchase beans at harvest.

In short, analysis of historical price data can be very useful for a producer in the process developing a production and marketing plan. Views presented in the next section serve to complement the preceding discussion.

6.3 Typical Variations from the General Seasonal Pattern

A plot of the dry bean price index can be helpful to see the typical seasonal price pattern, the evidence that this normal seasonal pattern is changing, and to assess the degree to which each agricultural year follows this general pattern (Figure 6.4).

Figure 6.4

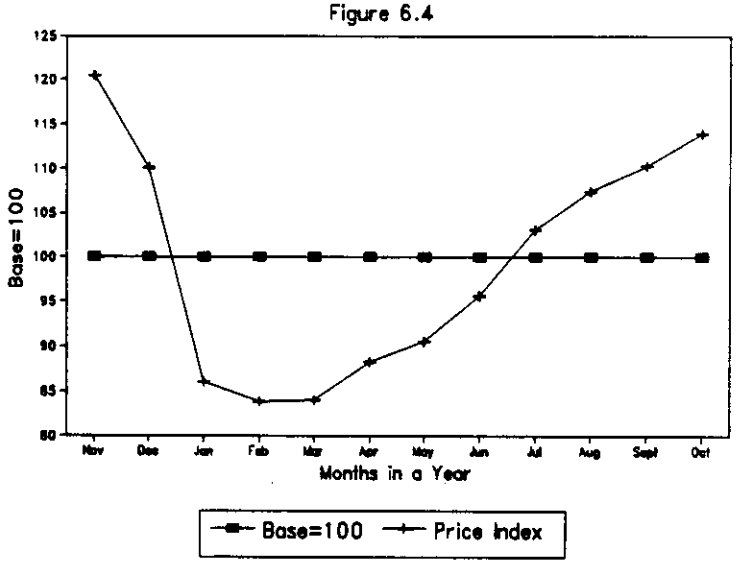


Figure 6.4: Dry Bean Price Index; 1972-1992

The graph of the estimated bean price index clearly shows three phases or key patterns with the following features: phase one (December to February) is characterized by a sharp decline in consumer price prior to the big harvest season; phase two (February through May) can be described as seasonal low with modest increases between the two harvests; and the third phase (June-November) is that of a sharp

increase in dry bean prices after the second harvest, with increases lasting until the beginning of the next harvest.

The remaining part of this section summarizes the results of the comparison of each years' actual seasonal price behavior with the general pattern found in the 1970-1990 seasonal index. Graphs of actual monthly bean real price behavior for each of the nineteen agricultural years are presented in Appendices A1.10 through A1.19.

Following the tradition of previous work, the DSA agricultural year (November through October of the following year) is used in all the figures for easy comparison with production and price graphs in this study. To facilitate the analysis of prior years, the nominal MINIPLAN price data (1972-1991) were inflated to December 1991 levels using the BNR's consumer price index as reported in International Financial Statistics. Appendices A1.6 and A1.7 contain the full set of nominal and real prices after inflation to December 1991 price levels respectively. The monthly CPI used for inflation process is also presented in the Appendix A1.10.

Figures in Appendices from A1.10 to A1.19 reveal that only one third of the nineteen agricultural years follow closely the general seasonal price pattern (1982, 1983, 1986, 1987, 1988, and 1990). These years generally show a decrease in bean prices prior to the big harvest, probably because some farmers start harvesting early in December and during the same period they (or others) are supplying the market, especially with green beans or dry beans from storage, in order to get enough space for their new product.

The second phase of the seasonal pattern, of more or less flat to slight increases in dry bean price, should be the result of the abundance of dry beans just after harvest. At this time farmers have enough beans to eat and some still have some in the field so that the overall the demand for dry beans is relatively low. As beans get dry, some household start to sell in other to get other consumption goods and services. However, quantities coming onto the market are relatively

small while the number of purchasers start growing. This results in a slight increase in dry bean price which is immediately smoothed by the second harvest. This smoothing process is also be a result of imports from neighboring countries. As already mentioned, the ending period of this second phase coincides with the big harvest periods in Zaire and Burundi.

The third phase of the general pattern is that of a sharp increase in dry bean price. Two major arguments can be given for such bean price behavior and the reader should refer to the graphs in section 4.1 of Chapter Four. One factor is a decline in monthly bean production from July forward. A second argument is the widening gap between the demand (number of purchasers) and the supply (number of sellers). This growing demand in the summer period should be associated with the fact that some households are better off from coffee sales, sorghum (big harvest in July) and beer bananas (big harvest in October). As already mentioned, the need for bean seed in mid-September to early October also significantly contributes to the bean price peak in these months.

For agricultural years that deviate somewhat from the general seasonal pattern (13 out of 19), some of the arguments given in section 6.1 of chapter six may apply. Additional insights are gained from the following section covering the same sample period, with relative emphasis on the most recent years. Generally, the extent to which deviations from normal patterns occur may indicate the potential complementary role of other sources of bean supply such as imports, stocks, and food aid in smoothing intra-year variations. Differences in inter-regional price variations, bean production and availability declines are also among major factors that result in unique yearly behavior.

6.4 Fluctuation in Monthly Prices

The prices for food crops are characterized by seasonal and geographic fluctuations. For dry beans in Rwanda, seasonal price

fluctuations have occurred every year, with changing intensity. Over the 19 year reference period and for the sake of easy comparison, a 5-year moving average (MAV) technique for Kigali-Ville real prices (December 1991=100) is used (see Table 6-1). For 1989, 1990, and 1991 years the comparison is based on 5-year moving average for 1988 (49 Frw/Kg).

Overall, 6 agricultural years out of 19 show monthly fluctuations roughly below their respective 5-year moving average. Three years (1975, 1980, and 1985) show monthly fluctuations clearly below the corresponding moving average. For January and February, two peak harvest months, prices fall above the moving average roughly in six years. Concerning the very poor harvest months (July-October), price fluctuations entirely fall below the average in 5 out of 19 years. Overall 1974 shows the highest price (156 Frw/Kg in November). The lowest price was observed in January 1984 (31 Frw/Kg).

If we particularly consider the more recent years, abnormal price increases are observed in 1989, a relative bean failure agricultural year in Rwanda (8 percent drop) with the southwestern region of the country being especially affected. The noticeable price increase started between April and May, reached its peak in June and stayed relatively high through November, before prices dropped significantly in early 1990.

In 1990, real bean prices stayed mostly below the five-year moving average from January to September with a smooth increase starting in May. Prices were nearly constant during the first quarter 1990 while peaking around October. One plausible explanation of this recent bean price behavior is the GOR decision to officially authorize dry bean imports from Uganda during the bean failure year of 1989 and to a lesser extent in 1990. However, it is difficult to conclude whether or not these official imports (through barter agreements) proved an effective means of reducing the price to almost its normal value in January 1990. In fact, there is an overlapping effect of these imports with the

relatively big bean harvest season in Rwanda in early 1990. Results in previous chapter also reveal that unofficial dry bean imports have substantially increased in recent years.

In 1991, bean prices mostly stayed below the moving average for the rest of the year with the lowest level in March and a progressive increase starting from June.

A tentative short list of key factors involved in price variability was addressed in section 6.1 dealing with annual dry bean prices. Some may also apply for the case under investigation. To extend the list, one can mention consumer income variability (although delay in salary payment is rarely experienced at least for the majority of government employees); variability in the price of other commodities especially substitutes; food imports and/or aid in periods of shortage (1989 case), and governmental entry into the market (through OPROVIA) to purchase dry beans for security stocks which reduces the supply available in the market and may result in higher market prices.

The seasonality of bean production in neighboring nations, of course, plays an increasingly important role. In both Burundi and Zaire (Kivu region), more beans are produced in the second season (harvest is in May through July) whereas in Rwanda more is produced in the first season (harvest in December through February).

6.5 Conclusion

The analysis of annual bean prices shows significant year-to-year fluctuations. Both nominal and real prices were responsive to 1974 and 1984 droughts. The GOR efforts to improve the markets seem to have been more successful in the last decade than in the 1970s. This is probably associated with the reduction in marketing and importing costs mostly due to the improvement of road infrastructure and the investment by the private sector in light trucks.

As expected, the normal seasonal pattern of bean prices shows relative lows at the peak of harvest followed by a price rise to a high

just prior to the subsequent harvest. There is, however, an intermediary phase characterized by a more or less flat to slight increase in bean prices. The analysis shows that historical price data can provide bean growers with an efficient tool to help improve their production and marketing plans. Such analysis results are also essential for government policy decision aimed at facilitating a more market-oriented food policy in Rwanda.

The analysis of variation from the general seasonal pattern shows that only 6 out of 19 agricultural years follow closely the general pattern. The deviation of the other 13 years is associated with many factors including yearly changes in weather pattern, domestic price policy, seasonality and absolute levels of bean production in neighboring countries, etc. The fact that 13 out of the past 19 years vary somewhat from the common seasonal price pattern is a strong argument of the need for on-going monitoring and analysis of key factors associated with changing market forces.

CHAPTER VII. DRY BEAN MARKET PERFORMANCE: A REVIEW OF POSSIBLE PUBLIC AND PRIVATE ACTIONS UNDER DIFFERENT DRY BEAN SUPPLY SCENARIOS

This chapter is confined to an analysis of selected transitory policies, especially those for dry beans, pursued in Rwanda. It begins with a very brief review of self-sufficiency and self-reliance options. This is followed by an analysis of the frequency of typical dry bean supply scenarios in Rwanda and three neighboring countries (Burundi, Uganda, and Zaire) referred to as the "Region". Finally, four common scenarios are selected and potential governmental and private sector actions to improve market performance during these typical periods are discussed.

7.1 Government Policy

7.1.1 Changing Degree of Self-Sufficiency

Food self-sufficiency is a dynamic concept in Rwanda as well as other countries. In fact, the interaction of a number of dynamic relationships causes self-sufficiency to change through time. According to Rask (1991) these relationships include food consumption changes, principally diet changes, as they relate to variation in income level; production changes, as affected by technological development and limited by resource endowments; public policy, as it affects both production and consumption, primarily through commodity prices; and population growth, as it diminishes the gains made in national income growth and agricultural productivity.

Results in Chapter Three showed that bean production in Rwanda is no longer keeping up with population growth. Another finding was the tendency of farmers to shift area planted from beans to sweet potatoes and bananas. Chapter Four empirically demonstrated that rural households in Rwanda are increasingly net importers of beans while Chapter Five described the environment of cross-border trade. Chapter Six showed the impact of these findings (among many other factors) on bean price behavior in the last two decades, with an emphasis on the

most recent years. With all of this in mind and assuming a food policy of promoting greater degrees of self-sufficiency, two potential options are often considered.

7.1.1.1 Direct Technological Change

Strategies can be developed to promote cost-reducing technological innovations that can and will be adopted by smallholders. This is a basic element because new technology provides an opportunity to produce beans at lower real costs, allowing farmers to obtain a higher income position, and offering consumers the opportunity to purchase at lower prices. Increased productivity in beans also may permit farm households to assure their own bean needs with fewer resources, thereby releasing resources for other income-earning crops.

Higher incomes allow increased access to a larger and more varied diet as well as improved health care and sanitation, all of which improve household food security. In addition, higher farmer incomes translate into increased demand for other goods and services produced in other parts of the economy, stimulating economic growth and employment more broadly. The technological package in Rwanda generally includes improved bean varieties, mineral fertilizer, rhizobia inoculation and insecticides.

7.1.1.2 Raising Domestic Bean Prices

The seemingly most obvious but very often misleading way to achieve greater self-sufficiency is to raise domestic prices. If this option is adopted (as was attempted in 1986), analysis has shown how a serious conflict between producer and consumer interests arises. There are relatively few producers who are net sellers, but a large majority who are net buyers. Likewise, if bean imports are restricted and protection is provided to domestic smallholders, then the rural and urban poor, who consume beans as food key sources of both calories and proteins, will suffer. On the other hand, if bean imports are highly

subsidized, domestic farmers will have reduced incentives to produce. Thus, a strategy to raise prices, as opposed to one based on reducing unit costs of production (and hence the real cost of food to consumers), raises serious questions for Rwanda, where 84 percent of the rural population are net buyers of dry beans who would be hurt in the short run by higher prices.

From the above comments, it clearly appears that the preferred way to promote greater self-sufficiency is through technological change to reduce the costs of domestic bean production. If these costs are reduced, then the supply curve for beans will shift outward, and other things being equal (prices remain the same), production will expand, and imports are either reduced or eliminated.

7.1.2 Self-Reliance

Food self-reliance is a broader concept of self-sufficiency policy; that is, the country has the ability to feed itself either from domestic production or from commercial imports. In fact, many countries' earnings from exports are enough to meet their food needs through imports. Historically GOR policy has been characterized by the vision of a non-importing, autonomous approach to food (including beans) resulting in self-sufficiency, at both the national and the farm level. More recently, GOR policy has focused on stimulating exports and encouraging greater market participation.

7.1.2.1 Potential Trade of Dry Beans and Export Crops

Currently, the process of farmer integration into markets as both sellers and buyers has already begun, yet further steps are likely needed. This evidence is empirically supported by the findings from the 1983 ENBC (Minot, 1992), the 1986 survey of household transactions on beans and sorghum (Loveridge, 1988), and the present analysis of the 1990 ENRD data.

On the export crops side, World Bank (1992) notices that it appears that coffee and tea exports need much more attention, in terms of both growth and diversification. Following a self-reliance policy, other things being equal, one can expect an increase in production of high value crops, including coffee and tea, and a greater reliance by these farmers on purchasing their basic food from other producers who are specializing to some extent in food production.

Currently, the supply of beans clearly depends to some degree on events beyond national borders, and in the case of Rwanda, domestic consumption of beans is not confined to what is locally produced, as confirmed by analysis results in previous chapters and other studies. Indeed while it appears that domestic output of dry beans on a per capita basis has declined significantly in the past 5-7 years, real bean prices have only increased slightly. In fact, greater regional supplies and relatively unrestricted imports of beans most likely have been a positive force in keeping domestic prices in Rwanda at reasonable levels. However, more is needed to understand the regional markets effects on Rwanda. Likewise, recent trends suggest that real prices are increasing. This makes it even more important to study factors associated with regional supply and demand.

7.2 Inventory and Frequency of Possible Bean Supply Scenarios

7.2.1 Criteria and Methodology Used for Scenarios Specification

Three general levels in dry bean supply can be conceptualized in Rwanda and within the Region: Normal, Below Trend (Deficit), and Above Trend (Surplus). With respect to these different levels, nine transitory scenarios of dry bean supply can be defined.

To classify the years of the period from 1970 to 1990 into one of these different levels, data from FAO on dry bean production per capita are used and deviations from trends are computed for both Rwanda and Region. An arbitrary closed interval of [+10%, -10%] around the trend is adopted to consider a particular year as Normal. A yearly change

Table 7-1: Dry Bean Supply Scenarios in Rwanda and the Region

RWANDA	REGION
Below Trend	Normal
Below Trend	Below Trend
Below Trend	Above Trend
Normal	Normal
Normal	Below Trend
Normal	Above Trend
Above Trend	Normal
Above Trend	Below Trend
Above Trend	Above Trend

greater than +10 percent or below -10 percent per year is classified as an above trend or a below trend year, respectively. The results are summarized in Table 7-2.

Table 7-2: Deviations of Dry Bean Production per Capita from Trend; 1970-1990

Year	Rwanda (%)	Region (%)
1970	+15	-11
1971	+10	0
1972	-5	-2
1973	-9	-8
1974	-32	-15
1975	-5	+16
1976	-2	+18
1977	-1	+8
1978	-6	+8
1979	-4	-12
1980	-8	-14
1981	-6	0
1982	+2	+4
1983	+15	+4
1984	+1	-12
1985	+26	-1
1986	+14	+1
1987	+7	+4
1988	-2	+4
1989	-13	0
1990	-35	-7

These indicate that the 1974 drought significantly affected both domestic and regional bean production. The case of 1990 needs further investigation in order to determine the factors responsible for the

observed deviations of production from trend, especially in Rwanda where we notice a deviation of -35% as compared to -32% in 1974.

7.2.2 Frequency of Scenario Occurrence

According to the criteria utilized, Table 7-3 shows no cases of below trend-above trend and above trend-above trend combinations respectively over the sample period. Nine out of twenty years are concentrated in the upper left cell of the table (normal years in both locations). Three above trend years are identified in Rwanda against two in the Region. Two years (1974 and 1989) are classified as below trend in both places. Surprisingly, the 1984 generalized drought year shows as normal in Rwanda with a one percent deviation above the trend.

Table 7-3: Distribution of Years in Different Scenarios

REGION	RWANDA		
	Normal	Below Trend	Above Trend
Normal	71 72 73 77 78 81 82 87 88	90	83 85 86
Below Trend	79 80 84	74 89	70
Above Trend	75 76	None	None

7.3 Common and Extreme Supply Scenarios Cases: Possible Public and Private Actions

The following discussion of dry bean supply scenarios is not meant to be a detailed analysis of the bean problems facing Rwanda, but rather a beginning of potential strategic actions to be considered by decision makers to cope with a particular state of bean supply in order to reverse the short to medium term seriousness of potentially adverse price trends. The first goal of such actions is to protect both the farmers' income and the consumers' pocketbook. A related goal would be to minimize government outlays to achieve desired goals of protection for producers and consumers. The actions listed below are of a suggestive nature and no attempt is made to discuss instruments needed

to implement them. Follow-up analysis will obviously be required. With the present discussion, the goal is to list possible actions that match various supply situations. One or more action can apply in one or more specific case.

7.3.1 Common Supply Scenarios Cases

7.3.1.1 Domestic Below Trend and Regional Normal Supply; Domestic Below Trend and Regional Above Trend Supply

Only one case (1990) falls in this bean supply scenarios and applies for the domestic below trend and normal supply of beans in the region. Prices in this year roughly followed the general seasonal pattern except that they stayed constant during the first quarter and mostly below the 5-year moving average for the reasons previously discussed. The short run supply shock due to domestic shortfall appear to be quickly offset by normal or above trend supply in the Region if we consider actual price behavior in 1991 (see Appendices A1.18 and 19).

A. Public Actions

Under these circumstances bean consumers could be made better off through greater informal trade liberalization, barter agreements, relaxing the licensing administrative burdens for traders, and improvement of regional and local transportation networks. While some controls to avoid oversupplying the market may be necessary, too much import regulation ultimately raises trader costs and consumer prices in domestic markets. Other possible actions could include encouraging greater competition in bean trading between regions, strengthening the local Chamber of Commerce, and intensifying interregional and regional business trips/travels. Overall, government decision makers can expect short run price increases to diminish rather quickly, providing access to region supply is not blocked.

B. Private actions

Private businessmen could be encouraged to invest more in truck purchases for transporting and easy distribution. The banking system could be evaluated to see how more loans for this activity can be encouraged.

In general, traders could develop a better functioning informal market information network to permit them to follow supply and price developments in distant as well as local markets.

7.3.2 Extreme Supply Scenarios Cases

7.3.2.1 Domestic Below Trend and Regional Below Trend Supply

Under the criteria utilized, only two of the past 20 years (1974 and 1989) fit in this category. Prices in Rwanda during these years go significantly higher and remain at such levels relatively longer before the recovery from such bean supply shocks. It appears to have taken approximatively three to four years to naturally recover from the drought induced bean supply shock in 1974, although the late arrival of food aid may have prolonged the recovery. For 1989, the recovery was more rapidly attained through official arrangements for bean imports from regional markets, which dropped prices nearly to normal level within the period of the next year.

A. Public Actions

Government decision makers clearly need to anticipate that these extreme scenarios can happen, although with reduced frequency. One suggested action is to get better and more timely information pertaining to regional and/or international supplies and trading opportunities in order to reduce high search costs by public and private firms. Another alternative could be to facilitate information exchange among prospective trading partners: avis d'appel d'offre/auction.

In the case of extreme shortages, appeal for outside support in form of grants and concessionary imports could be considered. However,

the historical record shows that food aid imports from outside the region are often not sent in time to really help solve the problem. Also, if massive world market food aid supplies are provided, but come one year late, the natural recovery process in the region and in Rwanda could be disrupted.

The GOR could also draw down on domestic reserve stocks, although the historical size maintained by GOR has been small. The relative infrequency of this supply scenario (2 out of 20 years) suggests that carrying emergency stocks would probably not be cost effective.

B. Private Actions

High market prices would encourage stockholders to make beans available to the market. For the reduced bean volumes available, a concern is how to develop an effective distribution system and a reasonable pricing scheme so that the poor, at least, would be insulated from the effects of significantly high prices. During prior high bean price periods, there is evidence that consumers shifted to other food products. To the extent this is possible, general measures to facilitate local and regional trade will assist private traders in the process of searching out and marketing alternative products. High prices for beans would also increase incentives to search out supplies of alternative calorie sources in more distant regional markets.

7.3.2.2 Domestic Above Trend and Regional Above Trend Supply

As already mentioned, no case falls in this bean supply scenario. Results of production trend analysis in Chapter Three indicate that this supply scenario is not very common. However, the following suggests some relevant actions for consideration if such a supply scenario should occur.

A. Public Actions

Facilitate information exchange among prospective trading partners, allow private sector traders maximum flexibility in informal export trade. Make cash available for OPROVIA to enable it to purchase dry beans from producers on a timely basis. OPROVIA could let out bids, and major merchants could bid to supply transactions sites with beans. Facilitate greater export liberalization, with reduced financial and administrative burdens of the current system of licensing. Promote regional exchange of information.

B. Private Actions

The following strategies could be explored: improvement or investment in transport and storage facilities for development of local and regional marketing capabilities. Also develop better business linkage with international markets that might provide markets for substantial volumes of bean surpluses.

7.4 Conclusion

The discussion in this chapter recognizes that actions considered are heavily influenced by the various interest groups affected. Bean producers, consumers, traders, and many other participants in bean market may all have some influence over the development and implementation of the policies outlined above. Bean system participants are, of course, expected to try to influence these policies so as to serve their own interests.

In many respects, the regional bean production and marketing system seems to have performed relatively well. Modest supplies of a wide variety of beans have been offered to consumers at reasonable prices except in abnormal agricultural years. After the 1990 significant price run up, rapid use of both public and private regional trade mechanisms seems to have quickly returned the system to normal price patterns. The list of actions is preliminary and not in the least

exhaustive. The purpose of this is to begin exploring ways to promote an effective working environment between public and private participants in the bean subsector, and to begin thinking systematically about how to use regional trade to help solve cases of shortfall and excess supply in Rwanda.

CHAPTER VIII. SUMMARY, CONCLUSIONS AND DISCUSSION OF POLICY IMPLICATIONS

8.1 Review of the Major Points

The general objective of this study was to analyze recent production, marketing and trade relationships for dry beans in the context of production and pricing changes facing other major food crops grown in Rwanda. Five more specific objectives derived from the need for analysis to guide market-oriented food policy concerns. They were to:

- Analyze national-level agricultural production (both total and per capita) and price trends for dry beans and 7 related major food crops grown in Rwanda;
- Analyze household level dry bean market behavior (volume of domestic household level bean transactions);
- Analyze the historical behavior of dry bean imports as potential sources of calories and proteins to make up national short-falls. Also describe the nature of informal cross-border trade in dry beans and other agro-based and consumer commodities;
- Analyze annual and seasonal dry bean prices and factors associated with price variation;
- Under different domestic and regional dry bean supply scenarios (short-falls or excess bean production in Rwanda and/or neighboring nations), suggest possible public and private sector actions that might improve performance of the bean market for both producers and consumers. This could include recommendations for further analyses and/or data collection needed to continue assisting the GOR to improve its market-oriented bean and related crop policy.

8.1.1 The State of Agriculture and Food Crop Supply

Today more than 8 million people live in Rwanda, and there is a growing concern about the food security and nutritional status of major segments of this population. Population density is already the highest

in Africa. With little room for extension of cultivated land, the increasing pressure of population has resulted in fragmentation of farms into smaller units. Even the most land available households have only about 0.4 hectares per adult equivalent. The lowest 50% of households have only about one tenth of a hectare of land available per adult equivalent. These trends suggest that future increments in domestic food output will increasingly depend on continued improvements in agricultural technology in areas of yield-oriented production growth and on the spread of new technology to areas that still have not benefited from it. Such small farm sizes have also created a tremendous need for expansion of off-farm agricultural and non-farm employment as a strategy to acquire adequate household income, and in turn, purchase needed food and other goods and services.

Analysis of trends in agricultural production patterns leaves a relatively pessimistic picture. Domestic crop production appears to be not only lagging behind growth in demand but may also have reached a production possibility frontier. Simply put, aggregate agricultural supply since the mid 1980s is not responding to diverse incentives offered to farmers.

Adding population growth to the equation, analysis of trends in bean and other major food crop production depicts a rapidly decreasing domestic per capita calorie and protein output in Rwanda. This approach did not take into account animal products, diverse forms of food imports, and household level purchases as potential supplemental sources of calories and proteins. Including these sources will slightly improve the food availability picture for many households, but will still leave serious problems.

While falling in the 1970s, calorie prices in most recent years are no longer decreasing and appear to be starting to climb. Analysis shows that the composite calorie price series tends to be pulled up in part because of the relatively higher price of calories from bananas, many of which are used as inputs into traditional beer.

Overall, present food intake levels for large groups of the population appear to be below recommended dietary energy requirements. Other studies have documented that significant segments of the population are suffering from malnutrition.

8.1.2 Dry Bean Transactions

The number of rural households depending on market procured supplies of beans has been increasing significantly over the past 4 years. Although variation in food consumption is noticeable across geographic zones, throughout the country beans is one of the dominant ingredients in the diet of the population. Virtually all rural households attempt to produce beans. Beans are a relatively cheap and important source of protein, so per capita consumption is relatively high among low-income groups. Data show that beans are also the third most important source of caloric food production, accounting for 16% of total calorie production.

Yet most Rwandan farmers are net buyers of beans (84%). In 1990, slightly over one third of rural households purchased some 50% of the beans consumed in their households. Thus, stability of bean prices is critical to social stability in rural as well as urban Rwanda. Results of analysis of ENRD data also confirm that a small (and increasing) number of households (14%) account for a large volume of beans sold. Households that are net sellers of beans appear to have larger farms (on both an absolute and adult equivalent basis). They also tend to earn a higher average income, both from agriculture and non-farm sources. Hence, any policy which aims at increasing bean prices will hurt a huge majority of smallholders and benefit relatively few households that are already among the relatively well off.

Comparative analysis between 1986 and 1990 agricultural years shows a decline in bean and overall calorie production and/or availability on a per capita basis across all household net bean transaction categories. Likewise, total calorie production from the 8

key crops among households in the net buyer categories shows a downward trend between 1986 and 1990.

Net bean sales at the household level also appear to be somewhat strongly correlated with net sales of maize and sorghum throughout the agroclimatical zones (with strong significance in the East zone). Net bean sellers also appear to be significantly net buyers of white potatoes. Given the farm level relationship between sales of beans, sorghum and maize, the estimate of Loveridge (1992) that Rwanda also imports significant quantities of sorghum is not surprising.

Correlation results of sweet potato net sales reveal that there is specialization in sales of this crop. Among net sellers of sweet potatoes there are also strong and significant negative relationships, especially with beans, peas and white potatoes within the zones. The percentage of net seller households is also relatively similar across agriclimatical zones. These findings suggest a clear household level crop specialization pattern across Rwanda wherein some farmers manage to sell sweet potatoes, and buy other calorie and protein sources.

For the case of households with banana net sales, results suggest even more household specialization, but sellers are also spread across most of the agroclimatical zones. No statistically and significant positive nor negative correlations were found at the zone level with any other food crops, thus indicating considerable farm level specialization for banana sellers. The analysis suggests that banana net sellers throughout the zones may have relatively larger farm sizes, on which they are producing most of their own food, and selling bananas to earn cash income for non-food requirements.

From the discussion above, there are at least two implications for food security and related policy. First, for none of the key commodities studied can analysts ignore the fact that significant groups of rural households only buy. That is, selected households are not producing adequate supplies on their own farms, and are buying food to make up for these shortfalls. Hence there is a need to learn more about

their income or revenue circumstances (as done with beans) in order to better understand alternative ways to assist these households to increase income and/or stimulate production. Second, given small farm sizes, many households already appear to have selected different strategies to specialize in selling one or more crops, plus available labor to gain income. More in-depth analysis is needed to understand the various income generating strategies and the factors influencing these, before a clear picture can emerge about viable option for improving these strategies.

8.1.3 Informal Imports

There is also substantial evidence that a wide range of agricultural commodities, including beans and other consumer goods flow between Rwanda and its neighboring countries through informal markets. Quantities of dry beans informally traded are estimated with the 1990 ENRD data. In addition, observations on the widespread availability of imported beans in border towns indicates that flows have been quite large. Using the net informal imports identity approach, the analysis confirms that Rwanda is importing an increasing supply of dry beans. An estimated 61,000 metric tons of beans were imported during 1990 agricultural year to meet the needs of rural consumers. This compares with an estimated 36,000 metric tons in 1986. Loveridge (1992) found also that there are informal imports of sorghum (26,000 metric tons) and cassava (21,000 metric tons) in 1990 just to satisfy rural market demands. Implication of findings about growing informal imports are treated in the policy section below.

8.1.4 Dry Bean Price Patterns and Factors Associated With Variation

Keeping prices within the reach of rural and urban consumers, still providing incentives for farmers to produce more, plus preventing wide fluctuations in the level of commodity prices continues to constitute multiple challenges for GOR agricultural food policy. The

analysis shows that annual price fluctuations for beans in the late 1980s have increased. Some particular aspects of Rwanda's recent history are mentioned as plausible explanations for such fluctuations: more bean imports, i.e, a higher portion of domestic market supply coming from informal imports, the nature of net bean sellers in Rwanda who appear to be more concentrated in the East zone, the on-going transition from a predominantly subsistence economy to a moderately commercialized one, and changes in GOR pricing schemes. Other potential factors include changes in domestic marketing costs, changes in regional trade costs and changes in weather cycles.

Turning to the seasonality of bean prices, regular intra-year variations roughly follow a bimodal distribution in conformity with the annual domestic bean production cycle and informal import cycles. Prices start from seasonal lows in December-January as the new harvest comes into the markets. Prices show flat to modest rises in the consecutive months between February and May, then they increase faster in the summer and early small rainy season months from June to October. The months between July and October represent high price points, with the peak normally in October-November. During peak price months, most of the supply in the rural markets is coming from informal imports. Changes from year to year in both domestic and regional supplies can alter the pattern of seasonal prices. This analysis highlights the critical importance of having historical price data, and the need for on-going price data collection and analysis to provide bean growers, as well as policy makers, with useful information for developing and implementing production, marketing and import plans.

8.1.5 Different Bean Supply Scenarios and Suggested Possible Public and Private Actions

Rwanda is heavily dependent on informal imports of beans. In 1990, an estimate of around 82% per year of beans bought in rural and urban market are coming from informal imports. Although Rwanda and neighboring countries have more or less similar climate patterns, to the

extent that data are accurate, differences in per capita bean production deviations from trend are clearly noticeable. Suggested policy actions (both public and private) for specific bean supply scenario are critical if the bean subsector in Rwanda is to perform adequately.

The GOR decision makers' good will, frank cooperation among private investors and traders and willingness to rely on the socio-economic and political environment in neighboring countries all have important roles to play. In addition, better coordination and harmonization of everyone's actions need to be given special attention, especially in the years of extreme bean supply scenarios.

The following recommendations are believed to be of some help for Rwandan policy makers in the pursuit of market-oriented food policies based on national self-reliance for beans and other crops, rather than strict self-sufficiency.

8.2 Policy Recommendations

With the basic structure outlined, attempts to resolve Rwanda's food problem still draw nationwide attention and generous international assistance. Given current population growth, the need for technological change among the subsistence food crops in general, and beans in particular, will continue to be central to household food security discussion as one of the means of promoting a market-oriented food policy. Clearly, this is a narrow focus and has to be coupled with the need for diversification of the rural economy, including substantial transformation of both agricultural and non-agricultural sectors, fostered by an improved infrastructure base, among other things.

In a low income country like Rwanda where 83% of total expenditure in rural area is allocated to food in general (Schnepf, 1992) with 22% to beans in particular (Miniplan, 1988), fluctuations in bean prices have a profound effect on the welfare of the poor consumers. A rise in bean prices can cause great hardship and even nutritional hazard for the majority of rural households. Assuming that the prevailing bean prices

mostly reflect the freeplay of market forces, an appropriate public policy to meet the basic food needs of the poor (both rural and urban) consumers has to be considered. Results from this analysis indicate that more is needed to explore how the group of rural households that are net buyers of beans (84%) and other products are able to earn their incomes, especially from farm and skilled labor sales of all types. A basic challenge is to better understand how to raise this income.

Informal cross-border trade of beans and other products also has to be more openly acknowledged, facilitated, and better harmonized in the region. Its legitimization could have an important positive effect on the food security. Also, border trade could be encouraged, where feasible, by investing in transport and storage facilities. Additional empirical studies are needed to identify neighboring food supply areas, markets, marketing agents and specific trade problems. Country-specific studies could tackle the issue of developing more workable and persuasive comparative advantage policies and resolving related conflicts. Although laborious, such work is essential for developing more in-depth understanding of the impacts of informal markets on household food security as well as on market-oriented food policy goals and overall development.

Households who have the least land available per adult equivalent, who depend mostly on this land for their food supply, who also have not been able to earn much income from selling labor, need short as well as long run solutions to inadequate food availability problems. In the short run, it may only be feasible for these households to try to raise on farm output for direct consumption. Research to determine whether it is possible to accomplish this should most likely focus on higher calorie potential crops such as sweet potatoes and bananas. Longer-run solutions seeking alternative agricultural cash crops as well as non-farm options are also needed.

For households currently producing food crops for the market, production technology and market improvement research should especially

focused on the Eastern agroclimatical zone, and should further investigate the strong relationships among beans, maize and sorghum sales revealed by this analysis.

There is also a need to explore in more detail household level behavior surrounding both sweet potato and banana production, sales and purchases (analysis similar to that done for beans).

The above suggestions in no way assure certainty in improving the wealth of all Rwandan. As such, they are possible facilitative steps, which still require additional analysis. Such policy analysis and implementation involves both capital and human resources. Thus, investment in human capital through education programs is required, although the payoff is not likely to occur in the short-run.

8.3 Limitations of the Study

This study has at least three limitations. First, the sometimes conflicting FAO and DSA production data are of some concern, particularly when using the most recent FAO series for the specific case of Bananas. More work is needed to understand the approach of FAO, and to work towards a more consistent set of statistics.

Second, there is little historic available data on agricultural informal cross-border trade in general, and particularly for beans. In addition, available official statistics on bean production in neighboring countries and imports in Rwanda are recognized as weak, and need improvement.

Lastly, this study focused on a sample of beans and 7 other major crops to attempt to analyze dietary patterns of the population. It does not include non-food crop sources of calorie and protein such as animal products in order to give a more complete picture.

APPENDIX

Table A1.1: Comparison of FAO and DSA Banana Production Estimates and Adjustment for Bananas (in Thousands of Metric Tons); 1986-1990.

Year	FAO	DSA	Adjusted
1986	2100	2398	2541
1987	2130	2592	2577
1988	2140	2776	2589
1989	2125	2966	2571
1990	2098	2775	2538

Note: The column "Adjusted" is obtained as following. A percentage difference is computed between the two sources of data for each year. Then an average of the five percentages is calculated (21%) and applied to FAO data.

Table A1.2: Caloric and Protein Conversion Factors for 8 Major Food Crops; 1991.

Food Crop	Calorie (Kcal/Kg)	Protein (Gr/Kg)	Lipids (Gr/Kg)
Cooking Bananas	801.90	7.13	1.78
Beer Bananas	196.42	1.27	0.00
Fruit Bananas	522.72	8.91	0.59
Total Bananas	359.53	3.31	0.44
Dry Beans	3031.06	195.76	13.53
Dry Peas	3121.17	205.32	10.13
Sorghum	3037.74	71.54	4.26
Maize	3225.32	84.92	37.94
Cassava	1023.07	39.93	2.85
W.Potatoes	574.40	11.91	0.70
S.Potatoes	1080.53	14.29	1.79

Source: DSA, 1991

Table A1.3: MINIPLAN Dry Bean Prices Inflated to December 1991 Level.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1972	73.63	79.83	79.28	72.99	60.51	66.16	78.46	78.39	83.99	88.62	87.88	93.98
1973	77.73	59.69	59.08	58.83	57.22	56.25	60.36	70.06	67.03	62.81	50.33	65.33
1974	42.63	47.17	54.71	56.34	56.05	57.38	80.52	99.01	101.77	101.39	156.44	120.83
1975	90.06	83.14	78.45	99.03	128.20	76.05	86.03	82.43	90.42	87.09	116.39	64.19
1976	64.12	70.12	67.01	64.46	64.27	61.99	71.39	77.86	81.76	74.29	90.01	77.75
1977	68.00	68.12	62.61	59.55	56.80	59.65	67.78	72.97	69.89	82.57	86.21	80.65
1978	52.17	51.71	45.20	45.34	40.03	49.75	47.87	52.61	57.40	56.09	63.28	67.28
1979	55.78	53.55	56.40	59.04	54.65	56.93	59.65	62.76	62.88	79.51	75.80	77.75
1980	72.83	58.39	67.73	70.23	68.06	69.65	67.78	68.77	77.28	72.68	68.21	70.80
1981	47.03	38.53	39.86	37.76	33.52	36.89	38.09	42.00	45.43	43.99	40.70	38.61
1982	32.20	32.25	35.42	41.27	38.13	46.23	53.89	52.04	51.83	56.91	63.84	65.05
1983	33.29	34.38	36.19	37.67	35.73	38.35	47.88	53.94	51.10	49.79	49.56	55.14
1984	30.83	39.61	43.64	48.00	49.57	87.22	86.00	79.00	87.78	108.07	104.06	63.11
1985	53.41	58.26	56.32	60.57	57.73	60.04	58.80	59.80	58.63	58.33	64.94	54.56
1986	37.13	41.23	38.77	38.91	35.60	34.74	37.21	38.15	42.23	42.23	42.20	42.20
1987	40.74	36.67	36.72	38.00	47.79	53.34	65.82	69.27	71.01	72.86	76.19	69.03
1988	46.43	45.82	46.30	46.42	49.40	48.90	51.02	51.57	50.35	51.26	53.12	48.07
1989	44.24	43.99	47.87	51.66	74.35	77.88	72.86	71.72	69.61	67.94	59.80	54.14
1990	44.91	44.78	44.78	45.07	44.99	48.08	48.95	49.84	52.09	60.64	61.62	52.10
1991	46.80	44.76	38.04	45.03	44.48	43.09	46.00	50.20	50.85	52.53	50.26	53.00

Note: Nominal Prices for January 1972 through December 1974 are from Gikongoro. All others from Kigali.

Table A1.4: MINIPLAN Monthly Nominal Dry Bean Prices

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1972	12	13	13	12	10	11	13	13	14	15	15	16
1973	13	10	10	10	10	10	11	13	13	12	10	13
1974	9	10	12	13	13	14	20	25	25	25	39	32
1975	26	24	23	30	39	24	27	26	29	28	38	21
1976	21	23	22	21	21	21	24	26	27	25	30	26
1977	25	25	23	22	21	22	25	27	28	32	34	32
1978	25	25	22	22	20	25	24	26	28	28	32	34
1979	21	21	23	25	24	25	27	27	27	35	34	35
1980	34	27	31	33	32	33	32	33	37	35	33	35
1981	26	21	22	21	19	21	22	24	26	25	23	22
1982	20	20	22	26	24	29	34	33	33	37	42	43
1983	22	23	24	25	24	26	33	37	35	34	34	38
1984	21	27	30	33	34	62	63	58	65	81	77	46
1985	39	43	41	44	42	44	43	43	42	42	47	39
1986	26	29	27	27	25	25	27	28	31	31	31	31
1987	30	27	27	28	36	41	50	52	53	55	58	52
1988	35	35	35	35	38	38	40	40	39	40	41	37
1989	34	34	37	40	58	62	57	56	54	53	46	42
1990	35	35	35	35	35	38	39	40	42	51	55	47
1991	43	42	36	43	43	42	45	49	50	52	50	53

Note: Nominal Prices for January 1972 through December 1974 are from Gikongoro. All others from Kigali.

Table A1.5: Annual Nominal Prices (in Frw/Kg) for 8 Major Food Crops; 1970-1990

Year	Beans	Maize	Sweet Potatoes	Peas	White Potatoes	Sorghum	Banana	Cassava
1970	13	10	5	13	9	13	4	7
1971	12	14	5	13	10	15	4	7
1972	14	6	6	15	9	14	4	7
1973	11	10	5	13	8	16	6	7
1974	22	12	7	25	11	18	7	7
1975	28	20	9	40	15	18	10	7
1976	24	14	9	26	13	24	9	7
1977	26	16	10	29	13	16	10	7
1978	26	17	10	30	15	21	11	9
1979	27	18	12	34	18	27	12	10
1980	33	22	15	42	16	25	16	12
1981	23	20	13	39	14	27	16	11
1982	30	25	15	41	14	27	13	10
1983	30	28	14	37	14	25	14	11
1984	49	58	17	54	16	32	20	15
1985	42	37	18	68	15	31	21	24
1986	28	62	14	43	12	29	15	10
1987	42	29	16	59	15	28	17	11
1988	38	27	15	48	17	24	19	15
1989	46	34	14	69	17	30	16	16
1990	41	35	16	66	16	32	17	16

Source: The nominal prices are from MINIPLAN

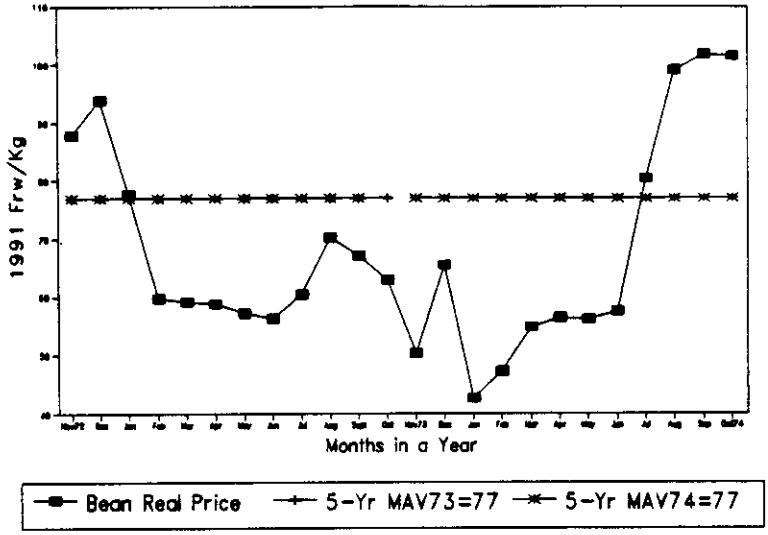
Table A1.6: Monthly Consumer Price Index: 1972-1991

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1972	16.3	16.3	16.4	16.4	16.5	16.6	16.6	16.6	16.7	16.9	17.1	17.0
1973	16.7	16.8	16.9	17.0	17.5	17.8	18.2	18.68	19.4	19.1	19.9	19.9
1974	21.1	21.2	21.9	23.1	23.2	24.4	24.8	25.3	24.6	24.7	24.9	26.5
1975	28.9	28.9	29.3	30.3	30.4	31.6	31.4	31.5	32.1	32.2	32.6	32.7
1976	32.8	32.8	32.8	32.6	32.7	33.9	33.6	33.4	33.0	33.6	33.3	33.4
1977	36.8	36.7	36.7	36.9	37.0	36.9	36.9	37.0	40.1	38.8	39.4	39.7
1978	47.9	48.3	48.7	48.5	50.0	50.2	50.1	49.4	48.8	49.9	50.6	50.5
1979	37.6	39.2	40.8	42.3	43.9	43.9	45.3	43.0	42.9	44.0	44.9	45.0
1980	46.7	46.2	45.8	47.0	47.0	47.4	47.2	48.0	47.9	48.2	48.4	49.4
1981	55.3	54.5	55.2	55.6	56.7	56.9	57.8	57.1	57.2	56.8	56.5	57.0
1982	62.1	62.0	62.1	63.0	63.0	62.7	63.0	63.4	63.7	65.0	65.8	66.1
1983	66.1	66.9	66.3	66.4	67.2	67.8	68.9	68.6	68.5	68.3	68.6	68.9
1984	68.1	68.2	68.8	68.8	68.6	71.1	73.3	73.4	74.1	75.0	74.0	72.9
1985	73.0	73.8	72.8	72.6	72.7	73.3	73.1	71.9	71.6	72.0	72.4	71.5
1986	70.0	70.3	69.6	69.4	70.2	72.0	72.6	73.4	73.4	73.4	73.5	73.5
1987	73.6	73.6	73.5	73.7	75.3	76.9	76.0	75.1	74.6	75.5	76.1	75.3
1988	75.4	76.4	75.6	75.4	76.9	77.7	78.4	77.6	77.5	78.0	77.2	77.0
1989	76.9	77.3	77.3	77.4	78.0	79.6	78.2	78.1	77.6	78.0	76.9	77.6
1990	77.9	78.2	78.2	77.6	77.8	79.0	79.7	80.3	80.6	84.1	89.3	90.2
1991	91.9	93.8	94.6	95.5	96.7	97.5	97.8	97.6	98.3	99.0	99.5	100.0

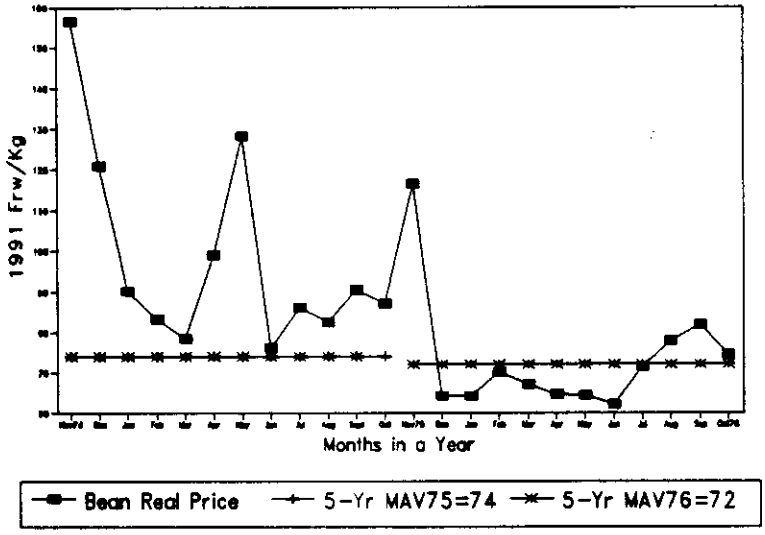
Source: Monthly nominal CPI from International Financial Statistics

Figures A1.10-A1.19: Dry Bean Prices: Monthly Observations over 19 Agricultural Years and Corresponding 5-Year Moving Average; 1972-1991

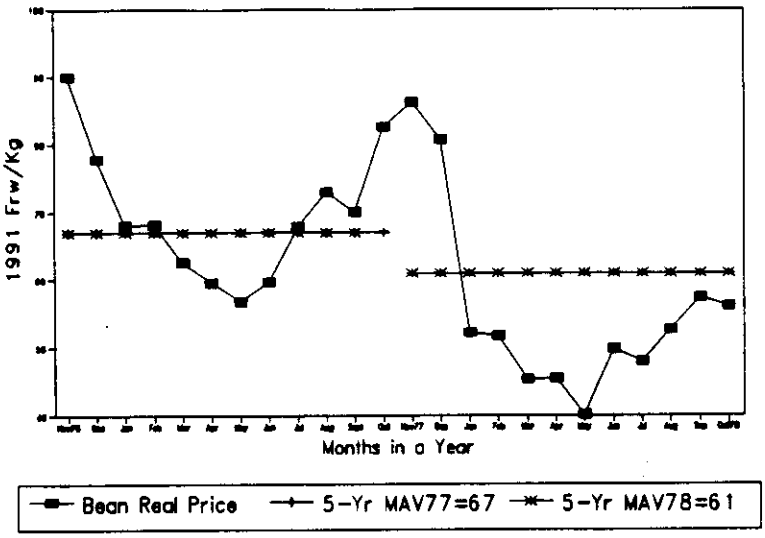
Appendix A1.10 (1973-1974)



Appendix A1.11 (1975-1976)



Appendix A1.12 (1977-1978)



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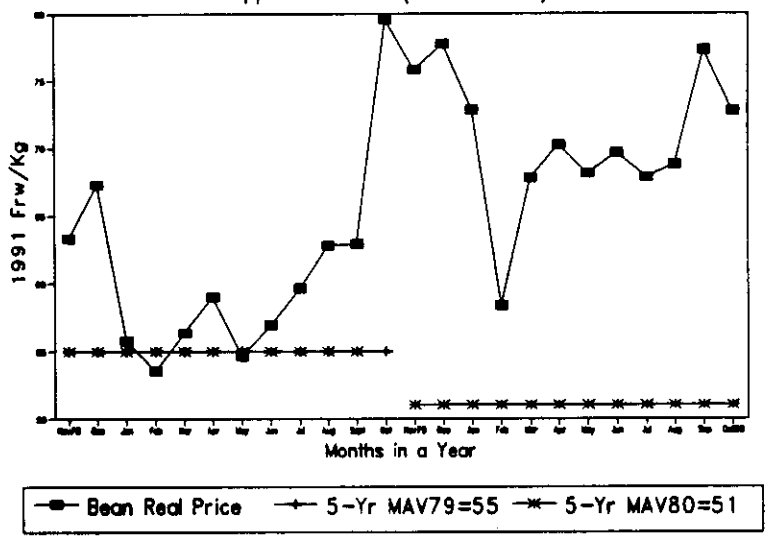
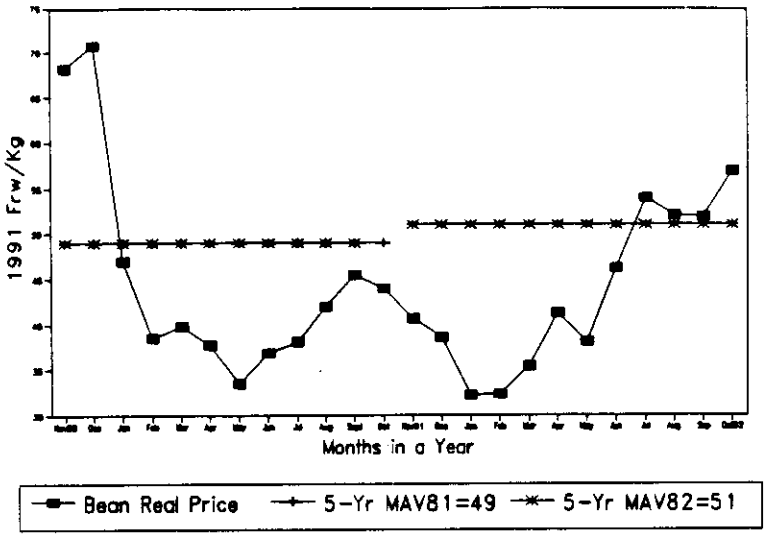


Appendix A1.14 (1981–1982)



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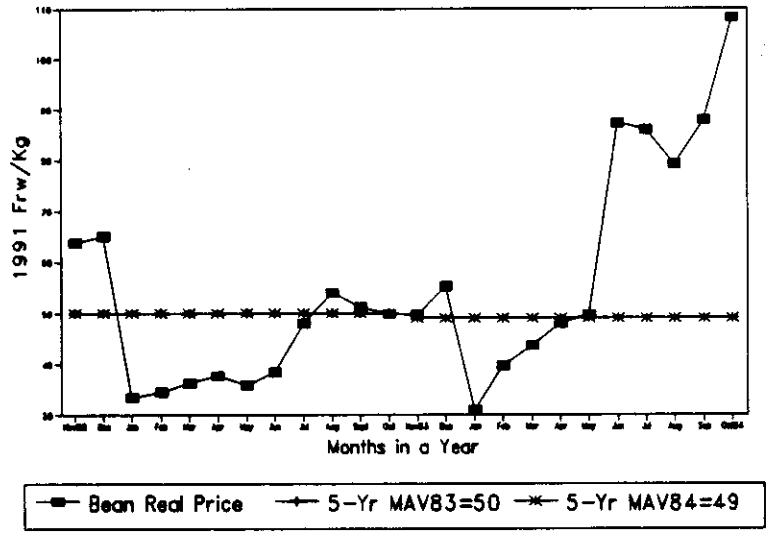
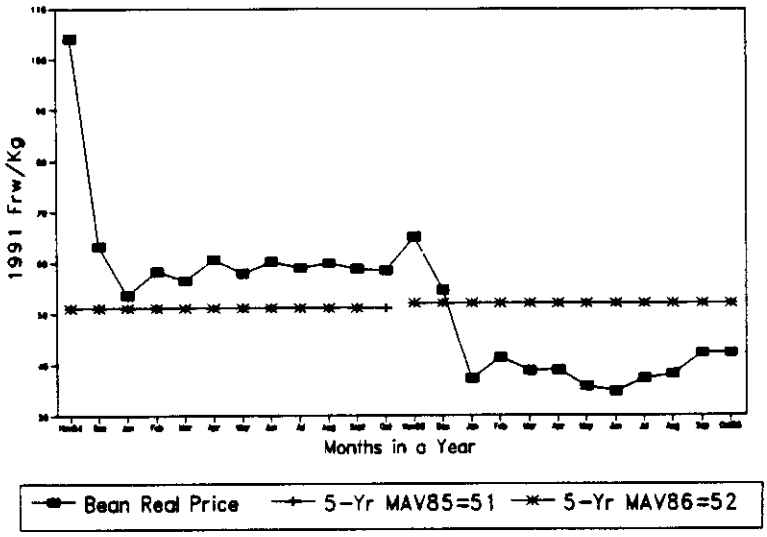
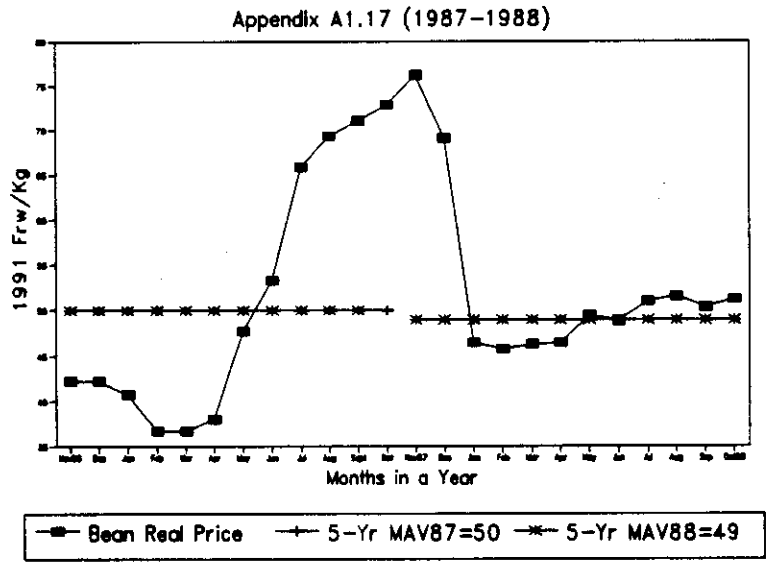


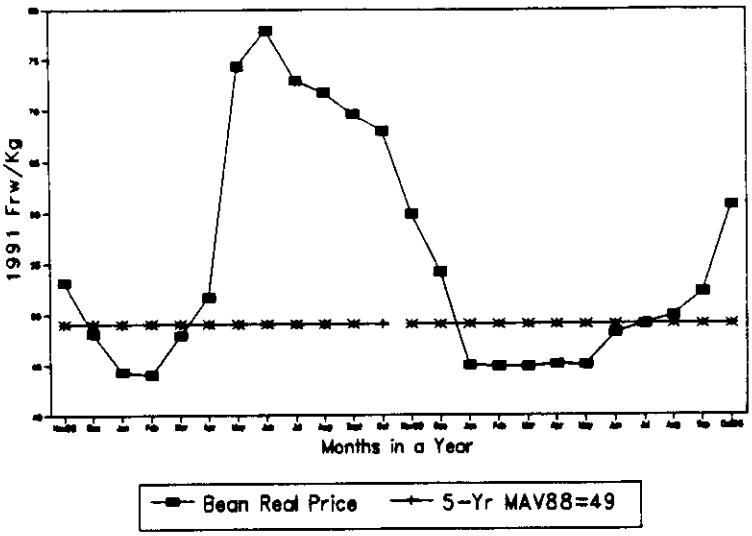
Appendix A1.16 (1985–1986)



Appendix A1.17 (1987–1988)



Appendix A1.18 (1989-1990)



Appendix A1.19 (1991)

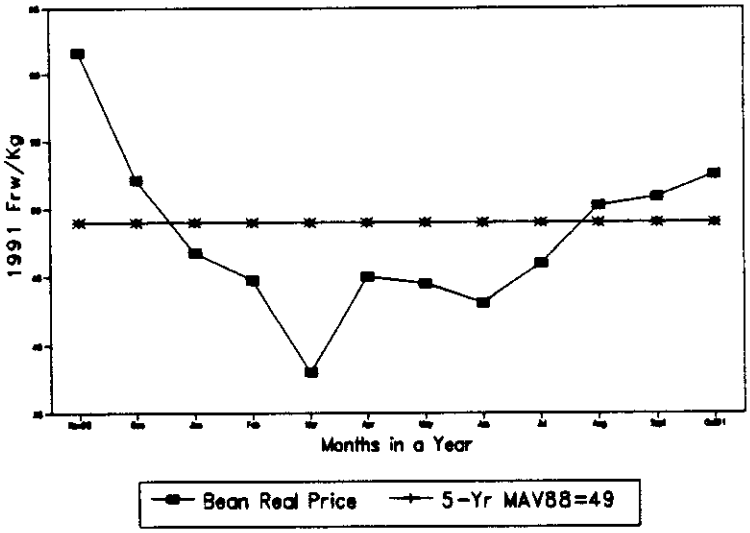
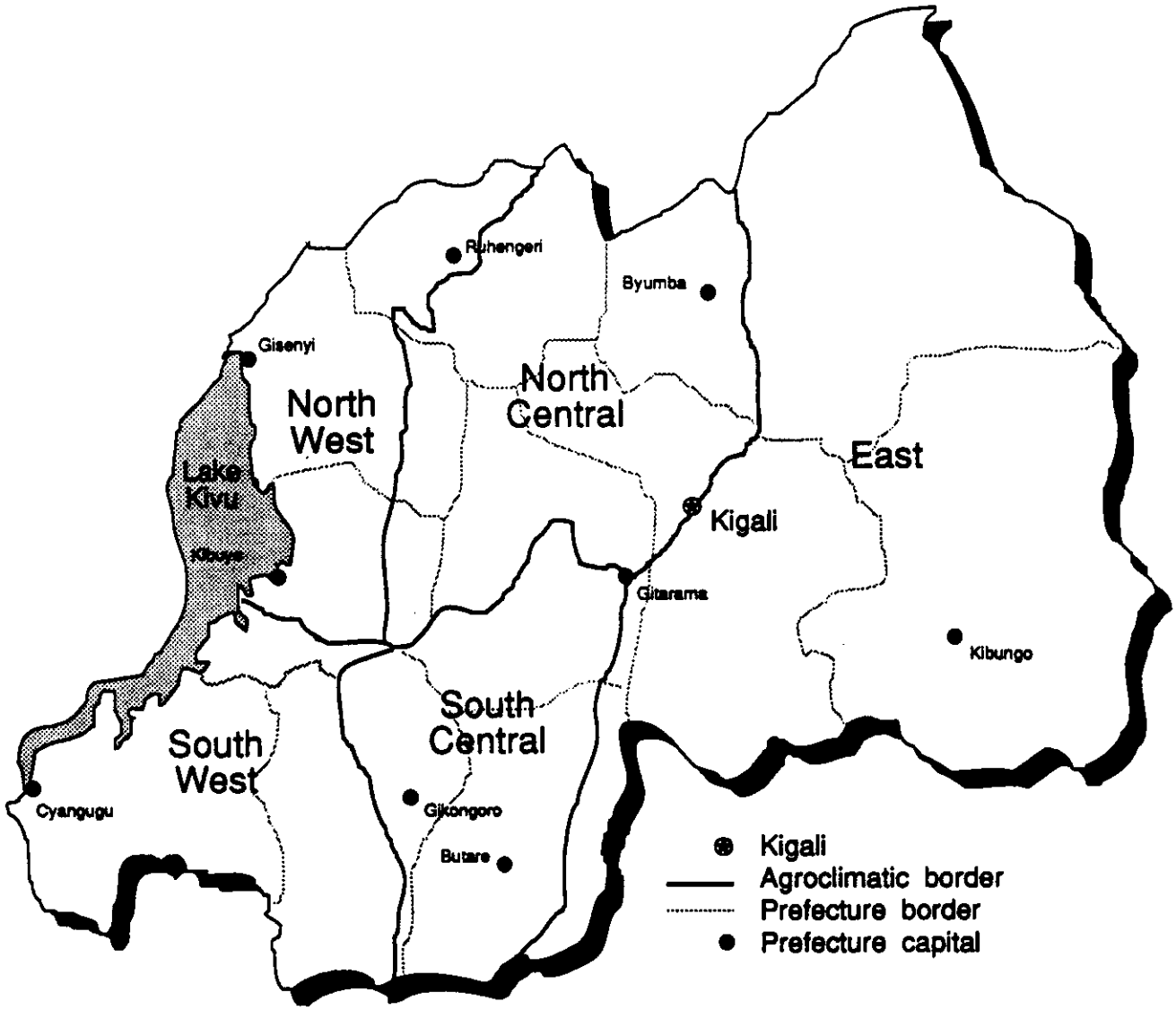


Figure A1.20: Agroclimatic Zones of Rwanda (From Schnepf, 1992)



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